Georgia-Pacific

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J. Michael Davis
Chief Counsel
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November 30,2006

Barbara J. Cook, P.E., Chief
Northern California Coastal Cleanup Operations Branch
700 Heinz Avenue
Berkeley, CA 94710-2721

Re: Hazardous Substance Information Request/Georgia-Pacific Corporation Fort Bragg Sawmill, Fort Bragg, Mendocino County

Dear Ms. Cook:

This is in response to your letter dated October 11,2006 requesting information from Georgia-Pacific related to "all off site locations that received fly ash from the GP Fort Bragg Sawmill". By letter dated November 2,2006 from Mr. Paul Montney to Mr. Ryan Miya GP requested an extension until December 1,2006 to respond to the information request.

Attached you will find all available records we could locate that were in Georgia-Pacific's custody or control, or reasonably available to us, regarding the offsite application of fly ash from our Georgia-Pacific Fort Bragg facility. As you also know, we have taken samples from one of the locations where the fly ash was land applied, the McGuire farm, and we have begun receiving results from those samples. We verbally notified Mr. Miya of the initial results, however we are not including the final written results with this package as those results have not been validated. We will continue to review relevant files related to the Fort Bragg operation and should we determine there are additional documents responsive to the information request we will forward those to you immediately upon discovery. Should you have any additional questions or concerns regarding this information or the information request please contact me.

Sincerely,

J. Michael Davis

cc: Ms. Bridgette DeShields
Mr. John Rogers
Mr. James Baskin
Ms. Marie Jones
Mr. Craig Hunt
Ms. Vivian Murai

Information Request
Off Site Fly Ash
GP Fort Bragg Sawmill

Georgia-Pacific Corporation
Fort Bragg, California

December 2006

BBL®
an ARCADIS company

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
1971				
02/03/71	Regulatory: Planning and Reporting Requirements for Accidental Spills and Discharges,	NCRWQCB	unknown	General and contingency provisions for sampling, analysis and reporting of spills and accidental discharges. Retyped July 1982.
1974				
07/24/74	Regulatory: Planning and Reporting Requirements for Accidental Spills and Discharges,	Ben Kor (NCRWQCB)	unknown	General and contingency provisions for sampling, analysis and reporting of spills and accidental discharges. Retyped January 1986.
1983				
01/01/83	Book: Chlorinated dioxins and dibenzofurans in the total environment.	Editors: E. Choudhary, L. Keith, C. Rap	unknown	Book section included: Human Exposure to Polychlorinated dibenzo-p-dioxins and dibenzofurans.
04/21/83	Letter: re: Classification of fly ash as nonhazardous	Toxic Substances Control Division (Richard Wilcoxon)	Albert's Best (Carl Johnson); State Solid Waste Mgmt. Board - NCRWQCB; Environmental Health Director (Ukiahm CA); Georgia Pacific Corp. (Sue O'Leary); Ray Tuvell	Affirmative response to Carl Johnson's request for fly ash produced by Georgia Pacific Corporation to be classified as nonhazardous.
12/31/83	Fire Incident Report	unknown	unknown	Type and number of fires reporting in 1983 by month. No location specified.
1984				
01/11/84	Draft: Article 11. Criteria for Identfication of Hazardous and Extremely Hazardous Wastes	unknown	unknown	Document outlining regulatory language used in regard to toxic substances (ie. definitions, sampling procedures and compounds of concern).
07/27/84	Results: fly ash nutrient data	Alpha Analytical Labratories, Inc. (Bruce Delowe)	Georgia-Pacific (Sue O'Leary)	Nutrient content in three ash samples from various points in the waste stream.
09/30/84	Letter and Results: re: Dioxin and furan analysis in one composite soil sample.	California Analytical Laboratories, Inc. (Michael Miille, Anthony Wong)	Ellie Giovannoni	Analytical results of CDFs and CDD's for one composite sample collected by Ms. Giovannoni. Only OCDD detected (0.24 ng/g).
10/16/84	Letter: re: Request for expertise in OCDD analysis	County of Mendocino Director of Environmental Health (Gerald	Ellie Giovannoni	Mr. Davis informs Mrs. Giovannoni that he does not have the expertise to assess the risk of OCDD and will pass her request on to the California State Deparment of Health Services.
12/18/84	Letter: re: Usage of fly ash as soil amendment and classification of fly ash as by-product rather than Group II waste.	NCRWQCB (Susan Warner)	Toxic Substances Control Division Department of Health Services (David Leu); Georgia Pacific Corp. (Sue O'Leary); Gerald Davis	Ms. Warner requests that the Toxic Substances Control Division assess the appropriateness of the Fort Bragg Shavings Company using fly ash as a soil amendment and Georgia Pacific Corporation's insistance that fly ash be considered a by-product with potential commercial use rather than a Group II waste.
12/18/84	Letter: re: Request for Fort Bragg Shavings Company to disclose information regarding fly ash stockpiles.	NCRWQCB (Susan Warner)	Fort Bragg Shavings Company; Gerald Davis	Ms. Warner requests that the Fort Bragg Shavings Company disclose all information regarding fly ash stockpiles, particlarily location of piles, distance from waterways, ect.
1985				
01/01/85	Book	Michigan State University (Michael A. Kamrin), Limna-Tech, Inc. (Paul W. Rogers)	unknown	Book "Dioxins in the Environment."
01/02/85	Memo: Letters between Georgia Pacific Corp. & Ft. Bragg Shavings	NCRWQCB (Susan Warner)	California Wastem Managementd Board (Robert Ludwig)	Memo refering to recent phone conversation in which letters regarding fly ash from Georgia Pacific Corp. and Ft. Bragg Shavings, Inc were requested.
01/03/85	Note	NCRWQCB (Susan Warner)	Files - GP Fort Bragg	Noting Carl Johnson was going to be late on replying to letter
01/11/85	Letter: Acknowledgement of concern about usage of the ash-activated carbon product.	Fort Bragg Shavings Inc. (Don Foxx, Nog Johnson)	David Joseph, cc: Water Quality Control Board Sacramento & Santa Rosa; Solid Waste Management Board; Congressman Doug Bosco; Senator Barry Keene; Mendocino Dept. of Public health, Ukiah & Fort Bragg; Mendocino County Chamber of Commerence; Bruce Wyette Davis, JTC Laboratories; Georgia Pacific Corp.; Jared Carter, Attorney, Fort Bragg Shavings; Mendocino Co. Board of Supervisors; Open Letter to the Editor; Fort Bragg Advocate & Beacon; Mendocino County	Acknowledgement of concern about usage of the ash-activated carbon product and details of use areas, ongoing evaluations, and volume estimates

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
0/22/85	Letter and Results: Dioxin/Furan	County of Mendocino Director of Environmental Health (Gerald Davis).	Department of Health Services Toxic Substances Control Division (Beth Bufton); NCRWQCB (Susan Warner)	Request for Mrs. Bufton to review the results for human health risk.
02/04/85	Letter: Response to Ft. Bragg Saving use of ash amendment	Dept. of Heath Services (David J. Leu)	NCRWQCB (Susan Warner)	Response to 12/18/84 letter regarding Georgia-Pacific Corporation's fly ash that is being used as a soil amendment by the Fort Bragg Shavings Co.
02/21/85	Memo: re ash complaints to Warden D. Patten	NCRWQCB (Frank Reichmuth)	NCRWQCB (Susan Warner)	Call from Warden Dennis Patten regarding ash problem, he is receiving a lot of complaints. Says material washed into creek as result of lates storm 2/12/85 - 2/17/85
02/28/85	Letter: dioxin results from Giovanni soil sample	County of Mendocino Director of Environmental Health (Gerald	Dept.of Health Services (Dwight R. Hoenig)	Confirming Octa Chlorodioxin is not a potent dioxin and their chemist confirms a reading of .25 nanograms/grams (0.24 parts per billion) is below the background level usually found in ambient soil samples.
Mar-85	Report: Papermill wood-derived boiler ash as a fertilizer 1. available nutrients and liming value	Dr. Lewis M. Naylor and James A. Johnson Department of Agricultural Engineering, Cornell University, Ithaca, NY	Georgia Pacific Corp. Lyons Falls, New York	Report describing experiments performed to evaluate changes in extractable nutrients and soil pH as a result of using papermill wood derived boiler ash as a soil amendment. Results indicate ash neutralizing value about 1/2 that of limestone.
03/06/85	Letter	County of Mendocino Director of Environmental Health (Gerald Davis).	Ellen Giovannoni, cc: FBHD, APCD, Norman deVall	Attached letter dated 2/28/85 from Chief of the Toxic Substances Control Division, North Coast CA Section, which he states that the sample results indicate that there is no danger of environmental contamination in the are sampled.
04/16/85	Letter: request for ash storage drainage control plans at Pudding creek	David C. Joseph (NCRWQCB)	Don Foxx, Fort Bragg Shavings, Inc. cc: Jerry Davis and Ed Bridges, Mendocino County Health Departtment	Request for plans to control runoff from ash storage site in Pudding Creek.
04/16/85	Letter: request for analysis of ash waste streams	David C. Joseph (NCRWQCB)	Georgia Pacific Corp. (Sue O'Leary), cc: Fort Bragg Shavings Inc.; Mendocino County Health Department (Gerald Davis, Ed Bridges)	Enclosed letter from Department of Health Services (April 21, 1883) concerning designation of fly ash as hazardous or non-narzardous. Request analysis of all ash waste production streams for metals and cyanide within 30 d.
04/30/85	Letter: Request for information	Georgia Pacific Corp. (Sue O'Leary)	Dept. of Health Services (Bill Quan) cc: NCRWQCB (David Joseph); DOHS (David Leu); Georgia Pacific Corp. (Jim Coon, Dow Jacobszoon); Fort Bragg Shavings, Inc. (Don Foxx)	Request for DOH information regarding classification of ash as hazardous or non-hazardous, notification lapses, and requirements for non-hazardous classification
May-85	Report	Lewis Nayor, James Johnson Dept. of Agricultural Engineering	unknown	Papermill Wood-Derived Boiler Ash as a Fertilizer I. Available nutrients and liming value
05/07/85	Lab results: metals	Multi-Tech Labratories, Inc.	Georgia Pacific Corp.	Metals content in samples received 4/22/85
05/16/85	Cover Letter: enclosed letter decribing TCCD results	County of Mendocino Director of Environmental Health (Gerald	Ellen Giovannoni	Enclosing copy of letter dated 2/28/85 from the Chief of Toxic Substance Control Divison, No. Coast CA Section that states there is no danger of environmental contamination in the area sampled. (letter not attached)
05/17/85	Letter: Ft. Bragg mill ash analyses results	Georgia Pacific Corp. (Sue O'Leary)	CA Water Regional Water Quality Contol Board (David Joseph), cc: Georgia Pacific Corp (J. A. Coon, D. G. Jacobszoon); DOHS (Bill Quan)	Cover letter states reaffirmation of DOHS classification of ash as non-harzadous, Ash data from samples collected on 4/19/85 attached
05/17/85	Memo: Ash Disposal/Georgia Pacific of Fort Bragg Shavings	NCRWQCB (Susan Warner)	Bob Tancreto, Craig Johnson, File - Fort Bragg Shavings	States recommended actions to address runoff complaint.
05/23/85	Letter: DOHS ash classification	Dept. of Heath Services (David Leu)	Sue O'Leary, Georgia-Pacific Corporation, cc: North Coast Regional Water Quality Control Board	Letter affirming that GP ash is classified as non-hazardous
05/29/85	Memo: Ft. Bragg Shavings	NCRWQCB (Susan Warner)	NCRWQCB (Craig Johnson, Bob Tancreto, Candi Parker)	Summary of actions planned and low priority nature of Ft. Bragg Shavings disposal ash
06/30/85	Incident Report 7/1/84 - 6/30/85	unknown	unknown	Reported fire incidents from July 1, 1984- June 30, 1985. Locations not specified.
07/08/85	Letter: Ft. Bragg Shavings Co. Soil Amendment Program	NCRWQCB (Bob Tancreto)	NCRWQCB (Candi Parker)	Draft of 7/19/85 letter
07/19/85	Letter: Ft. Bragg Shavings Co. Soil Amendment Program	NCRWQCB (Candi Parker)	NCRWQCB (Bob Tancreto)	Results of McGuire Ranch inspection on June 26 and July 18th. State no immediate threat to water quality.
08/15/85	Memo	Mendocino Co. Health Dept. (Ed Bridges)	NCRWQCB (Susan A. Warner)	Need application rates, cover, etc for disposal used as amendment
08/22/85	Letter: GP waste ash classification by NCRWQCB	NCRWQCB (David Joseph)	Georgia Pacific Corp. (Sue O'Leary) cc: Mendocino Co. Health Dept., Ukiah (Gerald Davis); Mendocino Co. Health Dept., Fort Bragg (Ed Bridges); Fort Bragg Shavings, Inc.	NCRWQCB considers fly ash generated by GP to be Class III waste and not appropriate for use in amendments. Request cease of innapropriate disposal actions and technical report per Porter-Cologne WQ Act.

Georgia-Pacific Fort Bragg Ash Document File Information				
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08/28/85	Letter: Woodwaste Residue Disposal Abatement	Robert F. Swan, Deputy Director Air Pollution Control	Georgia Pacific Corp. (Dow Jacobsen, Sue O'Leary) cc: Environmental Health Divison; Planning and Building Services (Ed Bridges, Dave Koppel)	Request immediate abatement /mitigation of landfilling of GP ash as it creates nuisance airborne particles.
08/30/85	Letter: Response to request for abatement	Dow Jacobsen (Western Wood Prod MFG)	Mendocino Co. Air Pollution Control (Robert F. Swan) cc: Georgia Pacific Corp. (J. Coon, S. O'Leary, William Craig); County Health, Fort Bragg (Ed Bridges); County Health, Ukiah (Dave Koppel); Fort Bragg Shavings	Describes actions taken to address airborne particle problem at Bald Hill and Canyon Rd.
09/03/85	Regulatory: Complaint Form	Laurie Simmons	NCRWQCB (Candi Parker)	Fly ash disposal complaint
09/10/85	Memo: Fly ash disposal	NCRWQCB (Candi Parker)	NCRWQCB (Bob Tancreto)	Description of sites within Mendocino County that have fly ash amended soil.
09/13/85	Regulatory: Complaint Investigation Report	Shirley Ciancio	Ed Bridges	Fly ash disposal complaint.
09/13/85	Regulatory: Complaint Investigation Report	Eleanor Ellisor	Ed Bridges	Fly ash disposal complaint.
09/13/85	Regulatory: Complaint Investigation Report	Mr. Cebula, 16541 Powers Lane	Ed Bridges	Fly ash disposal complaint.
09/25/85	Memo: Complaint	S. Galli	Ed Bridges, Mendocino County	Fly ash disposal complaint against Manuel Martinez Property
09/25/85	Memo: Complaint	unknown	Michele Shattuck	Fly ash disposal complaint at Canyon Dr. propoerty
10/01/85	Appendix 2 Rules for land application of sludge and residuals Chapter 567	Maine Dept. of Env. Protection	NCRQWCB (Feb 16, 1990)	Interim Standards for Sludges and Residuals Containing PCDD and PCDFs
10/02/85	Memo: re Meeting with Georgia Pacific Corp. and local agencies on disposal of fly ash	NCRWQCB (Susan A. Warner)	Craig Johnson, Bob Tancreto and Candi Parker (GP)	Details of meeting with GP on 10/1/85, map and sites threatening water quality attached.
10/02/85	Memo	NCRWQCB (Susan A. Warner)	Craig Johnson, Bob Tancreto, Candi Parker, File - Georgia Pacific. Ft. Bragg	Subject: Meeting with Georgia-Pacific, Ft. Bragg, and local agencies on ash
10/02/85	Letter: proposal of interim disposal measures	Georgia Pacific Corp. (Sue O'Leary)	Dr. David C. Joseph, Georgia-Pacific Corporation	Propose trench disposal of woodwaste on an emergency basis, initiation of soil amendment on GP property at Little Valley
10/04/85	Letter: response to interim proposals	NCRWQCB (Susan A. Warner)	Georgia Pacific Corp. (Sue O'Leary), Bob Swan, Ed Bridges, Gerald Davis	Approve Little Valley amendment project until 10/18/85, require submittal of technical information to proceed with approval for use as agricultural soil amendment
10/18/85	Interoffice Communication Subject: Georgia Pacific Fly Ash Report	Albert Wellman (RWQCB)	NCRWQCB (Susan Warner, Frank Reichmuth)	Agreed to allow after-hours delivery of GP Fly Ash Report
10/18/85	Cover Letter/Technical Report: Fly Ash Report	Georgia Pacific Corp. (Sue O'Leary)	NCRWQCB (David Joseph)	Report detailing proposed Little Valley soil amendment project and monitoring plan.
10/25/85	Letter	Robert Blanz, State of Arkansas, Dept. of Pollution Control and	Docket Clerk, Officice of Solid Waste (WH-562) U.S Environmental Protection	Re: Section 3001/Dioxin Residues
10/25/85	Interoffice Communication Subject: Meeting with GP on agricultural amendment use of ash produced at Fort Bragg	NCRWQCB (Susan A. Warner)	NCRWQCB (Frank Reichmuth)	Chronological outline of GP fly ash problem and assessment of fly ash report submitted by GP 10/18/06. Concerns re buffer zones, wet weather activities, loading rates.
11/08/85	Cover Letter: forms for report of waste discharge	NCRWQCB (Susan Warner)	Georgia Pacific Corp. (Sue O'Leary)	Forms required to submit a report of waste discharge (not included).
12/11/85	Complaint Form	TV (initials)	NCRWQCB (Susan Warner)	fly ash disposal complaint by Gloria Davis re Little Valley runoff
12/17/85	Check	Georgia-Pacific Corp.	State Water Resources Control Board	4421
12/17/85	Cover Letter: Form 200	Georgia Pacific Corp. (Sue O'Leary)	NCRWQCB (Susan A. Warner)	Enclosed are completed Form 200, the filing fee and the technical information that was requested to file report of waste discharge. (no forms attached).
12/17/85	Mini-Memo	NCRWQCB (Susan Warner)	Gloria Davis	Sending info regarding Little Valley project.
1986				
01/30/86	Regulatory: Waste Discharge Requirements for Georgia Pacific Corp. Ft. Bragg Soil Amendment	NCRWQCB (Benjamin Kor)	unknown	Waste Discharge Requirements. Regulations and monitoring requirements for Georgia Pacific Corp.'s Fort Bragg Little Valley Soil Amendment Project.

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
01/02/86	Letter: notice: proposed waste discharge requirements for G-P Corporation Ft. Bragg Soil Amendment	NCRWQCB (Benjamin Kor)	SWRCB (Archie Matthews), DFG, Mendocino County Health Department, DOHS, EMB, DWR, USDI, Dept. of Parks and Recreation (James Doyle), Mendocino County Planning Dept.	Distribution of the Proposed Waste Discharge Requirements for Georgia-Pacific Corp. for the Fort Bragg Soil Amendment. Comments and recommendations are solicited from the various Federal, State, County and Regulatory agencies.
01/02/86	Letter: re: Usage of fly ash as soil amendment	NCRWQCB (Susan Warner)	Georgia Pacific Corp. (Sue O'Leary)	Ms. Warner expresses concern with Georgia Pacific Corp. proposal to use test pits. Revegetation in areas with wide C:N ration main area of concern. A rough worksheet by Ms. Warner is included.
01/14/86	Memo: G.P. Ash	NCRWQCB (Frank Reichmuth)	NCRWQCB (Susan Warner)	Re: phone conversation about NCRWQCB regional board meeting.
01/14/86	Memo: Sanitary Engineering Branch comments on Georgia Pacific Corporation's Fort Bragg Soil Amendment	Sanitary Engineering Branch (B. David Clark)	NCRWQCB (Benjamin D. Kor)	Sanitary Engineering Branch states that at the time they have no comment on the Georgia Pacific Corporation's Fort Bragg Soil Amendment.
01/14/86	Letter: Citizen respose regarding Order 86-3	Diane Aston	NCRWQCB	Mrs. Aston requests that the NCRWQCB hold a public hearing regarding Order 86-3.
01/23/86	Letter: Citizen response to usage of Little Valley Road for Georgia Pacific Ash Project	Gloria Davis	NCRWQCB	Mrs. Davis expresses concern regarding the usage of Little Valley Road by Georgia Pacific Corporation. Mrs. Davis includes statistics produced by local knowledge.
01/24/86	Letter: Staff report and tenative order on Georgia Pacific Corportation's ash operation	NCRWQCB (Susan A. Warner)	Gloria Davis	
01/26/86	Letter: Citizen response to usage of Little Valley Road for Georgia Pacific Ash Project	Arden Hurley	NCRWQCB	Mrs. Hurley expresses concern over the usage of Little Valley Road by Georgia Pacific Corporation. Also attached is a handwritten note by Mrs. Davis requesting Mrs. Hurley's letter be submitted for consideration by the CRWQCB-NCR.
01/30/86	Table: Loads of Ash to Little Valley	Georgia Pacific Corp. (Sue O'Leary)	NCRWQCB (Susan Warner)	Handwritten table showing the number of ash loads per day from October 1985 through January 1986.
02/04/86	Inspection: CRWQCB-NCR Inspection Cover Sheet	NCRWQCB (Susan Warner)	NCRWQCB (Frank Reichmuth, Dennis Salisbury)	Facility Name, GP Soil Amendment, does not pass inspection because of discharge of ash to surface streams.
02/04/86	Inspection: WDS Violations Input Form	NCRWQCB (Susan Warner)	NCRWQCB (Frank Reichmuth, Dennis Salisbury)	Facility Name, GP Soil Amendment, is written up for Noncompliance not included in "C" (C = Violation of effluent limitations) because of discharge of ash to surface streams.
02/04/86	Letter: re: Waste Discharge Requirements Order No. 86-3	NCRWQCB (Benjamin Kor)	Georgia Pacific Corp. (Sue O'Leary), Gerald Davis, Gloria Davis, Arden Hurley, Diane Aston	Mr. Kor enclosed a copy of the Waste Discharge Requirements Order no. 86-3 and the associated monitoring program for the ash soil amendment project on Little Valley Road. Actual enclosures are not attached.
02/05/86	Regulatory: Notice of Adoption	NCRWQCB (Benjamin Kor)	CSWRCB-Division of Water Quality (Archie Matthews, DFG-Sacramento, DFG-Yountville, Mendocino County Health Department, SEB-Santa Rosa, DWR-Central District-Sacramento, USDI-F&WS-Sacramento, Dept. of Parks & Recreation (James M. Doyle), EPI-Center, Office of Planning Analysis-	Notice of Adoption of Waste Discharge Requirements for Georgia Pacific Corporation Fort Bragg Soil Amendment.
02/06/86	Regulatory: NCRWQCB Inspection Cover Sheet	NCRWQCB (Susan Warner)	NCRWQCB (Frank Reichmuth, Dennis Salisbury)	Follow-up inspection of Facility Name, GP Soil Amendment. The Facility is found to be in violation because of discharged ash to surface streams.
02/10/86	Memo: Inspection of the Little Valley Soil Amendment site	NCRWQCB (Susan Warner)	NCRWQCB (Frank Reichmuth)	Detailed description of Georgia Pacific Corporation's violation at Facility Name, GP Soil Amendment.
02/11/86	Letter: re: CRWQCB-NCR 02/04/84 & 02/06/84 Inspections	NCRWQCB (Benjamin Kor)	Georgia Pacific Corp. (Sue O'Leary), Gerald Davis, Ed Bridges, Gloria Davis	Mr. Kor informs Georgia Pacific Corp. that CRWQCB-NCR inspections revealed that ash had been discharged to surface streams thereby leading him to issue a Cleanup and Abatement Order No. 86-43 in pursuant to Section 13304 of the Water Code.
02/13/86	Regulatory: Notice	NCRWQCB (Benjamin Kor)	CSWRCB-Division of Water Quality (Archie Matthews, DFG-Sacramento, DFG-Yountville, Sonoma County Health Department, SEB-Santa Rosa, DWR-Central District-Sacramento, USDI-F&WS-Sacramento, EPA, W-3-2, All Board Members	Notice of Cleanup and Abatement Order No. 86-43 for Georgia Pacific Corporation Fort Bragg Ash Soil Amendment.
02/26/86	Letter: re: Usage of Georgia Pacific fly ash on the playing field within the new track at the high	NCRWQCB (Susan Warner)	Mendocino Unified School District (Donald L. Kirkpatrick)	Ms. Warner advises Mr. Kirkpatrick that fly ash can be used on the playing field but only if the included precautions are followed.
03/10/86	Report: Technical Report for Georgia Pacific Ash Soil Amendment Project	Georgia Pacific Corp. (Sue O'Leary)	NCRWQCB (Benjamin Kor)	Technical Report as required under the Cleanup and Abatement Order 86-43.

Georgia-Pacific Fort Bragg Ash Document File Information				
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04/15/86	Report: March Report: Fort Bragg Soil Amendment Monitoring and Reporting Program No. 86-3	Georgia Pacific Corp. (Sue O'Leary)	NCRWQCB (Benjamin Kor)	March report for the Georgia Pacific Soil Amending Project as per Revised Monitoring and Reporting Program 86-3.
04/17/86	Letter: re: Discharge of waste to land	David M. Snetsinger	Jack Cox	Copy of Subchapter 15 Discharge of Wast to Land (guidance document for waste disposal sites).
04/18/86	Newspaper Article: New U.S. Evidence Reported on Dioxin as Health Hazard (San Francisco Chronicle)	unknown	unknown	Article regarding health hazards of dioxins.
05/13/86	Letter: Response to a request for information about the Ft. Bragg Soil Amendment project	State Water Resources Control Board (Patricia C. Gorup - stenographer)	Cristy Blackfield	Cover letter indicates that copies from the Ft. Bragg Soil Amendment project were provided for a billed fee of $3.78. No copies are enclosed with letter.
05/15/86	Report: April Report: Fort Bragg Soil Amendment Monitoring and Reporting Program No. 86-3	Georgia Pacific Corp. (Sue O'Leary)	NCRWQCB (Benjamin Kor)	April report for the Georgia Pacific Soil Amending Project as per Revised Monitoring and Reporting Program 86-3.
05/17/86	Letter: Citizen query as to the affects of dioxins & other toxins	Kristy Sarconi	NCRWQCB (Susan Warner)	Mrs. Sarconi asks Ms. Warner to please explain the affects Georgia Pacific Corporation's fly ash will have throughout the local ecosystem, namely whether the ash is contaminated with dioxins and/or other toxins.
05/23/86	Letter: response to a request for information about the Ft. Bragg Soil Amendment project	State Water Resources Control Board (Patricia C. Gorup - stenographer)	Douglas L. Strauch	Cover letter indicates that copies from the Ft. Bragg Soil Amendment project and a copy of the report of Waste Discharge froms were provided for a billed fee of $6.18. No copies are enclosed with letter.
05/29/86	Letter: Response regarding query of health hazards of dioxins	County of Mendocino Director of Environmental Health (Gerald F. Davis).	Kristy Sarconi, Craig McMillan, NCRWQCB (Susan Warner), Fort Bragg Health Department	Mr. Davis advises Mrs. Sarconi that at this time he agrees with the NCWQCB's position that there is no evidence that the woodwaste ash presents a hazard to the public from dibenzofurans of dioxins.
06/04/86	Letter: Response regarding query of health hazards of dioxins	NCRWQCB (Susan Warner)	Kristy Sarconi, Mendocino County Health Department (Gerald Davis)	Ms. Warner explains that most likely the Georgia Pacific Corporation is not producing ash with dioxins or furans because feedstock is not treated with cloronated compounds.
06/10/86	Interoffice Communication: Evaluation of alternative sites for soil amendment use of ash	NCRWQCB (Susan Warner)	NCRWQCB (Frank Reichmuth)	Ms. Warner discusses meetings and site inspections with Georgia Pacific Corporation employees regarding the use of fly ash as soil amendment in clover and grass fields.
06/17/86	Letter: Request for Ft. Bragg ash amendment	John Podesta (Green Valley Nursery)	RWQCB	Requesting amendments to improve fertility of nursery soil.
06/19/86	Report: May Report: Fort Bragg Soil Amendment Monitoring and Reporting Program No. 86-3	Georgia Pacific Corp. (Sue O'Leary)	NCRWQCB (Benjamin Kor)	May report for the Georgia Pacific Soil Amending Project as per Revised Monitoring and Reporting Program 86-3.
06/30/86	Table: Fire Incident Summary Report 07/01/85-06/30/86	unknown	unknown	Summary of fires 07/01/85-06/30/86. Locations and/or districts of fires not specified.
07/08/86	Bulletin: University of California Cooperative Extension Quarterly Narrative Report	Roderick A. Shippey	unknown	Citizen assessment of fly ash used at the McGuire Ranch.
07/09/86	Results: Georgia Pacific Fly Ash Test	unknown	unknown	Handwritten table showing amount of fly ash used on test plots. Location of test plots unspecified.
07/14/86	Report: June Report: Fort Bragg Soil Amendment Monitoring and Reporting Program No. 86-3	Georgia Pacific Corp. (Sue O'Leary)	NCRWQCB (Benjamin Kor)	June report for the Georgia Pacific Soil Amending Project as per Revised Monitoring and Reporting Program 86-3.
07/17/86	Letter: Florist's reguest to use Georgia Pacific Corp.'s fly ash in soil.	Green Valley Nursery (John Podesta)	Water Quality Control Board	Mr. Podesta requests approval from the Water Quality Control Board to use fly ash to improve the fertility of his soil.
07/24/86	Letter: Request for more information on the usage of ash from florist, John Podesta	NCRWQCB (Susan Warner)	Green Valley Nursery (John Podesta), Georgia Pacific Corp. (Sue O'Leary), Mendocino County Health Department (Ed Bridges)	Ms. Warner requests information regarding how many acres will be treated, the amount of ash to be used, the soil characteristics and the mitigating management techniques.
07/25/86	Report: Annual Report: Georgia Pacific Soil Amending Project	Georgia Pacific Corp. (Sue O'Leary)	NCRWQCB (Susan Warner)	Annual report as required by the Revised Monitoring and Reporting Program 86-3 for the Soil Amending Project.
08/07/86	Letter: re: photos of Little Valley Soil Amending Project	Georgia Pacific Corp. (Sue O'Leary)	NCRWQCB (Benjamin Kor)	Photos showing the growth on several fo the fly-ash amended areas. Photos not attached.
08/22/86	Report: July Report: Fort Bragg Soil Amendment Monitoring and Reporting Program No. 86-3	Georgia Pacific Corp. (Sue O'Leary)	NCRWQCB (Benjamin Kor)	July report for the Georgia Pacific Soil Amending Project as per Revised Monitoring and Reporting Program 86-3.

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
09/09/86	Letter: re: Inspection of the Little Valley Ash Project prior to the rainy season	Western Wood Products MFG (David Larkin)	NCRWQCD (Susan Warner)	Letter confirming rainy season inspection. Map included designating location of winter stock pile.
09/10/86	Letter: re: Analytical tests on woodwaste ash purchased from a garden store	Kristy Sarconi	California Analytical Lab (Tony Wong)	Letter requesting test for dioxins, dibenzofurans, arsenic and pentachlorophenol on woodwaste ash.
09/17/86	Report: August Report: Fort Bragg Soil Amendment Monitoring and Reporting Program No. 86-3	Georgia Pacific Corp. (Dow Jacobszoon)	NCRWQCB (Benjamin Kor)	August report for the Georgia Pacific Soil Amending Project as per Revised Monitoring and Reporting Program 86-3.
09/22/86	Report: soil analysis	UCCE Ukiah (Roderick A. Shippey)	Unknown	Soil nutrients and chemistry results for GP pasture samples received 7/16/86
09/29/86	Results and Photos: Soil analysis of Georgia Pacific Corp.'s Little Valley plot	University of California Cooperative Extension (Roderick Shippey)	NCRWQCB (Susan Warner)	Analytical results of Georgia Pacific Corp.'s Little Valley plot/pasture. Soil tested contained fly ash.
Oct-86	Report: Rules for Land Application of Sludge and Residuals, Chapter 567 (partial)	EPA, State of Maine	Unknown	Appendix D is attached to the report cover and covers Interim Standars for Sludges and Residuals Containing Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans (PCDDs and PCDFs). This report was initally labeled as Attachment #11 to an unidentified report.
Oct-86	Report: Interm Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated dibenzo-p-Dioxins and -Dibenzofurans (CDDs and CDFs)	USEPA (Judith Bellin, Donald Barnes)	unknown	Federal document describing dioxins and furans in the environment and how to assess their environmental fate. Recommendations on how to perform human health risk assessments also included.
10/07/86	Report: September Report: Fort Bragg Soil Amendment Monitoring and Reporting Program No. 86-3	Georgia Pacific Corp. (Marita Martin)	NCRWQCB (Benjamin Kor)	September 1986 report for the Georgia Pacific Soil Amending Project as per Revised Monitoring and Reporting Program 86-3.
10/09/86	Letter and Results: Dioxin/Furan	California Analytical Laboratories (Ben Buechler)	Ellie Giovannoni	Cover letter and results for one woodwaste ash sample. Tested for dioxins, furans, PCP and arsenic.
10/30/86	Letter: re: Change of sampling stations	NCRWQCB (Susan Warner)	Georgia Pacific Corp. (Don Jacobszoon)	Ms. Warner deleted four sampling locations and added two for the Revised Monitoring and Reporting Program No. 86-3. Map included.
11/05/86	Letter: re: Little Valley Monitoring Requirements	Georgia Pacific Corp. (Steven Petrin, Jack Anderson)	NCRWQCB (Susan Warner)	Georgia Pacific Corp. requests that Ms. Warner clarify which points are to be sampled and how often.
11/07/86	Report: October Report: Fort Bragg Soil Amendment Monitoring and Reporting Program No. 86-3	Georgia Pacific Corp. (Steven Petrin, Jack Anderson)	NCRWQCB (Benjamin Kor)	October report for the Georgia Pacific Soil Amending Project as per Revised Monitoring and Reporting Program 86-3.
11/13/86	Memo: Inspection of the ash pilot project, Little River	NCRWQCB (Susan Warner)	NCRWQCB (Frank Reichmuth)	Ms. Warner describes a site inspection of ash trial experiments set out by Rod Shippee of the Mendocino County Agricultural Extension.
11/17/86	Letter: Summarization of telephone conversation 11/12/86	NCRWQCB (Susan Warner)	Georgia Pacific Corp. (Steven Petrin)	Ms. Warner clarifies a phone conversation regarding bioassay species, the mill inspection sheet and Little Valley Creek Monitoring Requirements.
11/19/86	Memo: Fort Bragg, CA - Dioxin in Wood Ash	Georgia Pacific Corp. (Fred McCaig)	Georgia Pacific Corp. (Rick Horder, C. Tolar, B. Zoffmann, A. Bell)	Mr. McCaig discusses the results from California Analytical Laboratory, Inc in regard to the woodwaste ash as requested by Ellie Giovannoni.
12/08/86	Letter: incorporation of the Ft. Bragg ash into a commerical project	F.V. Tara Dawn (Tom Estes)	NCRWQCB (Susan Warner)	Letter requests about forty truck loads of fly ash into a clay salty soil to help break the soil down. Mr. Estes states that he has utilities to incoporate the fly ash immediately, keep it damp and eunsure that there will no drainage into nearby creeks.
12/08/86	Memo: Inspection of proposed Estes soil amendment site north of Ft. Bragg	NCRWQCB (Susan Warner)	NCRWQCB (Frank Reichmuth)	Discussion of Mr. Tom Estes' request to use fly ash as a soil amendment. Ms. Warner briefly inspected the Estes estate and concurs that use of the fly ash at the site would be appropriate.
12/08/86	Memo: Inspection of proposed Estes soil amendment site north of Fort Bragg	NCRWQCB (Susan Warner)	Frank Reichmuth, Georgia Pacific Corp.	Ms. Warner describes a site inspection of Tom Estes' property. Mr. Estes wishes to use ash as a soil amendment. Ms. Warner recommens approval for a one-time application of ash but only if Mr. Estes controls runoff and airborn drift.
12/08/86	Letter: re: Usage of fly ash as soil amendment	Tom Estes	NCRWQCB (Susan Warner)	Mr. Estes requests approval of usage of Georgia Pacific Corp. fly ash as a soil amendment.
12/17/86	Report: Novermber Report: Fort Bragg Soil Amendment Monitoring and Reporting Program No. 86-3	Georgia Pacific Corp. (Steven Petrin)	NCRWQCB (Benjamin Kor)	November report for the Georgia Pacific Soil Amending Project as per Revised Monitoring and Reporting Program 86-3.
12/23/86	Letter: re: OCDD's presence in woodwaste ash	Ellie Giovannoni	NCRWQCB	Mrs. Ellie Giovannoni expresses concern over and requests an inspection of the level of OCDD found in woodwaste ash.
12/30/86	Regulatory: CRWQCB-NCR Inspection Cover Sheet	NCRWQCB (Susan Warner)	NCRWQCB (Fred Reichmuth, Dennis Salisbury)	Ms. Susan Warner completed a 'B' Type inspection of Facility Name, Georgia Pacific Fort Bragg Soil Amendment. The facility was found to be in compliance.

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12/31/86	Letter: re: Corrections to previous letter re: OCDD's presence in woodwaste ash	Ellie Giovannoni	NCRWQCB	Mrs. Ellie Giovannoni enters corrections to her previous letter (12/23/86).
12/31/86	Letter; re: Usage of fly ash as soil amendment	NCRWQCB (Susan Warner)	Tom Estes, Mendocino County Health Department (Ed Bridges)	Ms. Susan Warner approves Mr. Estes request to use fly ash as a soil amendment.
1987				
01/09/87	Memo: Inspection of fly ash soil amendment use	NCRWQCB (Susan Warner)	CRWQCB (Frank Reichmuth)	Updates to inspections of Little Valley, Allen Spring, and McGuire Ranch sites.
01/14/87	Report: monitoring report for Little Valley site	Georgia-Pacific Corp. (Steve Petrin)	NCRWQCB (Benjamin D. Kor)	December 1986 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
01/20/87	Letter: re: concerns posed by Fort Bragg resident about the potential for toxins in the fly ash stockpile	NCRWQCB (Susan Warner)	Ellie Giovannoni	Response to letters from Ms. Giovannoni dated December 23 and 31, 1986. Ms. Giovannoni's concerns center around the fly ash generation and disposal process and possible dioxin contamination of the ash. Ms. Warner promises to send a copy of Ms. Giovannoni's letters to the county and state health departments.
01/21/87	Letter: re: Ellie Giovannoi's concerns about the potential for toxins in the fly ash stockpile	NCRWQCB (Susan Warner)	Mendocino County Environmental Health Director (Gerald Davis)	Ms. Warner informs the County Health Dept. of concerns posed by residents of Ft. Bragg re: possible dioxin contamination of ash being stockpiled on the GP work sites.
01/21/87	Letter: re: Ellie Giovannoi's concerns about the potential for toxins in the fly ash stockpile	NCRWQCB (Susan Warner)	State Dept. of Health Services. (David J. Leu)	Ms. Warner informs the State Health Dept. of concerns posed by residents of Ft. Bragg re: possible dioxin contamination of ash being stockpiled on the GP work sites. She also asks Dr. Leu's assessment in determining whether a further investigation is warranted.
01/27/87	Letter: Concerns about ash data used in recent correspondence	Ellie Giovannoni	NCRWQCB (Susan Warner)	Ms. Giovannoni is concerned that the recent correspondence sent to Dr. Leu and Mr. Davis contained old ash data from 1984 instead of more recent samples collected in 1986.
02/02/87	Letter: response to Susan Warner's letter dated 1/21/87	State Dept. of Health Services. (David J. Leu)	NCRWQCB (Susan Warner)	Letter answering Susan Warner's questions regarding whether fly ash has been analyzed for dioxin contaminants and whether the alleged contamination requires further determination
02/04/87	Letter: request for new ash analysis	CRWQCB (Susan Warner)	Georgia Pacific Corp. (Steve Petrin)	Letter reiterating complaints by Fort Bragg residents re: the ash pile contamination and asking for a technical report describing the appropriate sampling plan and schedule for further analysis of PCDF and/or PCDD in the ash by 02/28/87.
02/12/87	Report: monitoring report for Little Valley site Jan 1987	Georgia-Pacific Corp. (Steve Petrin)	NCRWQCB (Benjamin D. Kor)	January 1987 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
02/13/87	Report: quarterly narrative of ash amendment test plots	University of California Cooperative Extension, County Agricultural Center, Mendocino County (Roderick A. Shippey)	Unknown	Field report on ash amendment test plots.
02/24/87	Letter: reponse to Ellie Giovannoni's letter to David Leu dated 01/28/87 and letter to 60 Minutes dated 01/18/87	State Dept. of Health Services. (David J. Leu)	Ellie Giovannoni	Letter explaining in detail Dr. Leu's assesment that dioxins in the ash pile are not the cause of Ms. Giovannoni's illness.
02/26/87	Memo: Dioxin in Wood Ash	Georgia Pacific Corp. Fred McCaig	Georgia-Pacific. Rick Horder, Beth Zoffman, Addison Bell. CC: Jack Anderson, Doug Dutton.	Memo addressing the ash pile concerns in Fort Bragg and updating staff on Steve Petrin's 02/27/97 report. Attached sampling plan for wood ash dioxin as requested by RWQCB by 2/28/87.
02/27/87	Report: response to Susan Warner's letter dated 02/04/87	Georgia Pacific Corp. (Steve Petrin)	NCRWQCB (Susan Warner)	Sampling plan for chlorinated dioxin analysis as requested by RWQCB. Plan was drafted by GP's Central Engineering Department in Atlanta.
03/03/87	Letter: response to Steve Petrin's report dated 02/27/87	NCRWQCB (Susan Warner)	Georgia-Pacific Corp. (Steve Petrin)	Response to sampling plan, which is deemed adequate except on one account: Susan Warner requests that Plychlorinated dibenzofurans also be analyzed.
03/13/87	Letter: response to Susan Warner's letter and request for additional analysis, dated 03/03/87	Georgia Pacific Corp. (Steve Petrin)	NCRWQCB (Susan Warner)	Letter confirms receipt of Susan Warner's request for additional analysis. Georgia-Pacific will amend Section IX of the plan to include a plycholorinated dibenzofuran analysis.
03/13/87	Report: monitoring report for Little Valley site	Georgia Pacific Corp. (Steve Petrin)	CRWQCB (Benjamin D. Kor)	February 1987 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
03/23/87	Letter: response to Steve Petrin's letter dated 03/16/87	NCRWQCB (Susan Warner)	Georgia-Pacific Corp. (Steve Petrin)	Letter confirms receipt of Steve Petrin's letter and agreement to conduct further analysis of the ash pile. Letter also notes a telephon conversation between Warner and Petrin regarding the potentiallly hazardous nature of furans associated with dioxins.
03/26/87	Memo: Soil Removal - Willits Site	Georgia Pacific Corp. (J.A. Anderson)	Georgia-Pacific Corp. (Steve Petrin, G. D. Dutton, P. Fetter, R.A. Horder, G. F. McCaig, D. P. Roberto)	Memo congratulating staff on obtaining regulatory concurrence for the declassification of the soil at the site.
04/15/87	Letter: request from Ft. Bragg resident to obtain ash from the GP mill for fertilizer use	Michael A. Cleary	CRWQCB (Susan Warner)	Resident would like to acquire ash from the fly ash stockpile to enhance the soil on his farm.
04/15/87	Report: monitoring report for Little Valley site	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Benjamin D. Kor)	March 1987 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.

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04/23/87	Letter: response to request to obtain ash from the GP mill for fertilizer use	CRWQCB (Susan Warner)	Michael A. Cleary	Letter advises Mr. Cleary of several points to consider when incorporating fly ash into the soil. She also suggests that Mr. Cleary contact Rod Shippey of the County Farm Advisor's office (UCCE) to obtain information on proper pasture seed composition.
05/07/87	Letter: request from Ft. Bragg resident to obtain ash from the GP mill for fertilizer use	Dan Murray	CRWQCB (Susan Warner)	Resident would like to acquire ash from the fly ash stockpile to enhance the soil on his farm.
05/08/87	Letter: request from Ft. Bragg resident to obtain ash from the GP mill for fertilizer use	L.M. Remstedt	CRWQCB (Susan Warner)	Resident would like to acquire ash from the fly ash stockpile to enhance the soil on his farm.
05/14/87	Letter: request for extension of reporting deadline	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Susan Warner)	Letter confirms that analysis of the fly ash for chlorinated dibenzo dioxins and dibenzo furans is taking longer than anticipated. A new deadline of mid-June is suggested.
05/15/87	Report: monitoring report for Little Valley site	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Benjamin D. Kor)	April 1987 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
05/16/87	Report: Sample analytical results	Enseco Cal-Lab. (Michael W. Orbanosky)	Georgia-Pacific Corp. (Steve Petrin)	Analytical results of three fly ash samples sent to the lab. These samples are taken from the fly ash work sites and are being used to determine the level of toxins in the ash.
05/20/87	Letter: request from Ft. Bragg resident to obtain ash from the GP mill for fertilizer use	Thor Coblenz	CRWQCB (Susan Warner)	Resident would like to acquire ash from the fly ash stockpile to enhance the soil on his farm.
05/27/87	Memo: Inspection results from Little Valley site	CRWQCB (Susan Warner)	CRWQCB (Frank Reichmuth)	Memo detailing the inspection of the Little Valley ash amendment area on 05/19/87 and suggesting future action.
05/28/87	Letter: Ft. Bragg resident confirms receipt of ash and use as fertilizer on his farm	Michael A. Cleary	CRWQCB (Susan Warner)	Mr. Cleary writes that due to the inability of his wells to sufficiently dampen the ash as it was incorporated, he has decided to postpone the reaminer of the project until the ground planted has grown to maturity. He states that no ash has blwon and the grass and clover is growing well.
05/29/87	Letter: response to request to obtain ash from the GP mill for fertilizer use	CRWQCB (Susan Warner)	Dan Murray	Letter advises Mr. Murray that Ms. Warner is awaiting the results of further tests on the fly ash and that she does not wish to authorize its use as a soil amendment until these results are in. She suggests that Mr. Murray contact the CRWQCB in five weeks.
05/29/87	Letter: response to request to obtain ash from the GP mill for fertilizer use	CRWQCB (Susan Warner)	L.M. Remstedt	Letter advises Mr. Remstedt that Ms. Warner is awaiting the results of further tests on the fly ash and that she does not wish to authorize its use as a soil amendment until these results are in. She suggests that Mr. Remstedt contact the CRWQCB in five weeks.
05/29/87	Letter: response to request to obtain ash from the GP mill for fertilizer use	CRWQCB (Susan Warner)	Thor Coblenz	Letter advises Mr. Coblenz that Ms. Warner is awaiting the results of further tests on the fly ash and that she does not wish to authorize its use as a soil amendment until these results are in. She suggests that Mr. Coblenz contact the CRWQCB in five weeks.
05/29/87	Letter re: dioxin/furin report deadline extension request	CRWQCB (Susan Warner)	Georgia-Pacific Corp. (Steve Petrin)	Letter confims receipt of a letter from Steve Petrin dated 05/14/87. Petrin's letter had asked for an extension on the date required for submittal of the dioxin/furan report. Warner agrees to 6/15/87 as the new deadline.
06/01/87	Letter re: enclosed order to rescind a order 86-43	CRWQCB (Susan Warner)	Georgia-Pacific Corp. (Steve Petrin)	Enclosed is Order No. 87-80 rescinding Cleanup and Abatement Order No. 86-43 for the Little Valley ash soil amendment site. The Letter also addresses Warner's concerns re: the ash stockpiled in the are south of area "A". She requests that incorporation activities commence immediately on the stockpiled area.
06/01/87	Report: Technical bulletin	National Council of Paper Industry for Air and Stream Improvement.	Unknown	Assessment of Human Health Risks Related to Exposure to Dioxin From land application of wastewater Sludge in Maine.
06/03/87	Report: Sample analytical results	Enseco Cal-Lab (Robert S. Mitzel)	Georgia-Pacific Corp. (Steve Petrin)	Enclosed report includes analytical results for the 2,3,7,8 TCFD isomer that Petrin requested on 06/01/06
06/03/87	Letter: response to Susan Warner's letter and rescinded order dated 06/01/87	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Susan Warner)	Letter thanks Warner for the rescinded order and goes on to state that her concerns re: incorporation of stockpiled ash south of Area "A" has already begun and that no new matieral has been stockpiled in this are since late April.
06/08/87	Letter re: Enseco Cal-Lab's sample analytical results dated 05/16/87	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Susan Warner)	Letter refers to the analytical results obtained through Enseco Cal-lab and states that the sample analyzed showed that no dioxins were present. The analysis for furans yielded a trace amount and the lab will conduct an isomer-specific analysis to determin which TCDFs were detected.
06/16/87	Report: monitoring report for Little Valley site	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Benjamin D. Kor)	May 1987 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
06/18/87	Letter re: Enseco-Cal lab's analytical results	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Susan Warner)	Letter passes on Enseco-Cal lab's analytical results re: isomer-specific analysis. There were trace amounts of 2378-TCDF (15 ppt) detected.
06/25/87	Letter: request from Ft. Bragg resident to obtain ash from the GP mill for fertilizer use	Linda Sallinen	CRWQCB (Susan Warner)	Resident would like to acquire ash from the fly ash stockpile to enhance the soil on her farm.
07/02/87	Letter: response to Enseco-Cal Lab's sample analytical results	CRWQCB (Susan Warner)	Georgia-Pacific Corp. (Steve Petrin)	Letter details how the results indicating the presence of 2,3,7,8-tetracholorodibenzofuran in the fly ash sample make it necessary that no further soil amendment usage of the ash outside of the Little Valley site will be permited until the contaminant question is resolved. Warner requests a workplan detailing additional tests.
07/06/87	Report: Quarterly narrative	Univ. California Cooperative Extension, Ukiah (Roderick A. Shippey)	Unknown	Field report on ash amendment test plots.

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07/06/87	Letter: response to Ft. Bragg resident re: use of fly ash as fertilizer	CRWQCB (Susan Warner)	Michael A. Cleary	Ms. Warner proposes that she inspect the site in August. She also states that additional lab analyses of the ashshas been requested and she will need to obtain and evaluate this new data prior to approving additional use of ash on farm land
07/08/87	Letter: response to request to obtain ash from the GP mill for fertilizer use	CRWQCB (Susan Warner)	Linda Sallinen	Letter advises Ms. Sallinen that Ms. Warner is awaiting the results of further tests on the fly ash and that she does not wish to authorize its use as a soil amendment until these results are in. She suggests that Ms. Sallinen contact the CRWQCB in six weeks.
07/15/87	Report: monitoring report for Little Valley site	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Benjamin D. Kor)	June 1987 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
07/28/87	Letter: from Fort Bragg resident	Ellie Giovannoni	CRWQCB (Susan Warner)	Letter readdresses Ms. Giovannoni's concerns regarding GP's forest work in Ft. Bragg. Ms. Giovannoni refers to several general environmental concerns and also specifically asks if GP has complied with requests for additional anlysis of the fly ash.
07/30/87	Report: monitoring report for Little Valley and Allen Springs sites	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Benjamin D. Kor)	1986 Annual Report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
07/31/87	Work Plan: Wood fly ash sampling and analysis plan	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Susan Warner)	11-week plan for obtaining and accurate analysis of the dibenzofuran content in wood fired boiler fly ash at the GP Ft. Bragg Wood Production Plant.
08/03/87	Memo: Fly Ash Analysis	Georgia-Pacific Corp. (Steve Petrin)	Georgia-Pacific Corps. (Jack Anderson)	Memo explains that further analysis will need to be conducted at the ash pile site to try and resolve the dioxin/furan issue. GP decided to composite several samples as a single sample would most likely yield the same results as the previous analysis. Mr. Petrin will comply with Ms. Warner's request to include a feedstock sampling, despite his reservations.
08/11/87	Letter: response to Ms. Giovannoi's letter dated 07/28/87	CRWQCB (Susan Warner)	Ellie Giovannoni	Letter details the various requests made by the Agency to GP for analysis, and GP's corresponding work plans and revisions to work plans to comply with CRWQCB's requests. It reiterates the level of tetrachlorodibenzofurans found in the fly ash and states that new sampling and analysis will be conducted by the
08/11/87	Letter: response to proposed sampling and analysis plan	CRWQCB (Susan Warner)	Georgia-Pacific Corp. (Steve Petrin)	Letter comments per telephone conversation on 08/05/87 and reiterates that samples of the feedstock for the moitoring period should be obtained and held until the dibenzofuran analytical results are available. The letter agrees to the time frame suggested by the work plan.
08/11/87	Report: July 1987 Little Valley monitoring report	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Benjamin D. Kor)	July 1987 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
08/25/87	Memo: Ft. Bragg - Dioxin/Furan Study	Georgia-Pacific (J. Anderson)	Gerogia-Pacific Corp. (GD Dutton. P Fetter, RA Horder, GF McCaig, DL Mobley, B. Zoffman)	Intracompany memo containing letters from water quality agencies requesting second analysis of Ft. Bragg fly ash due to low levels of tetra furans found in initial samples. 12 samples will be collected and analyzed for furans only. Communication and data supporting this decision is included, dating back to May 29, 1986.
09/10/87	Report: August 1987 Little Valley monitoring report	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Benjamin D. Kor)	August 1987 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
09/10/87	Letter: Little Valley site inspection results	CRWQCB (Susan Warner)	Georgia-Pacific Corp. (Steve Petrin)	Letter addresses Ms. Warner's concerns that the area of the proposed ash stockpiling is near a stream tributary to Little Valley Creek. She requests that a brief plan be submitted outlining how GP will ensure that the ash is not placed in an area which potentially could discharge to the tributary.
09/11/87	Letter: Alum Pond sediments	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Susan Warner)	Aluminum content in Alum Pond sediments analyzed to determine usefulness as aoil amendment. Request to incorporate this material with other fly ash for disposal at Little Valley.
09/14/87	Letter: Update on potential harm caused by exposure to dioxin/furan in the residents of Ft. Bragg	Ellie Giovannoni	CRWQCB (Susan Warner)	Ms. Giovannoni details the various complaints made by Ft. Bragg residents and states several examples of other residents who are experiencing symptoms similar to her own. She also sites the use of herbicides and other unspecified pollutants as the cause of contaminated trees in Europe and Canada and ends her letter with a reference to "Agent Orange", which she associates as being correlative to the chemicals being used at the GP wood products site.
09/28/87	Letter: follow-up to Alum Pond sediment discussion.	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Susan Warner)	Letter provides additional information concerning the Alum Pond fly-ash sediments. Enclosed is a copy of the results from the last analysis and a plan to dredge the material over a dispersed time period (plans not final).
10/01/87	Memo: Georgia-Pacific Ash soil Amendment inspection results	CRWQCB (Susan Warner)	CRWQCB (Frank Reichmuth)	After inspecting the site with Steve Petrin and Dave Larking (both of GP), Ms. Warner notes that Mr. Petrin had proposed expanding the site to include an acre-wide area containing very young redwood trees. Ms. Warner requested that a new map showing the addition should be provided. She also discussed stream protection measures during the site visit.
10/10/87	Report: Sept. 198 Little Valley monitoring report	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Benjamin D. Kor)	September 1987 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
10/13/87	Report: analytical results from boiler ash samples	Enseco-Cal lab. (Michael J. Miille)	Georgia-Pacific Corp. (Steve Petrin)	Report contains the results for the 12 fly-ash samples from the GP boiler Ash Project, P.O. Number 15058 (MR-#01942), received by the lab on 09/16/87.
10/22/87	Letter: re: Enseco-Cal Lab's analysis of the fly ash for chlorinated furans.	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Susan Warner)	Enclosed are the lab results from Enseco-Cal Lab, dated 10/13/87. Mr. Petrin states that based on the analytical results of the twelve samples, no 2,3,7,8 isomers were detected and only very trace amounts of the other tetra-isomers were found. He believes that this resolves the contamination question.
10/23/87	Letter: response to letter of 09/28/87 re: alum pond	CRWQCB (Susan Warner)	Georgia-Pacific Corp. (Steve Petrin)	After review, Ms. Warner determines that the proposal to sue the ash from the alum ponds along with the other ash at GP for a soil amendment in accordance with the Little Valley Waste Discharge Requirment appears appropriate. She suggests that dredging and stockpiling of the ash materials occur separately and additionaly states other points for further discussion.

