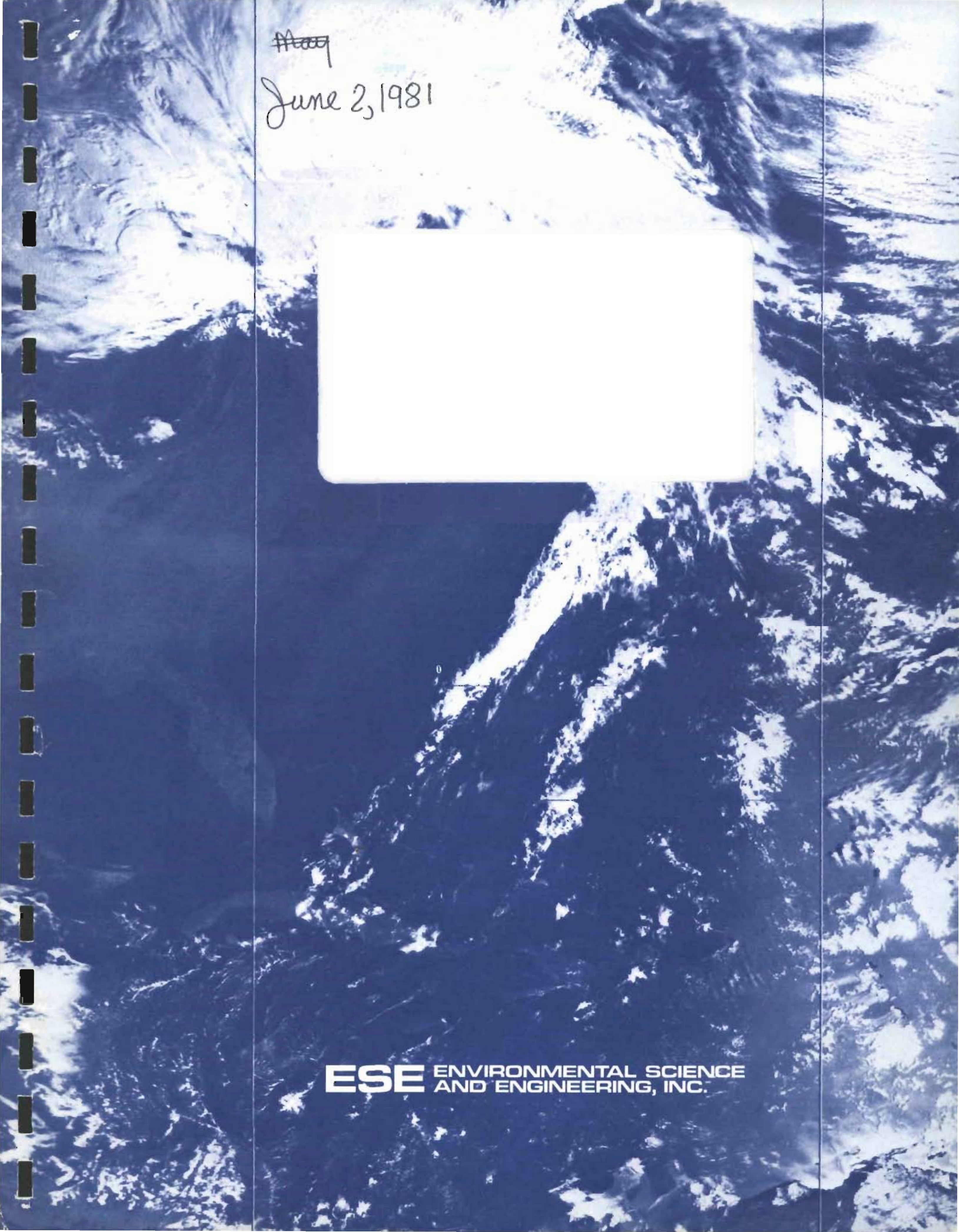

June 2, 1981

ESE ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.

PREVENTION OF SIGNIFICANT DETERIORATION ANALYSIS FOR THE PROPOSED GEORGIA-PACIFIC PLANT MODIFICATION

Prepared for:

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1.0 SUMMARY

Georgia-Pacific Corporation (G-P) is proposing to construct and operate five new sources of air pollutants at its existing kraft pulp mill near Palatka, Florida (see Figure 5-1 in Section 5 of this report). These new sources will include a recovery boiler and associated smelt tanks (2), a lime kiln, and a combination boiler fired by bark and peat. The proposed modification at the G-P mill will double production to 2,400 tons per day of unbleached pulp.

The State of Florida Department of Environmental Regulation (DER) and United States Environmental Protection Agency (EPA) have promulgated regulations concerning the Prevention of Significant Deterioration (PSD). All new major sources of air pollution must undergo a PSD review to determine if significant deterioration will be caused by the proposed new source. The proposed action is subject to both state and federal PSD regulations by virtue of an increase over specified emission levels for several air pollutants.

In response to these requirements, G-P contracted ESE, Inc. to perform a PSD analysis for the proposed action. The analysis was conducted using suggested and approved EPA and Florida DER atmospheric dispersion models and modeling techniques. Results showed that allowable PSD increments and State of Florida Ambient Air Quality Standards (AAQS) would not be violated as a result of the increased operating capacity of the mill. The analysis was based on maximum predicted emissions from the proposed and existing units.

Best Available Control Technology (BACT) for all affected pollutants will be met using appropriate control techniques and proper operation and maintenance procedures for the proposed modification. A BACT analysis is presented in the construction permit applications, which are submitted concurrently with this report to the State of Florida for state and federal review (see Appendix A).

Operation of the mill with the proposed additions functioning is not expected to have a significant impact upon visibility, soils, or vegetation, or on any area which has been designated Class I for PSD purposes. This report provides an evaluation of the PSD analysis and provides a complete description of the methods, data bases, results, and conclusions of the study.

2.0 PROJECT DESCRIPTION

This PSD report concerns the impact analysis for a proposed major modification to the existing G-P kraft pulp mill. Currently, two power boilers, a combination boiler and a recovery boiler are operating at the mill. In addition, there are two smelt tanks associated with the recovery boiler, and a lime kiln. The proposed action will add a recovery boiler and associated smelt tanks, a combination boiler, and a lime kiln. The new units at the Palatka mill will enable G-P to double the pulp production from the current rate and generate 2,400 tons per day of pulp.

The proposed combination boiler will burn peat and wood for steam production while the recovery boiler will burn black liquor solids. Fuel oil will be burned in these boilers only for startup, shutdown, emergencies, and system checking. The lime kiln uses lime mud ($CaCO_3$) in the process and also burns fuel oil. Site construction for the combination boiler is scheduled for December 1981 with completion targeted for 1983. Construction on the recovery boiler and lime kiln will begin approximately in September 1982, with completion scheduled for 1985.

Stack parameters for all G-P sources (existing and proposed) are presented in Table 2-1. The projected modeled emissions for the sources represent maximum capacity and maximum fuel usage. Emissions for the proposed sources are shown in Table 2-2. Emissions for existing sources are shown in Table 4-2 in Section 4. Maximum particulate emissions for the proposed combination boiler result from 100-percent bark firing, and maximum SO_2 emissions result from 100-percent peat firing.

Table 2-1. Stack Parameters for G-P Existing and Proposed Sources

Source	Stack Height (ft)	Stack Diameter (ft)	Flue Gas Temperature (°F)	Flue Gas Velocity (fps)
Power Boiler No. 4 (P.B. #4)	122	4.0	400	47.7
Power Boiler No. 5 (P.B. #5)	230	9.2	477	50.2
Combination Boiler No. 4 (Combo Blr #4)	230	10.0	400	34.5
Lime Kiln No. 4 (L.K. #4)	149	4.3	172	54.0
Recovery Boiler No. 4 (R.B. #4)	250	13.2	394	45.7
Smelt Dissolving Tanks No (4) (Smelt #4)	250	5.0	163	27.1
Proposed R.B. #5	250	13.2	394	45.7
Proposed L.K. #5	149	4.3	172	54.0
Proposed Combo Blr. #5	250	12.0	351	50.5
Proposed Smelt Tank Vents (Smelt #5)	250	5.0	163	27.1

Sources: ESE, 1981. G-P, 1981.

Table 2-2. Projected Emissions from Proposed Sources for the G-P Plant Modification

Source	Pollutant	Emissions Maximum (lb/hr)	Emissions Actual (TPY)	Allowable Emissions (lb/hr)	Potential Emissions (lb/hr)	Potential Emissions (TPY)
Combination Boiler #5	Particulate	216.7	928	216.7	9,561	41,878
	SO_2	653.6	2,206		654	2,863
	NO_x	255.0	981		255	1,117
	VOC	69.4	282		69	304
	CO	255.0	981		255	1,117
Recovery Boiler #5	Particulate	75.4	323.0	75.4	7,500	32,850
	SO_2	250.0	1,071.0		250	1,095
	NO_x	89.1	381.7		89	390
	VOC	48.0	205.6		48	210
	CO	871.2	3,732.0		871	3,816
	TRS	5.2	22.3	5.2	650	2,847
Smelt Tank Vents #5	Particulate	15.0	64.3	15.0	250	1,095
	SO_2	5.0	21.4		5	22
	TRS	1.3	5.4	1.3	22	96
Lime Kiln #5	Particulate	29.3	125.5	29.3	2,250	9,855
	SO_2	10.0	42.8		15	66
	NO_x	93.8	402.0		94	411
	VOC	24.0	102.8		27	120
	CO	500.0	2,142.0		500	2,190
	TRS	1.1	4.7	1.1	38	164

Source: ESE, 1981.

3.0 AIR QUALITY REVIEW REQUIREMENTS

The following discussion pertains to air quality regulatory requirements that must be met for the major modification proposed by G-P. These requirements include demonstrating compliance with AAQS and PSD increment consumption.

3.1 AMBIENT AIR QUALITY STANDARDS

As a result of the requirements of the 1970 Amendments to the Clean Air Act (CAA), EPA enacted Primary and Secondary National AAQS (Federal Register, 1971) for six air pollutants. Primary National AAQS are required to protect the public health, and Secondary National AAQS are required to protect the public welfare from any known or anticipated adverse effects associated with the presence of pollutants in the ambient air.

Table 3-1 presents the existing applicable National and State of Florida AAQS. In January 1972, the State of Florida promulgated the Secondary National AAQS as the State AAQS. Since states have the discretion of adopting or maintaining more stringent ambient air quality standards than those established by EPA, the State of Florida has chosen to retain the annual AAQS and 24-hour secondary AAQS for sulfur dioxide (SO_2) that have been eliminated by EPA since 1971. Pollutants for which AAQS have been established are termed "criteria" pollutants.

Areas of the country in violation of any of the AAQS are designated as "nonattainment areas," and new or modified sources to be located in or near these areas may be subject to more stringent air permitting requirements than sources located in ~~non-~~attainment areas. Putnam County is designated as an attainment area for all pollutants. However, Duval County, approximately 51 kilometers (km) to the north-northeast, has been designated as nonattainment for ozone (O_3), and the downtown Jacksonville area (approximately 71 km from G-P) in Duval County has been designated as nonattainment for particulate matter. No other areas within 100 km of the G-P site have been designated as nonattainment for any pollutant.

Table 3-1. National and State of Florida AAQS Applicable to the Proposed G-P Modification

Pollutant	Averaging Time	National Primary Standard	National Secondary Standard	Florida
Suspended Particulate Matter	Annual Geometric Mean	75 ug/m^3	60 ug/m^3	60 ug/m^3
	24-Hour Maximum*	260 ug/m^3	150 ug/m^3	150 ug/m^3
Sulfur Dioxide	Annual Arithmetic Mean	80 ug/m^3	NA†	60 ug/m^3
	24-Hour Maximum*	365 ug/m^3	NA†	260 ug/m^3
	3-Hour Maximum*	NA†	1,300 ug/m^3	1,300 ug/m^3
Carbon Monoxide	8-Hour Maximum*	10 mg/m^3	10 mg/m^3	10 mg/m^3
	1-Hour Maximum*	40 mg/m^3	40 mg/m^3	40 mg/m^3
Hydrocarbons	3-Hour Maximum* (6 to 9 A.M.)	160 ug/m^3	160 ug/m^3	160 ug/m^3
Nitrogen Dioxide	Annual Arithmetic Mean	100 ug/m^3	100 ug/m^3	100 ug/m^3
Ozone	1-Hour Maximum*	235 ug/m^3	235 ug/m^3	160 ug/m^3
Lead	Calendar Quarter Arithmetic Mean	1.5 ug/m^3	1.5 ug/m^3	NA†

* Maximum concentration not to be exceeded more than once per year.
† No standard exists.

Source: 40 CFR Part 50, 1980.

3.2 PREVENTION OF SIGNIFICANT DETERIORATION

3.2.1 General Requirements

Under federal PSD review requirements, all major new or modified sources of air pollutants regulated under the CAA must be reviewed and approved by EPA (or in this case, reviewed by Florida DER since technical and administrative review authority before final approval by EPA has been delegated to the state). A "major stationary source" is defined as any one of 28 named source categories which has the potential to emit 100 tons per year (TPY) or more, or any other stationary source which has the potential to emit 250 TPY or more, of any pollutant regulated under the Act. "Potential to emit" means the capability at maximum design capacity to emit a pollutant after the application of control equipment (40 CFR 52.21).

"Major modification" means any physical change in the design or operation of a major stationary source, or a series of contemporaneous changes in the design or operation of a major stationary source, that would result in a significant net increase in the source's potential to emit any pollutant subject to regulation under the CAA. (40 CFR 52.21). "Significant" is defined as any increase in emissions in excess of specified levels (Table 3-2).

The PSD review is used to determine whether significant air quality deterioration will result from the new or modified source. This section addresses PSD requirements contained in 40 CFR 52.21, Prevention of Significant Deterioration of Air Quality, and in the State of Florida PSD Regulations, Chapter 17-2, Florida Administrative Code. New major sources and modifications are required to undergo the following federal reviews related to PSD:

1. Control technology review,
2. Source impact analysis,
3. Air quality analysis (monitoring),

Table 3-2. Significant Emission Rates and De Minimis Air Quality Impact Levels

Pollutant	Significant Emission Rate (TPY)	De Minimis Air Quality Impact Level
Carbon Monoxide	100	575 ug/m^3, 8-hour average
Nitrogen Dioxide	40	14 ug/m^3, 24-hour
Total Suspended Particulates	25	10 ug/m^3, 24-hour
Sulfur Dioxide	40	13 ug/m^3, 24-hour
Ozone*	40 (volatile organic compounds)	
Lead	0.5	0.1 ug/m^3, 3-month
Mercury	0.1	0.25 ug/m^3, 24-hour
Beryllium	0.0004	0.0005 ug/m^3, 24-hour
Asbestos	1	†
Fluorides	3.0	0.25 ug/m^3, 24-hour
Sulfuric Acid Mist	7	†
Vinyl Chloride	1.0	15 ug/m^3, maximum value
Total Reduced Sulfur		
Hydrogen sulfide	10	10 ug/m^3, 1-hour
Reduced Sulfur Compounds		
(including H_2S)	10	10 ug/m^3, 1-hour
Hydrogen sulfide	10	0.023 ug/m^3, 1-hour
Benzene	0	0
Radionuclides	0	0
Inorganic Arsenic	0	0

* A de minimis air quality level is not given for ozone. However, a plant which is subject to PSD review and has a net increase of 100 TPY of volatile organic compounds would be required to perform an ambient air quality analysis.

† No satisfactory monitoring technique available at this time.

Source: EPA, 1980, 40CFR Part 52, Section 52.21.

4. Source information, and
5. Additional impact analyses.

The control technology review includes determination of BACT for each applicable pollutant. BACT information is contained in the DER construction permit application submitted concurrently with this report (see Appendix A).

Source impact analysis requires demonstration of compliance with federal and state AAQS and allowable increment limitations (see Table 3-3). Projected ambient impacts upon designated nonattainment areas and federally promulgated Class I PSD areas must also be addressed. The monitoring portion of PSD review requires that an analysis of continuous ambient air monitoring data be performed for the impact area of the proposed source. Source information, including process design parameters and control equipment information, must be submitted to the reviewing agencies. Additional analyses of the proposed source's impact upon soils, vegetation, and visibility, especially pertaining to Class I PSD areas, must be performed.

The PSD regulations specifically require the use of atmospheric dispersion models in performing impact analyses, estimating baseline and future air quality levels, and determining compliance with AAQS and allowable PSD increments. Guidance for the use and application of dispersion models is presented in the EPA publication, "Guideline on Air Quality Models" (EPA, 1978a). (Note: Recently, EPA held conferences and distributed revised guidelines in draft form.) The models used in the PSD analysis for G-P were the long-term (ISCLT) and short-term (ISCST) Industrial Source Complex models.

Various lengths of record for meteorological data can be used for short-term modeling. A 5-year period can be used with corresponding evaluation of highest, second-highest concentrations for comparison to AAQS or PSD increments. The term "highest, second-highest" refers to

Table 3-3. Federal and State of Florida PSD Allowable Increments (ug/m^3)

Pollutant/Averaging Time	Class I	Class II	Class III
Particulate Matter			
Annual Geometric Mean	5	19	37
24-Hour Maximum*	10	37	75
Sulfur Dioxide			
Annual Arithmetic Mean	2	20	40
24-Hour Maximum*	5	91	182
3-Hour Maximum*	25	512	700

* Maximum concentration not to be exceeded more than once per year.

Sources: Public Law 95-95, Clean Air Act Amendments of 1977.
Federal Register, Vol. 43, No. 118, June 19, 1978.

the highest at all receptors of the second-highest concentrations (i.e., the highest concentration at each receptor is discarded). The second-highest concentration is significant because the short-term AAQS specify that the level should not be exceeded at any location more than once a year. If less than 5 years of meteorological data are used, the highest concentration at any location must be used.

Florida DER has promulgated PSD regulations similar to those of EPA. Table 3-4 presents the applicable PSD regulations of Florida DER and EPA. Some important differences between the state and federal review requirements exist. The first is in the definition of "potential to emit," which determines if a new or modified source is "major" and therefore subject to PSD review. EPA defines "potential to emit" as emissions after control, and takes into account any decrease in emissions due to the application of control equipment which has been incorporated into the design of the source. Florida DER defines "potential emissions" as those emissions before the application of control equipment, unless such equipment is an inherent part of the process. The second major difference is in the EPA and Florida DER definition of "baseline" air quality. The following discussions describe in more detail the PSD requirements for the state and federal regulations, including the difference in baseline analysis.

3.2.2 Source Applicability

DER Review

The level of PSD analysis required for state review is based on the quantity of projected emissions from the modification. Pollutants from the proposed action with potential emissions (prior to control) in excess of 100 TPY are subject to PSD review. As Table 2-2 shows, the proposed action exceeds this amount for all pollutants listed therein. As such, a demonstration of air quality impacts and PSD increments is required. With regard to BACT, under DER rules for a PSD source, no increase in pollutant concentrations over the baseline will be allowed unless BACT is employed to control emissions from the facility.

Table 3-4. PSD Regulations Applicable to the Proposed G-P Modification

Requirement	Federal Regulation*	State of Florida Regulation†
General Source Applicability	40 CFR 52.21(i)	FAC 17-2.04(1)
Control Technology Review	40 CFR 52.21(j)	
New Source Performance Standards	40 CFR 52.21(j)(1)	FAC 17-2.03(1)(a)
Best Available Control Technology	40 CFR 52.21(j)(2)	FAC 17-2.04(6)(c)
Source Impact Analysis	40 CFR 52.21(k)	
Ambient Air Quality Standards	40 CFR 52.21(k)(1)	FAC 17-2.04(6)(a)
Allowable Increments	40 CFR 52.21(k)(2)	FAC 17-2.04(6)(a)
Air Quality Analysis (Monitoring)	40 CFR 52.21(m)	
Source Information	40 CFR 52.21(n)	FAC 17-2.04(6)(a)
Stack Heights	40 CFR 52.21(h)	
Additional Impact Analyses	40 CFR 52.21(o)	
Public Participation	40 CFR 52.21(q)	FAC 17-2.04(9)
Referenced Requirements		
Best Available Control Technology	40 CFR 52.21(b)(10)	FAC 17-2.03
Ambient Air Quality Standards	40 CFR 50	FAC 17-2.06(1)
Allowable Increments	40 CFR 52.21(c)	FAC 17-2.04(1)

* CFR = Code of Federal Regulations, 1980.
† FAC = Florida Administrative Code, Chapter 17-2, Supplement 101.

Sources: Code of Federal Regulations, 1980.
Florida Administrative Code, Chapter 17-2, Supplement 101.

As shown in the modeling analysis included with this report, no net increase in TSP concentrations is predicted over the baseline concentration. In addition, because of the large estimated decrease in TRS emissions, since the baseline, it can be assumed that no increase over the baseline for TRS has occurred.

In Chapter 17-2.03, Florida Administrative Code, it is required that a BACT determination be made following receipt of a permit to construct a major emitting facility which does not have an emission limiting standard in Section 17-2.05 or which is subject to BACT under 17-2.04. Since the proposed Combination Boiler #5 and Recovery Boiler #5 have a particulate emission limiting standard in Chapter 17-2.05, and the proposed Recovery Boiler #5 has a TRS emission limiting standard, and no increase over the baseline is predicted for these pollutants, BACT is not applicable to particulate and TRS emissions from these sources. A BACT analysis was conducted for all other pollutants listed in Table 2-2 and is contained in the construction permit application for each appropriate source (see Appendix A).

Baseline--State of Florida

For PSD purposes, the State of Florida has defined baseline concentration as:

> For sulfur dioxide and particulate matter, the applicable ambient concentration levels existing during 1974 plus any additional concentrations for the area of impact estimated to result from sources permitted for construction but not operating prior to January 1, 1975 . . . In the case of the 3-hour and 24-hour concentrations, only the second highest concentrations shall be considered [Florida Administrative Code, Chapter 17-2.02(14)].

In October 1978, the Florida DER Bureau of Air Quality Management published "Guidelines on Prevention of Significant Deterioration (PSD)--PSD Review." The document states: "Baseline emissions data consist of the January 1, 1975 allowable emission rates and January 1, 1975 stack configurations for all sources holding either an operating or construction permit during any part of 1974." As a result, Florida DER requires the formal establishment of a baseline concentration level. Because of the adopted definition, only modeling can be used to determine the baseline levels.

EPA Review

Under EPA regulations for PSD, the level of analysis required for a new major source or major modification is based on the net emissions increases in comparison with significant emission levels presented in Table 3-2. For a particular pollutant, a net increase in emissions due to a new major source or modification of a major source which is greater than the appropriate de minimis level would impose compliance with BACT, an air quality and PSD increment impact analysis, and preconstruction monitoring and the other PSD requirements listed in Table 3-4 for that pollutant.

The net emissions increase for a modification is determined after consideration of contemporaneous changes in actual emissions. A decrease in actual emissions may be credited only if it occurs after the date of 5 years prior to the commencement of construction (on the modification) (Federal Register, Vol. 45, No. 154, pp. 52701).

Certain contemporaneous emission decreases have occurred at G-P for which reduction credit is taken. The final year of operation for Recovery Boilers (RB) No. 1, 2, and 3, and the associated smelt tanks, was 1976. The 5-year period prior to the projected date on the commencement of construction (December 1981) began in December 1976. Therefore, emissions from RB Nos. 1, 2, and 3 and the associated smelt tanks are contemporaneous (see Table 3-6). These emissions are shown in Table 3-5 and are compared with the proposed sources. The existing sources at G-P are not included in the comparison because the normal operation, and therefore the annual emissions, will not change. As the

Table 3-5. Comparison of EPA Contemporaneous Emission Reductions With Proposed Emissions For G-P Paper Mill Modification

	Emissions (TPY)					
	TSP	SO_2	CO	NO_2	VOC	TRS
EPA Contemporaneous Reduction Sources						
Recovery Boiler #1	331	207	1,282	126	21	537
Recovery Boiler #2	423	296	1,832	180	30	768
Recovery Boiler #3	458	286	1,766	174	29	745
Smelt Tanks #1	10	4	—	—	—	19
Smelt Tanks #2	15	6	—	—	—	26
Smelt Tanks #3	14	6	—	—	—	25
Totals	1,251	805	4,880	480	80	2,120
Proposed Sources						
Lime Kiln #5	126	43	2,142	402	103	5
Recovery Boiler #5	323	1,071	3,732	382	206	22
Smelt Tanks #5	15	21	—	—	—	5
Combination Boiler #5	928	2,206	981	981	282	—
Totals	1,392	3,341	6,855	1,765	591	32
Difference*	+141	+2,536	+1,975	+1,285	+511	-2,088

* Positive numbers indicate a net emission increase; a (-) indicates a net emission decrease.

Source: ESE, 1981.

Table 3-6. List of Key Dates for the Proposed G-P Modification

Source	Construction Permit or Commence Construction	Operation Permit	Cease Operation
Lime Kiln #1	Prior to January 1, 1975	May 17, 1973	June 1976
Lime Kiln #2	Prior to January 1, 1975	May 17, 1973	1976
Lime Kiln #3	Prior to January 1, 1975	May 17, 1973	1976
Recovery Boiler and Smelt #1	Prior to January 1, 1975	May 17, 1973	December 1976†
Recovery Boiler and Smelt #2	Prior to January 1, 1975	May 17, 1973	December 1976†
Recovery Boiler and Smelt #3	Prior to January 1, 1975	May 17, 1973	December 1976†
Power Boiler #4	March 11, 1971	September 10, 1976	NA
Power Boiler #5††	May 17, 1973	October 19, 1976	NA
Combination Boiler #4	July 3, 1975*	March 3, 1971	NA
Lime Kiln #4	October 1974	March 1976	NA
Recovery Boiler and Smelt #4	October 1974	August 5, 1977	NA

* Application for new collectors. Operation permit with new collectors granted October 7, 1977.

† Served on a standby operation status before permanent shutdown in March 1977.

†† May 1973 was the initial construction date. October 1976 represents a modification to the boiler and corresponding emission reductions.

Source: ESE, 1981.

difference between the emissions from the contemporaneous reduction sources and the proposed sources shows, there is a decrease in total reduced sulfur (TRS) compound; therefore, further PSD analysis for this pollutant is not required. An impact analysis and BACT are required for pollutants other than TRS, due to net emission increases greater than the appropriate significant emission rates (see Table 3-2).

Source applicability with regard to preconstruction monitoring is addressed in the PSD Plan of Study (POS) document for the proposed G-P plant modification. This document was submitted to DER in May 1981. Results of the ambient monitoring applicability analysis show that total suspended particulate (TSP) and SO_2 monitoring is necessary. This monitoring is being conducted in accordance with the network design, data reporting, and quality assurance procedures outlined in the POS document.

In addition to air quality impact analyses, federal PSD regulations require additional analyses of the impairment to visibility and the impacts on soils and vegetation that would occur as a result of the proposed modification for pollutants for which there is a significant emissions increase. These analyses are to be conducted primarily for Class I PSD areas. Impacts due to general commercial, residential, industrial, and other growth associated with the source must also be addressed.

Baseline--EPA

EPA defines baseline concentration as that ambient concentration level which exists in the baseline area at the time of the applicable baseline date (40 CFR 52.21 (b)(13)(i). A baseline concentration is determined for each pollutant for which a baseline date is established and shall include:

1. The allowable emissions of major stationary sources which commenced construction before January 6, 1975, but were not in operation by the applicable baseline date;

2. The actual emissions representative of sources in existence on the applicable baseline date, except for those listed below, which will affect the maximum allowable increases:
   a. Actual emissions from any major stationary source on which construction commenced after January 6, 1975; and
   b. Actual emissions increases and decreases at any stationary source occurring after the baseline date.

When considering actual emission rates, EPA is referring to emissions estimated from source records and any other information reflecting actual source operation over the 2-year time period preceding the baseline date. The baseline date is 1977 and is applicable for both particulate matter and SO_2 for all attainment areas of the state. When applying the baseline emissions concept, EPA does not require the establishment of a formal baseline concentration.

When considering factors such as hours of operation, capacity utilization, and types of materials combusted, processed, and/or stored, the values existing at the baseline date will generally be used; however, the EPA baseline emissions concept can also include future increases in hours of operation or capacity utilization as they occur, if it is demonstrated that a source's operation after the baseline date is more representative of normal operation than its operation preceding the baseline date (Federal Register, 1980).

Modeling

In the modeling for PSD increment consumption, source applicability refers to dates for commencement of construction, beginning of operation, and any dates for the cease of operation. These dates are listed for all G-P sources in Table 3-6. The dates are important in determining baseline emission rates.

Federal PSD regulations require that changes in actual emissions due to major source construction commencing after January 6, 1975 not be included in the EPA baseline and that they affect the maximum allowable increments. As shown in Table 3-6, several sources were shut down in 1976. These sources were operating prior to 1975 and thus are included in the DER baseline. Curtailment of emissions from these sources expands the increment and is therefore included as EPA baseline to take credit for said expansion upon subtraction from the projected concentrations. Normal operation of the other sources listed in Table 3-6 will not be affected by the proposed action and therefore baseline emission conditions are the same as the projected emissions conditions.

3.3 GOOD ENGINEERING PRACTICE STACK HEIGHT

The 1977 CAA Amendments require that the degree of emission limitation necessary for control of any pollutant not be affected by a stack height that exceeds good engineering practice (GEP) or any other dispersion technique. On January 12, 1979, EPA promulgated proposed regulations on stack heights. The proposed GEP stack height means the highest of:

a) 30 meters, or

b) a height established by applying the formula:

$$H_g = H + 1.5L \qquad \text{(Equation 1)}$$

where: H_g = GEP stack height,

H = Height of the structure or nearby structure, and

L = Lesser dimension (height or width of the structure or nearby structure).

"Nearby" is defined for a specific structure or terrain feature as that distance equal to five times the lesser of the height or width dimension of the structure or terrain feature not greater than one-half mile (EPA, 1978d). While the actual stack height employed can exceed this height, modeling for determining compliance with AAQS and PSD increments must incorporate the GEP stack height.

Two major imposing structures are present at the G-P mill. All stacks except for the lime kiln stacks will be most affected by the Recovery Boiler Building wake. The lime kiln stacks are influenced by the lime kiln structure. The lime kiln structure is not a solid building but a lattice of steel members; however, it was considered for building wake effects. The appropriate buidling dimensions are listed in Table 3-7. Following is a GEP stack height determination for each proposed stack using the above equation and the appropriate building dimensions given in Table 3-7.

Lime Kiln: Influencing Height = 82 feet
Influencing Width = 47 feet
GEP = 82 + 1.5(47) = 153 feet
(Proposed height = 149 feet)

Combination Boiler:
Influencing Height = 211.7 feet
Influencing Width = 88 feet
GEP = 211.7 + 1.5(88) = 344 feet
(Proposed height = 250 feet)

Recovery Boiler: Same as Combination Boiler
(Proposed height = 250 feet)

Smelt Tanks: Influencing Height = 211.7 feet
Influencing Width = 102.5 feet (stacks located on top of recovery boiler)
GEP = 211.7 + 1.5(102.5) = 365 feet
(Proposed height = 250 feet)

Table 3-7. Building Dimensions for Major Influencing Structures At G-P Palatka Paper Mill

Structure	Height (ft)	Width (ft)	Depth (ft)
Recovery Boiler	211.7	88	102.5
Lime Kiln	82	47	40

Source: G-P, 1981.

Because of the proposed stack heights being less than GEP, a downwash analysis must be performed and is presented in Section 6.

4.0 ATMOSPHERIC DISPERSION MODELING METHODOLOGY

To evaluate completely the impact of emissions and to determine compliance with AAQS and other regulations, the relationship between atmospheric emissions and air quality must be established. One approach to determine this relationship is to assume that a change in emissions would cause a proportionate change in air quality. This approach, however, does not explicitly include the effects of meteorology, topography, and stack gas parameters. Therefore, this method does not ensure an accurate estimate of the impact of emissions on the overall air quality.

In response to this deficiency, the air quality dispersion model has become an accepted method for estimating the spatial distribution of pollutant concentrations. Currently, the dispersion models are generally restricted to nonreactive or slow-reacting pollutants, such as SO_2, particulate matter, and CO. Current state-of-the-art techniques in dispersion modeling cannot accurately predict concentrations for reactive pollutant species such as nitrogen dioxide (NO_2), hydrocarbons (HC), and photochemical oxidants.

Mathematical dispersion models simulate the effects of stack height, stack flow parameters, source distributions, and atmospheric elements such as air flow and mixing on the transport and dispersion of pollutants emitted into the atmosphere. Dispersion models are useful for calculating the spatial distribution of concentrations that result from various sources, and these models can be used to estimate ground-level concentrations for extreme meteorological conditions. Figure 4-1, which illustrates the procedure to follow in applying a mathematical model, shows that by compiling existing emissions, meteorological, and air quality data, a dispersion model can estimate the impact of source emissions on air quality. The model is also useful in predicting the relative change in air quality as a result of varying emission parameters, meteorological conditions, and source distributions.

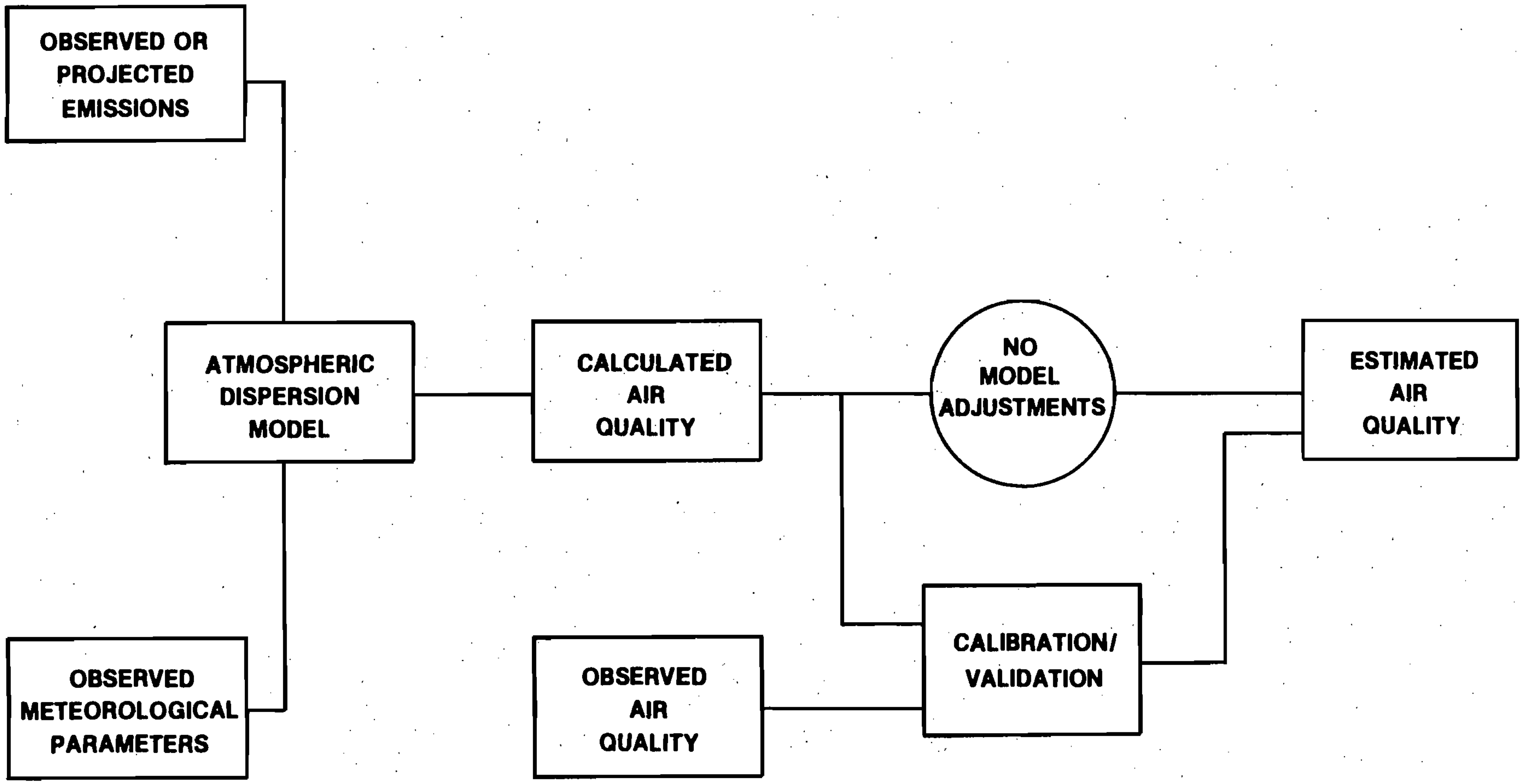

Figure 4-1
FLOW DIAGRAM FOR THE APPLICATION OF ATMOSPHERIC DISPERSION MODELS.

ENVIRONMENTAL SCIENCE
AND ENGINEERING, INC.

EPA has developed several dispersion models which use the Gaussian diffusion equation. The basic formulation of the Gaussian equation assumes that the ground-level concentration is inversely proportional to the mean wind speed. The Gaussian distribution describes the horizontal and vertical pollutant dispersion in a plane normal to the wind direction.

An atmospheric dispersion model can be defined as a mathematical description of the transport, dispersion, and transformation processes that occur in the atmosphere. In the case of SO_2, it is generally assumed that chemical conversion of this substance is small with respect to its average residence time in the atmosphere. In the case of particulate matter, it is assumed that no particles are scavenged from the atmosphere by fallout or washout. These conservative assumptions tend to result in higher predicted concentrations than actual measured concentrations.

Florida DER and EPA Ambient Air Quality Standards are for annual, 24-hour, 8-hour, and 3-hour periods of time; therefore, the dispersion models must predict concentrations for various averaging times. Most dispersion models, however, estimate concentrations for a 1-hour period or for seasonal or annual time periods. If an average concentration for an intermediate period is required, then two options, both of which are approved by EPA and Florida DER, are available:

1. The short-term model can be used to estimate concentrations hour by hour for the period of interest, and an average of all hours can be taken with consideration given to an appropriate calibration factor.
2. Statistical techniques suggested by Larsen (1971) for log-normally distributed data or empirical techniques as summarized by Strom (1976) for point sources can be utilized to convert a concentration from one averaging time to another.

In this study, Method 1 was utilized to determine point source impacts for the annual, 24-hour, 8-hour, 3-hour, and 1-hour averaging times.

The long-term AAQS for TSP is expressed in terms of an annual geometric mean. The air dispersion models, however, calculate annual arithmetic mean concentrations. Therefore, a method of conversion from arithmetic mean to geometric mean concentration is necessary in order to compare estimates with air quality standards. Larsen (1971) has developed an equation which expresses the relationship for log-normally distributed data:

$$Mg = \frac{Maa}{\exp\,(0.5\ \ln 2\ S_g)} \qquad \text{(Equation 2)}$$

where: M_g = geometric mean
M_{aa} = arithmetic mean
S_g = standard geometric deviation

An analysis of many years of ambient TSP data indicates that the log-normal assumption is a good approximation for suspended particulates in suburban and rural areas. This analysis also shows that S_g values normally range from 1.0 to 2.0 for an annual period, with a typical value of 1.5. Inserting an S_g of 1.5 into Equation 2 results in a M_g/M_{aa} ratio of 0.92. This ratio is used to convert arithmetic mean TSP levels to geometric mean TSP levels, based upon the modeling results.

4.1 COMPUTER MODELS

Two EPA-approved computer models were used to estimate or predict the grond-level pollutant concentrations in this study. The Industrial Source Complex Model Long Term (ISCLT) was used to predict annual impacts, and the Industrial Source Complex Model Short Term (ISCST) was used for impact predictions for shorter averaging times.

In the ISCLT, sources within a 50-km radius were modeled. The impact area receptor grid for the model covered a 25-km^2 radius surrounding the G-P site, with receptors placed at a 0.5-km spacing.

In the ISCST, the receptors were spaced at 0.3-km intervals along 10-degree radials, beginning at 0.6 km for SO_2 and 0.3 for TSP. The worst-case meteorology was determined from this modeling. The ISCST model allows the user to input spatially distributed sources and was used for receptor refinement (at 2 degrees radial, and 0.1-km spacing) to resolve the maximum impact predictions. The short-term modeling case runs and meteorological periods are presented in Table 4-1.

4.2 METEOROLOGY

Meteorological data used in the ISC modeling were obtained from the Jacksonville Airport (surface observations) and Valdosta, Georgia (upper air data) for the years 1970 through 1974. Recorded data included wind direction, wind speed, stability class, mixing depth, and ambient temperature for each hour. Wind directions are randomized within a 10-degree sector by EPA's randomization scheme. The ISCST model processed each hour of the data set to estimate hourly concentrations over the 5-year period. These concentrations were averaged over each applicable averaging period to provide the user with the desired concentrations.

The ISCLT used the data record as a joint frequency distribution of wind direction, wind speed, and atmospheric stability class over the 5-year period. This data format is provided by the National Climatic Center's (NCC) "Star" program. In addition, annual averaged values of temperature, pressure, and maximum afternoon mixing heights are used. These data are used in the ISCLT to estimate the spatial distribution of annual averaged concentrations of baseline and future ambient concentration levels.

4.3 EMISSIONS INVENTORY

For short-term modeling, major sources located within a 15-km radius were considered, while the area of consideration extended to 50-km in the long-term modeling. Basis for the inventory was the Air Permit Inventory System (APIS). In addition, construction permit applications

Table 4-1. Short-Term Modeling Case Runs and Meteorological Periods

Scenario	Day
SO_2	
Maximum 24-Hour	195, 1971 280, 1970
Interaction with Seminole Electric	230, 1972
Interaction with FP&L Plants	180, 1974
Maximum 3-Hour	126, 8/1973
Interaction with Seminole Electric	109, 4/1974
Interaction with FP&L Plants	219, 5/1972
TSP	
Maximum 24-Hour	222, 1971 137, 1973 281, 1970
Interaction with Seminole Electric	7, 1973
Interaction with FP&L Plants	143, 1971

and various modeling reports were considered in developing the inventory, and the maximum emission rates contained therein were used.

4.4 AIR QUALITY IMPACT DETERMINATION

The ISCLT model was used to estimate annual average ground-level concentrations for TSP and SO_2. For these pollutants, modeling was performed for permitted sources within a 50-km radius, including the G-P sources. For annual nitrogen oxides (NO_x), reference is made to the March 1981 POS for which NO_x modeling was conducted. These modeling results showed that the proposed action will pose no threat to the AAQS. All annual printouts are included in Appendix B of this report.

Evaluation of short-term maximum impacts (highest, second-highest) for TSP and SO_2 for the G-P proposed conditions was made using the ISCST. The appropriate highest, second-highest concentrations were determined in 5-year ISCST executions with the following short-term interacting sources included with the G-P sources in the source input data:

1. Seminole Electric (7.5 km and 39 degrees from G-P),
2. FPL Putnam (10.9 km and 150 degrees from G-P), and
3. FPL Palatka (10.6 km and 147 degrees from G-P).

The results of the 5-year ISCST modeling were refined using the ISCST model to determine the maximum impacts and impacts in the interacting directions. The modeled sources and emissions are shown in Table 4-2.

4.5 INCREMENT CONSUMPTION DETERMINATION

The maximum short-term PSD increment consumption was determined by subtracting receptors point-by-point in 5-year ISCST baseline executions from 5-year ISCST projected impacts. Seminole Electric is the only new source in the G-P impact area and currently is under construction. FPL Palatka consumes TSP increments by virtue of a variance to emit particulate up to 0.3 lb/10^6 Btu, increased from 0.1 lb/10^6 Btu. FPL Putnam

Table 4-2. Modeled Sources and Emissions for G-P Proposed Modification

Source	Baseline Emissions Annual (TPY) TSP	 SO_2	 Short-Term (lb/hr) TSP	 SO_2	Projected Emissions (lb/hr) TSP	 SO_2
Recovery Boiler #1	345	216	78.8	49.3	—	—
Recovery Boiler #2	441	309	100.7	70.5	—	—
Recovery Boiler #3	477	298	109.0	68.1	—	—
Recovery Boiler #4	729	1,215	166.5	277.5	166.5	277.5
Proposed Recovery Boiler #5	—	—	—	—	75.4	250.0
Smelt #1	11	4	2.4	1.0	—	—
Smelt #2	16	6	3.6	1.4	—	—
Smelt #3	14	6	3.3	1.4	—	—
Smelt #4	193	25	40.8	5.6	40.8	5.6
Proposed Smelt	—	—	—	—	15.0	5.2
Lime Kiln #1	788	8	180.0	0.24	—	—
Lime Kiln #2	416	8	95.0	0.24	—	—
Lime Kiln #3	407	17	93.0	0.48	—	—
Lime Kiln #4	54.6	48.6	31.6	11.1	31.6	11.1
Proposed Lime Kiln #5	—	—	—	—	29.3	10.5
Power Boiler #4	105	1,192	106.3	2,848.1	106.3	2,848.1
Power Boiler #5	186	4,658	46.4	1,279.0	46.4	1,279.0
Combination Boiler #4	2,561	1,008	711.8	962.5	117.0	962.5
Proposed Combination Boiler #5	—	—	—	—	216.7	654.0
FPL Palatka	468	12,888	107.0	2,942.5	321.0	2,942.5
FPL Putnam	1,206	6,723	275.4	1,535.0	275.4	3,070.0
Seminole	—	—	—	—	324.6	12,984.1

Sources: ESE, 1981. G-P, 1981.

affects SO_2 increment due to a fuel switch (0.35 to 0.7-percent sulfur oil) and a stack height increase.

Maximum allowable emissions for the existing sources at G-P were used for both short-term baseline and projected modeling. Use of these data is justifiable for the short-term baseline modeling because stack test results showed that the sources operated up to the maximum allowable rates. For the long-term baseline modeling, however, conditions represented in annual operating reports were used. The modeled sources and the emissions are shown in Table 4-2.

As with the short-term increment analysis, impacts in 5-year ISCLT baseline executions were subtracted from 5-year ISCLT executions for the projected conditions to determine long-term TSP and SO_2 increment consumption.

A TSP background concentration was unavailable from existing data. However, the Seminole Electric PSD was consulted and the values therein were used. The second-highest measured 24-hour TSP concentration from a former FDER monitor at Kay Larkin Aiport was 80 ug/m^3. This value is very high for background and probably include some influence from the G-P mill. The probability of this level occurring concurrent with worst-case meteorology for point source emissions is very small. Nevertheless, 80 ug/m^3 was used to represent extreme worst-case conditions. The annual TSP background concentration was assumed 40 ug/m^3 and was obtained from PSD modeling guidelines.

4.6 DOWNWASH METHODOLOGY

As shown in Section 3.3, the proposed stacks for G-P are at a height less then GEP. The required downwash analysis was conducted using the downwash option in the ISCST. The ISCST refinement executions for the highest, second-highest 24-hour TSP and SO_2 concentrations were modified to request contributions from the proposed G-P sources only, with and without downwash considerations. These modeling executions were compared to show what increase in impact could be expected due to downwash effects.

In addition, 4 hours of meteorological conditions conducive to downwash effects were selected and requested in ISCST executions with and without downwash conditions. These four meteorological conditions were: a "C" stability class and a low wind speed representative of that class (5 mps); a "C" stability class and a high wind speed representative of that class (10 mps), and; a low (12 mps) and high wind speed (15 mps) representative of a "D" stability class.

These comparisions with and without downwash considerations indicate whether downwash conditions will have an adverse effect on the air quality impact of the proposed sources.

5.0 AMBIENT AIR MONITORING

Preconstruction ambient monitoring is being conducted at the G-P site. Preliminary emissions analysis and modeling indicated that TSP and SO_2 monitoring was necessary. One SO_2 continuous site and four TSP sites were chosen to represent background, and an area of high impact for existing and proposed conditions (see Figure 5-1 for locations of preconstruction monitoring sites). The monitoring data collected at these sites will be submitted quarterly to DER. For further description of the preconstruction monitoring analysis, refer to the POS submitted to DER in March 1981.

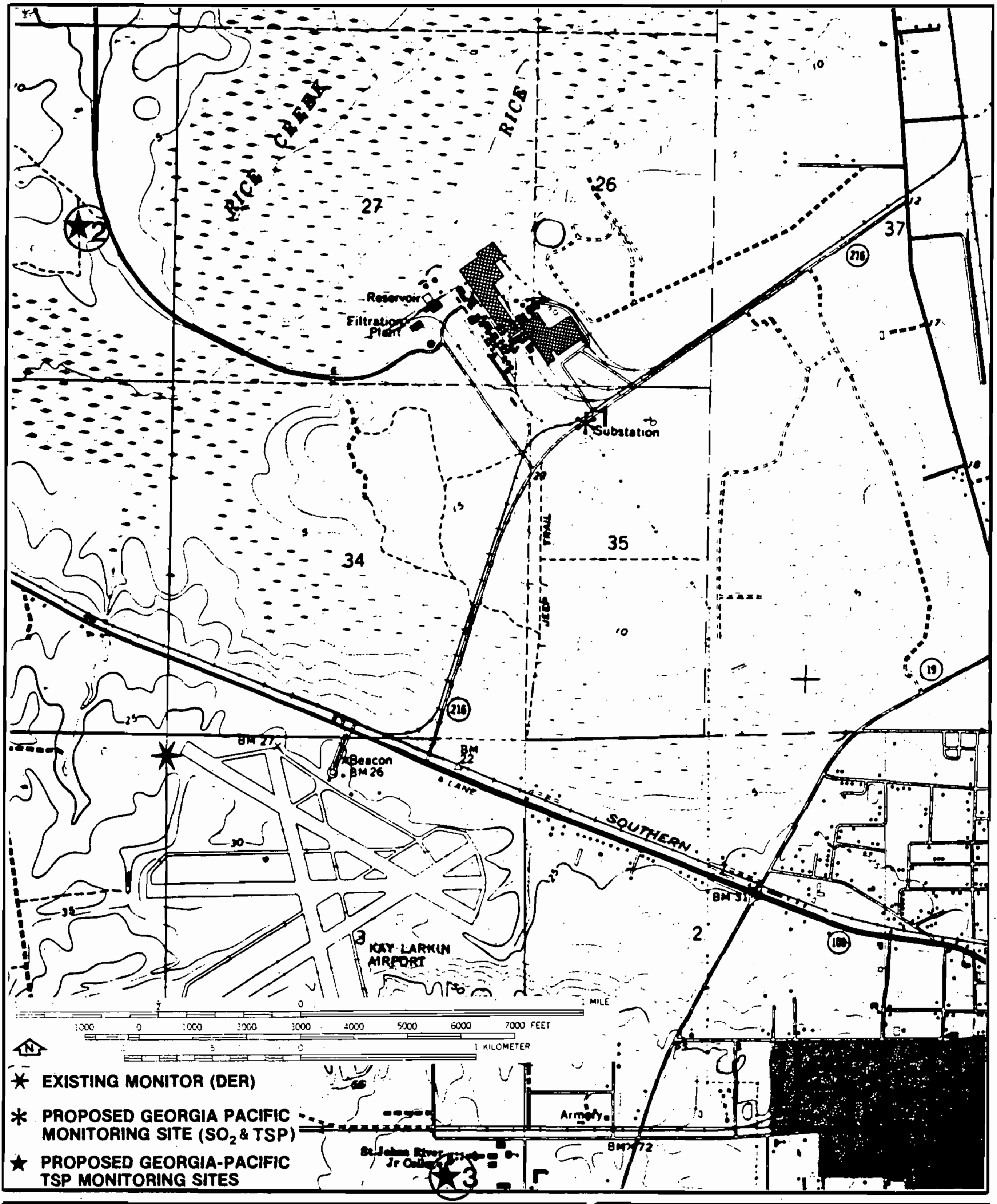

Figure 5-1

LOCATION OF EXISTING AMBIENT MONITORS AND PROPOSED GEORGIA-PACIFIC MONITORING STATIONS

SOURCE: ESE, 1981.

GEORGIA-PACIFIC CORPORATION

6.0 IMPACT ANALYSIS RESULTS

6.1 AIR QUALITY STANDARDS

6.1.1 Particulate Matter

The highest, second-highest predicted 24-hour ground-level concentration for the projected conditions considering the proposed action at G-P is 107.5 ug/m^3, including an assumed background concentration of 80 ug/m^3. This predicted maximum impact (highest, second-highest) is 72 percent of the AAQS for TSP. Predicted maximum interaction impacts are 101, 105, and 102 ug/m^3 (including background). These interactions are 67, 70, and 68 percent of the AAQS for TSP and result from operations at Seminole Electric, FPL Palatka, and FPL Putnam, respectively.

The maximum predicted annual TSP impact for the projected conditions, including all interacting sources, is 44 ug/m^3 and is 73 percent of the annual AAQS for TSP. This value includes the assumed background of 40 ug/m^3. All modeling results are shown in Table 6-1 along with the applicable AAQS for visual comparison.

6.1.2 Sulfur Dioxide

The highest, second-highest 3- and 24-hour concentrations predicted for the proposed conditions are 295 and 98 ug/m^3, respectively. Predicted highest, second-highest concentrations due to interaction with Seminole Electric, FPL Putnam, and FPL Palatka are 191, 214, and 214 ug/m^3, respectively, for the 3-hour averaging time, and 47, 59, and 59 ug/m^3, respectively, for the 24-hour averaging time (see Table 6-1). The maximum predicted annual SO_2 impact as a result of the proposed action and including interacting sources is 22 ug/m^3, or 37 percent of the annual SO_2 standard.

6.1.3 Nitrogen Oxides and Carbon Monoxide

Preliminary modeling conducted for the POS showed small impacts for NO_x and CO; therefore, no additional modeling was conducted.

6.2 INCREMENT CONSUMPTION

The short-term increment consumption analysis is the same for the federal review as for DER; however, because EPA uses actual baseline emissions

Table 6-1. Proposed G-P Mill Modification: Maximum Annual and Highest, Second-Highest Short-Term Predicted Concentrations*

	Concentration (ug/m^3)				
Scenario	3-Hour SO_2	24-Hour SO_2	24-Hour TSP	Annual SO_2	Annual TSP
Maximum Predicted	295	98	108	22	44
Interaction with Seminole Electric	191	47	101	--	--
Interaction with FPL Putnam	214	59	105	--	--
Interaction with FPL Palatka	214	59	102	--	--
State of Florida Standard	1,300	260	150	60	60

* Concentrations include a TSP background of 80 ug/m^3 (24-hour) and 40 ug/m^3 (annual).

Source: ESE, 1981.

instead of allowable, the annual analysis predicted slightly different consumptions for the proposed action. The predicted short-term SO_2 and TSP increment consumption under both EPA and DER regulations is negative (i.e., an air quality improvement at all locations compared to the baseline concentrations).

Annual TSP increment consumption under both DER and EPA regulations was negative at all receptor locations, indicating an improvement in TSP air quality compared to the baseline concentrations. Annual SO_2 increment consumption based on DER regulations was less than 5 ug/m^3, and annual SO_2 increment consumption was less than 6 ug/m^3. In both the annual and short-term maximum increment consumption results, the appropriate interacting sources were considered. Maximum interactions are presented in Table 6-2 along with allowable Class II increments for comparison purposes.

6.3 CLASS I IMPACTS

Because of the distance to the nearest Class I area (Okefenokee Swamp, 120 km northwest), impacts on the Class I area were not addressed quantitatively. However, increment modeling in the vicinity of G-P showed a substantial decrease in TSP levels since the baseline.

6.4 DOWNWASH

In comparing the 24-hour highest, second-highest TSP refinement execution requesting the G-P proposed sources only with and without downwash, it was found that with the consideration of downwash effects, the maximum increase was only 1 ug/m^3 above no downwash considerations. For the 24-hour SO_2 refinement, the maximum increase was 5 ug/m^3 above the no-downwash case (24-hour averages).

In comparing four selected hours of meteorological data conducive to downwash effects, the maximum 1-hour increase due to downwash was 27 ug/m^3 for TSP and 50 ug/m for SO_2. Using the EPA method given in the guidelines document, Volume 10, a factor of 0.6 (maximum) was used

Table 6-2. Summary of PSD Increment Consumption Results: Proposed G-P Modification

Pollutant	EPA 3-Hour	EPA 24-Hour	EPA Annual	DER 3-Hour	DER 24-Hour	DER Annual
	Increment Consumption (ug/m^3)					
Sulfur Dioxide						
Maximum Increment Consumption	<0	<0	<6	<0	<0	<5
Allowable Increment	512	91	20	512	91	20
Particulate						
Maximum Increment Consumption	--	<0	<0	--	<0	<0
Allowable Increment	--	37	19	--	37	19

Source: ESE, 1981.

to correct for a 24-hour average. The increases were then predicted to be 16 ug/m^3 and 30 ug/m^3, respectively. If these increases were applied to the worst-case modeling results (see Sections 6.1.1 and 6.1.2), the resulting concentrations would remain below AAQS (123.5 ug/m^3 for 24-hour TSP and 127.6 for 24-hour SO_2), indicating that the stacks proposed at heights less than GEP will not pose a threat to AAQS.

7.0 ADDITIONAL IMPACTS ON SOILS, VEGETATION, AND VISIBILITY

7.1 IMPACTS ON SOILS AND VEGETATION

Impacts on soils and vegetation due to operation of the proposed sources are expected to be minor. The projected highest, second-highest 3-hour SO_2 concentration of 295 ug/m^3 and annual mean concentration of 22 ug/m^3 (see Table 7-1) are well below levels generally reported for damage to sensitive plant species. As an example of such damage levels, European studies have found one-half hour levels of 3,406 ug/m^3 and long-term means of 393 ug/m^3 to approximate threshold levels for several species (Heck and Brandt, 1977). Other long-term studies have indicated threshold ranges for sensitive species of 47 ug/m^3 to 78 ug/m^3 over two to four months of exposure and 31 ug/m^3 over seven months (Florida Sulfur Oxides Study, Inc., 1978).

Alfalfa, which is commonly thought to be one of the most SO_2-sensitive species, has a 2-hour threshold level of at least 2,620 ug/m^2 and an 8-hour threshold of 655 ug/m^2 (Heck and Brandt, 1977), far above the predicted impact levels. Based upon results such as these, no discernable impacts are predicted from this source.

Particulate matter is generally considered to have a relatively unimportant effect on vegetation (Jacobson & Hill, 1970). A net air quality improvement is predicted over the baseline conditions (see Section 7); as such, no adverse effect on soils and vegetation due to particulate emissions is expected.

Plant species classified as "sensitive" to NO_2, such as pinto bean, cucumber, lettuce, and tomato, displayed injury when exposed to NO_2 levels of 3,760 to 4,960 ug/m^3 for a 2-hour period. Extremely resistant species, such as heath, were unaffected by an exposure of 1,900,000 ug/m^3 for 1 hour. Blue grass, orange tree plants, and rye are all classified as "intermediate" in resistance to NO_2 injury.

It has been found that NO_x concentration is more important to plant injury than the duration of exposure (Jacobson, et al., 1970). Because of the very low levels of NO_2 predicted to occur due to the proposed action, no effect on plants or soils is expected.

Effects of SO_2, NO_2, and particulate matter emissions upon soils are expected to be negligible. Acid rain effects in the area are generally unknown due to a lack of data for the region (Florida Sulfur Oxides Study, Inc., 1978): the potential for significant acid rain effects due to the proposed source is considered to be very low.

7.2 VISIBILITY IMPACTS

The proposed source is expected to have no significant impairment on visibility in the immediate affected area or upon the nonattainment or Class I PSD areas previously described in Section 2.0. During construction at the mill, construction activities may have a small transient effect on local visibility. The visible particulate emissions produced by various construction activities such as earth movement and heavy machinery operation, should have short-term impacts on visibility and should occur only during the actual construction activities. There should be no long-term impairment on visibility due to construction activities for the proposed source.

No significant impact on visibility is expected at the nearest Class I area from operation of the various facilities for the proposed modification. This area (Okefenokee Swamp) is located more than 120 km from the G-P site, and therefore, no quantitative visibility analysis was conducted.

8.0 CONCLUSIONS

Based upon atmospheric dispersion modeling results presented in Section 5, it is predicted that the allowable Class II PSD increments will not be exceeded. Impacts on the nearest Class I area will be less than the allowable increments as a result of the proposed G-P mill modification due to the large distance to the Class I area. In addition, it is expected that AAQS will not be exceeded, and that designated nonattainment areas will not be significantly affected by the proposed source. These results are based on modeling of worst-case meteorological conditions, 100-percent load conditions, and maximum allowable emissions from all G-P and interacting sources. This scenario has a low probability of occurrence, since the above conditions would have to occur simultaneously.

All NSPS will be met by appropriate facilities in the complex. Each facility will apply BACT where required to control emissions.

Impacts upon soils, vegetation, and visibility in the area of the proposed site are not predicted to be significant. All stacks within the complex will conform to GEP regulations. All ambient air monitoring requirements are being satisfied by the preconstruction monitoring program conducted by G-P.

In summary, the proposed action for the G-P Palatka plant is expected to comply with all state and federal PSD and air quality regulations.

REFERENCES

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Larsen, R.I. 1971. A Mathematical Model for Relating Air Quality Measurements to Air Quality Standards. Pub. No. AP-89. U.S. EPA, Office of Air Programs, Research Triangle Park, North Carolina.

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U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. 1978c. Guidelines for Determining Best Available Control Technology (BACT).

U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. 1978d. Technical Support for Determination of Good Engineering Practice Stack Height. Research Triangle Park, North Carolina.

APPENDIX A

CONSTRUCTION PERMIT APPLICATIONS

APPENDIX A

CONSTRUCTION PERMIT APPLICATIONS

COMBINATION BOILER NO. 5

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Combination Boiler No. 5 [x] New[1] [ ] Existing[1]

APPLICATION TYPE: [x] Construction [ ] Operation [ ] Modification

COMPANY NAME: Georgia-Pacific Corporation COUNTY: Putnam

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peeking Unit No. 2, Gas Fired) Combination Boiler No. 5 with ESP

SOURCE LOCATION: Street N. of S.R. 216, W. of U.S. 17 City Palatka

UTM: East 434.0 North 3,283.4

Latitude 29 ° 41 ' 00 "N Longitude 81 ° 40 ' 45 "W

APPLICANT NAME AND TITLE: Roger C. Sherwood, Technical Director

APPLICANT ADDRESS: P.O. Box 919, Palatka, Florida 32077

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Georgia-Pacific Corporation.

I certify that the statements made in this application for a construction permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: Roger C. Sherwood by wka

Roger C. Sherwood, Technical Director
Name and Title (Please Type)

Date: 6-2-81 Telephone No. 904/325-2001

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed: David A. Buff

David A. Buff
Name (Please Type)

Environmental Science and Engineering, Inc.
Company Name (Please Type)

P.O. Box ESE, Gainesville, Florida 32604
Mailing Address (Please Type)

Date: 6-2-81 Telephone No. 904/372-3318

(Affix Seal)

Florida Registration No. 19011

---

[1] See Section 17-2.02(15) and (22), Florida Administrative Code, (F.A.C.)

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

A new 700,000 lb/hr steam combination boiler equipped with an ESP will be constructed adjacent to the present No.4 recovery boiler. The boiler will be fired by peat, wood waste (primarily bark), or a combination of these two fuels. The source will comply with all applicable state and federal regulations.

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction December, 1981 Completion of Construction 1983

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

ESP: $2.5 million - $4.0 million

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

Not applicable

E. Is this application associated with or part of a Development of Regional Impact (DRI) pursuant to Chapter 380, Florida Statutes, and Chapter 22F-2, Florida Administrative Code? Yes [✓ No]

F. Normal equipment operating time: hrs/day 24 ; days/wk 7 ; wks/yr 51 ; if power plant, hrs/yr 8568 ;

if seasonal, describe:

G. If this is a new source or major modification, answer the following questions. (Yes or No)

1. Is this source in a non-attainment area for a particular pollutant? No
   - a. If yes, has "offset" been applied? -
   - b. If yes, has "Lowest Achievable Emission Rate" been applied? -
   - c. If yes, list non-attainment pollutants. -
2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. Yes
3. Does the State "Prevention of Significant Deterioriation" (PSD) requirements apply to this source? If yes, see Sections VI and VII. Yes
4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? No
5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? No

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
	Not applicable			

B. Process Rate, if applicable: (See Section V, Item 1)

1. Total Process Input Rate (lbs/hr): Not applicable
2. Product Weight (lbs/hr): 700,000 lb/hr steam max

C. Airborne Contaminants Emitted:

Name of Contaminant	Emission[1]		Allowed Emission[2] Rate per Ch. 17-2, F.A.C.	Allowable[3] Emission lbs/hr	Potential Emission[4]		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/hr	T/yr	
Particulate	216.7	928	17-2.05; 0.2 lb/MM Btu	216.7	9,561	41,878	D
Sulfur Dioxide	653.6	2,206	NA		654	2,863	D
Nitrogen Oxides	255.0	981	NA		255	1,117	D
VOC	69.4	282	NA		69	304	D
Carbon Monoxide	255.0	981	NA		255	1,117	D

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles[5] Size Collected (in microns)	Basis for Efficiency (Sec. V, It[5]
Electrostatic Precipitator:	Particulate matter	99%+	Submicron	See Item
Environmental Elements				VI.F.10 and
or equivalent				Attachment B

[1] See Section V, Item 2.

[2] Reference applicable emission standards and units (e.g., Section 17-2.05(6) Table II, E. (1), F.A.C. — 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard

[4] Emission, if source operated without control (See Section V, Item 3)

[5] If Applicable

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
Wood Waste	76,490 lb/hr	254,965 lb/hr*	1,083.6
Peat	152,508 lb/hr	217,869 lb/hr*	1,005.9
No.6 Fuel Oil (2.5% S)**	0	40	250

*Units Natural Gas, MMCF/hr; Fuel Oils, barrels/hr; Coal, lbs/hr

* When fired singly and not in combination with other fuel.

** Utilized for startup, shutdown, and emergency only

Fuel Analysis: See Attachment A for peat and wood waste

Percent Sulfur: Oil: 2.5% S

Percent Ash: 0

Density: 7.9 lbs/gal

Typical Percent Nitrogen: 0.1

Heat Capacity: 18,500 BTU/lb

146,000 BTU/gal

Other Fuel Contaminants (which may cause air pollution):

F. If applicable, indicate the percent of fuel used for space heating. Annual Average NA Maximum NA

G. Indicate liquid or solid wastes generated and method of disposal.

ESP particulate collected

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: 250 ft.

Stack Diameter: 12.0 ft.

Gas Flow Rate: 403,275[1]/342,900[2] ACFM

Gas Exit Temperature: 350/350 °F.

Water Vapor Content: 14/12 %

Velocity: 59.4/50.5 FPS

1 = 100% wood waste firing
2 = 100% peat firing

SECTION IV: INCINERATOR INFORMATION

Not Applicable

Type of Waste	Type O (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq & Gas By-prod.)	Type VI (Solid By-prod.)
Lbs/hr Incinerated							

Description of Waste

Total Weight Incinerated (lbs/hr)

Design Capacity (lbs/hr)

Approximate Number of Hours of Operation per day

days/week

Manufacturer

Date Constructed

Model No.

	Volume (ft)^3	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ______________ ft. Stack Diameter ______________ Stack Temp. ______________

Gas Flow Rate: ______________ ACFM ______________ DSCFM* Velocity ______________ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: ☐ Cyclone ☐ Wet Scrubber ☐ Afterburner ☐ Other (specify) ______________

Brief description of operating characteristics of control devices: ______________

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight – show derivation.

   See Attachment A

2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.,) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.

   See Attachment A

3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).

   See Attachment A

4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, etc.).

   See Attachment B

5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3, and 5 should be consistent: actual emissions = potential (1-efficiency).

   See Attachment B

6. An 8½" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.

   See Attachment A

7. An 8½" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).

   See PSD report

8. An 8½" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

   See Attachment A

ATTACHMENT A

EMISSIONS ESTIMATES

A. Fuel Usage Calculations

Heat Requirements: 1,548 Btu/lb, with 65% boiler efficiency on wood waste; 1,437 Btu/lb, with 70% boiler efficiency on peat.

Fuel Analysis (see attached documentation):

Wood waste: 4,250 Btu/lb at 50% moisture
Peat: 4,617 Btu/lb at 50% moisture

Steam Requirements = 700,000 lb/hr design

Wood Waste Usage and Heat Input:

$700{,}000 \times 1{,}548 \div 4{,}250 = 254{,}965$ lb/hr (wet)
$254{,}965 \times 4{,}250 = 1{,}083.6 \times 10^6$ Btu/hr

Peat Usage and Heat Input:

$700{,}000 \times 1{,}437 \div 4{,}617 = 217{,}869$ lb/hr (wet)
$217{,}869 \times 4{,}617 = 1{,}005.9 \times 10^6$ Btu/hr

Fuel Oil Burning: 2.5% S oil will be utilized for startup, shutdown, and emergencies only. Maximum heat input due to oil will be 250×10^6 Btu/hr.

B. Emissions Calculations

Particulate

Emission Regulations: Since this is not a fossil-fuel fired boiler, only State of Florida regulation for carbonaceous fuel burning equipment applies

0.2 lb/10^6 Btu

Max Heat Input = $1{,}083.6 \times 10^6$ Btu/hr

Max Emissions = $1{,}083.6 \times 0.2 = 216.7$ lb/hr

Actual Emissions = $216.7 \times 24 \times 7 \times 51 \div 2{,}000 = 928.3$ tons/yr

Potential Emissions: Use AP-42 factor for uncontrolled bark firing (Table 1.6-1) of 75 lb/ton

254,965 lb/hr ÷ 2,000 x 75 = 9,561 lb/hr = 41,878 tons/yr

Calculation of Outlet Grain Loading:

216.7 lb/hr ÷ 226,562 dscf/min ÷ 60 x 7,000 gr/lb = 0.11 gr/dscf

Sulfur Dioxide

Maximum Emissions:

Wood waste: AP-42 factor (Table 1.6-1) = 1.5 lb/ton (wet)

254,965 lb/hr ÷ 2,000 x 1.5 = 191.2 lb/hr

Peat: Assume max 0.3% S (dry basis) in fuel, or 0.15% S on a wet basis, and total conversion to SO_2*

217,869 lb/hr (wet) x 0.0015 x 2 lb SO_2/lb S = 653.6 lb/hr

Actual Emissions: Assume 70% peat firing and 30% wood waste firing annually

Wood waste: 191.2 lb/hr x 24 x 7 x 51 x 0.30 ÷ 2,000 = 245.7 tons/yr

Peat: 653.6 lb/hr x 24 x 7 x 51 x 0.70 ÷ 2,000 = 1,960 tons/yr

TOTAL = 2,205.7 tons/yr

Potential Emissions:

Greatest potential is with 100% peat firing

653.6 lb/hr x 8,760 ÷ 2,000 = 2,863 tons/yr

Nitrogen Oxides

Maximum Emissions: From paper presented at 1981 TAPPI Environmental Conference (copy attached), for normal stoker-spreader boiler, maximum mesured emissions for wood waste = 1.91 lb/ton wet. A factor of 2 lb/ton was therefore used (assume same for peat).

Wood waste: 254,965 lb/hr ÷ 2,000 x 2 = 255 lb/hr

Peat: 217,869 lb/hr ÷ 2,000 x 2 = 217.9 lb/hr

---

* Available literature indicates as little as 20 percent of the theoretical SO_2 from peat firing exits with the boiler flue gases.

Actual Emissions:

Wood waste: 255 x 24 x 7 x 51 x 0.3 ÷ 2,000 = 327.7 tons/yr

Peat: 217.9 x 24 x 7 x 51 x 0.7 ÷ 2,000 = 653.4 tons/yr

TOTAL = 981 tons/yr

Potential Emissions: Greatest when firing 100% wood waste

255 lb/hr x 8,760 ÷ 2,000 = 1,117 tons/yr

Volatile Organic Compounds (VOC)

Maximum Emissions: From paper presented at 1981 TAPPI Environmental Conference. Proposed boiler will utilize suspension burning, therefore no underfire or overfire air. Since this type burning promotes fuel and air mixing and therefore good combustion, the average VOC emission factor of 0.064 lb/10^6 Btu was used. Same factor assumed for peat.

Wood waste: 1,083.6 x 10^6 Btu/hr x 0.064/10^6 =
69.4 lb/hr

Peat: 1,005.9 x 10^6 Btu/hr x 0.064/10^6 = 64.4 lb/hr

Actual Emissions:

Wood waste: 69.4 x 24 x 7 x 51 x 0.3 ÷ 2,000 = 89.2 tons/yr

Peat: 64.4 x 24 x 7 x 51 x 0.7 ÷ 2,000 = 193.1 tons/yr

TOTAL = 282.3 tons/yr

Potential Emissions: Greatest when burning 100% wood waste

69.4 lb/hr x 8,760 ÷ 2,000 = 304 tons/yr

Carbon Monoxide

Maximum Emissions: Use lower AP-42 factor (Table 1.6-1) of 2 lb/ton wet wood waste for well designed boiler. Assume same for peat.

Wood waste: 254,965 ÷ 2,000 x 2 = 255 lb/hr

Peat: 217,869 ÷ 2,000 x 2 = 217.9 lb/hr

Actual Emissions:

Wood waste: 255 x 24 x 7 x 51 x 0.3 ÷ 2,000 = 327.7 tons/yr

Peat: 217.9 x 24 x 7 x 51 x 0.7 ÷ 2,000 = 653.4 tons/yr

TOTAL = 981.1 tons/yr

Potential Emissions: Greatest when burning 100% wood waste

255 lb/hr x 8,760 ÷ 2,000 = 1,117 tons/yr

Other Regulated Pollutants

Emission factors for other regulated pollutants are not known to exist at this time, therefore no emission estimates are presented.

COMBUSTION CALCULATIONS

Following methods outlined in Steam, Badcock & Wilcox, 1975.

Wood (Pine Bark)

Based on 50 percent moisture in as-fired fuel, mole method. 25 percent excess air.

	Ultimate Analysis (lb/100 lb fuel)			Moles/100 lb Fuel		Required for Combustion Moles/100 lb Fuel at 100 Percent Total Air	
						Oxygen	Dry Air
C	26.7	÷ 12	=	2.23	x 1.0, 4.76	2.23	10.61
H_2	2.8	÷ 2.016	=	1.39	x 0.5, 2.38	0.7	3.31
O_2	18.95	÷ 32	=	0.59			
N_2	0.05	÷ 28	=	0.002			
S	0.05	÷ 32	=	0.002	x 1.0, 4.76		
H_2O	50	÷ 18	=	2.78			
Ash	1.45	---					
TOTAL	100.0			6.99		2.93	13.92
Less O_2 in Fuel						-0.59	-2.81
Required at 100% Total Air						2.34	11.11
Required at 125% Total Air						2.92	13.89
Excess Air						--	2.78
Excess O_2						0.58	---

Products of Combustion		Moles/100 lb fuel
CO_2	2.23 x 1	2.23
H_2O	1.39 x 1 + 0.59 + 0.29	2.27
SO_2	0.002 x 1	0.002
N_2	13.89 x 0.79	10.97
O_2 (excess)		0.58
TOTAL WET		16.05
TOTAL DRY		13.78

ACFM: 254,965 lb/hr wet x 16.05 moles/100 lb fuel = 40,922 moles/hr

40,922 moles/hr x 1,545.3 ft-lb_f/lb-mole-°R x (350 + 460)°R ÷ 2,116.8 lb_f/ft^2 ÷ 60 min/hr = 403,295 acfm

$\frac{14.7\#}{IN^2} \times \frac{144 IN^2}{FT^2}$

DSCFM: 254,965 lb/hr wet x 13.78 moles/100 lb fuel = 35,134 moles/hr

35,134 moles/hr x 1,545.3 x (70 + 460) ÷ 2,116.8 ÷ 60 = 226,562 dscfm

Peat

Based on 50 percent moisture in as-fired fuel, mole method, 25 percent excess air.