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11/01/87	Report: Toxicological Report for 2,3,7,8-TCDD	Michael Neal and Dipak Basu (Center for Chemical Hazard	unknown	Toxicological Profile Report for 2,3,7,8-TCDD. Task 53 for Contract 68-03-3228.
11/02/87	Memo: Subchapter 15 Classification of Fly Ash	CRWQCB (Craig Johnson)	State Water Resources Control Board (James Baetge)	Letter alerts the State Water Resources Control Board of the detection of tetrachlorodibenzofurans in the samples from the GP Ft. Bragg site. Technical support in determining whether the ash is still appropriate to use as a soil amendment or whether it should be considered a designated waste is requested.
11/02/87	Letter: waste classification of the fly ash	CRWQCB (Susan Warner)	State Dept. of Health Services. (David J. Leu)	Ms. Warner updates Dr. Leu on the analytical results of the fly ash. Although the Regional Board doesn't consider the ash to be hazardous, she is passing on the information in the event that Dr. Leu may wish to review the data and reconsider the waste classifications.
11/04/87	Report: Oct 1987 Little Valley monitoring report	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Benjamin D. Kor)	October 1987 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
11/10/87	Letter: Dioxin '87 meetings in Las Vegas	University of Nevada-Reno, Dept. of Biochemistry (Glenn C. Miller)	Office of Solid Waste Emergency Response, US EPA (Cate Jenkins)	Correspondence regarding various dioxin-related topics. Enclosed is an article on Photolysis of Octachlorodibenzo-p-dioxin on Soils: Production of 2,3,7,8-TCDD; slides from the presentation of said article at the Dioxin '87 Conference in Las Vegas on October 1987; Order No. 86-3 from the CRWQCB; a letter from Richard Wilcox (CA State Dept. of Health Services) to Carl Johnson stamped on 04/21/83 re: the classification of ash from the GP Ft. Bragg site as nonhazardous waste; and a memo from Harold Singer (State Water Reources Control Board) to Craig Johnson (CRWQCB) re: the reclassification of the ash as hazardous waste.
11/18/87	Letter: clarification on the Little Valley stockpile area map	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Susan Warner)	Letter notes that there is no formal drainage ditch between the stockpile and the stream, but the entire area has been ripped, effectively ditching the are several times over.
11/22/87	Memo: Ft. Bragg, CA Ash Problem	Drill, Friess, Hays, Loomis & Shaffer, Inc. Consultants in Toxicology (S. Friess)	Georgia-Pacific Corp. (C.T. Howlett, Esq.)	Letter agrees with EPA TEF approach to determining risk in fly ash, concludes "insignificant " risk from dioxins in ash
12/01/87	Memo: RWQCB request for clairfication on subchaper 15 classification of fly ash (DWQ Control No. 229)	State Water Resources Control Board (Frank Palmer)	State Water Resources Control Board (Bud Eagle)	Comments on Craig Johnson's memo to James Baetge of November 2, 1987, concerning characteristics of fly ash at the GP Ft. Bragg plant.
12/03/87	Letter: assessment of the levels of tetrachlorinated dibenzofurans found in the Ft. Bragg fly ash.	University of California Cooperative Extension (Carl K. Winter)	UCCE Ukiah (Rod Shippey)	Mr. Winter finds the levels of TCFD found be to very low and thatt he potential for TCFD to pose a threat to water quality is extremely low.
12/04/87	Report: Quarterly narrative on ash amendment test plots	Univ. California Cooperative Extension, Ukiah (Roderick A. Shippey)	Unknown	Report notes that a second set of flyash as a soil amendment test plot began in the fall. Mr. Shippey states that the fly ash solid waste disposal tests at Ft. Bragg has been so successful, he anticipates beginning another series of tests in Potter Valley.
12/15/87	Report: monitoring report	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Benjamin D. Kor)	November 1987 report for Soil Amending Project as per revised Monitoring and Reporting Program 86-3.
1988				
01/21/88	Cover Letter: GP Soil monitoring data 1987	Steven Petrin, Environmental Health & Safety CA Wood Products	NCRWQCB (Benjamin Kor)	Enclosed 12/1997 monitoring data for the Georgia-Pacific Soil Amending Project
01/26/88	Memorandum: Classification of GP fly ash	Harold J. Singer, State Water Resources Control Board	Craig Johnson (NCRWQCB)	Classification of fly ash from Georgia-Pacific Corporation, Fort Bragg, CA does not meet "decomposable" criterion for use as soil amendment.
01/31/88	Cover Letter: GP Soil monitoring annual report 1987	Steven Petrin, Environmental Health & Safety CA Wood Products	NCRWQCB (Benjamin Kor)	1987 Annual Report for the Georgia Pacific Soil Amending Project as per Monitoring and Reporting Program 86-3
02/09/88	Article: Congenital Poisoning by Polychlorinated Biphenyls and Their Contaminants in Taiwan	Walter J. Rogan, Beth C. Gladen, Kun-Long Hung, Shin-Lan Koong, Ling-Yu Shih, James S Taylor, Ying-Chin Wu, Dorothy Yang, N. Beth Ragan, Chen-Chin Hsu	unkown	Congenital Poisoning by Polychlorinated Biphenyls and Their Contaminants in Taiwan
02/19/88	Letter: Cease fly ash amendments	NCRWQCB (Mark Neely)	Steven Petrin, Environmental Health & Safety CA Wood Products	Due to the findings, the Regional Board intends to recind Waste Discharge Requirements Order No. 86-3, and Georgia-Pacific will be required to devise an aternative disposal method. GP requested to immediately cease incorporation of fly ash as amendment.
03/21/88	Cover Letter & Report: GP Soil Monitoring report	Steven Petrin, Environmental Health & Safety CA Wood Products	NCRWQCB (Benjamin Kor)	2/1988 report for the Georgia-Pacific Soil Amending Project as per monitoring and reporting program 86-3

Georgia-Pacific Fort Bragg Ash Document File Information				
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04/04/88	NOTICE: Recision of Waste Discharge Requirements for GP fly ash	NCRWQCB (Benjamin Kor)	cc: SWRCB, Division of Water Quality, Attn: Archie Matthews; SWRCB, Office of the Chief Counsel, Attn: Bonnie Wolstoncroft; DFG, Sacramento; DFG Yountville; Mendocino County Health Department, Attn: Gerald F. Davis; DOHS, SEB, Santa Rosa, Attn: B. David Clark, DWR, Central District, Sacramento, Attn: James M. Doyle; Mendocino County Planning Department, Ukiah, Attn: Ray Hall	Proposed Recision of Waste Discharge Requirements for Georgia-Pacific Corporation Fort Bragg Ash Soil Amendment, Mendocino County
04/04/88	Cover Letter: recision order	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Don Whitman) cc: Dow Jacobszoon, Gerald W. Tice, Pete Fetter	enclosed copy of tentative order to recind the waste discharge requirements, order no. 86-3 (not enclosed)
04/05/88	Note: G.P. Ash Disposal	NCRWQCB (Mark Neely)	Frank Reichmuth cc: F. McCraig, S. Friess, G. Tice	Subject: G.P. Ash Disposal Spoke to Kip Howlett of G-P in Washington DC, regarding their rebuttal of the findings of Dioxin and Furans in the G-P Ash. He told him he was sending information that day which indicated the TCDF and TCDD are not a problem in soil amendment
04/05/88	Letter: Request for removal of proposed recision from RWQCB agenda	C. T. Howlett, VP Government Affairs, Georgia-Pacific	Frank Reichmuth cc: F. McCaig, S. Friess, G. Tice	Re: Soil Amendment of Fly Ash - Order No. 86-3 Letter acknowledging that they requested that the rescission of Waste Discharge Requirements Orfer Number 86-3 be removed from the Board's April 28 meeting agenda.
04/08/88	Letter: response to request	NCRWQCB (Frank Reichmuth)	C. T. Howlett, VP Government Affairs, Georgia-Pacific cc: Lowell Ambrosini	Honoring the request of the confirming that the item will not be considered at the April 28th meeting. Although the letter was not received in enough time to be removed from the agenda.
05/20/88	Monitoring Plan: Revised Monitoring and Reporting Program	NCRWQCB	for GP Ft. Bragg Soil Amendment	Revised Monitoring and Reporting Program No 86-3 for GP Corporation Ft. Bragg Soil Amendment Program (no cover letter). Attachemnt 1: Waste Discharge Requirements for B Kor from 1986.
05/23/88	Report: revised monitoring and reporting program No. 86-3	CRWQCG	Unknown	Monitoring and Reporting Program 86-3, requiring samples and environmental records at Little Creek during ash disposal.
05/23/88	Letter:response to request for changes in soil monitoring plan	CA Regional Water Quality Control Board - North Coast Region	Georgia Pacific Corp. (Kent Mayer)	letter in response to request for changes in the Monitoring and Reporting Programs for both the Fort Bragg Sawmill and the Little Valley soil amendment.
05/27/88	Letter: ash classification	NCRWQCB (Benjamin Kor)	Georgia Pacific Corp. (Don Whitman) cc: Frank Palmer, SWRCB; Kip Howlett; Gerald W. Tice; Kent Mayer; G. Doug Dutton	confirm agreements reached in their office on May 12, 1988, regarding the possible recision of the Waste Discharge Requirements for the Little Valley soil amendment site. Ash regarded as nonhazardous and decomposable.
06/10/88	Facilities Inspection Report	State of CA	Georgia-Pacfic Corp. - Ft. Bragg Ash Soil Amendment	In Compliance. Approved Amendment sites for 87-88 Stockpile, and 88-89 Stockpile and Amendment
06/10/88	Report: Soil Monitoring Report, May 1988	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	5/1988 report for the Georgia-Pacific Soil Amending Project as per revised Monitoring and Reporting Progem 86-3
06/14/88	Inteoffice Communication	NCRWQCB (Mark Neely)	NCRWQCB (Frank Reichmuth), File - Georgia-Pacific Ash Soil Amendment	subject: Compliance inspection of G-P Ash Little Valley Soil Amendment Site
07/12/88	Report: GP Soil Monitoring	Kent C. Mayer, Environmental Engineer, Georgia-Pacific	NCRWQCB (Mark Neely)	6/1988 report for the Soil Amending Project for Georgia-Pacific, as per Monitoring and Reporting Order No. 88-3
07/15/88	Cover Letter: proposal for fly ash sampling	C. T. Howlett, VP Government Affairs, Georgia-Pacific	NCRWQCB (Benjamin Kor)	attached Proposal for Research Plan to determine Non-2,3,7,8 TCDFs in Fly Ash Amended Soil and Related Environmental Vectors
07/15/88	Proposal :Research Plan to determine Non-2,3,7,8 TCDFs in Fly Ash Amended Soil and Related Environmental Vectors	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Kent Mayer)	Proposal for Research Plan to determine Non-2,3,7,8 TCDFs in Fly Ash Amended Soil and Related Environmental Vectors
07/27/88	Letter: Assent to proposed amendement site	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Kent Mayer)	Letter serving as official confirmation of assent. During Mark's inspection of the Little Valley ash amending site on June 12, 1988. Mark agreed to Georgia-Pacific's proposed amendment site for the 1987-88 winter period stockpile. The amending is to take place just to the north of the stockpile.
08/05/88	Memo: Review of proposal submitted by Georgia Pacific Corp.	CSWRCB (Frank Palmer)	NCRWQCB (Frank Reichmuth)	Mr. Palmer recommends that fly ash and fly ash amended soils produced by Georgia Pacfic Corp. should be tested for 2,3,7,8-TCDF as well as non-2,3,7,8-TCDF isomers. Mr. Palmer makes this recommendation based on an article in **Science** (07/15/88) and two studies, Masuda *et al.* (1983) and Rappe *et al.* (1983).
08/08/88	Report : July Soil Monitoring report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Report for Soil Amending project for July 1988, as per Monitoring and Reporting Order 86-3
08/15/88	Letter: assent to ash diposal practices	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Dave Larkin)	reaffirming some of the best management practices that they had agreed on

Georgia-Pacific Fort Bragg Ash Document File Information				
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08/25/88	Letter: re: Proposal for Research Plan to Determine non-2,3,7,8-TCDFs in Fly Ash Amended Soil and Related Environmental	NCRWQCB (Benjamin Kor)	Georgia Pacific Corp. (C.T. Howlett, Jr.)	Letter stating NCRWQCB received Georgia Pacific Corp.'s proposal to to study non-2,3,7,8-TCDF isomers. NREWQCB advises that Georgia Pacific Corp also study 2,3,7,8-TCDF.
09/09/88	Report : Aug Soil Monitoring Report	Kent C. Mayer, Environmental Engineer, Georgia-Pacific	NCRWQCB (Mark Neely)	Report for Soil Amending project as per Monitoring and Reporting Order 86-3, for August 1988
09/20/88	Facilities Inspection Report	State of CA	Georgia Pacfic Corp. - Ft. Bragg Ash Soil Amendment	Amending in process. Some wind dispersion of ash, but no impact on water apparent.
10/04/88	Interoffice Communication: Little Valley Inspection results	NCRWQCB (Mark Neely)	NCRWQCB (Frank Reichmuth), File	Compliance inspection of Georgia-Pacific Soil Amendment site, Little Valley, Mendocino County
10/13/88	Report: Sept Soil Monitoring	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Report for Soil Amending project as per Monitoring and Reporting Order 86-3, for September 1988
11/10/88	Report: Oct Soil Monitoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	October 1988, Monitoring and Reporting report for the soil amending project as per order number 86-3
11/11/88	Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Amendment to the October 1988, Monitoring and Reporting Program number 86-3
11/23/88	Letter: request for schedule for non-2,3,7,8-TCDF study	NCRWQCB (Mark Neely)	C.T. Howlett Jr., Georgia Pacific	Requesting timeline as well as a progress report for the study by December 5, 1988
11/29/88	Letter : submitted timeline for fly ash research plan	Georgia Pacific Corp. (Gerald Tice)	Benjamin Kor, CA Regional Water Quality Control Board, cc: A. T. Johnson, Kent Mayer, D. B. Whitman, C. T. Howlett, Jr., G. D. Dutton, G. F.	Schedule for the Fly Ash Amended Soil Study
12/12/88	Coover Letter for Report : Nov soil monitornig report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Report for Soil Amending project, as per Monitoring and Reporting Order 86-3, for Nov. 1988
12/16/88	Facilities Inspection Report	State of CA	Georgia-Pacfic Corp. - Ft. Bragg Ash Soil Amendment	No Apparent Violation. No. Discharge Occuring.
12/30/88	Interoffice Communication: Little Valley Inspection results	NCRWQCB (Mark Neely)	NCRWQCB (Frank Reichmuth), File: G-P Ash Soil Amendment	Compliance inspection of Georgia-Pacific Soil Amendment site, Little Valley on Dec 16, 1988
1989				
01/05/89	Report: Water Sample results	Sue J. Long, Project Chemist, National Environmental Testing, Inc.	NCRWQCB (Mark Neely)	Analytical Results for One Water Sample Received 12/16/88 The report is written in confirmation of results telefaxed on January 5, 1989
01/09/89	Lab Analysis: Little Valley Soil results	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Lab analysis for CEC, percent base saturation and pH for our receiving soils, at Little Valley, as per Monitoring and Reporting Program No. 86-3. Samples taken November, 1988, and were taken at a depth of 1" and about
01/11/89	Report: Dec 1988 Soil Monitoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific and its Little Valley soil amending project, for the month of December 1988.
02/01/89	Letter: Proceeding with Phase II	Gerald Tice, Wood Products Manufacturing Division	NCRWQCB (Benjamin Kor) cc: A. T. Johnson, P. Fetter, K. Mayer, D. B. Whitman, C. T. Howlett, Jr., G. D. Dutton, G. F. McCraig	Letting them know they plan to proceed with Phase 2 sampling as outlined in November's letter.
02/14/89	Report: Jan 1989 Soil Monitoring report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	January 1989, Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific at Fort Bragg (Little Valley)
02/16/89	Letter: schedule for reports	NCRWQCB (Mark Neely)	Gerald Tice, Wood Products Manufacturing Division	accepting the proposed schedule
03/13/89	Report: Feb 1989 Soil Monitoring report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	February 1989, Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific at Fort Bragg (Little Valley)
03/21/89	Facilities Inspection Report	State of CA	Georgia Pacfic Corp. Ash Soil Amendment	Stockpile shows no sign of Surface Transport of ash. No Amending since last inspection.
04/11/89	Report: Mar 1989 Soil Monitoring report	Georgia Pacific Corp. (Kent Mayer)	Mark Neely, CA Regional Water Quality Control Board	March 1989, Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific at Fort Bragg (Little Valley)
04/14/89	Interoffice Communication: Inspection results	NCRWQCB (Mark Neely)	Frank Reichmuth, File: G-P Soil Amendment	Compliance inspection of Georgia-Pacific Ft. Bragg Ash Soil Amendment with K. Meyer on 21 March
05/04/89	Report: April Soil Monitoring report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	April 1989, Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific at Fort Bragg (Little Valley) - not attached
05/05/89	Report: April Soil Monitoring report amendment	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	As an amendment to the April 1989 Monitoring ans Reporting Program report dated 5/4/89, there was 2.56 inches of perception for the month.
06/06/89	Letter: request for delayed reporting of Amended Soil Study	Gerald Tice, Wood Products Manufacturing Division	Mark Neely, CA Regional Water Quality Control Board, cc: C. T. Howlett, Jr., A. T. Johnson, L. P. E. Otwell, P. M. Fetter, K. C. Mayer, L. D. Ambrosini, D. B. Whitman, G. F. McCraig, T. N. Treichelt	Explaintion for delay in completing the Fly Ash Amended Soil Study at the Little Valley site near the Fort Bragg, CA mill.
06/14/89	Report: May 1989 Soil Monitoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	May 1989, Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific Corporation at Fort Bragg, CA (Little Valley)

Georgia-Pacific Fort Bragg Ash Document File Information				
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07/14/89	Report: June 1989 Soil Montoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	June 1989, Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific Corporation at Fort Bragg, CA (Little Valley)
07/18/89	Report: 1988 Annual Soil Monitoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	1988 Annual report for the Georgia-Pacific Soil Amending Project as per Monitoring and Reporting Program No. 86-3
08/10/89	Report: July 1989 Soil Monitoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	July 1989, Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific Corporation at Fort Bragg, CA (Little Valley)
08/17/89	Facilities Inspection Report	State of CA	Georgia Pacfic Corp. Ft. Bragg Soil Amendment	New storage/amendment area approved
09/11/89	Report: Aug 1989 Soil Monitoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Aug 1989, Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific Corporation at Fort Bragg, CA (Little Valley)
09/12/89	Interoffice Communication: Inspection results	NCRWQCB (Mark Neely)	Frank Reichmuth, File: G-P Soil Amendment	Compliance inspection of Georgia-Pacific Ft. Bragg Ash Soil Amendment
09/19/89	Letter: Amendment site selection and ROWD form	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Kent Mayer, Gerald Tice, Dave Larkin)	Confirming the site for the new storage was approved. Reminder that the Waste Discharge Requirements for the site expire on January 30, 1990.
09/21/89	Report: OHEA Critique to Champion Corportaion's Alternative Risk Assessment for TCDD: Discharge Permit for the Canton (North Carolina) Mill	USEPA (Steven Bayard)	Water Management Division Region IV (John Marlar), Human Health Assessment Group (Charles Ris), NCRWQCB	Dioxin/Furan human health risk assessment for Champion Internation Corp. State by state reference of numeric criteria included.
09/26/89	Letter: ROWD form	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Completed Report of Waste Discharge (ROWD) form for the continuation of the Little Valley soil amendment site Waste Discharge Requirements. Fee calculation
10/13/89	Report: Sept 1989 Soil Monitoring Results	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	September 1989, Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific Corporation at Fort Bragg, CA (Little Valley)
11/13/89	Letter: receipt of ROWD and concerns	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Kent Mayer, Gerald Tice, Don Whitman, C. T.	Expressing concern of series of delays which have greatly reduced the time available for staff to review the report before the permit expires on January 30, 1990.
11/13/89	Report: Oct 1989 Soil Monitoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	October 1989, Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific Corporation at Fort Bragg, CA (Little Valley)
11/20/89	Results: Soil CED analysis Oct 1989	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Results for the October soil analysis for CED, % Sat. and pH, as per Order No. 86-3 for Georgia Pacific Corporation at Fort Bragg, CA (Little Valley)
12/13/89	Report: Nov 1989 Soil monitoring	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	November 1989, Monitoring and Reporting Program report, as per Order No. 86-3, for Georgia-Pacific Corporation at Fort Bragg, CA (Little Valley)
12/21/89	Report: "TCDF Study on Fly Ash Amended Soil and Related Environmental vectors"	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Benjamin Kor)	Results of 1988 Study of Ft. Bragg sawmill fly ash and amendments into soil at the Little Valley site. Study attached and 6 appendices
1990				
01/01/90	Report: Little Valley Monitoring Report Jan-June 1990	Unknown	unknown	Compiled results from soil amendment monitoring required by order 86-3.
01/02/90	Memo: "TCDF Study on Fly Ash Soil and Related Environmental Vectors)	NCRWQCB (Frank Reichmuth)	CSWCRB (Jesse Diaz)	Request for review of "TCDF Study on Fly Ash Soil and Related Environmental Vectors."
01/03/90	Memo: Re: "TCDF Study on Fly Ash Amended Soil and Related Environmental vectors"	Georgia Pacific Corp. (Gerald Tice)	Georgia Pacific Corp. (DK Mortensen, DL Glass, WL Duke, DL Mobley, CT Howlett Jr., AT Johnson, LD Ambrosini, RL Burns, PM Fetter, AF Hodges, KC Mayer, GF McCraig, LPE Otwell, T. Treichelt, D. Whitman)	Mr. Tice includes sections of the report so that other Georgia Pacific Corp. facilities can refer to them if questions arise concerning dioxins and furans in fly ash.
02/05/90	Letter: re: Expiration of Waste Discharge Requirements Order No. 86-3.	NCRQWCB (Benjamin Kor)	Georgia Pacific Corp. (Kent Mayer)	Mr. Kor notifies Georgia Pacific Corp. that the Waste Discharge Requirements Order No. 86-3 expired on January 30, 1990 and that the Regional Board meeting to discuss new requirements will be on 02/22/90.
02/09/90	Letter and Regulatory: Tenative waste discharge requirements order no. 90-32	NCRQWCB (Benjamin Kor)	SWRCB (Archie Matthews, Bonnie Wolstoncroft), DFG, Mendocino County Health Department (Gerald Davis), DOHS, EMB, USDI, Dept. Parks and Rec (James Doyle) Mendocino County Planning Dept. (Ray Hall)	Proposed Waste Discharge Requirements for GP Ft. Bragg Soil Amendment Order 90-32. Comments requested.
02/09/90	Memo: re: Waste Discharge Requirements for Georgia Pacific Corp. Application of Wookwaste Ash as Soil Amendment	NCRWQCB (Frank Reichmuth)	Regional Board Members	Request for review of staff report for item No. 14. Enclosures not attached.

Georgia-Pacific Fort Bragg Ash Document File Information				
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02/09/90	Memo: re: Classification of Fly Ash from Georgia Pacific Corp. Ft. Bragg, CA	NCRWQCB (Benjamin Kor)	CSWRCB (Jesse Diaz), NCRWQCB (Frank Palmer)	
02/15/90	Memo: Comments on a report by the Georgia Pacific Corp. dated December 1989: "TCDF Study on Fly Ash Amended Soil and Related Environmental Vectors"	CSWRCB (Frank Palmer)	NCRWQCB (Frank Reichmuth)	Mr. Palmer advises that since 2,3,7,8-TCDF was detected in the fly ash amended soil, a high resolution isomer specific analysis must be performed before the SRWCB can make a hazard assessment recommendation for the Waste Discharge Requirements Order No. 90-32.
02/15/90	Report: Staff Report: Review of a study by the Georgia Pacific Corp.: "TCDF Study on Fly Ash Amended Soil and Related Environmental Vectors" (Attachment 3)	CSWRCB (Frank Palmer)	NCRWQCB	Detailed report by Mr. Palmer outlining his recommendations to better analyze the presence of dioxins and furans in fly ash amended soil. Attached with 02/15/90 memo to NCRWQCB (Frank Reichmuth).
02/16/90	Appendix: Appendix 1: Samples Collected for the Georgia Pacific Corp.'s Three Phase Study	Georgia Pacific Corp.	unknown	Present/Not Present analysis of 2,3,7,8-TCDF in various samples taken from Georgia Pacific Corp.'s Little Valley fly ash amended soil plots and from Georgia Pacific Corp.'s boiler fly ash.
02/16/90	Letter: re: 2,3,7,8-TCDD human health risk assessment criteria	USEPA (Madonna Narveaz)	CSWRCB (Archie Matthews, Frank Palmer, Michael Perrone), NCRWQCB (Bill Rodriquez), CVRWQCB (Sterling Davis, Dennis Wilson), Bruce Mackler	Letter notifying agencies of 2,3,7,8-TCDD criteria being developed by states and a criqtique of an alternative risk assessment for 2,3,7,8-TCDD.
02/22/90	Report: Executive Officer summary of NCRWQCB mtg. Item 14	Mark Neely (NCRWQCB)	unknown	Item 14: Waste Discharge Requirements for GP ash as soil amendment order 90-32, discussed on Feb 22, 1990.
02/22/90	Report: Executive Officer summary of NCRWQCB mtg. Item 14	Mark Neely (RWQCB)	unknown	Addendum to Item 14: amendment to Order 90-32, requiring feasibility study for alternative disposal methods, reporting, and expiry of order.
02/26/90	Letter: re: Dioxin/Furan detection and exposure limits in Georgia Pacific Corp. fly ash	Timber Association of California (Steven Petrin)	NCRWQCB (Frank Reichmuth), Georgia Pacific Corp. (Kent Mayer)	Mr. Petrin discredits the samples analyzed on behalf of Ellie Giovannoni, states that OCDDs were not found in the sampling by Georgia Pacific Corp. and that at worst case scenario exposures are below 5 picograms per day.
02/26/90	Letter: re: Requested copies of dioxin/furan reports	NCRWQCB (Frank Reichmuth)	Timber Association of California (Steven Petrin)	Mr. Reichmuth sends Mr. Petrin Georgia Pacific Corp.'s Ash Study, Frank Palmer's review and February Regional Board staff report as requested.
02/27/90	Letter: re: Comments by Frank Palmer regarding TCDFs	NCRWQCB (Frank Reichmuth)	Georgia Pacific Corp. (Gerald Tice)	Mr. Reichmuth sends Mr. Tice the recommendations made by Frank Palmer and requests Georgia Pacific Corp. attend a meeting March 26, 1990 to resolve the dioxin/furan issues.
03/05/90	Letter: Waste Discharge Requirements Order No. 90-32	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Benjamin Kor)	Mr. Kor notifies Georgia Pacific Corp. of the adopted Waste Discharge Requirements Order No. 90-32 for the Fort Bragg Soil Amendment. Adoption took place 02/22/90 and will expire 07/01/91. NCRWQCB requests a Report of Waste Discharge due before 03/01/91.
03/05/90	Regulatory: Notice of Adoption of Waste Discharge Requirements for Georgia Pacific Corp. Fort Bragg Soil Amendment	NCRWQCB	CWRCB (Archie Matthews, Bonnie Wolstoncroft), DFG (Youtville), Mendocino County Health Dept. (Gerald Davis), DOHS-EMB-Santa Rosa (District Representative), DWR-Sacramento (Rick Woddard), USDI F&WS (Sacramento), Dept. Parks & Recreation-Sacramento (James Doyle), Mendocino County Planning Department-Ukiah (Ray	Waste Discharge Requirements Order No. 90-32 for Georgia Pacific Corporation Fort Bragg Soil Amendment adopted on 02/22/90.
03/13/90	Letter and Results: re: Follow-up dioxin/furan data to NCRWQCB meeting 02/22/90	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Benjamin Kor), Georgia Pacific Corp. (Kent Mayer, Don Whitman)	Mr. Tice raises concerns over recommendations made by Frank Palmer and offers clarification. Analytical results of 2,3,7,8-TCDF and total TCDF are included for fly ash and fly ash amended soil. 2,3,7,8-TCDF and total TCDF are detected in four out of five samples.
03/28/90	Letter: re: Georgia Pacific Corp. response to Frank Palmer's recommendations	NCRWQCB (Frank Reichmuth)	Georgia Pacific Corp. (Kent Mayer, Don Whitman), CSWRCB (Frank Palmer)	Mr. Reichmuth requests that Georgia Pacific Corp. analyze samples according to EPA protocol as outlined in "Interm Procedures for Estimating Risks Associated with Exposures ot Mixtures of Chlorinated Dibenzo-p-Dioxins and -Dibenzofurans (CDD's) and (CDF's) and 1989 Update." Mr. Reichmuth advises that analysis should focus on sediment samples and aquatic animals.
05/01/90	Letter: re: Fort Bragg Ash Amendment Project	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Frank Reichmuth), Georgia Pacific Corp. (Kent Mayer, Don	Mr. Tice states that dioxin/furan samples have been received and requests an extension for a meeting between Georgia Pacific Corp. representatives and the NCRWQCB until after a Georgia Pacific Corp. meeting in Atlanta.
05/21/90	Letter: re: Conference call on 05/17/90 pertaining to Little Valley Ash Project	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Benjamin Kor), Georgia Pacific Corp. (Kent Mayer, Don Whitman)	Letter to confirm details of a conference call between Georgia Pacific Corp. employess, NCRWQCB employees and Mr. Marty Lay of Selvage, Heber, Nelson and Associates (sampling consultants). Main topics included sediment, soil, and ash sampling and the two reports required by Waste Discharge Requirements Order No. 90-
05/22/90	Letter: re: Dioxin/Furan testing methods	Georgia Pacific Corp. (John Tice, IV)	NCRWQCB (John Hannum)	Mr. Tice, IV sends information regarding EPA Method 8290, ASTM Method D 75-87, SW-846, and the Enseco-Cal Laboratories modifications to Method 8290 to incorporate NCASI Method 551.

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
05/25/90	Letter: June 1990 Quarterly Progress Report	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Benjamin Kor), Georgia Pacific Corp. (Kent Mayer, Don Whitman, D. Modi, J. Tice, T. Treichelt, A.T. Johnson)	Notification that the quarterly progress report has been submitted as in accordance with the Waste Discharge Requirements Order No. 90-32. Timeline of report of conversatons, sampling and decisions is included.
05/29/90	Letter: re: Georgia Pacific Corp. Fort Bragg quarterly report	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Benjamin Kor)	Letter indicating that Mr. Tice mailed the quarterly report via certified mail.
05/30/90	Report: Georgia Pacific Corp. Fort Bragg, CA Little Valley Study Ash Stockpile Sampling	SHN, Inc	unknown	Final report requested by Georgia Pacific Corp. to perform sampling consultation.
05/30/90	Regulatory: Facilities Inspection Report	NCRWQCB (Frank Reichmuth)	CSWRCB	"A" type compliance inspection. Mr. Reichmuth notes - ash pile was sampled for TCDD and TCDF tetra to octa dioxin and furans also.
06/06/90	Letter: re: Georgia Pacific Corp. Fort Bragg Ash Project	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Benjamin Kor), Georgia Pacific Corp. (Kent Mayer, Don Whitman)	Letter to document a meeting between author, recipients, Frank Reichmuth, John Hannum, unnamed Georgia Pacific Corp.employees, unnamed representatives from SHN, Inc and Karen Theiss and Associates. Meeting was to discuss sampling locations and procedures.
06/14/90	Report: Dioxin results in ash from Little Valley	Michael Mille (Enseco Labs)	Georgia Pacific Corp. (Jay Tice)	Preliminary data for two ash samples from the Fort Bragg Little Valley Projec .collected on May 30, 1990. Note low standard recovery for some isomers.
06/15/90	Results: Dioxin/Furan Study	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Frank Reichmuth)	Preliminary data for two ash samples from the Fort Bragg Little Valley Project. For both samples dioxins and furans were detected.
06/25/90	Report: Georgia Pacific Corp. Fort Bragg, CA Little Valley Creek Sediment Sampling	SHN, Inc	unknown	Final report as requested by Georgia Pacific Corp. to perform sampling consultation.
06/25/90	Report: Sampling log for Georgia Pacific Corp. Fort Bragg, CA Little Valley Creek Sediment Sampling	SHN, Inc	NCRWQCB	Handwritten report detailing the sampling procedures and locations of sediment sampling in the Little Valley Creek.
06/25/90	Regulatory: Facilities Inspection Report	NCRWQCB (Mark Neely)	CSWRCB	"B" type compliance inspection. Mr. Neely notes - observed aquatic sampling, inspected potential stockpiling/amending areas.
06/25/90	Results: Dioxin/Furan	Enseco-CAL lab (Michael Miille)	Georgia Pacific Corp. (Jay Tice)	Analytical results of two ash samples obtained from Georgia Pacific Corp.'s Little Valley Project site.
06/28/90	Letter: re: Alternative Disposal Methods Report	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Benjamin Kor), Georgia Pacific Corp. (Kent Mayer, Don	Mr. Tice includes Georgia Pacific Corp.'s Alternative Feasibility Study as required by Waste Discharge Requirements Order 90-32. Study addresses methods other than soil amending for disposal of fly.
07/01/90	Regulatory: Waste Discharge Requirements Order No. 90-154	NCRWQCB (B. Kor)	unknown	Waste Discharge Requirements and Monitoring and Reporting Plan for GP ft. Bragg ash use as soil amendment (order 90-154)
07/05/90	Results: Dioxin/Furan study	Enseco-Cal Lab (Michael Miille)	Georgia Pacific Corp. (Gerald Tice)	Analytical results from two fish samples obtained from Georgia Pacific Corp. Fort Bragg Little Valley Project.
07/10/90	Report: Field Methodology	Karen Theiss and Associates (Karen Theiss)	Georgia Pacific Corp. (Gerald Tice)	Report of the field methodology used by Karen Theiss and Associates for the selection of appropriate organisms for the aquatic bioaccumulation study of Georgia Pacific Corp.'s Little Valley Creek Project.
07/10/90	Letter and Report: re: Proposed stormwater diversion system	NCRWQCB (Albert Wellman)	Georgia Pacific Corp. (Ed Wojinski, Bob Kelly, Don Whitman, Kent Mayer)	Technical Report, as required by the Cleanup and Abatement Order 86-159, which outlines methods to separate storm water from the process wastewater and to prevent future discharges of wastewater and woody debris to the Pacific Ocean.
07/10/90	Letter: re: Dioxin/Furan analysis of Georgia Pacific Corp. boiler ash and fish tissue	NCRWQCB (Mark Neely)	Dept. of Health Services (Dave Siegel), CSWRCB (Frank Palmer)	Mr. Neely encloses the final lab results of the dioxin and furan analysis for the boiler ash and fish tissue samples collected from an adjacent creek.
07/10/90	Results: Dioxin/Furan study	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Frank Reichmuth)	Final analytical results of the stickle back fish tissue samples collected from Georgia Pacific Corp.'s Little Valley Creek Project.
07/11/90	Report: Dioxins in Little Valley soil	Michael Mille (Enseco Labs)	Gerald Tice, Wood Products Manufacturing Division	Results of dioxin analysis of four soil samples from Little Valley colelcted on 25 June, 1990.
07/12/90	Memo: Comparison of Fort Bragg dioxin/furan concentrations versus 104 Mill Study	Georgia Pacific Corp. (J.J. Tice, IV)	Georgia Pacific Corp. (Distribution)	Mr. Tice, IV asserts that the Fort Bragg fly ash has similar concentrations of PCDD and PCDF as that of high grade paper and that the very low concentrations of PCDD and PCDF are not uptaken by the aquatic environment.
07/16/90	Letter: re: Sampling agreed to in conference call on 05/17/90	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Benjamin Kor), Georgia Pacific Corp. (T. Deer, Kent Mayer, Don Whitman)	Letter notifies NCRWQCB that sampling requested 05/17/90 has been completed. Mr. Tice summarizes results and requests a renewal or reissuance of the Waste Discharge Permit for the soil amending at the Little Valley site. Map attached.
07/17/90	Letter: re: Dioxin/Furan study	NCRWQCB (Mark Neely)	Dept. of Health Services (Dave Siegel), CSWRCB (Frank Palmer)	Preliminary lab results of the dioxin and furan analysis of the stream sediments from Georgia Pacific Corp.'s Little Valley Creek Project. Actual results not attacted.
07/19/90	Letter: Estimates of area available for ash amendment	Jere Melo (GP Chief Forester)	Mark Neeley (RWQCB), cc: k Mayer, G. Tice, T. Deer, D. Larkin	Map showing areas for proposed ash amendment in Little Valley.
07/25/90	Letter: BMPs for agricultural use of wood ash	Steven Petrin, Environmental Health & Safety CA Wood Products	Benjamin Kor (NCRWQCB)	Letter describing organization of committee of ash generators to develop BMPs
07/31/90	Regulatory: Regional Board Order No. 90-154	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Gerald Tice)	Revised Waste Discharge Requirements for the Georgia Pacific Fort Bragg Soil Amendment to be considered during the Regional Board meetin 08/16/90.

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
08/09/90	Letter: re: Georgia Pacific Corp. Fort Bragg, CA site inspection 07/31/90	NCRWQCB (Albert Wellman)	Georgia Pacific Corp. (Ed Wojinski, Don Whitman, Kent Mayer)	Letter indicating that Mr. Wellman sent a copy of his inspection to Georgia Pacific Corp. Inspection not attached.
08/14/90	Results: Little Valley July 1990 Monitoring Report	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Kent Mayer)	Volume and area of deposited ash for July 1990.
08/22/90	Regulatory: Notice of Adoption	NCRWQCB (Benjamin Kor)	CSWRCB (Archie Matthews, Bonnie Wolstoncroft), DFG (Sacramento, Youtville), Mendocino County Health Dept. (Gerald Davis), DOHS-EMB-Santa Rosa (District Representative), DWR-Sacramento (Rick Woddard), USDI F&WS (Sacramento), Dept. Parks & Recreation-Sacramento (James Doyle), Mendocino County Planning Department-Ukiah (Ray Hall)	Notice of adoption of Waste Dicharge Requirements for Georgia Pacific Corp. Fort Bragg Soil Amendment on 08/16/90.
08/22/90	Letter: re: Waste Discharge Requirements Order No. 90-154	NCRWQCB (Benjamin Kor)	Georgia Pacific Corp. (Gerald Tice, Kent Mayer, Don Whitman).	Letter confirming a copy of Waste Discharge Requirements Order No. 90-154 was sent to Georgia Pacific Corp.
08/29/90	Letter and Results: re: Residual chlorine in outfall discharge	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Albert Wellman)	Mr. Mayer informs Mr. Wellman that Georgia Pacific Corp. believes the residual chlorine detected in the outfall discharge is from the city running 50ppm chlorinated water through newly installed water lines because they had never previously detected residual chlorine.
08/29/90	Memo: Re: phone call from K. Meyer regarding GP Ft Bragg sawmill	Albert Wellman (RWQCB)	RWQCB (M. Neely, F. Reichmuth)	GP investigating increase in chlorine at discharge likely due to city of Ft. Bragg flushing of new pipes in vicinity. A. Wellman requested written report with analytical backup.
08/30/90	Letter: re: September 1990 Quarterly Progress Report	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Benjamin Kor), Georgia Pacific Corp. (A.T. Johnson, K. Mayer, D. Modi, J. Tice, T. Treichelt, D. Whitman, T. Deer, G. McCaig)	Letter confirming that Georgia Pacific Corp. submitted the September 1990 Quarterly Progress Report as in compliance with Waste Discharge Requirements Order No. 90-154.
09/07/90	Results: Dioxin/Furan study	PACE, Inc (Carol Posthuma)	NCRWQCB (Robert Klamt)	Analytical results from two solid samples taken from Georgia Pacific Corp.'s Little Valley Project site.
09/13/90	Results: Little Valley August 1990 Monitoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Volume and area of deposited as for August 1990.
09/21/90	Letter: re: Residual chlorine in outfall discharge	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Albert Wellman)	Mr. Mayer informs Mr. Wellman that residual chlorine is as of 09/18/90 no longer detected in outfall discharge.
09/24/90	Memo: Re: phone call from J. Melo regarding ash incorporation	Mark Neely (NCRWQCB)	Frank Reichmuth (RWQCB)	J. Melo requested extension to incorporated ash after 10/1/90. M. Neeley agreed to extension through Oct 5.
10/12/90	Results: Little Valley September 1990 Monitoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for September 1990.
10/24/90	Memo: Review of Risk Assessment Report, Gaylord Container Corporation, Antioch,	CVRWQCB (Dennis Wilson)	NCRWQCB (Kenneth Landau), CSWRCB (Frank Palmer)	Similar dioxin/furan bioaccumulation risk assessment which could be used in regard to other paper mills and paper mill effluent.
11/08/90	Results: Little Valley October 1990 Monitoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Volume and area of depostited ash for October 1990.
11/14/90	Memo: Dioxin Risks	Dept. of Health Services (Steven Book)	NCRWQCB (Kenneth Landau)	Review of Envirologic Data's article, "Risks Associated with Potential Exposure to dioxin through Activities Associated with the Manufacture of Bleached Pulp at Gaylord Container Corporation, Antioch, CA."
11/26/90	Regulatory: Facilities Inspection Report	Mark Neely (NCRWQCB)	CSWRCB	"B" type compliance inspection. Mr. Neely notes - no apparent violations.
11/30/90	Letter: re: December 1990 Quarterly Progress Report	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Benjamin Kor), Georgia Pacific Corp. (A.T. Johnson, K. Mayer, D. Modi, J. Tice, T. Treichelt, D. Whitman, T. Deer, C.T. Howlett, Jr.)	Letter confirming that Georgia Pacific Corp. submitted the December 1990 Quarterly Progress Report as in compliance with Waste Discharge Requirements Order No. 90-154.
Dec-90	Results: Little Valley December 1990 Monitoring Report	Georgia Pacific Corp.	unkown	Volume and area of deposited ash for December 1990.
12/06/90	Results: Little Valley November 1990 Monitoring Report	Georgia Pacific Corp. (Kent Mayer)	NCRWQCB (Mark Neely)	Volume and area of deposited as for November 1990.
12/20/90	Letter: re: Sampling protocol for Phase II of bioaccumulation study	Georgia Pacific Corp. (Gerald Tice)	NCRWQCB (Benjamin Kor), Georgia Pacific Corp. (C.T. Howlett, Jr., A.T. Johnson, K. Mayer, D. Modi, J. Tice, D. Whitman, T. Deer, L. Otwell)	Sampling protocol developed by Karen Theiss and Associates for Phase II of the bioaccumulation study at the Little Valley ash amendment site.
1991				

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
01/04/91	Report: monitoring reports of the Little Valley site (Jan-June, Sept 1991)	Georgia-Pacific Corp. (Kent Mayer)	CRWQCB (Mark Neely)	December 1990 report for the Monitoring and Reporting Program 90-154. Also includes Jan -June, Sept. 1991.
02/08/91	Letter: response to GP's proposal for the second round of sampling of aquatic biota in Little Valley	CRWQCB (Mark Neely)	Georgia-Pacific Corp. (Gerald Tice)	Letter clarifies that the proposal should be more specific with re: to isomer analysis for polychlorinated dioxins and furans with emphasis on analyzing the root portion of the aquatic plants. Additionally, the present waste Discharge Requirments will expire in July and a new Report will need to be submitted as sson as possible.
02/14/91	Letter: response to Mr. Neely's letter dated 02/08/91	Georgia-Pacific Corp. (Gerald Tice)	CRWQCB (Mark Neely)	Letter confirms receipt of the specified changes to the proposal. The sampling will occur on March 5, 1991.
02/21/91	Memo: Comments on risk assessment performed for Gaylord Continaer Corporation by Envirologic Data	State Water Resources Control Board (Francis Palmer)	CVRWQCB (F. Wayne Pierson)	Memo contains Mr. Palmer's comments on the Envirologic Data risk assessment report. Concludes no significant risk due to release of dioxin contaminated Gaylord effluent to San Joaquin River.
02/26/91	Report: quarterly progress in compliance with Waste Discharge Requirements Order No. 90-154	Georgia-Pacific Corp. (Gerald Tice)	CRWQCB (Benjamin Kor)	Report reiterates that since December 1990, GP has filed a sampling plan for additional sampling to further evaluate the potential bioaccumulation threat to the aquatic habitat of Little Valley Creek. It references Feb. 2 as the date in which CRWQCB agreed to the sampling plan and March 5 and 6 as the new sampling dates.
02/26/91	Report: waste discharge application form for the continued use of the Little Valley site	Georgia-Pacific Corp. (Gerald Tice)	CRWQCB (Mark Neely)	Report includes information on: Purpose of Sampling; Producer of Waste; Process of Production; Type of Waste; Declared Waste Components; Date of Sampling; Location of Sampling; Weather; Personnel on Site; Sample Summary as well as Sampling Protocol; Fileld Data Sampling Summary and information re: Sample Transport and Shipping.
04/01/91	Report: Little Valley Creek Second Round Sediment Sampling April 16&17 1991	SHN Consulting Engineers and Gelologists	Georgia-Pacific Corp.	Report includes information on: Preparation; Sampling Rationale and Methodology; Sampling Location Layout; Sediment Sampling as well as Conclusions
04/12/91	Letter: scheule for aquatic sampling at the Little Valley site	Georgia-Pacific Corp. (Gerald Tice)	CRWQCB (Mark Neely)	Letter indicates that sampling will continue at Little Valley on April 16 and 17, 1991 and that the analysis should be completed in four weeks with a report scheduled for completion by May 31, 1991. Additionally, Mr. Tice informs Mr. Neely that they have not been able to conduct aquatic sampling at the site due to excessive rainfall.
05/01/91	Report: Dioxin analysis of tissue samples	Enseco-Cal Lab. (Michael Miille)	Georgia-Pacific Corp. (Gerald Tice)	Analytical results for 2,3,7,8-substitutes dioxins in six plant and four fish samples received on 19 April, 1991. Additional samples archived.
05/03/91	Report: Dioxin analysis of soil samples	Enseco-Cal Lab. (Michael Miille)	Georgia-Pacific Corp. (Gerald Tice)	Analytical results for 2,3,7,8-substitutes dioxins in six soil samples from Little Valley received on 19 April, 1991.
05/16/91	Report: Phase II sampling for the aquatic bioaccumulation study at Little Valley	Karen Theiss and Associated. Biological and Environmental Consultants (Karen Theiss)	Georgia-Pacific Corp. (Gerald Tice)	Project report for Phase II sampling of Little Valley: Aquatic bioaccumulation of Dioxins from Little Valley Creek near Ft . Bragg. Samples shipped to Enseco-Cal Labs on 18 April, 1991.
06/03/91	Report: final report on the results of the aquatic sampling program conducted on April 16 and 17 at the Little Valley site	Georgia-Pacific Corp. (Gerald Tice)	CRWQCB (Benjamin Kor)	Report is the final result of sampling analysis done at the Little Valley site for Order No. 90-154. Included are consultative reports from Karen Theiss and Associates, SHN Consulting Engineers, and Enseco-Cal Labs. (not attached)
06/03/91	Report: quarterly progress in compliance with Waste Discharge Requirements Order No. 90-154	Georgia-Pacific Corp. (Gerald Tice)	CRWQCB (Benjamin Kor)	Reports reiterates that since March 1991, GP has completed the additional Little Valley Creek aquatic sampling and all consultatnts reports and analysis have been completed. GP's report to CRWQCB was submitted on June, 3, 1991. The results continue to show no evidence of bioaccumulation in the aquatic environment. All sampling and analysis required by Order No. 90-154 have been satisfied.
06/05/91	Cover letter: re: the GP ash soil amendment project	CRWQCB (Frank Reichmuth)	Integrated Waste Management Board (John Blue)	Cover letter indicates that a copy of the dioxin/furan sampling results from the ash soil amendment project was enclosed. No enclosure attached to copy.
06/10/91	Letter: copy of the draft Regional Board Order No. 91-93, revised Waste Discharge Requirments for the GP Ft. Bragg Soil Amendment.	CRWQCB (Mark Neely)	Georgia-Pacific Corp. (Gerald Tice)	Enclosures include an Application for Facility Permit Waste/Discharge and a vicinity map of the Little Valley area. No revised WDR attached.
06/11/91	Letter: reissue Waste Discharge Requirements for the Little Valley soil Amendment site	CRWQCB (Mark Neely)	Georgia-Pacific Corp. (Gerald Tice)	Letter requests submittal of a Report of Waste Discharge (ROWD) to the Regional Boardy by July 15, 1991.
06/11/91	Notice: Proposed Waste Discharge Requirements	CRWQCB (Benjamin Kor)	SWRCB (Archie Matthews, Frances McChesney), DFG, Mendocino County Health Department (Gerald Davis), DOHS, EMB, DWR (Robert Matteoli), USDI, Dept. of Parks and Recreation (James Doyle), Mendocino County Planning Dept. (Ray Hall)	Distribution of the Proposed Waste Discharge Requirements for Georgia-Pacific Corp. for the Fort Bragg Soil Amendment. Comments and recommendations are solicited from the various Federal, State, County and Regulatory agencies.
07/01/91	Report: Best management practices for wood fly ash	Georgia-Pacific Corp.	Unknown	Details best management practices based on lessons learned. These practices are meant to meet the CRWQCB's requirements for conducting sampling and aanlysis at the Little Valley Soil Amendment site.

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
07/01/91	Report: Summary Report of CDF/CDD Study Activities Conducted on the Little Valley Flyash Soil Amendment Site 1988 - 1991	Georgia-Pacific Corp.	Unknown	Report serves as an overview of all Georgia-Pacific activities at the site during the time frame recorded.
07/03/91	Cover letter: re: Waste Discharge Requirments Order NO. 91-93	CRWQCB (Benjamin Kor)	Georgia-Pacific Corp. (Gerald Tice)	Cover letter indicates that a copy of the WDRO is attached. No enclosure attached to copy at this time.
07/03/91	Notice: re: adoption of Waste Discharge Requirments	CRWQCB (Benjamin Kor)	SWRCB (Archie Matthews, Frances McChesney), DFG, Mendocino County Health Department (Gerald Davis), DOHS, EMB, DWR (Robert Matteoli), USDI, Dept. of Parks and Recreation (James Doyle), Mendocino County Planning Dept. (Ray Hall)	Notice alerts various Federal, State, County and Regulatory agencies of the adoption of WDR for GP Ft. Bragg Soil Amendment.
07/08/91	Report: monitoring report of the Little Valley site	Georgia-Pacific Corp. (Petter Fetter)	CRWQCB (Mark Neely)	June 1991 report for the Monitoring and Reporting Program 90-154.
07/11/91	Memo: Ft. Bragg 1991 Data - Toxicity Equivalents	Georgia-Pacific Corp. (J. J. Tice)	GP Distribution list: D. Modi, S. Friess, L. Otwell, G. Tice, T. Treichelt, CT Howlett, Maggie Dean, T. Kemeny	Calculated results of toxicity equivalents from the 1991 Ft. Bragg samples using the I-TEFs/89 Toxicity equivalent factors. Levels considered "innocuous".
07/17/91	Memo: Permit Application	Georgia-Pacific Corp. (Donald Baker)	Georgia-Pacific Corp. (Donald Whitman)	Attached is the original permit application for the Little Valley project. Request for signature on form and forwarding to Mark Neely (CRWQCB)
07/17/91	Report: completed report of waste discharge application form for the continuatio of the Little Valley site	Georgia-Pacific Corp. (Gerald Tice)	CRWQCB (Mark Neely)	Report also includes the final summary report, best management practices plan and an updated map of the Little Valley site.
07/23/91	Notice: Proposed Waste Discharge Requirements	CRWQCB (Benjamin Kor)	SWRCB (Archie Matthews, Frances McChesney), DFG, Mendocino County Health Department (Gerald Davis), DOHS, EMB, DWR (Robert Matteoli), USDI, Dept. of Parks and Recreation (James Doyle), Mendocino County Planning Dept. (Ray Hall)	Distribution of the Proposed Waste Discharge Requirements for Georgia-Pacific Corp. for the Fort Bragg Soil Amendment. Comments and recommendations are solicited from the various Federal, State, County and Regulatory agencies.
07/23/91	Letter: re: revised Waste Dishcarge Requirments for the Georgia-Pacific Fort Bragg Soil	CRWQCB (Mark Neely)	Georgia-Pacific Corp. (Gerald Tice)	Copy of Revised Regional Board Order No. 91-121 is referenced but not attached.
08/10/91	Report: monitoring report of the Little Valley site	Georgia-Pacific Corp. (Petter Fetter)	CRWQCB (Mark Neely)	Jully 1991 report for the Monitoring and Reporting Program 90-154.
08/26/91	Letter: Waste Discharge Requirement for Order 91-121	CRWQCB (Benjamin Kor)	Georgia-Pacific Corp. (Gerald Tice)	Waste Discharge Requirement for order 91-121 for GP Ft. Bragg Soil Amendment using waste fly ash in Little Valley.
09/26/91	Report: monitoring report of the Little Valley site	Georgia-Pacific Corp. (Petter Fetter)	CRWQCB (Mark Neely)	August 1991 report for the Monitoring and Reporting Program 90-154.
10/22/91	Letter: request for assistance	CRWQCB (Mark Neely)	Office of Environmental Health Hazard Assessment (Dave Siegel)	Letter requests assistance in determining hazards posted by the direct grazing of animals on lands utilized for the use of boiler ash as a soil amendment and of amending activities on the property of a nearby landowner.
10/28/91	Permit application	Georgia-Pacific Corp. (Ted Deer)	CRWQCB	Application for Facility Permit/Waste Discharge in the Mt. Diablo Merdian.
10/28/91	Report: Amendment to Report of Waste Discharge	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Mark Neely)	Completed report of waste discharge application for purposes of amending the current order (91-121) to expand operation to the McGuire Ranch property.
10/31/91	Letter: cover letter attached to amended page 1 of the waste discharge for the McGuire Ranch	Georgia-Pacific Corp. (Steve Petrin)	CRWQCB (Mark Neely)	Amendment to application dated October 28, 1991. Ammended permit is attached.
11/15/91	Report: monitoring report of the Little Valley site	Georgia-Pacific Corp. (Larry Lake)	CRWQCB (Mark Neely)	October 1991 report for the Monitoring and Reporting Program 90-154.
12/04/91	Report: monitoring report of the Little Valley site	Georgia-Pacific Corp. (Larry Lake)	CRWQCB (Mark Neely)	November 1991 report for the Monitoring and Reporting Program 90-154.
1992				
01/07/92	Results: Little Valley December 1991 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for December 1991.
01/21/92	Letter: re: Waste Discharge Requirements for proposed ash disposal at McGuire Ranch	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Steven Petrin, Jerry Barr, Gerald Tice),	Mr. Neely informs Georgia Pacific Corp. that because the proposed site is not on Georgia Pacific Corp. property, Georgia Pacific Corp. will need to re-file in order to adopt waste discharge requirements. Issues of concern are direct grazing on ash amended soil and the soil's capacity to assimilate the ash and become toxic to plant
01/30/92	Letter: Owners of McGuire Ranch	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Mr. Lake sends NCRWQCB the names and address of the owners of McGuire Ranch and filing fee for WDR.