	Ultimate Analysis (lb/100 lb fuel)		Moles/ 100 lb Fuel		Required for Combustion Moles/100 lb Fuel at 100 Percent Total Air: Oxygen	Dry Air
C	27.88 ÷ 12	=	2.32	x 1.0, 4.76	2.32	11.04
H_2	2.22 ÷ 2.016	=	1.10	x 0.5, 2.38	0.55	2.62
O_2	16.11 ÷ 32	=	0.5			
N_2	0.91 ÷ 28	=	0.03			
S	0.12 ÷ 32	=	0.004	x 1.0, 4.76	0.004	0.02
H_2O	50 ÷ 18	=	2.78			
Ash	2.77 --					
TOTAL	100.0		6.73		2.87	13.68
Less O_2 in Fuel					-0.50	-2.38
Required at 100% Total Air					2.37	11.30
Required at 125% Total Air					2.96	14.13
Excess Air					--	2.83
Excess O_2					0.59	--

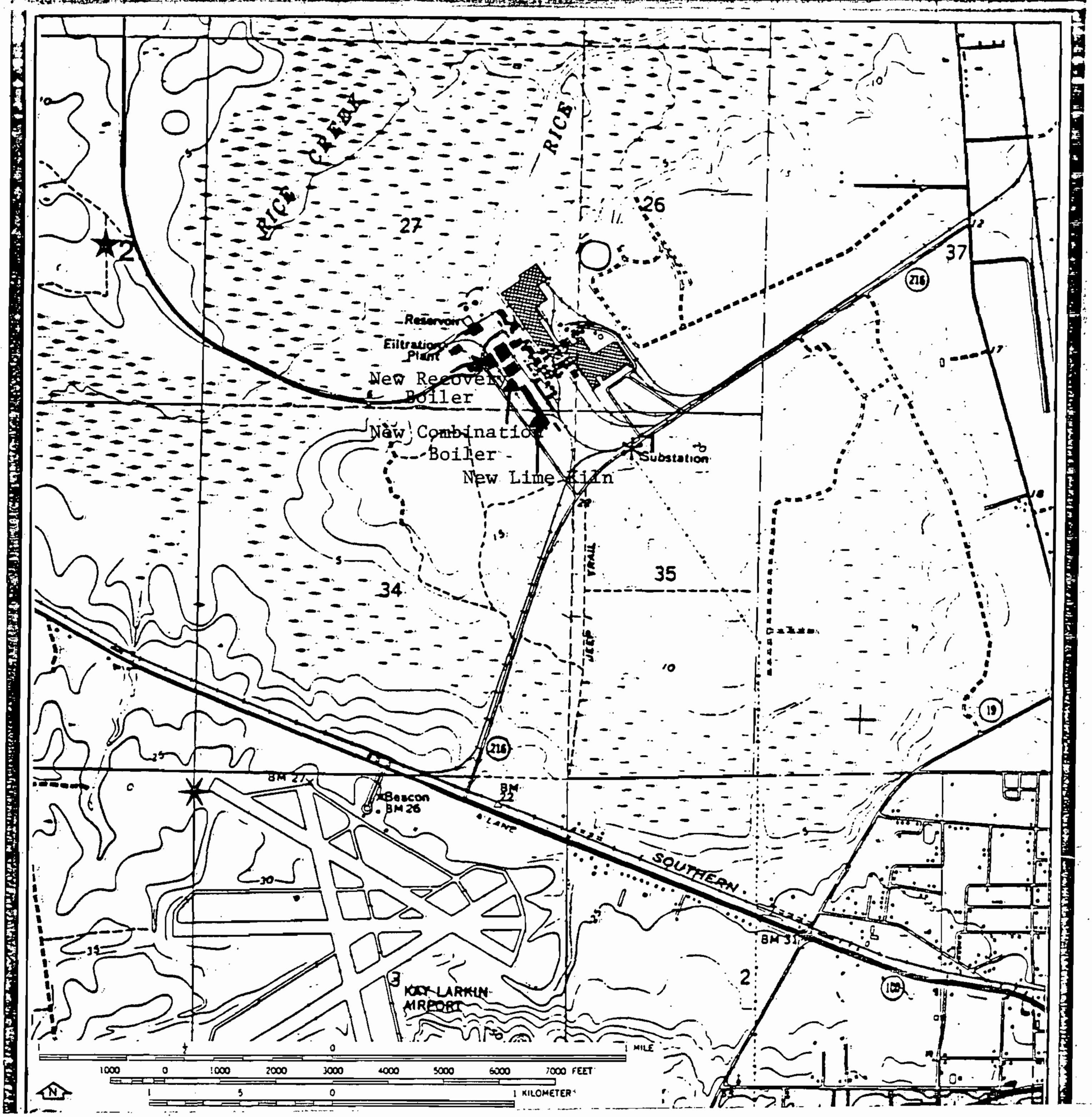
Products of Combustion		Moles/100 lb fuel
CO_2	2.32 x 1	2.32
H_2O	1.1 x 1 + 0.5 + 0.3	1.9
SO_2	0.004 x 1	0.004
N_2	14.13 x 0.79	11.16
O_2 (excess)		0.59
TOTAL WET		15.97
TOTAL DRY		14.07

ACFM: 217,869 lb/hr wet x 15.97 moles/100 lb fuel = 34,794 moles/hr

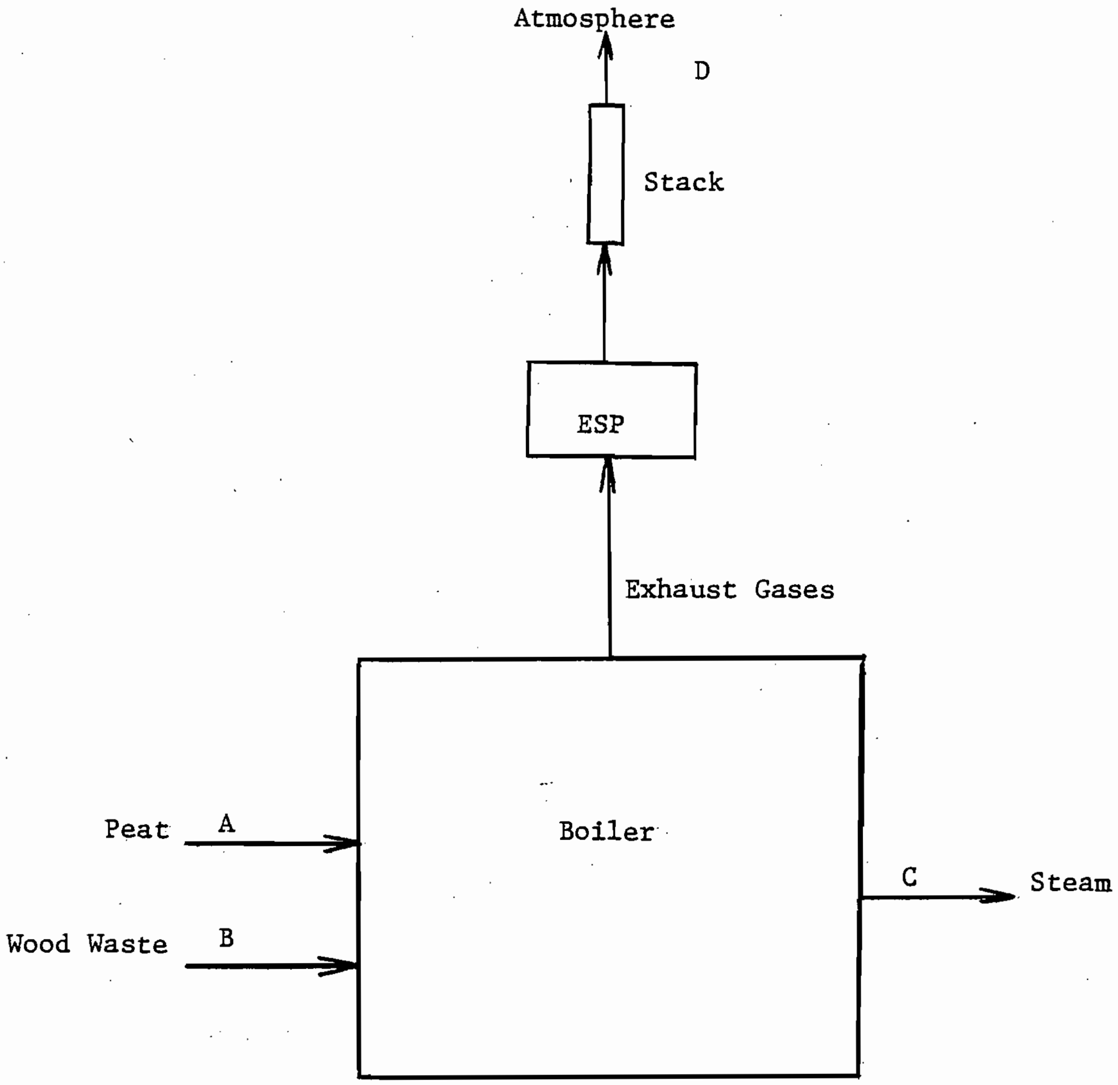
34,794 moles/hr x 1,545.3 x (350 + 460) ÷ 2,116.8 ÷ 60
= 342,900 acfm

DSCFM: 217,869 lb/hr wet x 14.07 moles/100 lb fuel = 30,654 moles/hr

30,654 moles/hr x 1,545.3 x (70 + 460) ÷ 2,116.8 ÷ 60
= 197,673 dscfm



Georgia-Pacific Corporation
Plot Plan
Palatka, Florida



Flow Diagram
Proposed Combination Boiler

FORM 407 REV.PG

PITTSBURGH TESTING LABORATORY

ESTABLISHED 1881
850 POPLAR STREET, PITTSBURGH, PA. 15220

PLEASE REPLY TO:
P. O. BOX 1646
PITTSBURGH, PA. 15230

AREA CODE 412 TELEPHONE 922-4000

LABORATORY No. 813880
ORDER No. PG-16017

CLIENT'S No. Ltr. of 1/15/81
Mr. Paul M. White

REPORT

Feb. 20, 1981

Sample Description: PEAT

Sample Identification: L/4 - P/18 Little Santa Fe Tract

Submitted by: Georgia Pacific Corporation

Reported to:
Georgia Pacific Corporation
Southern Division
Florida Woodland
P.O. Box 1040
Palatka, Florida 32077

	As Received	Dry Basis	GP Res
Moisture	89.61%	----	
BTU Per Pound	959	9,234	9,024
Carbon	------	55.76%	
Hydrogen	------	4.44%	
Oxygen	------	32.21%	
Nitrogen	------	1.82%	
Sulfur	------	.24%	
Ash	------	5.53%	3.37

PITTSBURGH TESTING LABORATORY

William S. Carlson
Manager, Chemical Department

2-Client
Attn: Mr. Paul M. White

fvl

Steam / its generation and use

Babcock & Wilcox
161 East 42nd Street, New York, N.Y. 10017

which in turn is cracked to a gas by the heat. Refinery gas is also used for enrichment. It may either be mixed with the steam and passed through the coke bed or mixed directly with the water gas. Such enriched water gas is called "carbureted water gas" (Table 30) and it is piped for relatively short distances through city mains for industrial and domestic consumption. Where it is so used, it is cleaned at the source to remove sulfur gases and other impurities. In many areas use of carbureted water gas has been replaced by natural gas.

Producer gas. When coal or coke is burned with a deficiency of air and a controlled amount of moisture (steam), a gas known as producer gas is obtained. This gas, after removal of entrained ash and sulfur compounds, is used near its source because of its low heating value.

Gasification using in-situ combustion of coal has been carried out by the Bureau of Mines on an experimental basis at Gorgas, Alabama. The purpose of these tests was to demonstrate that energy from coal in seams too thin for mining could be made available through underground gasification. Russia has made producer gas for power generation using this process. This means of gasification is not economically competitive in the U.S. at the present time.

Coke from petroleum

The heavy residuals from the various petroleum cracking processes are presently utilized in a number of ways to produce a higher yield of lighter hydrocarbons and a solid residue suitable for fuel. Characteristics of these residues vary widely, depending on the process used. Solid fuels from oil include delayed coke, fluid coke and petroleum pitch. Some selected analyses are given in Table 31.

Table 31
Selected analyses of solid fuels derived from oil

Analyses (dry basis), % by wt	Delayed Coke		Fluid Coke	
Proximate				
Volatile matter	10.8	9.0	6.0	6.7
Fixed carbon	88.5	90.9	93.7	93.2
Ash	0.7	0.1	0.3	0.1
Ultimate				
Sulfur	9.9	1.5	4.7	5.7
Heating value, Btu/lb	14,700	15,700	14,160	14,290

The delayed coking process uses residual oil heated and pumped to a reactor for coking. Coke is deposited as a solid mass and is subsequently stripped either mechanically or hydraulically, in the form of lumps and granular material. Some of these cokes are easy to burn and pulverize, while others are quite difficult.

Fluid coke is produced by spraying hot residual feed onto externally heated seed coke in a fluid bed. The fluid coke is removed as small particles, which are built up in layers similar to an onion. This coke can be pulverized and burned, or it can be burned in the as-received size in a Cyclone Furnace. Both types of firing require some supplemental fuel to aid ignition.

The process producing petroleum pitch is an alternate to the coking process and yields fuels of various characteristics. Melting points vary considerably and the physical properties vary from soft and gummy to hard and friable. The low melting point pitches may be heated and burned like heavy oil, while those with higher melting points may be pulverized and burned, or crushed and burned in the Cyclone Furnace.

Wood

Selected analyses and heating values of several types of wood (also analyses of wood ash) are given in Table 32. Wood, in common with all types of vegetation, is composed primarily of carbohydrates and consequently has a relatively low heating value compared with bituminous coal and oil.

Wood bark may pick up impurities during transportation. It is common practice to drag the rough logs to central loading points in the logging area. This results in sand pick-up. Where the logs are salt-water borne, bark will absorb sea water with its included salt. Combustion temperatures from burning dry bark may be high enough for impurities to cause fluxing of refractory furnace walls and fouling of boiler heating surfaces, unless sufficient furnace cooling surface is provided. Sand passing through the boiler banks can cause erosion of boiler

Table 32
Analyses of wood and wood ash

Wood analyses (dry basis), % by wt	Pine Bark	Oak Bark	Spruce Bark*	Redwood Bark*
Proximate				
Volatile matter	72.9	76.0	69.6	72.6
Fixed carbon	24.2	18.7	26.6	27.0
Ash	2.9	5.3	3.8	0.4
Ultimate				
Hydrogen	5.6	5.4	5.7	5.1
Carbon	53.4	49.7	51.8	51.9
Sulfur	0.1	0.1	0.1	0.1
Nitrogen	0.1	0.2	0.2	0.1
Oxygen	37.9	39.3	38.4	42.4
Ash	2.9	5.3	3.8	0.4
Heating value, Btu/lb	9030	8370	8740	8350
Ash analyses, % by wt				
SiO_2	39.0	11.1	32.0	14.3
Fe_2O_3	3.0	3.3	6.4	3.5
TiO_2	0.2	0.1	0.8	0.3
Al_2O_3	14.0	0.1	11.0	4.0
Mn_3O_4	Trace	Trace	1.5	0.1
CaO	25.5	64.5	25.3	6.0
MgO	6.5	1.2	4.1	6.6
Na_2O	1.3	8.9	8.0	18.0
K_2O	6.0	0.2	2.4	10.6
SO_3	0.3	2.0	2.1	7.4
Cl	Trace	Trace	Trace	18.4
Ash fusibility, F				
Reducing				
Initial deformation	2180	2690		
Softening	2240	2720		
Fluid	2310	2740		
Oxidizing				
Initial deformation	2210	2680		
Softening	2280	2730		
Fluid	2350	2750		

---

* Salt-water stored.

1.6 WOOD/BARK WASTE COMBUSTION IN BOILERS

Revised by Thomas Lahre

1.6.1 General [1-3]

Today, the burning of wood/bark waste in boilers is largely confined to those industries where it is available as a by-product. It is burned both to recover heat energy and to alleviate a potential solid waste disposal problem. Wood/bark waste may include large pieces such as slabs, logs, and bark strips as well as smaller pieces such as ends, shavings, and sawdust. Heating values for this waste range from 8000 to 9000 Btu/lb, on a dry basis; however, because of typical moisture contents of 40 to 75 percent, the as-fired heating values for many wood/bark waste materials range as low as 4000 to 6000 Btu/lb. Generally, bark is the major type of waste burned in pulp mills; whereas, a variable mixture of wood and bark waste, or wood waste alone, is most frequently burned in the lumber, furniture, and plywood industries.

1.6.2 Firing Practices[1-3]

A variety of boiler firing configurations are utilized for burning wood/bark waste. One common type in smaller operations is the Dutch Oven, or extension type of furnace with a flat grate. In this unit the fuel is fed through the furnace roof and burned in a cone-shaped pile on the grate. In many other, generally larger, operations, more conventional boilers have been modified to burn wood/bark waste. These units may include spreader stokers with traveling grates, vibrating grate stokers, etc., as well as tangentially fired or cyclone fired boilers. Generally, an auxiliary fuel is burned in these units to maintain constant steam when the waste fuel supply fluctuates and/or to provide more steam than is possible from the waste supply alone.

1.6.3 Emissions [1,2,4-8]

The major pollutant of concern from wood/bark boilers is particulate matter although other pollutants, particularly carbon monoxide, may be emitted in significant amounts under poor operating conditions. These emissions depend on a number of variables including (1) the composition of the waste fuel burned, (2) the degree of fly-ash reinjection employed, and (3) furnace design and operating conditions.

The composition of wood/bark waste depends largely on the industry from whence it originates. Pulping operations, for instance, produce great quantities of bark that may contain more than 70 percent moisture (by weight) as well as high levels of sand and other noncombustibles. Because of this, bark boilers in pulp mills may emit considerable amounts of particulate matter to the atmosphere unless they are well controlled. On the other hand, some operations such as furniture manufacture, produce a clean, dry (5 to 50 percent moisture) wood waste that results in relatively few particulate emissions when properly burned. Still other operations, such as sawmills, burn a variable mixture of bark and wood waste that results in particulate emissions somewhere in between these two extremes.

Fly-ash reinjection, which is commonly employed in many larger boilers to improve fuel-use efficiency, has a considerable effect on particulate emissions. Because a fraction of the collected fly-ash is reinjected into the boiler, the dust loading from the furnace, and consequently from the collection device, increases significantly per ton of wood waste burned. It is reported that full reinjection can cause a 10-fold increase in the dust loadings of some systems although increases of 1.2 to 2 times are more typical for boilers employing 50 to 100 percent reinjection. A major factor affecting this dust loading increase is the extent to which the sand and other non-combustibles can be successfully separated from the fly-ash before reinjection to the furnace.

Furnace design and operating conditions are particularly important when burning wood and bark waste. For example, because of the high moisture content in this waste, a larger area of refractory surface should be provided to dry the fuel prior to combustion. In addition, sufficient secondary air must be supplied over the fuel bed to burn the volatiles that account for most of the combustible material in the waste. When proper drying conditions do not exist, or when sufficient secondary air is not available, the combustion temperature is lowered, incomplete combustion occurs, and increased particulate, carbon monoxide, and hydrocarbon emissions will result.

Emission factors for wood waste boilers are presented in Table 1.6-1. For boilers where fly-ash reinjection is employed, two factors are shown: the first represents the dust loading reaching the control equipment; the value in parenthesis represents the dust loading after controls assuming about 80 percent control efficiency. All other factors represent uncontrolled emissions.

Table 1.6-1. EMISSION FACTORS FOR WOOD AND BARK WASTE COMBUSTION IN BOILERS
EMISSION FACTOR RATING: B

Pollutant	Emissions	
	lb/ton	kg/MT
Particulates[a]		
Bark[b,c]		
With fly-ash reinjection[d]	75 (15)	37.5 (7.5)
Without fly-ash reinjection	50	25
Wood/bark mixture[b,e]		
With fly-ash reinjection[d]	45 (9)	22.5 (4.5)
Without fly-ash reinjection	30	15
Wood[f,g]	5-15	2.5-7.5
Sulfur oxides (SO_2)[h,i]	1.5	0.75
Carbon monoxide[j]	2-60	1-30
Hydrocarbons[k]	2-70	1-35
Nitrogen oxides (NO_2)[l]	10	5

[a] These emission factors were determined for boilers burning gas or oil as an auxiliary fuel, and it was assumed all particulates resulted from the waste fuel alone. When coal is burned as an auxiliary fuel, the appropriate emission factor from Table 1.1-2 should be used in addition to the above factor.

[b] These factors based on an as-fired moisture content of 50 percent.

[c] References 2, 4, 9.

[d] This factor represents a typical dust loading reaching the control equipment for boilers employing fly-ash reinjection. The value in parenthesis represents emissions after the control equipment assuming an average efficiency of 80 percent.

[e] References 7, 10.

[f] This waste includes clean, dry (5 to 50 percent moisture) sawdust, shavings, ends, etc., and no bark. For well designed and operated boilers use lower value and higher values for others. This factor is expressed on an as-fired moisture content basis assuming no fly-ash reinjection.

[g] References 11-13.

[h] This factor is calculated by material balance assuming a maximum sulfur content of 0.1 percent in the waste. When auxiliary fuels are burned, the appropriate factors from Tables 1.1-2, 1.3-1, or 1.4-1 should be used in addition to determine sulfur oxide emissions.

[i] References 1, 5, 7.

[j] This factor is based on engineering judgment and limited data from references 11 through 13. Use lower values for well designed and operated boilers.

[k] This factor is based on limited data from references 13 through 15. Use lower values for well designed and operated boilers.

[l] Reference 16.

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TAPPI

NOx EMISSIONS FROM COMBUSTION SOURCES IN THE PULP AND PAPER INDUSTRY

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ABSTRACT

The body of information presented in this paper is directed to those individuals associated with the determination of NOx emissions from combustion processes used for the manufacture of pulp and paper and power generation from wood-residue firing. In order to expand a limited information base on these sources a total of ten wood-residue fired boilers, one wood-fired burner, ten kraft recovery units and five lime kilns were sampled for NOx. Sampling at eight sites firing roughly 50% moisture wood-residue determined that the NOx emissions on three-contiguous hour average basis ranged from 0.05 to 0.23 pounds NOx per million Btu's heat input. Wood-residue fired at 27% to 30% with wood fines at 8% to 10% moisture produced three-hour average maximums of 0.27 and 0.29 pounds NOx per million Btu at the two sites tested. Sampling conducted on small, medium and large kraft recovery furnaces indicated NOx emissions which ranged from 0.05 to 0.14 pounds per million Btu. A relationship found for the small and medium size recovery furnaces tested between NOx emissions and size based on black liquor solids fired was not indicated from further sampling conducted at large furnaces (greater than 1000 tons of pulp per day). Data generated during the lime kiln study ranged from 0.07 to 1.21 pounds NOx per million Btu heat input for kilns firing either oil or natural gas fuel. One natural gas-fired lime kiln site afforded the opportunity to study the relationship between combustion zone or burned lime (CaO) temperature and NOx emission levels.

INTRODUCTION

The United States Environmental Protection Agency has designated nitrogen dioxide (NO_2) as a criteria pollutant; therefore, reliable estimates of oxides of nitrogen (NOx) emissions are also required for carrying out the modelling of combustion source emissions required for satisfying Prevention of Significant Deterioration regulations. Since available information is limited relative to the potential for emission of NOx from combustion processes associated with the manufacture of pulp and paper and power generation from boilers fired on wood residue, the establishment of a larger data base is desirable.

The NCASI conducted a national program in cooperation with individual member mills designed to provide information on oxides of nitrogen emissions from "kraft recovery units" (defined as both the recovery furnace and boiler sections), lime kilns, and wood-residue fired power boilers.

BACKGROUND AND LITERATURE REVIEW

GENERAL

The emission of oxides of nitrogen (NOx) from combustion sources is influenced by a number of factors which include combustion temperature, "instantaneous flame temperature," fuel-bound nitrogen and operational parameters such as excess oxygen and the method of fuel firing. A comprehensive literature search representative of recent publications associated with NOx formation kinetic theory, measurement techniques, field sampling methodology, source control strategies, previously reported field results and the effects of these gases in the ambient was performed and is presented in NCASI Technical Bulletin No. 102 titled, "A Study of Nitrogen Oxides Emissions from Wood-Residue Boilers," November 1979. The presence in the literature of only two articles on NOx emissions (with the results determined from a limited number of short-interval "grab samples") from kraft recovery furnaces, lime kilns, and 100% wood-residue fired boilers points toward the void this particular field research addresses.

EXPERIMENTAL METHODS

GENERAL

The basic monitor used was the Monitor Labs Nitrogen Oxides Analyzer Model 8440E which was modified for stack concentrations with 0 to 200 ppm and 0 to 5000 ppm the low and high range, respectively. The unit was a gas phase device which utilized the chemiluminescence principle for continuous detection and reporting of Nitric Oxide (NO), Nitrogen Dioxide (NO_2), and Oxides of Nitrogen (NOx) on a ppm dry basis. The operation of the monitor was dependent on chemiluminescence of an activated molecular nitrogen dioxide species which was produced by the reaction between NO and O_3 in an evacuated reaction chamber. The use of a MOLYCON converter to chemically reduce the NO_2 fraction in the sample to NO was utilized in the monitor. This allowed a determination of the total oxides of nitrogen through a sample and detector system which was, except for the converter, identical to that used for the NO measurement. The NO_2 content was obtained by electronically subtracting the NO response from the total NOx response which represented the sum of the NO and NO_2 in the sampled gas.

MONITORING SYSTEM ADAPTATION TO SOURCE NOx MEASUREMENTS

The apparatus used for source NOx sampling is depicted in Figure 1. Several of the components noted as "optional" in the schematic were not found to be required for accurate sampling of some of the sources. The system was designed for consistent operation for vacuum or pressure source gas conditions through the use of a high sampling flow rate and a vented "buffering chamber." An additional pump was located on the cyclone condenser drop-out line to insure minimal water/gas contact and to protect the monitor against possible moisture carry-over.

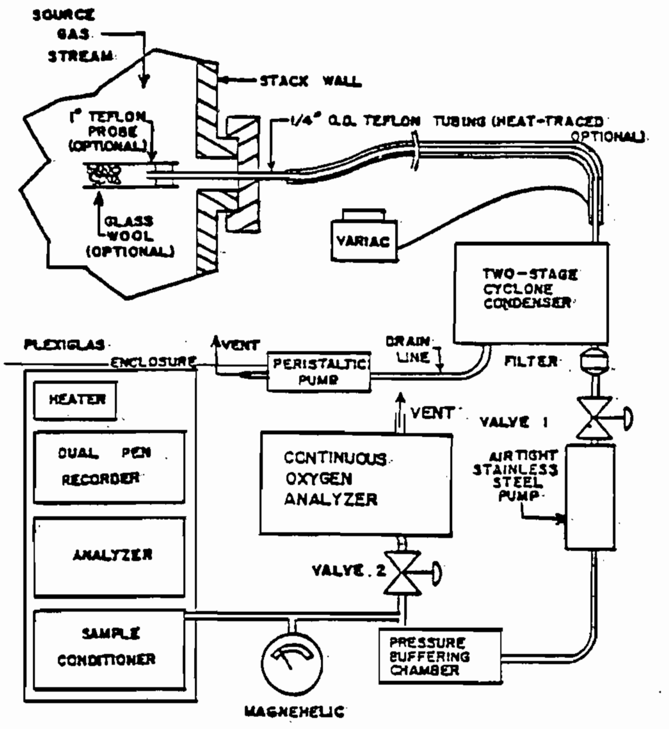

Figure 1. Schematic of NOx Source Measurement System.

CALIBRATION OF SOURCE NOx MONITOR

The span gas employed for instrument calibration was obtained from Airco Industrial Gases and contained in aluminum cylinders. Two standards were used, one at 100 and the other at 500 ppm nitric oxide (NO) packed in dry nitrogen. These gases are considered equivalent to primary standards or standard reference materials (SRM's) by the National Bureau of Standards (NBS).

For purposes of quality assurance, the sample system calibration was also augmented with spiking trials at sometime during the testing at a majority of the sites. These trials were carried out drawing pulling approximately half the usual combustion gas sample flow normally measured by the monitor with the balance of the flow supplied from calibrated cylinder span gas.

RESULTS

DESCRIPTION OF WOOD-RESIDUE FIRED SYSTEMS SURVEYED

The ten wood-residue fired boilers and one wood-residue fired cyclone burner investigated as part of the oxides of nitrogen survey included four boiler sites in the Southeast United States with the remainder in the Northwest. One of the ten boilers was a fluidized bed unit while the others were either normal spreader-stoker or a modified spreader-stoker configuration. The cyclone burner site sampled did not have a boiler section. The predominate fuel fired in all of the boilers during the study period was wood residue, although a portion of the data for some of the sources was collected during the firing of limited quantities of oil and natural gas with the balance wood residue.

WOOD RESIDUE COMBUSTION SITE NOx EMISSIONS

The nitrogen oxides emission results for the 11 wood-residue fired combustion sites sampled are presented in Table 1. Following the format of existing new source performance standards for large steam generation facilities the data was compiled into first, hourly averages and then into three-hour averages. The mean and limits for each site are noted in the table. The values noted in terms of pounds NOx per ton of wet wood fuel may be compared to EPA document "AP-42" which specifies an "emission factor" for wood-residue boilers of 10 pounds NOx per ton of wet wood fuel.

A level of 0.30 pounds NOx per million Btu is the current standard for oil-fired steam generators. Each three-hour average measured at the 11 wood-residue fueled boilers was found to be below this standard. The use of wood residue as fuel, then, represents lower nitrogen oxides emissions than that which would be expected from oil firing. The partial or total conversion of oil burning facilities to wood-residue firing would be expected to favorably address the overall reduction potential of NOx emissions based on alternative fuel use. No significant dependence of NOx emissions based on units of pounds per million Btu was found when compared to boiler size rated in terms of energy output.

A level of 0.25 pounds NOx per million Btu was judged to be representative for wood-residue firing as signified by the data in Table 1. The three exceptions which exceeded this criteria corresponded to first, the site symbolized as No. 1 and represented in Figure 2 was indicative of normal wood-residue firing with the fuel at 45 to 55 percent moisture. After installation of a rotary wood drying system at this location, the three-hour average NOx emission mean doubled to 0.22 pounds per million Btu heat input with a three-hour average upper limit of 0.27 pounds NOx per million Btu as shown in Table 1 for site 1A. The dried wood had an average moisture content of 26 percent with wood fines, produced from the drying process at 8 percent moisture, fired in the boiler overfire air ports. Another boiler fired on dried wood residue and indicated as site No. 9A also exceeded on occasion 0.25 pounds NOx per million Btu. Site No. 10 which represented a fluidized bed wood-residue boiler was the final exception.

Sampling Site and Boiler Type	NOx (3) Hour Average Mean (lb/10^6 Btu)	NOx (3) Hour Average Mean (ng/J)[a]	NOx (3) Hour Average Mean (lb/TWWF)[b]	NOx (3) Hour Average Limits (lb/10^6 Btu)	NOx (3) Hour Average Limits (ng/J)[a]	NOx (3) Hour Average Limits (lb/TWWF)[b]
1: S.S.[c]	0.11	48	1.10	0.09-0.17	37-72	0.84-1.65
1A: S.S.[d]	0.22	95	2.19	0.20-0.27	86-117	2.00-2.69
2: S.S.	0.14	61	1.14	0.11-0.16	46-69	0.86-1.28
3: S.S.	0.08	32	0.67	0.05-0.10	22-41	0.45-0.85
4: S.S.	0.13	57	1.18	0.08-0.18	36-77	0.75-1.60
5: S.S.	0.20	86	1.78	0.19-0.22	82-95	1.69-1.97
5B: S.S.	0.17	72	1.50	0.15-0.18	65-79	1.35-1.64
6A: S.S.	0.17	72	1.51	0.15-0.19	63-81	1.32-1.69
6B: S.S.	0.11	47	0.98	0.09-0.12	38-55	0.78-1.15
7A: S.S.	0.18	78	1.62	0.15-0.22	64-96	1.33-1.98
8A: S.S.	0.21	92	1.91	0.19-0.23	82-100	1.69-2.06
9A: S.S.(f)[e]	0.22	94	1.43	0.11-0.29	45-125	0.69-1.91
10: F.B.[f]	0.23	97	1.52	0.17-0.28	72-119	1.13-1.87
11: C.B.[g]	0.11	48	1.82	0.08-0.14	36-60	1.37-2.28

Table 1. Nox Emission Rate Summary for Wood Residue Boilers. a: 1 lb/10^6 Btu = 430 nanograms/Joule heat input; b: pounds NOx per ton wet wood fuel; c: spreader-stoker boiler; d: spreader-stoker boiler with rotary wood dryer and fines injection in overfire air; e: spreader-stoker boiler with fuel dryer and fines injection in overfire air (these results were based on bark fuel only from multiple regression of NOx total (y), steam from bark (x_1) and steam produced from oil (x_2); f: fluidized bed boiler; g: cyclone burner w/o boiler section.

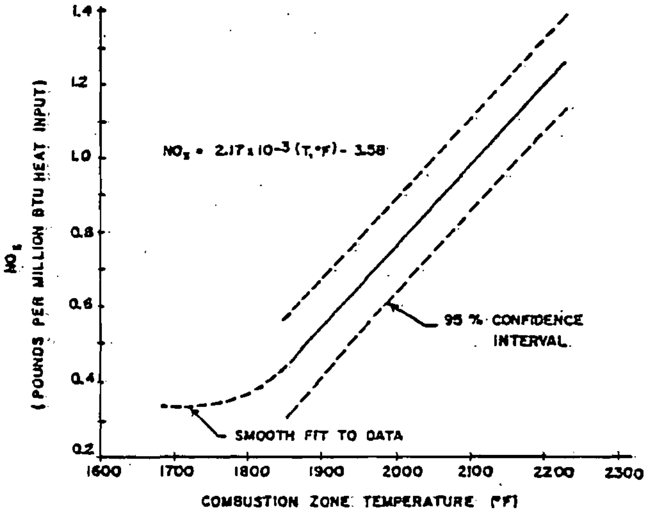

Figure 2. The Relationship Between Combustion Zone Temperature and NOx Emissions at Lime Kiln Site No. 5.

WET SCRUBBER INFLUENCE ON NOx EMISSIONS

The oxides of nitrogen reduction potential of wet scrubbers installed on wood-residue fired boilers was studied at two sites. The three-hour average means and limits for the inlet and outlet of the wet scrubbers at the two sources are depicted as sites No. 5A and 5B and No. 6A and 6B in Table 1. Higher flame temperatures in the combustion zone during sampling at the scrubber inlet were judged to be the probable cause of the higher mean NOx concentration found at both locations. From these findings it was concluded that the reduction of NOx across wet scrubbers on wood-residue fired boilers was not significant.

DESCRIPTION OF KRAFT RECOVERY FURNACE SYSTEMS SURVEYED

Four of the six kraft recovery units studied as part of the oxides of nitrogen survey (Nos. 1, 2, 4 and 5) and displayed in Table 2 were located in the Northwest United States with the balance (Nos. 3 and 6) in the Southeast. Three of the units employed non-direct contact evaporators (non-DCE) while the other three were of the direct contact evaporator (DCE) configuration. The predominate fuel fired in all of the recovery units during the study period was black liquor, although a portion of the data for source No. 6 was collected while a limited quantity of oil was fired with the balance black liquor.

KRAFT RECOVERY UNIT SITE NOx EMISSIONS

The nitrogen oxides emission results for the ten recovery units sampled are presented in Table 2. Following the structure of NOx regulation format for NOx emissions at other sources, the data was compiled into first, hourly averages and then into three-hour averages. The mean and limits for each site are noted in the table. Both the three-hour mean and limits are given in Table 2 with units of pounds NOx per million Btu heat input and nanograms NOx per Joule heat input for each of the ten sites. The NOx emission rate reported in (lb/ton pulp) are based on production estimated by mill personnel. All of the recovery unit sources represented in the table except site No. 6 were sampled when firing 100 percent black liquor. The one exception averaged 84 percent black liquor with oil contributing an average of 16 percent of the total Btu heat input for the study period. It was concluded from the sampling conducted at the ten sites that the operation of an electrostatic precipitator for particulate control did not have a significant impact on NOx emission rates from kraft recovery units.

Location & Furnace Type	Tons Pulp Per Day Mean	NOx (3) Hour Average Mean			NOx (3) Hour Average Limits		
		(lb/10^6 Btu)	(ng/J)	(lb/ton pulp)	(lb/10^6 Btu)	(ng/J)	(lb/ton pulp)
1:N.D.[a]	348	0.07	29	1.49	0.05-0.08	23-35	1.18-1.82
2:N.D.	573	0.08	33	1.31	0.05-0.09	23-39	0.92-1.53
3:N.D.	521	0.13	56	3.04	0.11-0.14	48-61	2.60-3.30
4: D.[b]	517	0.07	32	1.27	0.06-0.09	25-39	0.98-1.55
5: D.	773	0.11	48	1.92	0.10-0.13	42-55	1.69-2.19
6: D.	304[c]	0.11	49	2.67[c]	0.08-0.13	36-56	1.97[c]-3.04[c]
7:N.D.	1,118	0.09	36	1.73	0.06-0.11	26-48	1.24-2.25
8:N.D.	1,161	0.08	34	1.44	0.07-0.09	31-40	1.30-1.68
9: D.	1,308	0.09	38	1.63[c]	0.07-0.11	32-47	1.36[c]-2.20[c]
10: D.	1,680	0.08	36	1.23	0.07-0.10	31-43	1.06-1.46

Table 2. NOx Emission Rate Summary for Kraft Recovery Furnaces Sampled. a: non-direct contact evaporator system; b: direct contact evaporator system; c: based on black liquor solids fired only without adjustment for 16% oil firing.

The ten kraft recovery units represent two phases of study. Sites No. 1 through No. 6 correspond to small and medium size units investigation in the initial phase of sampling. Relationships determined from this work on a limited number of data points indicated NOx emissions to be dependent on the quantity of black liquor solids fired per hour. No such dependence was found upon further study at four additional sites characterized as large kraft recovery units in the 1,100 to 1,700 tons of pulp per day size.

Investigation into potential causes for NOx emission levels measured was undertaken at sites No. 7 and No. 9. No relationship was found between oxides of nitrogen emissions and the number of liquor burners employed, the type of burner tips used, or the liquor pressure measured at the burner tip of these sites. Examination of the NOx emission levels and black liquor solids fired indicated that the highest occurred when the furnace was operated at one-half to three-fourths of the maximum capacity. These peak NOx emissions were produced under identical furnace firing conditions (50% to 75% capacity) as were employed for the high NOx emissions found for the two medium size furnaces, as compared to lower relative emissions noted for the three small size furnaces firing at maximum capacity. The more recent data may suggest furnace firing rate, as a percentage of the total capacity, as a reason higher emissions were measured for medium size as compared to the small size furnaces testing in the Phase I study.

An emission level of 0.30 pounds NOx per million Btu corresponds to the existing standard for oil-fired steam generators. Each three-hour average measured at the ten kraft recovery unit sites was found to be below this existing standard. The use of kraft black liquor as an alternative to oil fuel, then, would represent lower oxides of nitrogen emissions than that which would be expected from oil firing in steam generators.

DESCRIPTION OF KRAFT MILL LIME KILN SYSTEMS SURVEYED

The emissions from a total of five lime kilns were sampled as part of the nitrogen oxides survey. Three of the kilns (Nos. 1, 2, and 4 as represented in Table 3) were located in the Northwest United States with the balance (Nos. 3 and 5) in the Southeast. Three of the lime kilns were fired on oil alone, one kiln fired natural gas and one could be fired on oil or natural gas. The NOx emission rates were determined for both fuel firing modes during the study interval at site No. 4.

LIME KILN SITE NOx EMISSIONS

The oxides of nitrogen emission results for the five kiln systems sampled are presented in Table 3. As specified in the Federal Register the data was compiled into first, hourly averages and then into three-hour averages. Both the three-hour mean and limits are given in Table 3 with units of pounds NOx per million Btu heat input and nanograms NOx per

Joule heat input for each of the five sites and six combustion modes studied. All of the lime kiln sources represented in the table except Nos. 4B and 5 corresponded to 100 percent oil firing. The two exceptions were kiln sites fired on 100 percent natural gas during the study period.

Location & Furnace Type	Tons Pulp Per Day Mean	NOx (3) Hour Average Mean (lb/10^6 Btu)	NOx (3) Hour Average Mean (ng/J)	NOx (3) Hour Average Mean (lb/ton pulp)	NOx (3) Hour Average Limits (lb/10^6 Btu)	NOx (3) Hour Average Limits (ng/J)	NOx (3) Hour Average Limits (lb/ton pulp)
1: Oil	360	0.92	395	2.21	0.18-1.07	348-458	1.95-2.57
2: Oil	735	0.17	72	0.39	0.07-0.31	31-131	0.17-0.71
3: Oil	351	0.17	73	0.42	0.09-0.23	39-99	0.23-0.57
4A: Oil	348	0.34	145	1.07	0.25-0.59	106-252	0.79-1.86
4B: Gas	348	0.31	135	0.79	0.21-0.42	90-180	0.70-1.40
5: Gas	428	0.84	361	2.79	0.37-1.21	159-520	1.23-4.01

Table 3. NOx Emission Rate Summary for Lime Kilns Sampled.

As noted previously, the current standard for oil-fired steam generators is 0.30 pounds NOx per million Btu. A lower value of 0.20 pounds NOx per million Btu corresponds to the current standard for natural gas-fired steam generators. As shown in the table, three out of four of the kilns fired on oil had at least one three-hour interval over 0.30 pounds NOx per million Btu. Two of these three sites were found to have data means over the oil-fired boiler standard. Both of the kilns which fired natural gas also had a majority of their three-hour NOx averages above the standard for natural gas-fired boilers.

The wide upper range and high three-hour average NOx emission upper limit representative of the natural gas-fired kiln at site No. 5 pointed toward a potential correlation between NOx emission rate and burner type and operating mode. A relationship between combustion zone or burned lime (CaO) temperature and NOx emission rate was obtained and is presented in Figure 2. The relationship in the Figure was based on a total of 37 data points. The solid portion of the curve indicates the use of linear regression techniques performed on 33 of these data points which were judged to follow a close linear distribution. The regression gave the following equation having a correlation coefficient, R, of 0.965:

$$\frac{\text{lb NOx}}{10^6\,\text{Btu}} = 2.17 \times 10^{-3}\,(\text{Temperature, °F}) - 3.58$$

The dashed portion of the center curve was a smooth fit approximation through the remaining four data points. Based on the data collected encompassing various modes of kiln operation, there was judged to be a potential for reduction of NOx emissions to less than 0.4 pounds per million Btu. Adjustment of the gas firing rate and the excess air levels supplied to the kiln's burner may enable the combustion zone or CaO temperature as measured by the radiation pyrometer to be controlled at less than 1850°F. Below this temperature the NOx to combustion zone temperature relationship was judged to be insignificant based on the limited amount of data collected on this burner.

Further sampling work is projected to address the correlation between lime kiln NOx emission production on combustion zone or burner zone flame temperatures as measured with radiation pyrometers and perhaps optical pyrometers.

CONCLUSIONS

1. Based on conventional firing of 100 percent wood residue at approximately 50 percent moisture, the NOx emissions on a three contiguous hour average basis were found to have lower and upper limits of 0.05 to 0.23 pounds NOx per million Btu heat input (25 ppm to 136 ppm NOx were the maximum lower and upper limits found for the eight boilers on an in-stack concentration basis). This corresponded to 0.45 to 2.06 pounds NOx per ton of wet wood. These values, then, represent the absolute minimum and maximum measurements determined from the sampling at eight boilers ranging from 80,000 to 380,000 pounds of steam per hour. These NOx emission rates are about 5 to 20% of those reported in EPA document "AP-42", a widely used source of emission estimates.

2. Sources Nos. 1A and 9 represented in Table 1 utilized dried wood residue as fuel that was considerably lower in moisture content. Higher NOx emissions were found for these locations as a possible consequence of this mode of operation. A three-hour average high of 0.27 pounds of NOx per million Btu heat input (118 ppm NOx) or 2.7 pounds of NOx per ton of wet wood fuel was found for site No. 1A. Site No. 9 was represented with a level of 0.29 pounds of NOx per million Btu heat input (117 ppm NOx) or 1.9 pounds NOx per ton of wet wood fuel was the highest three-hour average determined for this site. An additional combustion source was tested in order to address the relationship of lower wood fuel moisture content on the reduction of NOx emissions. The results from this testing are represented as site No. 11 in Table 1. Oxides of nitrogen ranged as high as 2.3 pounds per ton of wet wood fuel or 0.14 pounds per million Btu heat input (22 ppm NOx with 18% oxygen in the flue gas) at this burner

source. The effect of fuel drying practices on NOx emission production cannot be completely defined at this time, but may represent a potential for increased NOx emissions.

3. A fluidized bed wood boiler designated as site No. 10 was sampled when firing wood residue of 60 percent moisture content. The boiler produced 1.9 pounds NOx per ton of wet wood or 0.28 pounds per million Btu heat input (135 ppm NOx) based on the highest three-hour average found. This source may be an example of NOx emissions produced through high instantaneous peak flame temperatures.

4. Reductions in Nox emissions across wet scrubbers installed at two wood-residue boiler sites were judged to be, in part, a consequence of boiler operating conditions during the sampling interval at each location. This is equivalent with the effectiveness of wet scrubbers in NOx control at other sources.

5. The significance and impact of nitrogen emissions from wood-residue combustion may be addressed as follows: (a) the NOx formed from wood-residue firing in the United States is low when compared to the firing of other fossil fuels such as coal, oil, or even natural gas, (b) the total NOx contribution from all wood-residue fired sources is low, (c) of the 11 representative tested for NOx, only two boilers were in excess of 250 million Btu per hour capacity and (d) the majority of the wood-residue combustion sites are located in non-urban locations and outside heavily populated areas. Based on these criteria it is evident that NOx emissions from wood-residue fired sources incur minimal effects to NOx sensitive areas and population centers.

6. For the kraft recovery unit sampling with 100 percent black liquor firing, the NOx emissions ranged from 0.05 to 0.14 pounds NOx per million Btu heat input (26 ppm to 71 ppm NOx were the extremes found on an in-stack concentration basis) as shown in Table 2. The three-hour average limits found on a pulp production basis varied between 0.92 to 3.30 pounds of NOx per ton of pulp. There was no discernable difference in NOx emissions from furnaces with or without direct contact evaporators. In addition, no dependence of NOx on the quantity of black liquor solids fired per hour was found between the small or medium and large size (> 1000 tpd) kraft recovery units evaluated.

7. Sampling conducted before an electrostatic precipitator at kraft recovery unit site No. 2 was judged to be equivalent to results found for NOx emission levels after an electrostatic precipitator at sites Nos. 1 and 4.

8. The relationship between combustion zone temperature and NOx emission levels was studied at one site. The data supplied by mill personnel at this site indicated that combustion zone or burned lime (CaO) temperatures below 1850°F were required to reduce the NOx concentrations produced by the existing natural gas burners to less than 0.4 pounds per million Btu heat input.

9. The data generated during the lime kiln study indicated a three-hour mean emission rate ranging from 0.07 to 1.21 pounds of NOx per million Btu heat input (27 ppm to 428 ppm were the extremes found on an in-stack concentration basis) for kilns firing either oil or natural gas fuel. This corresponded to 0.17 to 4.01 pounds of NOx per ton of pulp production.

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VOLATILE ORGANIC COMPOUND EMISSIONS FROM PACIFIC NORTHWEST PULP AND PAPER INDUSTRY COMBUSTION SOURCES *

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ABSTRACT

Total gaseous non-methane organic compounds (TGNMO) were measured from wood-residue fired boilers, kraft recovery furnaces, and kraft process lime kilns with the EPA Reference Method 25. An interference to EPA Method 25 on combustion sources was noted and corrected for.

Wood-residue fired boiler TGNMO emissions were found to correlate to overfire air use. Larger proportions of overfire air result in lower TGNMO emissions. Kraft recovery furnace TGNMO emission levels were influenced by the use of direct contact evaporators. Direct contact evaporators were found to contribute to TGNMO emissions. Emissions from lime kilns were difficult to measure. Lime kiln TGNMO emissions were found to depend upon the source of make-up water. Use of contaminated water in the lime kiln area contributed significantly to TGNMO emissions. Wet scrubbers did not remove TGNMO's from wood-residue fired boiler or lime kiln emissions.

INTRODUCTION

Volatile organic compounds are considered by the Environmental Protection Agency to be photo-oxidants resulting in the formation of ozone and are thereby designated criteria pollutants. Potential emissions of these criteria pollutants in amounts greater than a threshold tonnage per year results in classification of new sources as major. Major new sources and existing source modifications must satisfy non-attainment (NA) or prevention of significant deterioration (PSD) regulations mandated by the 1977 Clean Air Act Amendment.

To date, no definitive assessment has been made of total gaseous organic compounds emissions resulting from pulp and paper industry combustion sources. Modelling to satisfy non-attainment and PSD regulations is unreliable with the information presently available. It is also unknown which and what size new pulp and paper mill processes will be considered major sources with respect to gaseous organics.

Hydrocarbon emission factors expressed as methane for wood-residue fired boilers published in AP 42, 1979 (1) were 1 g hydrocarbon per kg (2 lb ton) of 50% moisture fuel fired. This value translates to 0.11 kg carbon per 10^9 J (.22 lb/~~ton~~ 10^6 Btu) fired assuming 2.08×10^6 J (9,000 Btu/lb) wood-residue heat value. The values published in the 1979 supplement are the same as published in the AP 42 1976 edition and no new references are listed. Consequently, little is known about the method used in obtaining this data or if the procedures used would yield data consistent with the EPA reference method for sampling hydrocarbon emissions. Any comparisons made between the data presented in this text and the value presented in AP 42, should consider the difference in methods by which the data was generated. No hydrocarbon emission factors for kraft recovery furnaces or kraft process lime kilns are listed in AP 42.

The National Council is conducting a survey of total gaseous organic emissions from the pulp and paper industry to provide a data base on potential emissions to be expected from various sources. It was the aim of this project to produce data consistent with the EPA reference method for the measurement of total gaseous nonmethane organic compounds (TGNMO). The sampling and analysis procedures used in this study were in accordance with EPA Method 25, published in the Federal Register October 3, 1980.[2]

SAMPLING AND ANALYSIS PROCEDURES

The EPA-25 analytical procedure yields values for carbon dioxide, carbon monoxide, methane and total gaseous organics. The analytical procedure was altered to produce results for ethane and ethylene. Methane and ethane are not photoreactive and were not included in the results. The TGNMO results were reported as methane.

The principle of EPA-25 is to separate the light compounds (those with vapor pressures at -78°C) from the less volatile organics by capture of less volatile compounds in a cold trap in the field. The light components are captured in an evacuated tank. The samples were returned to the laboratory for analysis where the trap containing condensed organics was heated red hot while purified air swept the trap contents through a catalytic oxidizer to convert organics to CO_2 for analysis. Prior to heating the cold trap is flushed with carbon compound free air to remove flue gas CO_2. The light organics captured in the evacuated tank were separated on a chromatographic column yielding concentrations for CO, CH_4, CO_2, C_2H_6, C_2H_4, and all other organics. Summation of the trap and tank organics gives results for calculating TGNMO stack concentrations. All results are reported as methane.

SAMPLING

Field samples were taken in duplicate through 1/4 stainless steel probes for one-hour duration. The stack end of the probe was filled with quartz glass wool before each sample was drawn to prevent collection of particles in the traps. Six feet of 1/8 in.

* Note: The kg/10^9J figures in this paper are high by a factor of 10.

stainless steel tubing connected the probes to each trap which were submerged in granular dry ice. Schematics of the trap construction and sampling assembly are presented in Figures 1 and 2, respectively. Condensible organics and water vapor were captured in the traps. From the traps the gas flowed through a rotometer, a flow control valve, and into a 17-liter evacuated stainless steel tank. The sampling system was leak checked prior to commencement of sampling. After sampling the trap and sampling lines were transported to the laboratory packed in dry ice. Tank pressures were measured before and after sampling to determine sample size.

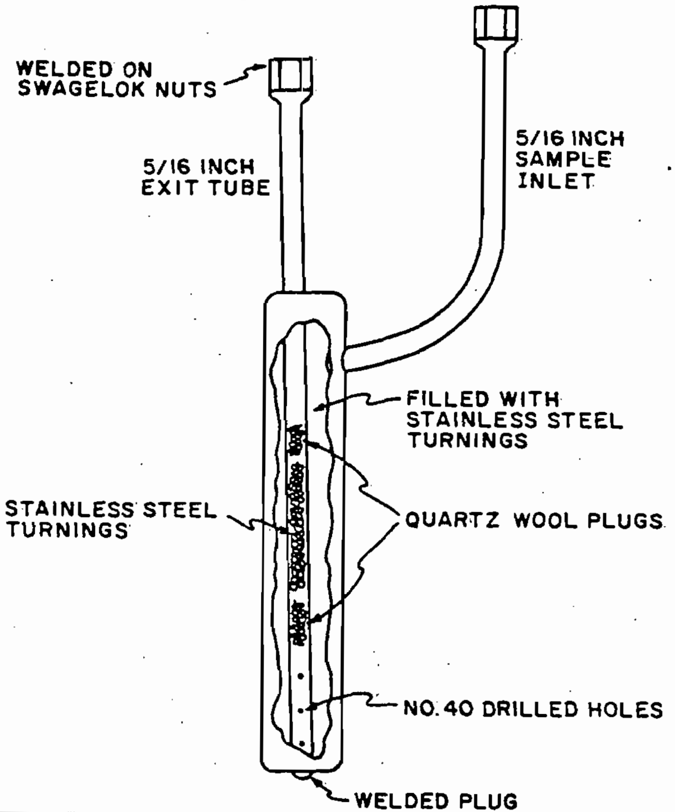

Figure 1. Condensate Trap.

SAMPLE PREPARATION

Upon returning to the laboratory, each trap and sample tank combination used in the field was connected to the trap burning system in the sequence of trap, oxidation tube furnace, U-tube water trap packed in dry ice and IR analyzer and sampling vessel as shown in Figure 3. The stack gas remaining in the trap was flushed into the tank with carbon compound free air (hereafter referred to as zero air) with the flow through the trap and oxidation furnace reversed.

Following sampling tank pressurization, an evacuated vessel was attached in the tank's place. Zero air was passed through the sampling line and trap while they were heated to a dull red color with an acetylene torch. Care was taken that the sampling line, trap, and lines to the oxidizer were heated sequentially so that incompletely oxidized organics that might recondense in the system would be revolatilized.

Zero air was prepared by further purifying zero grade air from cylinders. Air from the cylinder was passed over an oxidation catalyst to oxidize organic contents and then passed through ascarite for carbon dioxide removal. The nitrogen carrier gas used for the chromatographic column was cleaned by passing through a molecular sieve and through a catalytic oxidation column.

SAMPLE ANALYSIS

The analysis system components consisted of an injection port with an inert septum, a silicon SF-96 on Chromosorb W/Porapak Q column operated at -78°C, -30°C, 25°C, and 100°C with back flush capability, a MnO_2 oxidation furnace for oxidation of the CH_4, CO, and VOC's to CO_2, and hydrogen addition to the nitrogen carrier at a rhodium catalyst methanator to convert CO_2 to CH_4. The CH_4 was analyzed by a flame ionization detector (FID).

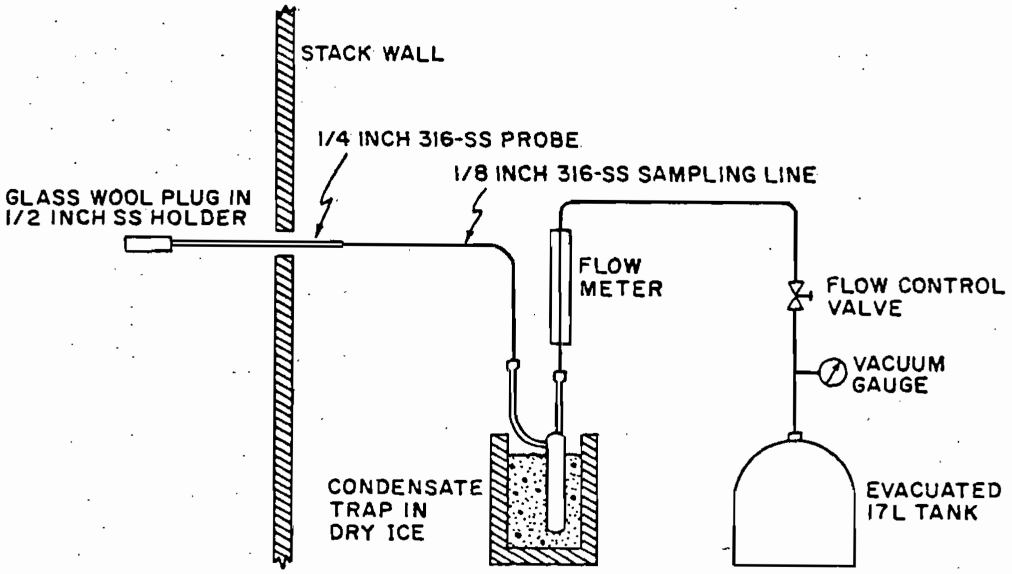

Figure 2. TGNMO Sampling Train.

The FID output was integrated with an electronic integrator. Figure 4 depicts the system.

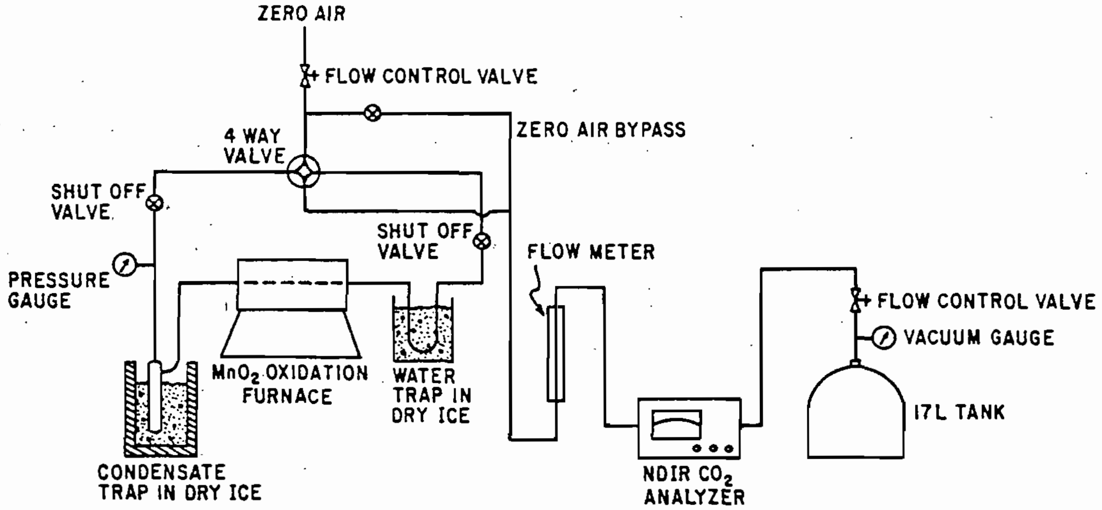

Figure 3. Revised Trap Burn Out System.

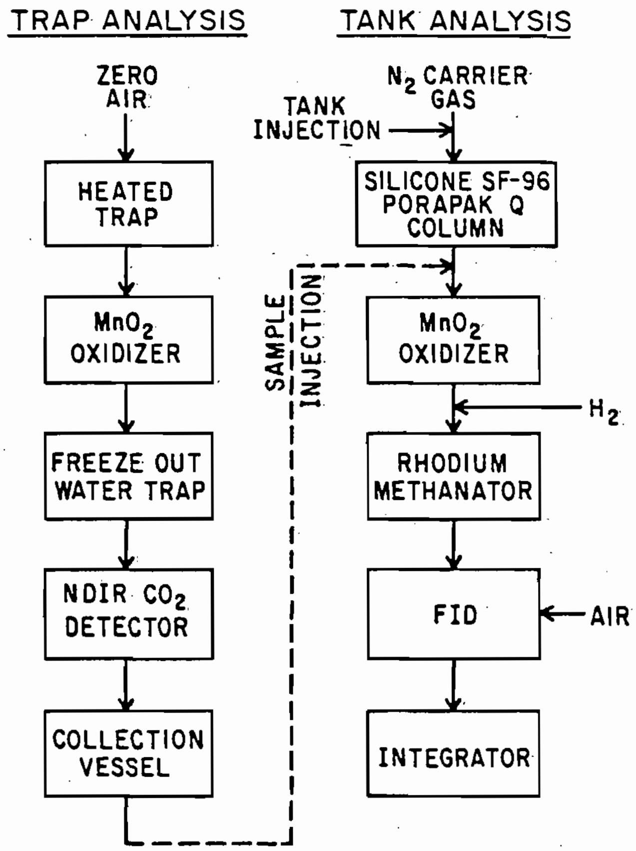

Figure 4. TGNMO Analytical Scheme.

Starting with the column submerged in a dry ice-isopropanol bath at -78°C, a 5 ml sample was drawn from the pressurized evacuated sampling tank and injected into the carrier gas to the column. Carbon monoxide and methane were separated. The column was then operated at -30°C for carbon dioxide, ethane, ethylene, and acetylene elution. After these compounds eluted, the column was placed in a boiling water bath and the carrier gas flow through the column reversed. The organic compounds were released from the column. If no C_2 compounds were found subsequent samples were analyzed at room temperature for CO_2 elution to speed analysis.

The trap burn-off vessel contents were analyzed by injecting 5 ml drawn from the vessel into the carrier gas bypassing the chromatographic column and entering the oxidation furnace.

CALCULATIONS

Laboratory results are in terms of ppm TGNMO as methane as found in the sampling tank or vessel. These were corrected to standard conditions in the stack. Summation of tank and vessel concentrations are presented as stack TGNMO concentration at standard conditions.

For wood-residue boilers stack TGNMO concentrations were converted to $Kg/10^9 J$ ($lb/10^6$ Btu) emissions through use of conversion formulas published in 40 CFR 121:1516, 60.45, Sections E and F. The conversion equation used was:

$$E = C\, F_c \frac{100}{\%\ CO_2}$$

where E = pollutant emissions, $Kg/10^9 J$ ($lb/10^6$ Btu)

where C = pollutant concentration, ng/DSCM (lb/DSCF)

and F_c = 0.494×10^{-7} SCM CO_2/J (1840 SCF $CO_2/10^6$ Btu) for wood-residue

For kraft recovery furnaces and lime kilns, stack TGNMO's were converted to $Kg/10^9 J$ ($lb/10^6$ Btu) emissions by multiplying stack concentrations by the stack gas flow rate and an appropriate units conversion factor. Stack flow rates were measured by S-type pitot tube traverses at the point of sampling each day samples were taken. Gas molecular weights were calculated from Orsat analysis results and moisture contents determined by measurement of the water found in the condensate traps.

QUALITY CONTROL

The TGNMO analysis system was checked for proper operation at frequent intervals. Daily checks were made for the FID sensitivity, zero air purity, column carrier gas purity and system leaks. Weekly checks were made on all catalysts efficiencies. Biweekly checks were made for evacuated sampling tank leaks and tank contamination. A thorough discussion of sampling and quality control procedures appears in the NCASI Atmospheric Quality Improvement Technical Bulletin No. 109.[3]

CARBON DIOXIDE ABSORPTION INTERFERENCE

The EPA-25 analysis scheme oxidizes all organics to CO_2 and subsequently reduces them to methane for detection. Any carbon dioxide lingering in the cold traps when the organics are burned will constitute a positive interference. Combustion sources contain high percentages of CO_2 and moisture which needs to be separated from the organics in the sample. This is normally accomplished by flushing the trap with zero air. However, when CO_2 becomes trapped in the ice matrix formed from freezing stack gas moisture it cannot be flushed from the trap.

This CO_2 interference was accounted for in this study by measuring in the laboratory the interference at different CO_2 and moisture levels in organic compound free simulated stack gases. The appropriate interference level was subtracted from the field sampling results. These interference studies are discussed in detail in NCASI Atmospheric Quality Improvement Technical Bulletin No. 109.[3]

SOURCE DESCRIPTION

During the course of this study four wood-residue boilers, five kraft recovery furnaces, and three lime kilns were sampled for TGNMO emissions.

All of the wood-residue fired boilers sampled were spreader-stokers. Boiler A is rated at 82000 Kg/hr (180,000 lb/hr) steam at 4100 k Pa (600 psi) while burning Douglas fir derived wood-residue at 45% moisture. Undergrate combustion air was preheated to 230°C (450°F). Overfire air makes up 4% of the total air and was not preheated. Boiler B is rated at 270,000 Kg/hr (600,000 lb/hr) steam at 7000 k Pa (1000 psig) burning a combination of Douglas fir wood-residue and oil or gas. Primary air was about 70% of the total air flow and overfire and windbox air was 30% of the total air flow, all of which was preheated. Boiler C is rated at 680,000 Kg/hr (150,000 lb/hr) steam at 4300 k Pa (625 psig) burning Douglas fir wood-residue and bark. Combustion air was preheated to about 270°C (520°F). Undergrate air was 75 to 80% of the total air flow and overfire air about 20 to 25% of the total air flow. Boiler D is rated at 182,000 Kg/hr (400,000 lb/hr) steam when burning Douglas fir derived wood-residue at 55% moisture. Primary air was about 60% and the overfire air about 40% of the total air flow, all of which was preheated.

The wood-residue fired boilers were sampled before wet scrubbers. Boiler D was sampled following a dry scrubber. The results from sampling wood-residue boilers represent uncontrolled emissions. One wood-residue boiler was sampled simultaneously prior to and following an impingement type wet scrubber to determine the effect of scrubbers on TGNMO's. The scrubber used fresh water as makeup.

Five kraft recovery furnaces were sampled for TGNMO emissions. Furnace A was equipped with a non-direct contact evaporator and rated to fire 28,000 Kg dry black liquor solids per hour (62,000 lb bls/hr). Furnace B was equipped with a direct contact evaporator and black liquor oxidizer and rated to fire 62,000 Kg bls/hr (137,000 lb bls/hr). Furnace C was equipped with a noncontact evaporator and rated to fire 10,000 Kg bls/hr (22,000 lb bls/hr). Recovery furnace D was equipped with a direct contact evaporator and a black liquor oxidizer and was rated at 45,400 Kg bls/hr (100,000 lb bls/hr). Furnace E was equipped with a noncontact evaporator and rated at 45,400 Kg bls/hr (100,000 lb bls/hr). All the recovery furnaces were sampled after electrostatic precipitators and ID fans.

Three lime kilns associated with the kraft recovery process were sampled. Lime Kiln A has a capacity to produce 7.8 metric tons (8.6 tons) lime per hour, but averaged 6.0 metric tons (6.6 tons) per hour. This kiln used fresh water in all of its systems and did not burn noncondensible gases. It did have problems with green liquor dregs carryover into the lime mud. Lime Kiln B had a capacity to produce 6.3 metric tons (7 tons) lime per hour, but averaged 5.3 metric tons (5.8 tons) per hour. Evaporator condensates were used to wash the lime mud and as makeup water elsewhere in the system. This lime kiln also burned noncondensible gases. Lime Kiln C had a capacity to produce 8.6 metric tons (9.5 tons) per hour lime, but averaged 6.2 metric tons (6.8 tons) per hour when the samples were taken. This kiln used all fresh water for all wash and makeup purposes and burned noncondensible gases from the digester. All the lime kilns were sampled both before and after wet scrubbers.

The sources studied in this program were considered representative of current boiler design and operating practices.

RESULTS

PRECISION

Using only data points where samples were collected in duplicate allowed for statistical estimates of the precision of the EPA-25 sampling procedure. The variation due to the sampling procedure was separated from the variation of the TGNMO emissions from the sources by a statistical technique called analyses of variance. Using a lumped relative standard deviation of 0.23 for wood-residue fired boilers and 0.20 for kraft recovery furnaces and using the appropriate z statistics it can be shown that the average of the duplicate samples taken at a source are within ±32% and ±28% of the true values at the 95% confidence level for wood-residue fired boilers and kraft recovery furnaces respectively.

The analysis of variance results also showed that only from boiler A and in furnaces C, D, and E was there significant enough variation in TGNMO emissions to be resolvable by the EPA sampling technique. In all other sources the variation within the EPA-25 sampling technique obscured what variation there may have been from the source.

WOOD-RESIDUE FIRED BOILERS

Average corrected TGNMO emissions from the wood-residue fired boilers studied expressed as methane equivalent were 0.43, 0.22, 0.31, 0.14 Kg/10^9 J (0.10, 0.050, 0.072, 0.032 lb/10^6 Btu) for boilers A through D respectively. Average CO_2 absorption interferences were 0.082, 0.066, 0.061 and 0.066 Kg/10^9 J (0.019, 0.015, 0.014 and 0.015 lb/10^6 Btu) for boilers A through D respectively. These average emission rates were found to be related to the percentage of the total air fired as overfire or secondary air. As illustrated in Figure 5 the greater the percentage of total air used as overfire, the lower the TGNMO emission rates were. Data corrected for CO_2 absorption interference was used for plotting Figure 5. When 12% overfire air was used, as in boiler A, an average TGNMO emission rate of 0.43 Kg/10^9 J (0.10 lb/10^6 Btu) was experienced. At 40% overfire air use, less than 0.13 Kg/10^9 J (0.03 lb/10^6 Btu) TGNMO emissions result.

CORRELATION TO BOILER OPERATION

The TGNMO emission data was searched for relationships to operating conditions such as steam production, flue gas moisture content and boiler flue gas exit temperature. No strong correlations could be found with any of the recorded operating parameters. Most of the boiler operations were over a narrow range of operating parameters.

Both boilers A and C showed a trend with higher TGNMO emissions higher stack oxygen levels as shown in Figures 6 and 7.

It is possible to postulate that in boilers A and C, where most of the combustion air was provided under the grates, uneven burning could result. An uneven fuel cover on the grate could allow combustion air to pass through some portions of the grate unreacted. High pressure drops elsewhere across the bed would prevent sufficient air to pass through the fuel for complete combustion. Inadequate gas turbulence would allow uncombusted organics to escape the combustion zone resulting in a TGNMO emission. Furnaces using overfire air are designed to induce turbulence for gas mixing and complete combustion. With low overfire air usage, evenness of the fuel on the grate would influence TGNMO emissions.

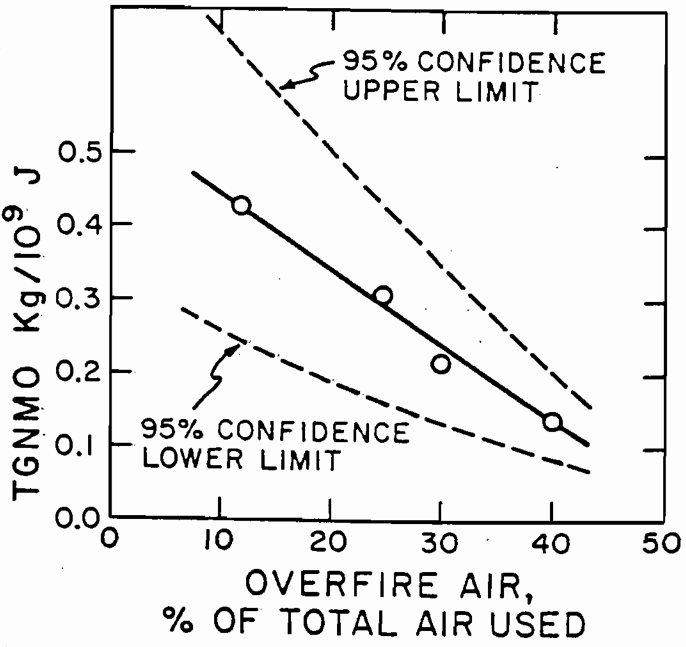

Figure 5. Relationship Between TGNMO and Overfire Air Use.

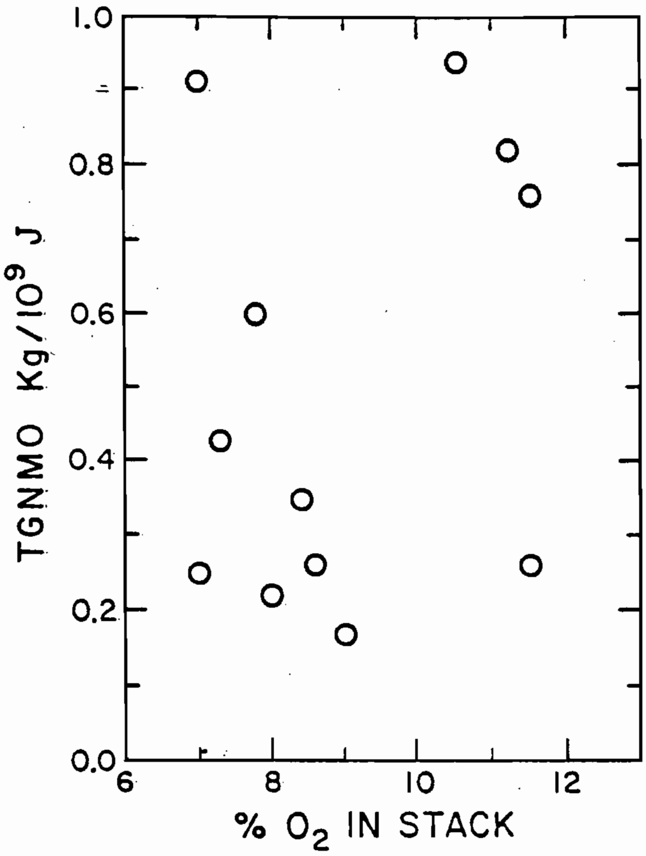

Figure 6. Relationship Between TGNMO and Stack % O_2 for Boiler A

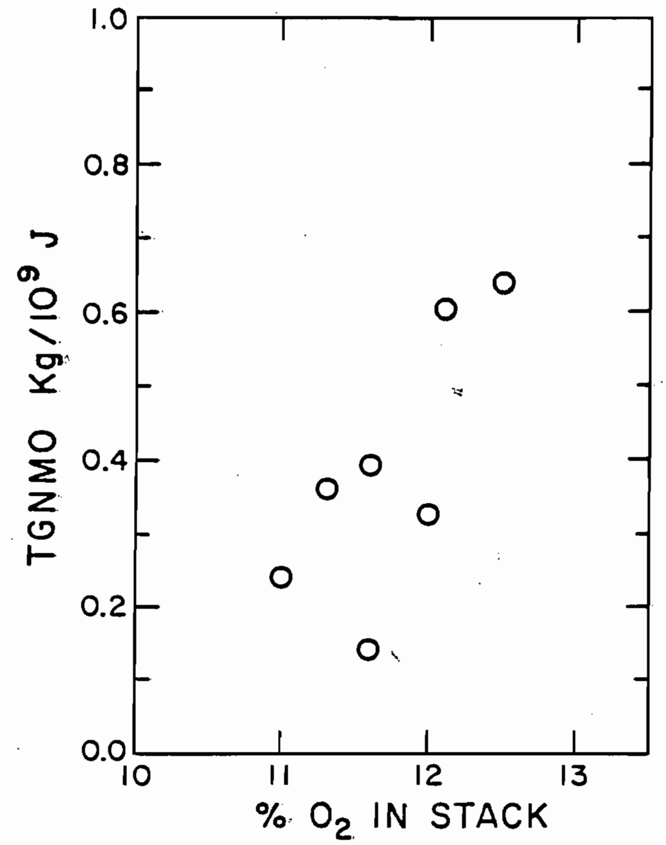

Figure 7. Relationship Between TGNMO and Stack % O_2 for Boiler C

Mills B and D showed no relationship between TGNMO's and flue gas oxygen content.

Carbon monoxide emissions correlated with stack gas moisture content and auxiliary fuel type for boiler B and with O_2 for boiler C. The high CO emissions for boiler B occurred when a large amount of oil was burned while flue gas oxygen content was high, indicating too short of a residence time for complete combustion of oil. Carbon monoxide emissions were always low when natural gas was burned as an auxiliary fuel in boiler B.

Both the carbon monoxide and TGNMO's for boiler C increased in proportion with flue gas oxygen content indicating a common mechanism and incomplete combustion of these materials.

EFFECT OF A WET SCRUBBER ON TGNMO EMISSIONS

Samples were taken simultaneously preceding and following an impingement type wet scrubber to determine if removal of TGNMO's occurred. There was a small reduction in TGNMO's across the scrubber averaging about 0.15 kg/10^9 J (0.012 lb/10^6 Btu).

No significant removal of TGNMO's should be expected from impingement type wet scrubbers used on wood-residue fired boilers. This type of scrubber is not designed for gas absorption and does not function well in that capacity. Any high boiling point organic compounds present in the flue gas may condense to form particulate organics will be removed from the scrubber water along with other solids. Lower boiling point soluble organics such as alcohols removed by the scrubber would likely be stripped from the recirculated scrubber water into the gas stream. However, if a contaminated water makeup (i.e., evaporator condensate) is used in the scrubber, evaporation and stripping of the contaminated water could lead to an increase in TGNMO emissions.

KRAFT RECOVERY FURNACE RESULTS

Average TGNMO emissions as methane collected from kraft recovery furnaces are shown in Table 1. The emissions are reported in terms of parts per million, Kg/10^9 J (lb/10^6 Btu) fired, Kg/1000 Kg (lb/1000 lb) dry black liquor solids fired, and Kg/metric ton (lb/ton) pulp rated capacity. As expected, the magnitude of the TGNMO emissions separated into two levels corresponding to furnaces equipped with direct contact evaporators (DCE) and those not equipped with direct contact evaporators (NDCE). DCE furnaces averaged 0.45 kg/10^9 J (0.10 lb/10^6 Btu) emissions and NDCE furnaces averaged 0.18 kg/10^9 J (0.043 lb/10^6 Btu) emissions.

Recovery Furnace	TGNMO ppm	TGNMO Kg/10^9J (lb/10^6 Btu)	TGNMO Kg/1000 Kg bls (lb/1000 lb bls)	TGNMO Kg/Ton Pulp (lb/Ton Pulp)
A (NDCE)	82	0.17 (0.040)	0.24 (0.24)	0.4 (0.8)
B (DCE)	172	0.43 (0.100)	0.55 (0.55)	0.7 (1.4)
C (NDCE)	89	0.15 (0.035)	0.17 (0.17)	0.2 (0.4)
D (DCE)	169	0.46 (0.106)	0.63 (0.63)	1.0 (2.1)
E (NDCE)	61	0.23 (0.054)	0.32 (0.32)	0.5 (1.0)

Table 1. Average TGNMO Emissions From Kraft Recovery Furnaces.

Weak correlations could be found between TGNMO emissions in Kg/10^9J and stack gas flow rates and oxygen content. TGNMO emissions from furnace C weakly correlated with total stack flow at the point of measurement. Higher stack flow rates resulted in higher TGNMO emissions in Kg/10^9J fired. When stack gas flow rates were corrected to zero percent oxygen there was no correlation with TGNMO emissions. TGNMO emissions in Kg/10^9J also correlated with stack gas oxygen content for furnaces D and E. For furnace D higher emissions occurred at higher stack gas oxygen content. For furnace E higher TGNMO emissions in Kg/10^9J occurred at lower stack gas oxygen levels. When TGNMO emissions were compared to the flue gas oxygen levels as it left the furace as measured by mill instruments, there was no correlation. No other correlations could be found between TGNMO emissions and recovery furnace operating parameters.

A strong correlation was noted between TGNMO and carbon monoxide for the NDCE recovery furnaces as shown in Figure 8. High ppm TGNMO emissions were synonymous with high CO emissions. This relationship holds for TGNMO emissions expressed in Kg/10^9 J and CO emissions expressed in ppm. The correlation of Kg/10^9 J TGNMO emissions to ppm CO emissions was strongest for the small furnace C and weakest in the large furnace E. Furnace A's TGNMO emissions did not vary enough to produce a relationship.

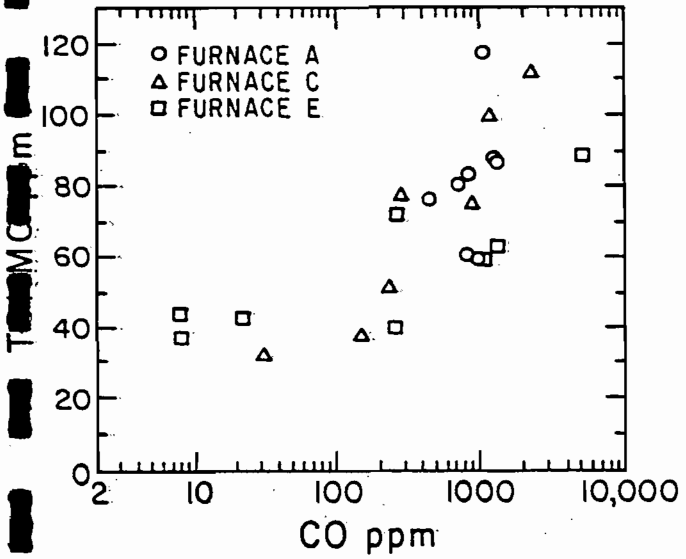

Figure 8. Relationship Between TGNMO and CO Emissions from Kraft Recovery Furnaces

The lower ppm TGNMO values shown in Figure 8 approach the limit of detectability of EPA Method 25 for NDCE recovery furnaces. limit of detectability was estimated to be 40 ppm TGNMO.

These correlations indicate that TGNMO and CO emissions are influenced by the same mechanism within the boiler. High CO emissions indicate incomplete combustion. Incomplete combustion may result from improper air mixing in the furnace, insufficient combustion time, or insufficient temperature allowing uncombusted gases to pass from the reduction zone and through the oxidation zone to the stack uncombusted. Sufficient oxygen was always present to allow for complete combustion.

The data indicate that control for minimum CO emissions should result in minimum TGNMO emissions.

Geometric means of carbon monoxide emissions from recovery furnaces were 3.8, 0.12, .1, 0.078, 1.6 Kg/10^9J (0.88, 0.025, 0.26, .018, and 0.37 lb/10^6 Btu) for furnaces A through E, respectively. Variation in the data could not be tied to any operational parameters. Carbon monoxide emissions need to be studied in more detail than time allowed in this study to elucidate factors controlling its emission.

KRAFT PROCESS LIME KILNS

Average TGNMO emissions as methane from three lime kilns both before and after wet scrubbers are shown in Table 2. The emissions are reported in terms of parts per million and Kg per metric ton (lb per ton) CaO produced. Kiln B produced the highest emissions. The high emissions from this kiln likely result from organics introduced into the lime production process with the contaminated water used to wash the lime mud and for makeup elsewhere in the system. These organics are driven into the gas stream when the lime mud is dried.

The TGNMO emissions from Kiln A are also likely due to organic compounds contained in the water associated with the lime mud rather than from uncombusted fuel. In a laboratory study, a measured quantity of lime mud from Kiln A was heated to drive off water and organic compounds into the sample preparation system in the TGNMO analysis procedure. Results showed 0.22 Kg (0.44 lb) TGNMO per ton lime produced when heated. Corrected field sampling results showed emissions of 0.18 Kg/metric ton (0.37 lb/ton) lime produced. The organics present in the lime mud are likely to result from carryover from the green liquor system. TGNMO emissions from Kiln C were below the minimum detectable level for EPA Method 25.

Kiln		TGNMO ppm	TGNMO Kg/Metric Ton Lime Produced (lb/Ton Lime Produced)
A.	Before Scrubber	122	0.28 (0.56)
A.	After Scrubber	102	0.26 (0.52)
B.	Before Scrubber	338	1.02 (2.05)
B.	After Scrubber	251	0.90 (1.80)
C.	Before Scrubber	31	0.11 (0.22)
C.	After Scrubber	48	0.18 (0.37)

Table 2. Average TGNMO From Lime Kilns.

CONCLUSIONS

(1) Hydrocarbon emission factors expressed as methane for wood-residue fired boilers published in AP 42, Supplement 9 in 1979 (1) were 1 g (2 lb/ton) hydrocarbon per kg of 50% moisture fuel fired. This value translates to 0.11 Kg (0.22 lb) hydrocarbon per 10^9J (million Btu) fired assuming 2080 J/ton (9,000 Btu per pound) wood-residue heat value. This is

two to four times the contribution indicated by this study conducted on wood-residue boilers fired with woods on the Pacific Northwest and considered as representative of current design practices. Any comparisons made between the data generated and presented in this text and the value presented in AP 42, Supplement 9 should consider the lack of knowledge concerning the difference in methods by which the data was generated.