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
02/03/92	Letter: re: Change of ash stockpile location	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Mr. Lake requests that Georgia Pacific Corp. be allowed to temporarily relocate its flyash stockpile due to prevailing northwest winds during the spring season.
02/05/92	Letter: re: Grazing on amended areas in Little Valley	Georgia Pacific Corp. (Steven Petrin)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (Larry Lake, Gerald Tice,	Mr. Petrin discusses grazing that occurred on the Little Valley plot and grazing permits.
02/10/92	Results: Little Valley January 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for January 1992 reported per 91-121. No activity on the site in January.
02/13/92	Letter: re: Draft of Regional Board Order No. 92-26	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Steven Petrin), James McGuire, Barbara McGuire	Enclosed is a draft of the Regional Board Order No. 92-26 as it pertains to possible soil amendment at the McGuire Ranch. Comments are requested.
02/13/92	Regulatory: Notice of Proposed Waste Discharge Requirements	NCRWQCB (Benjamin Kor)	CSWRCB (Archie Matthews, Frances McChesney), DFG (Sacramento, Yountville), Mendocino County Health Department (Gerald Davis), DOHS-EMB-Santa Rosa (District Representative), DWR-Sacramento (Robert Matteoli), USDI F&WS (Sacramento), Dept. Parks & Recreation-Sacramento (James Doyle), Mendocino County Planning Department-Ukiah (Ray Hall)	Notice of Proposed Waste Discharge Requirements for Georgia Pacific Corp. Fort Bragg Soil Amendment and James and Barbara McGuire. Subject to alterations after to review by recipients.
02/21/92	Memo: Risk Associated with use of Wood Ash as a Soil Amendment	California EPA (David Siegel)	NCRWQCB (Mark Neely), Frank Palmer, Julio Salinas, Susan Knadle	Recommendations on how to assess the human health hazard associated with consuming animals allowed to graze on fly ash amended soil.
02/24/92	Letter: re: An $800.00 check for the Little Valley site permit	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Larry Lake)	Mr. Neely informs Georgia Pacific Corp. that the permit fee has been raised from $800.00 to $900.00 and asks if Georgia Pacific Corp. will submit a new check.
02/25/92	Letter: re: Ash Health Risk Assessment	Georgia Pacific Corp. (Stevin Petrin)	NCRWQCB (Frank Reichmuth), Georgia Pacific Corp. (Larry Lake, Gerald Tice, J. Tice)	Mr. Petrin comments on the California EPA's report by Dr. Siegel, mainly the assumptions used to assess human health risk.
03/04/92	Regulatory: Notice of Adoption of Waste Discharge Requirements	NCRWQCB (Benjamin Kor)	CSWRCB (Archie Matthews), DFG (Sacramento, Yountville), Mendocino County Health Department (Gerald Davis), DOHS-EMB-Santa Rosa (District Representative), DWR-Sacramento (Robert Matteoli), USDI F&WS (Sacramento), Dept. Parks & Recreation-Sacramento (James Doyle), Mendocino County Planning Department-Ukiah (Ray Hall), EPA (San Francisco)	Notice of Adoption of Waste Discharge Requirements for Georgia Pacific Corporation Fort Bragg Soil Amendment at McGuire Ranch 92-26. Adopted 02/26/92.
03/04/92	Letter: re: Ash stockpiling and soil amendmening at McGuire Ranch	NCRWQCB (Benjamin Kor)	James and Barbara McGuire	Mr. Kor informs the McGuire's that since the proper ash amending rate has not yet been determined, only stockpiling of ash can occur on their property.
03/10/92	Results: Little Valley February 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for February 1992 per order 91-121. No activity on site.
03/12/92	Letter: re: Returned check	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Larry Lake)	Mr. Neely returned check number 904164 due to an error in fee calculation.
04/10/92	Results: Little Valley March 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for March 1992 per order 91-121. No activity on site.
05/08/92	Results: Little Valley April 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for April 1992 per order 91-121. No activity on site.
06/11/92	Letter: re: Permit fees for North Coast Board Order 91-121	Georgia Pacific Corp. (Stevin Petrin)	CSWRCB (Accounting Office), Georgia Pacific Corp. (Larry Lake, Gerald Tice), NCRWQCB (Mark Neely)	Mr. Petrin informs the CSWRCB that a "Past Due Invoice" sent to Georgia Pacific Corp. regarding amending activities is incorrect.
06/15/92	Results: Little Valley May 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for May 1992 per order 91-121. No activity on site.
07/15/92	Results: Little Valley June 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records forJune 1992 per order 91-121. No activity on site.
08/12/92	Results: Little Valley July 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for July 1992 per order 91-121. No activity on site.
09/16/92	Results: Little Valley August 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for August 1992 per order 91-121. No activity on site.
10/15/92	Results: Little Valley September 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for September 1992 per order 91-121. No activity on site.
11/13/92	Results: Little Valley October 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for October 1992 per order 91-121. No activity on site.

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
12/10/92	Results: Little Valley November 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for November 1992 per order 91-121. No activity on site.
1993				
01/15/93	Results: Little Valley Dec 1992 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for Dec 1992 per order 91-121. No activity on site.
02/01/93	Results: Feb 1993 Rainfall records	Georgia Pacific Corp.	unkown	Fainfall on various days in February 1993. Part of Monthly monitoring report.
02/15/93	Results: Little Valley January 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Rainfall records for January 1993 per order 91-121. No activity on site.
03/17/93	Results: McGuire Ranch February 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (Steven Petrin)	Rainfall records for February 1993 reported per 92-26.
03/18/93	Letter: Request for reduced monirong at Little Valley	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (Steven Petrin)	No activitiy at Little Valley, request only 1 annual inspection until resume activitiy
04/14/93	Results: Little Valley March 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for March 1993 per order 91-121. No activity on site.
04/14/93	Results: McGuire Ranch March 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (Steven Petrin)	Volume and area of deposited ash for March 1993 per 92-26..
05/17/93	Results: McGuire Ranch April 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (Steven Petrin, P. Johnson)	Volume and area of deposited ash for April 1993 per 92-26.
06/14/93	Results: Little Valley May 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (S. Petrin, P. Johnson)	Volume and area of deposited ash for May 1993 per order 91-121. No activity on site.
06/14/93	Results: McGuire Ranch May 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (S. Petrin, P. Johnson)	Volume and area of deposited ash for May 1993 per 92-26.
07/12/93	Results: Little Valley June 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (S. Petrin, P. Johnson)	Volume and area of deposited ash for June 1993 per order 91-121. No activity on site.
07/15/93	Results: McGuire Ranch June 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (S. Petrin, P. Johnson)	Volume and area of deposited ash for June 1993 per 92-26. No Activity on site.
08/12/93	Results: Little Valley July 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (S. Petrin, P. Johnson)	Volume and area of deposited ash for July 1993 per order 91-121. No activity on site.
08/13/93	Results: McGuire Ranch July 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (S. Petrin, P. Johnson)	Volume and area of deposited ash for July 1993 per 92-26.
09/15/93	Results: Little Valley August 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for August 1993 per order 91-121. No activity on site.
09/15/93	Results: McGuire Ranch August 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for August 1993 per 92-26.
10/15/93	Results: September 1993 Effluent Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Effluent monitoring report for September 1993. Cyanide was detected in four samples prompting an investigation by Georgia Pacific Corp. as explained in accompanying letter.
10/15/93	Results: Little Valley September 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for September 1993 per order 91-121. No activity on site.
10/15/93	Results: McGuire Ranch September 1993 Monitoring	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for September 1993 per 92-26.
11/11/93	Results: Little Valley October 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for October 1993 per order 91-121. No activity on site.
11/12/93	Results: McGuire Ranch October 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for October 1993 per 92-26.
12/15/93	Results: Little Valley November 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for November 1993 per order 91-121. No activity on site.
12/15/93	Results: McGuire Ranch November 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for November 1993 per 92-26.
1994				
01/15/94	Results: Little Valley December 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for December 1993 per order 91-121. No activity on site.
01/15/94	Results: McGuire Ranch December 1993 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for December 1993 per 92-26.
02/15/94	Results: McGuire Ranch January 1994 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for January 1994 per 92-26.
03/15/94	Results: McGuire Ranch February 1994 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for February 1994 per 92-26.
04/15/94	Results: McGuire Ranch March 1994 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely)	Volume and area of deposited ash for March 1994 per 92-26.

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
05/13/94	Results: McGuire Ranch April 1994 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for April 1994 per 92-26.
06/15/94	Results: McGuire Ranch May 1994 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for May 1994 per 92-26.
07/13/94	Results: McGuire Ranch June 1994 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for June 1994 per 92-26.
08/15/94	Results: McGuire Ranch July 1994 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for July 1994 per 92-26.
09/15/94	Results: McGuire Ranch August 1994 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for August 1994 per 92-26.
10/12/94	Results: McGuire Ranch September 1994 Monitoring	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for September 1994 per 92-26.
11/14/94	Results: McGuire Ranch October 1994 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for October 1994 per 92-26.
12/14/94	Results: McGuire Ranch November 1994 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for November 1994 per 92-26.
1995				
01/13/95	Results: McGuire Ranch December 1994 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for December 1994 per 92-26.
02/13/95	Results: McGuire Ranch January 1995 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for January 1995 per 92-26.
03/16/95	Results: McGuire Ranch February 1995 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for February 1995 per 92-26.
04/16/95	Results: McGuire Ranch March 1995 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for March 1995 per 92-26.
05/15/95	Results: McGuire Ranch April 1995 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for April 1995 per 92-26.
06/09/95	Results: McGuire Ranch May 1995 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for May 1995 per 92-26.
07/17/95	Results: McGuire Ranch June 1995 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (T. Ray)	Volume and area of deposited ash for June 1995 per 92-26.
08/19/95	Results: McGuire Ranch July 1995 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (P. Johnson)	Volume and area of deposited ash for July 1995 per 92-26.
09/15/95	Results: McGuire Ranch August 1995 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (P. Johnson)	Volume and area of deposited ash for August 1995 per 92-26.
10/15/95	Results: McGuire Ranch September 1995 Monitoring	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (P. Johnson)	Volume and area of deposited ash for September 1995 per 92-26.
11/24/95	Results: McGuire Ranch October 1995 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (P. Johnson)	Volume and area of deposited ash for October 1995 per 92-26.
12/28/95	Results: McGuire Ranch November 1995 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (P. Johnson)	Volume and area of deposited ash for November 1995 per 92-26.
1996				
01/18/96	Results: McGuire Ranch December 1995 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (P. Johnson)	Volume and area of deposited ash for December 1995 per order 92-26.
02/21/96	Results: McGuire Ranch January 1996 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for January 1996 per order 92-26.
03/15/96	Results: McGuire Ranch February 1996 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for February 1996 per order 92-26.
04/10/96	Results: McGuire Ranch March 1996 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for March 1996 per order 92-26.
05/15/96	Results: McGuire Ranch April 1996 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for April 1996 per order 92-26.
06/10/96	Results: McGuire Ranch May 1996 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for May 1996 per order 92-26.
07/11/96	Results: McGuire Ranch June 1996 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for June 1996 per order 92-26.
08/14/96	Results: McGuire Ranch July 1996 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for July 1996 per order 92-26.

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
09/12/96	Results: McGuire Ranch August 1996 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for August 1996 per order 92-26.
10/11/96	Results: McGuire Ranch September 1996 Monitoring	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for September 1996 per order 92-26.
11/11/96	Results: McGuire Ranch October 1996 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for October 1996 per order 92-26.
12/06/96	Regulatory: Waste Discharge Requirements Order No. 96-96	NCRWQCB (Benjamin Kor)	unknown	Waste Discharge Requirements Order No. 96-96 for Georgia Pacific Corp. and James and Barbara McGuire Fort Bragg Soil Amendment.
12/18/96	Results: McGuire Ranch Novermber 1996 Monitoring	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for November 1996 per order 92-26.
1997				
01/10/97	Results: McGuire Ranch December 1996 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for December 1996 per order 92-26.
01/10/97	Regulatory: Facilities Inspection Report	NCRWQCB (Mark Neely)	unknown	"B" type compliance inspection of McGuire Ranch Disposal site. Mr. Neely notes a small discharge of ash, no water quality impacts.
02/14/97	Results: McGuire Ranch January 1997 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for January 1997 per order 92-26.
03/11/97	Results: McGuire Ranch February 1997 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for February 1997 per order 92-26.
04/15/97	Results: McGuire Ranch March 1997 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for March 1997 per order 92-26.
04/16/97	Letter: Compliance inspection of Georgia Pacific Corp. Fort Bragg/McGuire Ash Disposal	NCRWQCB (Mark Neely)	NCRWQCB (Frank Reichmuth)	Mr. Neely summarizes his findings during his 01/10/97 compliance inspection. Evidence of a minor discharge of ash into a roadside ditch. Report attached.
05/13/97	Results: McGuire Ranch April 1997 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for April 1997 per order 92-26.
05/15/97	Regulatory: Facilities Inspection Report	NCRWQCB (Mark Neely)	unknown	"B" type compliance inspection of Ft. Bragg sawmill. No violations.
06/16/97	Results: McGuire Ranch May 1997 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for May 1997 per order 92-26.
07/15/97	Results: McGuire Ranch June 1997 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for June 1997 per order 92-26.
07/28/97	Letter: re: Compliance Inspection of Georgia Pacific Corp. Fort Bragg Sawmill	NCRWQCB (Mark Neely)	NCRWQCB (Frank Reichmuth)	Mr. Neely summarizes his findings during his 05/15/97 compliance inspection.
08/13/97	Letter: re: Stormwater runoff reduction program	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Georgia Pacific Corp. requests that the date of submission for their stormwater runoff reduction program be 04/30/98.
08/14/97	Letter: re: Proposal to divert treated industrial waste to City of Fort Bragg's sewage treatment	NCRWQCB (Mark Neely)	Georgia Pacific Corp. (Larry Lake), City of Fort Bragg (Dave Goble)	Mr. Neely verifies agreements made during a meeting on 06/12/97, namely Georgia Pacific Corp. will provide a schematic flow diagram, analyze treated industrial waste and conduct a stormwater runoff reduction program.
08/15/97	Results: McGuire Ranch July 1997 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for July 1997 per order 92-26.
09/11/97	Results: McGuire Ranch August 1997 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for August 1997 per order 92-26.
10/14/97	Results: McGuire Ranch September 1997 Monitoring	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for September 1997 per order 92-26.
11/11/97	Results: McGuire Ranch October 1997 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for October 1997 per order 92-26.
12/11/97	Results: McGuire Ranch November 1997 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for November 1997 per order 92-26.
1998				
01/12/98	Results: McGuire Ranch December 1997 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for December 1997 per order 92-26.
01/16/98	Regulatory: Facilities Inspection Report	NCRWQCB (Mark Neely)	unknown	"B" type compliance inspection. Mr. Neely notes stormwater discharge from log yard excessively turbid and a visible discoloration of bay
02/26/98	Results: McGuire Ranch January 1998 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for January 1998 per order 92-26.
03/15/98	Results: McGuire Ranch February 1998 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for February 1998 per order 92-26.

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
04/20/98	Results: McGuire Ranch March 1998 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for March 1998 per order 92-26.
05/20/98	Results: McGuire Ranch April 1998 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for April 1998 per order 92-26.
06/20/98	Results: McGuire Ranch May 1998 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood)	Volume and area of deposited ash for May 1998 per order 92-26.
07/16/98	Results: McGuire Ranch June 1998 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for June 1998 per order 92-26.
08/14/98	Results: McGuire Ranch July 1998 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for July 1998 per order 92-26.
09/21/98	Results: McGuire Ranch August 1998 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for August 1998 per order 92-26.
10/23/98	Results: McGuire Ranch September 1998 Monitoring	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Mark Neely), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for September 1998 per order 92-26.
11/13/98	Results: McGuire Ranch October 1998 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for October 1998 per order 92-26.
12/16/98	Results: McGuire Ranch November 1998 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for November 1998 per order 92-26.
1999				
01/15/99	Results: McGuire Ranch December 1998 Monitoring Report	Georgia Pacific Corp. (Larry Lake)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for December 1998 per order 92-26.
02/22/99	Results: McGuire Ranch January 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for January 1999 per order 92-26.
03/10/99	Results: McGuire Ranch February 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for Febraury 1999 per order 92-26.
04/15/99	Results: McGuire Ranch March 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for March 1999 per order 92-26.
05/13/99	Results: McGuire Ranch April 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for April 1999 per order 92-26.
06/08/99	Results: McGuire Ranch May 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for May 1999 per order 92-26.
07/13/99	Results: McGuire Ranch June 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for June 1999 per order 92-26.
08/16/99	Results: McGuire Ranch July 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for July 1999 per order 92-26.
09/15/99	Results: McGuire Ranch August 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for August 1999 per order 92-26.
10/13/99	Results: McGuire Ranch September 1999 Monitoring	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Vath), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for September 1999 per order 92-26.
11/11/99	Results: McGuire Ranch October 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for October 1999 per order 92-26.
12/13/99	Results: McGuire Ranch November 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for November 1999 per order 92-26.
2000				
01/04/00	Letter and Results: Omitted data from the McGuire Ranch November 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman)	pH data from samples N. Road, S. Road, N. Pond, S. Pond.
01/11/00	Results: McGuire Ranch December 1999 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Volume and area of deposited ash for December 1999 per order 92-26.
02/14/00	Results: McGuire Ranch January 2000 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
03/16/00	Results: McGuire Ranch Febraury 2000 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
04/14/00	Results: McGuire Ranch March 2000 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
05/10/00	Results: McGuire Ranch April 2000 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
06/13/00	Results: McGuire Ranch May 2000 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
07/13/00	Results: McGuire Ranch June 2000 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
08/15/00	Results: McGuire Ranch July 2000 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
09/15/00	Results: McGuire Ranch August 2000 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
10/13/00	Results: McGuire Ranch September 2000 Monitoring	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
11/15/00	Results: McGuire Ranch October 2000 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Al Wellman), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
12/12/00	Results: McGuire Ranch November 2000 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
2001				
01/15/01	Results: McGuire Ranch December 2000 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
02/13/01	Results: McGuire Ranch January 2001 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
03/14/01	Results: McGuire Ranch February 2001 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
04/13/01	Results: McGuire Ranch March 2001 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
05/11/01	Results: McGuire Ranch April 2001 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
06/11/01	Results: McGuire Ranch May 2001 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
07/13/01	Results: McGuire Ranch June 2001 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
08/15/01	Results: McGuire Ranch July 2001 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
09/18/01	Results: McGuire Ranch August 2001 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
10/16/01	Results: McGuire Ranch September 2001 Monitoring	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
11/26/01	Results: McGuire Ranch October 2001 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
12/18/01	Results: McGuire Ranch November 2001 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
2002				
01/21/02	Results: McGuire Ranch December 2001 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
02/25/02	Results: McGuire Ranch January 2002 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
03/26/02	Results: McGuire Ranch February 2002 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Sherwood, R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
04/22/02	Results: McGuire Ranch March 2002 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
05/17/02	Results: McGuire Ranch April 2002 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
06/25/02	Results: McGuire Ranch May 2002 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
07/23/02	Results: McGuire Ranch June 2002 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
08/26/02	Results: McGuire Ranch July 2002 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
09/13/02	Results: McGuire Ranch August 2002 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
10/22/02	Results: McGuire Ranch September 2002 Monitoring	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
11/15/02	Results: McGuire Ranch October 2002 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (R. Holen)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
12/19/02	Results: McGuire Ranch November 2002 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
2003				
01/27/03	Results: McGuire Ranch December 2002 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 92-26 (96-096).
02/27/03	Results: McGuire Ranch January 2003 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
03/24/03	Results: McGuire Ranch February 2003 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
04/23/03	Results: McGuire Ranch March 2003 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
06/02/03	Results: McGuire Ranch April 2003 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
06/18/03	Results: McGuire Ranch May 2003 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
07/23/03	Results: McGuire Ranch June 2003 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
08/25/03	Results: McGuire Ranch July 2003 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
09/22/03	Results: McGuire Ranch August 2003 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
10/16/03	Results: McGuire Ranch September 2003 Monitoring	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
11/20/03	Results: McGuire Ranch October 2003 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
12/17/03	Results: McGuire Ranch November 2003 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
2004				
01/14/04	Results: McGuire Ranch December 2003 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
02/24/04	Results: McGuire Ranch January 2004 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
03/25/04	Results: McGuire Ranch February 2004 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
04/21/04	Results: McGuire Ranch March 2004 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
05/24/04	Results: McGuire Ranch April 2004 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
06/21/04	Results: McGuire Ranch May 2004 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
07/01/04	Results: McGuire Ranch June 2004 Monitoring Report	Georgia Pacific Corp. (Douglas Heitmeyer)	NCRWQCB (Charles Reed), Georgia Pacific Corp. (Paul Johnson)	Monthy monitoring report for rainfall, pH, COD and volume and area of deposited ash as required by Monitoring and Reporting Program No. 96-96.
09/02/04	Report: Exponent external review of GP sampling data from Ft.	Lisa Yost, Gregory Brorby (Exponent)	Julie Raming (GP)	Review of dioxin -related materials and data from 1989-2004. Disucss potential sources of dioxins and iterate that dioxin concentrations in fly ash are low and consistent with rural background levels.
2005				
11/14/05	Results: Dioxin/Furan analysis of two soil samples	Alta Analytical Laboratory, Inc (Martha Maier)	Curtis & Tompkins, Ltd. (Lisa Brooker)	Analytical results for 17 dioxin/furan congeners of two soil samples, AS7.1 and AS7.2 received 10/26/06.
2006				
02/16/06	Results: Dioxin/Furan analysis of two soil samples	Alta Analytical Laboratory, Inc (Martha Maier)	Curtis & Tompkins, Ltd. (Lisa Brooker)	Analytical results for 17 dioxin/furan congeners of two soil samples, DP10.7-5 and DP10.9-9.5 received 2/9/06.
02/21/06	Results: Dioxin/Furan analysis of three soil samples	Alta Analytical Laboratory, Inc (Martha Maier)	Curtis & Tompkins, Ltd. (Lisa Brooker)	Analytical results for 17 dioxin/furan congeners of three soil samples, DP8.7-2, DP8.9-2.5 and HSA4.5-16 received 2/8/06..
03/01/06	Results: Dioxin/Furan analysis of one composite soil sample,	Alta Analytical Laboratory, Inc (Martha Maier)	Curtis & Tompkins, Ltd. (Lisa Brooker)	Analytical results for 17 dioxin/furan congeners of one soil sample labeled, COMPOSITE, received 2/16/06..
06/07/06	Generator Waste Profile	Ellen Frosch, Michael Acton (Acton Mickelson Environmental, Inc.)	Brad Bonner, Allied Waste Services cc: Ms. Julie B. Raming, P.G., Georgia-Pacific Corporation	completed Generator Waste Profile Sheet

Georgia-Pacific Fort Bragg Ash Document File Information				
Date	**Document ID**	**Author**	**Recipient**	**Content**
07/14/06	Email: summary description of McGuire rance ash amendments (1993-2002)	Georgia Pacific Corp. (Douglas Heitmeyer)	Julie Raming (GP), Michael Acton (Acton Mickelson Environmental, Inc.)	Summary of ash ammendments 1993-2002, map, table of 1986-1993 amendments, and excel file attachment (ashvolume12.xls)
07/14/06	Report: Dioxin Sampling and Analysis Report **(Previously submitted to DTSC)**	John Mattey, Cohn O'Donnell, Jeff Heglie, Michael Acton (Acton Mickelson Env. Inc.)	GP Corporation, Wood Products Manufacturing Facility	Final Report with maps, data, and analysis of dioxin in Ft. Bragg ash, and disposal and handling procedures, ordered by RWQCB on June 13, 2006. **(Previously submitted to DTSC)**
08/09/06	Report: Sampling results and landfill transport details for Ash Pile Parcel 7. **(Previously submitted to DTSC)**	Michael Acton, Barbara Mickelson (Acton, Mickelson Environmental Inc.)	Denise Tsuji (DTSC), Craig Hunt(RWQCB) cc: GP (Julie Raming, Doug Heitmeyer), City of Ft. Bragg (Linda Ruffing), BBL (Bridgette	Material chracterized as non-hazardous and accepted for disposal at Keller Canyon landfill. All analytes were less than Total Threshold Limit Concnetrations and Soluble Threshold Limit Concentrations. Truck transport details are arranged in amended app. E. **(Previously submitted to DTSC)**

California Regional Water Quality Control Board
Worth Coast Region

CONTINGENCY PLANNING AND NOTIFICATION REQUIREMENTS

FOR

ACCIDENTAL SPILLS AND DISCHARGES

ORDER NO. 74-151

The California Regional Water Quality Control Board, North Coast Region, finds that:

1. Section 13225 of the Porter-Cologne Water Quality Control Act requires the Regional Board to perform general duties to assure positive water quality control.

2. The Regional Board has been advised of situations in which preparation for, and response to accidental discharges and spills have been inadequate.

3. Persons discharging waste or conveying, supplying, storing, or managing wastes or hazardous materials have the primary responsibility for contingency planning, incident reporting and continuous and diligent action to abate the effects of such unintentional or accidental discharge.

THEREFORE, IT IS HEREBY ORDERED THAT:

I. All persons who discharge wastes or convey, supply, store, or otherwise manage wastes or other hazardous material shall:

A. Prepare and submit to this Regional Board, according to a time schedule prescribed by the Executive Officer, a contingency plan defining the following:

1. Potential locations and/or circumstances under which accidental discharge incidents might be expected to occur,

2. Possible water quality effects of accidental discharges,

3. The conceptual plan for cleanup and abatement of accidental discharge incidents, including:

a. The individual who will be in charge of cleanup and abatement activities, on behalf of the discharger,

b. The equipment and manpower available to the discharger to implement the cleanup and abatement plans,

B. Immediately report to the Regional Board any accidental discharge incidents, Such notification shall be made by telephone as soon as the responsible person or his agent has knowledge of the incident,

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California Regional Water Quality Control Board
North Coast Region

GENERAL MONITORING AND REPORTING PROVISIONS

February 3, 1971
(Retyped July, 1982)

GENERAL PROVISIONS FOR SAMPLING AND ANALYSIS

Unless otherwise noted, all sampling, sample preservation, and analyses shall be conducted in accordance with the current edition of "Standard Methods for the Examination of Water and Waste Water" or approved by the Executive Officer.

All analyses shall be performed in a laboratory certified to perform such analyses by the California State Department of Health or a laboratory approved by the Executive Officer.

All samples shall be representative of the waste discharge under the conditions of peak load.

GENERAL PROVISIONS FOR REPORTING

For every item where the requirements are not met, the discharger shall submit a statement of the actions undertaken or proposed which will bring the discharge into full compliance with requirements at the earliest time and submit a timetable for correction.

By January 30 of each year, the discharger shall submit an annual report to the regional board. The report shall contain both tabular and graphical summaries of the monitoring data obtained during the previous year. In addition, the discharger shall discuss the compliance record and the corrective actions taken or planed which may be needed to bring the discharge into full compliance with the waste discharge requirements.

The discharger shall file a written report within 90 days after the average dry-weather flow for any month that equals or exceeds 75 percent of the design capacity of the waste treatment or disposal facilities. The report shall contain a schedule for studies, design, and other steps needed to provide additional capacity or limit the flow below the design capacity prior to the time when the waste flow rate equals the capacity of the present units.

California Regional Water Quality Control Board
North Coast Region

GENERAL MONITORING AND REPORTING PROVISIONS

February 3, 1971
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The discharger shall file a written report within 90 days after the average dry-weather flow for any month that equals or exceeds 75 percent of the design capacity of the waste treatment or disposal facilities. The report shall contain a schedule for studies, design, and other steps needed to provide additional capacity or limit the flow below the design capacity prior to the time when the waste flow rate equals the capacity of the present units.

California Regional Water Quality Control Board
North Coast Region

CONTINGENCY PLANNING AND NOTIFICATION REQUIREMENTS

FOR

ACCIDENTAL SPILLS AND DISCHARGES

ORDER NO. 74-151

See #9 of Provision Requirements

The California Regional Water Quality Control Board, North Coast Region, finds that:

1. Section 13225 of the Porter-Cologne Water Quality Control Act requires the Regional Board to perform general duties to assure positive water quality control.

2. The Regional Board has been advised of situations in which preparations for, and response to accidental discharges and spills have been inadequate.

3. Persons discharging waste or conveying, supplying, storing, or managing wastes or hazardous materials have the primary responsibility for contingency planning, incident reporting and continuous and diligent action to abate the effects of such unintentional or accidental discharge.

THEREFORE, IT IS HEREBY ORDERED THAT:

I. All persons who discharge wastes or convey, supply, store, or otherwise manage wastes or other hazardous material *shall:*

A. Prepare and submit to this Regional Board, according to a time schedule prescribed by the Executive Officer, a contingency plan defining the following:

1. Potential locations and/or circumstances under which accidental discharge incidents might be expected to occur,

2. Possible water quality effects of accidental discharges,

3. The conceptual plan for cleanup and abatement of accidental discharge incidents, including:

a. The individual who will be in charge of cleanup and abatement activities on behalf of the discharger,

b. The equipment and manpower available to the discharger to implement the cleanup and abatement plans,

B. Immediately report to the Regional Board any accidental discharge incidents. Such notification shall be made by telephone as soon as the responsible person or his agent has knowledge of the incident.

C. Immediately begin diligent and continuous action to cleanup and abate the effects of any unintentional or accidental discharge. Such action shall include temporary measures to abate the discharge prior to completing permanent repairs to damaged facilities.

D. Confirm the telephone notification in writing within two weeks of the telephone notification. The written notification shall include: reasons for the discharge, duration and volume of the discharge, steps taken to correct the problem and steps being taken to prevent the problem from recurring.

II. Upon original receipt of phone report (1 the Executive Officer shall immediately notify all affected agencies and known users of waters affected by the unintentional or accidental discharge.

III. Provide updated information to the Regional Board in the event of change of staff, size of the facility, or change of operating procedures which will affect the previously established contingency plan.

IV. The Executive Officer or his employees shall maintain liaison with the discharger and other affected agencies and persons to provide assistance in cleanup and abatement activities.

V. The Executive Officer shall transmit copies of this Order to all persons whose discharges of waste handling activities are governed by Waste Discharge Requirements or an NPDES Permit. Such transmittal shall include a current listing of telephone numbers of the Executive Officer and his key employees to facilitate compliance with Item I.B of this Order.

Ordered by _____
Benjamin D. Kor
Executive Officer

July 24, 1974
(Retyped January, 1986)

Your primary notification should be to the Regional Board office at Santa Rosa at (707) 576-2220. During off hours, you will be able to leave a recorded message at that number and, if you have a spill or discharge emergency, you will also be referred to the State Office of Emergency Services (OES) at (800) 852-7550. OES maintains a roster of key employees and will relay your notification to Regional Board staff.

California Regional Water Quality Control Board
North Coast Region

GENERAL MONITORING AND REPORTING PROVISIONS

February 3, 1971
(Retyped July, 1982)

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All samples shall be representative of the waste discharge under the conditions of peak load.

GENERAL PROVISIONS FOR REPORTING

For every item where the requirements are not met, the discharger shall submit a statement of the actions undertaken or proposed which will bring the discharge into full compliance with requirements at the earliest time and submit a timetable for correction.

By January 30 of each year, the discharger shall submit an annual report to the regional board. The report shall contain both tabular and graphical summaries of the monitoring data obtained during the previous year. In addition, the discharger shall discuss the compliance record and the corrective actions taken or planned which may be needed to bring the discharge into full compliance with the waste discharge requirements.

The discharger shall file a written report within 90 days after the average dry-weather flow for any month that equals or exceeds 75 percent of the design capacity of the waste treatment or disposal facilities. The report shall contain a schedule for studies, design, and other steps needed to provide additional capacity or limit the flow below the design capacity prior to the time when the waste flow rate equals the capacity of the present units.

Santa Rosa, California 95401

CHLORINATED DIOXINS AND DIBENZOFURANS IN THE TOTAL ENVIRONMENT II

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Levels of Chlorinated Organics in a Municipal Incinerator

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The presence of polychlorinated dibenzo-*p*-dioxins (PCDD) in emissions from municipal incinerators is well documented in a review by Lustenhouwer [1]. Municipal incinerators in The Netherlands, Canada, Japan, Switzerland, Italy, Germany, France, Sweden, and the United States have been studied. In spite of the many designs of these incinerators, and the variation in composition of municipal waste that exists among the different countries, PCDD has been detected in all studies. Large differences, however, exist in the relative amounts of various PCDD congeners and in the pattern of isomers within each specific congener, for samples taken from different incinerators.

Although they have not yet been as fully investigated as the PCDD compounds, the polychlorinated dibenzofurans (PCDF) are also prominent in municipal incinerator emissions. In fact, total PCDF concentrations are generally greater than total PCDD concentrations. The emphasis of some investigations on levels of PCDD is a result of the great concern over one specific compound, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD). Isomer-specific analysis for this compound, however, generally has shown that it is a minor component of the total concentration of tetrachlorinated dibenzo-*p*-dioxins [2]. Since several of the PCDF compounds have demonstrated similar toxicities to the toxicity of 2,3,7,8-TCDD in laboratory animal studies, estimates of the environmental im-

pact of incinerator emissions must take into account PCDF as well as PCDD levels.

Laboratory studies have shown that PCDD-PCDF compounds can be formed in chemical reactions involving such precursors as chlorinated phenols [3], chlorobenzenes [4], and polychlorinated biphenyls [5]. Although it has not been demonstrated that the mechanisms of PCDD-PCDF formation in incinerators involve these precursors, a recent study has shown them to be present in large quantities in the emissions of a municipal incinerator situated in the United States [6]. By monitoring levels of possible precursors in addition to levels of PCDD-PCDF compounds, an indication of the mechanism for PCDD-PCDF formation may be established. The chemistry of combustion reactions which occur municipal incinerators is so complex that this indirect approach isnecessary.

The principal variables which affect PCDD-PCDF formation must be associated with the composition of the feedstock and the incinerator operating conditions. No investigations of these factors have yet been reported. Such studies may indicate methods of reducing the formation of PCDD-PCDF compounds.

The data presented in this chapter are the first to include levels of chlorinated compounds in the feedstock to, as well as in the emissions from, a municipal incinerator. Possible precursors such as chlorophenols, chlorobenzenes, and polychlorinated biphenyls have been measured in addition to the various PCDD and PCDF congeners. Furthermore, all solid and liquid process sidestreams and slack emissions were analyzed, to give a total picture of incinerator emissions.

EXPERIMENTAL METHODS

Collection of Samples

Description of Facility

Figure 34.1 is a simplified diagram of the municipal incinerator studied. The overall facility consists of three incinerators, each with its own cooling tower and electrostatic precipitator, that feed into a common stack. The incinerators are not designed for energy recovery. Refuse is charged to the feed chute at a rate of approximately 8 metric tons/hr per incinerator. The refuse is incinerated at a temperature of 1010°C. Extraneous heating of the burning garbage is usually not required, but is added by two natural gas burners when the temperature of the furnace exit gases falls below 870°C. Heavy ash falls through the grates to hoppers, which in turn discharge the ash to a water-filled trough. Trough effluent is discharged via an overflow pipe which is fed to sanitary sewers. Samples of this trough overflow water and particulates in the trough overflow water were collected. for lysis. The ash from the trough is transported by conveyors to a holding a This holding area includes bottom ash, precipitator flyash, partic-

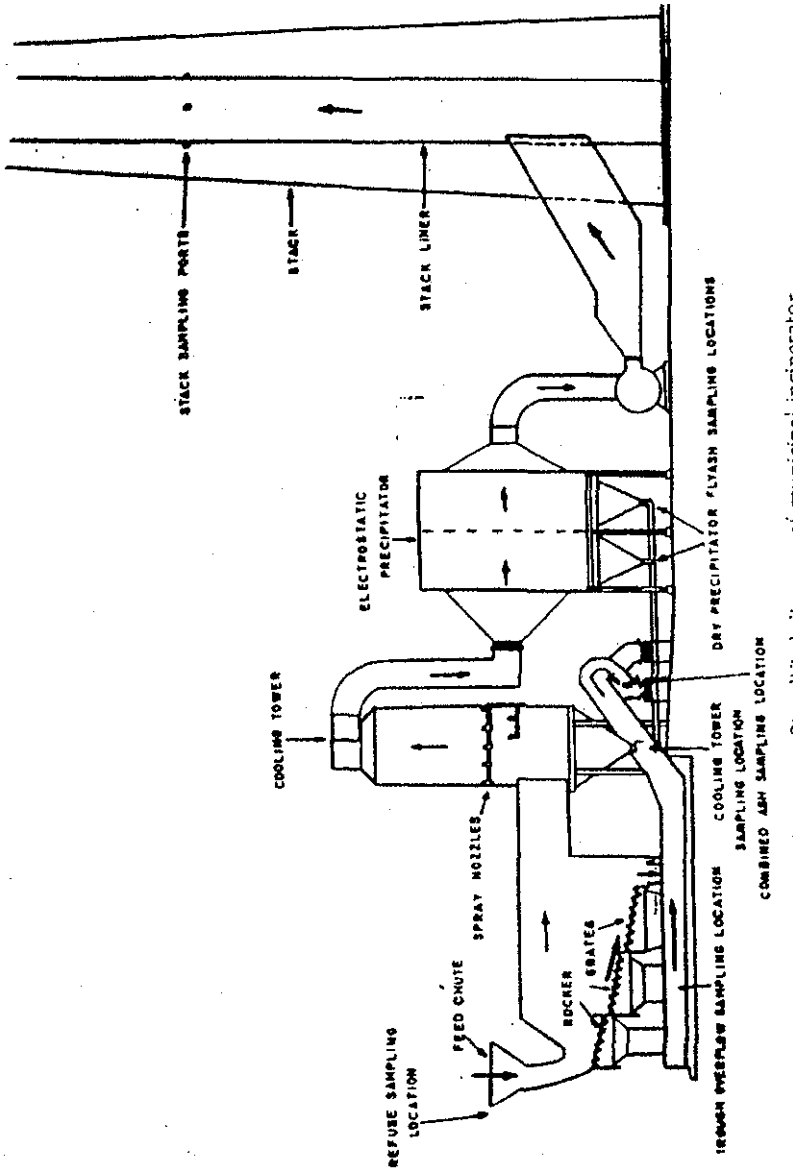

Figure 34.1. Simplified diagram of municipal incinerator.

ulates from the cooling tower, and scrubber particulates. The particulates in the holding area. which are used for landfill. are called combined ash. The amount of flyash in the combined ash is unspecified but is probably no greater than 2–4% of the combined ash by weight. The bottom ash was inaccessible for sampling before being mixed with flyash. A cooling tower is needed to reduce the temperature of incinerator gases from about 900°C to 280°C. About 50% of the cooling tower water used for this purpose is vaporized and eventually emitted from the stack. Temperatures in the stack range from about 230°C to 250°C and stack gas velocities are 1.5 ms^{-1} to 8.2 ms^{-1}. Stack gas moisture content is over 30%.

Stack Sample Collection

Three 24-hour stack samples were collected in a I-week time period during December 1981, using a modified EPA method 5 train. Changes to the EPA train are shown in Figure 34.2. Alter the third impinger, two florisil cartridges were placed in series. The cartridges were each packed with about 10 g florisil, and were held in place vertically to avoid channeling. Volumes of gas collected (dry reference) in the three 24-hour tests were 15.4, 16.2, and 16.9 m^3. The weights of particulate matter collected on corresponding filters were 240, 514, and 784 mg. Each stack sample collected resulted in 4 samples for GC-MS analysis, including the filter and rinsings from the probe and front part of the sampling train, impinger contents and' rinsings, and two separate florisil cartridges. Figure 34.1 shows the location of the stack sampling ports.

Process Sample Collection

Process samples refer to solid material including combined ash, dry precipitator flyash, particulates from the trough overflow water and cooling tower effluent, and liquid samples which include the trough overflow and cooling tower effluent. One set of process samples was collected for each stack sample. To obtain samples which were representative of the stack sample, each process sample was taken every 3 hr from each incinerator during the 24-hr stack sampling period. For each type of sample. the separate 3-hour samples were combined and well mixed to give a 24-hr composite. Particulate samples were well ground to increase sample homogeneity. From the composite samples an aliquot of 4 l (trough overflow water, cooling tower effluent) or 50 g (particulate samples) was used for extraction and analysis. Incinerator sampling locations for the various process samples are indicated in Figure 34.1.

Feedstock Sampling Procedure

A representative sample, based on visual inspection, of 140–180 kg refuse was taken every 3 hr from a pit which holds the refuse charged to each incinerator

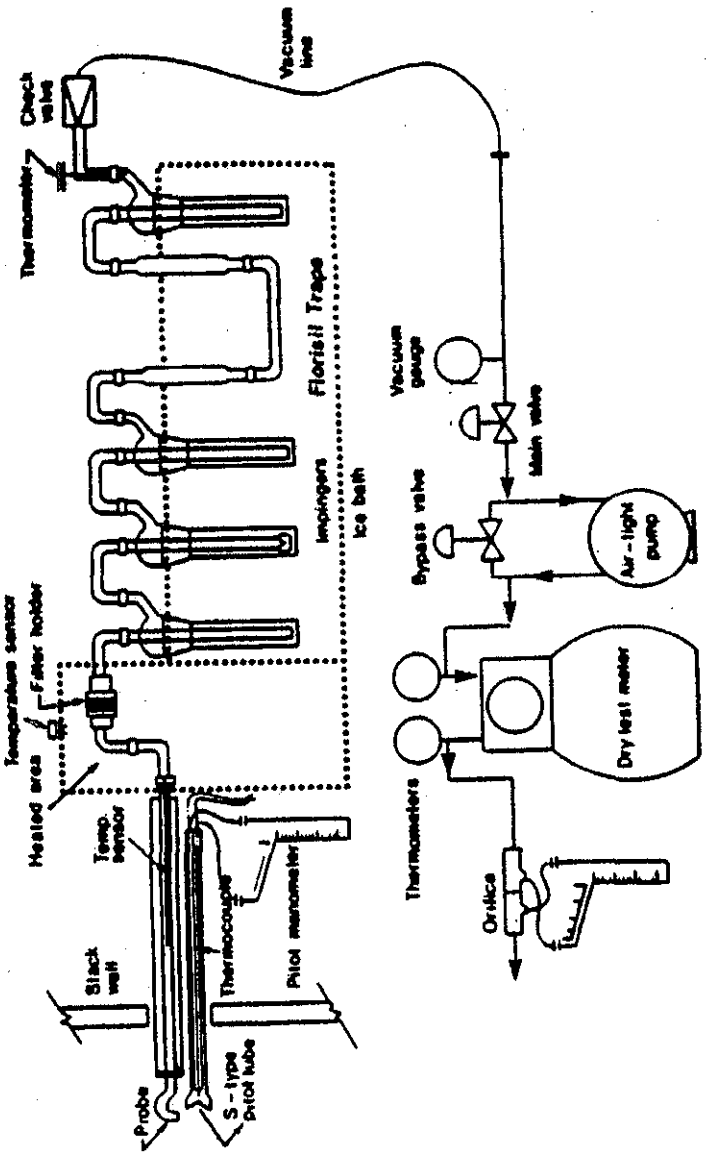

Figure 34.2. Modified EPA method 5 train used to sample stack emissions.

during the 24-hr stark sampling period. Individual 3-hr samples were sorted into four categories: paper products, wood products, and textiles; plastics, rubber, and leather products; food and gardening wastes; and ferrous metal, nonferrous metal, and glass products. The weights of these different fractions were recorded and a composite sample of about 10 kg containing the categories in their correct weight ratios was obtained. Individual 3-hr samples of material from the first three categories were shredded together to produce a 24-hr composite sample. The shredded composite sample was then milled to less than 0.5 mm. Of this sample, 50 g were extracted as described later. The ferrous and nonferrous fractions of the 3-hr samples were not milled or extracted.

Extraction of Samples

Spiking of Samples

To evaluate the efficiency of extraction, cleanup and GC-MS analysis of samples, a known amount of ^{37}Cl-octachlorodibenzo-*p*-dioxin (^{37}Cl-OCDD) was added to each sample prior to extraction. Stack sampler were recovered from the sampling train before spiking. Quantification of the amount of spike recovered was performed by GC-MS.

Stack Sampling Train Extraction

Sampling Probe Nozzle, i t Half of Filter Holder, Cyclone Bypass. Stack sampling trains were transported intact to the laboratory. All openings were sealed with aluminum foil prior to transport. The interior of the probe was rinsed 3 times with pentane. then brushed with a precleaned shotgun brush under additional pentane washing. The brush was rinsed with pentane to collect any trapped particulates, then the entire rinsing procedure was repeated using methylene chloride. The nickel-plated nozzle and glassware from the front half of the train were each rinsed twice with pentane and methylene chloride. Rinsings were filtered through the train's spent glass fibre filter and retained for subsequent Soxhlet extraction of the filtered particulates.

f a *Fibre Filter Extraction.* After drying at ambient temperature and weighing to determine the particulate catch, the filter and residue were ground using mortar and pestle and stirred with 300 ml 1 M HCl for one hour. The residue was centrifuged. filtered using a new glass fibre filter, and rinsed with deionized water. The filter and residue were then air dried and extracted in a Soxhlet apparatus. Pentane and methylene chloride rinses from the front half of the sampling probe w used initially as extraction solvents, at a cycle rate of 3/hr for 8 hr. A seco -hr extraction was performed using toluene. The samples were charged to glass extraction thimbles for these extractions over a bed of pre-

extracted silica (5–15 g, depending on sample size). After column chromatography cleanup, final sample volume for GC-MS analysis was 10 μl.

Impinger Contents and Associated Glassware. The glass fibre filter glass fritted support was extracted with 2 X 300 ml pentane and then 2 × 300 ml methylene chloride in an ultrasonic bath. Pentane and methylene chloride rinses of the rear half of the filter holder were added to the respective pentane and methylene chloride filter frit extracts. Impinger connecting glassware was rinsed with small volumes of acetone, followed by 4 rinsings employing generous quantities of pentane and methylene chloride. The pentane and acetone rinses of connecting glassware were added to the pentane extract of the glass fritted filter support, while the methylene chloride extract was added to the corresponding methylene chloride extract of the glass fritted filter support.

Liquid-liquid extraction of impinger contents was performed using the acetone-pentane rinse described above, with the addition of sufficient pentane to ensure a total extraction volume of 300 ml solvent per litre of impinger solution.

Extraction was repeated 4 times hy vigorous shaking for at least 5 min each time, and each extract was filtered through precleaned anhydrous sodium sulphate. The above procedure was repeated using methylene chloride. Extracts were concentrated by a Kuderna-Danish evaporator, cleaned up hy column chromatography, and combined to a final sample volume of 50 μl for GC-MS analysis.

Florisil Cartridges. Florisil cartridge contents were extracted using about 150 m pentane-methylene chloride hy Soxhiet apparatus. Extraction periods of 8 hr with a cycle rate of 3/hr were employed. Soxhlet extraction was repeated for an additional 8 hr using toluene. Extracts were concentrated by Kuderna-Danish apparatus, cleaned up as described later, and combined for GC-MS analysis. Fina sample volume for analysis of florisil extracts was 10 μl.

Process Sample Extraction

Liquid Samples *Including Trough Overflow and Cooling Tower Effluent.* A 4 l aliquot of the 24-hr composite was extracted using a separatory funnel and employing 300 ml pentane per litre of sample. Each pentane extract was filtered throug anhydrous sodium sulphate. The entire extraction procedure was repeated wit methylene chloride. Extracts were concentrated by Kuderna-Danish for colum chromatography clean-up. Final sample volume for GC-MS analysis was 10 μ

Solid Samples Including Precipitator Flyash, Combined Ash, Filtered Residue from Liquid Samples, Feedstock. For flyash, combined ash, feedstock, 50 aliquots of the 24-hr composite were used for Soxhlet extra . Before extra

tion, acid treatment of particulates was performed using 1 M HCl as described for the glass fibre filter. Extraction was by Soxhlet apparatus for 48 hr using toluene. After column chromatography cleanup, extracts were reduced to 100 μl (flyash) or 10 μl (other particulate samples) for GC-MS analysis. All samples were spiked with ^{37}Cl-OCDD before extraction.

Glassware Preparation

All glassware was cleaned by washing with aqueous detergent solution, rinsing with tap and distilled water, then by multiple solvent rinsings using methanol, acetone, and methylene chloride. A final pentane rinse was collected, concentrated by Kuderna-Danish apparatus, and then analyzed by GC-electron capture detection. Solvent rinsing of glassware was repeated if necessary until the GC analysis showed no peaks present in the PCDD-PCDF elution region. All solvents were distilled-in-glass grade from Caledon laboratories, Georgetown, Ontario, Canada.

Column Chromatography Cleanup

The initial cleanup column consisted of. from bottom to top of column, 1.0 g silica. 2.0 g 33% 1 M NaOH on silica. 1.0 g silica, 4.0 g 44% H_2SO_4 on silica, and 2.0 g silica. After a prewash with 30 ml hexane, incinerator samples were charged to the top of the column with three 5 ml hexane rinses of the sample container, andeluted with an additional 85 ml hexane. A keeper of 0.5 ml isooctane was added to the effluent. which was then concentrated to about 5 ml. The packing material retained chlorophenols (CP), which were extracted by shaking with hexane and methylene chloride. Chlorophenol extracts were concentrated by Kuderna-Danish apparatus and methylated for analysis by gas chromatography.

The concentrated eluant from the initial cleanup column was further treated using a dual-column system consisting of a short top column of 10% $AgNO_3$ on silica and a bottom alumina column. Samples were eluted using 100 ml pentane, which was collected for polychlorinated biphenyl (PCB) and chlorobenzene (CB) analysis. Before GC analysis, the pentane extract containing PCB and CB compounds was concentrated by Kuderna-Danish apparatus and eluted through a 36 cm florisil column using 20 ml pentane.

After eluting PCB and CB compounds from the dual-column system, the top $AgNO_3$ column was removed and the alumina column rinsed with 20 ml 10% CCl_4 in hexane followed by 20 ml hexane. PCDD and PCDF compounds were then recovered from the alumina by elution with 45 ml methylene chloride. Final sample volumes for GC-MS analysis were 10–100 l in isooctane solvent. Final sample v res were achieved by evaporating to dryness in Pierce reacti-vials and addi ne appropriate solvent volume by microlitre syringe.

Instrumental Analysis

PCDD-PCDF Determination

Concentrated sample extracts were analyzed by capillary column GC-low-resolution MS. A DB-5 fused silica column (30 m × 0.22 mm, J & W Scientific) was directly coupled to the ion source of a Finnigan 4000 GC-MS equipped with INCOS data system. Splitless injection was employed, and the GC was programmed from 80°C to 235°C at 15°C/min, then to 280°C at 4°C/min, and held at 280°C for 10 min. Injection temperature was 260°C and the GC-MS transfer line was 280°C.

Analysis was performed by operating the MS in the electron impact selected ion monitoring (SIM) mode. Three ions were monitored for each PCDD and PCDF congener, corresponding to the M$^+$, (M + 2)$^+$, and (M + 4)$^+$ ions. For maximum sensitivity, only 6 ions were monitored at a time, for the PCDD and PCDF compounds having the same number of chlorine atoms. This group of 6 ions was switched at previously determined times, just before the compounds of the next higher degree of chlorination started to elute from the GC column. Separation between PCDD-PCDF compounds containin): different degrees of chlorination was sufficient to allow detection of all PCDD and PCDF compounds containing four or more chlorines. No attempt was made to determine lower chlorinated PCDD-PCDF compounds.

Quantification was by an external standard which contained 1,2,3,4-TCDD, 2,3,7,8-TCDD, 2.3.7.8-TCDF, one representative isomer of the penta-hexa- and heptachlorinated *dibenzo-p-dioxins*, octachlorodibenzo-*p*-dioxin (OCDD), and octachlorodibenzofuran (OCDF). Concentrations of compounds in the external standard ranged from 30 to 40 pg/μl. PCDD and PCDF data were not corrected for recovery of the internal spike. However. recoveries of trial samples (filter, florisil, and impinger) averaged 43%: recoveries of process samples averaged 32%.

Chlorophenob (CP), Chlorobenzenes (CB), Polychlorinated Biphenyls (PCB)

CP, CB, and PCB analyses were performed by dual capillary column pas chromatography-dual electron capture detector (ECD). A Varian 6000/Vista 402 GC was equipped with two 50 m × 0.2 mm fused silica columns, one an SE-54 phase and the other an OV-1 phase. The GC oven was programmed from 90°C to 260°C at 3°C/min and held for 3 min. Identification of CP, CB, and PCB peaks was by correspondence of retention times on the two columns with those of standards. Also, the ratio of peak areas from each compound on the two ECD detectors was required to match the ratio determined by injection of an external standard, Quantification was based on this external standard ture which contained all CP and CB compounds.

RESULTS AND DISCUSSION

Table **34.1** is a list of the samples analyzed, and gives amounts extracted as well as some sampling information. Because liquid process samples were expected to be very low in organics content, only one representative sample from the three tests of each of these types was analyzed. No PCDD-PCDF compounds were detected in the trough overflow water, cooling tower water, or quench water: and PCB, chlorophenol, and chlorobenzene amounts were about the same as background levels in these samples. Therefore, remaining liquid process samples were not analyzed.

Analytical Results—PCDD and PCDF

In all three tests, more than 95% of the total PCDD-PCDF detected in train samples was found in the impingers. In process samples, 95% of the total was from the precipitator flyash. Figure **34.3** is a comparison of the total ion plots for the test 3 impinger and flyash extracts. Elution regions for the various PCDD-PCDF congeners are indicated.

A total of **30** ions was required for each PCDD-PCDF analysis, but only 6 were monitored at any specific time. A new group of 6 ions was chosen at the end of each congener elution region indicated in Figure 34.3. Numbers at the tops of peaks are scan numbers, where each scan consists of the abundances of the six ions monitored. Including the ion dwell times and computer overhead time, each sran required about 1.3 sec to prrform.

Table 34.1. Sampling Information

Sampling Parameter	*Test 1*	*Test 2*	*Test 3*
Average stack gas temp (°C)	262	256	245
Stack gas volume sampled (m^3)	15.4	16.2	16.9
Stack particulates sampled (mg)	240	514	784
Impinger catch (ml)	2490	2340	2215
ESP flyash extracted (g)	50	50	50
Combined ash extracted (g)	50	50	50
Trough overflow water extracted (l)	4	4	4
Trough Overflow particulates			
Cooling tower water extracted (l)	4	4	4
Cooling lower particulates			
Quench water volume extracted (l)	4	4	4
Quench water particulates			

Note: In addition to the samples listed, two florisil cartridges were extracted for each test. Data presented here are for the totals in both florisil cartridges.

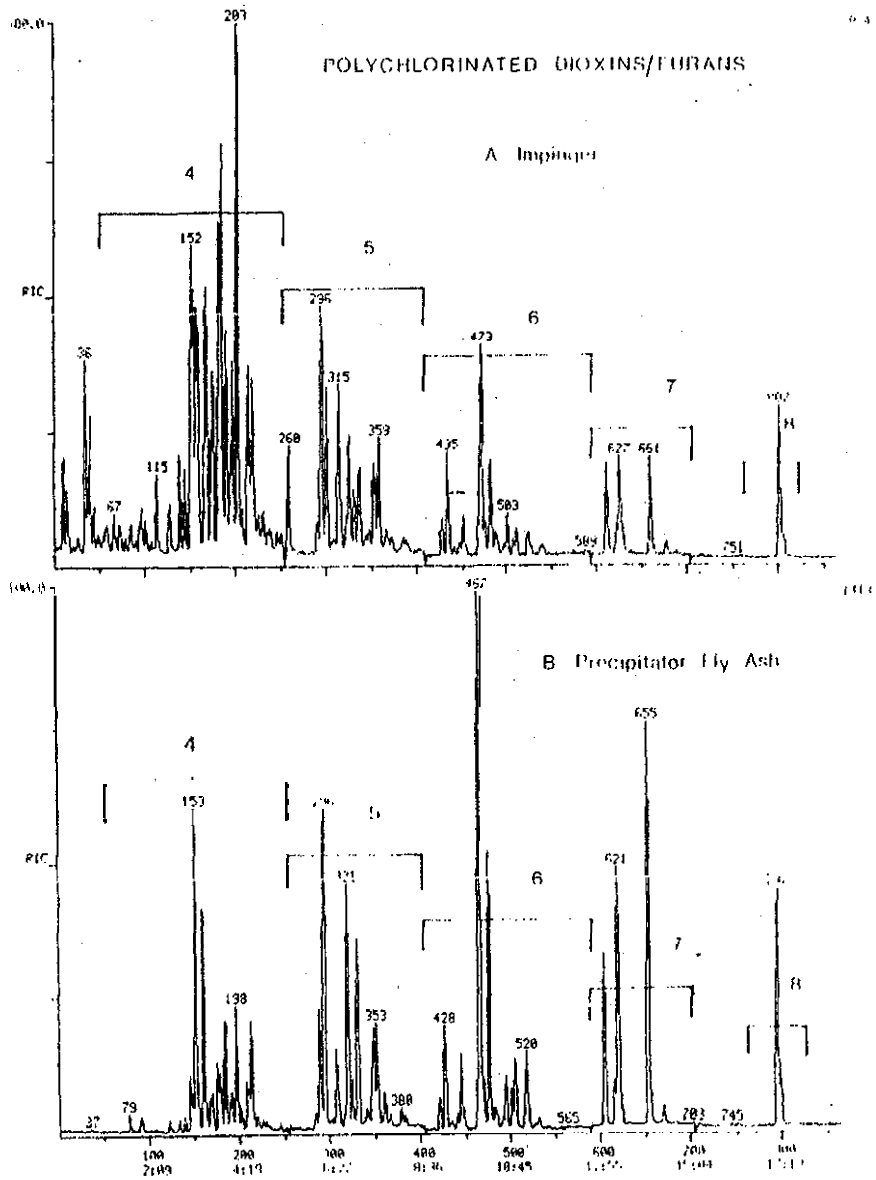

Figure 34.3. Total PCDD-PCDF ion plot for test 3 impinger and flyash extracts.

PCDD-PCDF Isomer *Patterns*

Patterns of isomers detected for the various PCDD-PCDF congeners varied little between the different types of samples analyzed or from test to test. Typical p

terns are illustrated in Figure 34.4 for the tetra-, penta-, and hexachlorinated dioxins. Figure 34.5 shows the corresponding PCDF isomer patterns. The ion abundance plots in Figures 34.4 and 34.5 are from the same flyash extract for which the total ion plot is given in Figure 34.3. Some differences wereobserved in isomer patterns between samples, but these were generally very small. Figure 34.6 illustrates the extent of variation in patterns that was observed. In the top two

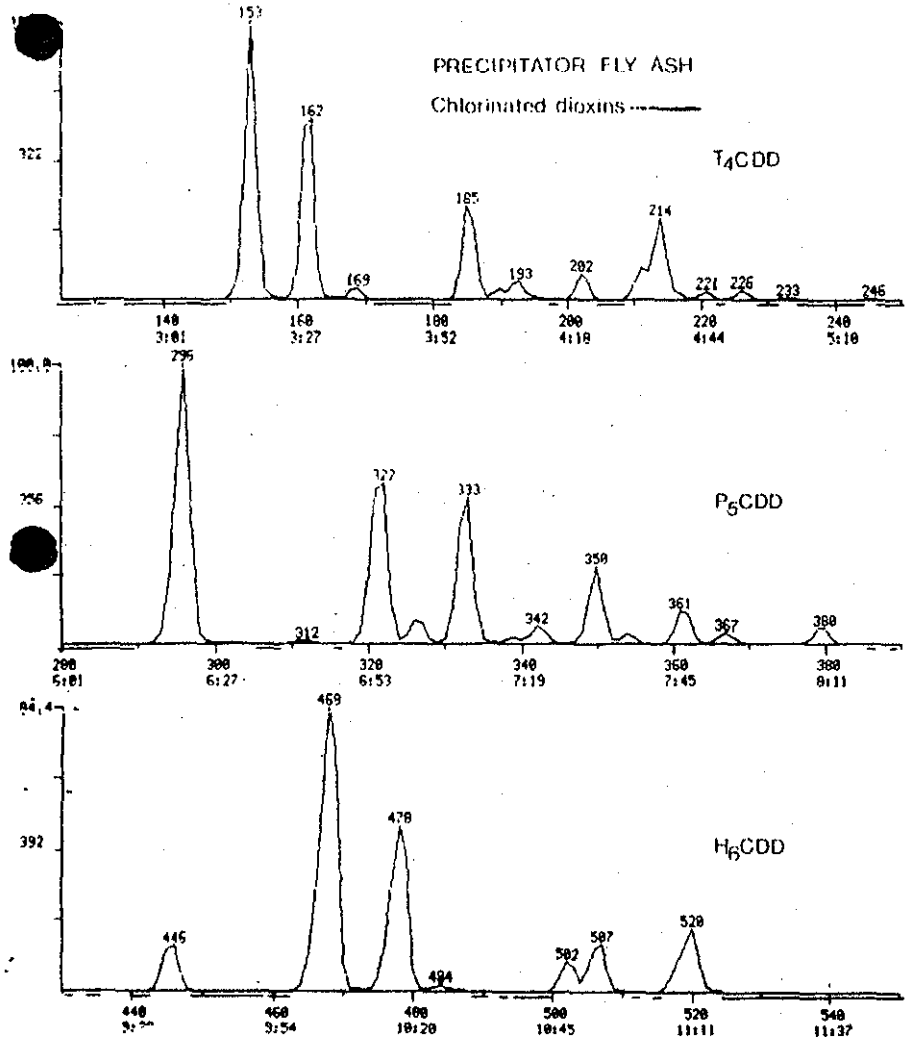

Figure 34.4. ...mer patterns for tetra-, penta-, and hexachlorinated dibenzo-*p*-dioxins from GC-MS analysis of flyash extract.

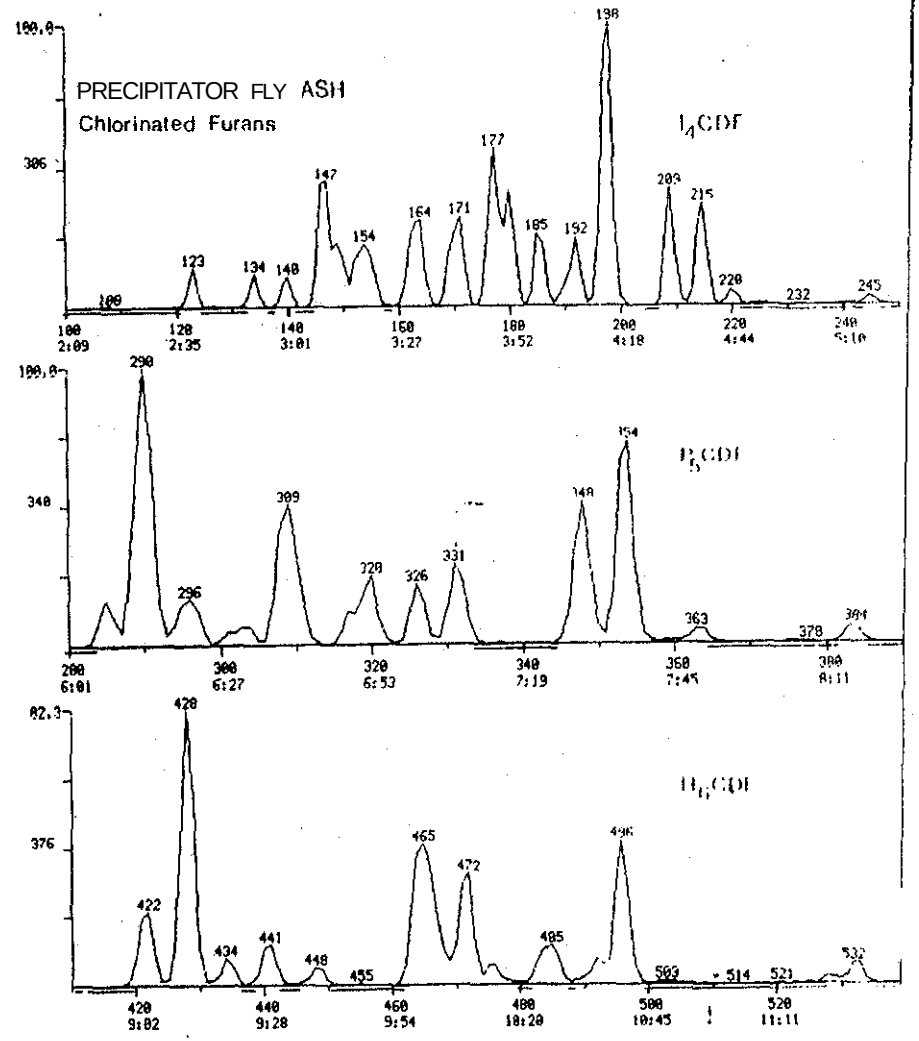

Figure 34.5. Isomer patterns for tetra-, penta-, and hexachlorinated furans from GC-M analysis of flyash extract.

plots of the ion abundance of T_4CDD from analysis of the lest I flyash and test impinger, some differences are evident. The later eluting peaks of the impinge extract are more prominent, relative to the first two peaks. The general pattern however, are similar, and the same isomers observed in the flyash extract are pre sent in the impinger extract. For the P_5CDD analyses shown in the bottom tw plots the patterns are more similar. This closer similar' vas more oft observed in the extracts analysed. No variations in patt... of isomers fo

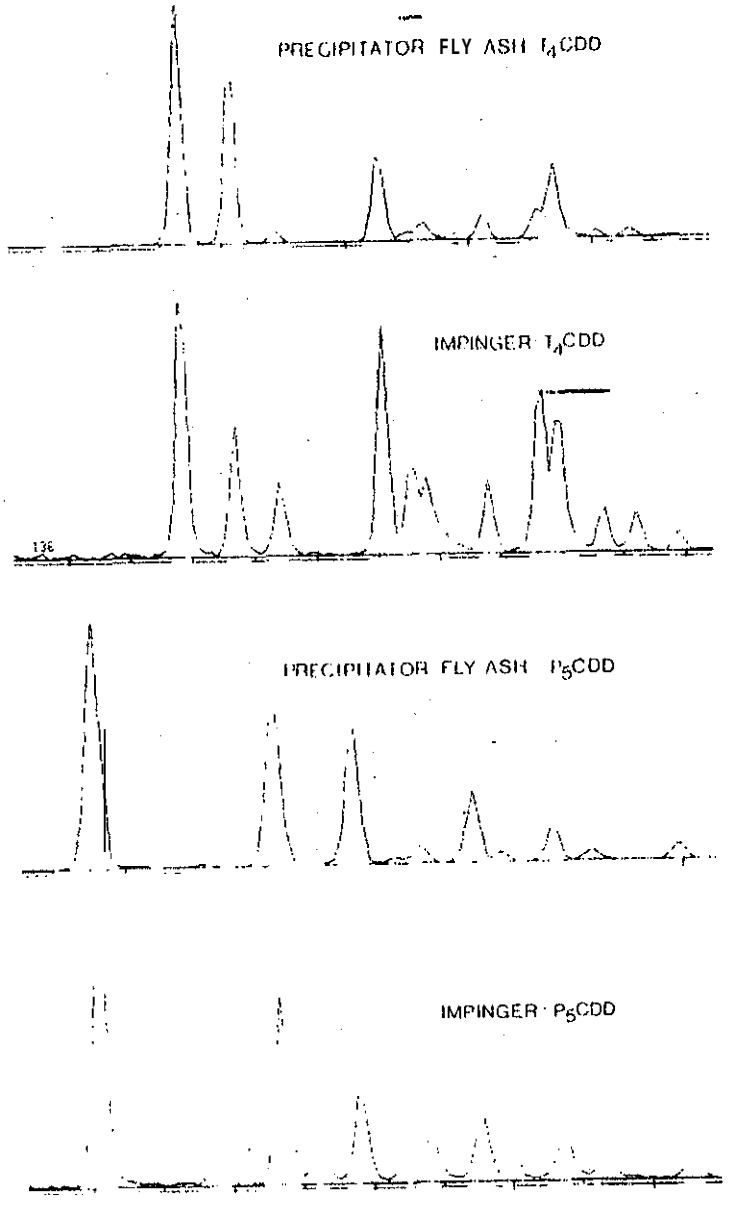

Figure 34.6. Comparison of tetra. and **pentachlorinated dibenzo-*p*-dioxins** from GC-MS **analysis of** test **1 flyash** and test 3 impinger extracts.

specific congeners due to different types of samples or for different tests were observed.

Figures 34.4–34.6 also **illustrate** the low **background** which was generally observed. Only one of the three ions monitored for each congener has been plotted. Figure 34.7 is an **example** of all three ions monitored for the P_5CDD compounds detected in a precipitator **flyash** extract. All peaks detected are present in all three plots with ratios of **62:100:60** for the **354:356:358** ions. The theoretical ratios are **61:100:65**. Figure 34.7 is typical **of** sample extracts containing large quantities of PCDD-PCDF. As the amounts detected approach **detection** limits, the patterns appear to change and the difference between observed **and** theoretical ratios becomes greater. Data such as illustrated in Figure 34.7 are the result of the combined use of specific cleanup procedures and selective GC-MS detection.

About 60% of the total possible PCDD-PCDF congeners containing 4–8 chlorines were detected as distinct or merged peaks. Table 34.2 summarizes the maximum numbers **of** isomers observed for each congener group. Of the possible 136 different compounds, 81 were observe& For the T_4CDD, T_4CDF, and P_5CDF congeners, where the total possible number of isomers is greater **than** 20 lor each group, only 42 of 88 possible compounds were observed. or 48%. In thr remaining congeners, 41 of 48 possible compounds, or **85%, were observed**. This probably indicates that GC resolution is the limitation in observing more isomers. The true number of PCDD-PCDF compounds present is probably greater than 81

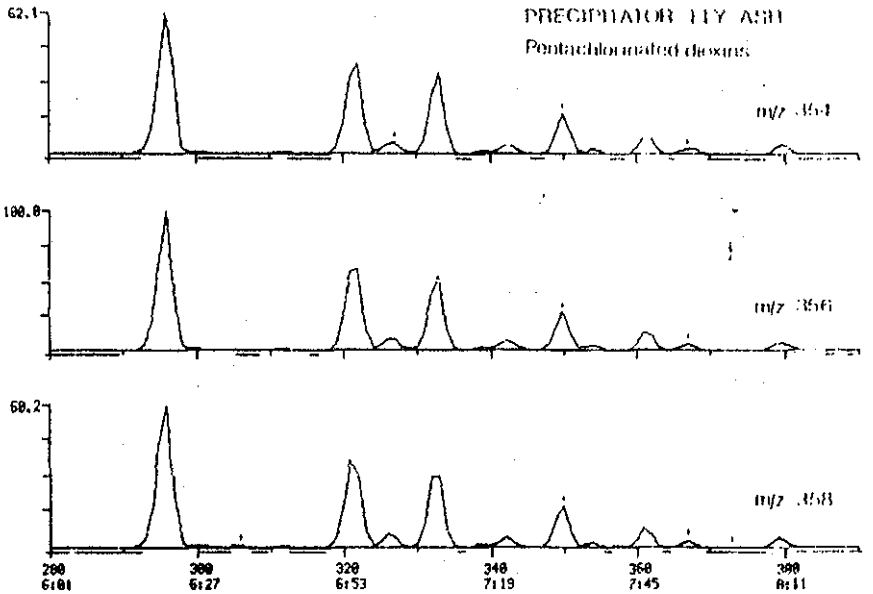

Figure 34.7. Correspondence of 3 ions for GC-MS analysis of pentac ...ated dibenzo-*p*-**dioxins** in **flyash** extract.

Table 34.2. Chlorinated Dibenzo-*p*-Dioxins and Dibenzofurans—Numbers of Isomers Observed

Congener	*Tetra-*	*Penta-*	*Hexa-*	*Hepta-*	*Octa-*	*Total*
PCDD	11/22*	11/14	7/10	2/2	1/1	32/49
PCDF	17/38	14/28	13/16	4/4	1/1	49/87
Total	28/60	25/42	20/26	6/6	2/2	81/136

*Number of isomers observed/total number of possible isomers.

Train Sample Data

Results from the analysis of filtered particulates, impingers, and florisil cartridges are shown in Table 34.3. Florisil cartridges were extracted separately but combined before GC-MS analysis. Data from other Ontario Ministry of the Environment studies have shown that the second florisil cartridge contains about 5%, on average, of the PCDD-PCDF detected in the first cartridge [7]. The second trap is necessary as a backup in occasional instances where channeling or breakthrough occurs in the first trap.

Data presented in Table 34.3 were not adjusted for volumes of stack gases sampled or weight of stack particulates collected. Since all three tests were conducted for the same sampling period, these data are the amounts of PCDD-PCDF emitted from the incinerator stack during 24 hours. All stack data reported here are compared on this basis.

For the three tests, an average of only 0.3% of the total PCDD-PCDF was found in the florisil cartridges. In tests 1 and 3, over 95% of the total was in the impingers, while for test 2 the total was distributed in a ratio of about 40:60 between the filter and impingers, respectively. Except for the PCDF congeners in test 3, the amounts detected for various PCDD and PCDF congeners followed the same pattern. This is shown in Table 34.4, which gives relative congener distributions of PCDD and PCDF in the stack emissions. The most abundant congeners are the hexachlorinated compounds, for both PCDD and PCDF. With a single exception, the octachlorinated species are least abundant, followed by the tetrachlorinated compounds. On average, the hexachlorinated species were 45% of the total PCDD detected in stack emissions, and 30% of the PCDF. Tetrachlorinated isomers represented only 7% of the total PCDD detected. Tetrachlorinated furans averaged 28% of total PCDF detected, but this is due to test 3, where the PCDF congeners did not follow the same pattern as was observed for the other tests, in which TCDF isomers were only 13% of the total. Total PCDD and total PCDF were about the same for tests 1 and 2. In test 3, high levels of TCDF and P_5CDF congeners account for a total PCDF which is about twice as great as the

Table 34.3. PCDD/PCDF in Stack Emissions*

	Test 1				*Test 2*				*Test 3*			
Congener	*Filter*	*Impinger*	*Florisil*	*Total*	*Filter*	*Impinger*	*Florisil*	*Total*	*Filter*	*Impinger*	*Florisil*	*Total*
T_4CDD	11	450	1.0	460	83	450	ND†	530	ND	1.000	ND	1,000
P_5CDD	44	540	1.0	580	370	460	2.0	830	1.0	2,200	ND	2,200
H_6CDD	77	1,900	18.0	2,000	2,300	2,700	ND	5,000	83.0	5,400	6.0	5,500
H_7CDD	81	1,000	16.0	1,100	1,500	1,900	18.0	3,400	170.0	2,300	28.0	2,500
OCDD	76	200	6.0	280	1,600	420	4.0	2,000	29.0	560	22.0	610
	290	4,100	41.0	4,400	5,900	5,900	24.0	12,000	280.0	12,000	56.0	12,000
Total	24	870	1.0	900	58	1,000	1.0	1,100	ND	9,900	1.0	9,900
T_4CDF	44	1,100	3.0	1,100	350	990	ND	1,300	ND	5,800	1.0	5,800
P_5CDF	53	2,500	11.0	2,600	1,600	3,700	ND	5,300	24.0	4,900	21.0	4,900
H_6CDF	29	1,200	5.0	1,200	880	1,500	14.0	2,400	23.0	5,000	10.0	5,000
H_7CDF	12	200	3.0	220	230	280	2.0	410	6.2	280	3.0	290
OCDF	160	5,900	23.0	6,000	3,000	7,500	17.0	10,000	53.0	26,000	38.0	26,000
Total	450	10,000	64.0	10,000	8,900	13,000	41.0	22,000	330.0	38,000	94.0	38,000
Total PCDD + PCDF												

*All data reported as total nanograms per 24-hr sampling period. Data are not corrected for recoveries.
†Not detected; detection limits are total T_4CDD, T_4CDF, P_5CDD, P_5CDF: 0.8 ng sample; total H_6CDD, H_6CDF: 3.0 ng per sample.

Table 34.4. Relative Congener Distributions of PCDD-PCDF in Stack Emissions

	Test 1		Test 2		Test 3		Average ng†	
Congener*	PCDD	PCDF	PCDD	PCDF	PCDD	PCDF	PCDD	PCDF
tetra-	20	40	10	20	20	100	660	4,000
penta-	30	40	20	30	40	W	1,200	2,700
hexa-	100	100	100	100	100	50	4,200	4.300
hepta-	60	50	70	50	50	50	2,300	2,900
octa-	10	8	40	8	10	3	9W	310

*Amount of each congener in nanograms normalized to largest = 1W for PCDD and PCDF in each test.

†Average nanograms detected lor each congener in three tests.

Process *Sample Data*

Liquid process samples which were analyzed did not contain detectable amounts of PCDD-PCDF compounds. Data from solid process samples, which include precipitator flyash, combined ash, and particulates from the trough overflow, are presented in Table 34.5. These data are presented as total nanograms per **gram** extracted. No PCDD-PCDF were detected in combined ash samples for tests 1 and 3. Total PCDD-PCDF found in the test 2 combined ash extract was only 7% of the total detected in the test 2 flyash extract. About 2–4% of weight of the combined ash is from precipitator flyash, but the exact amount cannot he specified for the specific incinerator investigated. The remaining weight of combined ash is from bottom ash that falls beneath the grills where initial burning of municipal waste is effected. Data from Table 34.5 indicate that bottom ash is not a significant source of PCDD-PCDF compounds. Test 2 combined ash probably contains detectable levels of PCDD-PCDF because it is composed of a much greater fraction of flyash than does the tests 1 and 3 combined ash.

PCDD and PCDF detected in precipitator flyash and trough overflow particulates generally follow the same pattern as observed for stack emissions, where the hexachlorinated isomers have the highest concentration, compared to the other congeners, and the tetra- and octachlorinated compounds have the lowest relative concentrations. In process sample extracts, the total PCDD concentrations detected were greater than corresponding total PCDF concentrations. This trend, however, was reversed in stack sample extracts, where the average PCDF amounts were greater than average PCDD amounts.

PCDD-PCDF in *Feedstock*

Ta 1.6 gives the concentrations of PCDD-PCDF detected in the feedstock
chlormated dibenrofurans were detected. Lower chlorinated dibenzo-*p*-dioxins

Table 34.5. PCDD/PCDF Concentrations in Solid Process Samples (ng/g)

	Test 1			Test 2			Test 3		
Congener	Flyash	Combined Ash	Trough Overflow	Flyash	Combined Ash	Trough Overflow	Flyash	Combined Ash	Trough Overflow
T_4CDD	240	nd*	2	200	14	1	64	nd	10
P_5CDD	600	nd	6	420	41	3	110	nd	23
H_6CDD	2,000	nd	31	1,900	57	5	430	nd	70
H_7CDD	830	nd	20	1,200	34	2	190	nd	34
OCDD	140	nd	16	1,200	7	2	36	nd	5
Total	3,800	nd	75	4,900	150	13	830	nd	140
T_4CDF	150	nd	1	50	3	1	26	nd	26
P_5CDF	390	nd	6	150	13	1	52	nd	23
H_6CDF	880	nd	20	680	8	2	120	nd	48
H_7CDF	350	nd	10	380	17	nd	72	nd	6
OCDF	31	nd	1	62	1	1	8	nd	2
Total PCDD + PCDF	1,800	nd	38	2,300	42	4	280	nd	110
	5,600	nd	110	6,200	190	17	1,100	nd	250

*Not detected; detection limits are total T_4CDD, T_4CDF, P_5CDD, P_5CDF, 0.2 ng g; total H_6CDD, H_6CDF, 1.0 ng g; total H_7CDD, H_7CDF, OCDD, OCDF: 0.3 ng g.

were also not detected. Both H_7CDD isomers and OCDD were found in feedstock extracts of all three tests. The concentrations reported are less accurate than for other process samples, because the feedstock extracts contained such high levels of total organics that they were difficult to elute from the cleanup columns employed and required several dilutions before analyzing by GC-MS.

The similar feedstock concentrations for the three tests reflect the similarity in the composition of the feedstock. Since handsorting of raw municipal garbage was required before milling, the approximate component composition of each feedstock sample was determined, and these are presented in Table 34.7. Test 1 and test 3 feedstock have virtually identical composition, while test 2 feedstock has less paper and textiles but more plastics and rubber than do tests 1 and 3.

Analytical Results—PCB, CB, CP

Train Sample Data

Table 34.8 is a summary of the polychlorinated biphenyls (PCB), chlorinated benzenes (CB), and chlorophenols (CP) detected in the stack emissions. CB and CP compounds are grouped according to degree of chlorination. As was the case for PCDD-PCDF stack emissions, all data in Table 34.8 are reported as total nanograms per 24-hr sampling period.

Table 34.6. PCDD-PCDF Concentrations in Feedstock (ng/g)

		Chlorinated Dioxins					
	Total PCDF	*Tetra-*	*Penta*	*Hexa-*	*Hepta-*	*Octa-*	*Total*
Test 1	nd*	nd	nd	nd	0.1	0.4	0.5
Test 2	nd	nd	nd	nd	0.4	0.5	0.9
Test 3	nd	nd	nd	nd	1.0	0.6	1.6

*Not detected; detection limits are: total T_4CDD, T_4CDF, P_5CDD, P_5CDF: 0.1 ng/g; total H_6CDD, H_6CDF: 0.5 ng/g; total H_7CDF, OCDF: 0.3 ng/g.

Table 34.7. Approximate Feedstock Composition (% total weight for each type of material)

	Paper and Textiles	*Plastics and Rubber*	*Garden and Food*	*Metals and Glass*
Test 1	59	11	17	13
Test 2	50	18	19	13
Test 3	59	11	11	19

Table 34.8. PCB, CB, CP Levels in Stack Emissions (total ng in 24-hr stack sample)

	Test 1				*Test 2*				*Test 3*			
Congener	Filter	*Impinger*	*Florisil*	Total	Filter	*Impinger*	*Florisil*	Total	Filter	*Impinger*	*Florisil*	*Total*
Total PCB	48	270	130	450	27	1,300	11	1,300	nd*	†	190	190
Chlorinated Benzenes												
tri-	25	920	9,300	10.000	40	420	5,600	6,100	37	†	11,000	11,030
tetra-	47	700	28,000	29.000	68	1.300	410	1,800	56	†	37.000	37.000
penta-	11	1.100	16,000	17.000	64	3,300	220	3,600	17	†	37,000	37,000
hexa-	28	1,100	400	5.100	110	3.600	94	3,800	11	†	9,700	9,700
Total	110	3,800	58,000	62,000	280	8,700	6.300	15.000	120	†	95.000	95.000
Chlorinated Phenols												
tri-	6.100	52,000	7.30	65.000	nd	28,000	2,200	30,000	650	5,600	2.700	9,000
tetra-	nd	35.000	7,500	43.000	nd	29.000	50	29,000	nd	36.000	920	37.000
penta-	50	18,000	4,500	23.000	nd	23.000	880	24.000	90	18,000	880	19,000
Total	6.200	110,000	19,000	140.000	nd	80,000	2.300	82.000	740	60,000	4.500	65.000
Total PCB, CB, and CP	6,400	114,000	77,000	200,000	310	90,000	8,600	98,000	860	60,000	100,000	160,000

*Not detected: detection limits for total PCB: 2.0 ng; total trichlorophenols: 10 ng sample; total tetrachlorophenols and pentachlorophenol: 10 ng sample.
†Sample lost in preparation.

PCB amounts are very low in all samples, compared to CB and CP compounds. The PCB amounts shown in Table 34.8 are near background levels for filter extracts and not very much greater in the other sample extracts. Over one-half of the total PCB detected in the stack emissions of all three tests was from the test 2 impingers, and this amount is low compared to the total CB and CP detected in this sample extract.

The quantities of chlorobenzenes detected on filter extracts were only slightly greater than PCB amounts. Over 99% of total chlorobenzenes were present in the impingers and florisil cartridges. In test 1, over 90% was in the impingers, but for test 2 only 40% of chlorobenzenes were in the impingers. Distribution of these compounds between impingers and filters depends upon the filter temperatures, which for all tests were maintained at about 120°C. These data show that chlorobenzenes in the stack are primarily in the vapour state.

Distribution of CB amounts among the various chlorinated congeners is different for each test. In test 1, about 50% of the total CB is from the tetrachlorinated isomers, while for test 2 the penta- and hexachlorinated compounds are both more abundant, and in test 3 most of the total CB detected was evenly divided between tetra- and pentachlorobenzene. Of the total chlorobenzenes detected in each test. the average percent distribution among the tri-, tetra-, penta-, and hexachlorinated compounds was 16:40:34:10. Over 95% of the trichlorobenzenes detected was split about equally between the 1,2,4- and 1.2.3-isomers, while 90% of tetrachlorobenzenes were from the 1,2,4,5- and 1.2.3.4-isomers.

Chlorophenols in stark rmissinns were trapped efficiently by the impingers, which contained an average of 87% of the total detected in the train sample extracts for the three tests. Less than 3% of the total was detected in the filter extracts. On average, the total CP quantities in the train were distributed about equally between the tri-, tetra-, and pentachlorinated congeners, which have a percent distribution of the total of 36:40:24, respectively. About 70% of the trichlorinated total was from the 2,4,6- isomer, and 20% was due to the 2,4,5-isomer. For the tetrachlorinated compounds, 93% was from the 2,3,4,6-isomer, while none of the 2.3.5.6-compound was detected.

Process Sample Data

Liquid process samples contained very low levels of PCB, CB, and CP compounds. In the solid process samples, including precipitator flyash, combined ash, and particulates from the trough overflow, only the flyash contained appreciable concentrations of CB and CP compounds. PCB were at low concentrations for all process samples, as wasobserved for the stack samples.

Table 34.9 is a summary of the total PCB, CB, and CP concentrations in 'pr' samples. Combined ash and trough overflow particulates container' concentrations of these compounds, compared to flyash and feedstock extrac...

than feedstock, while PCB concentrations are greater in the feedstock by a of 4.

Chlorophenol congener ratios are about the same in flyash as tor the emissions. The percent distribution of total chlorophenols between the tri penta chlorinated congeners in the train is 36:40:24, respectively, and th responding ratios for the precipitator flyash are 33:42:25. As was observ the train samples, most of the trichlorinated total was from the 2,4,6- i (90%), and the next most abundant trichlorinated phenol was the 2.4.5- ' (4%). For the tetrachlorinated congeners, the 2,3,5,6- isomer was not de 'while 93% of the total tetra congener amount was contributed by th 4,6-isomer.

Comparison of Chlorinated Species

Three tests are not sufficient to develop rigorous models to describe the re ships between the various chlorinated species investigated in this study. relationships exist, however, then general trends in the data should he ev

Table 34.10 is a comparison in the total PCDD + PCDF, CP, and CI detected in feedstock, stack, and flyash samples for the three tests. Feeste precipitator flyash concentrations are ng/g, while the stack values are pr as total nanograms detected during each 24-hr Test. Because PCB leve generally low and varied little from sample-to-sample or test-to-test, the not included in Table 34.10.

Concentrations of total PCDD-PCDF in feedstock increase stepwi test 1 to test 3 from 0.5 to 1.6 ng/g. This range may not be indicative of a ferences in the feedstock concentrations of PCDD-PCDF, considering ficulties experienced in feedstock analysis. Total stack emissions of PCDI for the three tests, however, follow the same pattern as feedstock concent By normalizing to the lowest value obtained, relative feedstock concen are 1.0:1.8:3.2 for test 1:test 2:test 3, and the corresponding ratios for stac sions are 1.0:2.2:3.8. Although concentrations in feedstock appear to be v compared to total stack emissions, it must be remembered that many feedstock were incinerated, and these low concentrations may represe amounts of PCDD-PCDF input t o the incinerator. While stack emiss composed of the full range of PCDD-PCDF congeners from the tetra-chlorinated species, only hepta- and octachlorinated dibenzo-p-dioxi detected in feedstock. The patterns observed in feedstock and stack samp not observed for precipitator flyash. The lowest total PCDD-PCDF c tions in flyash occurred for test 3, although concentrations in the feeds stack samples were greatest for this test.

There appears to he no relationship in the qua ...es of chloropl chlorobenzenes in the feedstock, stack, or flyash san ... In feedstock ... lowest in test 2; for stack emissions, test 3 is lowest

Table 34.9. Total Concentrations of PCB, CB, and CP in Process Samples (ng/g)

	Flyash			Feedstock			Combined Ash			Trough Overflow		
	1*	2	3	1	2	3	1	2	3	1	2	3
PCB	24	360	54	110	1,500	250	2	7	3	1	ndt	1
CB	1,000	1,100	2,400	35	42	47	17	26	30	1	1	1
CP	400	760	1,100	400	84	470	10	1	10	5	4	6
Total	1,400	2,200	3,600	550	1,600	770	29	34	43	7	5	8

*1,2,3 = Test 1, Test 2, Test 3.
†Not detected.

Table 34.10. Comparison of Chlorinated Organics in Incinerator Samples'

	Total PCDD + PWF			Total Chlorophenois			Total Chlorobenzenes		
	It	2	3	1	2	3	1	2	3
Feedstock	0.5	0.9	1.6	400	84	470	35	42	47
Stack	10,000	22,000	38,000	140,000	82,000	65,000	62,000	15,000	95,000‡
Flyash	5,600	6,200	1,100	400	760	1,100	1,000	1,100	2,400

*Feedstock and flyash total concentrations in ng/g; stack emissions are total ng detected in each 24-hour test.
†1,2,3 = Test 1, Test 2, Test 3.
‡Does not include contribution from impingers

test 3, but about the same for test 1 and test 2 flyash, while chlorobenzenes in the test 1 stack emissions are much greater than the test 2 emissions.

No definite trends are apparent in the amounts of chlorobenzenes and total PCDD-PCDF detected in the three tests. In the precipitator flyash, concentrations of PCDD-PCDF decrease from test 1 to test 3, while chlorobenzene concentrations increase from test 1 to test 3. The absolute differences in concentrations between tests, however, are not great enough to suggest this trend is significant without conducting many more experiments.

A similar trend is observed between the levels of PCDD-PCDF and levels of chlorophenols in the stack emissions. PCDD-PCDF amounts increase from test 1 to test 3, while chlorophenols decrease from test 1 to test 3. Test 1:test 2:test 3 ratios of PCDD-PCDF levels in stack emissions are 1.0:2.2:3.8, while the corresponding ratios for chlorophenols are 2.2:1.3:1.0.

CONCLUSIONS

This study is the first to report levels of chlorinated organics in the feedstock to a municipal incinerator. Although no lower chlorinated PCDD compounds and no PCDF compounds were detected in the feedstock, high levels of all chlorinated congeners of PCDD and PCDF from the tetra- to octa-species were found in the stack emissions and in the precipitator flyash. A few general trends between the levels of CP, CB, and PCDD-PCDF compounds were observed, although the number of tests is too small to determine any definite correlations. PCB levels were generally low for all tests and different types of samples, often approaching background amounts. It may be concluded that PCB compounds are only minor components of the emissions from the incinerator studied, and they probably are not major contributors to the formation of PCDD-PCDF compounds in this incinerator. Almost all of the PCDD-PCDF emitted from the incinerator were detected in the stack emissions and the precipitator flyash. Bottom ash is not a significant source of PCDD-PCDF.

A large number of studies have now been reported concerning the levels of PCDD and/or PCDF compounds in incinerator effluents. Results of these studies are difficult to compare, since few of the studies present data for the same range of compounds and sample types. In most cases, the relative amounts of the various chlorinated congeners are greatest for the higher chlorinated species for both PCDD and PCDF classes of compounds. Often, the hexachlorinated congeners have the greatest relative abundances, for stack emissions and precipitator flyash. The ratio of total PCDD:PCDF concentrations will generally be greater in flyash than in stack emissions, which probably indicates that PCDF compounds have a greater volatility compared to the corresponding PCDD analogues. Another possibility, however, is that different mechanisms exist for the formation or condensation of PCDD-PCDF compounds on precipitator flyash than in the stack emissions.

For the investigation of relationships between the various chlorinated

species. more tests must be performed. Future investigations should analyze PCDF as well as PCDD congeners in stack emissions as well as in corresponding precipitator flyash so that different studies can be compared. Many of the published studies to date are difficult to compare with each other because of the general paucity of data presented. By determining the concentrations of chlorophenols and chlorobenzenes in these samples, in addition to the PCDD-PCDF, the additional data needed to determine relationships between the various chlorinated species can he obtained.

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REFERENCES

1. Lustenhouwer. J W.A., Olie. K., and Hutzinger, O. *Chemosphere* 9:501 (1980).
2. Tiernan, T.O , Taylor, M.L., Garrett. J.H., Van Ness, G.F., Solch, J G.. Deis, D.A , and Wagel, D.J. *Chemosphere* 12:595 (1983).
3. Jansson, B., and Sundstrom, G. *Sci* Tot *Environ* 10:209 (1978).
4. Buser, H.R. *Chemosphere* 6:415 (1979).
5. Buser. H.R., and Rappe. C. *Chemosphere* 3:157 (1979).
6. Taylor, M.. Tiernan, T.O., Garrett, J.H., Van Ness, G.F. and Solch, J.G. Assessments of incineration processes as sources of supertoxic chlorinated hydrocarbons: Concentrations of polychlorinated dibenzo-*p*-dioxins/dibenzofurans and possible precursor compounds in incinerator effluents, in *Chlorinated Dioxins and Dibenzofurans in the Total Environment*, G. Choudhary. L.H. Keith, and C. Rappe, eds. Boston: Butteworth-Ann Arbor Science. vol. 1 (1983).
7. Ozvacic, V.. Wong, G., Tosine, H., Clement, R., Osborne, J., and Thorndyke, S. Determination of chlorinated dibenzo-*p*-dioxins, chlorinated dibenzofurans, chlorinated biphenyls, chlorobenzenes and chlorophenols in air emissions and other process streams at SWARU in Hamilton, Ontario Ministry of Environment Report ARB-02-84-ETRD, Toronto. Ontario, Canada, July, 1964.

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Adsorption, Chlorination, and Photolysis of Selected Chlorinated Dioxins on Flyash from Municipal Incinerators Using Laboratory Simulation of Emission Processes

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Polychlorinated dibenzo-*p*-dioxins (PCDD) have been found on flyash produced through combustion of municipal refuse in incinerators [1,2]. These chlorinated dioxins were present on flyash collected from electrostatic precipitators from incinerators in several countries [3,4,5] and release of such flyash to the atmosphere may constitute a general source of PCDD loading in the environment [6]. Exact origins or mechanisms of formation of PCDD in incinerators remain unknown, although efforts to delineate the problem are in progress [7].

In 1979 Townsend [8] proposed an explanation for trends in PCDD composition on flyash from inspection of an extensive data base generated from a Dow Chemical Co. chlorinated dioxin research program [4]. Townsend observed that ratios of total PCDD series (i.e., tetachlorodibenzodioxin (TCDD) to octachlorodibenzodioxin (OCDD)) were not constant upon release of flyash into the atmosphere, and that such ratios varied as a function of distance from the point source. At an unspecified distance, an equilibrium between PCDD was reached and no further changes in relative composition occurred. The fundamental assumption in this model was that PCDD were not chemically inert on flyash particulate surfaces and that chlorination and dechlorination reactions occurred between pai

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CHLORINATED DIOXINS AND DIBENZOFURANS IN THE TOTAL ENVIRONMENT

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7. Thibodeaux, L.J. I. *Haz.* Mar. 4:3 (1981).
8. Thibodeaux, L.J. *Chemodynamics—Environmental* Mouement of Chemicals in Air. *Water* and Soil (New York: John Wiley & Sons, Inc., 1979).
9. Thibodeaux, L.J. and B. Becker, Enoiron. *Prog.* (Fall 1982).
10. Schaum, J., and J. Falco. "Exposure Analysis of Vertac Facility." Exposure Assessmmt Group, Office Health and Environmental Assessment, ORD, U.S. EPA, Washington, D.C. (1981).

6

2,3,7,8-Tetrachlorodibenzo-*p*-dioxin and 2,3,7,8-Tetrachlorodibenzofuran Residues in Great Lakes Commercial and Sport Fish

J.J. Ryan, P.-Y. Lau, J.C. Pilon and D. Lewis

2,3,7,8,-Tetrachlorodibenzo-*p*-dioxin (2,3,7,8-tetra-CDD) has been the subject of a great deal of scientific and public interest, mainly due to its potent toxicological properties. Early attempts [1] to detect this chlorinated aromatic hydrocarbon in aquatic species were hampered by the lack of sensitive, specific and reliable techniques. However, with the advent of superior extraction, purification and chromatographic procedures coupled with highly sensitive and specific mass spectrometers, the measurement of contaminants such as *dioxins* and *furans* at low parts per trillion has become feasible in the last few years.

As a result, in late 1978 the U.S. Environmental Protection Agency (EPA) reported preliminary observations [2] on the presence of 2,3,7,8-tetra-CDD in several species of fish originating from rivers that flow into Lake Huron in the vicinity of Saginaw Bay. Details of this survey were published [3] and revealed that 26 of 36 samples comprising six different species of fish were positive for 2,3,7,8-tetra-CDD. Values of the positive samples ranged from 4 to 695 ppt, with 10 lish samples containing more than 40 ppt 2,3,7,8-tetra-CDD. Channel catfish and carp (bottom feeders) had the highest mean values (157 and 55 ppt, respectively). The New York state Department of Health reported their preliminary findings (news release, April 24, 1979) that sampling seven fish from Lake Ontario demonstrated measurable levels of 2,3,7,8,-tetra-CDD in two fish. At the same time the authors' analysis of Great Lakes fish indicated that tetra-CDD residues were present, but the reliability of the method was uncertain, because the precision, accuracy and detection limits had not been established. As a result, the methodology was examined further, modified and subsequently included in an international interlaboratory comparison with twelve other laboratories. This exchange of fish samples demonstrated that, provided an internal standard was

used, many laboratories experienced in low-level organic residue analysis could measure tetra-CDD at parts-per-trillion levels with a relative standard deviation of 15–25% [4].

Further reports of dioxin in the environment came from the Canadian Wildlife Service [5], which found levels of up to 800 ppt tetra-CDD in herring gull (*Larus argentatus*) eggs from the Great Lakes with average values around 50 ppt. Highest levels were found in samples from Lake Ontario and the Saginaw Bay area of Lake Huron. This information has been summarized [6].

Because all of the data on tetra-CDD in fish and other biological samples were incomplete and still fragmentary, we decided to investigate the extent of 2,3,7,8-tetra-CDD contamination in commercial fish from Lake Ontario. Fish were chosen from Lake Ontario, as this lake is generally believed to contain the highest amount of chemical contamination of all the Great Lakes [7]. We were also aware that two other groups, the New York state Department of Health and Ontario Ministry of Environment (MOE), were conducting surveys on fish that contained substantial sampling of sport fish. Because we are mainly interested in fish used as food, our sampling was mostly of the commercial variety. This chapter gives the results of 2,3,7,8-tetra-CDD levels in commercial fish taken from Lake Ontario in 1980 and compares the levels with a smaller sampling of commercial fish taken in 1979 and sport fish taken in 1980. Preliminary data on the presence of 2,3,7,8-tetrachlorodibenzofuran (tetra-CDF) in some of these fish are also given.

MATERIALS AND METHODS

Sampling

Commercial fish were caught with seine nets throughout 1980. A total of 62 samples of Great Lakes commercial fish were collected, mostly (56) from the northeastern part of Lake Ontario near Kingston, Bay of Quinte and the Thousand Islands. This area has the only substantial commercial fishing operation on Lake Ontario. Four samples originated from Lake Erie and two from the Welland Canal. The kinds and numbers of fish samples are outlined in Table 6.1. Ten commercial species of fish were collected and analyzed. A pooled sample concept was used whereby enough fish were taken to prepare a homogenized composite of 2–3 kg of muscle fillet. This is our standard procedure for surveying contaminants in fish and was also necessary due to the small size and corresponding fillet from seven of the species. Catfish samples were chosen from previous analyses based on comparison of polychlorinated biphenyl (PCB) values and length such that the PCB level would be below 5 ppm. No carp are presently taken commercially because of restrictions on the sale of this fish due to PCB levels. As far as possible, at least 20% of the fish samples were collected from each of the spring (ice breakup–June 1), summer (June 1 to September 1) and fall (September to

Table 6.1 2,3,7,8-Tetra-CDD Levels (*ppt*) in 62 Samples of Great Lakes Fish (56 from Lake *Ontario*) d o n g with Average Values (± standard deviation) of PCB, Mirex and Fat Content

Species	Number Analyzed	Number Positive for Tetra-CDD	TCDD Levels: Mean of Positives (ppt)	TCDD Levels: Range Positives (ppt)	PCB (ppm)	Mirex[a] (ppb)	Fat (%)
Rock Bass	6	0			0.21±0.10	7.9±7.0	0.47±0.19
Sunfish	9	0			0.11±0.06	2.520.0	0.6720.16
Black Crappie	5	0			0.1810.08	4.0±3.4	0.66±0.46
White Perch	3	1		6.3	0.56±10.31	13.3±5.8	3.88±1.22
Yellow Perch	10	2	3.8	3.2–4.3	0.1220.05	5.5±3.9	0.822056
Brown Bullhead	7	2	6.0	3.4–8.6	0.13±0.03	4.6±3.7	1.45±0.29
White Sucker	5	2	3.0	2.0–4.0	0.4420.15	10.0±0.0	1.33±0.31
Catfish	3	3	15.5	12.8–17.7	3.63±0.52	103.0±21.0	12.50±1.84
Eel	6	5	19.8	6.4–38.5	4.90±2.78	148.0±88.0	36.60±4.54
Smelt	8	6	20.0	11.3–32.9	1.28±0.50	24.0±23.0	3.41±0.96

[a]Samples not detected were taken to be 2.5 ppb lone-half the detection limit of 5 ppb).

freeze) seasons. Fillet tissue without skin was ground in a food mixer, placed in plastic sample containers and frozen.

Smelt samples from 1979 were obtained, prepared and analyzed similarly to 1980 commercial fish. Sport fish caught in 1980 were available for analysis from two related studies and comprised either muscle fillet or whole fish samples.

Analysis

Aliquots (10 g) of the homogenized composite were analyzed for 2.3.7.8-tetra. CDD according to the method outlined by Ryan and Pilon [8] and Ryan et al. [4]. In summary, tissues were extracted with chloroform-methanol, the solvent was exchanged for hexane, and lipid degradation and removal were accomplished by partitioning against concentrated sulfuric acid. The extract was then applied to a mini-Florisil column. PCB were removed with the hexanedichloromethanc (98%/2%), and all the dioxins and furans were then eluted with dichloromethane. The tetra-CDD fraction was separated from other dioxin congeners and the extract was purified further using reverse-phase high-performance liquid chromatography (HPLC) by eluting with methanol. The tetra-CDD fraction was then injected onto a fused-silica capillary gas chromatographic (GC) column (DB-5, chemically bonded SE-54). The latter was coupled directly to a Vatian-MAT 311A mass spectrometer (MS) operating in the electron impact and single-ion monitoring (m/z 320. molecular ion of tetra-CDD) mode at a resolution (10% valley) of 1000. Multiple ion monitoring at m/z 257, 320 and 322 at high resolution (8000-10,000) on a VG-Micromass ZAB-2F instrument was used to confirm positive samples. An internal standard of ^{13}C-2,3,7,8-tetra-CDD at a level of 50 ppt (500 pg) was added before extraction to correct for losses in the workup. Recoveries of 58.9% (standard deviation = 18.6: n = 75) were obtained. Detection limits varied between 2 and 10 ppt, depending on the background from individual fish samples and the percent recovery. Our method distinguishes 2,3,7,8-tetra-CDD from other compounds as well as the 21 other tetra-CDD isomers. except for a possible two or three similar GC-eluting isomers. However. comparison of our validated method with other validated methods more specific for 2,3,7,8-tetra-CDD has demonstrated [4] no difference in levels of 2,3,7,8-tetra-CDD in several fish samples. The fish were analyzed in sets of six with each set containing one or two quality control samples such as a blank or fortified reagent blank or fish.

Fish were analyzed for 2.3.7.8-tetra-CDF in an analogous fashion to that for 2.3.7.8-tetra-CDD. The HPLC peak for 2,3,7,8-tetra CDF elutes slightly earlier than that for 2.3.7.8-tetra-CDD, so a wider HPLC fraction was taken. The GC conditions were also similar to those for tetra-CDD, again with a slightly earlier elution for tetra-CDF. The MS conditions for tetra-CDF were single-ion monitoring at m/z 304 and 306 at a resolution of 1000. Confirmation of the tetra-CDF levels by high-resolution MS has not yet been carried out. The values have been corrected for mechanical and absorptive losses by using ^{13}C-labeled 2,3,7,8-tetra-CDD as internal standard. The detection limits for tetra-CDF are similar to those for tetra-CDD, but the specificity of the method for the 2,3,7,8- isomer is uncertain, since only a few of the 38 tetra-CDF isomers are available for comparison.

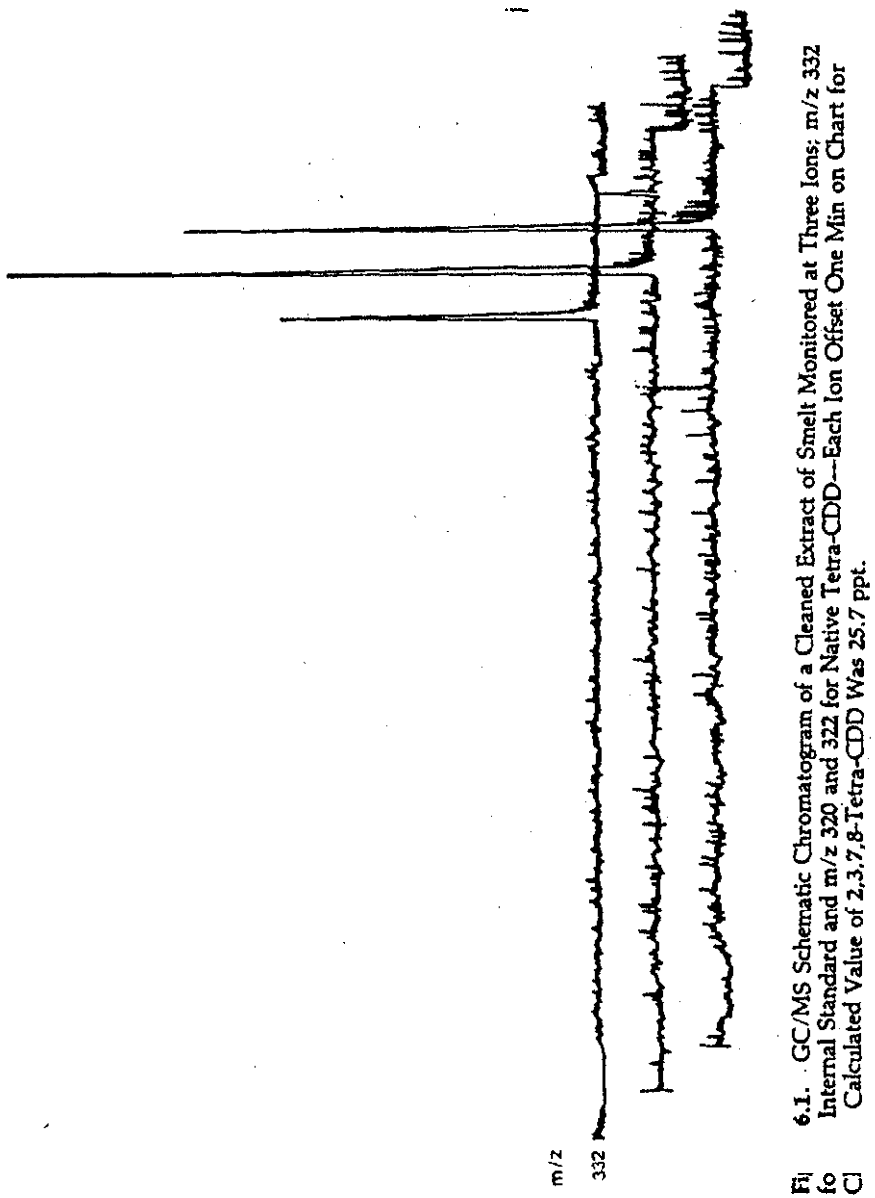
PCB and Mirex were determined in tissue, briefly as follows. Fish were trtracted with ethyl acetate and the extract defatted on a gel permeation column. Alter exchanging the solvent for hexane, the extract was purified further on a 2.% deactivated Florisil (previously activated at 130°C for 24 hr) column and the PCB and Mirex were eluted with hexane—a step that separates them from DDT. Measurement is effected by GC on a 2% OV-l plus 4% OV-210 column with election. capture detection—a column that separates the earlier-eluting PCB peaks from Mirex. Quantification of PCB is based on Aroclor 1254 as standard using the three major peaks eluting subsequent to DDE. Detection limit is about 0.01 ppm tor PCB and 5 ppb for Mirex.

Lipid content of fish tissue was determined according to the method Schmitt et al. [9]. A 10-g aliquot of tissue was first blended with anhydrous sodium sulfate and the powdery mixture was extracted with 20% acetone in isooctane. An aliquot of the centrifuged supernatant was evaporated to dryness under a stream of nitrogen and weighed. Value; are quoted in percent.

RESULTS AND DISCUSSION

Ihcdioxin, PCB, Mirex and fat content values for the 62 commercial fish samples from 1980 are summarized in Table 6.1. 2,3,7,8-Tetra-CDD was found in 21 of the 62 samples (34% positive), with values ranging between 2.0 and 38.5 ppt. Of these 62 samples, 12 (19%) had 2,3,7,8-tetra-CDD levels above 10 ppt and 5 (8%) were above 20 ppt. Of the ten species of commercial fish, seven had detectable levels of 2,3,7,8-tetra-CDD. The only isomer of tetra-CDD (22 are possible) present in all the positive samples was one that had all the characteristics of 2,3,7,8-tetra-CDD. Figure 6.1 shows a GC/MS tracing of a post-cleanup extract of smelt containing25.7 ppt 2,3,7,8-tetra-CDD. Ions monitored were 320 and 322 for native tetra-CDD and 332 for the isotopically labeled internal standard, each offset one min from each other on the chart. Only one signal for tetra-CDD is present in this extract; it occurs at the same time as that for a standard of the 2,3,7,8-tetra-CDD isomer, i.e., no other tetra-CDD isomers are present. The tetra-CDD values for the different fish species appear to fall into three groups. Rock bass, sunfish and black crappie had no detectable levels: white perch. yellow perch, brown bullhead and white sucker were found to contain levels below 10 ppt; and catfish, eel and smelt had the highest levels.