(2) Little TGNMO emission reduction was observed across the wet impingement type scrubber on the wood-residue fired boiler samples. Due to the design of these units, no significant reduction or contribution would be expected for units operated with a fresh water feed.

(3) TGNMO emissions from non-direct contact evaporator recovery furnaces were found to correlate with CO emissions.

(4) The emissions of TGNMO from direct contact evaporator equipped kraft recovers furnaces was higher than from non-direct contact evaporator kraft recovery furnaces.

(5) TGNMO emissions from lime kilns did not appear to be related to combustion but to other process variables such as use of contaminated water for mud washing or kiln scrubber fluid makeup.

REFERENCES

(1) "Compilation of Air Pollutant Emission Factors," 3rd Edition, Supplement 9, AP-42 1977.

(2) Federal Register 45 (194) October 3, 1980.

(3) "A Survey of Wood-Residue Fired Power Boiler Total Gaseous Nonmethane Organic Emissions in the Pacific Northwest," NCASI Atmospheric Quality Improvement Technical Bulletin No. 109, September 1980.

9. An application fee of $20, unless exempted by Section 17-4.05(3), F.A.C. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?
[ ] Yes [x] No

Contaminant	Rate or Concentration

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy) [x] Yes [ ] No

Contaminant	Rate or Concentration

See Attachment B-Note: These BACT determinations for wood-waste boilers.

No BACT determinations are known to have been made for a peat/wood waste boiler.

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration
Particulate Matter	0.2 lb/10^6 Btu heat input
Sulfur Dioxide	0.65 lb/10^6 Btu heat input
Nitrogen Oxides, VOC, CO	Boiler design and proper operation

D. Describe the existing control and treatment technology (if any). See Item VI.E.

1. Control Device/System:
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:
5. Useful Life:
6. Operating Costs:
7. Energy:
8. Maintenance Cost:
9. Emissions:

Contaminant	Rate or Concentration

*Explain method of determining D 3 above.

10. Stack Parameters

a. Height: ft. b. Diameter: ft.

c. Flow Rate: ACFM d. Temperature: °F

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1. Particulate

a. Control Device: Electrostatic precipitator w/wo Mechanical Collector

b. Operating Principles: Electrical charging of particles by high-voltage corona, migration of particles to oppositely charged electrode for collection. Cyclone dry collection can be used to reduce particle loading to ESP.

c. Efficiency*: 99%+ w/o Mech. Collector
99.5%+ w Mech. Collector

d. Capital Cost:

e. Useful Life: 5 to 10 years

f. Operating Cost: See Item F.10.

g. Energy*: 300/450 kw

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

Good

j. Applicability to manufacturing processes: Satisfactory. Bark fly ash reported harder to collect because of low resistivity.

k. Ability to construct with control device, install in available space, and operate within proposed levels:
Good. ESP's in operation on wood-fired boilers have demonstrated high, acceptable removal efficiencies.

2. Particulate

a. Control Device: Venturi Scrubber w/wo Mechanical Collector

b. Operating Principles: Exhaust gas stream is passed through throat or orifice where gas velocities are very high. Scrubbing liquid is introduced at throat, causing dispersal, and impaction and interception of particulate matter. Cyclone or mist eliminator follows to remove droplets. Mech. Collection used to reduce particula load to scrubber

c. Efficiency*: 90%-95% w/o Mech. Collector
95%-99%+w Mech. Collector

d. Capital Cost:

e. Useful Life: 5 to 10 years

f. Operating Cost: See Item F.10.

g. Energy**: 900/1,200 kw

h. Maintenance Costs:

i. Availability of construction materials and process chemicals:

Good

j. Applicability to manufacturing processes:

Good

k. Ability to construct with control device, install in available space, and operate within proposed levels:

Good. Venturi Scrubbers have been proven acceptable in meeting air pollution codes.

*Explain method of determining efficiency.

**Energy to be reported in units of electrical power — KWH design rate.

3. Particulate

a. Control Device: Fabric filter w/wo Mechanical Collector

b. Operating Principles: Exhaust gases are passed through a fabric filter where upon a dust cake is formed and particles are removed. Can be preceded by a Mechanical Collector to reduce dust load to baghouse.

c. Efficiency*: 99%+ w/o Mech. Collector
99.5%+ w Mech. Collector

d. Capital Cost:

e. Life: 15 to 20 years

f. Operating Cost: See Item F.10.

g. Energy: 500/800 kw

h. Maintenance Cost:

*Explain method of determining efficiency above:

i. Availability of construction materials and process chemicals:
Good

j. Applicability to manufacturing processes: Only a few installations on wood-fired boilers due to fire hazards. Recently, safety improvments have been made.

k. Ability to construct with control device, install in available space and operate within proposed levels:

4. Particulate

a. Control Device Gravel Bed Filter w/wo Mechanical Collector

b. Operating Principles: Utilizes a moving bed of granular material, through which gas stream is passed and particles are entrapped. Cyclone can precede to reduce dust loading.

c. Efficiency*: 95% wo Mech. Collector
99% w Mech. Collector

d. Capital Cost:

e. Life: 5 to 10 years

f. Operating Cost: See Item F.10.

g. Energy: 450/750 kw

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:
Good

j. Applicability to manufacturing processes:
Has proven to be successful on non-salt wood-waste fired boilers.

k. Ability to construct with control device, install in available space, and operate within proposed levels:
Good. Can generally meet air pollution codes.

F. Describe the control technology selected:

1. Control Device: Electrostatic Precipitator

2. Efficiency*: 99%+

3. Capital Cost:

4. Life: 5 to 10 years

5. Operating Cost: See Item F.10.

6. Energy: 300 kw

7. Maintenance Cost:

8. Manufacturer: Environmental Elements or equivalent

9. Other locations where employed on similar processes:
See Attachment B--attached list of ESP installations

a.

(1) Company:

(2) Mailing Address:

(3) City:

(4) State:

(5) Environmental Manager:

(6) Telephone No.:

*Explain method of determining efficiency above:

(7) Emissions*:

Contaminant	Rate or Concentration

(8) Process Rate*:

b.

(1) Company:

(2) Mailing Address:

(3) City:

(4) State:

*Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions*:

Contaminant	Rate or Concentration

(8) Process Rate*:

10. Reason for selection and description of systems:

ESP's, venturi scrubbers, fabric filters, and gravel bed filters, all with or without mechanical collectors preceding, have been demonstrated to adequately achieve the State of Florida regulation of 0.2 lb/10^6 Btu heat input due to carbonaceous fuel. All these devices can achieve similar levels of efficient particulate collection, exceeding 99 percent. Mechanical collectors are common on present installations, preceding the more efficient control device, primarily because most of these installations already were equipped with them to meet less stringent pollution codes and were later retrofitted.

Venturi scrubbers have proven to be the most popular devices on wood-waste boilers, due to their wide range of applicability for particulate removal. However, venturi's create a wastewater disposal problem, operating costs are high, and wear on the scrubber can be severe. ESP's have not been used as extensively because the resistivity of wood-waste fly ash makes such particles hard to collect. However, recent improvements and pilot studies on ESP operation now make these devices very attractive (see attached vendor literature). Fabric filters have also historically not been widely used on wood-waste boilers, primarily due to the fire hazard. Recent improvements in fire prevention and safety precautions now make these devices more attractive.

A cost comparison of the various particulate control devices is presented below, based upon three different cost computing sources. Because the parameters and assumptions utilized by each source are different, comparisons cannot be made between the different sources.

---

*Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

Control Method	Estimated Efficiency	Capital Costs ($\$ \times 10^6$) Ref. 1	Ref. 2	Ref. 3	Annual Costs ($\$ \times 10^6$) Ref. 1	Ref. 2
Venturi scrubber	95%	1.5	—	0.7	0.7	—
Venturi scrubber w/mech. collector	99%	—	4.9	1.3	—	2.1
ESP	99%	2.3	—	—	0.5	—
ESP w/mech. collector	99.5%	—	6.6	1.8	—	1.8
Fabric filter	99%	4.4	—	0.9	—	—
Fabric filter w/mech. collector	99.5%	—	7.7	1.5	—	2.2
Gravel bed filter	95%	—	—	0.7	—	—
Gravel bed filter w/mech. collector	99%	—	6.3	1.3	—	1.2

The data indicate the following:

1. Fabric filters display the highest capital costs, with ESP's next and venturi scrubbers the cheapest.

2. The addition of mechanical collectors can significantly increase capital costs, while only significantly increasing overall efficiency for the low efficiency control devices (i.e., gravel bed filter).

3. ESP's result in the lowest annualized costs, except for gravel bed filters, with venturi scrubbers next and baghouses most expensive.

4. ESP's achieve the highest degree of efficiency, as do baghouses, with venturi scrubbers and gravel bed filters displaying lower efficiencies.

To date, five BACT determinations have been made by U.S. EPA for bark and wood-waste boilers. These are summarized below:

Boiler Size	Fuels Fired	Particulate Emission Limit	Control	Efficiency
Approx. 520 x 10^6 Btu/hr	Bark & wood waste only	0.15 lb/10^6 Btu	ESP	96.5%
400,000 lb stm/hr	Wood waste only	0.02 gr/dscf	ESP	—
300,000 lb stm/hr	Wood waste only	0.04 gr/dscf	Venturi scrubber	—
200,000 lb stm/hr	Bark and wood waste	0.04 gr/dscf	Impingement scrubber	—
550,000 lb stm/hr	Bark and wood waste	0.20 lb/10^6 Btu	None listed	—

As shown, both ESP's and venturi scrubbers have been chosen as BACT, with varying resulting emission limits. For two of the applications, ESP's have been chosen.

G-P is proposing an ESP as BACT for particulate matter for the proposed combination peat/wood-waste fired boiler. ESP's are capable of achieving the highest degree of efficiency of any of the available control methods. Venturi scrubbers were rejected because of their high operating costs, maintenance and energy requirements, and waste-water disposal problems. Fabric filters were rejected because of their lack of widespread use on wood-waste boilers, their potential fire hazard, and their high annualized costs.

Because very limited data are available on the characteristics of peat firing, i.e., particle size, composition, resistivity, etc., and no full-scale boiler operations are known to exist in the U.S. at this time, G-P is proposing a BACT emission limit equal to the Florida carbonaceous fuel-burning regulation of 0.2 lb/10^6 Btu. This is approximately equivalent to an outlet grain loading of 0.11 gr/dscf based upon theoretical combustion calculations. It is believed a lower emission rate and grain loading can be achieved, but until further test data become available, G-P does not want to commit to any lower limit. As design data concerning the ESP become available, G-P will submit such information to the Florida DER. The PSD report indicates that the proposed emission level does not adversely affect particulate matter air quality levels in the area of the G-P mill.

10. Stack Parameters

a. Height: ft. b. Diameter: ft.

c. Flow Rate: ACFM d. Temperature: °F

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1. Sulfur Dioxide

a. Control Device: Sodium Scrubbing

b. Operating Principles: Wet scrubbing with acqueous solution, SO_2 is absorbed by solution. Requires sludge disposal, water treatment, and solution preparation.

c. Efficiency*: 90%+ d. Capital Cost: $4.0 million

e. Useful Life: 5 to 10 years f. Operating Cost:

Annualized costs = $2.3 million

g. Energy*: 2,400 kw h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

Assumed adequate

j. Applicability to manufacturing processes:

Has been applied to coal boilers

k. Ability to construct with control device, install in available space, and operate within proposed levels:

Assumed adequate

2. Sulfur Dioxide

a. Control Device: Dual Alkali Scrubbing

b. Operating Principles: Wet scrubbing of SO_2 gases by absorption in alkaline solution. Requires sludge disposal, water treatment, and solution preparation. Regeneration of solution by calcium alkali.

c. Efficiency*: 90%+ d. Capital Cost: $4.8 million

e. Useful Life: 5 to 10 years f. Operating Cost:

Annualized costs = $2.4 million

g. Energy**: 1,900 kw h. Maintenance Costs:

i. Availability of construction materials and process chemicals:

Assumed good.

j. Applicability to manufacturing processes:

Has been applied to coal boilers

k. Ability to construct with control device, install in available space, and operate within proposed levels:

Assumed adequate. Requires large land area for waste disposal.

*Explain method of determining efficiency.

**Energy to be reported in units of electrical power – KWH design rate.

3. Sulfur Dioxide

a. Control Device: Lime/Limestone Scrubbing

b. Operating Principles: Wet scrubbing with lime/limestone slurry. Waste disposal to settling pond, water recycle. SO_2 is absorbed by aqueous solution.

c. Efficiency*: 90%+ d. Capital Cost: $5.4 million

e. Life: 5 to 10 years f. Operating Cost:

Annualized costs = $2.9 million

g. Energy: 4,800 kw h. Maintenance Cost:

*Explain method of determining efficiency above.

i. Availability of construction materials and process chemicals:
Good

j. Applicability to manufacturing processes:
Has been applied to coal boilers

k. Ability to construct with control device, install in available space and operate within proposed levels:
Assumed satisfactory. Requires large land area for waste disposal.

4. Sulfur Dioxide

a. Control Device Low Sulfur Fuel (Peat/Wood)

b. Operating Principles: Low sulfur-containing fuels are utilized in the boiler, such as wood and/or peat.

c. Efficiency*:

d. Capital Cost:

e. Life: See Item F

f. Operating Cost: See Item F

g. Energy:

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:
Good

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected:

1. Control Device: Low Sulfur Fuel (Peat/Wood)

2. Efficiency*: 78%+, based upon comparison with 2.5% S oil

3. Capital Cost: Essentially none

4. Life:

5. Operating Cost:

6. Energy: None required except for fuel handling

7. Maintenance Cost: None

8. Manufacturer:
Not applicable

9. Other locations where employed on similar processes:

a. No known facilities presently burning peat. Many Kraft Pulp Mill boilers burning wood waste as fuel.

(1) Company:

(2) Mailing Address:

(3) City:

(4) State:

(5) Environmental Manager:

(6) Telephone No.:

*Explain method of determining efficiency above.

(7) Emissions*:

Contaminant	Rate or Concentration

(8) Process Rate*:

b.

(1) Company:

(2) Mailing Address:

(3) City:

(4) State:

*Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions*:

Contaminant	Rate or Concentration

(8) Process Rate*:

10. Reason for selection and description of systems:

Sulfur Dioxide

The firing of peat and/or wood waste is chosen as the best system of emission reduction considering energy, environmental, and economic impacts. Peat and wood waste both have inherent low sulfur contents. Based upon the AP-42 factor for wood waste burning of 1.5 lb/ton wet and a Btu value of 4,250 Btu/lb wet, SO_2 emissions from wood waste are equivalent to 0.18 lb/10^6 Btu. Similarly, based upon 0.15 percent S max (wet basis) and 4,617 Btu/lb SO_2 emissions from peat are equivalent to 0.65 lb/10^6 Btu heat input. Both of these values are well below the NSPS for fossil-fuel steam generators (non-utility) firing liquid fuel of 0.8 lb/10^6 Btu.

In addition, the available literature concerning peat firing indicates as much as 80 percent of the theoretical SO_2 is contained in the bottom ash or absorbed by the fly ash, therefore, it is expected that SO_2 emissions will be lower than the maximum figures presented herein. However, until the proposed unit becomes operational or test firings are conducted, the actual removal for Florida peat fired in a large wood waste boiler cannot be determined.

Presented below are several alternative fuel usage scenarios based upon peat, wood waste, and oil firing.

---

*Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

Percentage of Steam Produced From:				Sulfur Dioxide Emissions (tons/year)
Peat	Wood Waste	2.5% S Oil	1.0% S Oil	
70%	30%	--	--	2,206
--	--	100	--	10,131
--	--	--	100	4,052
--	50	50	--	5,475
--	100	--	--	818

The 70% peat/30% wood waste scenario is the anticipated usage for the proposed combination boiler. As shown, SO_2 emissions from this fuel scenario are about five (5) times less than from burning high-sulfur fuel oil and about a factor of two (2) times less than burning low-sulfur fuel oil. The peat/wood-waste scenario is also much less than a combination boiler fired by 50% wood waste and 50% oil. Only the 100% wood-waste firing represents lower SO_2 emission.

Out of five (5) BACT determinations by U.S. EPA on bark and wood-waste boilers, only one resulted in SO_2 emission limits being set. This was for a wood-waste only boiler, with a limit of 0.21 $lb/10^6$ Btu. None of the BACT determinations resulted in add-on SO_2 removal systems.

Add-on SO_2 removal systems for the proposed combination boiler were not considered justified due to the inherent low sulfur content of peat and wood waste, the excessive costs associated with an add-on system (estimated at over $4 million dollars capital costs and $2.3 million annualized costs), and the solid waste disposal and handling problems associated with these devices. The firing of peat and wood-waste in the proposed boiler is considered to be BACT, with a proposed maximum emission limit of 0.65 $lb/10^6$ Btu (based upon peat firing and until further data becomes available). As shown in the PSD report, this emission level does not adversely impact air quality in the area of the G-P mill.

Nitrogen Oxides, VOC, CO

Nitrogen oxides emissions have generally not been addressed in the literature with respect to wood waste and peat-fired boilers. The NCASI study (see attached copy) is the most specific study to date, dealing with wood-waste emissions. NO_x emissions from wood waste boilers were demonstrated to be significantly less than the AP-42 factor of 10 lb/ton wet wood waste. The highest measured rate was 1.91 lb/ton wet wood waste, or 0.21 lb/10^6 Btu. This is less than the NSPS for liquid fuel-burning fossil fuel steam generators of 0.3 lb/10^6 Btu. No significant dependence of NO_x on boiler size was found. Because of its low NO_x production, the proper burning of wood-waste (with peat assumed similar) and proper boiler operation is considered as the best available control technology. However, it is probable further reductions in NO_x emissions can be achieved by applying typical NO_x reduction techniques: flue gas recirculation; low excess air firing, low air preheat, and burner and boiler design. These techniques however must be balanced with proper boiler operation and the effects upon VOC and CO emissions considered.

Similarly, VOC emissions reported recently by NCASI for wood-waste burning are one-half or less of the AP-42 factor of about 0.22 lb/10^6 Btu. Emissions were found by NCASI to be a function of the percent overfire air utilized in the boiler: the greater the percentage of overfire, the lower the VOC emissions. Boilers using overfire air promote good combustion and thereby minimize VOC emissions. No relationship between VOC emissions and steam production, and flue gas moisture and temperature were found. Since no add-on VOC controls are feasible, and the proposed boiler will utilize suspension burning which promotes air/fuel mixing and good combustion, the proper firing of wood waste and peat and good boiler operation is considered to be BACT.

No add-on controls are feasible for CO, and again proper boiler operation and firing practices are considered as BACT. Although emissions of NO_x, VOC, and CO from peat burning are expected to be in the range of emissions from wood-waste burning, little literature is available on specific emission rates. Therefore, only "good boiler operation" is proposed as BACT at this time, with no specific emission limits.

REFERENCES

1. Operation and Maintenance of Particulate Control Devices in Kraft Pulp Mill and Crushed Stone Industries. PEDCO Environmental Specialists, Inc., Cincinnati, Ohio. EPA-600/2-78-210, October 1978.

2. Nonfossil Fuel-Fired Boilers--Background Information for Proposed Standards, Draft EPA Report, Chapters 3-9.

3. Control of Particulate Emission from Wood-Fired Boilers. PEDCo Environmental, Inc. EPA 340/1-77-026, 1977.

4. Personal Communication. Neal R. Davis, Applications Engineer, Environmental Elements Corporation, Baltimore, Maryland. May 22, 1981.

5. Technology Assessment Report for Industrial Boiler Applications: NO_x Flue Gas Treatment. Radian Corporation, EPA-600/7-79-178 g, December, 1978.

6. Control Techniques for Nitrogen Oxides Emissions from Stationary Sources, Second Edition. Acurex Corp., EPA-450/1-78-001, January 1978.

7. NO_x Emissions from Combustion Sources in the Pulp and Paper Industry. Hood, H.T. and Maner, R.A., NCASI. Paper presented at 1981 TAPPI Environmental Conference, New Orleans, LA.

8. Volatile Organic Compound Emissions from Pacific Northwest Pulp and Paper Industry Combustion Sources. Dallons, V.J. and Simon, C., NCASI. Paper presented at 1981 TAPPI Environmental Conference, New Orleans, LA.

9. Compilation of BACT/LAER Determinations, Revised. PEDCo Environmental Specialists, Inc. EPA-950/2-08-070, May 1980.

Attachment B

Combination Boiler BACT Information

Note: Neither the ESP equipment vendor nor the specific ESP model have yet been selected; therefore, generic design data are presented. Once specific equipment data become available, they will be provided to Florida DER.

1. Efficiency Calculations (based on wood-waste firing)

   Maximum emissions at State of Florida Standard = 216.7 lb/hr
   Potential emissions (uncontrolled) = 9,561 lb/hr.

   Required efficiency = (9,561 - 216.7) ÷ 9,561 x 100 = 97.7%.

2. Outlet grain loading at 216.7 lb/hr = 0.11 gr/dscf (see Attachment A).

1.3

BACT/LAER CLEARINGHOUSE REPORT

(not a kraft process)

SOURCE TYPE/SIZE: New bark/wood-waste boiler (72.4 tons of bark per hour @ 60% moisture) at an existing Paper Mill

NAME/ADDRESS: Great Northern Paper Co., East Millinocket, Maine 04430

DETERMINATION IS: ~~CONDITIONAL~~/FINAL/~~PENDING~~ ISSUED on May 1, 1979 (date), BASIS* of ~~BACT1/LAER~~/BAC
for ~~NEW~~/MODIFIED SOURCE

BY Environmental Protection Agency Region I (Agency) John Courcier (Person) 223-4448 (Phon

PERMIT PARAMETERS: AFFECTED FACILITIES	THROUGHPUT CAPACITY (Weight Rate)	POLLUTANT(s) EMITTED	EMISSION LIMIT(s) and (basis for)**	CONTROL STRATEGY DESCRIPT Equipment Type, Etc.	Ef
Bark & Wood-waste	72.4 Tons of bark	TSP	0.15#/MBtu (B)	ESP	96.4%
Boiler	per hour (@ 60%				
	moisture)	SO_2	0.21#/MBtu - Bark Only	Displacing oil consumption	-
			(State Permit)	by burning bark	
		NO_2	0.70#/MBtu-bark on bark oil	Design Features in Boiler	-
			0.30#/MBtu-oil (State Permit)		
		CO	0.23#/MBtu - (B)	Design Features in Boiler	-
		HC	0.23#/MBtu - (B)	Design Features in Boiler	-

NOTES: Source will be allowed to continue using 2.5% S oil during emergency situations. It was determined that the severe economic and energy impact of using a lower sulfur oil when compared with the nominal environmental benefits did not justify the switch to the low S. oil.

* Circle one. $BACT^1$ means a determination made under pre-1977 amendments; $BACT^2$ means post-1977 amendments to CAA.

** Basis symbols: Use B=BACT, N=NSPS, S=SIP, L=LAER

1.3

BACT/LAER CLEARINGHOUSE REPORT

SOURCE TYPE/SIZE: Power Plant - Wood Waste Fired

NAME/ADDRESS: Washington Water Power Kettle Falls, WA

DETERMINATION DATA: CONDITIONAL/[✓ FINAL]/PENDING for BACT/LAER on [✓ NEW]/MODIFIED SOURCE

KEY DATES: Application-Recd.________, Completed________; Determination-Proposed________, Final 3/13/80

BY: (Agency) EPA Region X Person Paul Boys Phone________

AFFECTED FACILITIES	THROUGHPUT CAPACITY	EMISSION RATE* -UNCONTROLLED*	EMISSION LIMITS (Basis)**	CONTROL STRATEGY DESCRIPTION Equipment type, etc.	Eff. %
Wood fired boiler	400,000#steam/hr	PM	.02gr./dscf@12% CO_2 (B	electrostatic precipitator	
			Opacity 10% (B		
		NOx	456(T/yr) (N)	proper equipment operation	
		CO	701(T/yr) (N)		
		HC	701(T/yr) (N)		

SOURCE OPERATION: BATCH/CONTINUOUS:________hrs/yr; % by Season ____ W ____ Sp ____ Su ____ F

NOTES:________

* Specify pollutant (PM, SO_2, NO_x, HC, CO or other) and mass emission rate

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, A = Achieved-in-Practice (AIP)

BACT/LAER CLEARINGHOUSE REPORT

1.3

SOURCE TYPE/SIZE: Hog fuel boiler/300,000 lb/hr steam

NAME/ADDRESS: Publishers Paper Newburg, Oregon

DETERMINATION DATA: CONDITIONAL [✓ FINAL] PENDING for BACT/LAER on [✓ NEW] MODIFIED SOURCE

KEY DATES: Application-Recd. ______, Completed ______; Determination-Proposed ______, Final 9/6/79

BY: (Agency) EPA Region X Person Paul Boys Phone ______

AFFECTED FACILITIES	THROUGHPUT CAPACITY	EMISSION RATE* -UNCONTROLLED	EMISSION LIMITS (Basis)**	CONTROL STRATEGY DESCRIPTION Equipment type, etc.	Eff. %
Hog fuel boiler	300,000 lb/hr steam	TSP	0.04 gr/dscf (B)	venturi scrubber	
		CO	569 ton/yr (B)	efficient operation	
		HC	569 ton/yr (B)	efficient operation	
		NOx	2850 ton/yr (B)	efficient operation	

SOURCE OPERATION: BATCH/CONTINUOUS: ______ hrs/yr; % by Season ____ W ____ Sp ____ Su ____ F

NOTES: ______

* Specify pollutant (PM, SO_2, NO_x, HC, CO or other) and mass emission rate

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, A = Achieved-in-Practice (AIP)

(10.1)

BACT/LAER CLEARINGHOUSE REPORT — Page 3 of 3 pages

SOURCE TYPE/SIZE: KRAFT PULP MILL — PULPING CAPACITY 1034 TONS/DAY

NAME/ADDRESS: BOISE CASCADE, P.O. BOX 500, WALLULA, WA 99363

DETERMINATION IS: CONDITIONAL/FINAL/PENDING: FOR NEW/MODIFIED SOURCE — DATE OF ISSUE: 2/24/78 — BASIS:* BACT[1]/LAER/[✓ BACT[2]]

BY EPA REGION X (Agency) — LARRY SIMS AND PAUL BOYS (Person) — (206) 442-1106 (Phone)

PERMIT PARAMETERS:

AFFECTED FACILITIES	THROUGHPUT CAPACITY, weight rate	POLLUTANT(S) EMITTED	EMISSION LIMIT(S) AND BASIS FOR**	CONTROL STRATEGY DESCRIPTION Equipment type, etc.	Eff.,%
Hogfuel boiler	200,000 lb/hr	TSP	0.04 gr/scf/459 (B)	I.D. Zurn Air System,	
	steam		lb/day	type MTSA, two parallel	
		Opacity	20% (S)	impinger type scrubbers	
Power boiler	200,000 lb/hr	TSP	299 lb/day (B)		
gas-oil (major)	steam	SO_2	3025 lb/day (B)		
		Opacity	20% (S)		

NOTES:

* Circle one. BACT-1 indicates determination made under pre-1977 amendments; BACT-2 indicates post-1977 amendments to CAA.

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, L = LAER, P = PSD Increment

1.3

BACT/LAER CLEARINGHOUSE REPORT

SOURCE TYPE/SIZE: Hog fuel boiler/550,000 lb/hr steam

NAME/ADDRESS: Potlatch, Lewislon, Idaho

DETERMINATION DATA: CONDITIONAL/[✓ FINAL]/PENDING for BACT/LAER on [✓ NEW]/MODIFIED SOURCE

KEY DATES: Application-Recd. ________, Completed ________; Determination-Proposed ________, Final 8/19/80

BY: (Agency) EPA Region X Person Paul Boys Phone ________

AFFECTED FACILITIES	THROUGHPUT CAPACITY	EMISSION RATE* -UNCONTROLLED	EMISSION LIMITS (Basis)**	CONTROL STRATEGY DESCRIPTION Equipment type, etc.	Eff. %
#4 Power Boiler	550,000lb/hr stea	NOx	0.2 lb/10^6 Btu (B)	Continuous air discharge grate, suspension firing of dry wood, tangantial firing, large firebox	

SOURCE OPERATION: BATCH/CONTINUOUS: ________ hrs/yr; % by Season ________ W ________ Sp ________ Su ________ F

NOTES: ________

* Specify pollutant (PM, SO_2, NO_x, HC, CO or other) and mass emission rate

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, A = Achieved-in-Practice (AIP)

Page ____ of ____

Rev. 5/80

Pilot Precipitator Studies on Combination Fuel Boilers

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Abstract

Environmental Elements Corporation, a subsidiary of Koppers Company, Inc., has employed an "in-house" pilot sized precipitator to study the precipitability of the particulate emanating from certain combination fuel-fired boilers. Studies were made with boilers burning bark and coal, bark and natural gas, and bark and oil. The results of these studies are described in this paper.

INTRODUCTION

Since the beginning of man's reign in our world, efforts have been continuing to extract the most energy out of whatever was at hand. Back in the days of the caveman, whenever an animal was killed, nearly every part of it was used. The meat was eaten, the skin treated and made into clothing or coverings, and the bones made into utensils, tools, and weapons. In those days, this was necessary because their weapons were such that they were unable to obtain an abundance of anything.

As man's technology advanced, he went through an era of waste. The thought then was that the earth's resources were unlimited, and man used them with this in mind. The great herds of buffalo, once thought to be limitless, are now almost extinct. Many other animals and other natural resources have suffered the same fate. We have, in time, come almost full circle, back to the realization that we can no longer waste energy that we must use our natural resources wisely, because in most cases, Mother Nature is slow to replace or replenish the supply.

An example of this awareness appeared in a recent advertisement from Georgia-Pacific. The American Pioneers were a hardy lot, but in clearing the land for home and farm, they consumed our forest resources at a rate we couldn't live with today. For a typical 320 sq. ft. (29.73 m^2) (16 ft. x 20 ft.) (4.88m x 6.10m) log cabin, our forebearers used 70 trees and burned what was left over. Today, that same number of trees would provide a 3,500 sq. ft. (325.16 m^2) home - plus enough tissue and paper product for an average family - for over 30 years. Today we know that we must grow our trees scientifically and manage our forests so that we can have a continuous harvest to feed the seemingly insatiable hunger for wood, for paper, and for paper products. Part of this process includes the complete utilization of all parts of the trees. The pulp and paper industry make paper from the cellulose fibers, which amount to about 50% of this primary raw material. Steam is generated by burning the remainder in the form of waste liquor and bark. I'm certain that all of you are aware of the processes that produce the bark which is a sizable by-product which must be disposed of, so I won't burden you with a description of them, but merely say that bark is a fuel, it is available, it will continue to be available, it is being used as a fuel, and it will continue to be used as a fuel. However, since it is a fuel and has an ash content, the various governments have decreed that the exhausting of this material into the atmosphere must be controlled. The burning of bark as a fuel is not a new concept but has been in progress for many years. Also, the pulp and paper industry have long ago recognized the fact that the exhaust gases from these combination boilers had to be treated to remove much of the resultant fly ash. It has been common practice to install mechanical collectors (cyclones, multiclones, etc.) in the system. Since the ash from this coal and bark firing usually contained a large amount of unburned material, the collected ash was reinjected into the furnace. This method is nominally 70-80% efficient when the collector is well maintained, but could easily degrade to 50% or less if the collector is not maintained properly.

Since today's pollution control regulations require that discharges must be much less than that attainable with this type of collector, Environmental Elements Corporation deployed their mobile pilot precipitator to study the precipitability of fly ashes that originate in this type of steam generator. Our first investigation into the feasibility of using an electrostatic precipitator on a combination fuel boiler was at the Covington, Virginia Mill of the West Virginia Pulp and Paper Company. This boiler burned a combination of bark and coal in a traveling-grate stoker-fired boiler. Two studies were made there, one with the fly ash that was removed by the cyclones reinjected into the boiler, and one without the fly ash reinjected. The second and most recent study into this subject was at the Ferguson Mill of the St. Regis Paper Company at Monticello, Mississippi. This boiler burns a combination of bark and natural gas or bark and No. 6 fuel oil. Here, of course, the only fuel burned on the traveling-grate stoker is the bark. This paper will be devoted to the presentation of the results of these studies.

The Covington, Virginia Mill of the West Virginia Pulp and Paper Company operates a power station which produces its own electrical power and uses the exhaust steam from the generators throughout the mill for processing. In two stoker-fired boilers they supplement their coal firing with the bark removed from the wood before pulping. In addition to obtaining the additional energy, it also eliminates the need of otherwise disposing of the bark. The boilers fire, on the average, between 32,500 to 35,000 pounds (13,620 to 15,890 Kg.) of bark per hour and were equipped with mechanical collectors of the multiclone type. The Ferguson Mill of the St. Regis Paper Company has a power station which combines the outputs of their waste heat boilers, a small package boiler and combination boiler which was used in this program. This plant normally produces all of the electrical power required in the mill. The combination boiler is rated at 600,000# (272,400 Kg.) of steam per hour. Normally, 60-70% of the fuel used is bark which is supplemented with gas or oil.

Test Equipment (Plate A)

The pilot precipitator used in the WESTVACO tests was a single chamber, 4 gas passage, 2 field precipitator, rigidly mounted on a 32 ft. (9.75m) semi-trailer. The discharge electrodes are mounted in pipe frames. The collecting plates are 10 gauge (3.571mm) flat plates, 4 ft. (1.22m) wide with a vertical center stiffener. The wire frames are suspended from a single center-bolt through the top pipe to a half-round, T-slotted bar, and are supported by insulators. The insulator compartments are outside the gas stream, and power is conveyed to the unit from the potheads by a metal bus bar. The plates are suspended from their corners on traverse support bars. The center two traverse bars are connected by a heavy bar with a center tapered socket which accepts the inner end of the plate rapper rod. The rapper rod projects through the roof with a multiflex boot providing a seal. The entire roof is removable so that alignment may be made or plate and/or frames removed or replaced. A small access door is provided between the fields on the side of the unit for inspection and/or maintenance. Transition sections at the inlet and outlet provide for the proper channeling of the gases into and out of the precipitator. Two perforated plates are installed in the inlet transition to give optimum flow distribution. The front end of the semi-trailer is enclosed and houses the transformer/rectifier, all electrical instruments and meters, and the necessary gear for running efficiency determinations. An eighteen inch diameter (.457m) duct was used to transport the gases from the boiler room, and the discharge was a short stack mounted directly on top of the fan. Test ports were located at the required distances from duct disturbances, and all tests were made at a single point. Traverses were made early in the program, and samples were withdrawn from a point of average velocity. An orifice with orifice taps was installed in the inlet duct, calibrated, and later used to set flow through the precipitator.

The pilot precipitator used in the St. Regis Paper Company tests was our, shall we say, Mark II model. Time and hard use finally rendered the first unit unfit for active duty, so a second one was built. Experience, gained from many tests run with the first unit brought about a much more sophisticated, and easier to operate unit. We have unitized it, so that it can be installed in places where the earlier one could not. We have improved the housing of the new one so that assembly can be more easily accomplished. We have installed automatic power controls to replace the old manual control. The control room is separate and contains improved instrumentation. The same 2.2 KVA transformer/rectifier is used, but it is located directly on the precipitator. Discharge electrode rappers have been installed and can be operated during the test if so desired. Plate rapping still employs a pneumatic impulse rapper which is normally actuated once each 30 seconds. A reverse impact pitot tube connected to a differential pressure gauge is now used to set and monitor flow which is controlled by a radial vane damper on the fan.

Test Procedure

Testing for efficiency in the WESTVACO Test Program was in accordance with ASME Power Test Codes 21 and 27 with some slight modifications, using medium porosity alundum thimbles. The tests conducted at St. Regis further modified the PTCs to use an instack Gelman Type A47 mm glass fibre filter at the outlet test station due to the small amount of sample collected during the short time duration tests. Alundum thimbles were used to determine inlet loadings as before.

Conclusions on Bark and Coal-Fired Boiler

Following the test program on the bark and coal boiler at WESTVACO, it was concluded that the precipitability of the ash could be classed as medium to good with 100% of the ash being reinjected. Precipitability decreased as the amount of reinjection decreased. Performance indicated that barbed wire discharge electrodes would be recommended with high intensity collector electrode rapping.

Summary of Results on Bark and Coal-Fired Boiler

The program was conducted using a stabilized efficiency method. Parameters were set up, such as gas velocity, rapper pressure, rapper interval, etc. early in the day. Sampling tests of 60 minutes duration were conducted over an eight to ten hour test period. A plot of these test results (Figures 1-A & 1-B) showed how collection efficiency varied with time. Parameters were varied from day to day until performance was constant. This represented the conditions at which the precipitator wanted to run. These numbers were then used in calculating appropriate sizes or a full size precipitator. Other information gained from these tests indicated that, even though the fly ash produced by the coal and ash was on the high side of what we consider normal resistivity, being 1.5×10^{11} ohm-cm, it was readily precipitable because of the high combustible content in the ash (25% LOI) plus the high moisture content of the gases (10-12%).

The effect of velocity was also studied, and we found that for increases in velocity from 3 ft./sec. (.9141m/sec.) to 5 ft./sec. (1.52m/sec.) the collection efficiency remained relatively constant.

The coal burned during the tests was an eastern, low sulfur (less than 1%S), high volatile bituminous coal with approximately 7.0% ash. Two types of discharge electrodes were tested - barbed and squared. The barbed indicated better performance. The high content of combustibles in the ash and the presence of an occasional, large fragment of still-burning bark was always possible. Self-ignition of the ash in the holding tank after removal from the pilot precipitator occurred several times which lead to a recommendation of some type of continuous ash removal system. Small buildups in the precipitator presented no problems along these lines, but the lack of inleakage kept the oxygen levels low and greatly reduced the chances of ignition either on the collecting surfaces or in hoppers, etc. The presence of a multiclone mechanical collector in front of the precipitator would be a help in removing most of the larger particles, although in the later study these sparkers were still encountered, despite the presence of a multiclone collector.

Another factor noted during the test period was, that when the bark was removed from the fuel supply, precipitator performance declined. This reflects truly the fact that low sulfur coal was being burned. When the moisture was lowered from 10-13% to 4-7%, the resistivity of the resultant ash was probably very high, and even though the inlet loading was reduced almost 50%, the residual was higher, being typically like a precipitator collecting ash from a low sulfur coal-fired boiler.

COAL ANALYSES (AS RECEIVED)

Sample Date	Percent Moisture	Percent Volatile	Percent Fixed Carbon	Percent Ash	Percent Sulfur
4/20	0.93	31.7	61.5	6.7	1.14
4/21	1.10	32.4	60.8	6.8	0.95
4/22	0.98	34.4	59.4	6.4	0.88
4/23	0.93	32.3	61.6	6.1	0.81
4/26	1.86	32.2	60.2	7.6	0.84
4/27	3.91	23.7	45.1	31.4	0.55*
4/28	1.49	31.4	60.9	7.7	0.97
4/29	1.12	32.5	59.6	7.9	1.00
4/30	1.24	32.2	61.4	6.3	0.95
5/1	1.30	33.0	58.8	8.2	1.01

*Bad Sample

Figure 1-A.

ASH ANALYSES

Sample Date	Fly Ash Reinjection	Ash Bark Firing	Resistivity Ohm-CM	Percent Loss on Ign.	Fineness % 10
4/21	Full	No	1.5×10^{11}	25.2	14.5
4/28	Full	Yes	7.2×10^{7}	18.6	17.0
4/29 (AM)	Part	Yes	5.7×10^{7}	29.1	11.0
4/29 (PM)	Part	Yes	1.5×10^{7}	26.3	7.1

Figure 1-B.

Conclusions on Bark and Oil or Gas-Fired Boiler

The ash produced by bark and oil or bark and gas firing could be classified as relatively easily precipitated. The ash produced by bark and oil firing produced a higher collection efficiency than the ash from bark and gas firing. Only one of our standard discharge electrodes was employed in the main phase of our program.

Summary of Results on Bark and Gas or Oil-Fired Boiler

The test program at the Ferguson Mill of the St. Regis Paper Company was conducted in a different manner than the tests at WESTVACO. At this location, we followed a procedure that has evolved as a result of doing numerous pilot precipitator studies during the interim between the WESTVACO tests and these. Our practice now is, based on past studies, we select the type of discharge electrode we feel will be best, set a gas volume which will give us a velocity in the unit that we feel will be comparable, and adjust the rapper to give us a medium intensity rap (Figure 2). With these parameters set, we request that the plant being tested set a load and fuel rate that is close to normal and maintain these conditions during our test period (Figure 3). They would come to the test conditions approximately three hours prior to our daily starting time and would maintain a steady state until we concluded our tests for the day. We maintained these conditions and tested for approximately one week. We ran as many short duration tests (25 minutes) as we could during an eight hour period and studied the results for stability, collection level, repeatability, etc. The bulk of our tests were run with oil being used as the supplemental fuel since it appears that natural gas will not be too available as a constant fuel source, plus there are many places where gas will not be available at all (Figure 4). These tests established a base which was subsequently used to compare with later results using other parameters. Using this method of evaluation, we determined that a low or medium level of rapping was sufficient to keep the wires and plates clean enough to maintain a constant performance. Sight glasses, installed in the roof of the pilot unit, were also utilized to insure that the plates and wires were uniformly and lightly builtup. These sight glasses were located over the two outside gas passages, and by utilizing a spotlight, one could look clearly into the outer gas passage and observe the cleanliness, the rapper action, etc.

RAPPING INTENSITY VS. PERFORMANCE

Rapping Intensity	Inlet Loading Gr/DSCF	Outlet Loading Gr/DSCF	Efficiency Percent
Low	0.3896	0.0073	98.13
Medium	0.3134	0.0070	97.77
High	0.4776	0.0101	97.88

NOTE: Gr/DSCF x 2.289 = Grams/Cubic Meter

Figure 2.

The effect of velocity was also studied, and we found that for increases in velocity from 3 ft./sec. (.9141m/sec.) to 5 ft./sec. (1.52m/sec.), the collection efficiency remained relatively constant.

Figure 3 shows that although the efficiencies remained nearly constant, the inlet loadings increased with the velocity, and the added inlet dust burden made a higher collection efficiency possible than would have been obtained assuming a constant inlet loading.

Gas Velocity Ft./Sec.	Inlet Loading Gr/DSCF	Outlet Loading Gr/DSCF	Efficiency Percent
3	0.3134	0.0070	97.77
4	0.3541	0.0098	97.23
5	0.3798	0.0103	97.29

NOTE: Gr/DSCF x 2.289 = Grams/Cubic Meter

Figure 3.

This was the limiting velocity on our equipment with this particular duct set-up, but it did indicate that a higher drift velocity than was obtained at 5 ft./sec. (1.52m/sec.) could be probably obtained and utilized for projecting a full sized precipitator. One of the main parameters studied in Figure 4 was the various fuel combinations.

FUEL COMBINATIONS VS. PERFORMANCE

Type of Fuel	Inlet Loading Gr/DSCF	Outlet Loading Gr/DSCF	Efficiency Percent
Natural Gas Plus Bark	0.3713	0.0176	95.26
Fuel Oil Plus Bark	0.3134	0.0070	97.77

Figure 4.

The combination of bark and oil and bark and natural gas were the two main factors under study (Figure 4). The ash produced by bark and fuel oil firing was more precipitable than the ash resulting from bark and natural gas firing. This is thought to be the result of several things. First, there are some sulfur oxides formed that aid in precipitation, and if any of the oil was not burned completely, its combining with the ash from the bark would tend to lower its normal resistivity. The ash resulting from the bark and oil precipitated with a drift velocity approximately 25% higher than when bark and gas were fired. When the amount of bark being burned with the oil was varied, it was found that as the amount of bark decreased, performance decreased. Of course, the inlet loading also decreased proportionately to the amount of bark being fired, and higher efficiencies are more difficult to obtain with very low inlet loads.

Dust loadings coming to the pilot precipitator were low during the entire program.

This is very understandable since the bark was the largest contributor to the total ash burden, and analysis showed that it only had approximately 0.7%-2.0% ash. In addition to this, the gases go through a multiclone mechanical collector before coming to the pilot precipitator. Throughout the program, we found inlet loadings from 0.150 to 0.500 Gr/SCFD (.3435 $\frac{\text{gram}}{\text{D SM}^3}$ to 1.157 $\frac{\text{gram.}}{\text{DS-M}^3}$

The fly ash was analyzed and showed the following properties (Figure 5).

BARK ANALYSES FROM ST. REGIS

Sample Number	Moisture Percent	Volatile Percent	Fixed Carbon Percent	Ash Percent	Sulfur Percent	BTU/LB.
1	37.8	47.0	14.1	1.1	0.06	5,755
2	35.7	49.6	13.7	1.0	0.02	5,701
3	30.5	55.9	11.9	1.7	0.01	5,983
4	36.9	47.3	14.9	0.9	0.05	5,728
5	36.5	49.9	11.9	1.7	0.04	5,503
6	34.6	50.6	14.1	0.7	0.03	5,869
7	31.5	54.7	11.9	1.9	0.02	5,910
8	31.0	56.6	10.5	1.9	0.02	5,610
Avg.	34.3	51.5	12.9	1.4	0.03	5,735

Figure 5.

1. It is very low in resistivity (10^6 - 10^7 ohm-cm).
2. It is relatively fine, 60% (by weight) less than 10 microns and 25% less than 5 microns. Tests also indicated no appreciable amount (by weight) is submicronic.
3. It had a very high loss on ignition (35-40%).
4. It had a bulk density of 18-23 lb./ft.^{3} (288.3 $\frac{\text{Kg}}{\text{M}^3}$ - 368.4 $\frac{\text{Kg}}{\text{M}^3}$)

The bark being used at this installation had the following properties, based on the average of daily samples analyzed.

1. Moisture, as received 30-38%.
2. Volatile, as received 47-57%.
3. Fixed carbon, as received 10-15%.
4. Ash, as received 0.7-2.0%.
5. Sulfur, as received 0.01-0.06%.
6. BTU, as received 4,500-6,000/lb. (10506.6 $\frac{\text{KJ}}{\text{Kg}}$ 14008.8 $\frac{\text{KJ.}}{\text{Kg}}$

The tests described in Figure 5 were run when the boiler was off load control; however, when large swings in load demand occurred, or when load demand was very low, the steam flow would vary. These plant variations were expected, and no demands were made that the system operate in a strict, narrow pattern. During the program, we experienced steam flow variations of greater than 2 to 1, bark firing rates also in the 2 to 1 range with oil and gas rates to match. Generally speaking, the pilot precipitator was capable of adjusting to any change in the flue gases and fly ash that occurred during these variations. Except on days when a low percentage of bark was specifically requested, bark rates averaged from approximately 60% to greater than 85% of the fuel based on BTU inputs. The bulk of our data was obtained under these conditions. The program consisted of approximately 200 individual grain loading determinations (inlet and outlet) during 24 days of testing over an 8 week period.

This program showed that this combination of fuels fired gives a fly ash that will be easily precipitated but also very easily reintrained, partially as a result of the high moisture content in the flue gases. If the bark were to be dried to a low moisture content, the resistivity would no doubt increase, but the high combustible content of the ash would keep it in the low resistivity, easy precipitability area. Also, because of the high combustible content, care will have to be taken when considering ash storage and removal. Occasionally, as we had found earlier at WESTVACO, "sparkers" will come through the multiclones, could lodge in a hopper full of ash, and with sufficient oxygen, start to char. This calls for continuous ash removal in any full size collector.

It has been clearly demonstrated, as has been described in the preceding pages, that electrostatic precipitators can successfully handle the effluent from combination fuel-fired boilers using bark and coal, bark and fuel oil, or bark and natural gas. The ash produced from the firing of these fuels in combination are not difficult to precipitate; the precipitator itself need not be excessively large to produce an acceptable stack appearance, and if a reliable ash removal system is employed, no fear should arise of the possibility of damage occurring because of still-burning pieces of bark being precipitated.

AIR CLEANING SYSTEMS

Fly Ash Installations Employing Low Sulfur Coal

PARTIAL LISTING

Air Cleaning Systems Group
P.O. Box 1318, 3700 Koppers St.
Baltimore, Maryland 21203
Telephone 301 368-7222

CUSTOMER PLANT AND LOCATION	NUMBER OF PRECIPITATORS ACFM	FUEL SOURCE	% SULFUR % ASH
NEW YORK STATE ELECTRIC & GAS Units 1 – 3 Jennison, New York	3 Precipitators Total 532,000	Eastern Bituminous	1.0 to 1.8 18 to 21
NEW YORK STATE ELECTRIC & GAS Units 1–4 Hickling, New York	4 Precipitators Total 570,000	Eastern Bituminous	1.0 to 1.9 25
ALCOA Units 1 – 3 Rockdale, Texas	6 Precipitators Total 1,380,000	Texas Lignite	0.8 to 1.1 15
APPALACHIAN POWER COMPANY Units 1 – 3 Clinch River, Carbo, Virginia	6 Precipitators Total 2,700,000	Eastern Bituminous	0.5 to 1.3 25
OHIO POWER COMPANY Gavin Units 1 & 2 Chesire, Ohio	12 Precipitators Total 8,820,000	Eastern Bituminous	0.9 to 1.75 6 to 17
OHIO POWER COMPANY Amos #3 Scary, West Virginia	6 Precipitators Total 4,410,000	Eastern Bituminous	0.8 to 1.6 16
PACIFIC POWER AND LIGHT COMPANY Centralia 1 & 2 Centralia, Washington	4 Precipitators Total 4,932,000	Mine Mouth	0.38 to 0.62 14 to 17
KENTUCKY POWER COMPANY Big Sandy #1 Louisa, Kentucky	1 Precipitator Total 950,000	Eastern Bituminous	0.7 to 0.97 10 to 20
APPALACHIAN POWER COMPANY **OHIO POWER COMPANY** Spom 1 – 4 New Haven, West Virginia	4 Precipitators Total 2,400,000	Eastern Bituminous	1.0 to 3.0 6 to 20
NEBRASKA PUBLIC POWER DISTRICT Gerald Gentlemen #2 Sutherland, Nebraska	4 Precipitators Total 3,700,000	Amax (WYO)	0.15 to 0.45 5 to 11
MEAD CORPORATION Chillicothe 5 & 7 Chillicothe, Ohio	1 Precipitator Total 310.000	West Kentucky	0.7 to 3.0 5 to 10
VIRGINIA ELECTRIC & POWER CO. Chesterfield #5 Dutch Gap, Virginia	2 Precipitators Total 1,300,000	Eastern Bituminous	0.7 to 1.5 8 to 11.5

ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

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AIR CLEANING SYSTEMS

Recent Fly Ash Installations

PARTIAL LISTING

Air Cleaning Systems Group
P.O. Box 1318, 3700 Koppers St.
Baltimore, Maryland 21203
Telephone 301 368-7222

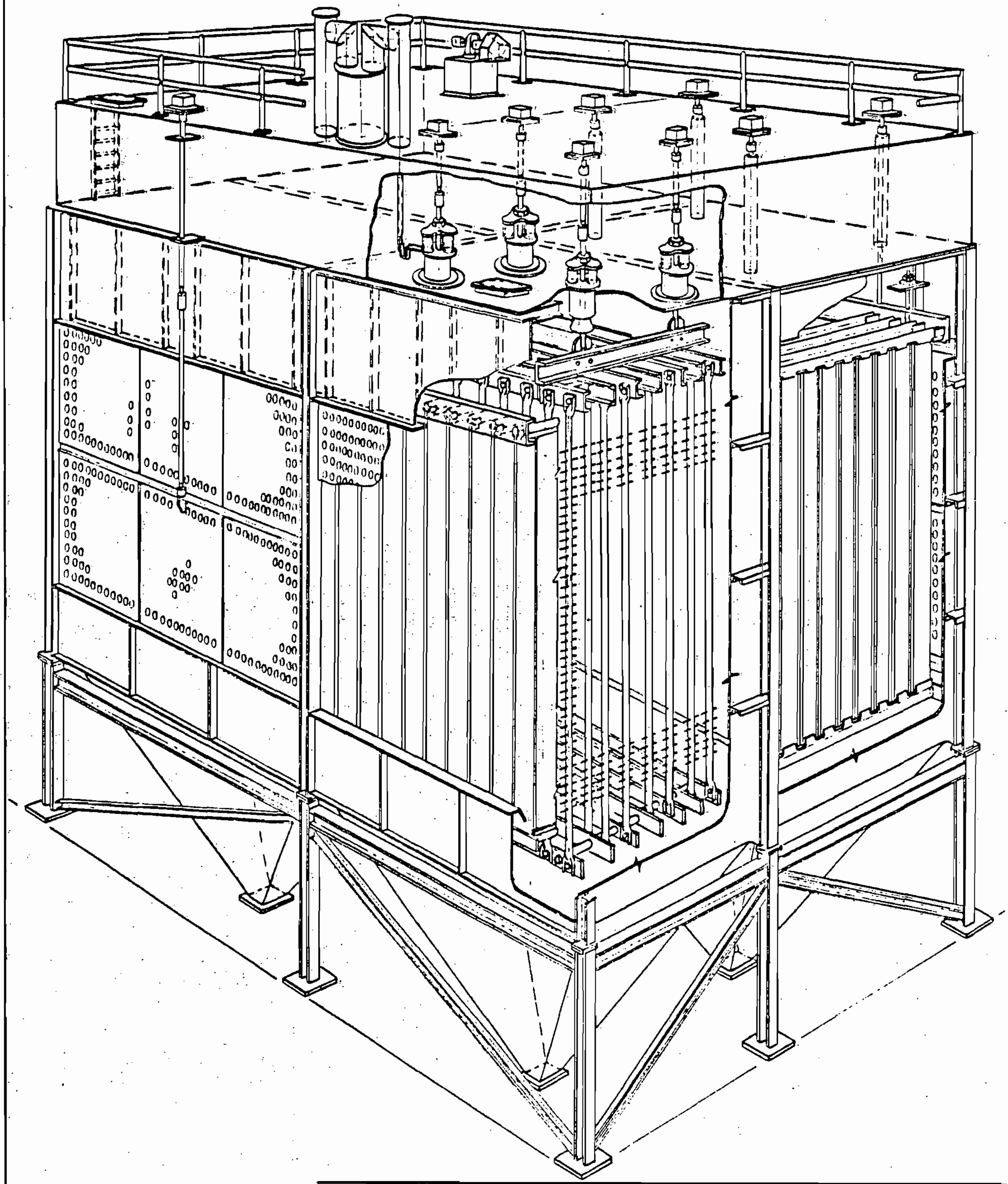
CUSTOMER PLANT AND LOCATION	START-UP AND OPERATING DATA
BALTIMORE GAS & ELECTRIC Unit #3, Wagner Station Baltimore, Maryland	April 1966; 1 boiler, 320 MW, 900,000 ACFM @ 295° F, 99.0% guaranteed efficiency.
NEW ENGLAND POWER CO. Units #1 and #2, Brayton Point Somerset, Massachusetts	May 1963, May 1964; 2 boilers, 240 MW each, 716,000 ACFM @ 260° F, 98.4% guaranteed efficiency.
NEW ENGLAND POWER CO. Unit #3, Brayton Point Somerset, Massachusetts	Late 1968; 1 boiler, 640 MW, 1,560,000 ACFM @ 255° F, 99.0% guaranteed efficiency.
CLEVELAND ELECTRIC ILLUMINATING COMPANY Unit #18, Lake Shore Station Cleveland, Ohio	July 1962; 1 boiler, 256 MW, 790,000 ACFM @ 250° F, 99.4% guaranteed efficiency.
COMMONWEALTH EDISON CO. Unit #8, Waukegan, Illinois	June 1962; 1 boiler, 355 MW, 1,051,000 ACFM @ 284° F, 98.0% guaranteed efficiency.
COMMONWEALTH EDISON CO. Unit #6, Joliet, Illinois	June 1966; 1 boiler, 360 MW, 1,105,000 ACFM @ 290° F, 98.0% guaranteed efficiency.
KENTUCKY POWER (A.E.P.) Kentucky Power, Big Sandy #1 Louisa, Kentucky	Late 1969; 1 boiler, 265 MW, 950,000 ACFM @ 285° F, 98.5% guaranteed efficiency.
VIRGINIA ELECTRIC & POWER CO. Unit #1 Yorktown, Virginia	April 1961; 1 boiler, 170 MW, 700,000 ACFM @ 350° F, 98.0% guaranteed efficiency. Coal/Coke Fired Boiler.
KANSAS CITY POWER AND LIGHT COMPANY Grand Ave. Station Kansas City, Missouri	Oct. 1968; 4 boilers, 95 MW total, 410,000 ACFM @ 355° F, 97.0% guaranteed efficiency.
ARCO POLYMERS Units #3 and #4 Monaca, Pennsylvania	Nov. 1969; 1 boiler, 400,000 #/Hr. Steam, 175,000 ACFM @ 400° F, 96.0% guaranteed efficiency.

ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

CUSTOMER PLANT AND LOCATION	START-UP AND OPERATING DATA
PUBLIC SERVICE COMPANY OF COLORADO Cherokee Unit #4 Denver, Colorado	Late 1968; 1 boiler, 350 MW, 1,390,000 ACFM @ 267° F, 87.0% guaranteed efficiency.
PITTSBURGH PLATE GLASS INDUSTRIES Units #11 & #12 Barberton, Ohio	Dec. 1968; 1 boiler, 600,000 #/Hr. Steam, 156,000 ACFM @ 325° F, 98.7% guaranteed efficiency. 1 boiler, 420,000 #/Hr. Steam, 232,000 ACFM.
PACIFIC POWER & LIGHT CO. AND WASHINGTON WATER POWER CO. Centralia, Washington Boilers #1 & #2	Sept. 1971; 1 boiler, 700 MW, 2,400,000 ACFM @ 315°F, 99.4% guaranteed efficiency. Sept. 1972; 1 boiler, 700 MW, 2,400,000 ACFM @ 315°F, 99.4% guaranteed efficiency.
APPALACHIAN POWER CO. (AEP) Amos Unit #3, Scary, West Virginia	Sept. 1973; 1 boiler, 1,300 MW, 6 @ 735,000 ACFM @ 300° F, 99.75% guaranteed efficiency.
OHIO POWER CO. (AEP) Gavin Unit 1 Cheshire, Ohio	Jan. 1974; 1 boiler, 1,300 MW, 6 @ 735,000 ACFM @ 300° F, 99.75% guaranteed efficiency.
Gavin Unit 2 Cheshire, Ohio	Jan. 1975; 1 boiler, 1,300 MW, 6 @ 735,000 ACFM @ 300° F, 99.75% guaranteed efficiency.
APPALACHIAN POWER CO. (AEP) Clinch River, Carbo, Virginia	Feb. 1974; 3 boilers, 230 MW, 6 @ 450,000 ACFM @ 315° F, 99.8% guaranteed efficiency.
NORTHERN INDIANA PUBLIC SERVICE Unit 12 Michigan City, Indiana	April 1974; 1 boiler, 600 MW, 2 @ 904,800 ACFM @ 325° F, 99.5% guaranteed efficiency.
NEW YORK STATE ELECTRIC AND GAS Hickling Units 1–4 East Coming, New York	March 1974; 4 boilers, 70 MW, 2 @ 135,000 ACFM @ 310° F, 99.5% guaranteed efficiency.
ALUMINUM CO. OF AMERICA Rockdale, Texas	Oct. 1974; 1 boiler, 150 MW, 3 @ 460,000 ACFM @ 300° F, 98.0% guaranteed efficiency. 2 Precipitators Feb. 1974; 1 boiler, 150 MW, @ 300° F. 2 Precipitators April 1975; 1 boiler, 150 MW, @ 300° F. 2 Precipitators
NEW YORK STATE ELECTRIC AND GAS Greenidge, New York	March 1975; 2 boilers, 125,000 #/Hr. Steam, 57,500 ACFM @ 380° F, 99.8% guaranteed efficiency. Dec. 1974; 1 boiler, 200,000 #/Hr. Steam, 118,000 ACFM @ 320° F, 99.5% guaranteed efficiency.
NEW YORK STATE ELECTRIC AND GAS Jennison, New York	July 1975; 3 boilers, 200,000 #/Hr. Steam, 3–399,000 ACFM @ 320 F, 99.5% guaranteed efficiency.

CUSTOMER PLANT AND LOCATION	START-UP AND OPERATING DATA
CONSUMERS POWER COMPANY Kam #1 and #2 Essexville, Michigan	Nov. 1976; 1 boiler, 265 MW, 2 @ 1,172,000 ACFM @ 315° F, 97.0% guaranteed efficiency. 1977, 1 boiler, 265 MW
OHIO POWER (AEP) Sporn #5 New Haven, West Virginia	Dec. 1977; 1 boiler, 450 MW, 2 @ 875,000 ACFM @ 310° F, 99.8% guaranteed efficiency.
OHIO POWER/APPALACHIAN POWER (AEP) Sporn #1, 2, 3, & 4 New Haven, West Virginia	Jan. 1979; 4 boilers, 155 MW 4 @ 600,000 ACFM @ 315° F, 99.8% guaranteed efficiency.
INDIANA & MICHIGAN ELECTRIC Breed Station #1 Fairfield, Indiana	Late 1977; 1 Cyclone Boiler, 450 MW, 2,000,000 ACFM @ 350° F, 98.7% guaranteed efficiency.
ST. JOSEPH POWER AND LIGHT Lake Road, Boiler #5 St. Joseph, Missouri	Nov. 1976; 1 pulverized coal boiler, 250,000 #/Hr. Steam 134,500 ACFM @ 311° F, 99.0% guaranteed efficiency.
INTERNATIONAL PAPER Mobile, Alabama	July 1976; Two Cyclone Boilers 450,000 #/Hr. Steam each, 219,000 ACFM @ 336° F, 99.5% guaranteed efficiency.
MEAD PAPERS INC. Boilers #5 & #7 Chillicothe, Ohio	Sept. 1976; 1 pulverized coal boiler, 570,000 #/Hr. Steam, 310,000 ACFM @ 334° F, 98.75% guaranteed efficiency. 1 Precipitators
MEAD PAPERS, INC. Boiler #8 Chillicothe, Ohio	Sept. 1976; 1 pulverized coal boiler, 410,000 #/Hr. Steam 218,000 ACFM @ 318° F, 98.75% guaranteed efficiency. 1 Precipitators
NEBRASKA PUBLIC POWER DISTRICT Gerald Gentleman #2 Sutherland, Nebraska	Jan. 1981; 1 pulverized coal boiler, 4,700,000 #/Hr. Steam 3,700,000 ACFM @ 720° F, 99.8% guaranteed efficiency. 4 Precipitators
WESTVACO Charleston, South Carolina	July, 1979, 1 pulverized coal boiler, 350,000 #/Hr. Steam 215,000 ACFM @ 375° F, 98.37% guaranteed efficiency (Rigid Discharge Electrode Design, "Rigitrode")
VIRGINIA ELECTRIC AND POWER COMPANY Dutch Gap, Virginia	June 1980, 1 pulverized coal boiler, 2,053,000 #/Hr. Steam 1,300,000 ACFM @ 311° F, 99.7% guaranteed efficiency (1 field out of service) 99.8% guaranteed efficiency (all fields in service) (Rigid Discharge Electrode Design, "Rigitrode") 2 Precipitators
ATLANTIC CITY ELECTRIC B.L. England Sta. Units 1 & 2 Beesley's Pt., New Jersey	Unit 1 Oct. 1980; 1 cyclone boiler 135MW, 593,000 ACFM @ 255° F 99.8% guaranteed efficiency, (Rigid Discharge Electrode Design, "Rigitrode") Unit 2 April 1981; 1 cyclone boiler 160MW, 760,000 ACFM @ 255° F; 99.11% guaranteed efficiency (Rigid Discharge Electrode Design, "Rigitrode")
INTERNATIONAL PAPER Mansfield, Louisiana	July 1981, 2 Pulverized Coal & Bark boilers 500,000 # Hr. steam 2–347,000 ACFM @ 350° F, 99.8% efficiency.

CUSTOMER PLANT AND LOCATION	START-UP AND OPERATING DATA
CROWN ZELLERBACH CANADA, LTD. Campbell River, B.C. Boilers 1, 2, 3	January, 1982; 3 Hog Fuel Boilers (salt-soaked logs); 285,000 ACFM @ 395°F; 87.50% guaranteed efficiency, triple chamber (Rigid Discharge Electrode Design, "Rigitrode")

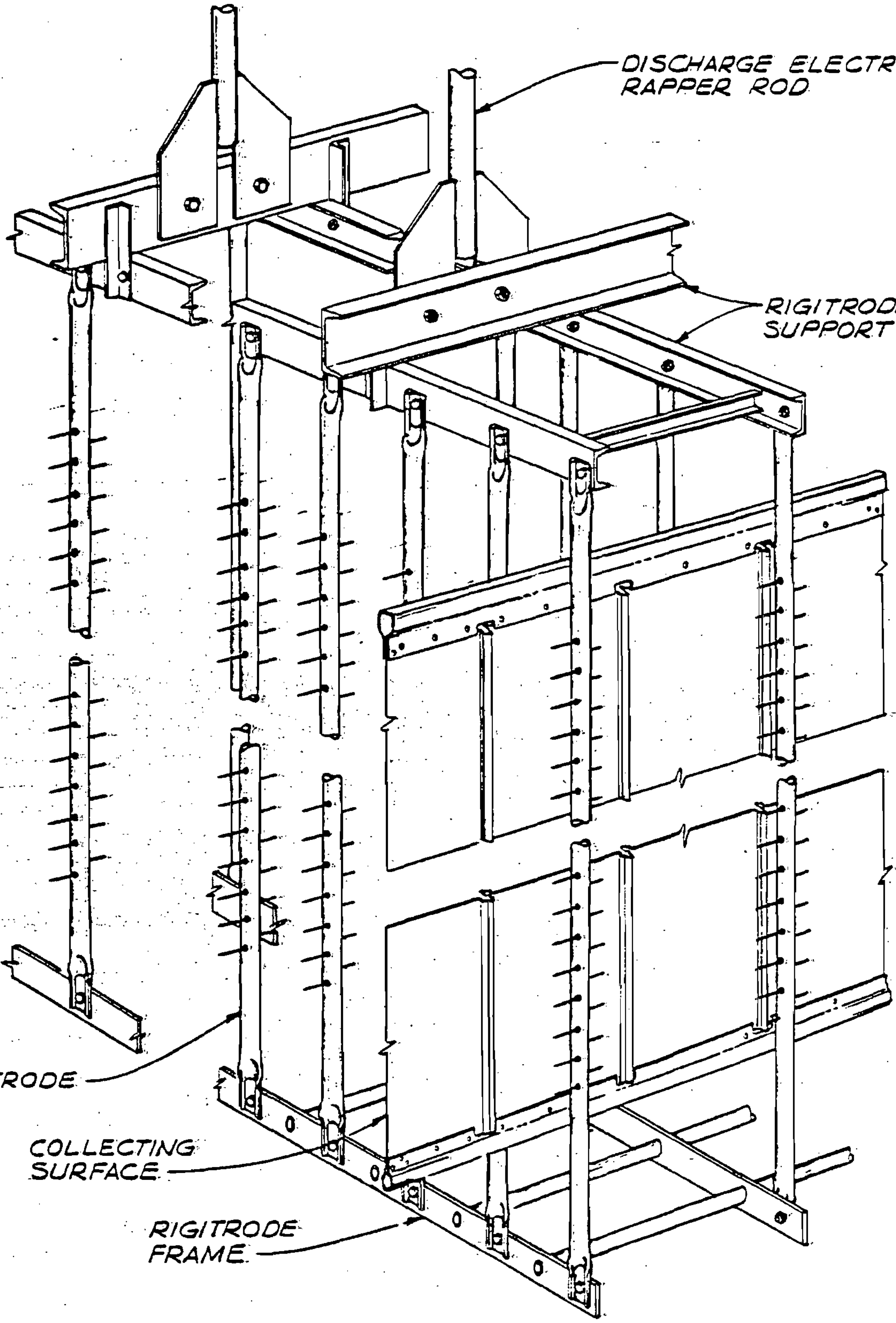


ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

TYPICAL RIGITRODE ARRANGEMENT WITH ELECTRIC RAPPING

DWG No. 1130

REV
F.W.S. 10-28-80

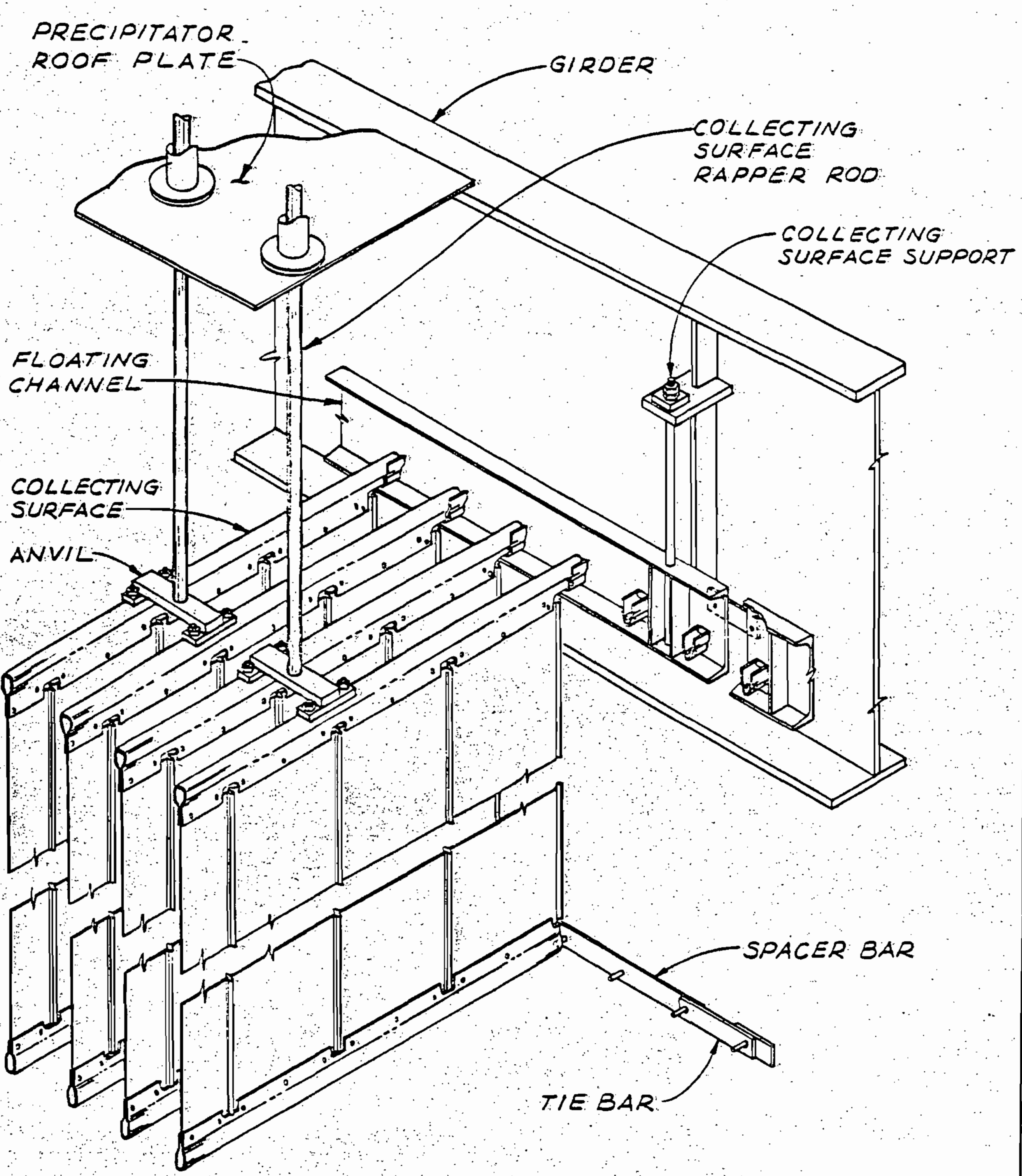


REV.
ELK 10-29-80

ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

RIGITRODE
DISCHARGE ELECTRODE
ARRANGEMENT

DWG. No. 1121



ELK 2-21-73

ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

COLLECTING SURFACE RAPPER ARRANGEMENT

DWG. No. 1120

SECTION VII – PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data

1. 3 no sites 3 TSP 1 (C) SO^2* 1 Wind spd/dir

Period of monitoring June / / 1981 to June / / 1982
month day year month day year

Other data recorded Ambient temperature at one (1) site

Attach all data or statistical summaries to this application.

2. Instrumentation, Field and Laboratory

a) Was instrumentation EPA referenced or its equivalent? X Yes ___ No

b) Was instrumentation calibrated in accordance with Department procedures? X Yes ___ No ___ Unknown

B. Meteorological Data Used for Air Quality Modeling

1. 5 Year(s) of data from 1 / 1 / 70 to 1 / 1 / 74
month day year month day year

2. Surface data obtained from (location) Jacksonville, Florida

3. Upper air (mixing height) data obtained from (location) Waycross, Georgia

4. Stability wind rose (STAR) data obtained from (location) Jacksonville, Florida

C. Computer Models Used

1. ISCST (5-year) Modified? If yes, attach description.

2. ISCLT (5-year) Modified? If yes, attach description.

3. ___ Modified? If yes, attach description.

4. ___ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables.

D. Applicants Maximum Allowable Emission Data

Pollutant	Emission Rate
TSP	See Section III.C. grams/sec
SO^2	See Section III.C. grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description on point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time.

F. Attach all other information supportive to the PSD review.

*Specify bubbler (B) or continuous (C).

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources.

Positive social and economic impacts are expected as a result of using the selected control technologies.

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology.

See Attachments

RECOVERY BOILER NO. 5

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Recovery Boiler No. 5 [x] New[1] [ ] Existing[1]

APPLICATION TYPE: [x] Construction [ ] Operation [ ] Modification

COMPANY NAME: Georgia-Pacific Corporation COUNTY: Putnam

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peeking Unit No. 2, Gas Fired) Recovery Boiler No. 5 with ESP and two Smelt Dissolving Tanks (No. 5 with scrubber)

SOURCE LOCATION: Street N. of S.R. 216, W. of U.S.17 City Palatka

UTM: East 434.0 North 3283.4

Latitude 29 ° 41 ' 00 "N Longitude 81 ° 40 ' 45 "W

APPLICANT NAME AND TITLE: Roger C. Sherwood, Technical Director

APPLICANT ADDRESS: P.O. Box 919, Palatka, Florida 32077

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Georgia-Pacific Corporation

I certify that the statements made in this application for a construction permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: Roger C. Sherwood by VLA

Roger C. Sherwood, Technical Director
Name and Title (Please Type)

Date: 6-2-81 Telephone No. 904/325-2001

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed: David A. Buff

David A. Buff
Name (Please Type)

Environmental Science and Engineering, Inc.
Company Name (Please Type)

P.O. Box ESE, Gainesville, Florida 32604
Mailing Address (Please Type)

(Affix Seal)

DAVID A. BUFF NO. 19011

Florida Registration No. 19011

Date: 6-2-81 Telephone No. 904/372-3318

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[1] See Section 17-2.02(15) and (22), Florida Administrative Code, (F.A.C.)

DER FORM 17-1.122(16) Page 1 of 10

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

A new 607,500 pound steam/hr, low odor, non-direct contact evaporation Recovery Boiler No. with electrostatic precipitator, will be constructed. In addition, two smelt dissolving tanks, No. 5, will be constructed, equipped with wet scrubbers. The source will comply with all applicable emission and air quality standards.

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction September 1982 Completion of Construction 1985

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

Precipitator - approx. $4.0 million

2 scrubber systems - approx. $210,000 each

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

Not applicable

E. Is this application associated with or part of a Development of Regional Impact (DRI) pursuant to Chapter 380, Florida Statutes, and Chapter 22F-2, Florida Administrative Code? ____ Yes __x__ No

F. Normal equipment operating time: hrs/day 24; days/wk 7; wks/yr 51; if power plant, hrs/yr ____;

if seasonal, describe: ____

G. If this is a new source or major modification, answer the following questions. (Yes or No)

1. Is this source in a non-attainment area for a particular pollutant? No
   a. If yes, has "offset" been applied? -
   b. If yes, has "Lowest Achievable Emission Rate" been applied? -
   c. If yes, list non-attainment pollutants. -
2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. Yes
3. Does the State "Prevention of Significant Deterioriation" (PSD) requirements apply to this source? If yes, see Sections VI and VII. Yes
4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? Yes
5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? No

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization* Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
Black Liquor	Particulate	5.5	230,769	A
Black Liquor Solids	Particulate	Unknown	150,000	A
Smelt	Particulate	Unknown	63,000	C

*At rated capacity

B. Process Rate, if applicable: (See Section V, Item 1)

1. Total Process Input Rate (lbs/hr): 150,000 lbs. Black Liquor Solids/hr.

2. Product Weight (lbs/hr): 63,000 lbs. Smelt/hr.; 607,500 lb/hr steam

C. Airborne Contaminants Emitted: See attached sheet

Name of Contaminant	Emission[1]		Allowed Emission[2] Rate per Ch. 17-2, F.A.C.	Allowable[3] Emission lbs/hr	Potential Emission[4]		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/hr	T/yr	

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles[5] Size Collected (in microns)	Basis for Efficiency (Sec. V, It[5]
ESP-Environmental	Particulate	99%	Submicron	See Attach-
elements				ment B
or equivalent				
Scrubbers--Flex Kleen or	Particulate	98%	Submicron	
equivalent				

[1] See Section V, Item 2.

[2] Reference applicable emission standards and units (e.g., Section 17-2.05(6) Table II, E. (1), F.A.C. – 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard

[4] Emission, if source operated without control (See Section V, Item 3)

[5] If Applicable

Section III-C. Airborne Contaminants Emitted

Name of Contaminant	Emission		Allowed Emissin Rate Per Ch. 17-2, F.A.C.	Allowable Emission (lbs/hr)	Potential Emission		Relate to Flow Diagram
	Maximum (lbs/hr)	Actual (Tons/yr)			(lbs/hr)	(Tons/yr)	
Recovery Boiler:							
Particulate	75.4	323.0	3 lb/3,000 BLS*	75.4**	7,500	32,850	D
Sulfur Dioxide	250.0	1,071.0	NA	NA	250	1,095	D
Nitrogen Oxides	89.1	381.7	NA	NA	89	390	D
Carbon Monoxide	871.2	3,732.0	NA	NA	871	3,816	D
Volatile Org. Comp.	48.0	205.6	NA	NA	48	210	D
Total Reduced Sulfur	5.2	22.3	1 ppm	5.2**	650	2,847	D
Smelt Tank Vents:							
Particulate	15.0	64.3	NA	15.0**	250	1,095	E
Sulfur Dioxide	5.0	21.4	NA	NA	5	22	E
Total Reduced Sulfur	1.3	5.4	NA	1.3**	22	96	E

* Federal NSPS is more stringent than State Regulation
** NSPS Level

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
Black Liquor at 65% Solids	230,679	230,679	990
No.6 Fuel Oil*	-	23.8	146

*Units Natural Gas, MMCF/hr; Fuel Oils, barrels/hr; Coal, lbs/hr

*Used only for startup, shutdown, emergencies, and systerm checking

Fuel Analysis: Black Liquor Solids/No. 6 Fuel Oil

Percent Sulfur: */ 2.5

Percent Ash: */0.1

Density: */7.88 lbs/gal

Typical Percent Nitrogen: */0

Heat Capacity: 6,600/18,500 BTU/lb */145,780 BTU/gal

Other Fuel Contaminants (which may cause air pollution): *Unknown

F. If applicable, indicate the percent of fuel used for space heating. Annual Average NA Maximum NA

G. Indicate liquid or solid wastes generated and method of disposal.

Particulate collected in ESP reinjected into process

Scrubber water reinjected to process or sent to waste treatment system

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: 250-RB; 250 -STV ft.