All samples of fish contained readily measurable levels of PCB. The first seven species in Table 6.1 all showed values less than 1.0 ppm and the last three species (catfish, eel and smelt) had values almost always greater than 1.0 ppm. The PCB values appeared to parallel the fat content in most cases, as those with low or high PCB also had low or high lipid. The levels of Mirex were much more variable and, in many cases, the value was at or near the detection limit of 5 ppb.



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6.1. GC/MS Schematic Chromatogram of a Cleaned Extract of Smelt Monitored at Three Ions; m/z 332 Internal Standard and m/z 320 and 322 for Native Tetra-CDD—Each Ion Offset One Min on Chart for Calculated Value of 2,3,7,8-Tetra-CDD Was 25.7 ppt.

Table 6.2, Individual Values of PCB, Mirex, and Fat Content for Three Fish Species Showing a High Level of 2,3,7,8-Tetra-CDD Contamination

Fish	TCDD (ppt)	PCB (ppm)	Mirex (ppb)	Fat Content (%)
Catfish	12.8	3.03	80	13.5
	16.1	3.88	110	13.7
	17.1	3.98	120	10.4
Eel	6.4	7.29	290	31.9
	9.2	8.78	170	37.9
	14.7	0.95	40	32.2
	30.4	3.61	160	42.7
	38.5	4.42	160	38.9
Smelt	11.3	1.86	ND[a]	2.6
	12.5	1.69	ND	3.1
	14.2	1.37	40	4.1
	23.3	1.16	50	4.5
	25.7	1.79	50	3.1
	32.9	1.20	40	4.3

[a]ND = not detected st limit of detection (5 ppb).

The average values for this contaminant in Table 6.1 are based on values of 2.5 ppb for those samples in which no Mirex was detected. Only in catfish, eel and. to a lesser extent (four of eight), smelt was Mirex readily detected and quantified.

Three fish species from the commercial fish of 1980 showed high levels of chlorinated hydocarbon contamination. The individual values for '14 of these fish are tabulated (Table 6.2) for samples that were positive for 2,3,7,8-tetra-CDD. For catfish, all three samples collected in November 1980 had high dioxin, lipid, Mirex and PCB (>3 ppm). The six smelt samples that were positive for 2.3.7.8-tetra-CDD had a fat level greater than 2%, a PCB content greater than ppm and some of the highest dioxin values. Four of the six were caught from the eastern part of Lake Ontario and two from the Welland Canal. Interestingly, the two of eight smelt samples in which no dioxin was found and in which the PCB content was low (<1.0 ppm) originated from Lake Erie. Five of the six eel samples were positive for tetra-CDD. This species had the highest PCB, Mirex and, by far, the highest lipid content.

For comparative purposes, a smaller sampling of salmonid sport fish from 1980 and commercial smelt from 1979 were analyzed for 2,3,7,8-tetra-CDD and PCB and these results are listed in Table 6.3. All salmonids collected from the Great lakes in 1980 had readily measurable levels of 2,3,7,8-tetra-CDD, with average values greater than those of commercial fish. The three trout samples represented whole fish and this type of sampling is believed to give tetra-CDD levels 30-50% higher than those obtained by fillet sampling. The only negative sampling from the salmonid sport fish originated from the Pacific Coast. All tetra-CDD positive salmonids also had high levels of PCB. The r samples

Table 6.3. 2,3,7,8-Tetra-CDD and PCB Levels in Sport Fish (1980) and Smelt (1979)

Species	Origin	TCDD (ppt)	PCB (ppm)
Lake Trout[a]	Lake Ontario	58	7.28
	Lake Huron	37	5.03
Rainbow Trout.	Lake Ontario	33	1.77
Coho Salmon	Lake Ontario	28[b]	7.39
	Pacific Coast	ND[c] (4)	0.03
Smelt	Lake Ontario	11	
		16	
		11	
	Lake Erie	ND[c] (2)	

[a] Whole fish.

[b] Also contained 36 ppt of hexa-CDD (three isomers) and 93 ppt of octa-CDD.

[c] ND = not detected at bracketed detection limit.

from 1979 also contained tetra-CDD, but the average values of the positives were somewhat lower than those smelt collected in 1980. Again, as in 1980, it is noteworthy that the Lake Erie sample contained no tetra-CDD.

A class of contaminants with similar chemical and toxicological properties to the chlorinated dibenzo-*p*-dioxins is the chlorinated dibenzofurans. Using similar methodology for estimating 2,3,7,8-tetra-CDD in fish, the analogous furan, 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-tetra-CDF), was determined in some of the fish in which 2,3,7,8-tetra-CDD was known to occur. These results are given in Table 6.4 for commercial fish from 1980 and for the salmonids. These preliminary data indicate that 2,3,7,8-tetra-CDF is also present in many of the fish samples from the Great Lakes at the same order of magnitude as 2,3,7,8-tetra-CDD and with a wide individual variation. Two eel samples not listed in Table 6.4 that contained 30 and 39 ppt 2,3,7,8-tetra-CDD were found to contain no detectable 2,3,7,8-tetra-CDF. The sampling of fish for tetra-CDF is somewhat biased, as most analysis has been done on samples known to contain 2,3,7,8-tetra-CDD above 10 ppt and probably does not reflect the average situation. In several cases, more than one isomer of tetra-CDF was present, but the exact configuration was uncertain due to lack of suitable standards and more definitive methodology.

Five of the commercial fish and all of the Great Lakes salmonid samples from 1980 were above the Canadian Health Protection Branch (HPB) regulation of 20 ppt for dioxin. Two of five commercial fish and three of four salmonids also surpassed a regulation of 2.0 ppm for PCB, individual fish in these samples and other pooled samples below 20 ppt could be significantly higher, since the composite sampling procedure could result in lower-level samples diluting higher-level sample ence the values for single fish could show a wider variation. A guideline of 25 ppt 2,3,7,8-tetra-CDD in fish has been set by the New York state

Table 6.4. Preliminary Data Comparing 2,3,7,8-Tetra-CDF Levels (ppt) in Fish to 2,3,7,8-Tetra-CDD

	Tetra-CDF			
Fish	2,3,7,8	Other Isomers[a]	Total	2,3,7,8 Tetra-CDD
Smelt	34	78 (2)	112	23
	19		19	26
	3.2		3.2	14
	16		16	11
Catfish	54	45 (1)	99	16
White Perch	14.7		14.7	6.3
Lake Trout	8.5		8.5	58
	24		24	37
Rainbow Trout	12	188 (2)	200	33
Ontario Salmon	79	74 (1)	153	28
Pacific Salmon	ND[b] (10)			ND (4)

[a] Number of tetra isomers present (not including 2,3,7,8-tetra-CDF) are in parentheses.

[b] ND = not detected at bracketed detection limit.

Department of Health. Their regulation is based on a weekly individual consumption of fish of 6–8 oz (150–200 g) whereas the Canadian regulation is based on a 4-oz (100-g) consumption.

The data in Table 6.2 for the three commercial fish species having high tetra-CDD levels were treated to a statistical analysis invoiving simple linear regression of the tetra-CDD content (dependent variable) on either the fat or PCB level (independent variables). For both the smelt and the eel sampling, there was a positive correlation between tetra-CDD and fat level and an inverse negative correlation between tetra-CDD and PCB (correlation coefficients of 0.54 and −0.52 for smelt and 0.65 and −0.45 for eels). Catfish, however, had opposite correlation coefficients: tetra-CDD on fat was negative ($r = -0.78$) and on PCB was positive ($r = 0.95$). No clear statistical relationship is evident for these fish species: this probably is due to the small sample size. The average PCB and Mirex levels and the positive tetra-CDD levels in Table 6.1 expand a range of 45.59 and 6.7, respectively. If these same values are adjusted on an equal-fat basis, the ranges for PCB and Mirex diminish to 4.2 and 5.3, respectively, while that for TCDD remains relatively unchanged at 10.9. A more empirical approach is to state that samples with a high lipid content had high PCB and Mirex contamination and a high probability for the presence of dioxin. Not enough sampling was available to make any attempt to correlate dioxin content with season of year or the area of Lake Ontario—a consequence of the expense of doing this resource-intensive analysis.

The data reported in Tables 6.1 to 6.3 indicate that the level! incidence

of 2.3.7.8-tetra-CDD can be categorized by fish species and possibly by locale. These observations for fish also are similar to the situation in herring gulls. Eggs of this fish-eating bird have been found to contain the highest concentrations of 2,3,7,8-tetra-CDD in samples from Lake Ontario, Saginaw Bay and Lake Huron. and lower amounts in the other Great Lakes areas [6]. A further observation in finding tetra-CDD levels in fish appears to be one of size. Zabik et al. [10] found a positive correlation between PCB level and size (length and/or weight) for carp from Lake Huron. Some species of adult fish with high levels of 2.3.7.8-tetra. CDD also have a large size (e.g., catfish and trout) and many with a small adult size (less than 250-300 mm) have little or no dioxin contamination. This trend is particularly evident for the related *Ictalurus* species. where bullhead is low but the larger catfish is high. Moreover, related information from New York state Department of Health and MOE from such sport species as brown, rainbow and lake trout, and chinook, atlantic and coho salmon tend to support this classification of tetra-CDD level by fish size.

There are at least two possible sources of 2,3,7,8-tetra-CDD and -CDF contamination in Great Lakes fish. The simplest explanation is that they are being emitted into the environment from a point source, entering the water and being accumulated in certain species. Certainly, the production of chlorinated phenols. related pesticides and PCB at several locations near the Great Lakes over many years and the subsequent emission of these contaminants directly in effluents or indirectly through slow leaching at waste sites would support this explanation. Another possibility. although less likely, is through fly ash generated by incineration of municipal solid waste. Fly ash contains a wide spectrum of dioxins and furans, with 2,3,7,8-tetra-CDD at least a minor component (<5%) of the tetrachlorinated portion. Bioaccumulation of 2,3,7,8-tetra-CDD and C D F isomers in the fish over the other isomers would lead to the single tetra-CDD or a few TCDF peaks as are found in fish. The fact that only one isomer of tetra-CDDand few of tetra-CDF are found in certain locales and not all Great Lakes makes the second explanation less feasible.

This work has shown that 2,3,7,8-tetra-CDD is a relatively common contaminant of Lake Ontario commercial fish collected in 1980 (about 25% of 62 samples contained levels >10 ppt). Certain species. such as catfish, eel and smelt, had the highest levels and these were associated with a high PCB and lipid content of the fish. Comparison of these data with a more limited sampling of smelt from 1979 and salmonid fish from 1980 indicated slightly lower levels of tetra-CDD in the former and higher levels in the latter categories of fish. Preliminary data are also presented on the presence of residues of 2,3,7,8-tetra-CDF in these fish samples at the same order of magnitude as 2.3.7.8-tetra-CDD,

ACKNOWLEDGMENTS

The authors: d like to thank H. McLeod of Health and Welfare Canada and A. Gervais of Fisheries and Ocean Canada for sample collection and delivery. P. Galway of the latter department kindly carried out the PCB and Mirex determinations. The skillfull technical help of L. Panopio and B. Kennedy effected some of the sample extraction and cleanup.

REFERENCES

1. Zitko, V. *Bull. Environ. Contam. Toxicol.* 7:105 (1972).
2. *Anon. Pest. Toxic Chem. News* 6:23 (November 8, 1978).
3. Harless, R.L., E.O. Oswald, R.G. Lewis, A.E. Dupuy, D.D. McDaniel and H. Tai. *Chemosphere* 11:193 (1982).
4. Ryan, J.J., J.C. Pilon, H.B.S. Conacher and D. Firestone. *J. Assoc. Off. Anal. Chem.* 66:(1983).
5. *Pest. Toxic Chem. News* 9:23 (December 10, 1980).
6. Nnrstrom, R.J., D.J. Hallett, M. Simon and M.J. Muivihiil. In: *Chlorinated Dioxins and Related Compounds: Impact on the Environment*, O. Hutzinger, R.W. Frei. E. Merrian and F. Pocchiari, Eds. (Oxford: Pergamon Press, 1982), p. 173.
7. Gilman, A.P.. G.A. Fox, D.B. Peakall, S.M. Teeple, T.R. Carroll and G.T. Haynes. *J. Wildlife Manage.* 41:458 (1977).
8. Ryan, J.J., and J.C. Pilon. *J. Chromatog.* 197:171 (1980).
9. Schmitt, C.J., J.L. Ludke and D.F. Walsh. *Pest. Monit. J.* 14:136 (1981).
10. Zabik, M.. C. Merrill and MJ. Zabik. *Bull. Environ Contam. Toxicol.* 28:592 (1982).

STATE OF CALIFORNIA—HEALTH AND WELF AGENCY GEORGE DEUKMEJIAN, Gov

DEPARTMENT OF HEALTH SERVICES
714/744 P STREET
SACRAMENTO, CA 95814
(916) 324-1826

APR 2 1 1983

Mr. Carl Johnson
Albert's Best
P.O. Box 1103
Fort Bragg, CA 95437

Cear Hr. Jchnson:

This is in response to your letter of December 6, 1982 and the subsequent February 18, 1983 laboratory report provided by Georgia-Pacific Corporation.

You request, based upcn the information provided, that the ash to be produced by the burning of wood by-products at the Georgia-Pacific Fort Bragg Mill be classified as nonhazardous waste. We have reviewed your request and the information provided by Georgia-Pacific and its conformance to the provisions outlined in our policy letter of November 2, 1982 for obtaining a nonhazardous classification for biomass ash.

Based on the information provided, we feel your project has met the criteria as outlined. Pursuant to the provisions of Title 22, Section 66305(b) of the California Administrative Code, the fly ash, bottom ash and flue gas emission control residue generated by the burning of wood by-products at the Georgia-Pacific Fort Bragg Mill is hereby classified as nonhazardous.

This classification is contingent upon the facility providing adequate operating measures to prevent hazardous wastes from entering the combustion process. We will request that the State Solid Waste Hanagement Board include such a provision in the facility permit issued pursuant to Government Code Section 66796.30 et seq.

Please be aware tha: while this classification exempts the waste ash from the hazardous haste regulations of the Department, the requirements of the Regional 'dater Quality Control Board and other agencies must be complied with.

Sincerely,

ORIGINAL SIGNED BY
RICHARD P. WILCOXON

Richard P. Wilcoxon
Acting Deputy Director
Toxic Substances Contrci Division

cc: See attached lis:.

APR 2 1

cc: State Solid Waste Mgmt. Board
North Coast Regional Water
Quality Control Board
1000 Coddingtown Center
Santa Rosa, CA 95401

Director, Environmental Health
Courthcuse
Ukiah, CA 95482

Sue O'Leary ✓
Georgia-Pacific Corporation
90 West Redwood Avenue
Fort Bragg, CA 95437

Mr. Ray Tuvell
1516 9th Street
Sacramento, CA 95814

1983 FIRE REPORT

TYPE OF CALLS	NUMBER OF CALLS	TOTAL MAN HOURS
BRUSH FIRES		
city	6	90
Rural District	18	385
Gut of District	2	66
Total	26	541
CHIMNEY FIRES		
City	37	690
Rural District	15	320
Total	52	1010
ELECTRICAL FIRES		
City	3	49
Rural District	6	110
Total	9	159
STRUCTURAL FIRES		
City	7	176
Rural District	15	561
Out of District	2	45
Total	24	782
FALSE ALARMS		
city	14	258
Rural District	4	75
Total	18	333
PUMP OUT BOATS		
Rural District	1	23
Total	1	23
WASH DOWN		
City	3	66
Total		66
TRUCK AND TRACTOR WRECKS		
Rural District	1	16
Total	1	16
RESCUE		
City	5	106
Rural District	4	90
Out of District	7	132
Total	16	328

TYPE OF CALLS	NUMBER OF CALLS	TOTAL MAN HOURS
STOVE FIRES		
Rural District	2	42
Total	2	42
RESUSCITATION RESCUE		
City	46	916
Rural District	39	718
Total	85	1637
AUTOMOBILE WRECKS		
City	3	56
Rural District	11	239
Total	14	295
TRASH FIRES		
City	4	51
Rural District	1	26
Total	5	77
FIRST AID		
City	4	68
Total	4	68
MOTORCYCLE WRECKS		
Rural District	1	30
Total	1	30
CAR FIRES		
city	13	226
Rural District	6	153
Total	19	379
PROPANE GAS LEAK		
City	1	24
District	2	52
Total	3	76
TOTAL CALLS		
City	146	2776
Rural District	125	2824
Out of District	11	318
Total	282	5918

KNOWN ARSON FIRES

7

TOTAL MAN HOURS INVESTIGATING FIRES

485

PRELINED DRAFT PAPER INDICATES AND IS TO BE USED ONLY FOR ALL NEW REGULATORY LANGUAGE.

Article 11. Criteria for Identification of Hazardous and Extremely Hazardous Wastes

66693. Applicability of Hazardous Waste Criteria.

Any waste which is hazardous pursuant to any of the criteria set forth in this Article is a hazardous waste and shall be managed in accordance with the provisions of this Chapter.

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

DRAFT

PRELINED DRAFT PAPER INDICATES AND IS TO BE USED ONLY FOR ALL NEWREGULATORYLANGUAGE.

ART 4 FOR DISCUSSION ONLY
Date JAN 1 1984

66694. Sampling and Sample Management.

Sampling and sample management of wastes and other materials for analysis and testing pursuant to the criteria of this Article shall be in accord with the sampling planning, methodology and equipment, and the sample processing, documentation and custody procedures specified in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods", SW-846, 2nd edition, U. S. Environmental Protection Agency, 1982.

NOTE: Authority cited: Sections 208, 1 and 25150, Health and Safety 25141
Code.

Reference: Section 25141, Health and Safety Code.

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Date JAN 11 19

Article 11. Criteria for Identification of Hazardous and Extremely Hazardous Wastes

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NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

DRAFT

66696. Toxicity Criteria.

(a) A waste, or a material, is toxic if it:

(1) Has an acute oral LD_{50} less than 5,000 milligrams per kilogram; or

(2) Has an acute dermal LD_{50} less than 4,300 milligrams per kilogram; or

(3) Has an acute inhalation LC_{50} less than 10,000 parts per million as a gas or vapor; or

(4) Has an acute aquatic 96-hour LC_{50} less than 500 milligrams per liter when measured in soft water (total hardness 40 to 48 milligrams per liter of calcium carbonate) with fathead minnows (Pimephales promelas), rainbow trout (Salmo gairdneri) or golden shiners (Notemigonus crysoleucas) according to procedures described in "Standard Methods for the Examination of Water and Wastewater (15th Edition)" or by other test methods or test fish approved by the Department, using test samples prepared or meeting the conditions for testing as prescribed in Section 66700 (c) and (d), and solubilized, suspended, dispersed or emulsified by the procedures recommended in the cited text or by sonication; or

(5) Contains any of the following substances at a single or combined concentration equal to or exceeding 0.001 percent by weight:

(A) 2-Acetylaminofluorene (2-AAF)

(B) Acrylonitrile

(C) 4-Aminodiphenyl

(D) Benzidine and its salts

(E) bis (Chloromethyl) ether (BCME)

(F) Chloromethyl methyl ether (CMME)

(G) 1,2-Dibromo-3-chloropropane (DBCP)

(H) 3,3'-Dichlorobenzidine and its salts (DCB)

(I) 4-Dimethylaminoazobenzene (DAB)

(J) Ethyleneimine (EI)

(K) α-Naphthylamine (1-NA)

(L) β-Naphthylamine (2-NA)

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(M) 4-Nitrobiphenyl (4-NBP)

(N) N-Nitrosodimethylamine (DMN)

(O) β-Propiolactone (BPL)

(P) Vinyl chloride (VCM); or

(6) Has been shown through experience or testing to pose a hazard to human health or environment because of its carcinogenicity, acute toxicity, chronic toxicity, bioaccumulatioe properties or persistence in the environment; or

(7) Contains a solubilized or extractable inorganic or organic persistent or bioaccumulative toxic substance at a concentration in milligrams per liter as determined pursuant to Section 66700 which exceeds the soluble threshold limit concentration as set forth in Section 66699 (c) or (d); or

(8) Does not necessarily conform to the conditions of paragraph (a)(7) of this section but contains an inorganic or organic persistent or bioaccumulative toxic substance, whether solubilized, extractable or non-extractable, which has a total wet-weight concentration in milligrams per kilogram exceeding its total threshold limit concentration as set forth in Section 66699 (c) or (d); or

(9) Is listed in 40 CFR 261 (revised as of July 1, 1932) as a hazardous waste which is:

(A) From a nonspecific source listed in Section 261.31; or

(B) From a specific source listed in Section 261.32; or

(C) An acute hazardous commercial chemical product or manufacturing chemical intermediate listed in Section 261.33 (e); or

(D) A toxic commercial chemical product or manufacturing chemical intermediate listed in Section 261.33 (f).

(10) A waste containing one or more materials which are toxic according to the criterion of subsection (a) (3) of this section may be classified by the Department as nonhazardous pursuant to Section 66305 if the waste is not hazardous by any other criterion of this Article and its head space vapor contains none of the above materials in concentrations exceeding their respective eight-hour inhalation LCSO or their LCLO. The head space vapor of a waste shall be prepared, and two milliliters of it shall be sampled using a five milliliter gas-tight syringe, according to method 5020 in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods", SW-846, 2nd edition, U. S. Environmental Protection Agency, 1962. The quantity of each material in milligrams, which is toxic according to the criterion of paragraph (a) (3) of this section, in thr sampling syringe shall be determined by comparison to liquid standard solutions according to the appropriate gas chromatographic procedures in method 8010, 8015, 8020 or

8030 in "Test Methods for the Evaluation of Solid Wastes, Physical/Chemical Methods', SW-846, 2nd edition, U. S. Environmental Protection Agency, 1982. The concentration of each material in the head space vapor shall be calculated using the following equation:

$$C_A = \frac{Q_A}{MW} \times 29.8 \text{ ml/mmole} \times \frac{1}{2 \times 10^{-6} M^3},$$

where C_A (in parts per million) is the concentration of material A in head space vapor, Q_A (in milligrams) is the quantity of material A in sampling syringe and MW (in milligrams per millimole) is the molecular weight of material A. Where an eight-hour LC_{50} is not available, an LC_{50} measured for another time (t) may be converted to an eight-hour value with the following equation:

$$\text{Eight-hour } LC_{50} = (t/8)^{.2} \times (\text{t-hour } LC_{50}).$$

(b) A waste containing one or more materials which are toxic according to any criterion of paragraph (a) (1) or (a) (2) of this section may be classified by the Department as nonhazardous pursuant to Section 66305 if the waste is not hazardous by any other criterion of this Article and the calculated toxicities conform to all of the following limits:

(1) The calculated oral LD_{50} of the waste mixture is greater than 5,000 milligrams per kilogram and the calculated dermal LD_{50} is greater than 4,300 milligrams per kilogram by the following equation:

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$$\text{Calculated oral or dermal } LD_{50} = \frac{100}{\sum_{x=1}^{n} \frac{\%Ax}{T_{Ax}}}$$

where %Ax is the weight percent of each component in the waste mixture and T_{Ax} is the acute oral or dermal LD_{50} or the acute oral LD_{Lo} of each component.

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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66699. Persistent and Bioaccumulative Toxic Substance.

(a) Any wast? is a hazardous waste which contains a substance listed in subsections (c) or (d) of this section: (1) at a concentration in milligrams per liter as determined pursuant to Section 66700 which exceeds its listed soluble threshold limit concentration, or (2) at a concentration in milligrams per kilogram in the waste which exceeds its listed total threshold limit concentration.

(b) A waste containing a persistent or bioaccumulative toxic substance not listed in subsections (c) or (d) of this section shall be managed as a hazardous waste unless prior written approval to deviate from this provision is granted pursuant to Section 66310.

(c) List of Inorganic Persistent and Bioaccumulative Toxic Substances and Their Soluble Threshold Limit Concentration (STLC) and Total Threshold Lixit Concentration (TTLC) Values.

Substance *†	STLC mg/l	TTLC Wet-Weight mg/kg
Antimony and/or antimony compounds	15	500
Arsenic and/or arsenic compounds	5.0	500
Asbestos	-	1.0 (as percent)
Barium and/or barium compounds (excluding barite)	100	10,000††
Beryllium and/or beryllium compounds	0.75	75

Cadmium and/or cadmium compounds	1.0	100
Chromium (VI) compounds	5	500
Chromium and/or chromium (III) compounds	560	2,500
Cobalt and/or cobalt compounds	80	8,000
Copper and/or copper compounds	25	2,500
Fluoride salts	180	18,000
Lead and/or lead compounds	5.0	1,000
Mercury and/or mercury compounds	0.2	20
Molybdenum and/or molybdenum compouncs	350	3,500
Nickel and/or nickel compounds	20	2,000
Selenium and/or selenium compounds	1.0	100
Silver and/or silver compounds		500
Thallium and/or thallium compounds	7.0	700
Vanadium and/or vanadium compounds	24	2,400
Zinc and/or zinc compounds	250	5,000

* STLC and TTLC values are calculated on the concentrations of the elements, not the compounds.

† In the case of asbestos and elemental metals, applies only if they are in a friable, powdered or finely divided state. Asbestos includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

tt Excluding barium sulfate.

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(d) List of Organic Persistent and Bioaccunulative Toxic Substances and Their Soluble Threshold Limit Concentration (STLC) and Total Threshold Limit Concentration (TTLC) Values.

Substance	STLC mg/l	TTLC Wet-Weight mg/kg
Aldrin	0.1	1.4
Chlordan	0.25	2.5
DDT, DDE, DDD	0.1	1.0
2,4-Dichlorophenoxyacetic acid	10	100
Dieldrin	0.8	8.0
Dioxin (2,3,7,8-TCDD)	0.001	0.01
Endrin	0.02	0.2
Heptachlor	0.47	4.7
Kepone	2.1	21
Lead compounds, organic	--	13
Lindane	0.4	4.0
Methoxychlor	10	100
Mirex	2.1	21
Pentachlorophenol	1.7	17
Polychlorinated biphenyls (PCBs)	5.0	50
Toxaphene	0.5	5
Trichloroethylene	204	2,040
2,4,5-Trichlorophenoxypropionic acid	1.0	10

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NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safetv Code.

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Environmental Samples", EPA-600/8-80-038, U. S. Environmental Protection Agency, 1980.

(3) For fluoride: "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, U. S. Environmental Protection Agency, 1979.

(4) For asbestos: Federal Register, Volume 47, Number 103, pages 23376-23389, May 27, 1982.

(c) Samples shall be prepared for analysis for total and extractable content of substances listed in Section 66889 as follows:

(1) Type i: If the waste or other material is a millable solid, the sample shall be passed directly, or shall be milled to pass, through a No. 10 (two millimeter) standard sieve before it is analyzed. If the sample contains non-friable solid particles which do not pass directly through a No. 10 sieve and which are extraneous and irrelevant as hazardous constituents to the waste or other material, they shall be removed to the extent feasible by mechanical means and discarded. These extraneous particles shall include rocks and pebbles, wood and plant debris, and manufactured ceramic, glass, metal, plastic, resin and rubber items and fragments. Solids which remain in the waste or other material after removal of the aforesaid extraneous particles shall be milled to pass through a No. 10 sieve and shall then be combined and mixed well with the solids which passed through the sieve without milling. The reconstituted sample shall then be analyzed as prescribed in this section.

(2) Type ii: If the waste or other material is a filterable mixture of liquid and solids in which the solids constitute five-tenths (0.5) percent by weight or greater of the sample, the liquid and solids shall be separated by filtration through a 0.45 micron membrane filter. The filtrate so obtained is to be designated as Initial Filtrate. Its volume is determined, and it is retained. The separated solids shall be sieved in a No. 10 sieve and any nonfriable extraneous particles of the kinds described and exemplified in subsection (c) (1) which do not pass through the sieve shall be removed to the extent feasible by mechanical means and discarded. The solids which remain after removal of the extraneous particles shall be milled to pass through a No. 10 sieve and shall be recombined with solids which passed through the sieve without milling. This recombined solid material shall be extracted following the procedure in subsection (f). A ratio of 10 milliliters of extraction solution per gram of solid shall be utilized with appropriate modifications for extraction vessel size. After completion of solids extraction, the filtered extractant is combined with Initial Filterate, mixed thoroughly and analyzed as described in subsection (f) (3).

(3) Type iii: If the waste or other material is a nonfilterable and nonmillable sludge, slurry, or oily, tarry or resinous material, it shall be analyzed as received unless it contains non-friable extraneous and irrelevant solid particles of the kinds described and exemplified in paragraph (c) (1) of this section. If it contains such solid particles and they are of such size as not to pass through a No. 10 sieve, they shall be removed to the extent feasible by mechanical means and discarded. The remainder of the sample shall be analyzed as prescribed in this section.

(4) If it is necessary to dry a solid sample or the solids fraction of a sample before sieving, milling or removal of extraneous solids, or if a sample is dried prior to analysis, all weight losses due to drying shall be determined, and these losses and the conditions of dryiog shall be reported.

(d) If the waste or other material is a liquid containing less than five-tenths (0.5) percent by weight of undissolved solids, it shall not be subject to the WET procedure, but shall be analyzed directly for the substances listed in Section 66699. The waste shall be classified as a hazardous waste if the total concentration in the waste of any substances listed in Section 6669.9 exceeds the TTLC valve given for that substance. If, however, the total concentration is less than the TTLC but exceeds the STLC when expressed on a milligrams per liter basis, the waste or other material shall be filtrred through a 0.45 micron membrane filter, the solids discarded and the filtrate shall be analyzed directly for the substances listed in Section 66699. The waste shall be classified as a hazardous waste if the concentration in the filtrate of any of the substances listed.in Section 66699 exceeds the STLC valve given for that substance.

(e) The WET extraction solution shall consist of 0.2 M sodium citrate at pH 5.0 ± 0.1, which is prepared by titrating an appropriate amount of analytical grade citric acid in deionized water with 4.0 N NaOH, except that the extraction solution for the determination of chromium (VI) shall consist of deionized water.

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vigorously agitated suspension. Examples of acceptable equipment are shown in test method 1310 in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods", SW-846, 2nd edition, U. S. Environmental Protection Agency, 1982. The temperature during the extraction shall be maintained between 20 and 40 degrees centigrade. After 48 hours of extracting, the contents of the Treatment and Blank containers are either filtered directly or centrifuged and then filtered. Filtering shall be through a medium porosity prefilter and then through a 0.45 micron membrane filter using a clean, thick-walled suction flask. For coarser solids, prefiltration shall not be necessary. Pressure filtration shall be an optional alternative to vacuum filtration. If the extracts are first centrifuged, glass or polyethylene bottles shall be used as prescribed for extractibn. for very fine solids, centrifuging at as high as 10,000 x G may he necessary. After centrifugation, the liquids are decanted, pre-filtered if necessary, and then passed through a 0.45 micron membrane filter. All filters shall be of low and identified extractable heavy metals, fluoride and organic chemicals content.

(3 If the filtered extracts are to be analyzed only for the metal elements listed in Section 66699 (c), the filtered extracts from the Treatment and Blank shall be transferred to clean polyethylene bottles and acidified with nitric acid Lo five percent by volume acid content soon after each extract is filtered. For those wastes or waste materials classified under subsection (c) (2), the Treatment shall be the Initial Filtrate combined with the extract generated by the WET extraction of the initially separated

solids. Similarly the Blank in this instance shall be the filtrate generated by the WET Blank accompanying the initially separated solids, to which is subsequently added a volume of deionized water equivalent to that of the Initial Filtrate. These procedures are to be followed prior to acidification of Treatment and Blank solutions with nitric acid to five percent (by volume) acid content.

The bottles are then stored at room temperature or frozen. If the extracts are also to be analyzed for the organic substances listed in Section 66699 (d), or for the organic substances only, the filtered extracts shall be transferred to clean glass bottles. If the extracts are to be analyzed for fluoride, they shall be transferred to clean polyethylene bottles. These extracts, containing organic substances or fluoride, shall not be acidified, but shall be frozen soon after each extract is obtained and held frozen until the day of analysis, unless the extracts are analyzed within 24 hours.

(g) Sample analysis and data treatment shall be as follows:

(1) Each of the filtered extracts from the Treatment and Blank extractions shall have been acidified to five percent by volume nitric acid, and stored at room temperature or frozen in polyethylene bottles or kept frozen without addition of acid in glass bottles until the day of analysis, as prescribed. Each of the extracts is thoroughly mixed just prior to being individually analyzed for the substances listed in Section 66699 in order

to determine whether the extractable concentration (EC) in the waste or other material exceeds the STLC for any of the substances listed. Procedures suitable for analysis of the extracts derived from the citrate extractions are given in "Methods for Chemical Analysis of Water and Wastes", EPA-60014-79-020, U. S. Environmental Protection Agency, 1979, and "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", EPA-600/4-82-057, U. S. Environmental Protection Agency, 1982.

(2) The net EC of a substance in the Treatment sample which is listed in Section 66699 shall be calculated and reported as milligrams per liter of sample (mg/l). This value is derived after subtracting the concentration of the substance in the appropriate Blank extract from that concentration determined in the Treatment extract.

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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66702. Ignitability Criteria.

(a) A waste, or a material, is ignitable if it:

(1) Is a liquid, other than an aqueous solution containing less than 24 percent alcohol by volume, and has a flash point less than 60 degrees centigrade (140 degrees Fahrenheit), as determined by a Pensky-Martens Closed Cup Tester, using the test method specified in American Society for Testing and Materials (ASTM) Standard D-93-79, or a Setaflash Closed Cup Tester, using the test method specified in ASTM Standard D-3278-78; or

(2) Is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard; or

(3) Is an ignitable compressed gas as defined in 49 CFR 173.300 (revised as of October 1, 1982) and as determined by the test methods described in that regulation; or

(4) Is an oxidizer as defined in 49 CFR 173.151 (revised as of October 1, 1982).

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Date JAN 11 1984

66702 - 2

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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66705. Reactivity Criteria.

(a) A waste, or a material, is reactive if it:

(1) is normally unstable and readily undergoes violent change without detonating; or

(2) Reacts violently with water; or

(3) Forms potentially explosive mixtures with water; or

(4) Generates toxic gases, vapors or fumes, when mixed with water, in a quantity sufficient to present a danger to human health or the environment; or

(5) is a cyanide or sulfide bearing waste which, when exposed to pH conditions between 2 and 12.5, generates toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment; or

(6) is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement; or

(7) is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure; or

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(8) Is a forbidden explosive as defined in 49 CFR 173.51 (revised as of October 1, 1982), or a Class A explosive as defined in 49 CFR 173.53 (revised as of October 1, 1982), or a Class B explosive as defined in 49 CFR 173.88 (revised as of October 1, 1982)

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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Date JAN 11 1984

66708. Corrosivity Criteria.

(aj A waste, or a material, is corrosive if it:

(1) Is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5, or its mixture with an equivalent veight of water produces a solution having a pH less than or equal to 2 or greater than or equal to 12.5. The pH shall be determined by a pH meter using either test method 9040 specified in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods", SW-846, U. S. Environmental Protection Agency, 2nd edition, 1982, or as described in "Methods for Analysis of Water and Wastes", EPA 600/4-79-020, March 1979; or

(2) Is a liquid, or when mixed with an equivalent weight of water produces a liquid, and corrodes steel (SAE 1020) at a rate greater than 6.35 millimeters (0.250 inch) per year at a test temperature of 55 degrees centigrade (130 degrees Fahrenheit) as determined by the test method specified in the National Association of Corrosion Engineers (NACE) Standard TM-01-69 as standardized as test method 1110 in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Hethods", SW-846, U. S. Environmental Protection Agency, 2nd edition, 1982.

NOTE: Authority cited: Sections 206, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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66717. Applicability of Extremely Hazardous Waste Criteria.

Any waste which is extremely hazardous pursuant to any of the criteria of Sections 66720 or 66723 is an extremely hazardous waste and shall be managed in accordance with the provisions of this Chapter.

NOTE: Authority cited: Sections 208, 25141, and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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66720. Extremely Hazardous Criteria.

(a) A waste, or a material, is extremely hazardous if it:

(1) Has an acute oral LD_{50} less than or equal to 50 milligrams per kilogram; or

(2) Has an acute dermal LD_{50} less than or equal to 50 milligrams per kilogram; or

(3) Has an acute inhalation LC_{50} less than or equal to 100 parts per million as a gas or vapor; or

(4) Contains any of the substances listed in Section 66696 (a) (5) at a single or combined concentration equal to or exceeding 0.1 percent by weight; or

(5) Has been shown through experience or testing to pose an extreme hazard to the public health because of its carcinogenicity, high acute or chronic toxicity, bioaccumulative properties, or persistence in the environment; or

(6) Contains a persistent or bioaccumulative toxic substance, whether solubilized, extractable or nonextractable, which has a total wet-weight concentration in milligrams per kilogram equal to or exceeding its total threshold limit concentration (TTLC) as set forth in Section 66723; or

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(7) Is water-reactive.

(b) A waste containing one or more materials which are extremely toxic according to any criterion of paragraphs (a) (1) or (a) (2) of this section may be classified by the Department as not extremely hazardous pursuant to Section 66305 if neither the calculated acute oral toxicity nor the calculated acute dermal toxicity of the waste using the equations in Sections 66696 (b) (1) are numerically equal to or less than the toxicity limits prescribed in paragraphs (a) (1) or (a) (2) of this section and the waste is not extremely hazardous by any other criterion of this section.

NOTE: Authorrty cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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66723. Total Threshold Limit Concentration Values of Persistent and Bioaccumulative Toxic Substances in Extremely Hazardous Wastes.

(a) Any waste containing a substance listed in subsection (b) of this section at a concentration equal to or exceeding its listed total threshold limit concentration is an extremely hazardous waste.

(b) List of Persistent and Bioaccumulative Toxic Substances and Their Total Threshold Limit Concentration (TTLC) Values.

Substance	TTLC (Wet-Weight in mg/kg)
Aldrin	140
Arsenic and/or arsenic compounds	50,000 (as As)
Beryllium and/or beryllium compounds	7,500 (as Be)
Cadmium and/or cadmium compounds	10,000 (as Cd)
Chlordan	250
2,4-Dichlorophenoxyacetic acid	10,000
Dieldrin	800
Dioxin (2,3,7,8-TCDD)	1
Endrin	20
Heptachlor	470
Kepone	2,100
Lead compounds, organic	1,300 (dry weight basis; as Pb)
Lindane	400

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Mercury and/or mercury compounds	**2,000** (as Hg)
Mirex	**2,100**
Polychlorinated biphenyls (PCBs)	**5,000**
Selenium and/or selenium compounds*	**10,000** (as Se)
Thallium and/or thallium compounds*	**70,000** (as Tl)
Toxaphene	**500**
2,4,5-Trichlorophenoxypropionic acid	1,000

* In the case of elemental metals, applies only if they are in a friable, powdered or finely divided state.

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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Alpha

Analytical Laboratories. Inc.

860 Waugh Lane. H-1. Ukiah. California 95482

(707) 468-0401

CLIENT Georgia Pacific
ADDRESS 90 W. Redwood Ave
Ft. Bragg, CA 95437

ATTN: Sue O'Leary

DATE COLLECTED ---
DATE IN LAB - -
COLLECTED BY client
SAMPLE TYPE ash

LABORATORY NO.: / CLIENT I.D.	4-1529 Hopper collector discharge Chute B	4-1530 Old boiler before scrubber	4-1531 New boiler before scrubber	
Nitrogen	**0.13**	0.12	**0.08**	%
Phosphorous	**0.06**	0.13	**0.04**	%
Potassium	**0.32**	0.89	**0.14**	%
Calcium	**0.9**	2.1	**0.5**	%
Magnesium	**0.2**	0.4	**0.2**	%

Alpha
Analytical Laboratories, Inc.

Bruce L. Colvin 7-27-84
LABORATORY DIRECTOR DATE

15

California Analytical Coborotories. Inc.
2544 Industrial Boulevard • West Sacramento, CA 95691 • (916) 372-1393

September 30, 1984
Lab No. 19087
Received: 8/21/84

Ellie Givoannoni
31251 Turner Road
Fort Bragg, CA 95431

Dear Ms. Givoannoni:

We have completed the analysis of tetrachloro to octachloro dioxins and dibenzofurans on the soil sample (composited from the contents of the two large plastic bags), and found 0.24 ppb (ng/gm) of octachlorodibenzo-p-dioxin. A summary of the results is enclosed.

If you have any questions, please do not hesitate to contact us.

Michael J. Miille, PhD
Director of GC/MS

Anthony S. Wong, PhD
Vice President

sjk

This report is for the sole and exclusive use of the client to whom it is addressed.
Samples not destroyed in testing are retained a maximum of thirty (30) days unless otherwise requested.

RESULTS

CLIENT ID: Composite Soil
CAL ID: 19087

	Amount Found ng/g	Detection Limit ng/g
Chlorodibenzofurans		
tetra	ND	0.004
penta	ND	0.003
hexa	ND	0.005
hepta	ND	0.002
octa	ND	0.003
Chlorodioxine		
tetra	ND	0.008
penta	ND	0.012
hexa	ND	0.004
octa	0.24	---

Anthony S. Wong, PhD
Anthony S. Wong, PhD

Sept. 30 - 1984
Date

UKIAH OFFICE
880 NORTH BUSH STREET
UKIAH, CA 95482
(707) 468-4461

FORT BRAGG OFFICE
790-A SOUTH FRANKLIN STREET
FORT BRAGG, CA 95437
(707) 964-4713

Craig M. McMillan, M.D.
Health Agency Director

COUNTY OF MENDOCINO
DEPARTMENT OF PUBLIC HEALTH
COURTHOUSE
UKIAH, CALIFORNIA 95482

Division of Environmental Health
880 No. Bush, Ukiah, Ca., 95482
October 16, 1984

Mrs. Ellie Giovannoni
31251 Turner Road
For:: Bragg, California 95437

Dear Mrs. Giovannoni

Thank you for your 11 October 1984 letter, and the 30 September 1984 report from California Analytical Laboratories, Inc.

I do not have the expertise to assess the risk from octa-chlorodioxins at .24 ppB, and i am therefore sending a request to the State Department of Health Services for their review and opinion on this. I will contact you as soon as I hear something from them.

Sincerely,

Gerald F. Davis
Director of Environmental Health

GFD:ew

File: 22.13

December 13, 1984

Dr. David Leu, Chief
Alternative Technology and Policy
Development Section
Toxic Substance Control Division
Department of Health Services
714 P Street
Sacramento, CA 95814

Dear Dr. Leu:

Georgia-Pacific Corporation in Fort Bragg apparently has an agreement with the Fort Bragg Stavings Company for use of fly ash generated at the Mill. Georgia-Pacific is not considering this material to be a Group II waste, but rather a by-product with potential commercial use. The Fort Bragg Savings Company is reportedly using the fly ash obtained from Georgia-Pacific Corporation as a soil amendment.

Cyanide concentrations in wet fly ash at Georgia-Pacific have been observed to be around I ▪ Our agency has received complaints on the use of the fly ash as a soil amendment from residents in the Fort Bragg area. Please provide us with your assessment on the appropriateness of use of this material as a soil amendment, and on its classification as a "product", rather then a Group II waste.

Sincerely,

Susan A. Werner
Associate Land and Water Use
Analyst

cc: Sue O'Leary, Georgia-Pacific
Jerry Davis

December 18, 1984

Fort Bragg Savings Company
P.O. Box 534
Fort Bragg, CA 95437

Dear Sirs:

We have received complaints on your stockpiling of fly ash received from the Georgia-Pacific Corporation. The complaints allege that you are piling ash in the vicinity of water courses where storms could wash some of the ash into streams. Please advise this office immediately of your practices involving this fly ash. In particular, please provide the following information:

1. Locations where fly ash is stored, mixed, or disposed;

2 Volumes of fly ash used on a monthly basis;

3. Length of time fly ash is stored prior to use.

This information should be submitted by January 3, 1985. Please call me if you have any questions on this matter.

Sincerely,

Susan A. Warner
Associate Land and Water Use
Analyst

cc: Jerry Davis

AH #8

DIOXINS IN THE ENVIRONMENT

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6. ENVIRONMENTAL FATE

6.1 OVERVIEW

The important sources of 2,3,7,8-TCDD in the environment are production and use of certain herbicides and chlorophenols, incineration of municipal and industrial wastes, and improper disposal of chemical wastes produced during the manufacture of 2,4,5-trichlorophenol; 2,4,5-T, and related herbicides, hexachlorophene, and chlorinated benzenes. The fate of 2,3,7,8-TCDD in the environment is not clearly understood. It appears that particulate-bound 2,3,7,8-TCDD in the air may undergo photolysis and may be removed by wet and dry deposition. The half-life of atmospheric 2,3,7,8-TCDD is such that 2,3,7,8-TCDD can be transported long distances in the air. The ultimate sink of airborne 2,3,7,8-TCDD is sediments of surface waters. The two processes that are likely to remove 2,3,7,8-TCDD from water and soils are vaporization and photolysis. The estimated half-life of 2,3,7,8-TCDD in surface water is >1 year, and the ultimate sink of aquatic 2,3,7,8-TCDD is sediments. The bioconcentration factor of 2,3,7,8-TCDD in the fathead minnow (*Pimephales promelas*) is 7900 to 9300. 2,3,7,8-TCDD is immobile in most soils, but horizontal movement of soil-bound 2,3,7,8-TCDD may occur in runoff water during flooding. As observed in Seveso, Italy, minimal vertical movement may occur in soils containing low organic matter. The estimated half-life of 2,3,7,8-TCDD is 1 to 3 years on soil surfaces and 10 to 12 years in the interior of soils. Although not accumulated, the level of 2,3,7,8-TCDD absorbed in parts of plants underground is of the same order of magnitude as in soil, but the aerial parts of plants contain 50% lower concentrations.

6.2 RELEASES TO THE ENVIRONMENT

Although the following paragraphs discuss the sources of 2,3,7,8-TCDD in the environment, the sources responsible for its background levels are not clear.

6.2.1 Production and Use of Certain Herbicides and Chlorophenols

The phenoxy herbicide 2,4,5-T produced prior to 1960 contained up to 100 μg/g 2,3,7,8-TCDD. The level of 2,3,7,8-TCDD in commercial 2,4,5-T has been reduced in recent years to <0.1 μg/g, and most commercial 2,4,5-T available today may contain <0.02 μg/g 2,3,7,8-TCDD. Agent Orange, a 1:1 mixture of butyl esters of 2,4,5-T and 2,4-D produced before 1970, contained 0.02 co 54 μg/g 2,3,7,8-TCDD. Hexachlorophene, a germicide manufactured from trichlorophenol, contains 0.2 to 0.5 ng/g 2,3,7,8-TCDD. 2,4,6-Trichloro-, 2,3,4,6-tetrachloro-, and pentachlorophenol were found to contain <0.1 μg/g other tetra isomers but no 2,3,7,8-TCDD. 2,3,7,8-TCDD was detected at a concentration <1 ng/g (2,3,7,8-TCDD detection limit of 0.03 ng/g) in all samples of sodium pentachlorophenate, 2,3,4,5-tetrachlorophenol, and

hexachlorophene. 2,4,5-Trichlorophenol, on the other hand, contained up to 6.2 μg/g 2,3,7,8-TCDD. Similarly, diphenyl ether herbicides were found to contain other tetrachloro isomers but no 2,3,7,8-TCDD (EPA 1985b, HSDB 1987. Rappe 1984, Hagenmaier 1986. Weeren and Asshauer 1985). From the analysis of sediments of A western Lake Ontario site, Czuczwa and Hites (1986) concluded that the likely source of tetrachlorodibenzo-p-dioxins was a pentachlorophenol production facility. The analytical method used, however, could not distinguish 2,3,7,8-TCDD from other tetraisomers.

6.2.2 Photochemical Reactions

The photochemical reaction of phenoxy herbicides has been found to produce polychlorinated dibenzo-p-dioxins through photodechlorination and subsequent condensation reactions; however, this process does not produce 2,3,7,8-TCDD (Rappe 1984). Lover substituted dibenzo-p-dioxins are also formed during photodechlorination of higher chlorine-substituted dibenzo-p-dioxins. Trace amounts of 2,3,7,8-TCDD were observed from the photodechlorination of both 1,2,3,6,7,8-hexa- and 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin (Buser 1979).

6.2.3 Thermal Reactions

Small amounts of 2.3.7.8-TCDD have been detected in the flue gases from municipal incinerators. From the experimentally determined concentrations in flue gases of five municipal incinerators, the maximum average concentration of 2,3,7,8-TCDD in ambient air at ground level was estimated as 38 fg/g. Incineration of industrial wastes containing 2,4,5-T salts and esters, polychlorinated benzenes, and chlorophenaxy ethers also produced 2,3,7,8-TCDD (Rappe 1984, Barnes 1983). Upon analysis of sediments from Saginav Bay, Saginaw River, and the Great Lakes, Czuczwa and Hites (1984, 1986) concluded that the source of tetrachlorodibenzo-p-dioxins was incineration, although the analytical method used was unable to separate 2,3,7,8-TCDD from other tetra isomers. Combustion of coal did not produce 2,3,7,8-TCDD at a detection limit of 1.2 ng/kg (HSDB 1987), but burning of woods did produce 0.65 μg/kg 2,3,7,8-TCDD (EPA 1985b). Exhausts from automobiles powered with leaded gasoline were reported to contain <0.05 to 0.3 ng 2,3,7,8-TCDD/24.8 km, but no 2,3,7,8-TCDD was detected in exhausts of automobiles powered with unleaded gasoline (Marklund et al. 1987). Accidental fires involving capacitors or transformers containing chlorobenzene will also release 2,3,7,8-TCDD to the environment. An example of such a contamination is the State Office Building in Binghamton, New York.

6.2.4 Improper Disposal of Chlorinated Chemical Wastes

Improper disposal of certain chemical wastes produced during the manufacture of 2,4,5-trichlorophenol, 2,4,5-T, and related herbicides, hexachlorophene, chlorinated benzenes. etc., may be a source of 2,3,7,8-TCDD in the environment. Examples of such improper disposal leading to the contamination of the environment are the Love Canal. Niagara Falls, New York, sites where 2,3,7,8-TCDD up to a level of 672 μg/kg was detected. Similarly, several sites in the state of Missouri were contaminated with up to 1750 μg/kg 2.3.7.8-TCDD (Tiernan et al.

1985).

6.3 ENVIRONMENTAL FATE

The fate of 2,3,7,8-TCDD in air, water, and soil is not understood with certainty. Although some experimental efforts have been directed in recent years to elucidate its fate in different media, a substantial data gap exists in this area. In air. 2,3,7,8-TCDD is likely to be present predominantly in the gas phase. The two important processes that may remove 2.3, 7,8-TCDD from the atmosphere are photochemical degradation and wet deposition. Even an estimate of the atmospheric half-life of 2,3,7,8-TCDD is not available. On the basis of photochemical experiments with 2,3,7,8-TCDD coated on silica gel, the half-life of atmospheric particulate 2,3,7,8-TCDD may be a few days. The half-life of atmospheric gas-phase 2,3,7,8-TCDD may be higher than particulate 2,3,7,8-TCDD. The lifetime of atmospheric 2,3,7,8-TCDD is such that it can be transported long distances in the air. The ultimate environmental sink of airborne particulate 2,3,7,8-TCDD is likely to be sediments of surface waters (Eitzer and Hites 1986, Czuczwa and Hites 1986. Choudhry and Hutzinger 1982).

The biodegradation of 2,3,7,8-TCDD in water is probably slow. The two processes that may be important for the removal of 2,3,7,8-TCDD are volatility and photodegradation. Although the photolysis of 2.3.7.8-TCDD in hydrogen-donating solvents is a fast process, a suspension of 2,3,7,8-TCDD in distilled water showed no appreciable photodegradation. In natural waters, the presence of small amounts of hydrogen-donating substrate or the presence of photosensitizers may account for its observed photodegradation; however, the photochemical degradability of 2.3.7.8-TCDD in water, as provided by model ecosystem studies (Tsushimoto et al. 1982, Matsumura et al. 1983). has not provided definite evidence through mass balance that the observed loss of 2.3.7.8-TCDD attributed to photolysis was not due to its sorption on sediment and biota. The photodegradation is usually a dechlorination process leading to the formation of tri- and dichlorinated dibenzo-p-dioxins. In sediment-containing lake water, the estimated half-life of 2,3,7,8-TCDD is >1.5 years. In lake water alone, the estimated half-life is >1 year. The ultimate sink of aquatic 2,3,7,8-TCDD is the sediment. Recent flow-through experiments with fathead minnows (*Pimephales* promelas) have shown that the bioconcentration factor for 2,3,7,8-TCDD in this species is 7900 to 9300 on a wet weight basis (EPA 1985b, Adams et al. 1986).

2,3,7,8-TCDD is expected to be immobile in most soils by irrigation and rainfalls. A downward movement of 10 cm in 12 years was observed with soil from Eglin Air Force Base. Although 2,3,7,8-TCDD usually does not leach through soil, leaching is possible in rare instances from soils of very low organic carbon content as a result of 2,3,7,8-TCDD solvation with organic solvent or biotic mixing by earthworms or other soil invertebrates. A white rot fungus (Phanerochaete *chrysosporium*) has been shown to degrade 2,3,7,8-TCDD. This biodegradation does not occur significantly in natural soils, probably because of the lack of this or other degrading microorganisms. Both volatilization and photoreaction may remove some 2,3,7,8-TCDD from soil surfaces. The photoreaction on soil surfaces can be greatly enhanced by the presence of hydrogen-

donating substrates (e.g., olive oil or arachis oil) in soil. The photoreaction vill be insignificant beyond the surface soil layers. The estimated half-life of 2,3,7,8-TCDD on soil surfaces is 1 to 3 years, but the half-life in the interior of soil may be 10 to 12 years (EPA 1985b, Freeman and Schroy 1986, Bumpus et al. 1985, HSDB 1987).

2,3,7,8-TCDD present on leaves of plants as a result of spraying herbicides will photolyze with a half-life of a few hours. The chemical is absorbed by higher plants and is probably translocated, but it is not accumulated. The absorption by underground parts may be at the same level as soil, but the aerial part contains ~50% lover concentrations (Choudhry and Hutzinger 1982, Sacchi et al. 1986).

STATE OF CALIFORNIA
MINI-MEMO
STD 100-B (REV. 9-70)

TO: Robert Ludwig
Calif. Waste Management Bd
1020 9th St
Suite 300 Sacto 95814

SUBJECT: Ft. Bragg Shavings

DATE: 1/2/85

File: G-P: Fort B

MESSAGE

Per our recent telephone conversation — here are letters to and from Georgia-Pacific on their fly ash, letters to Ft. Bragg shavings, and lab report on the alleged fly ash from Ft. athletic field.

RETURN TO | SIGNED: Susan Warren | ADDRESS: NCRWQCB #75 | PHONE: 570-2220

REPLY

SIGNED ►	ADDRESS	DATE

SEND PARTS 1 AND 3 INTACT — PART 3 WILL BE RETURNED WITH REPLY

OSP

To: Files – GP Ft Bragg 3 Jan 85

From: SAW

Re: Ft Bragg sewings

Carl Johnson telephoned me on 3 JAN 85 to let me know he would be late replying to our letter (due today) due to flu. He vowed try to submit the letter by Friday

Fort Bragg Shavings Inc.
P.O. Box 534
Fort Bragg, CA 95437

January 11, 1985

'85

David C. Joseph
Executive Officer
California Regional Water Quality Control Board
North Coast Region

It has come to our attention through a letter from Susan A. Warner, Associate Land and Water Use analyst at your office is concerned about our use of a product produced by Georgia-Pacific Corp. of Fort Bragg, California, and marketed by Fort Bragg Shavings, Inc.