Stack Diameter: 13.2-RB; 5.0-STV* ft.

Gas Flow Rate: 375,100-RB; 31,900 ea-STV ACFM

Gas Exit Temperature: 393-RB/163-STV °F.

Water Vapor Content: 25 %

Velocity: 45.7-RB; 27.1 ea-STV FPS

*Two identical stacks

SECTION IV: INCINERATOR INFORMATION

Not Applicable

Type of Waste	Type O (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq & Gas By-prod.)	Type VI (Solid By-prod.)
Lbs/hr Incinerated							

Description of Waste

Total Weight Incinerated (lbs/hr)

Design Capacity (lbs/hr)

Approximate Number of Hours of Operation per day

days/week

Manufacturer

Date Constructed

Model No.

	Volume (ft)^3	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: __________ ft. Stack Diameter __________ Stack Temp. __________

Gas Flow Rate: __________ ACFM __________ DSCFM* Velocity __________ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner [ ] Other (specify) __________

Brief description of operating characteristics of control devices: __________

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight — show derivation.
   See Attachment A
2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.,) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.
   See Attachment A
3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).
   See Attachment A
4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, etc.).
   See Attachment B
5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3, and 5 should be consistent: actual emissions = potential (1-efficiency).
   See Attachment B
6. An 8½" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.
   See Attachment A
7. An 8½" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).
   See PSD report
8. An 8½" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.
   See Combination Boiler #5 Application

ATTACHMENT A

EMISSIONS ESTIMATES

A. Fuel Usage and Process Weight Rates

Black liquor solids = 6,600 Btu/lb (dry basis)
Black liquor solids feed = 150,000 lb/hr (dry)
Btu needed per lb steam = 1,629.6
150,000 lb/hr x 6,600 Btu/lb ÷ 1,629.6 Btu/lb = 607,500 lb steam/hr

Heat input = 150,000 x 6,600 = 990 x 10^6 Btu/hr
Fuel oil only burned for startup, shut down, emergencies, and system checking
Maximum fuel oil, when burned =
1,000 gal/hr x 145,780 Btu/gal = 146 x 10^6 Btu

B. Recovery Boiler

1. Maximum Emissions

Particulate

Based on NSPS of 0.044 gr/dscf
Max flow rate = 200,000 dscfm (based on No. 4 recovery boiler operation)
200,000 dscfm x 60 x 0.044 gr/dscf ÷ 7,000 gr/lb = 75.4 lb/hr

Sulfur Dioxide

From AP-42: 5 lb SO_2/ton of air dried unbleached pulp

3,000 lb BLS = 1 ton air dried unbleached pulp (ADUP)
150,000 lb/hr BLS ÷ 3,000 = 50 tons/hr ADUP
50 x 5 = 250 lb/hr

361#/Hr

Nitrogen Oxides

From 1981 TAPPI conference paper, used highest emission factor for nondirect contact evaporator boilers with production greater than 1,000 tons/day: 0.09 lb/10^6 Btu

990 x 10^6 Btu/hr x 0.09/10^6 = 89.1 lb/hr

VOC

From TAPPI conference paper, for nondirect contact evaporator boilers, highest factor: 0.32 lb/1,000 lb BLS

150,000 lb/hr x 0.32 lb/1,000 lb = 48.0 lb/hr

Carbon Monoxide

From TAPPI conference paper, for nondirect contact evaporator furnaces, highest factor: 0.88 lb/10^6 Btu

$990 \times 10^6 \times 0.88/10^6 = 871.2$ lb/hr

From AP-42: use lower value for properly operated boiler: 2 lb/ton air dried unbleached pulp

$150{,}000 \div 3{,}000 \times 2 = 100$ lb/hr

Total Reduced Sulfur

NSPS = 5 ppm dry basis
MW H_2S = 34; 5 ppm = 6,953 ug/m^3
200,000 dscfm x $(.3048)^3$ m^3/ft^3 x 60 x 6,953 x 10^{-6} ÷ 454
= 5.2 lb/hr

State of Florida Standard = 1 ppm or 0.03 lb/3,000 lb BLS

1 ppm = 1 lb/hr
0.03 lb/3,000 lb BLS x 150,000 = 1.5 lb/hr

Other Regulated Pollutants

No known emission factor for other pollutants.

2. Actual Emissions

Particulate

75.4 lb/hr x 24 x 7 x 51 ÷ 2,000 = 323 tons/yr

Sulfur Dioxide

250 lb/hr x 24 x 7 x 51 ÷ 2,000 = 1,071 tons/yr

Nitrogen Oxides

89.1 lb/hr x 24 x 7 x 51 ÷ 2,000 = 381.7 tons/yr

VOC

48 lb/hr x 24 x 7 x 51 ÷ 2,000 = 205.6 tons/yr

Carbon Monoxide

871.2 lb/hr x 24 x 7 x 51 ÷ 2,000 = 3,732 tons/yr

Total Reduced Sulfur

5.2 lb/hr x 24 x 7 x 51 ÷ 2,000 = 22.3 tons/yr

3. Potential Emissions

Particulate

Use AP-42 untreated emission factor (Table 10.1.2-1) of 150 lb/ton ADUP

50 tons/hr ADUP x 150 = 7,500 lb/hr = 32,850 tons/yr

Sulfur Dioxide

AP-42 untreated factor same as with ESP (5 lb/ton)

250 lb/hr x 8,760 ÷ 2,000 = 1,095 tons/yr

Nitrogen Dioxide

89.1 lb/hr x 8,760 ÷ 2,000 = 390 tons/yr

VOC

48 lb/hr x 8,760 ÷ 2,000 = 210.2 tons/yr

Carbon Monoxide

871.2 lb/hr x 8,760 ÷ 2,000 = 3,815.9 tons/yr

Total Reduced Sulfur

Use AP-42 factor for H_2S and reduced sulfur compounds = 12 + 1 = 13 lb/ton ADUP

50 tons/hr x 13 = 650 lb/hr = 2,847 tons/yr

4. Smelt Dissolving Tanks

Particulate

Maximum Emissions: NSPS = 0.2 lb/ton BLS (dry basis)
150,000 lb/hr ÷ 2,000 x 0.2 = 15 lb/hr

Actual Emissions: 15.0 lb/hr x 24 x 7 x 51 ÷ 2,000 = 64.3 tons/yr

Potential Emissions: AP-42 factor for untreated emissions = 5 lb/ton ADUP

50 tons/hr x 5 = 250 lb/hr = 1,095 tons/yr

Sulfur Dioxide

Maximum Emissions: use AP-42 factor = 0.1 lb/ton ADUP
50 tons/hr x 0.1 = 5 lb/hr

Actual Emissions
5.0 lb/hr x 24 x 7 x 51 ÷ 2,000 = 21.4 tons/yr

Potential Emissions: same as maximum
5 lb/hr x 8,760 ÷ 2,000 = 21.9 tons/yr

Nitrogen Oxides, VOC, Carbon Monoxide

No emission factors available

Total Reduced Sulfur

Maximum Emissions: use NSPS of 0.0168 lb/ton BLS (dry weight)
150,000 ÷ 2,000 x 0.0168 = 1.26 lb/hr

Actual Emissions
1.26 lb/hr x 24 x 7 x 51 ÷ 2,000 = 5.4 tons/yr

Potential Emissions: Use combined AP-42 factor for H_2S and reduced sulfur compounds of 0.44 lb/ton ADUP

50 tons/hr x 0.44 = 22 lb/hr = 96.4 tons/yr

10. WOOD PRODUCTS INDUSTRY

Wood processing involves the conversion of raw wood to either pulp, pulpboard, or one of several types of wallboard including plywood, particleboard, or hardboard. This section presents emissions data for chemical wood pulping, for pulpboard and plywood manufacturing, and for woodworking operations. The burning of wood waste in boilers and conical burners is not included as it is discussed in Chapters 1 and 2 of this publication.

10.1 CHEMICAL WOOD PULPING

Revised by Thomas Lahre

10.1.1 General[1]

Chemical wood pulping involves the extraction of cellulose from wood by dissolving the lignin that binds the cellulose fibers together. The principal processes used in chemical pulping are the kraft, sulfite, neutral sulfite semichemical (NSSC), dissolving, and soda; the first three of these display the greatest potential for causing air pollution. The kraft process accounts for about 65 percent of all pulp produced in the United States; the sulfite and NSSC processes, together, account for less than 20 percent of the total. The choice of pulping process is determined by the product being made, by the type of wood species available, and by economic considerations.

10.1.2 Kraft Pulping

10.1.2.1 Process Description[1,2]–The kraft process (see Figure 10.1.2-1) involves the cooking of wood chips under pressure in the presence of a cooking liquor in either a batch or a continuous digester. The cooking liquor, or "white liquor," consisting of an aqueous solution of sodium sulfide and sodium hydroxide, dissolves the lignin that binds the cellulose fibers together.

When cooking is completed, the contents of the digester are forced into the blow tank. Here the major portion of the spent cooking liquor, which contains the dissolved lignin, is drained, and the pulp enters the initial stage of washing. From the blow tank the pulp passes through the knotter where unreacted chunks of wood are removed. The pulp is then washed and, in some mills, bleached before being pressed and dried into the finished product.

It is economically necessary to recover both the inorganic cooking chemicals and the heat content of the spent "black liquor," which is separated from the cooked pulp. Recovery is accomplished by first concentrating the liquor to a level that will support combustion and then feeding it to a furnace where burning and chemical recovery take place.

Initial concentration of the weak black liquor, which contains about 15 percent solids, occurs in the multiple-effect evaporator. Here process steam is passed countercurrent to the liquor in a series of evaporator tubes that increase the solids content to 40 to 55 percent. Further concentration is then effected in the direct contact evaporator. This is generally a scrubbing device (a cyclonic or venturi scrubber or a cascade evaporator) in which hot combustion gases from the recovery furnace mix with the incoming black liquor to raise its solids content to 55 to 70 percent.

The black liquor concentrate is then sprayed into the recovery furnace where the organic content supports combustion. The inorganic compounds fall to the bottom of the furnace and are discharged to the smelt dissolving tank to form a solution called "green liquor." The green liquor is then conveyed to a causticizer where slaked lime (calcium hydroxide) is added to convert the solution back to white liquor, which can be reused in subsequent cooks. Residual lime sludge from the causticizer can be recycled after being dewatered and calcined in the hot lime kiln.

Many mills need more steam for process heating, for driving equipment, for providing electric power, etc., than can be provided by the recovery furnace alone. Thus, conventional industrial boilers that burn coal, oil, natural gas, and in some cases, bark and wood waste are commonly employed.

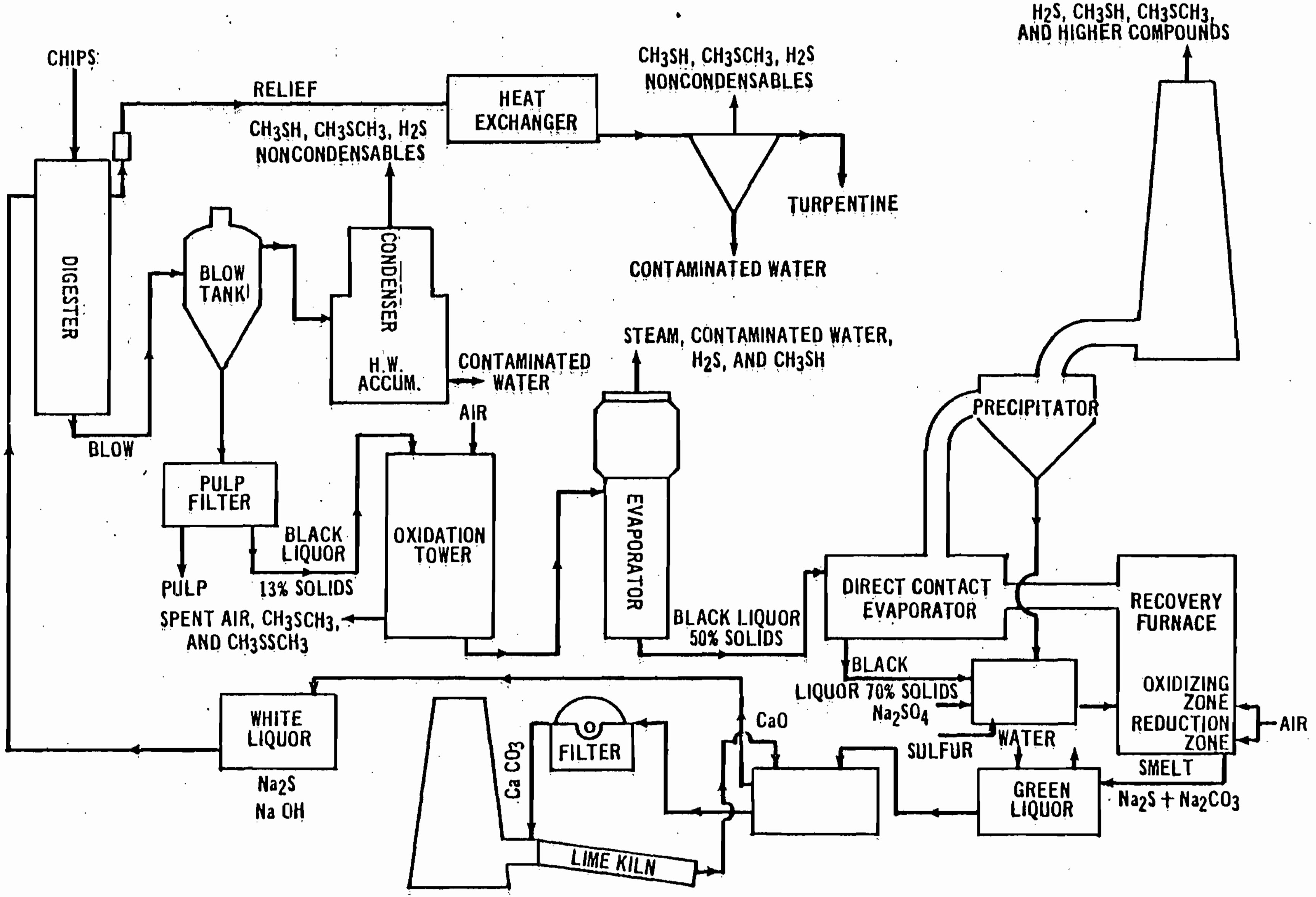


Figure 10.1.2-1. Typical kraft sulfate pulping and recovery process.

10.1.2.2. Emission and Controls[1-6]–Particulate emissions from the kraft process occur primarily from the recovery furnace, the lime kiln, and the smelt dissolving tank. These emissions consist mainly of sodium salts but include some calcium salts from the lime kiln. They are caused primarily by the carryover of solids plus the sublimation and condensation of the inorganic chemicals.

Particulate control is provided on recovery furnaces in a variety of ways. In mills where either a cyclonic scrubber or cascade evaporator serves as the direct contact evaporator, further control is necessary as these devices are generally only 20 to 50 percent efficient for particulates. Most often in these cases, an electrostatic precipitator is employed after the direct contact evaporator to provide an overall particulate control efficiency of 85 to >99 percent. In a few mills, however, a venturi scrubber is utilized as the direct contact evaporator and simultaneously provides 80 to 90 percent particulate control. In either case auxiliary scrubbers may be included after the precipitator or the venturi scrubber to provide additional control of particulates.

Particulate control on lime kilns is generally accomplished by scrubbers. Smelt dissolving tanks are commonly controlled by mesh pads but employ scrubbers when further control is needed.

The characteristic odor of the kraft mill is caused in large part by the emission of hydrogen sulfide. The major source is the direct contact evaporator in which the sodium sulfide in the black liquor reacts with the carbon dioxide in the furnace exhaust. The lime kiln can also be a potential source as a similar reaction occurs involving residual sodium sulfide in the lime mud. Lesser amounts of hydrogen sulfide are emitted with the noncondensible off-gasses from the digesters and multiple-effect evaporators.

The kraft-process odor also results from an assortment of organic sulfur compounds, all of which have extremely low odor thresholds. Methyl mercaptan and dimethyl sulfide are formed in reactions with the wood component lignin. Dimethyl disulfide is formed through the oxidation of mercaptan groups derived from the lignin. These compounds are emitted from many points within a mill; however, the main sources are the digester/blow tank systems and the direct contact evaporator.

Although odor control devices, per se, are not generally employed in kraft mills, control of reduced sulfur compounds can be accomplished by process modifications and by optimizing operating conditions. For example, black liquor oxidation systems, which oxidize sulfides into less reactive thiosulfates, can considerably reduce odorous sulfur emissions from the direct contact evaporator, although the vent gases from such systems become minor odor sources themselves. Noncondensible odorous gases vented from the digester/blow tank system and multiple-effect evaporators can be destroyed by thermal oxidation, usually by passing them through the lime kiln. Optimum operation of the recovery furnace, by avoiding overloading and by maintaining sufficient oxygen residual and turbulence, significantly reduces emissions of reduced sulfur compounds from this source. In addition, the use of fresh water instead of contaminated condensates in the scrubbers and pulp washers further reduces odorous emissions. The effect of any of these modifications on a given mill's emissions will vary considerably.

Several new mills have incorporated recovery systems that eliminate the conventional direct contact evaporators. In one system, preheated combustion air rather than flue gas provides direct contact evaporation. In the other, the multiple-effect evaporator system is extended to replace the direct contact evaporator altogether. In both of these systems, reduced sulfur emissions from the recovery furnace/direct contact evaporator reportedly can be reduced by more than 95 percent from conventional uncontrolled systems.

Sulfur dioxide emissions result mainly from oxidation of reduced sulfur compounds in the recovery furnace. It is reported that the direct contact evaporator absorbs 50 to 80 percent of these emissions; further scrubbing, if employed, can reduce them another 10 to 20 percent.

Potential sources of carbon monoxide emissions from the kraft process include the recovery furnace and lime kilns. The major cause of carbon monoxide emissions is furnace operation well above rated capacity, making it impossible to maintain oxidizing conditions.

Some nitrogen oxides are also emitted from the recovery furnace and lime kilns although the amounts are relatively small. Indications are that nitrogen oxides emissions from each of these sources are on the order of 1 pound per air-dried ton (0.5 kg/air-dried MT) of pulp produced.[5,6]

A major source of emissions in a kraft mill is the boiler for generating auxiliary steam and power. The fuels used are coal, oil, natural gas, or bark/wood waste. Emission factors for boilers are presented in Chapter 1.

Table 10.1.2-1 presents emission factors for a conventional kraft mill. The most widely used particulate controls devices are shown along with the odor reductions resulting from black liquor oxidation and incineration of noncondensible off-gases.

10.1.3 Acid Sulfite Pulping

by Tom Lahre

10.1.3.1 Process Description[14] - The production of acid sulfite pulp proceeds similarly to kraft pulping except that different chemicals are used in the cooking liquor. In place of the caustic solution used to dissolve the lignin in the wood, sulfurous acid is employed. To buffer the cooking solution, a bisulfite of sodium, magnesium, calcium, or ammonium is used. A simplified flow diagram of a magnesium-base process is shown in Figure 10.1.3-1.

Digestion is carried out under high pressure and high temperature in either batch-mode or continuous digesters in the presence of a sulfurous acid-bisulfite cooking liquor. When cooking is completed, the digester is either discharged at high pressure into a blow pit or its contents are pumped out at a lower pressure into a dump tank. The spent sulfite liquor (also called red liquor) then drains through the bottom of the tank and is either treated and disposed, incinerated, or sent to a plant for recovery of heat and chemicals. The pulp is then washed and processed through screens and centrifuges for removal of knots, bundles of fibers, and other materials. It subsequently may be bleached, pressed, and dried in paper-making operations.

Because of the variety of bases employed in the cooking liquor, numerous schemes for heat and/or chemical recovery have evolved. In calcium-base systems, which are used mostly in older mills, chemical recovery is not practical, and the spent liquor is usually discarded or incinerated. In ammonium-base operations, heat can be recovered from the spent liquor through combustion, but the ammonium base is consumed in the process. In sodium- or magnesium-base operations heat, sulfur, and base recovery are all feasible.

If recovery is practiced, the spent weak red liquor (which contains more than half of the raw materials as dissolved organic solids) is concentrated in a multiple-effect evaporator and direct contact evaporator to 55 to 60 percent solids. Strong liquor is sprayed into a furnace and burned, producing steam for the digesters, evaporators, etc., and to meet the mills power requirements.

When magnesium base liquor is burned, a flue gas is produced from which magnesium oxide is recovered in a multiple cyclone as fine white powder. The magnesium oxide is then water-slaked and used as circulating liquor in a series of venturi scrubbers which are designed to absorb sulfur dioxide from the flue gas and form a bisulfite solution for use in the cook cycle. When sodium-base liquor is burned, the inorganic compounds are recovered as a molten smelt containing sodium sulfide and sodium carbonate. This smelt may be processed further and used to absorb sulfur dioxide from the flue gas and sulfur burner. In some sodium-base mills, however, the smelt may be sold to a nearby kraft mill as raw material for producing green liquor.

Table 10.1.2-1. EMISSION FACTORS FOR SULFATE PULPING[a]
(unit weights of air-dried unbleached pulp)
EMISSION FACTOR RATING: A

Source	Type control	Particulates[b]		Sulfur dioxide (SO_2)[c]		Carbon monoxide[d]		Hydrogen sulfide($S^=$)[e]		RSH, RSR, RSSR($S^=$)[e,f]	
		lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT	lb/ton	kg/MT
Digester relief and blow tank	Untreated[g]	–	–	–	–	–	–	0.1	0.05	1.5	0.75
Brown stock washers	Untreated	–	–	0.01	0.005	–	–	0.02	0.01	0.2	0.1
Multiple effect evaporators	Untreated[g]	–	–	0.01	0.005	–	–	0.1	0.05	0.4	0.2
Recovery boiler and direct contact evaporator	Untreated[h]	150	75	5	2.5	2 - 60	1 - 30	12[i]	6[i]	1[i]	0.5[i]
	Venturi scrubber[j]	47	23.5	5	2.5	2 - 60	1 - 30	12[i]	6[i]	1[i]	0.5[i]
	Electrostatic precipitator	8	4	5	2.5	2 - 60	1 - 30	12[i]	6[i]	1[i]	0.5[i]
	Auxiliary scrubber	3 - 15[k]	1.5 - 7.5[k]	3	1.5	2 - 60	1 - 30	12[i]	6[i]	1[i]	0.5[i]
Smelt dissolving tank	Untreated	5	2.5	0.1	0.05	–	–	0.04	0.02	0.4	0.2
	Mesh pad	1	0.5	0.1	0.05	–	–	0.04	0.02	0.4	0.2
Lime kilns	Untreated	45	22.5	0.3	0.15	10	5	0.5	0.25	0.25	0.125
	Scrubber	3	1.5	0.2	0.1	10	5	0.5	0.25	0.25	0.125
Turpentine condenser	Untreated	–	–	–	–	–	–	0.01	0.005	0.5	0.25
Miscellaneous sources[l]	Untreated	–	–	–	–	–	–	–	–	0.5	0.25

[a] For more detailed data on specific types of mills, consult Reference 1.

[b] References 1, 7, 8.

[c] References 1, 7, 9, 10.

[d] References 6, 11. Use higher value for overloaded furnaces.

[e] References 1, 4, 7-10, 12, 13. These reduced sulfur compounds are usually expressed as sulfur.

[f] RSH-methyl mercaptan; RSR-dimethyl sulfide; RSSR-dimethyl disulfide.

[g] If the noncondensible gases from these sources are vented to the lime kiln, recovery furnace, or equivalent, the reduced sulfur compounds are destroyed.

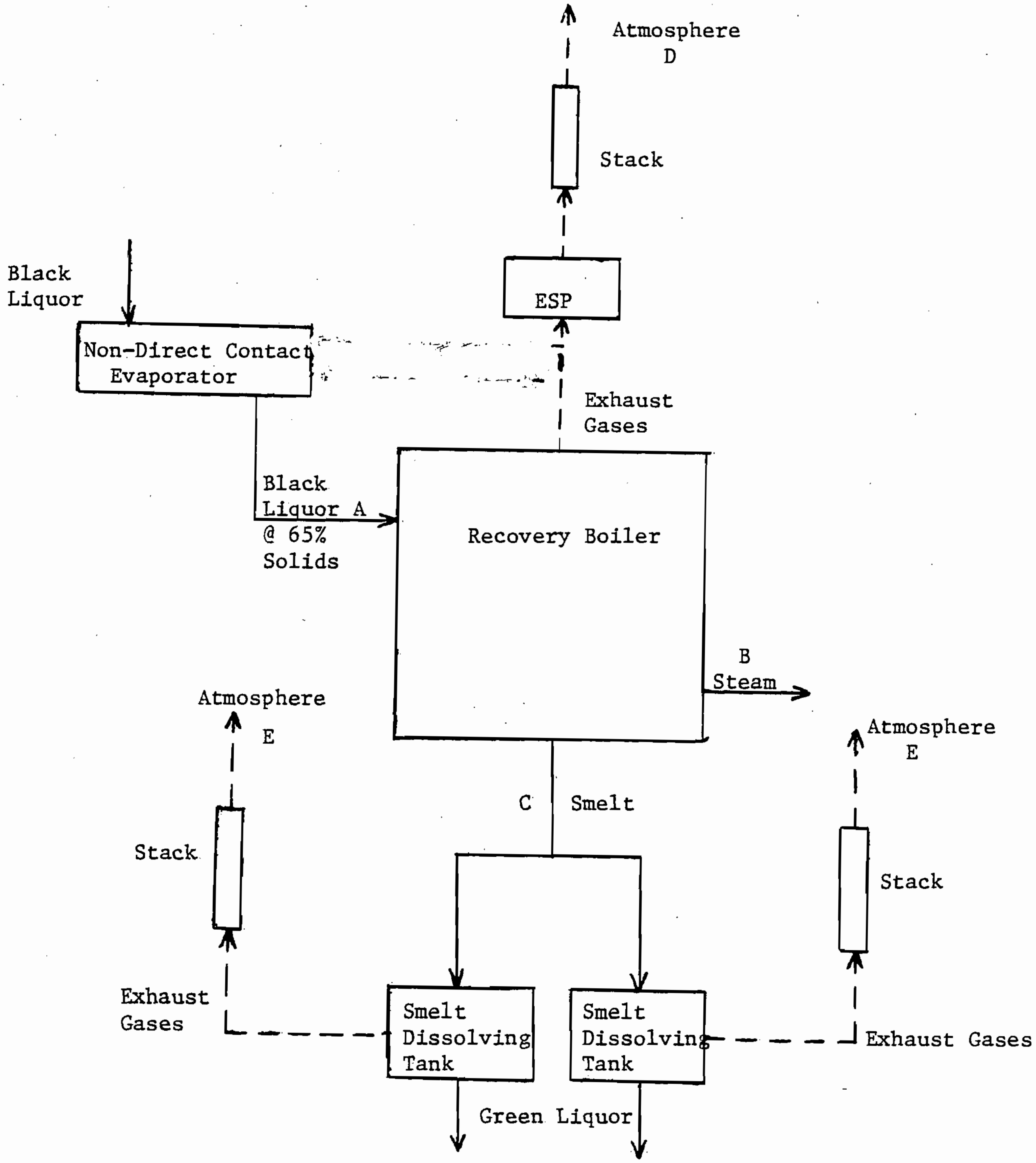
[h] These factors apply when either a cyclonic scrubber or cascade evaporator is used for direct contact evaporation with no further controls.

[i] These reduced sulfur compounds (TRS) are typically reduced by 50 percent when black liquor oxidation is employed but can be cut by 90 to 99 percent when oxidation is complete and the recovery furnace is operated optimally.

[j] These factors apply when a venturi scrubber is used for direct contact evaporation with no further controls.

[k] Use 15(7.5) when the auxiliary scrubber follows a venturi scrubber and 3(1.5) when employed after an electrostatic precipitator.

[l] Includes knotter vents, brownstock seal tanks, etc. When black liquor oxidation is included, a factor of 0.6(0.3) should be used.



Flow Diagram
Recovery Boiler #5

9. An application fee of $20, unless exempted by Section 17-4.05(3), F.A.C. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

Recovery Boiler

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?

☒ Yes ☐ No

Contaminant	Rate or Concentration
Particulate Matter	0.044 gr/dscf and 35% opacity
Total Reduced Sulfur	5 ppm by volume (dry basis)

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy) ☒ Yes ☐ No

Contaminant	Rate or Concentration
Particulate Matter	0.10 g/dscm (0.044 gr/dscf) at 8% O_2
Sulfur Dioxide	50 ppm - Internal Process Design of Boiler
Total Reduced Sulfur	5 ppm at 8% O_2 - low odor design of boiler

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration
Recovery Boiler: Particulate Matter	0.044 gr/dscf and 35% opacity
Total Reduced Sulfur	5 ppm at 8% O_2 - low odor design of boiler
All other pollutants	Boiler design and proper operation

D. Describe the existing control and treatment technology (if any).

1. Control Device/System: Electrostatic Precipitator
2. Operating Principles: Electric charging of particles by high voltage corona followed by migration to oppositely charged electrode for collection.
3. Efficiency:* 99%+ (manufacturer's data)
4. Capital Costs:
5. Useful Life: 5 to 10 years
6. Operating Costs:
7. Energy: 150 KW
8. Maintenance Cost:

See Attachment B

9. Emissions:

Contaminant	Rate or Concentration
See Attachment B	

*Explain method of determining D 3 above.

10. Stack Parameters See Attachment B

a. Height: ft. b. Diameter: ft.

c. Flow Rate: ACFM d. Temperature: °F

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1.

a. Control Device: Electrostatic Precipitator

b. Operating Principles: See Item D

c. Efficiency*: d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy*: h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

2.

a. Control Device:

b. Operating Principles:

c. Efficiency*: d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy**: h. Maintenance Costs:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

*Explain method of determining efficiency.

**Energy to be reported in units of electrical power – KWH design rate.

3.

a. Control Device:

b. Operating Principles:

c. Efficiency*: d. Capital Cost:

e. Life: f. Operating Cost:

g. Energy: h. Maintenance Cost:

*Explain method of determining efficiency above.

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space and operate within proposed levels:

4.

a. Control Device

b. Operating Principles:

c. Efficiency*:

d. Capital Cost:

e. Life:

f. Operating Cost:

g. Energy:

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected:

1. Control Device: Electrostatic Precipitator
2. Efficiency*: 99%+
3. Capital Cost:
4. Life: 5 to 10 years
5. Operating Cost: See Attachment B
6. Energy: 150 KW
7. Maintenance Cost:
8. Manufacturer: Environmental Elements or equivalent
9. Other locations where employed on similar processes:

a. See attached vendor list and efficiency guarantees.

(1) Company:

(2) Mailing Address:

(3) City:

(4) State:

(5) Environmental Manager:

(6) Telephone No.:

*Explain method of determining efficiency above:

(7) Emissions*:

Contaminant	Rate or Concentration

(8) Process Rate*:

b.

(1) Company:

(2) Mailing Address:

(3) City:

(4) State:

*Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions*:

Contaminant	Rate or Concentration

(8) Process Rate*:

10. Reason for selection and description of systems:

See attached sheet.

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*Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

Recovery Boiler - Nearly all recovery furnaces in the pulp and paper industry have been controlled by electrostatic precipitators (ESP's). The degree of control has varied, ranging from 90 percent on older installations to 99.8 percent on recent installations. The attached Environmental Elements brochure lists many of these installations, most of which are guaranteed at efficiencies above 99 percent. The proposed boiler will be a low odor, non-direct contact evaporation type boiler. No applications of fabric filters or wet scrubbers (except after ESP on existing unit) have been reported in the literature.

Because of the widespread usage of ESP's on recovery boilers, and their high removal efficiencies, an ESP was chosen as BACT for this application. Fabric filters would be unsuitable because of the sticky nature of the particulate, which would plug the bags.

An economic analysis was performed for various ESP control levels (see Attachment B). This analysis indicates that achieving a 0.02 gr/dscf exhaust loading compared to 0.044 (NSPS) would require 20 to 30 percent greater capital investment and about a 10 percent increase in annualized costs. In addition, the low-odor requirement for the new recovery boiler increases the size of the ESP by about 20 percent as compared to a high-odor boiler, further increasing the cost of control. Because of the relatively low particulate emission rate associated with the boilers at NSPS levels (75 lb/hr) and the small impact of all particulate sources at G-P (see PSD report), control below the NSPS level is not considered necessary or justified.

Three (3) BACT determinations are known to date for a recovery boiler. In all three, ESPs at 99.5 to 99.7 percent efficiency were selected to control particulate emissions to the 0.10 g/dscm (corrected to 8% O_2) NSPS level. This level is equivalent to 0.044 gr/dscf.

The attached test data summary for the existing recovery boiler at G-P (Attachment B) shows that the 0.044 gr/dscf NSPS level has been exceeded on occasion (6 times out of 23 tests). This has occurred even though the ESP for this recovery boiler is overdesigned (as stated by Environmental Elements and confirmed by their list of ESP installations--Hudson Pulp and Paper designed for 540,200 acfm but has actually not exceeded about 375,000 acfm). This overdesign has resulted in lower particulate emissions. As a result, the NSPS level of 0.044 gr/dscf is considered to be an emission level reasonably achievable, considering economics, energy and environmental impacts.

Sulfur dioxide control systems are not known to have been applied to recovery boilers, except in one case where BACT was an impingement-type wet scrubber. Because of the relatively low sulfur dioxide emission rate of the boiler of 250 lb/hr, equivalent to about 0.25 lb/10^6 Btu, no add on control systems are justified. Such a system would cost upwards of $4 million (see proposed Combination boiler application for similar costs), would produce a solid waste sludge which must be disposed of, and would require a significant energy input (approximately 2,000 kw). As a further comparison, the Seminole Electric Cooperative plant currently under construction near G-P will emit approximately 13,000 lb/hr of SO_2 under maximum load conditions. Therefore, BACT for the proposed recovery boiler for SO_2 is proposed as the uncontrolled AP-42 emission rate. EPA has declared BACT for SO_2 to be internal process design of boiler in the other BACT determinations done to date.

Information concerning NO_x emissions from Kraft Pulp Mill recovery furnaces is virtually nonexistent. As a result, little information is available concerning operational techniques and furnace modifications to reduce NO_x formation. The NCASI study (see Combination boiler application) represents the most comprehensive, up-to-date study available. In this study, NO_x emissions were found to be only a function of firing rate as a percentage of total capacity: as firing rate increased, NO_x emissions per 10^6 Btu heat input decreased. No relationship was found between NO_x emissions and:

- the number of liquor burners employed,
- the type of burner tips used, or
- the liquor pressure at the burner tips.

Since the NSPS for fossil-fuel steam generators for liquid fuel firing is 0.3 lb/10^6 Btu, the firing of black liquor in the proposed recovery furnace, with an expected emission rate of 0.09 lb/10^6 Btu for large furnaces, represents the best control method available for NO_x.

Similarly, no feasible control methods, except for proper boiler operation, are known to exist for VOC or CO. VOC emissions were found to be less for non-direct contact evaporation furnaces than for direct-contact evaporator furnaces (see NCASI study). Therefore, the proposed recovery boiler represents a lower VOC emission level. The data also indicate that minimum VOC emission correlate with minimum CO emissions.

For TRS, process controls and non-contact evaporators are considered as the only control technique for use on existing boilers (see Final Guideline Document: Control of TRS Emissions from Existing Kraft Pulp Mills). TRS emissions are described as a function of combustion air, rate of black liquor solids feed, turbulence in the oxidation zone, oxygen content of the fluegas, the spray pattern and droplet size of black liquor feed, and the degree of disturbance of the smelt bed. New boiler designs have considered these parameters as reducing TRS emissions.

The promulgated NSPS of 5 ppm was based upon achievable levels with the low-odor boiler. In the only BACT determination known to date for recovery boilers, the NSPS level was selected as BACT, with the control technique being the low-odor design. Consequently, BACT for TRS for the proposed boiler is proposed as the 5 ppm NSPS level, with utilization of the low-odor type recovery boiler.

REFERENCES

1. Personal Communication. Neal R. Davis, Applications Engineer, Environmental Elements Corporation, Baltimore, Maryland. May 22, 1981.

2. Operation and Maintenance of Particulate Control Devices in Kraft Pulp Mill and Crushed Stone Industries. PEDCO Environmental Specialists, Inc., Cincinnati, Ohio. EPA-600/2-78-210, October 1978.

3. Federal Register, Vol. 43, No. 37, February 23, 1981. Kraft Pulp Mills NSPS, pg. 7568-7598.

4. Technology Assessment Report for Industrial Boiler Applications: NO_x Flue Gas Treatment. Radian Corporation, EPA-600/7-79-178 g, December, 1978.

5. Control Techniques for Nitrogen Oxides Emissions from Stationary Sources, Second Edition. Acurex Corp., EPA-450/1-78-001, January 1978.

6. NO_x Emissions from Combustion Sources in the Pulp and Paper Industry. Hood, H.T. and Maner, R.A., NCASI. Paper presented at 1981 TAPPI Environmental Conference, New Orleans, LA.

7. Volatile Organic Compound Emissions from Pacific Northwest Pulp and Paper Industry Combustion Sources. Dallons, V.J. and Simon, C., NCASI. Paper presented at 1981 TAPPI Environmental Conference, New Orleans, LA.

8. Final Guideline Document: Control of TRS Emissions from Existing Kraft Pulp Mills. U.S. EPA, EPA-450/2-78-003a, 1978.

9. Compilation of BACT/LAER Determination, Revised. PEDC. Environmental Specialists, Inc. May 1980. EPA-450-2-08-070.

ATTACHMENT B

RECOVERY BOILER BACT INFORMATION

Flow Rate = 200,000 dscfm, 375,100 acfm (from present No. 4 recovery boiler operation)

NSPS Level = 0.044 gr/dscf particulate

Efficiency Calculations:

1. 0.044 gr/dscf x 200,000 x 60 ÷ 7,000 = 75.4 lb/hr

   Uncontrolled emissions (see Attachment A) = 7,500 lb/hr

   Efficiency = (7,500 - 75.4) ÷ 7,500 x 100 = 99% to meet NSPS level

2. 0.03 gr/dscf x 200,000 x 60 ÷ 7,000 = 51.4 lb/hr

   Efficiency required = (7,500 - 51.4) ÷ 7,500 x 100 = 99.3%

3. 0.02 gr/sdcf x 200,000 x 60 ÷ 7,000 = 34.3 lb/hr

   Efficiency required = (7,500 - 34.3) ÷ 7,500 x 100 = 99.5%

Cost Data for Low-Odor Recovery Boiler

Grain Loading (gr/dscf)	Mass Emissions (lb/hr)	Required Efficiency (%)	Capital Cost (x10^6$)	Annual Cost (x10^3$)
0.044	75.4	99.0	2.1	465
0.03	51.4	99.3	2.4	500
0.02	34.3	99.5	2.5	520

Cost data obtained from "Operation and Maintenance of Particulate Control Devices in Kraft Pulp Mill and Crushed Stone Industries," adjusted for 10 percent inflation rate per year. By comparison, Environmental Elements roughly estimated $5 million capital costs to meet 0.02 gr/dscf and $3.75 million capital cost to meet 0.044 gr/dscf.