This ash-activated carbon product is proving its worth as a soil amendment and as such is being used under several soil amendment labels and is now being sold in northern and southern California.

The University of California, Davis, is doing experimental work with the ash in revitalizing range pasture land.

This material is also being utilized in the Fort Bragg area on several experimental projects.

In all applications, equipment is immediately available to control any storm water run-off which might allow the activated charcoal to be washed into a waterway or stream.

We are working with JTC Environmental Consultants, Inc. of Rockville, Maryland in developing further uses and commercial applications of this new Georgia-Pacific product.

The JTC Environmental laboratory is conducting evaluations in such possible use as cattle feed, water pollution control, air purification, removal of pesticides and herbicides from water and from land which may have been saturated, and removal of heavy metals from water.

The fact that this form of activated-charcoal is a by-product and is economically produced, allows it to break into many applications which were not possible with activated charcoal produced in the regular commercial process.

We have several sites which have been completed as demonstration fields where the ash has been used as a soil amendment.

They include pastures near the Alberts Best Plant, Fort Bragg, pastures and orchards at Little River and Navarro Ridge, and a school playground for the Fort Bragg School District.

Ash, which is re-loaded for transport beyond the Fort Bragg area, is handled at the Alberts Best plant on Pearl Drive in Fort Bragg. This volume is about one hundred and sixty cubic yards per week during the growing season.

The total volume of the product produced would be difficult to estimate since the process is new and has had wide fluctuations depending on such things as electricity demand, species of wood, moisture content, size of wood chips, shavings, sawdust, work schedules, layoffs, etc., etc.

The Department of Public Health, State of California, has officially declared this Georgia-Pacific product is non-hazardous.

The Solid Waste Management Board of the State of California has "de-classified" the product and has encouraged Fort Bragg Shavings, Inc. in our efforts to develop commercial uses for it.

This new source of pure un-contaminated low-cost carbon promises to develop many commercial possibilities.

We at Fort Bragg Shavings, Inc. intend to pursue this in a spirit of cooperation with all agencies involved, and hope to do so without undue obstacles.

Ash which is produced by burning uncontaminated wood should not be compared with ash developed by burning garbage, paper or other waste materials.

Fort Bragg Shavings Inc.

Don Foxx
Noa Johnson

Noa Johnson

Copies to:

Water Quality Control Board, Sacramento
Water Quality Control Board, Santa Rosa
Solid Waste Management Board
Congressman Doug Bosco
Senator Barry Keene
Mendocino County Dept. of Public Health, Ukiah
Mendocino County Dept. of Public Health, Fort Bragg
Mendocino County Chamber of Commerce
Fort Bragg Chamber of Commerce
Bruce Wyette Davis
JTC Laboratories
Georgia Pacific Corporation
Jared Carter, Attorney, Fort Bragg Shavings
Mendocino Co. Board of Supervisors
Open Letter to the Editor, Fort Bragg Advocate & Beacon
Mendocino County Farm Advisor
State of California Fertilizer Association

Ft H.

UKIAH OFFICE
890 NORTH BUSH STREET
UKIAH, CA 95482
(707) 468-4461

FORT BRAGG OFFICE
430 SOUTH FRANKLIN STREET
FORT BRAGG, CA 95437
(707) 964-1713

WATER QUALITY
CONTROL BOARD
REGION 1

JAN 30 '85

DJ ☑ SAMPLE
BK ☐
CJ ☐
RT ☐

COUNTY OF MENDOCINO
DEPARTMENT OF PUBLIC HEALTH
COURTHOUSE
UKIAH, CALIFORNIA 95482

Craig M. McMillan, M.D.
Health Agency Director

Division of Environmental Health
880 No. Bush St., Ukiah, Ca. 95482
January 22, 1985

X G-P
Bragg

Beth Bufton, Waste Management Specialist
Department of Health Services
Toxic Substances Control Division
North Coast California Section
2151 Berkeley Way
Berkeley, California 94704-9980

Dear Beth:

Attached is a copy of the fly ash sample lab report No. 19087 from California Analytical Laboratories, Inc. Please review this, and advise me as to whether or not this level in the report constitute a risk to humans exposed to it.

If another sample of the material is necessary to enable you to properly evaluate the risk, my staff would be pleased obtain, or to assist you in obtaining it.

Thank you for your assistance in this matter

Sincerely,

Gerald F. Davis
Director of Environmental Health

cc: Sue Warner

enclosure: Attached (lab report)

File 22.10

RESULTS

CLIENT ID: Composite Soil
CAL ID: 19087

	Amount Found ng/g	Detection Limit ng/g
Chlorodibenzofurans		
tetra	ND	0.004
penta	ND	0.003
hexa	ND	0.005
hepta	ND	0.002
octa	ND	0.003
Chlorodioxins		
tetra	ND	0.008
penta	ND	0.012
hexa	ND	0.004
octa	0.24	---

Anthony S. Wong, PhD

Sept. 30 - 1984
Date

STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY

GEORGE DEUKMEJIAN, *Governor*

DEPARTMENT OF HEALTH SERVICES
14/744 P STREET
SACRAMENTO, CA 95814
(916) 324-3754

WATER QUALITY BOARD
REGION 1

February 4, 1985

FEB 7 '85

☐ DJ ☐ ☐ BK ☐ ☐ CJ FR ☐ ☐ RT ☐ ☐ JH ☐ ☐ BB ☐ ☐ JR ☐ ☐ REPLY

Ms. Susan A. Warner
Associate Land and Water Use Analyst
California Regional Water Quality Control Board,
North Coast Region
1000 Coddingtown Center
Santa Rosa, CA 95401

Dear Ms. Warner:

This is in response to your December 18, 1984 letter to me regarding Georgia-Pacific Corporation's fly ash that is being used as a soil amendment by the Fort Bragg Savings Company. As you have described the situation, the Department does not agree with Georgia-Pacific that the fly ash is a by-product.

Based on available toxicity data (References: Registry of Toxic Effects of Chemical Substances, NIOSH 1981-82, and Quality Criteria for Water U.S. EPA, July 1976) for sodium cyanide, fly ash with 1 ppm cyanide would not be considered hazardous waste. However, it has been the Department's experience that fly ash usually contains elevated levels of toxic heavy metal; without this additional information, the Department cannot classify the fly ash waste as nonhazardous.

The appropriateness of the use of the fly ash as a soil amendment depends upon various factors: environmental setting; fly ash contaminant levels, even if below Departmental hazardous waste criteria levels; fly ash application rates; etc.

A copy of Article 11, the Department's hazardous waste criteria and test procedures, is enclosed for your information.

If you have any questions concerning the above, please feel free to call Bill Quan of my staff at ATSS 8-454-3754.

Sincerely,

David J. Leu, Ph.D., Chief
Alternative Technology and
Policy Development Section
Toxic Substances Control Division

DJL:WQ:mg

Enclosure

cc: Bob McCormick, ATPDS

PRELINED DRAFT PAPER INDICATES AND IS TO BE USED ONLY FOR ALL NEW REGULATORY LANGUAGE.

Article 11. Criteria for Identification of Hazardous and Extremely Hazardous Wastes

66693. Applicability of Hazardous Waste Criteria.

Any waste which is hazardous pursuant to any of the criteria set forth in this Article is a hazardous waste and shall be managed in accordance with the provisions of this Chapter.

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

DRAFT

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DRAFT - FOR DISCUSSION ONLY
Date JAN 1 1984

66694. Sampling and Sample Management.

Sampling and sample management of wastes and other materials for analysis end testing pursuant to the criteria of this Article shall be in accord with the sampling planning, methodology and equipment, and the sample processing, documentation and custody procedures specified in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods", SW-846, 2nd edition, U. S. Environmental Protection Agency, 1982.

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

DRAFT

PRELINED DRAFT PAPER INDICATES AND IS TO BE **USED** ONLY FOR ALL **NEW** REGULATORY LANGUAGE.

DRAFT – FOR DISCUSSION ONLY

Date JAN 11 '82

Article 11. Criteria for Identification of Hazardous and Extremely Hazardous Wastes

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NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

DRAFT

66696. Toxicity Criteria.

(a) A waste, or a material, is *toxic* if it:

(1) Has an acute oral LD_{50} less than 5,000 milligrams per kilogram; or

(2) Has an acute dermal LD_{50} less than 4,300 milligrams per kilogram; or

(3) Has an acute inhalation LC_{50} less than 10,000 parts per million as a gas or vapor; or

(I) Has an acute a 96-hour LC_{50} less than [illegible] milligrams per liter when measured in soft water (total hardness 40 to 48 milligrams per liter of calcium carbonate) with fathead minnows (Pimephales promelas), rainbow trout (Salmo gairdneri) or golden shiners (Notemigonus crysoleucas) according to procedures described in "Standard Methods for the Examination of Water and Wastewater (15th Edition)" or by other test methods or test fish approved by the Department, using test samples prepared or meeting the conditions for testing as prescribed in Section 66700 (c) and (d), and solubilized, suspended, dispersed or emulsified by the procedures recommended in the cited text or by sonication; or

(5) Contains any of the following substances at a single or combined concentration equal to or exceeding 0.001 percent by weight:

(A) 2-Acetylaminofluorene (2-AAF)

(B) Acrylonitrile

(C) 4-Aminodiphenyl

(D) Benzidine and its salts

(E) bis (Chloromethyl) ether (BCME)

(F) Chloromethyl methyl ether (CMME)

(G) 1,2-Dibromo-3-chloropropane (DBCP)

(H) 3,3'-Dichlorobenzidine and its salts (DCB)

(I) 4-Dimethylaminoazobenzene (DAB)

(J) Ethyleneimine (EI)

(K) α-Naphthylamine (1-NA)

(L) β-Naphthylamine (2-NA)

(M) 4-Nitrobiphenyl (4-NBP)

(N) N-Nitrosodimethylamine (DMN)

(O) β-Propiolactone (BPL)

(P) Vinyl chloride (VCM); or

(6) Has been shown through experience or testing to pose a hazard to human health or environment because of its carcinogenicity, acute toxicity, chronic toxicity, bioaccumulative properties or persistence in the environment; or

(7) Contains a solubilized or extractable inorganic or organic persistent or bioaccumulative toxic substance at a concentration in milligrams per liter as determined pursuant to Section 66700 which exceeds the soluble threshold limit concentration as set forth in Section 66699 (c) or (d); or

(8) Does not necessarily conform to the conditions of paragraph (a) (7) of this section but contains an inorganic or organic persistent or bioaccumulative toxic substance, whether solubilized, extractable or non-extractable, which has a total wet-weight concentration in milligrams per kilogram exceeding its total threshold limit concentration as set forth in Section 66699 (c) or (d); or

(9) Is listed in 40 CFR 261 (revised as of July 1, 1932) as a hazardous waste which is:

(A) From a nonspecific source listed in Section 251.31; or

(B) From a specific source listed in Section 261.32; or

(C) An acute hazardous commercial chemical product or manufacturing chemical intermediate listed in Section 261.33 (e); or

(D) A toxic commercial chemical product or manufacturing chemical Intermediate listed in Section 261.33 (f).

(10) A waste containing one or more materials which are toxic according to the criterion of subsection (a) (3) f this section may be classified by the Department as nonhazardous pursuant to Section 66305 if the waste is not hazardous by any other criterion of this Article and its head space vapor contains none of the above materials in concentrations exceeding their respective eight-hour inhalation LC50 or their LCLO' The head space vapor of a waste shall be prepared, and two milliliters of it shall be sampled using a five milliliter gas-tight syringe, according to method 5020 in "lest Methods for the Evaluation of Solid Waste, Physical/Chemical Methods", SW-846, 2nd edition, U. S. Environmental Protection Agency, 1982. The quantity of each material in milligrams, which is toxic according to the criterion of paragraph (a) (3) of this section, in the sampling syringe shall be determined by comparison to liquid standard solutions according to the appropriate gas chromatographic procedures in method 8010, 6015, 8020 or

8030 in "Test Hethods for the Evaluation of Solid Wastes, Physical/Chemical Methods', *SW-846,* 2nd edition, U. S. Environmental Protection Agency, 1982. The concentration of each material in the head space vapor shall be calculated using the following equation:

$$C_A = \frac{Q_A}{MW} \times 29.8 \text{ ml/mmole} \times \frac{1}{2 \times 10^{-6} \text{ M}^3},$$

where C_A (in parts per million) is the concentration of material A in head space vapor, Q_A (in milligrams) is the quantity of material A in sampling syringe and MW (in milligrams per millimole) is the molecular weight of material A. Where an eight-hour LC_{50} is not available, an LC_{50} measured for another time (t) may be converted eight-hour value with the following equation:

$$\text{Eight-hour } LC_{50} = (t/8) \times (\text{t-hour } LC_{50}).$$

(b) A waste containing one or more materials which are toxic according to any criterion of paragraph (a) (1) or (a) (2) of this section may be classified by the Department as nonhazardous pursuant to Section 66305 if the waste is not hazardous by any other criterion of this Article and the calculated toxicities conform to all of the following limits:

(I) The calculated oral LD_{50} of the waste mixture is greater than *5,000* milligrams per kilogram and the calculated dermal LD_{50} is greater than *4,300* milligrams per kilogram by the following equation:

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$$\text{Calculated oral or dermal } LD_{50} = \frac{100}{\sum_{x=1}^{n} \frac{\%Ax}{T_{Ax}}}$$

where %Ax is the weight percent of each component in the waste mixture and T_{Ax} is the acute oral or dermal LD_{50} or the acute oral LD_{LO} of each component.

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

DRAFT

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66699. Persistent and Bioaccumulative Toxic Substance.

(a) Any waste is a hazardous waste which contains a substance listed in subsections (c) or (d) of this section: (1) at a concentration in milligrams per liter as determined pursuant to Section 66700 which exceeds its listed soluble threshold linit concentration, or (2) at a concentration in milligrams per kilogram in the waste which exceeds its listed total threshold limit concentration.

(b) A waste containing a persistent or bioaccumulative toxic substance not listed in subsections (c) or (d) of chis section shall be managed as a hazardous waste unless prior written approval to deviate from this provision is granted pursuant to S t 65310.

(c) List of Inorganic Persistent and Bioaccumulative Toxic Substances and Their Soluble Threshold Limit Concentration (STLC) and Total Threshold Linit Concentratiun (TTLC) Values.

Substance *†	STLC mg/l	TTLC Wet-Weight mg/kg
Antimony and/or antimony compounds	15	500
Arsenic and/or arsenic compounds	5.0	500
Asbestos	-	1.0 (as percent)
Barium and/or barium compounds (excluding barite)	100	10,0009
Beryllium and/or beryllium compounds	0.75	75

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Cadmium and/or cadmium compounds	1.0		100
Chromium (VI) compounds	5		500
Chromium and/or chromium (III) compounds	560		2,500
Cobalt and/or cobalt compounds	80		8,000
Copper and/or copper compounds	25		2,500
Fluoride salts	180	A	18,000
Lead and/or lead compounds	5.0		1,000
Mercury and/or mercury compounds	0.2		20
Molybdenum and/or molybdenum compounds	350		3,500
Nickel and/or nickel compounds	20		2,000
Selenium and/or selenium compounds	1.0		100
Silver and/or silver compounds			500
Thallium and/or thallium compounds	7.0		700
Vanadium and/or vanadium compounds	24		2,400
Zinc and/or zinc compounds	250		5,000

FINAL

* STLC and TTLC values are calculated on the concentrations of the elements, not the compounds.

t In the case of asbestos and elemental metals, applies only if they are in a friable, powdered or finely divided state. Asbestos includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

tt Excluding barium sulfate.

(d) List of Organic Persistent and Bioaccumulative Toxic Substances and Their Soluble Threshold Limit Concentration (STLC) an? Total Threshold Limit Concentration (TTLC) Values.

Substance	STLC mg/l	TTLC Wet-Weight mg/kg
Aldrin	0.14	1.4
Chlordan	0.25	2.5
DDT, DDE, DDD	0.1	1.0
2,4-Dichlorophenoxyacetic acid	10	100
Dieldrin	0.8	8.0
Dioxin (2,3,7,8-TCDD)	0.001	0.01
Endrin	0.02	0.2
Heptachlor	0.47	4.7
Kepone	2.1	21
Lead c p nds, organi	--	13
Lindane	0.4	4.0
Methoxychlor	10	100
Mirex	2.1	21
Pentachlorophenol	1.7	17
Polychlorinated biphenyls (PCBs)	5.0	50
Toxaphene	0.5	5
Trichloroethylene	204	2,040
2,4,5-Trichlorophenoxypropionic acid	1.0	10

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Date JAN 11 1984

66699 - 4

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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Environmental Samples", EPA-600/8-80-038, U. S. Environmental Protection Agency, 1980.

(3) For fluoride: "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, U. S. Environmental Protection Agency, 1979.

(4) For asbestos: Federal Register, Volume 47, Number 103, pages 23376-23389, May 27, 1982.

(c) Samples shall be prepared for analysis for total and extractable content of substances listed in Section 66699 as follows:

(1) Type i: If the waste or other material is a millable solid, the sample shall be passed directly, or shall be milled to pass, through a No. 10 (two millimeter) standard sieve before it is analyzed. If the sample contains non-friable solid particles which do not pass directly through a No. 10 sieve and which are extraneous and irrelevant as hazardous constituents to the aste or other material, they shall be removed to the extent feasible by mechanical means and discarded. These extraneous particles shall include rocks and pebbles, wood and plant debris, and manufactured ceramic, glass, metal, plastic, resin and rubber items and fragments. Solids which remain in the waste or other material after removal of the aforesaid extraneous particles shall be milled to pass through a No. 10 sieve and shall then be combined and mixed well with the solids which passed through the sieve without milling. The reconstituted sample shall then be analyzed as prescribed in this section.

(2) Type ii: If the waste or other material is a filterable mixture of liquid and solids in which the solids constitute five-tenths (0.5) percent by weight or greater of the sample, the liquid and solids shall be separated by filtration through a 0.45 micron membrane filter. The filtrate so obtained is to be designated as Initial Filtrate. Its volume is determined, and it is retained. The separated solids shall be sieved in a No. 10 sieve and any nonfriable extraneous particles of the kinds described and exemplified in subsection (c) (1) which do not pass through the sieve shall be removed to the extent feasible by mechanical means and discarded. The solids which remain after removal of the extraneous particles shall be milled to pass through a No. 10 sieve and shall be recombined with solids which passed through the sieve without milling. This recombined solid material shall be extracted following the procedure in subsection (f). A ratio of 10 milliliters of extraction solution per gram of solid shall be utilized with appropriate modifications for extraction vessel size. After completion of solids extraction, the filtered extractant is combined with Initial Filterate, mixed thoroughly and analyzed as described in subsection (f) (3).

(3) Type iii: If the waste or other material is a nonfilterable and nonmillable sludge, slurry, or oily, tarry or resinous material, it shall be analyzed as received unless it contains oon-friable extraneous and irrelevant solid particles of the kinds described and exemplified in paragraph (c) (1) of this section. If it contains such solid particles and they are of such size as not to pass through a No. 10 sieve, they shall be removed to the extent feasible by mechanical means and discarded. The remainder of the sample shall be analyzed as prescribed in this section.

(4) If it is necessary to dry a solid sample or the solids fraction of a sample before sieving, milling or removal of extraneous solids, or if a sample is dried prior to analysis, all weight losses due to drying shall be determined, and these losses and the conditions of drying shall he reported.

(d) If the waste or other material is a liquid containing less than five-tenths (0.5) percent by weight of undissolved solids, it shall not be subject to the WET procedure, but shall be analyzed directly for the substances listed in Section 66699. The waste shall be classified as a hazardous waste if the total concentration in the waste of any substances listed in Section 6669.9 exceeds the TTLC valve given for that substance. If, however, the total concentration is less than the TTLC but exceeds the STLC when expressed on a milligrams per liter basis, the waste or other material shall be filtered through a 0.45 micron membrane filter, the solids discarded and the filtrate shall be analyzed directly for the substances listed in Section 66699. The waste shall be classified as a hazardous waste if the concentration in the filtrate of any of the substances listed in Section 66699 exceeds the STLC valve given for that substance.

(e) The WET extraction solution shall consist of 0.2 M sodium citrate at pH 5.0 ± 0.1, which is prepared by titrating an appropriate amount of analytical grade citric acid in deionized water with 4.0 N NaOH, except that the extraction solution for the determination of chromium (VI) shall consist of deionized water.

vigorously agitated suspension. Examples of acceptable equipment are shown in test method 1310 in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods", SW-846, 2nd edition, U. S. Environmental Protection Agency, 1982. The temperature during the extraction shall be maintained between *20* and *40* degrees centigrade. After 48 hours of extracting, the contents of the Treatment and Blank containers are either filtered directly or centrifuged and then filtered. Filtering shall be through a medium porosity prefilter and then through a 0.45 micron membrane filter, using a clean, thich-walled suction flask. For courser solids. prefiltration shall not be necessary. Pressure filtration shall be an optional alternative to vacuum *filtration*. If the extracts are first centrifuged, glass or polyethylene bottles shall be used as prescribed for extraction. For very fine solids, centrifuging at as high as *10,000 x* G may be necessary. After centrifugation, the liquids are decanted, pre-filtered if necessary, and then passed through a 0.45 micron membrane filter. All filters shall be of low and identified extractable heavy metals, fluoride and organic chemicals content.

(3) If the filtered extracts are to be analyzed only for the metal elements listed in Section 66699 (c), the filtered extracts from the Treatment and Blank shall be transferred to clean polyethylene bottles and acidified with nitric acid to five percent by volume acid content soon after each extract is filtered. For those wastes or waste materials classified under subsection (c) (2), the Treatment shall be the Initial Filtrate combined with the extract generated by the WET extraction of the initially separated

solids. Similarly the Blank in this instance shall be the filtrate generated by the WET Blank accompanying the initially separated solids, to which is subsequently added a volume of deionized water equivalent to that of the Initial Filtrate. These procedures are to be followed prior to acidification of Treatment and Blank solutions with nitric acid to five percent (by volume) acid content.

The bottles are then stored at room tempera* re or frozen. If the extracts are also to be analyzed for the organic substances listed in Section 66699 (d), or for the organic substances only, the filtered extracts shall be transferred to clean glass bottles. If the extracts are to be analyzed for fluoride, they shall be transferred to clean polyethylene bottles. These extracts, containing organic substances or fluoride, shall not be acidified, but shall be frozen soon after each extract is obtained and held frozen until the day of analysis, unless the extracts are analyzed within 24 hours.

(g) Sample analysis and data treatment shall be as follows:

(1) Each of the filtered extracts from the Treatment and Blank extractions shall have been acidified to five percent by volume nitric acid, and stored at room temperature or frozen in polyethylene bottles or kept frozen without addition of acid in glass bottles until the day of analysis, as prescribed. Each of the extracts is thoroughly mixed just prior to being individually analyzed for the substances listed in Section 66699 in order

to determine whether the extractable concentration (EC) in the waste or other material exceeds the STLC for any of the substances listed. Procedures suitable for analysis of the extracts derived from the citrate extractions are given in "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, U. S. Environmental Protection Agency, 1979, and "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", EPA-600/4-82-057, U. S. Environmental Protection Agency, 1982.

(2) The net EC of a subsiance in the Treatment sample which is listed in Section 66699 shall be calculated and reported as milligrams per liter of sample (mg/l). This value is derived after subtracting the concentration of the substance in the appropriate Blank extract from that concentration determrned in the Treatment extract.

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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66702. Ignitability Criteria.

(a) A waste, or a material, is ignitable if it:

(1) Is a liquid, other than an aqueous solution containing less than 24 percent alcohol by volume, and has a flash pornt less than 60 degrees centigrade (140 degrees Fahrenheit), as determined by a Pensky-Martens Closed Cup Tester, using the test method specified in American Society for Testing and Materials (ASTM) Standard D-93-79, or a Setaflash Closed Cup Tester, using the test method specified in ASTM Standard D-3278-78; or

(2) Is not a liquid and is capable, under standard temperature and pressure, of causing fire thrdugh friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard; or

(3) Is an ignitable compressed gas as defined in 49 CFR 173.300 (revised as of October 1, 1982) and as determined by the test methods described in that regulation; or

(4) Is an oxidizer as defined in 49 CFR 173.151 (revised as of October 1, 1982).

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NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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66705. Reactivity Criteria.

(a) A waste, or a material, is reactive if it:

(1) is normally unstable and readily undergoes violent change without detonating; or

(2) Reacts violently with water; or

(3) Forms potentially explosive mixtures with water; or

(4) Generates toxic gases, vapors or fumes, when mixed with water, in a quantity sufficient to present a danger to human health or the environment; or

(5) is a cyanide or sulfide bearing waste which, when exposed to pH conditions between 2 and 12.5, generates toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment; or

(6) is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement; or

(7) is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure; or

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(8) Is a forbidden explosive as defined in 49 CFR 173.51 (revised as of October 1, 1982), or a Class A explosive as defined in 49 CFR 173.53 (revised as of October 1, 1982), or a Class B explosive as defined in 49 CFR 173.88 (revised as of October 1, 1982).

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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66708. Corrosivity Criteria.

(a) A waste, or a material, is corrosive if it:

(1) Is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5, or its mixture with an equivalent weight of water produces a solution having a pH less than or equal to 2 or greater than or equal to 12.5. The pH shall be determined by a pH meter using either test method 9040 specified in "Test Methods for the Evaluation of Solid Waste, *Physical/Chemical Methods*", SW-846, U. S. Environmental Protection Agency, 2nd edition, 1982, or as described in "Methods for Analysis of Water and Wastes", EPA 600/4-79-020, March 1979; or

(2) Is a liquid, or when mixed with an equivalent weight of water produces a liquid, and corrodes steel (SAE 1020) at a rate greater than 6.35 millimeters (0.250 inch) per year at a test temperature of 55 degrees centigrade (130 degrees Fahrenheit) as determined by the test method specified in the National Association of Corrosion Engineers (NACE) Standard TM-01-69 as standardized as test method 1110 in "Test Methods for the Evaluation's: Solid Waste, Physical/Chemical Methods", SW-846, U. S. Environmental Protection Agency, 2nd edition, 1982.

NOTE: Authority cited: Sections 206, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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Date JAN 11 1982

66717. Applicability of Extremely Hazardous Waste Criteria.

Any waste which is extremely hazardous pursuant to any of the criteria of Sections 66720 or 66723 is an extremely hazardous waste and shall be managed in accordance with the provisions of this Chapter.

NOTE: Authority cited: Sections 208, 25141, and 25150, Health and Safety Code.

Reference: Section 25141, Health and Safety Code.

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Date JAN 11 19[illegible]

66720. Extremely Hazardous Criteria.

(a) A waste, or a material, is extremely hazardous if it:

(1) Has an acute oral LD_{50} less than or equal to 50 milligrams per kilogram; or

(2) Has an acute dermal LD_{50} less than or equal to 50 milligrams per kilogram; or

(3) Has an acute inhalation LC_{50} less than or equal to 100 parts per million as a gas or vapor; or

(4) Contains any of the substances listed in Section 66696 (a) (5) at a single or combined concentration equal to or exceeding 0.1 percent by weight; or

(5) Has been shown through experience or testing to pose an extreme hazard to the public health because of its carcinogenicity, high acute or chronic toxicity, bioaccumulative properties, or persistence in the environment; or

(6) Contains a persistent or bioaccumulative toxic substance, whether solubilized, extractable or nonextractable, which has a total wet-weight concentration in milligrams per kilogram equal to or exceeding its total threshold limit concentration (TTLC) as set forth in Section 66723; or

(7) Is water-reactive.

(b) A waste containing one or more materials which are extremely toxic according to any criterion of paragraphs (a) (1) or (a) (2) of this section may be classified by the Department as not extremely hazardous pursuant to Section 66305 if neither the calculated acute oral toxicity nor the calculated acute dermal toxicity of the waste using the equations in Sections 66696 (b) (1) are numerically equal to or less than the toxicity limits prescribed in (a) (1) or (a) (2) of this and the waste is not extremely hazardous by any other criterion of this section.

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code.

Reference: Section 25141, lth and Safety Code.

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66723. Total Threshold Limit Concentration Values of Persistent and Bioaccumulative Toxic Substances in Extremely Hazardous Wastes.

(a) Any waste containing a substance listed in subsection (b) of this section at a concentration equal to or exceeding its listed total threshold limit concentration is an extremely hazardous waste.

(b) List of Persistent and Bioaccumulative Toxic Substances and Their Total Threshold Limit Concentration (TTLC) Values.

Substance	TTLC (Wet-Weight in mg/kg)
~~Aldrin~~	~~140~~
~~Arsenic and/or arsenic compounds~~	~~50,000 (as As)~~
~~Beryllium and/or beryllium compounds~~	~~7,500 (as Be)~~
~~Cadmium and/or cadmium compounds~~	~~10,000 (as Cd)~~
~~Chlordan~~	~~250~~
~~2,4 Dichlorophenoxyacetic acid~~	~~10,000~~
~~Dieldrin~~	~~800~~
~~Dioxin (2,3,7,8 TCDD)~~	~~1~~
~~Endrin~~	~~20~~
~~Heptachlor~~	~~470~~
~~Kepone~~	~~2,100~~
~~Lead compounds, organic~~	~~1,300 (dry weight basis; as Pb)~~
~~Lindane~~	~~400~~

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Mercury and/or mercury compounds	2,000 (as Hg)
Mirex	2,100
Polychlorinated biphenyls (PCBs)	5,000
Selenium and/or selenium compounds*	10,000 (as Se)
Thallium and/or thallium compounds*	70,000 (as Tl)
Toxaphene	500
2,4,5-Trichlorophenoxypropionic acid	1,000

* In the case of elemental-metals, applies only if they are in a friable, powdered or finely divided state.

NOTE: Authority cited: Sections 208, 25141 and 25150, Health and Safety Code;

Reference: Section 25141, Health and Safety Code.

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STATE OF CALIFORNIA

OFFICE MEMO
STD. 100 (REV. 11-75)

file - G.P. Soil Disposal, Ash

DATE: 2/21/85

TO: SW

ROOM NUMBER

FROM: FR

SUBJECT: RE: G.P. Ash

Warden Dennis Patten (964-5267 home) called regarding Ash Problem. He is getting alot of complaints. Please call him After Feb. 27 ~~th~~ and send him G.P. WDR and disposal plans.

He say material washed in creek as result of latest storm 2/14/85 - 2/17/85

OK. I recommend we go for penalties.

SW = Susan Warner

FR = Frank Reichmuth

STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF HEALTH SERVICES

2151 BERKELEY WAY
BERKELEY CA 94704
(415) 540-2043

February 28, 1985

Mr. Gerald Davis
Director of Environmental Health
Mendocino County
890 North Bush Street
Ukiah, CA 95482

Dear Mr. Davis:

Thank you for sending a copy of the laboratory results for the soil sample obtained by Mrs. Givoannoni.

Octa Chlorodioxin is not a potent dioxin and our chemist confirms a reading of .25 nanograms/grams (0.24 parts per billion) is below the background level usually found in ambient soil samples.

Please reassure Mrs. Givoannoni that since no trace of Tetro Chlorodioxin was found in the soil sample submitted by her, there is no danger of environmental contamination in the area where the soil sample was taken.

Sincerely,

Dwight R. Hoenig, Chief
North Coast California Section
Toxic Substances Control Division

DRH:ay

RECEIVED
MAR 04 1985
MEND. CO. HEALTH DEPT

PAPERHILL WOOD-DERIVED BOILER ASH AS A FERTILIZER

I. AVAILABLE NUTRIENTS AND LIMING VALUE

Georgia-Pacific Corporation
Lyons Falls, New York
June 1, 1984 to December 31, 1984

by

Dr. Lewis M. Naylor
James A. Johnson
Department of Agricultural Engineering
Cornell University
Ithaca, NY 14853

March 1985

Preface

This report has been prepared for the Georgia-Pacific Corporation, Lyons Falls, NY, as a basis for the evaluation of agricultural use of wood ash. It is anticipated that portions of this report may also be used by county extension agents and farmers to develop on-farm procedures for integrating use of the wood ash as a fertilizer supplement and alternative liming material into a soil fertility management program.

Acknowledgements

'The authars wish to thank the following individuals for their part in the successful completion of this research: Carol Doran, Andrea Foster. Gordon Johnson, and Eileen Sylvan.

Funding of this research was provided by the Georgia-Pacific Corporation, Lyons Falls. NY. Special thanks are due to Mr. Daniel P. McGough, Mr. Alfred G. Hofmann, Mr. Eric J. Schmidt far their leadership in initiation of the research, and continuing support during the project.

Authors

Dr. L. M. Naylor is a Research Associate and J. A Johnson is a Research Aide in the Department of Agricultural Engineering within the College of Agriculture and Life Science at Cornell University. Ithaca, New York.

Abstract

Paper mill wood-derived boiler ash was mixed with two acid soils at rates equivalent to 0, 2.24, 4.5, 9.0, 17.9 and 35.9 metric ton/ha in a soil incubation study to evaluate changes in extractable nutrients and soil pH. Levels of extractable P, K and Ca were increased linearly with application rate. Soil pH was increased linearly with the logarithm of the application rate. The ash was compared with commercial potash fertilizer and agricultural limestone. The equivalent neutralizing value was about half of that for agricultural limestone.

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LIST OF FIGURES

Summary

Paper mill wood-derived boiler ash was mixed with two soils and incubated for two months at 25°C to assess the fertilizer and lime value of the ash. Commercial potash fertilizer and ground limestone control treatments were included.

Analysis of the soil-ash mixtures for Morgan's solution extractable nutrients and water pH indicated that available phosphorus, potassium and calcium increased linearly with application rate. The average of this available fraction of each element for the two soils was: P = 0.013. K = 0.22 and Ca = 0.46. Only potassium availability varied importantly with soil type. This variation was evident for potassium in both wood ash and commercial potash fertilizer. Wood ash potassium was approximately one-third as available as that in the commercial potash fertilizer.

The wood ash was evaluated as a liming material by calculation of the equivalent neutralizing value (ENV) and estimated experimentally in an incubation study. The ENV of the ash calculated from the sum of the calcium and magnesium content expressed as calcium carbonate was 74. In parallel studies using commercial agricultural limestone as a control, the ENV of the wood ash wasestimated experimentally to be about 50. The reason for this discrepancy is not clear, but was not because of calcium insolubility. Available calcium for the wood ash (46%) was only slightly lower than for commercial limestone (54%). The ash was concluded to be a beneficial soil amendment as an alternative liming material and potash source.

PAPER MILL WOOD-DERIVED BOILER ASH AS A FERTILIZER

I. AVAILABLE NUTRIENTS AND LIMING VALUE

Lewis M. Naylor and James A. Johnson

I. RESEARCH OBJECTIVES

The overall objective of this research was to quantify through laboratory studies the agronomic value of high lime paper mill wood-derived ash as a fertilizer and an alternative liming material.

Specific objectives of this research were to:

1) Examine the characteristics of the wood ash in terms of macronutrient content (N, P, K, Ca, Mg) and trace mineral content.
2) Assess the availability of crop nutrients in the soil where the wood ash is incorporated.
3) Quantify the liming value of the high lime wood ash when incorporated into soil.

II. INTRODUCTION

Pulp and paper industries utilize enormous quantities of timber resources annually for production of paper products. Since a portion of the tree is unusable in production operations, these residuals such as the bark must be managed through other methods. Burning such residues known as hog fuel in wood fired boilers for production of steam and electricity is economical,

environmentally sound and energy conserving. Ash generated from burning the hog fuel is collected. Disposition of the boiler ash along with the fly ash from air pollution control represents the final step in this resource recovery program. This report discusses results and provides recommendations for the use of wood ash in agriculture.

Since the oil crisis in the 1970's, followed by rapidly rising energy costs, Americans have sought lower cost energy sources. However, the pulp and paper industry has used wood waste as fuel on a wide scale since the 1960's and has recognized that wood can be an important economical and readily available source of energy. However. what has not been adequately recognized is that the ash residual from such wood burning can be an important source of crop nutrients and lime for agricultural uses.

Wood ash has been known to be an important source of potash and lime for many years (1,2), although a recent comprehensive reference makes little reference to it (3). In the 1938 Yearbook of Agriculture (2). wood ash was suggested to "rate as a potash material with a comparatfvely high lime content, some phosphoric acid and magnesium, and small amounts of other elements." Unleached hardwood ashes were zuggested to contain upward of 6% potash in the form of carbonate, 2% phosphoric acid and 30% lime.

Thus, with the increasing use of wood as a fuel and the subsequent need to dispose of the ash, it is important to reconsider the use of wood ash for agricultural purposes, and to put such use on a quantitative basis.

Paper mill wood-derived ash contains phosphorus, potassium, calcium, magnesium and trace minerals derived from the burning of the hog fuel. These crop nutrients, present also in commercial fertilizers, are essential to maintenance of soil fertility. One of the interesting possibilities of using the high lime wood ash in agriculture is the potential for developing an

alternative liming material that supplies not only lime, but one which also provides potassium, phosphorus and trace minerals.

Lime is an essential component of a soil fertility program, especially in the northeast where many soils tend to be naturally acidic. For optimum crop production, soil pH must be adjusted to appropriate levels specific to each crop. In general, crops respond better to neutral soils than to acid soils and, hence, liming of acid soils is generally recommended for optimum yields. The lime needs of a crop are as critical as the need for agronomic applications of commercial fertilizer or appropriate cropvarieties. The increased yield potential of new varieties often cannot be achieved if the desirable soilpH is not maintained (4). The critical nature of maintaining proper soil pH and the cost of limestone mean that great care is necessary in recommending appropriate rates of lime amendments.

New York farmers tend not to take advantage of the benefits of maintaining adequate soil pH. One study has shown that 45 percent of nearly 10,000 soil samples analyzed from a 19 county area in New York had a pH less than 6.0 (5) compared with the optimum pH of 6.2 to 7.0. In years past: the government has helped pay for soil liming programs. With the demise of this program, there has tended to be inattention to one of the most basic aspects of plant nutrition--adequate soil pH.

Liming soils to appropriate pH nearly always enhances crop yields. A review of alfalfa and sorghum response to lime for 23 acid soils indicated that yields were increased on 22 of the soils where appropriate liming was practiced (6). Corn grain and soybean yields were increased dramatically by application of one to 13 metric tons/ha of lime to an acid sandy loam (7). In addition, appropriate liming enhances soybean nodulation, growth and hence, yields on soils (8). The principal soil factors affected by soil pH

adjustment and related to enhanced growth in these studies were the detoxification of Al, removing hydrogen ions as an inhibitor of nodulation, and supplying adequate Ca and Mg necessary for optimum plant growth. Thus, appropriate liming of soil can have important economic as well as agronomic benefits.

III. MATERIALS AND METHODS

Wood ash samples used in the research were supplied by the Georgia-Pacific Corporation. Lyons Falls, NY. These samples were collected in May, June and November, 1984, from the boiler ash collection bin. Ash from a home wood stove was collected in May and June. 1984. Only hardwoods (oak, maple and beech) and some newspaper were burned in the home wood stove. The limestones used as controls were purchased locally (Limecrest Pulverized Limestone, Limestone Products Corp., Sparta, NJ, and Modern Rotary Kiln Hydrated Lime, Millard Lime and Stone, Annville, PA), as was the potash (Muriate of Potash, Agway). Samples of each material were collected and chemically analyzed for pH, sodium, potassium, magnesium, calcium, aluminum, manganese, iron, nickel, copper, lead, zinc, cadmium, chromium, phosphorus, ammonia. total kjeldahl nitrogen (TKN), and total solids (9).

Fineness of the wood ash from Georgia-Pacific Corp. was determined by a standard sieve analysis. Sieve sizes used were USS Sieve Nos. 20, 60. 100 and 200, with a sample size of 250 g and a shaking time of 10 minutes.

The experimental lime equivalences of the wood ash and the effects on the available nutrient content of soil were investigated in a soil incubation studies. Mardin silt loam (coarse, loamy, mixed mesic Typic Fragiocrept) and Burdett silt loam (fine, loamy, mixed, mesic Aeric Ochraqualfs) soils were

used in the study. These two soils are representative of the many acid soils in New York that would benefit from liming. Use of the two different soils provided an opportunity to: (1) evaluate and compare chemical behavior of the ash in different soils and (2) to test the hypothesis that while soil chemical composition may vary, reactivity of the ash will he sufficiently uniform to allow generalized ash use guidelines to be written.

The experimental design was two soils by three liming/fertilizer treatments by six application rates by three replications for a total of 108 pots. The entire quantity of soil to *be* used in each experiment was screened (1 mm stainless steel) and homogenized for 30 minutes in a large. mechanical mixer. Wood ash and the commercial limestone materials were mixed with 3.0 kg of each soil in amounts of 0, 3.0. 6.0, 12, 24 and 48 g. These treatment rates were approximately equivalent to 0, 2.24, 4.5, 9.0, 17.9 and 35.9 metric tons/ hectare (0, 1, 2, 4, 8 and 16 tons/acre). The commercial potash fertilizer material was added to 3.0 kg of each soil in amounts of 0, 0.10, 0.20, 0.40, 0.80 and 1.60 g. These treatment rates are approximately equivalent to 0, 34, 68, 135, 270 and 540 kg/ha. Each treatment was mixed in bulk far 30 minutes in a small douhle shell mixer. divided into 3 - 1 kg replicate samples, and each sample placed into a 20 cm plastic pot with drain holes. Pots were incubated at 25°C for 60 days with periodic watering to simulate wet/dry cycles and physical/chemical reactions with the agricultural soils. At the end of the incubation period, soils were sampled and 10 g samples were analyzed individually for water pH, and extractable nutrients using Morgan's solution (10,11).

Data were examined statistically for outliers using the method of Dixon (12) and using analysis of variance procedures. Statistical differences between treatment means were evaluated using Duncan's New Yultiple Range Test (13).

IV. RESULTS AND DISCUSSION

Composition of wood ash, agricultural limestones and potash fertilizer. Wood ash derived from the wood-fired boiler ash collection bin contained the macro-nutrients calcium, magnesium, potassium and phosphorus, plus modest amounts of the micronutrients zinc and copper. The major macro-nutrient was calcium (13 to 27%), as noted in Table 1, samples 1, 2 and 3. Ash sample 1 was used in the experiments described in this report. Magnesium was present at about 1%. Phosphorus and potassium concentrations were, respectively, about 1%(20 lbs/ton or 10 kg/metric ton) and 3% (60 lbs/ton or 30 kg/metric ton), respectively, as P_2O_5 and K_2O. Thus, the ash was approximately equivalent to a 0-1-3 fertilizer.

Copper (0.07 kg/ton) and zinc (0.3 kg/ton) present in the ash applied to soil would help alleviate soil deficiencies in these trace minerals where they exist. In New York severe zinc deficiency is not common, but many soils require zinc additions on a periodic basis to assure appropriate plant available zinc levels in the soil to maintain crop quality and yield.

The three ash samples were fairly uniform in composition. Calcium was the exception. The sample analyzed in Hay 1984 contained nearly double the calcium concentration (27% vs 13 and 14%) of the other two samples. The reason for this is unclear. It may have been due to the type of wood burned in the boilers, but was not the result of a lower content of elements such as silicon that were not included in the analysis since similar increases were not observed in concentrations of the other elements except manganese. Manganese concentration in the Hay samples was 1.6 times greater than that analyzed in November 1984. Thus, if the ash is to be used as an alternative liming material, a quality assurance program would be desirable to establish existing concentrations of calcium and, hence, appropriate application rates.

Compared with commercial limestone, the ash samples 2 and 3 contain about 50% as much calcium and 20% as much magnesium, but in contrast, 10 times as much phosphorus, 20 times as much potassium, 7 times as much copper, 2.5 times as much zinc and a pH of over 12. Thus, the wood ash can serve as a liming material, but also provide modest amount of potassium and phosphorus, as well as trace amounts of micronutrients.

Wood ash from a home wood stove (Table 1, samples 4 and 5) was nearly as rich in calcium as commercial limestone and contained about four times as much potassium as the boiler-ash. The higher proportion of potassium may be associated with the lower burning temperatures present in wood stoves, accompanied by lower volatilization losses of the potassium compounds in the ash residual. Potassium compounds volatilize at about 1300°C. This temperature is somewhat higher than the operating temperature of most home wood stoves, but less than the 2000°C operating temperature for the boilers. Wood stove ash samples analyzed in this study would be approximately equivalent to a 0-3-14 fertilizer.

The potash fertilizer (muriate of potash, i.e., KCl) had a potassium concentration of 45.1%. This is equivalent to 54.1% as K_2O. Based on results of this analysis, this sample of the 0-0-60 fertilizer would appear to be outside the expected potassium concentration tolerance limits (14). The pH of the sample, 9.2, would suggest that a portion of the potassium was in the form of an oxide.

Fineness of the ash from the wood fired boilers was determined by sieve analysis (Table 2). Samples collected 6-29-84, 10-15-84 and 11-14-84 were analyzed. From 54 to 73% of the ash passed the 100 mesh sieve, indicating that not only would this fraction be highly effective as a neutralizing material due to the high pH, but would also react rapidly with soil acidity due to its fineness.

The material collected on the 20 and 60 mesh sieves was virtually all unburned carbon. This fraction consisted of about 25% of the total sample by weight and about 80% by volume.

Analysis of the ash by sieve size (Table 2) suggested that screening out the charcoal would enhance the analysis of the material as a fertilizer and as an alternative liming material. Calcium content of the material finer than 60 mesh was 17.7% relative to 1 to 3% for the coarser material. Lesser, but nonetheless interesting, enhancement was also evident for phosphorus, magnesium and potassium.

Although the economic value of the potassium and phosphorus may be as much as $16 per 2000 lb/ton, their concentration is lower than most commercial fertilizers. Thus, a potential user would need to spread the wood ash at 10 to 20 ton/ha (4.5 to 9 ton/acre) to obtain an appreciable increase in potassium. Since the ash is principally a liming material, such applications would occur only once in 2 to 5 years. Therefore, using the ash as a regular source of potassium or phosphorus would be impractical. However, in the year the ash is applied, users would obtain benefit from the potassium addition.

Availability of crop nutrients - Ash from the wood fired boilers (Sample 1) was mixed with Mardin silt loam and Rurdett silt loam at six rates equivalent to 0 to 35.9 metric tons/hectare. Maximum elemental additions for the two soils, Mardin and Burdett, were 283 kg/ha P, 1100 kg/ha K, 9680 kg/ha Ca and 556 kg/ha Mg.

Following two months incubation of the soils mixed with the six ash treatments and the lime and potash control treatments, the available nutrient content provided by these materials was estimated by extraction using Morgan's solution. The Morgan's solution extraction estimates the amount of soluble nutrient that is considered to be available for plant uptake in New York soils

(10.11) Results of the analyses of the extracting solution are given in Table 4.

Plots of the available potassium and phosphorus against the amount of the nutrient added to the soil (Figure 1) indicated that nutrients are available in varying proportions depending on soil type. Regression analysis was used to establish an estimate of the availability of each nutrient. Results are provided in Table 5 and shown in Figure 1.

Availability of potassium and phosphorus, as estimated by soil extraction using Morgan's solution, was a linear function of the amount of that nutrient added to the soil. The slope of the regression line suggests that about 18 to 35% of the added potassium was available. This contrasts with the estimated availability of the potassium in the commercial potash fertilizer, about 63 to 76%. The high temperatures achieved in the wood fired boilers were hypothesized to be associated with the lower potassium availability, possibly due to formation of insoluble fused potassium compounds with insoluble elements such as silicon. Thus, an experiment was conducted to test available potassium from wood ash from the home wood stove.

Wood ash (Sample 5, Table 1) was mixed with Mardin soil following the procedure described earlier for the wood fired boiler ash. Potassium added varied from the equivalent of 291 kg/ha to 2330 kg/ha. Available potassium varied from 302 kg/ha at the lowest rate to 1340 kg/ha at the highest note. Regression analysis of the data indicated that about 51% of the potassium was available (as extracted with Morgan's solution), as noted in Table 5. While an increase in available potassium is evident, this value is substantially lower than the 76% found with the commercial potash fertilizer. Thus, no firm conclusions may be drawn, but it does appear that availability may be to some extent associated with temperature.

Where the wood ash (Sample 1) is used as a liming material at 20 tonlha to improve soil pH, available potassium (25% available) would be increased by about 150 kg/ha. Based on results using, as a potassium control, commercial potash fertilizer for which about 70% of the applied K is available, this 150 kg/ha increase could be supplied by 215 kg/ha of fertilizer K. The 215 kg/ha K would be equivalent to about 355 kg/ha of commercial potash fertilizer containing 60% K_2O. Thus, the wood ash used as an alternative liming material will also provide as a secondary benefit important amounts of potassium.

Available phosphorus was about 1% of the amount added. Although this availability is small, it should be noted for perspective that 5 to 6 kg/ha of available phosphorus in the soil is considered adequate. As noted later a typical wood ash application rate to acid soil may be 20 tonlha. Such an application would add about 160 kg/ha of phosphorus. Thus, the wood ash can supply small amounts of phosphorus.

Effect on soil pH - The high lime wood ash (Sample 1) contained 270 kg calcium per metric ton. and had a pH of about 12.5. These characteristics suggest good potential of the material as an alternative liming material. An important and challenging part of this .research was to evaluate this liming potential compared with commercially available ground limestone.

Liming materials are compared using their equivalent neutralizing value (ENV). The ENV means the percent effectiveness of a particular limestone relative to a standard limestone with an ENV of 100. The ENV of a liming material is a function of (1) the total neutralizing value (TNV) and (2) the fineness of the limestone particles. The TNV is estimated from the sum of the calcium and magnesium contents expressed as calcium carbonate.

For the ground limestone sample used in this research (Table 1), the TNV would be, on a dry basis:

Ca: $31.4\% \times \frac{2.50\ CaCO_3\ \text{equivalents}^*}{\text{Ca equivalent}} = 78.5$

Mg: $5.09\% \times \frac{4.12\ CaCO_3\ \text{equivalent}}{\text{Mg equivalent}} = 21.0$

TNV = 78.5 + 21.0 = 99.5 as $CaCO_3$, dry basis

The fineness of the liming material is the second component of ENV. The finer the lime particles, the more rapidly the lime can react with soil acidity. Measurement of the fineness of the limestone particles is straightforward for most standard commercial liming materials. To determine the fineness, the lime is sieved using 20 and 100 mesh screens. The fineness score was calculated (4) for the ground limestone as shown below based on the sieve analysis provided by the manufacturer.

1. Passing 100 mesh 0.60

2. Passing 20 mesh 0.99
   Passing 100 mesh - 0.60
   20 to 100 mesh 0.39

   reaction value = 0.39 x 0.6† = 0.23

3. Fineness score = 0.83

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*Note: $\frac{\text{Equivalent wt } CaCO_3}{\text{Equivalent wt Ca}} = \frac{50}{20} = 2.50$

$\frac{\text{Equivalent wt Ca}}{\text{Equivalent wt Mg}} \times 2.50 = \frac{20.0}{12.15} \times 2.50 = 4.115 = 4.12$

†The 0.6 portion of the material in the 20 to 100 mesh range is multiplied by the standard for all materials to give the reaction value.

To obtain the ENV, the TNV is multiplied by the fineness score. The calculated ENV for the limestone would be:

ENV = TNV x fineness score

= 99.5 x 0.83 ≈ 82.6 = 83

Thus, the ENV of the ground limestone material used in this study as a control was calculated to be 83. The ENV guaranteed on the manufacturer's bag was 72.

The ENV of the sample of wood ash used in this research was calculated using a similar method. The TNV was estimated for samples 1 and 2 (Table 1), as an example.

Sample 1

Ca: 27.0% x 2.50 = 67.5

Mg: 1.55% x 4.12 = 6.4

TNV 73.9 or about 74 as $CaCO_3$

Sample 2

Ca: 14.7 x 2.5 = 36.8

Mg: 0.97 x 4.12 = 4.0

TNV 40.8 or about 41 as $CaCO_3$

However, one simplification may be possible for calculating the ENV of the wood ash because the ash consists largely of oxides of calcium and magnesium, based on the high pH. Lime sources such as calcium oxide or quick lime usually react with the soil rapidly enough for the particle size not to be as critical as for ground limestone or $CaCO_3$ (4). In this case all of the liming material is considered reactive and the fineness score is 1.00. Thus, the calculated ENV of the ash sample 1 would be about 74. However, the

substantial differences in calcium content of the wood ash samples 1, 2 and 3 (Table 1) clearly indicate the need for regular analyses of the ash in order to estahlish the current quality of the product when used as a fertilizer/ liming material.

A second approach for estimating ENV of the wood ash samples was based nn results of the soil incubation study. Using this experimental approach, the actual soil pH neutralization achieved with the wood ash was contrasted with ground limestone used as a control in parallel treatments. The results of this portion of the study are shown in Table 6, with the resulting regression equations for the plots (Figures 2 and 3) given in Table 7. It should be observed that the soil pH achieved is a linear function of the logarithm of the application rate. This relationship follows from the definition of pH: the negative logarithm of the hydrogen ion concentration. For comparison, a plot of results from parallel treatment using ground limestone and hydrated lime is provided in Figure 2, with the resulting regression equations given in Table 7.

The background pH of the soils used in this study, typically acid Mardin and Burdett silt loams, were 5.7 and 4.8, respectively. Forcomparison, the desirable agronomic pH for the following crops is (4):

Crops	pH
Clover, corn, grasses and oats	6.2
Barley, hirdsfoot, trefoil, and wheat	6.5
Alfalfa and soybeans	7.0

To achieve a pH of 6.2 for the Burdett soil using the liming materials, as shown in Figure 3, would require 9.7 ton/ha of limestone (ENV 83), and 17 ton/ha of the wood ash sample 1. Thus, a wood ash application of 17 ton/ha provided the equivalent soil pH neutralization as 9.7 ton/ha of the ground limestone (ENV 83). Using this comparison, the ENV may he estimated:

ENV (residuals) =

$$\text{ENV (control lime)} \times \frac{\text{control lime application to achieve pH 6.2}}{\text{wood ash application to achieve pH 6.2}}$$

For the ground limestone (ENV = 83) used as a control in this comparison, the wood ash was estimated to have an ENV of:

$$\text{ENV (wood ash. sample 2)} = 83 \times \frac{9.7}{17} = 47.$$

To achieve a pH of 6.5 on the same soil would be expected to require 14 ton/ha of the ground limestone or about 25 ton/ha of the wood ash resulting in an experimental ENV of about' 47 (Table 8).

Similar ENV results were obtained using the Rurdett soil in the experiment. As noted in Table 8, the experimental ENV was estimated at 52 to 55 for achieving soil pH of 6.2 and 6.5, respectively. In general, annual limestone applications should not exceed about 10 ton/ha. Where greater pH adjustment is desired, multiple applications over 2 or more years are recommended. Thus, estimating ENV from amounts of limestone and wood ash to achieve pH 7 may not be appropriate.

The reason for this large difference between the calculated and the experimental ENV was not clear. It was hypothesized initially that the calcium compounds in the ash might be less soluble due to the high boiler temperatures. However, results of studies of calcium availability (Table 5) of the wood ash (46%) contrasted with agricultural limestone (54%) indicated that differences were mall. Thus it is not clear at this time why such a large variation existed between the calculated and the experimental ENV.

These results, as now interpreted, do indicate that the calculated ENV 74 of the wood ash sample 1 may be optimistic. The experimental ENV of about 50

is about 68% of the calculated ENV for the two soils tested. Users should take this lower value into consideration when estimating application rates.

Application rate of the wood ash can be calculated in order to permit a user to achieve a desired soil pH. For example, lime recommendatioris are based on use of a limestone with an ENV of 100. If the recommended limestone rate is 2 tons per acre (current recommendations are given in tons/acre, rather than in metric tons/hectare), the application rate for an ENV 50 liming material would be calculated:

$$2 \frac{\text{tons}}{\text{acre}} \text{ for ENV 100 limestone} \times \frac{100}{\text{ENV 50 wood ash}} = 4 \frac{\text{tons}}{\text{acre}} \text{ or } 9 \frac{\text{metric tons}}{\text{ha}}$$

V. CONCLUSIONS

Paper mill wood-derived boiler ash was mixed with two soils in a two-month incubation study at 25°C to assess fertilizer and lime value of the ash. Commercial potash fertilizer and ground limestone control treatments were included.

Results of the study indicated that available calcium, phosphorus and potassium increased linearly with the ash application rate. The ash did not supply appreciable amounts of phosphorus, but was a good source of potassium and calcium. Soil pH was a function of the logarithm of the ash application rate. An experimental ENV of 50 was estimated for the ash sample tested in this study. The experimental ENV was about two-thirds of that calculated from the calcium and magnesium content of this ash. It was also concluded that the agricultural value of the ash could be enhanced by screening out unburned carbon.

Therefore, results of, this research suggest that the paper mill wood derived boiler ash can supply agronomically important amounts of plant nutrients. and can also serve as an alternative liming material.

VI. REFERENCES

1. Agee, A 1919. Right use of lime in soil improvement. Orange Judd Co., New York.

2. United States Oepartment of Agriculture. 1938. Soils and Men. Yearbook of Agriculture 1938. United States Government Printing Office. pp. 518-9.

3. Barber, SA 1967. Liming materials and practice, p. 125-160. In: RW. Pearson and F. Adams (ed.) Soil acidity and liming. Am. Soc. of Agron.. Madison, WI.

4. Cornell Field Crops Handbook. 1978. New York State College of Agriculture and Life Sciences. Cornell University. Ithaca, NY.

5. Lathwell, D.J. and TW. Scott. 1966. A study of soil fertility on New York farms. Cornell Extension Bulletin 1063. New York State College of Agriculture and Life Sciences. Cornell University, Ithaca. NY.

6. Sumner. ME 1979. Response of alfalfa and sorghum to lime and P on highly weathered soils. Agron. J. 71:763-766.

7. Bertsch, PM and MM Alley. 1981. Conventional and suspension limestone influence on soil chemical properties and on corn and soybean yields. Agron. J. 73:1075-1078.

8. Mengel, DB and EJ. Kamprath. 1978. Effects of soil pH and liming on growth and nodulation of soybeans in Histosols. Agron. J. 70:959-962.

9. Doty, WR, MC. Amacher and DE Baker. 1982. Manual of Methods. Soil and Environmental Chemistry Laboratory. Oepartment of Agronomy Information Report 121. Institute for Research on Land and Water Resources. The Pennsylvania State University. University Park. PA.

10. Greweling, T. and M. Peech. 1965. Chemical soil tests. Department of Agronomy Bulletin 960. Cornell University. Ithaca, NY.

11. Lathwell, OJ. and M. Peech. 1964. Interpretation of chemical soil tests. Department of Agronomy Bulletin 995. Cornell University, Ithaca, NY.

12. Snedecor, G.W. and W.G. Cochran. 1980. Statistical Methods, p. 280. The Iowa State University Press. Ames, IA.

13. Steel, RGD. and J.H. Torrie. 1960. Principles and Procedures of Statistics with Special Reference to the Riological Sciences. pp. 107-109. McGraw-Hill Book Co.. Inc.. New York.

14. New York State Department of Agriculture and Markets. 1975. Sale and Analysis of Commercial Fertilizer. Article 10. Sections 143-146e, 153.1-153.7. Circular 910. Division of Plant Industry. Albany, NY.

15. Anderson, L.L. and DA Tillman (Eds.). 1977. Fuels from Waste. Academic Press, NY. p. 84.

Table 1. Chemical composition of wood ash, commercial agricultural limes and commercial potash.

Parameter	Wood ash composition[1]					Ground Limestone	Hydrated Lime	Commercial Potash Fertilizer
	1	2	3	4	5			
	5-12-84	6-29-84	11-14-84	5-84	6-84	$CaCO_3$	CaO	KCl
	%							
Total - N	0.05	0.06	0.09	0.02	0.02	0.01	0.02	0.02
Organic - N	0.05	0.06	0.09	0.02	0.02	0.01	0.02	0.02
NH_4 - N	0	0	0	0	0	0	0	0.01
P	0.79	0.55	0.44	1.10	1.25	0.06	0.05	0.05
K	3.08	2.37	2.79	10.77	13.0	0.13	0.14	45.08
Ca	27.00	14.67	13.21	32.07	28.06	31.4	55.38	0.04
Mg	1.55	0.97	0.85	2.47	2.10	5.09	0.80	0.13
Na	0.27	0.23	0.27	0.54	0.37	0.07	0.05	1.41
Al	1.59	1.15	1.31	1.50	1.10	0.21	0.26	0.00
Fe	1.11	1.29	1.56	0.40	0.39	0.29	0.11	0.01
	mg/kg							
Cd	7.9	6.0	6.3	2.2	2.5	0.7	0.2	0.2
Cr	21.1	16.7	12.5	18.0	13.5	6.0	10.0	2.0
Cu	90.3	61.7	78.7	180	146	10	12.0	2.0
Mn	12700	6920	7770	7820	7380	453	41.1	5.0
Ni	49.1	43.0	30.6	56.6	58.2	20.0	34.0	10.0
Pb	72.2	51.1	53.1	67.1	44.2	55	45.1	21.0
Zn	381	232	316	1250	507	113	4.0	2.0
pH	12.7	12.4	12.3	12.1	12.7	9.9	12.5	9.2
Total Solids, %	99.71	98.92	99.77	99.79	99.65	100	99.87	99.83

[1]Means of duplicate analyses.
[2]Wood ash samples 1, 2 and 3 were collected from the boiler ash collection bin, Georgia Pacific Corporation, Lyons Falls, NJ. Ash samples 4 and 5 were collected from a home wood stove. Ash sample 1 was used in experiments presented in this report.

Table 2. Physical and chemical analysis of wood ash by USS sieve size.

	Sample collection date[1]			
	6-29-84	10-15-84	11-14-84	Mean
USS Sieve	% passing[2]			
20[3]	95.0 ± 0.13	75.5 ± 0.14	91.3 ± 0.14	87.3 ± 10.4
60[3]	83.7 ± 0.49	62.1 ± 0	78.3 ± 0.14	74.7 ± 11.2
100	72.7 ± 0.29	54.4 ± 0.07	67.8 ± 0.07	65.0 ± 9.5
200	———	41.2 ± 0.07	48.2 ± 0.42	———

	Ash analysis[4]. %			
	P	Ca	Mg	K
<20	0.06	1.1	0.4	1.1
20-60	0.12	3.2	0.3	1.8
<60	0.64	17.7	1.3	29

[1]Supplied by Georgia Pacific Corporation, Lyons Falls, NY.

[2]Mean ± std. dev. of duplicate samples. Sample size was 250 g.

[3]Material retained on screen was charcoal.

[4]Ash analysis (sample- collected 10-15-84) by Analytical Laboratories, New York State Agricultural Experiment Station, Geneva. NY.

Table 3a. Composition and equivalent application rates of constituents of wood ash sample 1.

		Ash addition, ton/hectare[1]				
		0	2.24	4.5	9.0	17.9	35.9
Parameter	Composition[2] kg/ton	Constituent addition, kg/ha					
Total-N	0.5	-	1.12	2-24	4.48	8.96	17.9
Organic-N	0.5	-	1.12	2.24	4.48	8.96	17.9
NH_4-N	0	-	0	0	0	0	0
P	7.9	-	17.7	35.4	70.8	142	283
K	30.8	-	69.0	138	276	552	1100
Ca	270	-	605	1210	2420	4840	9680
Mg	15.5	-	35	69	139	278	556
Na	2.7	-	6.0	12.1	24.2	48.4	96.8
Al	15.9	-	35.6	71.2	142	285	570
Fe	11.1	-	24.9	49.7	99.4	199	398
Mn	12.7	-	28.4	56.9	114	228	455
Cu	0.09	-	0.20	0.40	0.81	1.62	3.24
Zn	0.38	-	0.85	1.71	3.41	6.83	13.7

[1]Added to 3.0 kg of soil in amounts of 0. 3.0, 6.0, 12, 24 and 48 g.

[2]See also Sample 1, Table 1.

Table 3b. Composition and equivalent application rate of constituents of comnercial potash fertilizer.

		Commercial potash addition, kg/ha[1]					
		0	75	150	300	600	1200
Parameter	Composition[2] kg/ton	Elemental addition, kg/ha					
P	0.5	-	0.04	0.08	0.15	0.30	0.60
K	45	-	34	68	135	270	540
Ca	0.4	-	0.03	0.06	0.12	0.24	0.48
Mg	1.3	-	0.10	0.20	0.39	0.78	1.56
Na	14	-	1.06	2.12	4.23	8.46	16.9
Al	0	-	-	-	-	-	-
Fe	0.1	-	0.01	0.02	0.03	0.06	0.12
Mn	0.005	-	-	-	-	-	-
Cu	0.002	-	-	-	-	-	-
Zn	0.002	-	-	-	-	-	-

[1]Added to 3.0 kg of soil in amounts of 0.10, 0.20, 0.40, 0.80 and 1.60 g.

[2]See also Table 1.

Table 4. Effects of ash from wood-fired boilers on soil chemical properties[1].

	Wood ash incorporation rate, tons/hectare					
	0	2.24	4.5	9.0	17.9	35.9
	Available nutrients,[2] kg/hectare					
Burdett Series						
P	0.6 ± 0 d	1.6 ± 0 d	1.7 ± 0.97 c	2.2 ± 0 b,c	3.0 ± 0.65 b	4.5 ± 0 d
K	100 ± 1.9 f	128 ± 2.4 e	145 ± 1.1 d	165 ± 3.4 c	216 ± 6.0 b	307 ± 5.7 a
Mg	133 ± 5 e	164 ± 16 d	166 ± 6.0 d	191 ± 3.9 c	245 ± 18 b	220 ± 3.4 a
Ca	1520 ± 45 e	1980 ± 120 d	2190 ± 17 d	2720 ± 79 c	4060 ± 247 b	5760 ± 88 a
Fe	50 ± 5.8 a	45 ± 2.6 b	34 ± .64 c	24 ± 0 d	12 ± .65 e	10 ± .65 e
Al	356 ± 27 f	327 ± 7.2 e	273 ± 6.2 d	217 ± 2.6 c	139 ± 3.9 b	94 ± 2.4 a
Mn	16 ± 1.4 d	15 ± 1.1 c	12 ± .65 b	10 ± 0 a	15 ± 1.4 c	28 ± 1.7 e
Zn	2.2 ± 0.5 b	2.8 ± 0.3 a	1.7 ± 0.4 b,c	1.1 ± 0.1 d	1.4 ± 0.2 c,d	2.2 ± .2 a,b
(II) Mardin Series						
P	6.7 ± 0.6 d	7.9 ± 0 c	7.9 ± .6 c	9.0 ± 0 b	10 ± .6 b	11 ± 0 a
K	166 ± 20 e	179 ± 5.2 e	213 ± 3.6 d	268 ± 5.6 c	363 ± 10 b	547 ± 15 a
Mg	162 ± 13 d	173 ± 16 c,d	202 ± 4.7 c	235 ± 25 b	256 ± 7.8 a,b	275 ± 22 a
Ca	1560 ± 149 e	1830 ± 153 d,e	2250 ± 84 d	3010 ± 92 c	4320 ± 174 b	6020 ± 620 a
Fe	102 ± 11 a	83 ± 6.7 b	74 ± 3.9 b	52 ± 1 c	31 ± 2 d	22 ± 2 d
Al	226 ± 17 a	199 ± 10 b	179 ± 5.5 c	140 ± 1.1 d	103 ± 3.4 e	89 ± 11 e
Mn	35 ± 5.7 b,c	27 ± 4.5 c	28 ± 3.9 b,c	26 ± .65 c	38 ± 3.9 b,c	53 ± 11 a
Zn	4.4 ± 1.7 a	2.9 ± 0.66 a	3.3 ± 0.33 a	2.9 ± 0.63 a	2.9 ± 0.29 a	3.5 ± 0.76 a

[1]Soil-ash mixtures incubated at 25°C in pots for 60 days.

[2]Mean ± std. dev. of 3 replicates. Means followed by the same letter are not statistically different, $p<0.05$. Available nutrients were estimated from extraction of the soil using Morgan's solution.

Table 5. Results of regression analysis of available nutrients as a function of the amount of that nutrient added to soil.

Available Nutrient[1]	Material[2]	Soil	Regression Equation[3,4]	Correlation[5], R^2
P	Wood ash-GP	Mardin	$0.014\ R_p + 7.5$	0.89
P	Wood ash-GP	Rurdett	$0.012\ R_p + 1.1$	0.95
K	Wood ash-GP	Mardin	$0.35\ R_k + 165$	0.99
~~K~~	~~Wood ash-GP~~	~~Burdett~~	~~$0.18\ R_k + 113$~~	~~0.99~~
K	Potash	Mardin	$0.76\ R_k + 129$	0.99
K	Potash	Burdett	$0.63\ R_k + 110$	0.99
K	Wood ash-WS	Mardin	$0.51\ R_k + 150$	0.99
Ca	Wood ash-GP	Mardin	$0.47\ R_{Ca} + 1700$	0.98
Ca	Wood ash-GP	Burdett	$0.44\ R_{Ca} + 1680$	0.99
Ca	Limestone	Mardin	$0.49\ R_{Ca} + 3130$	0.99
Ca	Limestone	Burdett	$0.58\ R_{Ca} + 1670$	0.99
Ca	Hydrated Lime	Mardin	$0.64\ R_{Ca} + 3150$	0.99

[1]Available as measured by extraction of soil sample with Morgan's solution, in kg/ha.

[2]Wood ash-GP (Sample 1. Table 1), Wood ash-WS (Sample 5, Table 1) commercial potash fertilizer (KCl), ground limestone and hydrated lime. See Table 1 for analysis.

[3]R_X = Addition rate of X in kg/ha.

[4]The available fraction of the applied nutrient is equal to the slope of the regression line.

[5]For df = 17 (6 treatments x 3 replications) all regressions are significant at $p < 0.01$.

Table 6. Effect of wood ash and two commercial limestones on pH of two soils.

Sample	Soil	Application rate, tons/hectare, dry basis											
		0		2.24		4.5		9.0		17.9		35.9	
		pH_{H_2O}[1]											
Wood ash	Mardin	5.1	f	5.3	e	5.6	d	6.0	c	6.6	b	7.2	a
Ground limestone	Mardin	5.1	f	5.6	e	5.9	d	6.5	c	6.9	b	7.2	a
Wood ash	Burdett	4.8	f	5.0	e	5.2	d	5.5	c	6.1	b	7.0	a
Ground limestone	Burdett	4.8	f	5.1	e	5.5	d	6.1	c	6.7	b	7.3	a
Hydrated lime	Mardin	5.7	e	6.2	d	6.3	d	6.9	c	7.5	b	8.0	a
Ground limestone	Mardin	5.7	f	6.1	e	6.3	d	6.6	c	7.1	b	7.3	a

[1]Values in rows followed by the same letter are not statistically different. $p<0.05$.

Table 7. Results of regression analysis of soil pH as a function of the application rate of wood ash and commercial limestones.

Material	Soil	Regression Equation[1]	Correlation, R^2
Wood ash	Mardin	Soil pH_{H_2O} = 1.59 log R_{WA} + 4.62	0.98
Ground Limestone	Mardin	Soil pH_{H_2O} = 1.40 log R_L + 5.09	0.99
Wood ash	Burdett	Soil pH_{H_2O} = 1.63 log R_{WA} + 4.21	0.92
Ground Limestone	Burdett	Soil pH_{H_2O} + 1.86 log R_L + 4.37	0.99
Hydrated Lime	Mardin	Soil pH_{H_2O} = 1.59 log R_{HL} + 5.46	0.96
Ground Limestone	Mardin	Soil pH_{H_2O} = 1.06 log, R_L + 5.67	0.98

[1] R_{WA}, R_L and R_{HL} are the application rates in ton/ha of wood ash, ground limestone and hydrated lime, respectively.

Table 8. Calculated and experimental equivalent neutralizing value (ENV) of the wood ash.

Method used to estimate ENV	Mardin soil			Burdett soil		
	Rate, ton/ha			Rate, ton/ha		
	Lime	Ash[1]	ENV	Lime	Ash[1]	ENV
1. Calculated	83	74	--	83	74	--
2. Experimental, based on soil pH achieved during incubation period.[2]						
pH 6.2	6.2	9.9	52	9.7	17	47
pH 6.5	10	15	55	14	25	47
pH 7.0	23	31	62	--	--	--

[1]ENV of wood ash sample 1, Table 1.

[2]Two months at 25°C.

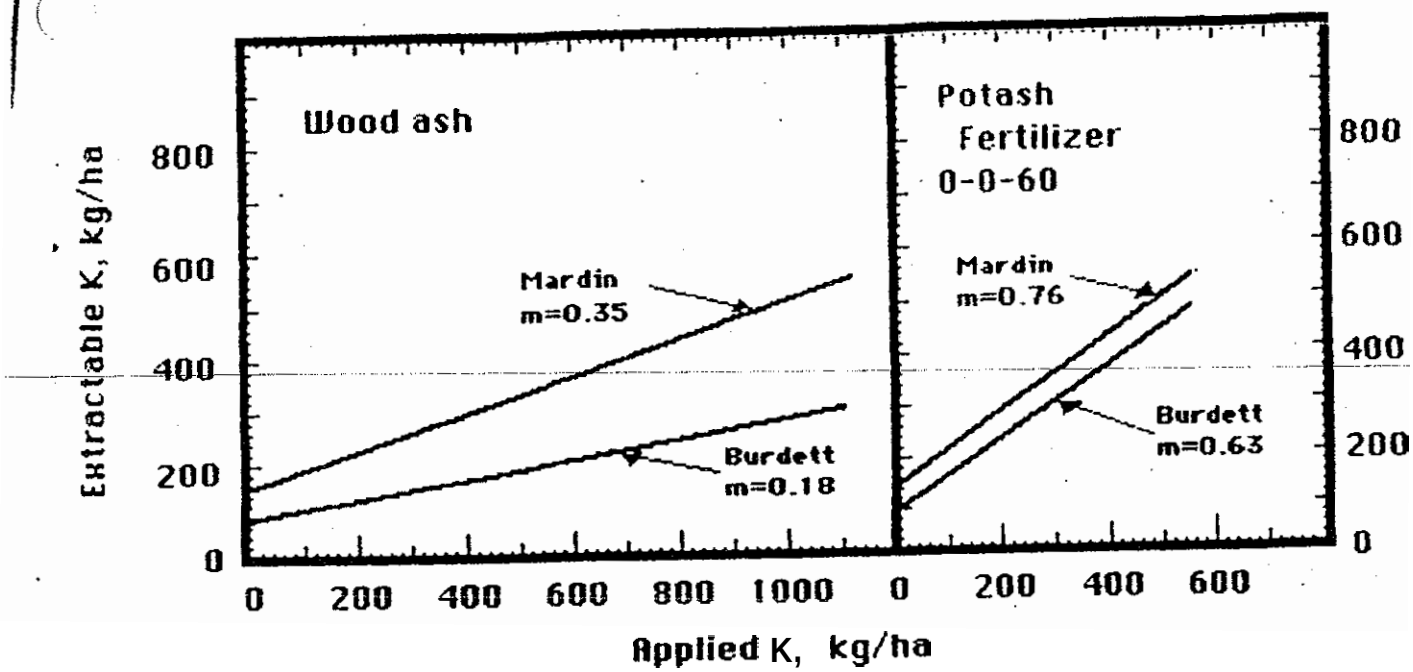


Figure 1. Available potassium in wood ash and commercial potash fertilizer when applied to two soils.

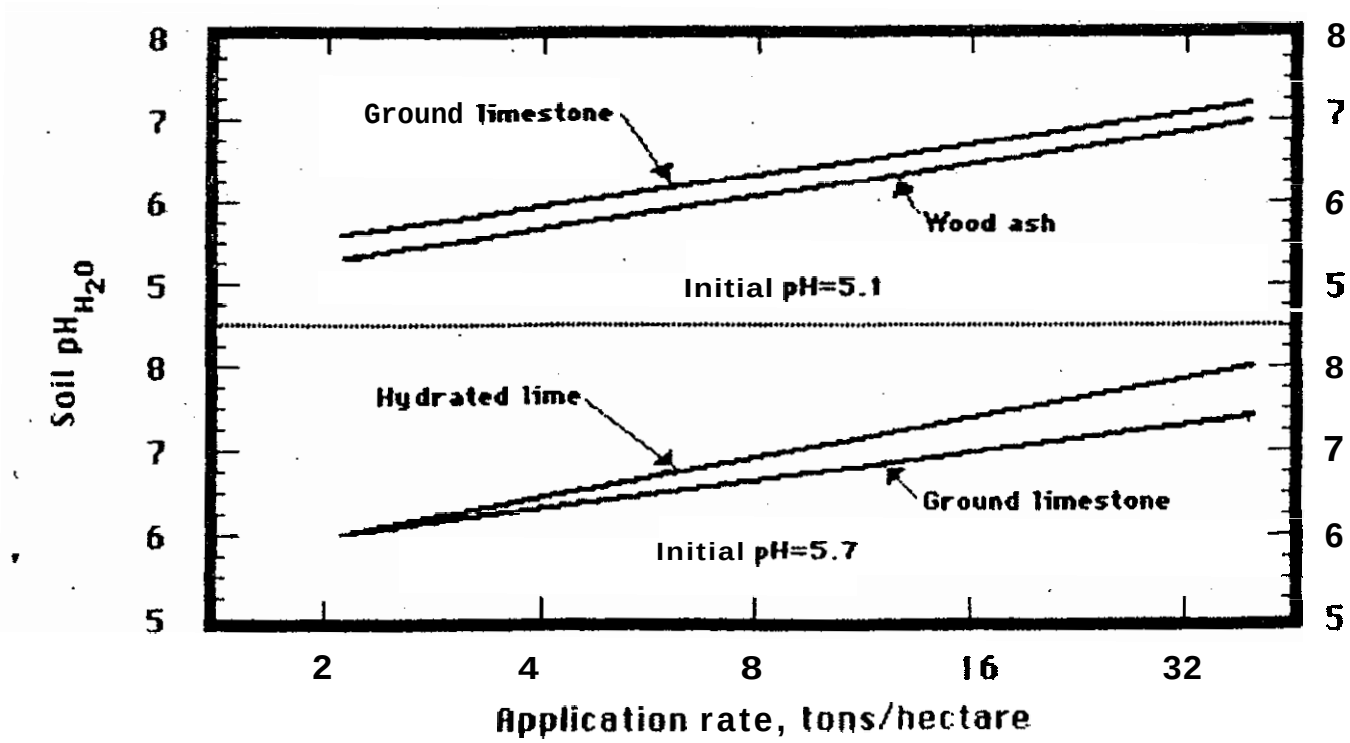


Figure 2. Variation of soil pH with application rate of wood ash and two limestones - Mardin silt loam.

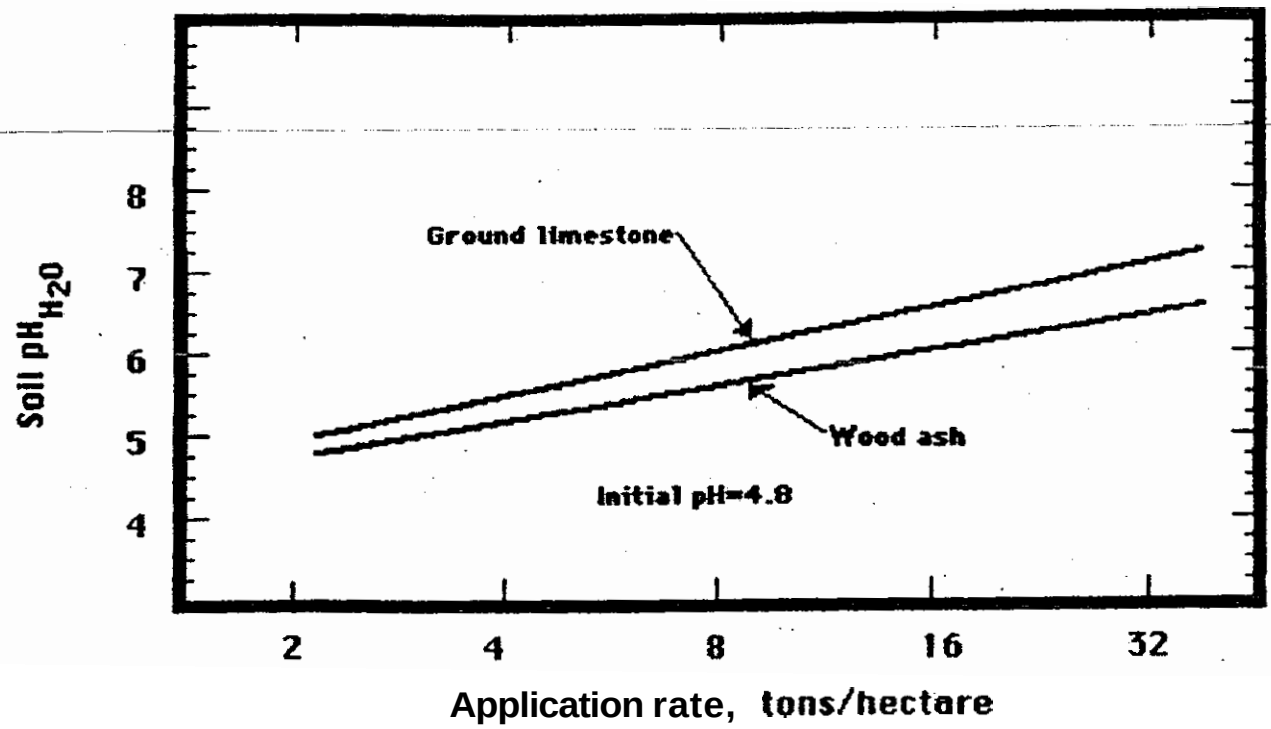


Figure 3. Variation of soil pH with application rate of wood ash and limestone - Burdett silt loam

UKIAH OFFICE
890 NORTH BUSH STREET
UKIAH, CA 95482
(707) 468-4461

FORT BRAGG OFFICE
790-A SOUTH FRANKLIN STREET
FORT BRAGG, CA 95437
(707) 964-4713

Craig M. McMillan, M.D.
Health Agency Director

COUNTY OF MENDOCINO
DEPARTMENT OF PUBLIC HEALTH
COURTHOUSE
UKIAH, CALIFORNIA 95482

Division of Environmental Health
880 No. Bush, Ukiah, Ca., 95482

March 6, 1985

VF → CP?

Mrs. Ellen Giovannoni
31251 Turner Road
Fort Bragg, California 95437

Dear Mrs. Giovannoni:

I have enclosed a copy of a letter dated February 29, 1935, from the Chief of the Toxic Substances Control Division, North Coast California Section. In this letter, he states that the sample results indicate that there is no danaer of environmental contamination in the area sampled.

If you have any questions please feel free to call me. (707-463-4466)

Sincerely,

Gerald F. Davis

Gerald F. Davis, R.S.
Director of Environmental Health

GFD: ew

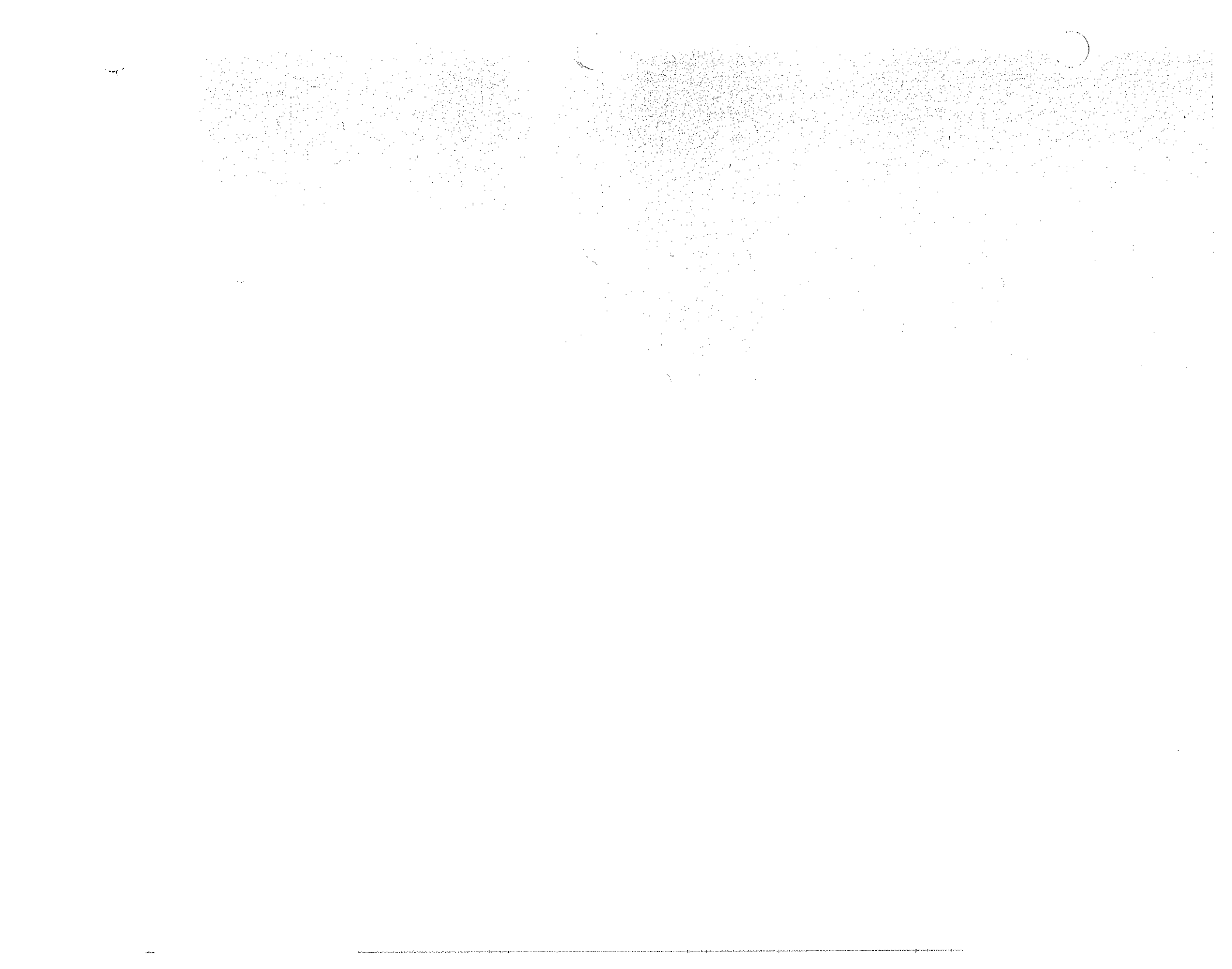
cc: FBHD
APCD
Norman deVall

WATER QUALITY
CONTROL BOARD
REGION I

MAY 16 '86

☐ BK ☐ RC
☐ CI ☐ SW
☐ FR ☐ CMH
☐ MT ☐ ____
☐ JM ☐ ____
☐ BB ☐ ____
☐ JG ☐ REPLY
☐ ALL STAFF ☒ FILE

File: 22.10



RECEIVED APR 17 1985

STATE OF CALIFORNIA GEORGE DEUKMEJIAN, *Governor*

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD—
NORTH COAST REGION**

1000 CODDINGTOWN CENTER
SANTA ROSA, CALIFORNIA 95401
Phone: 707-576-2220

CERTIFIED- Return Receipt Requested

WATER QUALITY CONTROL BOARD
REGION 1

April 16, 1985

Sue O'Leary
Georgia-Pacific Corporation
90 West Redwood Avenue
Fort Bragg, CA 95437

Dear Ms. O'Leary:

Enclosed for your information is a copy of a letter received from the State Department of Health Services (DOHS) concerning designation of fly ash as a hazardous or non-hazardous material. We are unaware of tests conducted on the various ash streams at the Fort Bragg mill to determine whether cyanide levels in all of the ash waste streams are below 1 ppm, and whether heavy metals are present in the ash. Accordingly, please analyze all of the ash waste production streams to determine the levels of cyanide and heavy metals (chromium, copper, arsenic, zinc, lead, mercury. nickel, manganese) present. This information should be provided to this office within 30 days of the receipt of this letter. It is your responsibility to obtain a clarification from the DOHS on the nature of the fly ash produced at the Fort Bragg mill. Until we receive indications from the DOHS that this material is not a waste, then handling of this material must comply with your waste discharge requirements. Stockpiling or disposal of this or other waste materials in an unapproved waste site would be a violation of your permit conditions.

I have enclosed for your information a letter recently sent to Fort Bragg Shavings. Incorporated, concerning their storage of fly ash received from your firm. You should be aware that Georgia-Pacific remains responsible for any inappropriate disposal of wastes generated at the Fort Bragg mill.

Sincerely,

David C. Joseph
Executive Officer

Enclosures

cc: Fort Bragg Shavings. Incorporated
Jerry Davis, Nendocino County Health Department
Ed Bridges, Nendocino County Health Department

RECEIPT FOR CERTIFIED MAIL

NO INSURANCE COVERAGE PROVIDED
NOT FOR INTERNATIONAL MAIL

(See Reverse)

P.O. 1983-403-517

Sent to Sue O'Leary

Street and No. Georgia-Pacific Corp.
90 West Redwood Avenue

P.O., State and ZIP Code
Fort Bragg, CA 95437

PS Form 3811, July 1982

● SENDER: Complete items 1, 2, 3, and 4.
Add your address in the "RETURN TO" space on reverse.

(CONSULT POSTMASTER FOR FEES)

1. The following service is requested (check one).
☒ Show to whom and date delivered ..... ____¢
☐ Show to whom, date, and address of delivery .. ____¢
2. ☐ RESTRICTED DELIVERY ..... ____¢
(The restricted delivery fee is charged in addition to the return receipt fee.)
85 TOTAL $____

3. ARTICLE ADDRESSED TO:
Sue O'Leary
Georgia-Pacific Corporation
90 West Redwood Avenue
Fort Bragg, CA 95437

4. TYPE OF SERVICE: ARTICLE NUMBER
☐ REGISTERED ☐ INSURED
☒ CERTIFIED ☐ COD 542 426
☐ EXPRESS MAIL

(Always obtain signature of addressee or agent)

I have received the article described above.
SIGNATURE ☒ Addressee ☐ Authorized agent
Jack Kelly

5. DATE OF DELIVERY
FORT BRAGG, CA MAR 17 1985

6. ADDRESSEE'S ADDRESS *(Only if requested)*

7. UNABLE TO DELIVER BECAUSE: 7a. ADDRESSEE'S INITIALS

RETURN RECEIPT

★ GPO: 1982-379-593

ATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD—
NORTH COAST REGION
00 CODDINGTOWN CENTER
NTA ROSA, CALIFORNIA 95401
Phone: 707-576-2220

GEORGE DEUKMEJIAN, Governor

CERTIFIED- Return Receipt Requested

April 16. 1985

Don Foxx
Fort Bragg Shavings, Incorporated
P.O. Box 534
Fort Bragg, CA 95437

Dear Mr. Foxx:

This office sent a letter to your firm last December following receipt of, a complaint concerning the storage of. fly ash at one of your sites in Pudding Creek watershed. Your letter in reply, dated January 11, 1985, indicated that the State Department, of Health Services had officially declared this Georgia-Pacific fly ash as non-hazardous. The State Department of Health Services (DOHS) has since advised us that several factors need to be considered prior to designation. of fly ash as non-hazardous. This office has no information that would indicate thst these factors have been evaluated in the case of the fly ash you are receiving from Geqrgia-Pacific. The DOHS letter is enclosed for your information.

We have observed one of your ash. storage sites in the Pudding Creek watershed, and have concerns on the drainage controls around this site. You should be advised: that the discharge of ash, sediment or similar materials to waters of the region 'can threaten beneficial uses, and drainage controls are" necessary to prevent impairment of water quality. Accordingly, please submit your pians to control runoff from this site and any other sites where ash is stored or stockpiled or where this material is used for a soil amendment. Your plans should be submitted within 20 days of the receipt of this letter.

Sincerely,

David C. Joseph
Executive Officer

Enclosure

cc: Jerry Davis, Mendocino County Health Department
Ed Bridges, Mendocino County Health Department

TO

OCJ

ROOM/STA. NO.

FROM

Don Foxx

ROOM/STA. NO.

REPRESENTING

Fort Bragg A—

DATE	TIME	PHONE
5/6	3	707-964-6669

- [x] Telephoned
- [x] Please Call
- [ ] Was In
- [ ] Returned Call
- [ ] Will Call Again
- [ ] Wants To See You

- [ ] Information
- [ ] Comment
- [ ] investigate
- [ ] Contact Me

Note and

- [ ] Re-route
- [ ] Return
- File

Reply

- [ ] My Signature
- [ ] Copy Me
- [ ] Forworded Per Request

MESSAGE/REMARKS

BY K—

STD 7 (REV. 10-79) STATE OF CALIFORNIA

COMBINATION OF STD 7 AND 118 (ROUTE SLIP) ANNUAL SAVINGS $8.300.

MESSAGE

OSP

RLT [illegible] / [illegible] 115-01
CRJ [illegible]
RRR

Don Foxx
Fort Bragg Flavors, Inc.
P.O. Box 534
Fort Bragg, CA 95437

Dear Mr. Foxx

Attached is a copy of our letter of April 16, 1985, to you regarding the storage of fly ash. We have not yet received a reply to this letter. Consequently, we must request you to submit a report of waste discharge pursuant to section 13260 of the Porter-Cologne Water Quality Control Act. Failure to file this report could result in a misdemeanor action, and/or referral to the Attorney General for injunctive relief. The necessary forms, filing fee schedule, etc., are enclosed for your assistance. Please return the completed application, filing fee, and pertinent information concerning your plans to control runoff from areas where ash is stored or stockpiled or where this material is used for a soil amendment. This material must be received by this office by June 10, 1985. Please contact

[redacted] of this office if you have any questions in this matter.

Sincerely,

DCJ

P 724 542 425

RECEIPT FOR CERTIFIED MAIL

NO INSURANCE COVERAGE PROVIDED
NOT FOR INTERNATIONAL MAIL

(See Reverse)

Sent to
Don Foxx

Street and No. Fort Bragg Shavings, Inc., P.O. Box 534

P.O., State and ZIP Code

O. 1983-403-517

PS Form 3811, July 1982

● SENDER: Complete items 1, 2, 3, and 4.
Add your address in the "RETURN TO" space on reverse.

(CONSULT POSTMASTER FOR FEES)

1. The following service is requested (check one).
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☐ Show to whom, date, and address of delivery .. ¢
2. ☐ RESTRICTED DELIVERY ..... ¢
(The restricted delivery fee is charged in addition to the return receipt fee.)

TOTAL $

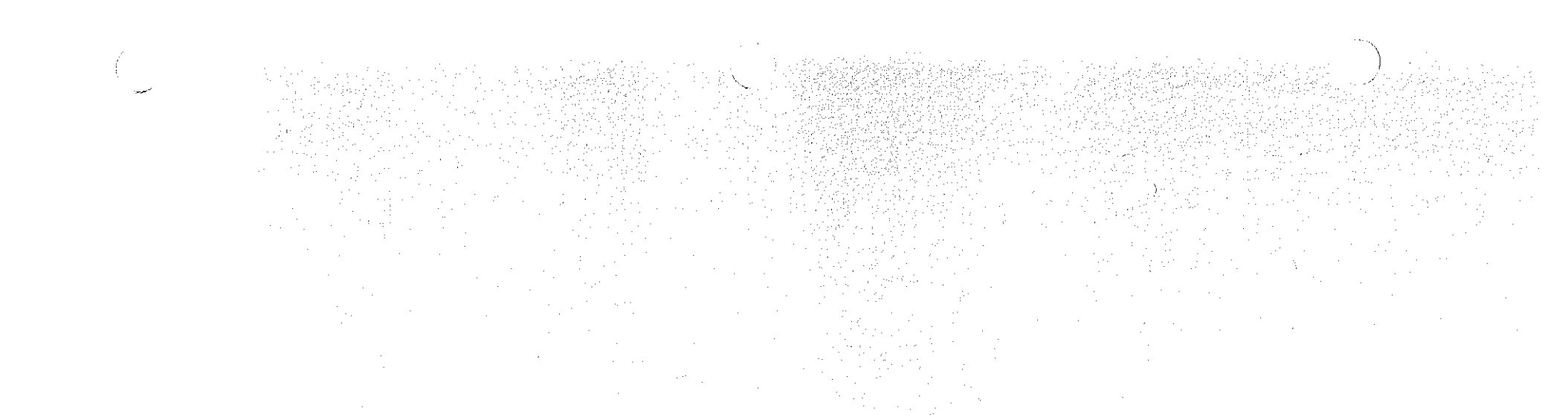
3. ARTICLE ADDRESSED TO:
Don Foxx
Fort Bragg Shavings, Inc.
P.O. Box 534, Fort Bragg, CA 954 7

4. TYPE OF SERVICE:
☐ REGISTERED ☐ INSURED
☒ CERTIFIED ☐ COD
☐ EXPRESS MAIL

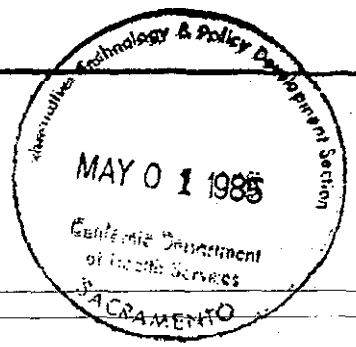
ARTICLE NUMBER
542 425

(Always obtain signature of addressee or agent)

I have received the article described above.
SIGNATURE ☐ Addressee ☐ Authorized agent



Georgia-Pacific Corporation . 90 West Redwood Avenue
Fort Bragg, California 95437
Telephone (707) 964-5651



April 30, 1985

Mr. Bill Quan
Department of Health Services
714/744 P Street
Sacramento, CA 95814

Dear Mr. Quan:

As per our conversation of last week, I am enclosing a copy of an April 23, 1983 letter that states that the "fly ash, bottom ash, and fly gas emission control residue generated by the burning of wood by-products at the Georgia-pacific Fort Bragg mill is classified as non-hazardous". You will note that this letter was also sent to the North Coast Regional Water Quality Control Board (RWQCB) by your department.

I am also enclosing a letter from David Joseph of the RWQCB which raises the following points:

1. The RWQCB does not know if Georgia-Pacific's ash has been declassified based on Dr. Leu's February 4, 1985 letter.

2. Dr. Joseph states that Georgia-Pacific's fly ash is not considered a by-product until your department gives its approval.

In order to respond to the RWQCB concerns in a timely manner, Georgia-Pacific requests, from your department, answers to the following questions:

1. Is Georgia-Pacific's fly ash, bottom ash, and flue gas emission control residue classified as non-hazardous as stated in the April 23, 1983 letter signed by Mr. Wilcoxon?

2. If they are not, Georgia-pacific would like to know why the corporation was not notified by the state as to the change?

3. What are the DOHS requirements to classify a material as a by-product as opposed to a waste?

4. Is it possible to have the ash by-products classified as a non-hazardous by-product in order to satisfy the RWQCB?

It has been Georgia-Pacific's impression that as long as the ash materials generated at the facility were intended for use and not for disposal, the material was a by-product and not a waste. When the company began trading the ash to Albert's Best and then to Fort Bragg Shavings, all ash generated in the state was classified as hazardous waste under Title 22. In order to trade it, the company chose to have it declassified from hazardous to non-hazardous to avoid possible regulatory problems with DHS or RWQCB. To my knowledge, there wasn't a classification at the time entitled "non-hazardous by-product" or we would have requested it. The ash is currently being marketed by Fort Bragg Shavings as a soil amendment for lands that do not produce crops for human consumption.

Georgia-Pacific needs to respond to the questions raised by the RWQCB by May 17, 1985. Therefore, I would appreciate a response to the four questions I've raised by May 15, 1985. If I do not hear from you by May 15, 1985, I will presume that Georgia-Pacific's ash is still classified as non-hazardous and that the company may call the ash a by-product as long as it is not intended for disposal.

If you have any questions regarding this matter, please contact me.

Sincerely,

Sue O'Leary

Sue O'Leary
Forest Hydrologist
Western Wood Prod Mfg
California Wood Products

SO:mm

cc: David Joseph - NCRWQCB
David Leu - DOHS
Jim Coon - Georgia-Pacific
Dow Jacobszoon - Georgia-Pacific
Don Foxx - Fort Bragg Shavings, Inc.

PAPERMILL WOOD-DERIVED BOILER RSH AS A FERTILIZER

I. Rvailable nutrients and liming value

LEWIS M. NIRYLOR
JAMES A. JOHNSON

MAY 1985

Department of Agricultural Engineering
Cornell University
Ithaca New Vork 14853

PAPERMILL WOOD-DERIVED BOILER ASH AS A FERTILIZER

I. AVAILABLE NUTRIENTS AND LIMING VALUE

Georgia-Pacific Corporation
Lyons Falls, New York
June 1. 1984 to December 31. 1984

by

Dr. Lewis M. Naylor
James A. Johnson
Department of Agricultural Engineering
Cornell University
Ithaca, NY 14853

March 1985

Preface

This report has been prepared for the Georgia-Pacific Corporation, Lyons Falls, NY, as a basis for the evaluation of agricultural use of wood ash. It is anticipated that portions of this report may also be used by county extension agents and farmers to develop on-farm procedures for integrating use of the wood ash as a fertilizer supplement and alternative liming material into a soil fertility management program.

Acknowledgements

The authors wish to thank the following individuals for their part in the successful completion of this research: Carol Doran, Andrea Foster, Gordon Johnson, and Eileen Sylvan.

Funding of this research was provided by the Georgia-Pacific Corporation, Lyons Falls, NY. Special thanks are due to Mr. Daniel P. McGough, Mr. Alfred G. Hofmann, Mr. Eric J. Schmidt for their leadership in initiation of the research, and continuing support during the project.

Authors

Dr. L. M. Naylor is a Research Associate and J. A Johnson is a Research Aide in the Department of Agricultural Engineering within the College of Agriculture and Life Science at Cornell University, Ithaca. New York.

Abstract

Paper mill wood-derived boiler ash was mixed with two acid soils at rates equivalent to 0, 2.24, 4.5, 9.0, 17.9 and 35.9 metric ton/ha in a soil incubation study to evaluate changes in extractable nutrients and soil pH. Levels of extractable P, K and Ca were increased linearly with application rate. Soil pH was increased linearly with the logarithm of the application rate. The ash was compared with commercial potash fertilizer and agricultural limestone. The equivalent neutralizing value was about half of that for agricultural limestone.

LIST OF TABLES

LIST OF FIGURES

Summary

Paper mill wood-derived boiler ash was mixed with two soils and incubated for two months at 25°C to assess the fertilizer and lime value of the ash. Commercial potash fertilizer and ground limestone control treatments were included.

Analysis of the soil-ash mixtures for Morgan's solution extractable nutrients and water pH indicated that available phosphorus, potassium and calcium increased linearly with application rate. The average of this available fraction of each element for the two soils was: P = 0.013. K = 0.22 and Ca = 0.46. Only potassium availability varied importantly with soil type. This variation was evident for potassium in both wood ash and conercial potash fertilizer. Wood ash potassium was approximately one-third as available as that in the conercial potash fertilizer.

The wood ash was evaluated as a liming material by calculation of the equivalent neutralizing value (ENV) and estimated experimentally in an incubation study. The ENV of the ash calculated from the sum of the calcium and magnesium content expressed as calcium carbonate was 74. In parallel studies using commercial agricultural limestone as a control, the ENV of the wood ash was estimated experimentally to be about 50. The reason for this discrepancy is not clear, but was not because of calcium insolubility. Available calcium for the wood ash (46%) was only slightly lower than for commercial limestone (54%). The ash was concluded to be a beneficial soil amendment as an alternative liming material and potash source.

PAPER MILL WOOD-DERIVED BOILER ASH AS A FERTILIZER

I. AVAILABLE NUTRIENTS AND LIMING VALUE

Lewis M. Naylor and James A Johnson

I. RESEARCH OBJECTIVES

The overall objective of this research was to quantify through laboratory studies the agronomic value of high lime paper mill wood-derived ash as a fertilizer and an alternative liming material.

Specific objectives of this research were to:

1) Examine the characteristics of the wood ash in terms of macronutrient content (N, P. K, Ca. Mg) and trace mineral content.
2) Assess the availability of crop nutrients in the soil where the wood ash is incorporated.
3) Quantify the liming value of the high lime wood ash when incorporated into soil.

II. INTRODUCTION

Pulp and paper industries utilize enormous quantities of timber resources annually for production of paper products. Since a portion of the tree is unusable in production operations, these residuals such as the bark must be managed through other methods. Burning such residues known as hog fuel in wood fired boilers for production of steam and electricity is economical,

environmentally sound and energy conserving. Ash generated from burning the hog fuel is collected. Disposition of the boiler ash along with the fly ash from air pollution control represents the final step in this resource recovery program. This report discusses results and provides recommendations for the use of wood ash in agriculture.

Since the oil crisis in the 1970's, followed by rapidly rising energy costs, Americans have sought lower cost energy sources. However, the pulp and paper industry has used wood waste as fuel on a wide scale since the 1960's and has recognized that wood can be an important economical and readily available source of energy. However, what has not been adequately recognized is that the ash residual from such wood burning can be an important source of crop nutrients and lime for agricultural uses.

Wood ash has been known to be an important source of potash and lime for many years (1,2), although a recent comprehensive reference makes little reference to it (3). In the 1938 Yearbook of Agriculture (2), wood ash was suggested to "rate as a potash material with a comparatively high lime content, some phosphoric acid and magnesium, and small amounts of other elements." Unleached hardwood ashes were suggested to contain upward of 6% potash in the form of carbonate, 2% phosphoric acid and 30% lime.

Thus, with the increasing use of wood as a fuel and the subsequent need to dispose of the ash, it is important to reconsider the use of wood ash for agricultural purposes, and to put such use on a quantitative basis.

Paper mill wood-derived ash contains phosphorus, potassium, calcium, magnesium and trace minerals derived from the burning of the hog fuel. These crop nutrients, present also in commercial fertilizers, are essential to maintenance of soil fertility. One of the interesting possibilities of using the high lime wood ash in agriculture is the potential for developing an

alternative liming material that supplies not only lime, but one which also provides potassium, phosphorus and trace minerals.

Lime is an essential component of a soil fertility program, especially in the northeast where many soils tend to be naturally acidic. For optimum crop production, soil pH must be adjusted to appropriate levels specific to each crop. In general, crops respond better to neutral soils than to acid soils and, hence, liming of acid soils is generally recommended for optimum yields. The lime needs of a crop are as critical as the need for agronomic applications of commercial fertilizer or appropriate cropvarieties. The increased yield potential of new varieties often cannot be achieved if the desirable soil pH is not maintained (4). The critical nature of maintaining proper soil pH and the cost of limestone mean that great care is necessary in recommending appropriate rates of lime amendments.

New York farmers tend not to take advantage of the benefits of maintaining adequate soil pH. One study has shown that 45 percent of nearly 10,000 soil samples analyzed from a 19 county area in New York had a pH less than 6.0 (5) compared with the optimum pH of 6.2 to 7.0. In years past. the government has helped pay for soil liming programs. With the demise of this program, there has tended to be inattention to one of the most basic aspects of plant nutrition--adequate soil pH.

Liming soils to appropriate pH nearly always enhances crop yields. A review of alfalfa and sorghum response to lime for 23 acid soils indicated that yields were increased on 22 of the soils where appropriate liming was practiced (6). Corn grain and soybean yields were increased dramatically by application of one to 13 metric tons/ha of lime to an acid sandy loam (7). In addition, appropriate liming enhances soybean nodulation, growth and hence, yields on soils (8). The principal soil factors affected by soil pH

adjustment and related to enhanced growth in these studies were the detoxification of Al, removing hydrogen ions as an inhibitor of nodulation, and supplying adequate Ca and Mg necessary for optimum plant growth. Thus, appropriate liming of soil can have important economic as well as agronomic benefits.

III. MATERIALS AND METHODS

Wood ash samples used in the research were supplied by the Georgia-Pacific Corporation, Lyons Falls, MY. These samples were collected in May, June and November, 1984, from the boiler ash collection bin. Ash from a home wood stove was collected in May and June, 1984. Only hardwoods (oak, maple and beech) and some newspaper were burned in the home wood stove. The limestones used as controls were purchased locally (Limecrest Pulverized Limestone, Limestone Products Corp., Sparta, NJ, and Modern Rotary Kiln Hydrated Lime, Millard Lime and Stone. Annville, PA), as was the potash (Muriate of Potash, Agway). Samples of each material were collected and chemically analyzed for pH, sodium, potassium, magnesium, calcium, aluminum, manganese, iron, nickel, copper, lead, zinc, cadmium, chromium, phosphorus, ammonia, total kjeldahl nitrogen (TKN), and total solids (9).

Fineness of the wood ash from Georgia-Pacific Corp. was determined by a standard sieve analysis. Sieve sizes used were USS Sieve Nos. 20, 60, 100 and 200, with a sample size of 250 g and a shaking time of 10 minutes.

The experimental lime equivalences of the wood ash and the effects on the available nutrient content of soil were investigated in a soil incubation .... studies. Mardin silt loam (coarse, loamy, mixed mesic Typic Fragiocrept) and Burdett silt loam (fine, loamy, mixed, mesic Aeric Ochraqualfs) soils were

used in the study. These two soils are representative of the many acid soils in New York that would benefit from Timing. Use of the two different soils provided an opportunity to: (1) evaluate and compare chemical behavior of the ash in different soils and (2) to test the hypothesis that while soil chemical composition may vary, reactivity of the ash will *he* sufficiently uniform to allow generalized ash use guidelines to be written.

The experimental design was two soils by three liming/fertilizer treatments by six application rates by three replications for a total of 108 pots. The entire quantity of soil to be used in each experiment was screened (1 mm stainless steel) and homogenized for 30 minutes in a large mechanical mixer. Wood ash and the commercial limestone materials were mixed with 3.0 kg of each soil in amounts of 0, 3.0. 6.0, 12, 24 and 48 g. These treatment rates were approximately equivalent to 0, 2.24. 4.5. 9.0, 17.9 and 35.9 metric tons/ hectare (0, 1, 2, 4, 8 and 16 tons/acre). The comnercial potash fertilizer material was added to 3.0 kg of each soil in amounts of 0, 0.10, 0.20, 0.40, 0.80 and 1.60 g. These treatment rates are approximately equivalent to *0,* 34, 68, 135, 270 and 540 kg/ha. Each treatment was mixed in bulk far 30 minutes in a small double shell mixer, divided into 3 - 1 kg replicate samples, and each sample placed into a 20 cm plastic pot with drain holes. Pots were incubated at 25°C for 60 days with periodic watering to simulate wet/dry cycles and physical/chemical reactions with the agricultural soils. At the end of the incubation period, soils were sampled and 10 *g* samples were analyzed individually for water pH, and extractable nutrients using Morgan's solution (10.11).

Data were examined statistically for outliers using the method of Dixon (12) and using analysis of variance procedures. Statistical differences between treatment means were evaluated using Duncan's New Yultiple Range Test (13).

IV. RESULTS AND DISCUSSION

Composition of wood ash, agricultural limestones and potash fertilizer. Wood ash derived from the wood-fired boiler ash collection bin contained the macro-nutrients calcium, magnesium, potassium and phosphorus, plus modest amounts of the micronutrients zinc and copper. The major macro-nutrient was calcium (13 to 27%), as noted in Table 1, samples 1, 2 and 3. Ash sample 1 was used in the experiments described in this report. Magnesium was present at about 1%. Phosphorus and potassium concentrations were, respectively, about 1%(20 lbs/ton or 10 kg/metric ton) and 3% (60 lbs/ton or 30 kg/metric ton), respectively, as P_2O_5 and K_2O. Thus, the ash was approximately equivalent to a 0-1-3 fertilizer.

Copper (0.07 kg/ton) and zinc (0.3 kg/ton) present in the ash applied to soil would help alleviate soil deficiencies in these trace minerals where they exist. In New York severe zinc deficiency is not common, but many soils require zinc additions on a periodic basis to assure appropriate plant available zinc levels in the soil to maintain crop quality and yield.

The three ash samples were fairly uniform in composition. Calcium was the exception. The sample analyzed in Hay 1984 contained nearly double the calcium concentration (27% vs 13 and 14%) of the other two samples. The reason for this is unclear. It may have been due to the type of wood burned in the boilers, but was not the result of a lower content of elements such as silicon that were not included in the analysis since similar increases were not observed in concentrations of the other elements except manganese. Manganese concentration in the Hay samples was 1.6 times greater than that analyzed in November 1984. Thus, if the ash is to be used as an alternative liming material, a quality assurance program would be desirable to establish existing concentrations of calcium and, hence, appropriate application rates.

Compared with commercial limestone, the ash samples 2 and 3 contain about 50% as much calcium and 20% as much magnesium, but in contrast, 10 times as much phosphorus. 20 times as much potassium. 7 times as much copper, 2.5 times as much zinc and a pH of over 12. Thus, the wood ash can serve as a liming material, but also provide modest amount of potassium and phosphorus, as well as trace amounts of micronutrients.

Wood ash from a home wood stove (Table 1, samples 4 and 5) was nearly as rich in calcium as commercial limestone and contained about four times as much potassium as the boiler-ash. The higher proportion of potassium may be associated with the lower burning temperatures present in wood stoves, accompanied by lower volatilization losses of the potassium compounds in the ash residual. Potassium compounds volatilize at about 1300°C. This temperature is somewhat higher than the operating temperature of most home wood stoves, but less than the 2000°C operating temperature for the boilers. Wood stove ash samples analyzed in this study would be approximately equivalent to a 0-3-14 fertilizer.

The potash fertilizer (muriate of potash, i.e., KCl) had a potassium concentration of 45.1%. This is equivalent to 54.1% as K_2O. Based on results of this analysis, this sample of the 0-0-60 fertilizer would appear to be outside the expected potassium concentration tolerance limits (14). The pH of the sample, 9.2, would suggest that a portion of the potassium was in the form of an oxide.

Fineness of the ash from the wood fired boilers was determined by sieve analysis (Table 2). Samples collected 6-29-84, 10-15-84 and 11-14-84 were analyzed. From 54 to 73% of the ash passed the 100 mesh sieve, indicating that not only would this fraction be highly effective as a neutralizing material due to the high pH, but would also react rapidly with soil acidity due to its fineness.

The material collected on the 20 and 60 mesh sieves was virtually all unburned carbon. This fraction consisted of about 25% of the total sample by weight and about 80% by volume.

Analysis of the ash by sieve size (Table 2) suggested that screening out the charcoal would enhance the analysis of the material as a fertilizer and as an alternative liming material. Calcium content of the material finer than 60 mesh was 17.7% relative to 1 to 3% for the coarser material. Lesser, but nonetheless interesting, enhancement was also evident for phosphorus, magnesium and potassium.

Although the economic value of the potassium and phosphorus may be as much as $16 per 2000 lb/ton, their concentration is lower than most commercial fertilizers. Thus, a potential user would need to spread the wood ash at 10 to 20 ton/ha (4.5 to 9 ton/acre) to obtain an appreciable increase in potassium. Since the ash is principally a liming material, such applications would occur only once in 2 to 5 years. Therefore, using the ash as a regular source of potassium or phosphorus would be impractical. However, in the year the ash is applied, users would obtain benefit from the potassium addition.

Availability of crop nutrients - Ash from the wood fired boilers (Sample 1) was mixed with Mardin silt loam and Rurdett silt loam at six rates equivalent to 0 to 35.9 metric tons/hectare. Maximum elemental additions for the two soils, Mardin and Burdett, were 283 kg/ha P, 1100 kg/ha K, 9680 kg/ha Ca and 556 kg/ha Mg.

Following two months incubation of the soils mixed with the six ash treatments and the lime and potash control treatments, the available nutrient content provided by these materials was estimated by extraction using Morgan's solution. The Morgan's solution extraction estimates the amount of soluble nutrient that is considered to be available for plant uptake in New York soils

(10,11). Results of the analyses of the extracting solution are given in Table 4.

Plots of the available potassium and phosphorus against the amount of the nutrient added to the soil (Figure 1) indicated that nutrients are available in varying proportions depending on soil type. Regression analysis was used to establish an estimate of the availability of each nutrient. Results are provided in Table 5 and shown in Figure 1.

Availability of potassium and phosphorus, as estimated by soil extraction using Morgan's solution, was a linear function of the amount of that nutrient added to the soil. The slope of the regression line suggests that about 18 to 35% of the added potassium was available. This contrasts with the estimated availability of the potassium in the commercial potash fertilizer, about 63 to 76%. The high temperatures achieved in the wood fired boilers were hypothesized to be associated with the lower potassium availability, possibly due to formation of insoluble fused potassium compounds with insoluble elements such as silicon. Thus, an experiment was conducted to test available potassium from wood ash from the home wood stove.

Wood ash (Sample 5. Table 1) was mixed with Mardin soil following the procedure described earlier for the wood fired boiler ash. Potassium added varied from the equivalent of 291 kg/ha to 2330 kg/ha. Available potassium varied from 302 kg/ha at the lowest rate to 1340 kg/ha at the highest note. Regression analysis of the data indicated that about 51% of the potassium was available (as extracted with Morgan's solution), as noted in Table 5. While an increase in available potassium is evident, this value is substantially lower than the 76% found with the commercial potash fertilizer. Thus. no firm conclusions may be drawn, but it does appear that availability may be to some extent associated with temperature.

Where the wood ash (Sample 1) is used as a liming material at 20 ton/ha to improve soil pH, available potassium (25% available) would be increased by about 150 kg/ha. Based on results using, as a potassium control, commercial potash fertilizer for which about 70% of the applied K is available, this 150 kg/ha increase could be supplied by 215 kg/ha of fertilizer K. The 215 kg/ha K would be equivalent to about 355 kg/ha of commercial potash fertilizer containing 60% K_2O. Thus, the wood ash used as an alternative liming material will also provide as a secondary benefit important amounts of potassium.

Available phosphorus was about 1% of the amount added. Although this availability is small, it should be noted for perspective that 5 to 6 kg/ha of available phosphorus in the soil is considered adequate. As noted later a typical wood ash application rate to acid soil may be 20 ton/ha. Such an application would add about 160 kg/ha of phosphorus, Thus, the wood ash can supply small amounts of phosphorus.

Effect on soil pH - The high lime wood ash (Sample 1) contained 270 kg calcium per metric ton, and had a pH of about 12.5. These characteristics suggest good potential of the material as an alternative liming material. An important and challenging part of this research was to evaluate this liming potential compared with commercially available ground limestone.

Liming materials are compared using their equivalent neutralizing value (ENV). The ENV means the percent effectiveness of a particular limestone relative to a standard limestone with an ENV of 100. The ENV of a liming material is a function of (1) the total neutralizing value (TNV) and (2) the fineness of the limestone particles. The TNV is estimated from the sum of the calcium and magnesium contents expressed as calcium carbonate.

For the ground limestone sample used in this research (Table 1), the TNV would be, on a dry basis:

Ca: $31.4\% \times \frac{2.50\ CaCO_3\ \text{equivalents}^*}{\text{Ca equivalent}} = 78.5$

Mg: $5.09\% \times \frac{4.12\ CaCO_3\ \text{equivalent}}{\text{Mg equivalent}} = 21.0$

TNV = 78.5 + 21.0 = 99.5 as $CaCO_3$, dry basis

The fineness of the liming material is the second component of ENV. The finer the lime particles, the more rapidly the lime can react with soil acidity. Measurement of the fineness of the limestone particles is straightforward for most standard commercial liming materials. To determine the fineness. the lime is sieved using 20 and 100 mesh screens. The fineness score was calculated (4) for the ground limestone as shown below based on the sieve analysis provided by the manufacturer.

1. Passing 100 mesh 0.60

2. Passing 20 mesh 0.99
   Passing 100 mesh - 0.60
   20 to 100 mesh 0.39

   reaction value = 0.39 x 0.6† = 0.23

3. Fineness score = 0.83

*Note: $\frac{\text{Equivalent wt } CaCO_3}{\text{Equivalent wt Ca}} = \frac{50}{20} = 2.50$

$\frac{\text{Equivalent wt Ca}}{\text{Equivalent wt Mg}} \times 2.50 = \frac{20.0}{12.15} \times 2.50 = 4.115 = 4.12$

†The portion of the material in the 20 to 100 mesh range is multiplied by the 0.6 standard for all materials to give the reaction value.

To obtain the ENV, the TNV is multiplied by the fineness score. The calculated ENV for the limestone would be:

ENV = TNV x fineness score

= 99.5 x 0.83 = 82.6 = 83

Thus, the ENV of the ground limestone material used in this study as a control was calculated to be 83. The ENV guaranteed on the manufacturer's bag was 72.

The ENV of the sample of wood ash used in this research was calculated using a similar method. The TNV was estimated for samples 1 and 2 (Table 1), as an example.

Sample 1

Ca: 27.0% x 2.50 = 67.5

Mg: 1.55% x 4.12 = 6.4

TNV 73.9 or about 74 as $CaCO_3$

Sample 2

Ca: 14.7 x 2.5 = 36.8

Mg: 0.97 x 4.12 = 4.0

TNV 40.8 or about 41 as $CaCO_3$

However, one simplification may be possible for calculating the ENV of the wood ash because the ash consists largely of oxides of calcium and magnesium, based on the high pH. Lime sources such as calcium oxide or quick lime usually react with the soil rapidly enough for the particle size not to be as critical as for grdund limestone or $CaCO_3$ (4). In this case all of the liming material is considered reactive and the fineness score is 1.00. Thus, the calculated ENV of the ash sample 1 would be about 74. However, the

substantial differences in calcium content of the wood ash samples 1, 2 and 3 (Table 1) clearly indicate the need for regular analyses of the ash in order to establish the current quality of the product when used as a fertilizer/ liming material.

A second approach for estimating ENV of the wood ash samples was hased nn results of the soil incubation study. Using this experimental approach, the actual soil pH neutralization achieved with the wood ash was contrasted with ground limestone used as a control in parallel treatments. The results of this portion of the study are shown in Table 6, with the resulting regression equations for the plots (Figures 2 and 3) given in Table 7. It should be observed that the soil pH achieved is a linear function of the logarithm of the application rate. This relationship follows from the definition of pH: the negative logarithm of the hydrogen ion concentration. For comparison, a plot of results from parallel treatment using ground limestone and hydrated lime is provided in Figure 2, with the resulting regression equations given in Table 7.

The background pH of the soils used in this study, typically acid Mardin and Burdett silt loams, were 5.7 and 4.8, respectively. For comparison, the desirable agronomic pH for the following crops is (4):

Crops	pH
Clover, corn, grasses and oats	6.2
Barley, hirdsfoot, trefoil, and wheat	6.5
Alfalfa and soybeans	7.0

To achieve a pH of 6.2 for the Burdett soil using the liming materials, as shown in Figure 3, would require 9.7 ton/ha of limestone (ENV 83). and 17 ton/ha of the wood ash sample 1. Thus, a wood ash application of 17 ton/ha provided the equivalent soil pH neutralization as 9.7 ton/ha of the ground limestone (ENV 83). Using this comparison, the ENV may he estimated:

ENV (residuals) =

$$\text{ENV (control lime)} \times \frac{\text{control lime application to achieve pH 6.2}}{\text{wood ash application to achieve pH 6.2}}$$

For the ground limestone (ENV = 83) used as a control in this comparison, the wood ash was estimated to have an ENV of:

$$\text{ENV (wood ash, sample 2)} = 83 \times \frac{9.7}{17} = 47.$$

To achieve a pH of 6.5 on the same soil would be expected to require 14 ton/ha of the ground limestone or about 25 ton/ha of the wood ash resulting in an experimental ENV of about 47 (Table 8).

Similar ENV results were obtained using the Rurdett soil in the experiment. As noted in Table 8, the experimental ENV was estimated at 52 to 55 for achieving soil pH of 6.2 and 6.5, respectively. In general, annual limestone applications should not exceed about 10 ton/ha. Where greater pH adjustment is desired, multiple applications over 2 or more years are recommended. Thus. estimating ENV from amounts of limestone and wood ash to achieve pH 7 may not be appropriate.

The reason for this large difference between the calculated and the experimental ENV was not clear. It was hypothesized initially that the calcium compounds in the ash might be less soluble due to the high boiler temperatures. However, results of studies of calcium availability (Table 5) of the wood ash (46%) contrasted with agricultural limestone (54%) indicated that differences were small. Thus it is not clear at this time why such a large variation existed between the calculated and the experimental ENV.

These results, as now interpreted, do indicate that the calculated ENV 74 of the wood ash sample 1 may be optimistic. The experimental ENV of about 50

is about 68% of the calculated ENV for the two soils tested. Users should take this lower value into consideration when estimating application rates.

Application rate of the wood ash can be calculated in order to permit a user to achieve a desired soil pH. For example, lime recommendations are based on use of a limestone with an ENV of 100. If the recommended limestone rate is 2 tons per acre (current recommendations are given in tons/acre, rather than in metric tons/hectare), the application rate for an ENV 50 liming material would be calculated:

$$2 \frac{\text{tons}}{\text{acre}} \text{ for ENV 100 limestone} \times \frac{100}{\text{ENV 50 wood ash}} = 4 \frac{\text{tons}}{\text{acre}} \text{ or } 9 \frac{\text{metric tons}}{\text{ha}}$$

V. CONCLUSIONS

Paper mill wood-derived boiler ash was mixed with two soils in a two-month incubation study at 25°C to assess fertilizer and lime value of the ash. Commercial potash fertilizer and ground limestone control treatments were included.

Results of the study indicated that available calcium, phosphorus and potassium increased linearly with the ash application rate. The ash did not supply appreciable amounts of phosphorus, but was a good source of potassium and calcium. Soil pH was a function of the logarithm of the ash application rate. An experimental ENV of 50 was estimated for the ash sample tested in this study. The experimental ENV was about two-thirds of that calculated from the calcium and magnesium content of this ash. It was also concluded that the agricultural value of the ash could be enhanced by screening out unburned carbon.

Therefore, results of this research suggest that the paper mill wood derived boiler ash can supply agronomically important amounts of plant nutrients, and can also serve as an alternative liming material.

VI. REFERENCES

1. Agee, A. 1919. Right use of lime in soil improvement. Orange Judd Co., New York.

2. United States Department of Agriculture. 1938. Soils and Men. Yearbook of Agriculture 1938. United States Government Printing Office. pp. 518-9.

3. Barber, S.A. 1967. Liming materials and practice, p. 125-160. In: R.W. Pearson and F. Adams (ed.) Soil acidity and liming. Am. Soc. of , Madison, WI.

4. Cornell Field Crops Handbook. 1978. New York State College Of Agriculture and Life Sciences. Cornell University, Ithaca, NY.

5. Lathwell, D.J. and T.W. Scott. 1966. A study of soil fertility on New York farms. Cornell Extension Bulletin 1063. New York State College of Agriculture and Life Sciences. Cornell University, Ithaca. NY.

6. Sumner, M.E. 1979. Response of alfalfa and sorghum to lime and P on highly weathered soils. Agron. J. 71:763-766.

7. Bertsch, P.M. and M.M. Alley. 1981. Conventional and suspension limestone influence on soil chemical properties and on corn and soybean yields. Agron. J. 73:1075-1078.

8. Mengel, D.B. and E.J. Kamprath. 1978. Effects of soil pH and liming on growth and nodulation of soybeans in Histosols. Agron. J. 70:959-962.

9. Doty, W.R., M.C. Amacher and D.E. Baker. 1982. Manual of Methods. Soil and Environmental Chemistry Laboratory. Department of Agronomy Information Report 121. Institute for Research on Land and Water Resources. The Pennsylvania State University. University Park. PA.

10. Greweling, T. and M. Peech. 1965. Chemical soil tests. Department of Agronomy Bulletin 960. Cornell University. Ithaca, NY.

11. Lathwell, D.J. and M. Peech. 1964. Interpretation of chemical soil tests. Department of Agronomy Bulletin 995. Cornell University, Ithaca, NY.

12. Snedecor, G.W. and W.G. Cochran. 1980. Statistical Methods, p. 280. The Iowa State University Press. Ames, IA.

13. Steel, R.G.O. and J.H. Torrie. 1960. Principles and Procedures of Statistics with Special Reference to the Biological Sciences. pp. 107-109. McGraw-Hill Book Co., Inc., New York.

14. New York State Department of Agriculture and Markets. 1975. Sale and Analysis of Commercial Fertilizer. Article 10. Sections 143-146e, 153.1-153.7. Circular 910. Division of Plant Industry. Albany. NY.

15. Anderson, L.L. and D.A. Tillman (Eds.). 1977. Fuels from Waste. Academic Press, NY. p. 84.

Table 1. Chemical composition of wood ash, commercial agricultural limes and commercial potash.

Parameter	Composition[1]							
	Wood ash					Ground Limestone	Hydrated Lime	Commercial Potash Fertilizer
	1	2	3	4	5			
	5-12-84	6-29-84	11-14-84	5-84	6-84	$CaCO_3$	CaO	KCl
	%							
Total - N	0.05	0.06	0.09	0.02	0.02	0.01	0.02	0.02
Organic - N	0.05	0.06	0.09	0.02	0.02	0.01	0.02	0.02
NH_4 - N	0	0	0	0	0	0	0	0.01
P	0.79	0.55	0.44	1.10	1.25	0.06	0.05	0.05
K	3.08	2.37	2.79	10.77	13.0	0.13	0.14	45.08
Ca	27.00	14.67	13.21	32.07	28.06	31.4	55.38	0.04
Mg	1.55	0.97	0.85	2.47	2.10	5.09	0.80	0.13
Na	0.27	0.23	0.27	0.54	0.37	0.07	0.05	1.41
Al	1.59	1.15	1.31	1.50	1.10	0.21	0.26	0.00
Fe	1.11	1.29	1.56	0.40	0.39	0.29	0.11	0.01
	mg/kg							
Cd	7.9	6.0	6.3	2.2	2.5	0.7	0.2	0.2
Cr	21.1	16.7	12.5	18.0	13.5	6.0	10.0	2.0
Cu	90.3	61.7	78.7	180	146	10	12.0	2.0
Mn	12700	6920	7770	7820	7380	453	41.1	5.0
Ni	49.1	43.0	30.6	56.6	58.2	20.0	34.0	10.0
Pb	72.2	51.1	53.1	67.1	44.2	55	45.1	21.0
Zn	381	232	316	1250	507	113	4.0	2.0
pH	12.7	12.4	12.3	12.1	12.7	9.9	12.5	9.2
Total Solids. %	99.71	98.92	99.77	99.79	99.65	100	99.87	99.83

[1]Means of duplicate analyses.
[2]Wood ash samples 1, 2 and 3 were collected from the boiler ash collection bin, Georgia Pacific Corporation, Lyons Falls, NJ. Ash samples 4 and 5 were collected from a home wood stove. Ash sample 1 was used in experiments presented in this report.

Table 2. Physical and chemical analysis of wood ash by USS sieve size.

	Sample collection date'			
	6-29-84	10-15-84	11-14-84	Mean
USS Sieve		% passing[2]		
20[3]	95.0 ± 0.13	75.5 ± 0.14	91.3 ± 0.14	87.3 ± 10.4
60[3]	83.7 ± 0.49	62.1 ± 0	78.3 ± 0.14	74.7 ± 11.2
100	72.7 ± 0.29	54.4 ± 0.07	67.8 ± 0.07	65.0 ± 9.5
200	———	41.2 ± 0.07	48.2 ± 0.42	———

	Ash analysis[4], %			
	P	Ca	Mg	K
t20	0.06	1.1	0.4	1.1
20-60	0.12	3.2	0.3	1.8
<60	0.64	17.7	1.3	2.9

' ~ ~ ~ ~ by iGeorgia Pacific Corporation, Lyons Falls, NY.

[2]Mean ± std. dev. of duplicate samples. Sample size was 250 g.

[3]Material retained on screen was charcoal.

[4]Ash analysis (sample. collected 10-15-84) by Analytical Laboratories, New York State Agricultural Experiment Station, Geneva, NY.

Table 3a. Composition and equivalent application rates of constituents of wood ash sample 1.

		Ash addition, ton/hectare[1]					
		0	2.24	4.5	9.0	17.9	35.9
Parameter	Composition[2] kg/ton	Constituent addition, kg/ha					
Total-N	0.5	-	1.12	2.24	4.48	8.96	17.9
Organic-N	0.5	-	1.12	2.24	4.48	8.96	17.9
NH_4-N	0	-	0	0	0	0	0
P	7.9	-	17.7	35.4	70.8	142	283
K	30.8	-	69.0	138	276	552	1100
Ca	270	-	605	1210	2420	4840	9680
Mg	15.5	-	35	69	139	278	556
Na	2.7	-	6.0	12.1	24.2	48.4	96.8
Al	15.9	-	35.6	71.2	142	285	570
Fe	11.1	-	24.9	49.7	99.4	199	398
Mn	12.7	-	28.4	56.9	114	228	455
Cu	0.09	-	0.20	0.40	0.81	1.62	3.24
Zn	0.38	-	0.85	1.71	3.41	6.83	13.7

[1]Added to 3.0 kg of soil in amounts of 0, 3.0, 6.0, 12, 24 and 48 g.

[2]See also Sample 1, Table 1.

Table 3b. Composition and equivalent application rate of constituents of commercial potash fertilizer.

		Commercial potash addition, kg/ha[1]					
		0	75	150	300	600	1200
Parameter	Composition[2] kg/ton	Elemental addition, kg/ha					
P	0.5	-	0.04	0.08	0.15	0.30	0.60
K	45	-	34	68	135	270	540
Ca	0.4	-	0.03	0.06	0.12	0.24	0.48
Mg	1.3	-	0.10	0.20	0.39	0.78	1.56
Na	14	-	1.06	2.12	4.23	8.46	16.9
Al	0	-	-	-	-	-	-
Fe	0.1	-	0.01	0.02	0.03	0.06	0.12
Mn	0.005	-	-	-	-	-	-
Cu	0.002	-	-	-	-	-	-
Zn	0.002	-	-	-	-	-	-

[1]Added to 3.0 kg of soil in amounts of 0.10, 0.20. 0.40, 0.80 and 1.60 g.

[2]See also Table I.

Table 4. Effects of ash from wood-fired boilers on soil chemical properties[1].

	Wood ash incorporation rate, tons/hectare																	
	0			2.24			4.5			9.0			17.9			35.9		
	Available nutrients,[2] kg/hectare																	
Burdett Series																		
P	0.6	± 0	d	1.6	± 0	d	1.7	± 0.97	c	2.2	± 0	b,c	3.0	± 0.65	b	4.5	± 0	d
K	100	± 1.9	f	128	± 2.4	e	145	± 1.1	d	165	± 3.4	c	216	± 6.0	b	307	± 5.7	a
Mg	133	± 5	e	164	± 16	d	166	± 6.0	d	191	± 3.9	c	245	± 18	b	220	± 3.4	a
Ca	1520	± 45	e	1980	± 120	d	2190	± 17	d	2720	± 79	c	4060	± 247	b	5760	± 88	a
Fe	50	± 5.8	a	45	± 2.6	b	34	± .64	c	24	± 0	d	12	± .65	e	10	± .65	e
Al	356	± 27	f	327	± 7.2	e	273	± 6.2	d	217	± 2.4	c	139	± 3.9	b	94	± 2.4	a
Mn	16	± 1.4	d	15	± 1.1	c	12	±.65	b	10	± 0	a	15	± 1.4	c	28	± 1.7	e
Zn	2.2	± 0.5	b	2.8	± 0.3	a	1.7	± 0.4	b,c	1.1	± 0.1	d	1.4	± 0.2	c,d	2.2	± .2	a,b
(II) Mardin Series																		
P	6.7	± 0.6	d	79	± 0	c	7.9	2.6	c	9.0	± 0	b.	10	± .6	b	11	± 0	a
K	166	± 20	e	179	t5.2	e	213	t3.6	d	268	± 5.6	c	363	± 10	b	547	± 15	a
Mg	162	± 13	d	173	± 16	c,d	202	i4.7	c	235	± 25	b	256	± 7.8	a,b	275	± 22	a
Ca	1560	± 149	e	1830	± 153	d,e	2250	± 84	d	3010	± 92	c	4320	± 174	b	6020	± 620	a
Fe	102	1	a	83	± 6.7	b	74	± 3.9	b	52	± 1	c	31	± 2	d	22	± 2	d
Al	226	± 17	a	199	± 10	b	179	± 55	c	140	± 1.1	d	103	± 3.4	e	89	± 11	e
Mn	35	± 5.7	b,c	27	± 4.5	c	28	± 39	b,c	26	± .65	c	38	± 3.9	b,c	53	± 11	a
Zn	4.4	± 1.7	a	2.9	± 0.66	a	3.3	± 0.33	a	2.9	± 0.63	a	2.9	± 0.29	a	3.5	± 0.76	a

[1]~oil-ashmixtures incubated at 25°C in pots for 60 days.

[2]Mean ± std, dev. of 3 replicates. Means followed by the same letter are not statistically different, $p<0.05$. Available nutrients were estimated from extraction of the soil using Morgan's solution.

Table 5. Results of regression analysis of available nutrients as a function of the amount of that nutrient added to soil.

Available Nutrient[1]	Material[2]	Soil	Regression Equation[3,4]	Correlation[5], R^2
P	Wood ash-GP	Mardin	0.014 R_p + 7.5	0.89
P	Wood ash-GP	Burdett	0.012 R_p + 1.1	0.95
K	Wood ash-GP	Mardin	0.35 R_k + 165	0.99
K	Wood ash-GP	Burdett	0.18 R_k + 113	0.99
K	Potash	Mardin	0.76 R_k + 129	0.99
K	Potash	Burdett	0.63 R_k + 110	0.99
K	Wood ash-WS	Mardin	0.51 R_k + 150	0.99
Ca	Wood ash-GP	Mardin	0.47 R_{Ca} + 1700	0.98
Ca	Wood ash-GP	Burdett	0.44 R_{Ca} + 1680	0.99
Ca	Limestone	Mardin	0.49 R_{Ca} + 3130	0.99
Ca	Limestone	Burdett	0.58 R_{Ca} + 1670	0.99
Ca	Hydrated Lime	Mardin	0.64 R_{Ca} + 3150	0.99

[1]Available as measured by extraction of soil sample with Morgan's solution, in kg/ha.

[2]Wood ash-GP (Sample 1, Table 1), Wood ash-WS (Sample 5, Table 1) commercial potash fertilizer (KCl), ground limestone and hydrated lime. See Table 1 for analysis.

[3]R_X = Addition rate of X in kg/ha.

[4]The available fraction of the applied nutrient is equal to the slope of the regression line.

[5]For df = 17 (6 treatments x 3 replications) all regressions are significant at $p < 0.01$.

Table 6. Effect of wood ash and two commercial limestones on pH of two soils.

Sample	Soil	Application rate, tons/hectare, dry basis					
		0	2.24	4.5	9.0	17.9	35.9
		pH_{H_2O}[1]					
Wood ash	Mardin	5.1 f	5.3 e	5.6 d	6.0 c	6.6 b	7.2 a
Ground limestone	Mardin	5.1 f	5.6 e	5.9 d	6.5 c	6.9 b	7.2 a
Wood ash	Burdett	4.8 f	5.0 e	5.2 d	5.5 c	6.1 b	7.0 a
Ground limestone	Burdett	4.8 f	5.1 e	5.5 d	6.1 c	6.7 b	7.3 a
Hydrated lime	Mardin	5.7 e	6.2 d	6.3 d	6.9 c	7.5 b	8.0 a
Ground limestone	Mardin	5.7 f	6.1 e	6.3 d	6.6 c	7.1 b	7.3 a

[1]Values in rows followed by the same letter are not statistically different, $p<0.05$.

Table 7. Results of regression analysis of soil pH as a function of the application rate of wood ash and commercial limestones.

Material	Soil	Regression Equation[1]	Correlation, R^2
Wood ash	Mardin	Soil pH_{H_2O} = 1.59 log R_{WA} + 4.62	0.98
Ground Limestone	Mardin	Soil pH_{H_2O} = 1.40 log R_L + 5.09	0.99
Wood ash	Burdett	Soil pH_{H_2O} = 1.63 log R_{WA} + 4.21	0.92
Ground Limestone	Burdett	Soil pH_{H_2O} + 1.86 log R_L + 4.37	0.99
Hydrated Lime	Mardin	Soil pH_{H_2O} = 1.59 log R_{HL} + 5.46	0.96
Ground Limestone	Mardin	Soil pH_{H_2O} = 1.06 log, R_L + 5.67	0.98

[1] R_{WA}, R_L and R_{HL} are the application rates in ton/ha of wood ash, ground limestone and hydrated lime, respectively.

Table 8. Calculated and experimental equivalent neutralizing value (ENV) of the wood ash.

Method used to estimate ENV	Mardin soil			Burdett soil		
	Rate, ton/ha			Rate, ton/ha		
	Lime	Ash[1]	ENV	Lime	Ash[1]	ENV
1. Calculated	83	74	--	83	74	--
2. Experimental, based on soil pH achieved during incubation period.[2]						
pH 6.2	6.2	9.9	52	9.7	17	47
pH 6.5	10	15	55	14	25	47
pH 7.0	23	31	62	--	--	--

[1]ENV of wood ash sample 1, Table 1

[2]Two months at 25°C.

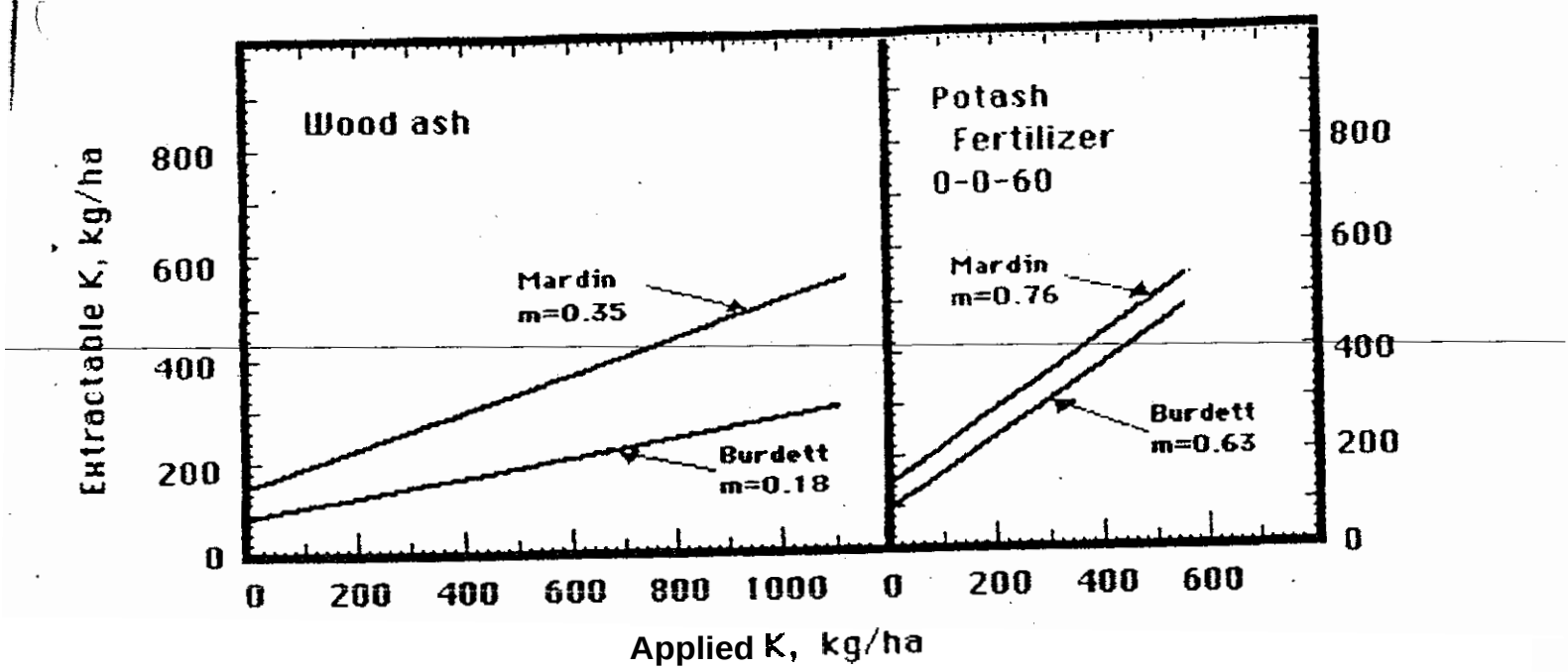


Figure 1. Available potassium in wood ash and commercial potash fertilizer when applied to two soils.

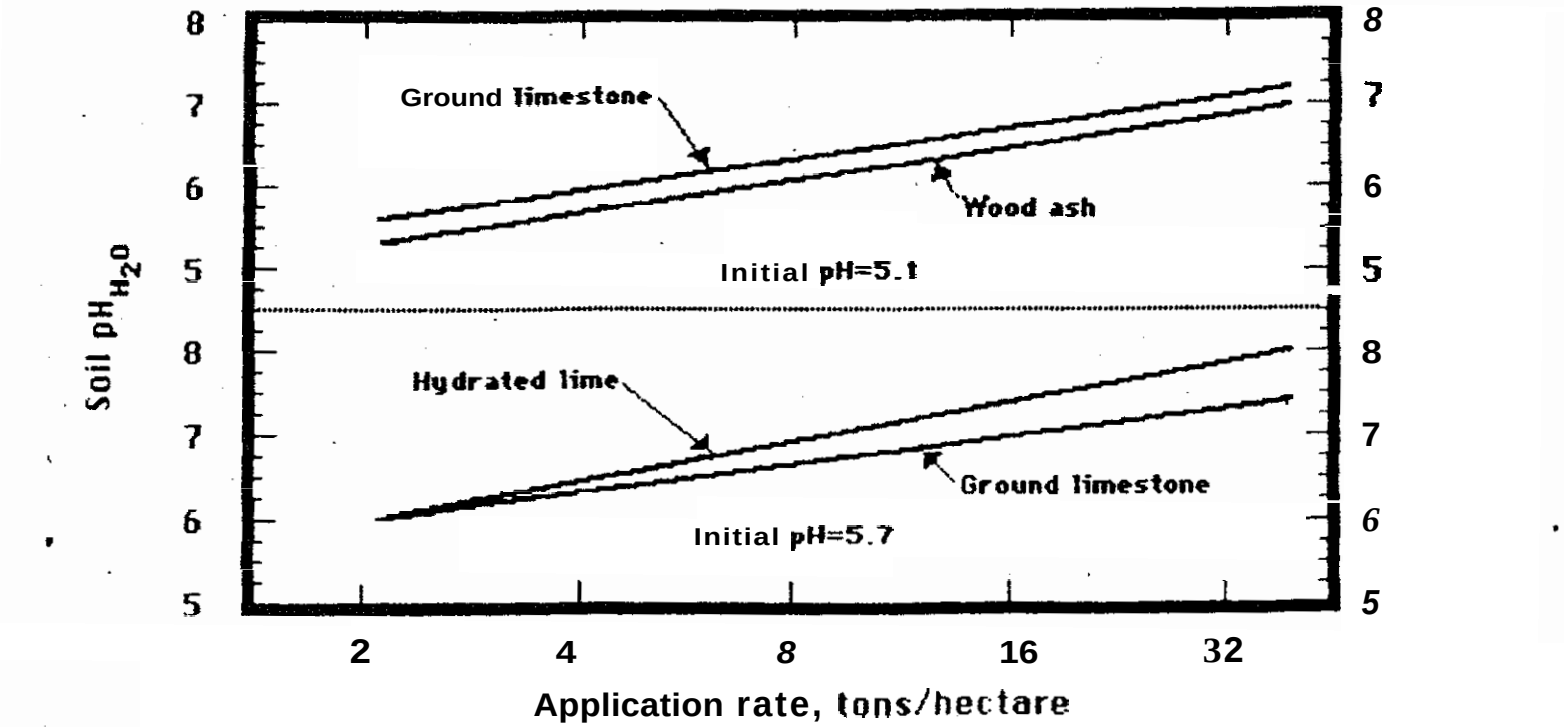


Figure 2. Variation of soil pH with application rate of wood ash and two limestones - Mardin silt loam.

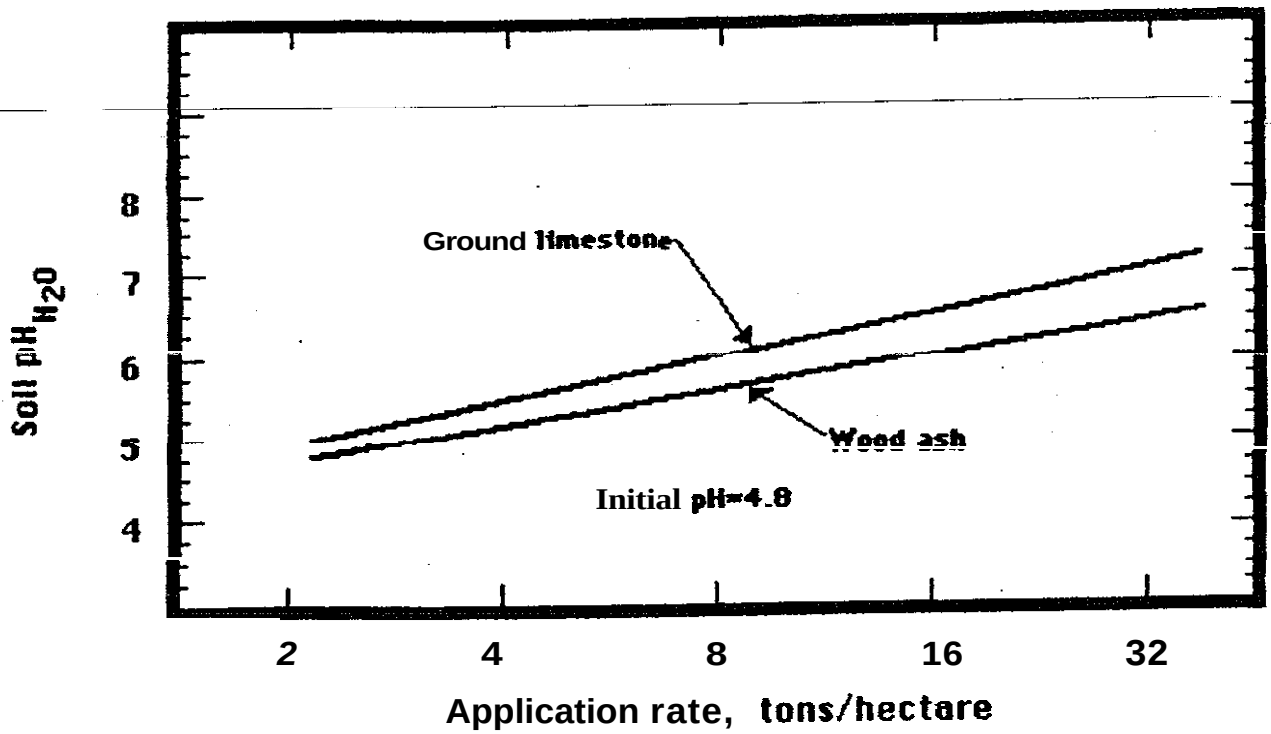


Figure 3. Variation of soil pH with application rate of wood ash and limestone - Burdett silt loam

Multi-Tech
Laboratories, Inc.
320 TESCONI CIRCLE. SUITE R • SANTA ROSA. CA 95401 ▪ (707) 544-5570

5-7-85

Georgia Pacific
90 W. Redwood Ave.
Ft. Bragg. Ca 95437

Date collected:	4-19-85
Date in Lab:	4-22-85
Collected By:	client

Laboratory number: 5-1993
Client I.D.: Material Release 9573
Sample Type: ash

	STLC mg/L	STLC LIMIT	TTLC mg/kg	TTLC LIMIT
Antimony	<1	15	<100	500
Arsenic	<1	5	<100	500
Barium	30	100	400	10000
Beryllium	<0.01	0.75	<1	75
Boron			2.4	
Cadmium	<0.1	1.0	<10	100
Chromium	0.1	560	15	2500
Chromium (+6)	0.08	5		
Chromium (+3)	<0.1	560		
Cobalt	<5	80	<500	8000
Copper	0.2	25	10	2500
Lead	<0.1	5	<10	1000
Mercury	<0.1	0.2	<20	20
Molybdenum	<1	350	<100	3500
Nickel	0.1	20	10	2000
Selenium	<0.1	1.0	<10	100
Silver	<0.1	5	<10	500
Thallium	<1	7	<100	700
Vanadium	<1	24	<100	2400
Zinc	0.1	250	20	5000
Moisture			4.96 %	

Samples were processed on an "as received" basis.,

Analytical Director

Georgia-Pacific Corporation
90 West Redwood Avenue
Fort Bragg, California 95437
Telephone (707) 964-5651

WATER QUALITY
CONTROL BOARD
REGION I

Nay 17, 1985

MAY 20 '85
DJ ☑ SW
SK ☐
CJ ☐
RT ☐
JR ☐ REPLY

Dr. David C. Joseph
~~California Regional Water~~
Quality Control Board
1000 Coddingtown Center
Santa Rosa, CA 95401

Dear Dr. Joseph:

Enclosed you will find the results of the latest ash analyses completed for the Fort Bragg mill. You will note that all analyses aeet the Department of Health Services **(DOHS)** limits.

After receiving your April 16 letter, I contacted Mr. Quan at DOHS who was not aware of Georgia-Pacific's ash declassification. He requested that I send him a copy of the declassification letter, and a copy of your letter. In addition, I was asked to include a list of questions that needed to be answered by DOHS and specify **a** date by which the response should be prepared. Mr. Quan indicated that if Georgia-Pacific did not receive a reply by the date specified, I could presume that Georgia-Pacific's interpretation of the regulations is correct.

Earlier this month, ***you*** were sent a copy of the letter sent to Mr. Quan which specifies a May 15, 1985 reply date. As of today, I have not received a reply from Mr. Quan. I must presume, for lack of a response, that Georgia-pacific's interpretation of the stated ash classification has been accepted by DOHS. The interpretation stated in my April 30, 1985 letter was that the ash is considered by Georgia-Pacific to be a non-hazardous waste by-product.

I will continue to pursue a written response from DOHS regarding the ash classification as a by product because the corporation, and I'm sure water quality, will not be satisfied until we receive one. The corporation is willing to discuss this topic with you or your staff at any tine.

Sincerely,

Sue O'Leary

Sue O'Leary
Forest Hydrologist
iiestern Wood Prod Mfg
California Wood Products

SO:mm
Encl.
cc: J. A. Coon - Georgia-Pacific
D. G. Jacobstoon - Georgia-Pacific
Bill Quan - **DOHS**

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WATER QUALITY
CONTROL BOARD
REGION 1

5-7-85

MAY 20 '85

Georgia Pacific
90 W. Redwood Ave.
Ft. Bragg, Ca 95437

DJ ___ ___
BK ___ ___
CJ ___ ___
RT ___ ___
JH ___ ___
BB ___ ___
CR ___ REPORT ___ FILE

Date collected: 4-19-85
Date in Lab: 4-22-85
Collected By: client

Laboratory number: 5-1993
Client I.D. : Material Release 9573
Sasple Type: ash

	STLC mg/L	STLC LIMIT	TTLC mg/kg	TTLC LIMIT
Antimony	<1	15	<100	500
Arsenic	<1	5	<100	500
Barium	30	100	400	10000
Beryllium	<0.01	0.75	<1	75
Boron			2.4	
Cadmium	<0.1	1.0	<10	100
Chromium	0.1	560	15	2500
Chromium (+6)	0.08	5		
Chromium (+3)	<0.1	560		
Cobalt	<5	80	<500	8000
Copper	0.2	25	10	2500
Lead	<0.1	5	<10	1000
Nercury	<0.1	0.2	<20	20
Molybdenum	<1	350	<100	3500
Nickel	0.1	20	10	2000
Selenium	<0.1	1.0	<10	100
Silver	<0.1	5	<10	500
Thallium	<1	7	<100	700
Vanadium	<1	24	<100	2400
Zinc	0.1	250	20	5000
Moisture			4.96 %	

Samples were processed on an "as received" basis.

Analytical Director

Multi-Tech
Laboratories, Inc.
320 TESCONI CIRCLE. SUITE R ▪ SANTA ROSA. CA 95401 ▪ (707) 544-5570

5-7-85

Georgia Pacific
90 W. **Redwood** Ave.
F:. Bragg, CA 95437

SAMPLE NUMBER: 5-1993

Date collected: 4-19-85
Date in lab: 4-22-85
Collected by: client
Sample type: ash

Client's ID: Material Release 9573

Cyanide: 0.19 mg/kg

Analytical Director

California Regional Water Quality Control Board
North Coast Region

INTEROFFICE COMMUNICATION

TO: Bob Tancreto DMS
Craig Johnson
File - Fort Bragg Shavings

DATE: May 17, 1985

FROM: Susan Warner

SUBJECT: Ash Disposal/Georgia-Pacific of Fort Bragg Shavings

To summarize recent events, Georgia-Pacific provides ash wastes (hazardous or non-hazardous is immaterial) purported as a "product" to Fort Bragg Shavings for use as a soil amendment. We have received a complaint concerning runoff carrying ash into streams; Fort Bragg Shavings was asked to tell us where ash is stored/used and how runoff is controlled, but did not provide this information.

If the ash is a non-hazardous waste (and it probably is), then I do not consider this a high priority facility justifying expenditure of much time. We can take any of the following actions:

1. No action, drop matter unless further complaints are received; or

2. Clarify waste as non-hazardous, authorize G-P to dispose of waste via Fort Bragg Shavings in one-time only agricultural land applications pursuant to farm advisor guidelines and adequate drainage control (modify G-P permit to include provision for this disposal method); or

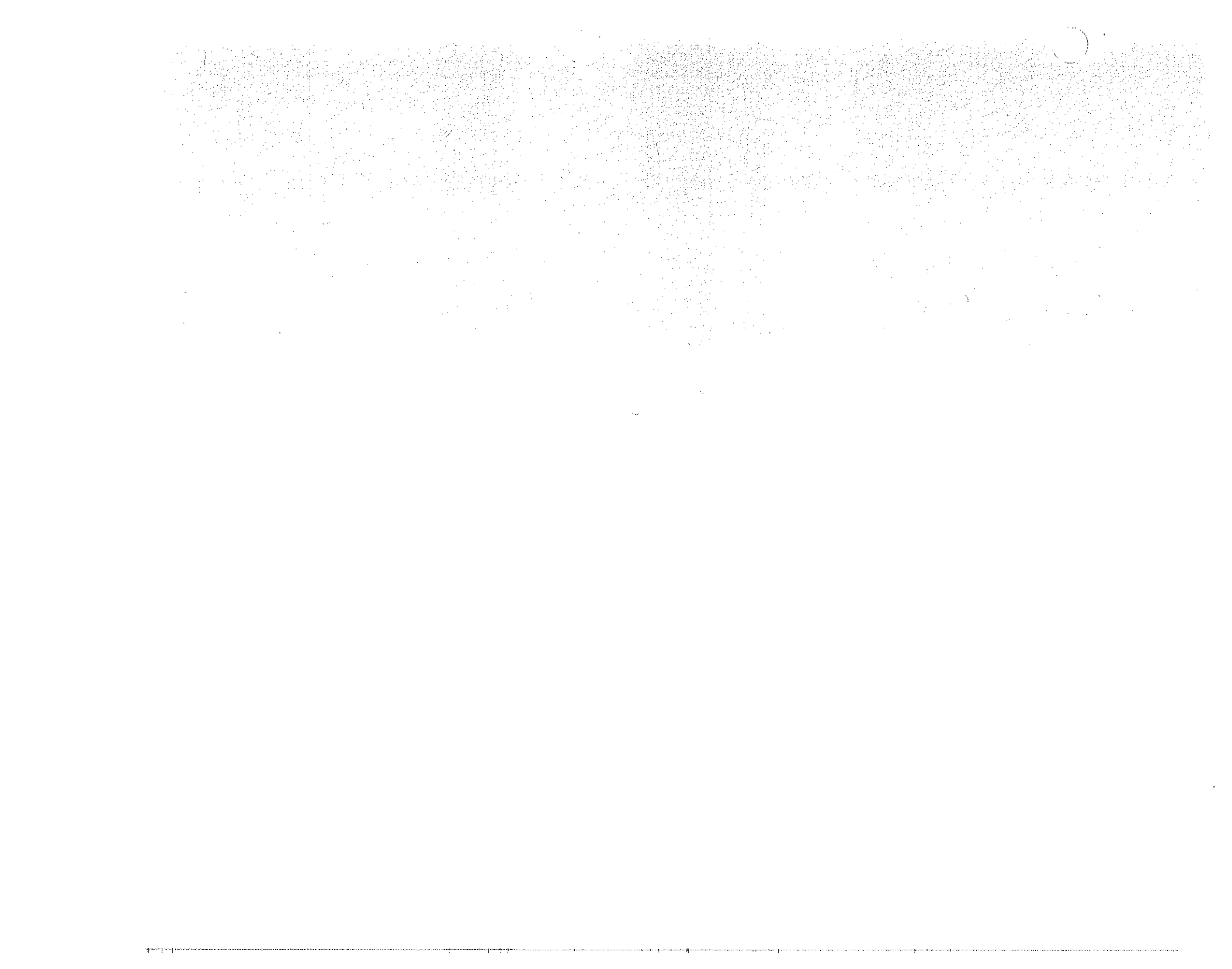
3. Take enforcement action requiring cleanup of existing sites, and disposal at a II-2 landfilll; or

4. Inspect sites annually after commencement of fall rains to determine if existing drainage controls are adequate.

My recommendation is to follow numbers 2 and 4 above, by meeting with G-P and Fort Bragg Shavings to permit land disposal as a soil amendment except from Subchapter 15 pursuant to Section 2511(f), which requires the Regional Board issue waste discharge requirements for the soil amendment of "non-hazardous decomposable waste".

Susan Warner

SAW:pcg



STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY — GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF HEALTH SERVICES
714/744 P STREET
SACRAMENTO, CA 95814
(916) 324-1807

MAY 30 '85

May 23, 1985

Ms. Sue O'Leary
Georgia-Pacific Corporation
90 West Redwood Avenue
Fort Bragg, CA 95437

e a r Ms. O'Leary:

This is in response to your April 30, 1985 letter to Bill Quan regarding the clarification of the Department's position on Georgia-Pacific's fly ash, bottom ash, and flue gas emission control residue produced by the onsite burning of wood by-products. You stated that the North Coast Regional Water Quality Control Board (RWQCB) does not know, on the basis of our February 4 letter to Georgia-Pacific, if the company's aforementioned wastes are nonhazardous. Our February d letter was in response to the RWQCB's question regarding the appropriateness of the proposed use of Georgia-Pacific's fly ash as a soil amendment and not whether the fly ash was nonhazardous by departmental criteria, which is another matter. It is true, however, thet the Department does consider the fly ash as nonhazardous as stated in the Department's April 21, 1983 letter. In other words, your fly ash is not regulated by our Department.

I hope the above clarifies the Department's position on Georgia-Pacific's fly ash. If you have any further questions on the matter, please do not hesitate to call Pill Quan of my staff at (916) 322-0482.

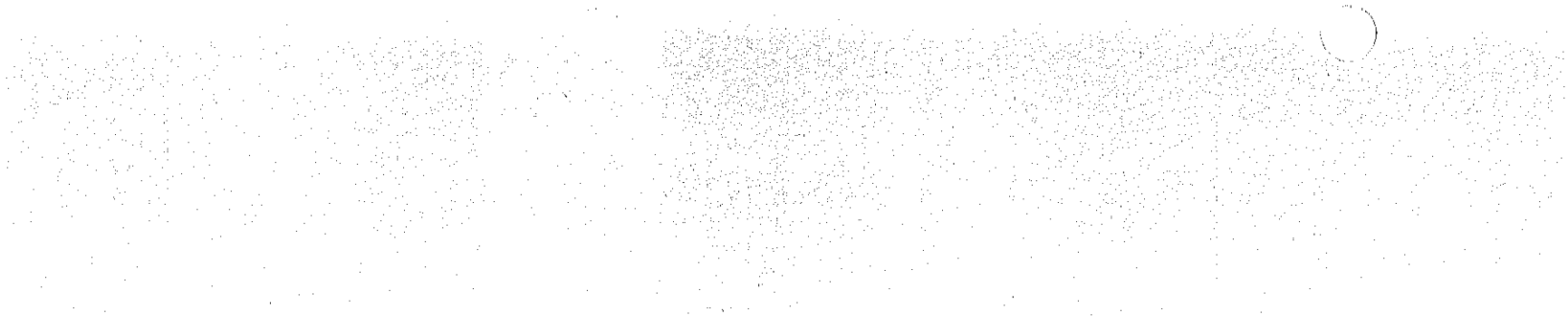
Sincerely,

David J. Leu

Cavid J. Leu, Ph.D., Chief
Alternative Technology & Policy
Development Section
Toxic Substances Control Division

DJL:WQ:sq

cc: North Coast Regional Water
Quality Control Board



NORTH COAST REGIONAL WATER QUALITY CONTROL BOARD

Interoffice Memorandum

TO: Craig Jonnson
Bob Tancreto
Candi Parker

DATE: May 29, 1985

FROM: Susan Warner

RE: Fort Bragg Shavings

Okay, guys, I think we agreed that:

Ash disposal from Georgia-Pacific via Fort Bragg Shavings is a low priority issue unless complaints are received.

No action will be taken with respect to modification of G-P's permit at this time.

No action will be taken regarding issuance of a permit or order to Fort Bragg Shavings at this time.

Candi and I will jointly inspect the ash disposal site on Pudding Creek which has generated previous complaints to determine whether there is a current water quality problem.

Any enforcement action for land disposal of the ash as a soil amendment would be a three-way enforcement on the generator of the waste (G-P), the purveyor of the amendment (Fort Bragg Shavings or WHOEVER is Albert's lastest psuedonym), and the landowner where the ash is deposited.

I will draft for joint approval and then send a letter to G-P and Fort Bragg Shavings indicating that (1) G-P is responsible for all wastes it generates; (2) wastes. products, soil amendments, or anything else should not be disposed of or placed where it could enter or threaten to enter waters and cause a water quality problem. Furthermore, Fort Bragg Shavings should alert their customers that the landowner who accepts the waste will be a responsible party for ensuring that no water quality problems result from use of the ash as a soil amendment.

Did I get it right? If so. inspection and drafts to follow.