OPERATION OF NO. 4 RECOVERY BOILER WITH ESP: SUMMARY OF TSP EMISSIONS TESTS

Date	Flow Rate (dscfm)	Grain Loading (gr/dscf)
02/28/77	164,109	0.0113
03/04/77	156,147	0.0497
03/04/77	159,474	0.0229
Average	159,910	0.0280
09/28/77	138,965	0.0369
09/29/77	140,863	0.0416
09/29/77	141,025	0.0157
Average	140,284	0.0314
03/78	167,837	0.0510
	165,821	0.0819
	185,644	0.0293
Average	173,100	0.0541
09/78	150,368	0.0485
	153,896	0.0446
	142,433	0.0514
Average	148,899	0.0482
04/79	229,303	---
	171,399	0.0306
	183,489	0.0158
Average	194,730	0.0232
09/79	134,951	0.0296
	142,429	0.0145
	152,045	0.0123
Average	143,142	0.0188
03/80	174,981	0.0060
	173,501	0.0141
	177,782	0.0139
Average	175,421	0.0113
09/80	196,637	0.038
	192,917	0.041
	198,136	0.007
Average	195,897	0.029

BACT/LAER CLEARINGHOUSE REPORT

10.1

[redacted] SOURCE TYPE/SIZE: Kraft pulp mill/ 660 ADT pulp/c

NAME/ADDRESS: Boise-Cascade Corporation, Rumford, Maine 04276

DETERMINATION IS: CONDITIONAL/[✓ FINAL]/~~PENDING~~; ISSUED on 4/6/79 (date), BASIS* of BACT^1/LAER/[✓ BAC
for NEW/[✓ MODIFIED] SOURCE

BY Environmental Protection Agency, Region I (Agency) John Courcier (Person), (FTS) 223-4448 (Phon

PERMIT PARAMETERS: AFFECTED FACILITIES	THROUGHPUT CAPACITY (Weight Rate)	POLLUTANT(s) EMITTED	EMISSION LIMIT(s) and (basis for)**	CONTROL STRATEGY DESCRIPT Equipment Type, Etc.	Ef
Recovery Boiler	850 ADT pulp/day	Particulates	0.10 g/dscm, corrected to 8% O_2; N	ESP	99.7%
		SO_2	150 ppm, corrected to 8% O_2; B	Internal Process Design of boiler	
		TRS	5 ppm, corrected to 8% O_2; N	Low-odor Design of boiler	
Smelt tank	850 ADT pulp/day	Particulates	0.1 g/kg of black liquor solids; N	low pressure (6-8" H_2O) scrubber	95%
		TRS	0.0084 g/kg black liquor solids; N	Wet scrubber	

NOTES: NSPS was considered to be BACT in this situation because the regs for kraft pulp mills are relatively recent (2/23/78)

* Circle one. BACT^1 means a determination made under pre-1977 amendments; BACT^2 means post-1977 amendments to CAA.

** Basis symbols: Use B=BACT, N=NSPS, S=SIP, L=LAER

PE

10.1

BACT/LAER CLEARINGHOUSE REPORT

SOURCE TYPE/SIZE: SEMICHEMICAL/KRAFT PULP MILL: 2194 TAD/D

NAME/ADDRESS: INTERNATIONAL PAPER COMPANY, PO BOX 160707, MOBILE, ALABAMA 36616

DETERMINATION DATA: CONDITIONAL/FINAL/PENDING for [✓ BACT]/LAER on NEW/MODIFIED SOURCE

KEY DATES: Application-Recd.______, Completed______; Determination-Proposed______, Final______

BY: (Agency) U.S. EPA REGION VI Person______ Phone______

AFFECTED FACILITIES	THROUGHPUT CAPACITY	EMISSION RATE* -UNCONTROLLED	EMISSION LIMITS (Basis)**	CONTROL STRATEGY DESCRIPTION Equipment type, etc.	Eff. %
Recovery furnaces (2)		SO_2	510 lb/h each (B)	Good process controls	
(straight kraft)		TRS	5 ppmv, at 8% O_2 (N)	Good process controls	
		CO	110 lb/h (B)	Good process controls	
		NO_x	88 lb/h (B)	Good process controls	
468		PM	54.0 lb/h ea, and (N)	Electrostatic precipitators	99.7
			0.10 g/dscm at 8% O_2	with pneumatic rappers	
Power/Steam Boilers (2)					
Coal fired:	$645x10^6$ Btu/h max.	SO_2	[a] 1.2 lb/10^6 Btu, (N)	Low sulfur fossil fuels to	
			and 774 lb/h ea.	meet NSPS requirements.	

SOURCE OPERATION: BATCH/CONTINUOUS:______hrs/yr; % by Season ____ W ____ Sp ____ Su ____ F

NOTES:

[a] Coal firing only

[b] 100% oil firing

[c] Firing fossil fuel with wood residue: proration is 1.2 lb/10^6 Btu for coal, 0.80 lb/10^6 Btu for oil, 0.24 lb/10^6 for wood contribution.

[d] Firing fossil fuels

* Specify pollutant (PM, SO_2, NO_x, HC, CO or other) and mass emission rate

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, A = Achieved-in-Practice (AIP)

BACT/LAER CLEARINGHOUSE REPORT

SOURCE TYPE/SIZE: SEMICHEMICAL/KRAFT PULP MILL: 2194 TAD/D

NAME/ADDRESS: INTERNATIONAL PAPER COMPANY, PO BOX 160707, MOBILE, ALABAMA 36616

DETERMINATION DATA: CONDITIONAL/FINAL/PENDING for BACT/LAER on NEW/MODIFIED SOURCE

KEY DATES: Application-Recd.________, Completed________; Determination-Proposed________, Final________

BY: (Agency) U.S. EPA REGION VI Person________ Phone________

AFFECTED FACILITIES Lime kiln (contd)	THROUGHPUT CAPACITY	EMISSION RATE -UNCONTROLLED*	EMISSION LIMITS (Basis)**	CONTROL STRATEGY DESCRIPTION Equipment type, etc.	Eff. %
		PM	61.1 lb/h (B)	Venturi scrubber with 28-30"	99.8
				pressure drop.	
		TRS	8 ppmv,dry, at 10% (N)	Good process controls and	
			O_2	incineration	
Dissolving Tanks (2)		PM	11.3 lb/h ea, and (N)	Water/fume impingement wet	99.8
476			0.1 g/kg black liquor	scrubber	
			solids		
		TRS	5 ppmv, dry, at 8% (N)	Good process controls.	
			O_2		
Lime Slaker		PM	2 lb/h (B)	Water/fumeimpingement wet scrubber	99.5

SOURCE OPERATION: BATCH/CONTINUOUS:________hrs/yr; % by Season ____ W ____ Sp ____ Su ____ F

NOTES:________

* Specify pollutant (PM, SO_2, NO_x, HC, CO or other) and mass emission rate

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, A = Achieved-in-Practice (AIP)

10.1

BACT/LAER CLEARINGHOUSE REPORT Page 1 of 3 pages

SOURCE TYPE/SIZE: KRAFT PULP MILL PULPING CAPACITY 1034 TONS/DAY

NAME/ADDRESS: BOISE CASCADE, P.O. BOX 500, WALLULA, WA 99363

DETERMINATION IS: CONDITIONAL/FINAL/PENDING: DATE OF ISSUE: 2/24/78 BASIS:* BACT^1/LAER/[✓ BACT^2]
FOR NEW/MODIFIED SOURCE

BY EPA REGION X (Agency) LARRY SIMS AND PAUL BOYS (Person) (206) 442-1106 (Phone)

PERMIT PARAMETERS:

AFFECTED FACILITIES	THROUGHPUT CAPACITY, weight rate	POLLUTANT(S) EMITTED	EMISSION LIMIT(S) AND BASIS FOR**	CONTROL STRATEGY DESCRIPTION	
				Equipment type, etc.	Eff.,%
Recovery boiler (No. 2)	238 ADT/day feed or 738,000[a]	TSP	0.44 gr/scf/476 lb/day (N)	ESP	99.5
		SO_2	160 ppm/5424 lb/day (B)	Impinger type wet scrubber	95
		Opacity	35% (N)		
Lime kiln	544 tons/day or 847 ADT	TSP (gas)	0.067 gr/scf/466 lb/day (B)	Venturi scrubber	

NOTES: [a] Pounds black liquor dry solids/day; ADT means Air Dried Tons.

Where no NSP requirement, state standards apply for opacity - 20%

* Circle one. BACT-1 indicates determination made under pre-1977 amendments; BACT-2 indicates post-1977 amendments to CAA.

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, L = LAER, P = PSD Increment

(10.1)

BACT/LAER CLEARINGHOUSE REPORT

Page 2 of 3 pages

SOURCE TYPE/SIZE: KRAFT PULP MILL PULPING CAPACITY 1034 TONS/DAY

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PERMIT PARAMETERS: AFFECTED FACILITIES	THROUGHPUT CAPACITY, weight rate	POLLUTANT(S) EMITTED	EMISSION LIMIT(S) AND BASIS FOR**	CONTROL STRATEGY DESCRIPTION	
				Equipment type, etc.	Eff.,%
Lime kiln (continued)		TSP (oil)	0.12 gr/scf/906 (B)		
			lb/day		
		Opacity	20% (S)		
		SO_2	5 ppm/19 lb/day (B)		
No.2 Dissolver vent	253 ADT	TSP	71 lb/day (N)	Chemico-type scrubber	
		Opacity	20% (S)	"	
Decker hood	200 ADT	TSP	0.01 ADT/2 lb/day (B)		
		Opacity	20% (S)		

NOTES:

* Circle one. BACT-1 indicates determination made under pre-1977 amendments; BACT-2 indicates post-1977 amendments to CAA.

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, L = LAER, P = PSD Increment

ENVIRONMENTAL
ELEMENTS
CORPORATION
Subsidiary of Koppers Company, Inc.

Clean Air From Paper Mill Recovery Boilers Without Corrosion

J. R. ZARFOSS
Mgr. Technical Development
Air Cleaning Systems
Environmental Elements Corp.
Baltimore, Maryland

PRESENTED AT A JOINT SEMINAR
SPONSORED BY
AIR POLLUTION CONTROL ASSOCIATION
NATIONAL ASSOCIATION OF CORROSION ENGINEERS
INDUSTRIAL GAS CLEANING INSTITUTE
ATLANTA, GEORGIA, JANUARY 1976

ACKGROUND

Collection of sodium sulphate (salt cake) from paper mill recovery boiler flue gas by electrostatic precipitators quires special attention. Excessive orrosion is an ever present hazard. The sources of the problem are the high moisture content of the flue gas nd the corrosive atmosphere surunding most installations.

A brief look at history will provide an understanding of the severity of the tuation. In the fifties, a precipitator as typically located on the ground with horizontal ductwork leading to a masonry stack. The ductwork was made of mild steel. In many installaons salt cake accumulated on the uct floor; probably the result of eddys and swirls in the gas stream. The steel under these accumulations corroded a rapid rate.

The precipitator shell was made of glazed tile block to inhibit chemical attack. Performance was generally tisfactory; however, cracks in the ortar and tile resulted in corrosion of the structural steel embedded in the wall.

Internal components of the precipitor were made of mild steel and had satisfactory life.

In the early sixties, a major design change was initiated in order to exnd the life of the ductwork. Precipitors were placed on top of the boiler building. All ductwork could then be vertically oriented to eliminate fall-out. addition, the quality of insulation as improved.

Ductwork corrosion was now under control. Because of the high elevation, tall stacks were not needed. Short, 15 ot, steel stub stacks were attached the top of the precipitator. It was quickly discovered that the stacks had to be well insulated to prevent corroon event at gas temperatures of 75°C (350°F).

These new boiler buildings were typically taller than the older buildings, and the precipitator was frequently ngulfed in vapors and gases from earby vents and stacks which were shorter in height. The atmosphere contained both acid mist and mists that ere caustic. Water as a vapor and a ist was also present. The paint on all exterior surfaces was rapidly attacked making it difficult to protect the steel. Copper was particularly vulnerable. ectrical components required frequent maintenance. Specification required that the alumnium hand rails could not be an alloy containing opper. Fittings, locks, and gauges of ass had a very short life.

The shell of the precipitator was still made of tile block, but the precitators became larger in size due to gher efficiency requirements. Building movement, vibration, and thermal stresses, combined with the larger size, caused additional maintenance roblems for the tile shell. These probms caused designers to consider alternatives, and by 1967 steel shell precipitators were in use. It was ancipated that this transition would reuire a thorough understanding of precipitator corrosion.

PROBLEM IDENTIFICATION

In the early stages, metal which is corroding rapidly has the appearance of many thin brittle sheets separated by layers of granular material. The brittle sheets are iron oxide in color, and the granular material is sometimes a bright orange. With time, the layers break away from the parent metal and extend out into space hinged along one side. The combined thickness can be as much as 1/2 inch. When the parent metal is examined in these localized areas, it has been found that only a few thousandths of an inch have been removed. This indicates a substantial increase in volume. Rapid corrosion is most frequently found on the inside surface of steel which has stiffeners or structural columns attached to the outside. It is also prevalent around door frames and in the corners of the shell. A typical precipitator is shown in fig. 1.

Corrosion problems were not restricted to the paper mill application; the scientific community, in response to the needs of industry, searched for the mechanisms by which metal is attacked when exposed to flue gas. In 1971, J. Gooch wrote an excellent summary of this work.

Flue gas from a boiler contains H_2O vapor with some SO_3 present. Below 415°F, 99% of the SO_3 vapor combines quickly with the H_2O vapor to form H_2SO_4 in the vapor phase.[1] As the temperature of the flue gas is lowered, the H_2SO_4 vapor becomes saturated and forms a "mist." Sulphuric acid in flue gas does not necessarily condense on a cool surface.[2]

The acid "dew-point" temperature is the beginning of the saturation process. This temperature cannot be accurately defined because there is no sharp boundary between the vapor and liquid phase. The amount "condensing" is a function of temperature with the maximum rate occurring 40-60°F below the onset temperature. As the temperature is lowered further, the rate decreases. Avoiding the temperature associated with the peak rate of saturation is highly desirable and more important than dew-point in controlling corrosion.[2] Unfortunately, it is not predictable.

The charts and graphs seen in literature relating H_2O, SO_3, and H_2SO_4 vapor to dew-point temperature should be considered only as the theoretical amount available in the gas. They cannot be used to predict corrosion.

The general "rusty" condition seen in most precipitators is probably the result of acid deposits and other harmful elements, such as chlorides, as they relate to both operating conditions and atmospheric moisture during idle periods. The rapid catastrophic corrosion, seen occasionally, is most likely the result of water condensing on the metal surface during operation and forming a dilute solution with whatever acids and salts are present. Depending on composition, this solution can vigorously attack the metal.[2] (Do not overlook air leakage as an aggravation factor.)

The dew-point temperature of the uncombined water vapor is separate and distinct from the acid dew-point. It is predictable and measureable and must be avoided to minimize corrosion. The dew-point is process dependent, but 75°C (165°F) is a typical value for recovery boiler flue gas.

There are other sources of trouble. Some precipitators have a re-circulating pool of liquid, referred to as "black liquor", under the treatment zone. It is used to catch and remove the collected material. Vapors from this pool are corrosive and this characteristic increases with greater amounts of oxygen and sodium sulphide.[3] Water vapor which also escapes from this pool, can locally raise the dew point temperature. Further compounding the problem is the temperature of the black liquor. The pool, being at 80°C (180°F), conducts heat from the steel shell causing it to approach the water vapor dew point.

To summarize, the amount of corrosion occurring on a low temperature metal surface in a precipitator is a function of the water and acid content of the flue gas, the metal and gas temperature, the composition of the particulate matter, the nature of the interactions occurring between the vapors, steel, and particulate matter and the rate of acid transfer to the metal surface.[1]

THE SOLUTION: maintain the temperature of the steel exposed to the flue gas above the dew point of the water vapor.

DESIGNS FOR TODAY

Precipitator installations being designed today have evolved from the problems of the past. Locating the precipitator on top the boiler building is not as attractive as it once was because of the high cost of exterior maintenance. Horizontal ductwork is again being used but is kept to a minimum. High quality insulation is used to maintain the temperature of the steel. Satisfactory ductwork is an accepted fact.

The main concern is the precipitator shell. Problems arise because the temperature of the shell varies over its surface. Heat available from the gas to maintain the shell temperature is not uniform inside the precipitator. The lowest amount of heat is available in the zones of slow gas circulation, such as the top, bottom and corners of the shell. Also, the heat loss characteristic is not uniform because of the structural members attached to the shell. At flue gas temperatures above 180°C (350°F) a well constructed, well insulated steel shell precipitator will have no problem, even in the cooler zones. Gas temperatures of 130°C to 140°C (265°F) are known to be a problem because the highest heat-loss surfaces, in the cooler zones, begin to show evidence of rapid corrosion. In practice, 150°C (300°F) is the approximate boundary below which supplemental heating is required in addition to insulation.

There are two heating techniques in practice today. Stationary electric heaters are sometimes placed between the insulation and shell panels in the problem areas. Another technique is to circulate heated air in the space between the insulation and the shell; 7000 CFM and 500,000 BTU per hour are typical values. This hot air chamber can also be formed by a double wall of steel. In the latter case, insulation is then placed against the outer skin. All steel components attached to the outside shell surface must be totally within the hot air chamber to inhibit heat loss.

The user, as well as the designer, must give careful consideration to the operating procedures. There have been instances where vapors and gases have been vented into the precipitator as a means of releasing them into the atmosphere. If these gases are low in temperature and/or have a high moisture content, they can create major problems. Rapid localized corrosion surrounding the point of entry is a result typical of this practice. The reason is, of course, the raising of the dew-point temperature or the cooling of steel in the troubled area. Two examples illustrate the severity of the situation. A vent from a tank containing a hot liquid was introduced into the lower portion of the precipitator. This is typically the zone of lowest temperature. In this space under the treatment zone or located gas baffles and the lower extremities of the collection surfaces. After three months of this practice, a 3 ft. diameter hole was found in the ⅛ inch baffle, and the bottom 24 inches of nearby 18 GA. collection surfaces were destroyed. At another installation, water was substituted for the black liquor pool under the treatment zone. The additional moisture from the water pool and, possibly, its temperature caused rapid corrosion. In only six months, the bottom six feet of all collection surfaces were transformed into a configuration similar to lace.

Upon shutting down a precipitator and observing the salt cake clinging to the inside surfaces, some operators have thought it best to wash the components with water. Sodium sulphate is soluble in water, and washing is a relatively easy accomplishment. However, this raises the humidity of the air inside the treatment zone, and the liquid solution created by the water and Sodium Sulfate can be highly corrosive. The result is more harmful than if the precipitator had been left dirty. Every washing seems to take its toll especially if the precipitator is then to remain idle for long periods of time. The recommended procedure for idle periods is to close all doors and hatches and to maintain the temperature of the steel shell above the water dew-point of the contained atmosphere.

In the past, experimenters have painted the inside surface of the steel with protective coatings. The object was to prevent condensation from coming in contact with the metal. In this way, it was hoped to eliminate the dependency upon expensive insulation. Surface preparation was costly and had to be done expertly to have any chance of success. With use, small ruptures in the coating were commonplace allowing the elements of corrosion to enter. This procedure has not had a good long-range history.

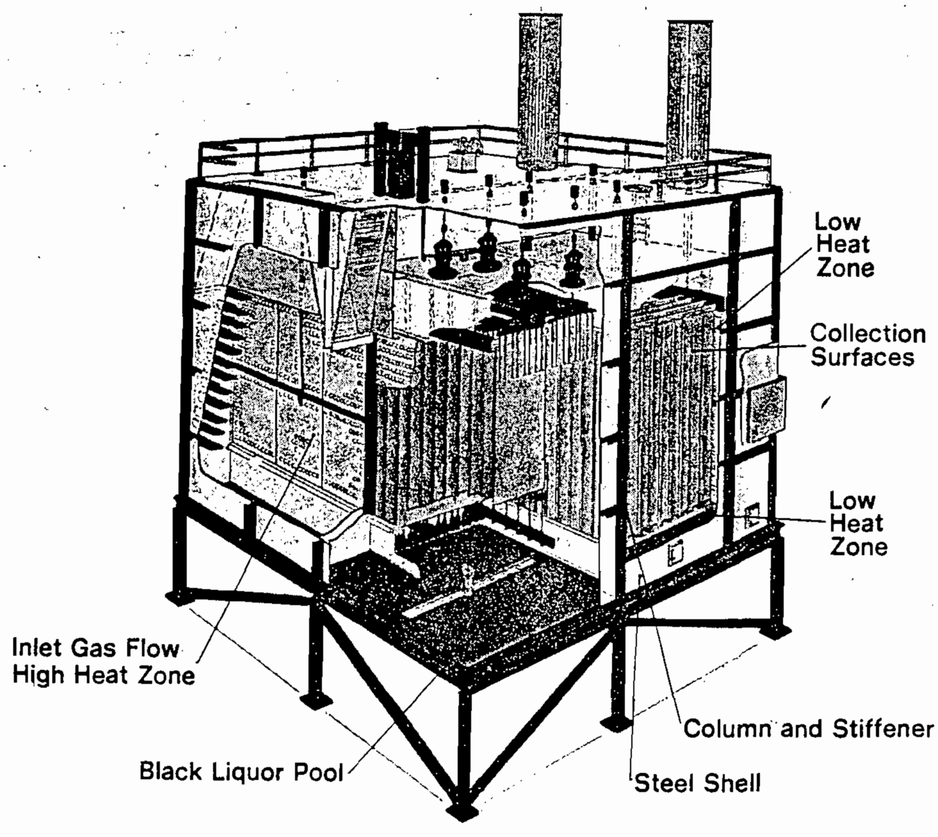
Good maintenance is paramount in the fight against corrosion. The integrity of the insulation must be frequently inspected and kept water tight. Many precipitators operate under negative pressure and the inleakage of air can be disastrous. Inleakage around door seals, access ports, and cracks in the steel must be sealed as soon as discovered.

Corrosion in the paper mill atmosphere is commonplace, and describing the problems of precipitator installations does not mean that they are misapplied. Properly designed and maintained, a precipitator will give many years of dependable service. The original steel shell designs are 9 years old and going strong.

REFERENCES

1. J. P. Gooch, "Low Temperature Corrosion by Sulphuric Acid in Power Plant Systems." Paper presented by Southern Research Institute at the Electrostatic Precipitator Symposium. February, 1971.
2. J. R. Rylands and J. R. Jenkinson. "The Acid Dew Point." *Journal of Institute of Fuel*. June, 1954. Page 299.
3. L. Stockman and A. Tansen, *Svensk Paperstidn.* 62, 907 to 914 (1959) (original in Swedish with English and German summaries); through *Abstr. Bull. Inst. Paper Chem.* 30, 1164 to 1165 (1960). *The Paper Industry.* June, 1960. Page 215.

Fig. 1



TYPICAL ELECTROSTATIC PRECIPITATOR

AIR CLEANING SYSTEMS

SALT CAKE PRECIPITATOR INSTALLATIONS

PARTIAL LISTING

Air Cleaning Systems Group
P.O. Box 1318, 3700 Koppers St.
Baltimore, Maryland 21203
Telephone 301 368-7222

YEAR & S. O. NUMBER	CUSTOMER PLANT AND LOCATION	OPERATING DATA
1971		
370568	**WESTVACO CORPORATION** Charleston, South Carolina	278,000 ACFM @ 350°, 99.3% guaranteed efficiency, wet bottom, steel shell
370570	**LINCOLN PULP & PAPER CO.** Lincoln, Maine	121,500 ACFM @ 436°, 99.0% guaranteed efficiency, dry bottom, steel shell, **CONTROLLED ODOR BOILER**
370578	**SOUTHWEST FOREST INDUSTRIES** Panama City, Florida	300,000 ACFM @ 325°, 99.6% guaranteed efficiency, wet bottom, steel shell
370593	**FEDERAL PAPER BOARD CO., INC.** Reigelwood, North Carolina	212,000 ACFM @ 375°, 99.7% guaranteed efficiency, wet bottom, steel shell
370597	**CHAMPION PAPER** Pasadena, Texas (2 units)	216,000 ACFM each @ 400°, 99.75% guaranteed efficiency, wet bottom, filled tile shell
370600	**OWENS-ILLINOIS** Tomahawk, Wisconsin	83,000 ACFM @ 450°, 99.5% guaranteed efficiency, dry bottom, steel shell
370601	**OWENS-ILLINOIS** Valdosta, Georgia	128,000 ACFM @ 320°, 99.6% guaranteed efficiency, wet bottom, steel shell
370602	**OWENS-ILLINOIS** Valdosta, Georgia	128,000 ACFM @ 320°, 99.6% guaranteed efficiency, wet bottom, steel shell
1972		
370607	**TEMPLE, INC.** Silsbee, Texas	220,000 ACFM @ 330°, secondary collection, 96.9% guaranteed efficiency, wet bottom, steel shell
370608	**TEMPLE, INC.** Silsbee, Texas	250,000 ACFM @ 300°, secondary collector, 90.0% guaranteed efficiency, wet bottom, steel shell
370610	**BOWATERS CAROLINA CORP.** Catawba, South Carolina	200,000 ACFM @ 310°, 99.6% guaranteed efficiency, wet bottom, steel shell
370623	**CONTINENTAL FOREST INDUSTRIES** Augusta, Georgia	220,000 ACFM @ 325°, 99.5% guaranteed efficiency, wet bottom, steel shell
370626	**INTERNATIONAL PAPER CO.** Georgetown, South Carolina	345,000 ACFM @ 325°, 99.5% guaranteed efficiency, wet bottom, steel shell
370628	**UNION CAMP CORP.** Savannah, Georgia	502,000 ACFM @ 350°, 99.65% guaranteed efficiency, wet bottom, steel shell
370635	**CHAMPION INTERNATIONAL** Pasadena, Texas	281,000 ACFM @ 315°, 99.8% guaranteed efficiency, wet bottom, steel shell
370637	**CONTINENTAL FOREST INDUSTRIES** Port Wentworth, Georgia	240,000 ACFM @ 325°, 99.5% guaranteed efficiency, wet bottom, steel shell

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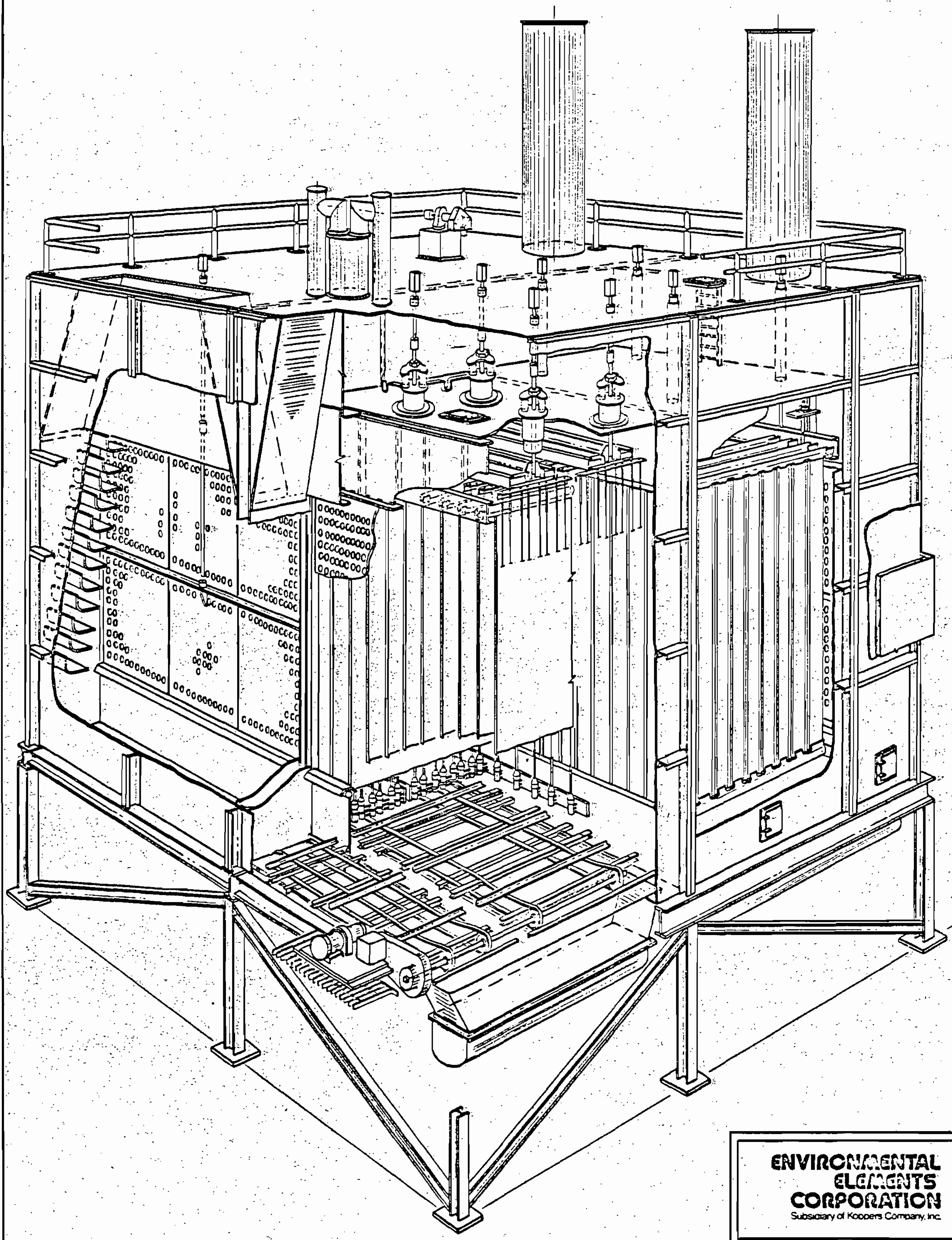
YEAR & S. O. NUMBER	CUSTOMER PLANT AND LOCATION	OPERATING DATA
370639	INTERNATIONAL PAPER Gardiner, Oregon	275,000 ACFM @ 395°, 99.5% guaranteed efficiency, dry bottom, steel shell
370640	SCOTT PAPER COMPANY Mobile, Alabama	140,000 ACFM @ 250°, 99.7% guaranteed efficiency, wet bottom, steel shell
370663	SOUTH CAROLINA INDUSTRIES Florence, South Carolina	375,000 ACFM @ 450°, 99.7% guaranteed efficiency, wet bottom, steel shell, CONTROLLED ODOR BOILER
1973		
370676	P.H. GLATFELTER CO. Spring Grove, Pennsylvania	230,000 ACFM @ 300°, 99.5% guaranteed efficiency, wet bottom, steel shell
370678	ARKANSAS KRAFT CORP. Morrilton, Arkansas	260,000 ACFM @ 430°, 99.5% guaranteed efficiency, wet bottom, steel shell, CONTROLLED ODOR BOILER
370680	INTERNATIONAL PAPER CO. Springhill, Louisiana	185,000 ACFM @ 325°, 99.6% guaranteed efficiency, wet bottom, steel shell
370681	INTERNATIONAL PAPER CO. Springhill, LA.	250,000 ACFM @ 325°, 99.6% guaranteed efficiency, wet bottom, steel shell
370682	INTERNATIONAL PAPER CO. Pine Bluff, Arkansas	319,000 ACFM @ 325°, 99.6% guaranteed efficiency, wet bottom, steel shell
370683	INTERNATIONAL PAPER CO. Natchez, Mississippi	315,000 ACFM @ 325°, 99.6% guaranteed efficiency, wet bottom, steel shell
370692	CONTAINER CORPORATION Fernandina Beach, Florida	240,000 ACFM @ 240°, 99.6% guaranteed efficiency, wet bottom, steel shell
370693	CONTAINER CORPORATION Fernandina Beach, Florida	420,000 ACFM @ 400°, 99.6% guaranteed efficiency, dry bottom, steel shell, CONTROLLED ODOR BOILER
370694	SCOTT PAPER COMPANY Mobile, Alabama	160,000 ACFM @ 300°, 99.6% guaranteed efficiency, wet bottom, steel shell
370697	ST. REGIS PAPER CO. Pensacola, Florida	335,000 ACFM @ 370°, 99.63% guaranteed efficiency, dry bottom, steel shell, CONTROLLED ODOR BOILER
370709	PINEVILLE KRAFT CORP. Pineville, LA.	300,000 ACFM @ 290°, 99.6% guaranteed efficiency, wet bottom, steel shell
370710	GULF STATES PAPER Demopolis, Alabama	250,000 ACFM @ 350°, 99.5% guaranteed efficiency, wet bottom, steel shell
1974		
370717	FEDERAL PAPERBOARD CO. Riegelwood, North Carolina	260,000 ACFM @ 275°, 99.525% guaranteed efficiency, wet bottom, steel shell
370718	CONTINENTAL FOREST INDUSTRIES Hodge, Louisiana	162,500 ACFM @ 300°, 99.5% guaranteed efficiency, wet bottom, steel shell
370722	SCOTT PAPER COMPANY Skowhegan, Maine	450,000 ACFM @ 400°, 99.8% guaranteed efficiency, dry bottom, steel shell, CONTROLLED ODOR BOILER
370725	CONTAINER CORPORATION Brewton, Alabama	200,000 ACFM @ 270°, 99.5% guaranteed efficiency, wet bottom, steel shell
370726	CONTAINER CORPORATION Cali, Columbia	118,000 ACFM @ 325°, 99.5% guaranteed efficiency, wet bottom, steel shell
370735	WESTERN KRAFT COMPANY Hawesville, Kentucky	125,000 ACFM @ 350°, 99.5% guaranteed efficiency, wet bottom, steel shell
370741	HUDSON PULP & PAPER CO. Palatka, Florida	540,200 ACFM @ 385°, 99.75% guaranteed efficiency, dry bottom, steel shell, CONTROLLED ODOR BOILER
370747	GEORGIA PACIFIC CORP. Port Hudson, Louisiana	455,000 ACFM @ 325°, 99.5% guaranteed efficiency, wet bottom, steel shell

YEAR & S. O. NUMBER	CUSTOMER PLANT AND LOCATION	OPERATING DATA
370750	**CONSOLIDATED PAPERS** Wisconsin Rapids, Wisconsin	175,000 ACFM @ 310°, 99.5% guaranteed efficiency, wet bottom, steel sheel
370751	**OLINKRAFT, INC.** West Monroe, Louisiana	315,000 ACFM @ 410°, 99.7% guaranteed efficiency, wet bottom, steel shell, **CONTROLLED ODOR BOILER**
1975		
370758	**POTLATCH CORPORATION** McGehee, Arkansas	225,000 ACFM @ 410°, 99.7% guaranteed efficiency, dry bottom, steel shell, **CONTROLLED ODOR BOILER**
370760	**KIMBERLY CLARK CORP. UNIT 2** Coosa Pines, Alabama	100,000 ACFM @ 340°, 99.6% guaranteed efficiency, wet bottom, steel shell
370761	**KIMBERLY CLARK CORP. UNIT 3** Coosa Pines, Alabama	337,000 ACFM @ 426°, 99.7% guaranteed efficiency, dry bottom, steel shell, **CONTROLLED ODOR BOILER**
370764	**UNION-CAMP CORPORATION** Franklin, Virginia	500,000 ACFM @ 470°, 99.8% guaranteed efficiency, dry bottom, steel shell, **CONTROLLED ODOR BOILER**
370771	**OLINKRAFT, INC.** West Monroe, Louisiana	185,000 ACFM @ 325°, Secondary Collector, 94% guaranteed efficiency, wet bottom, steel shell
370772	**THE MEAD CORPORATION** Chillicothe, Ohio	399,000 ACFM @ 420°, 99.7% guaranteed efficiency, dry bottom, steel shell, **CONTROLLED ODOR BOILER**
370783	**INTERNATIONAL PAPER** Texarkana, Texas	440,000 ACFM @ 325°, 99.6% guaranteed efficiency, wet bottom, steel shell
370785	**WESTERN KRAFT** Campti, Louisiana	173,000 ACFM @ 415°, 99.65% guaranteed efficiency, wet bottom, steel shell, **CONTROLLED ODOR BOILER**
1976		
370801	**INTERNATIONAL PAPER CO.** Bastrop, Louisiana	125,000 ACFM @ 315°, 97.33% guaranteed efficiency, wet bottom, steel shell
370804	**CONTAINER CORPORATION** Cali, Colombia	81,250 ACFM @ 325°, 99.55% guaranteed efficiency, wet bottom, steel shell
370808	**GEORGIA PACIFIC CORP.** Crossett, Arkansas	450,000 ACFM @ 325°, 99.5% guaranteed efficiency, wet bottom, steel shell
370809	**CONTAINER CORPORATION** Fernandina Beach, Florida	500,000 ACFM @ 400°, 99.75% guaranteed efficiency, dry bottom, steel shell, **CONTROLLED ODOR BOILER**
1977		
370833	**NIGERIAL PAPER MILL, LTD.** Lagos, Nigeria	94,350 ACFM @ 325°, 99% guaranteed efficiency, wet bottom, steel shell
370834	**CONTINENTAL FOREST INDUS.** Port Wentworth, Ga.	535,000ACFM @ 410°, 99.8125% guaranteed efficiency, wet bottom, steel shell, 1200 T/D B&W
370846	**TEMPLE EASTEX, INC.** Silsbee, Texas	250,000 ACFM @ 425°, 98% guaranteed efficiency (99.75% overall guarantee) wet bottom, steel shell, boiler converted to low odor
370851	**WESTVACO** Charleston, S.C.	400,000 ACFM @ 285°, 99% guaranteed efficiency, wet bottom, steel shell, #6 #7 & #8 boilers @ 250 T/D each
370858	**CONTINENTAL FOREST INDUS.** Augusta, Ga.	220,000 ACFM @ 325°, 99.5% guaranteed efficiency, wet bottom steel shell 550 T/D B&W

YEAR & S. O. NUMBER	CUSTOMER PLANT AND LOCATION	OPERATING DATA
1978		
370863	**MEAD CORPORATION** Escanaba, Michigan	400,000 ACFM @ 465°, 99.7% guaranteed efficiency, dry bottom, steel shell, 500 T/D **CONTROLLED ODOR BOILER**
370868	**SCOTT PAPER COMPANY** Mobile, Alabama	180,000 ACFM @ 300°, 99.6% guaranteed efficiency, wet bottom, steel shell, 500 T/D boiler.
370875	**INTERNATIONAL PAPER CO.** Gardiner, Oregon	325,000 ACFM @ 425°, additional field 99.6% overall guaranteed efficiency, dry bottom, steel shell, two 420 T/D **CONTROLLED ODOR BOILER**
370879	**CONTINENTAL FOREST IND.** Hopewell, Virginia	432,000 ACFM @ 425°, 99.7% guaranteed efficiency, wet bottom, steel shell, **CONTROLLED ODOR BOILER.**
370884	**CHAMPION PAPER, INC.** Canton, North Carolina	360,000 ACFM @ 325°, 99.5% guaranteed efficiency, wet bottom, steel shell, 900 T/D Boiler
370891	**S. D. WARREN** Muskegon, Michigan	145,000 ACFM @ 300°, 99.5% guaranteed efficiency, wet bottom, steel shell.
370896	**OWENS ILLINOIS** Orange, Texas	430,000 @ 300°, secondary collector 94.0% guaranteed efficiency, wet bottom, steel shell, two 550 T/D B & W boilers.
1979		
420016	**TEMPLE EASTEX** Silsbee, Texas	220,000 ACFM @ 330°F, Primary Collector, 99.6% guaranteed overall efficiency, wet bottom, steel shell.
420025	**WESTVACO** Wickliffe, Kentucky	360,000 ACFM @ 320°F, 99.5% guaranteed efficiency, wet bottom, steel shell, 3,200,000 lbs. Bls/Day.
420026	**HAMMERMILL PAPER CO.** Selma, Alabama	380,000 ACFM @ 410°F, 99.65% guaranteed efficiency, wet bottom, steel shell, 900 TPD **CONTROLLED ODOR BOILER.**
420027	**INTERNATIONAL PAPER CO.** Mansfield, Louisiana	Two precipitators each 370,000 ACFM @ 412°F, 99.7% guaranteed efficiency, wet bottom, steel shell, two 900 TPD boilers **CONTROLLED ODOR BOILERS.**
1980		
420034	**ALABAMA KRAFT CORPORATION** Phenix City, Alabama	360,000 ACFM @ 340°F, 99.66% guaranteed efficiency, wet bottom, steel shell, conventional boiler
420041	**GEORGIA PACIFIC CORP.** Crossett, Arkansas	730,000 ACFM @ 430°F, 99.8% guaranteed efficiency, wet bottom, steel shell, 1500 TPD **CONTROLLED ODOR BOILER**
420051	**MACMILLAN BLOEDEL, INC.** Pine Hill, Alabama	461,351 ACFM @ 414°F, 99.8% guaranteed efficiency, wet bottom, steel shell, 1500 TPD **CONTROLLED ODOR BOILER**
420062	**UNION CAMP CORPORATION** Montgomery, Alabama	320,000 ACFM @ 350°F, 99.7% guaranteed efficiency, wet bottom, steel shell, 750 TPD conventional boiler



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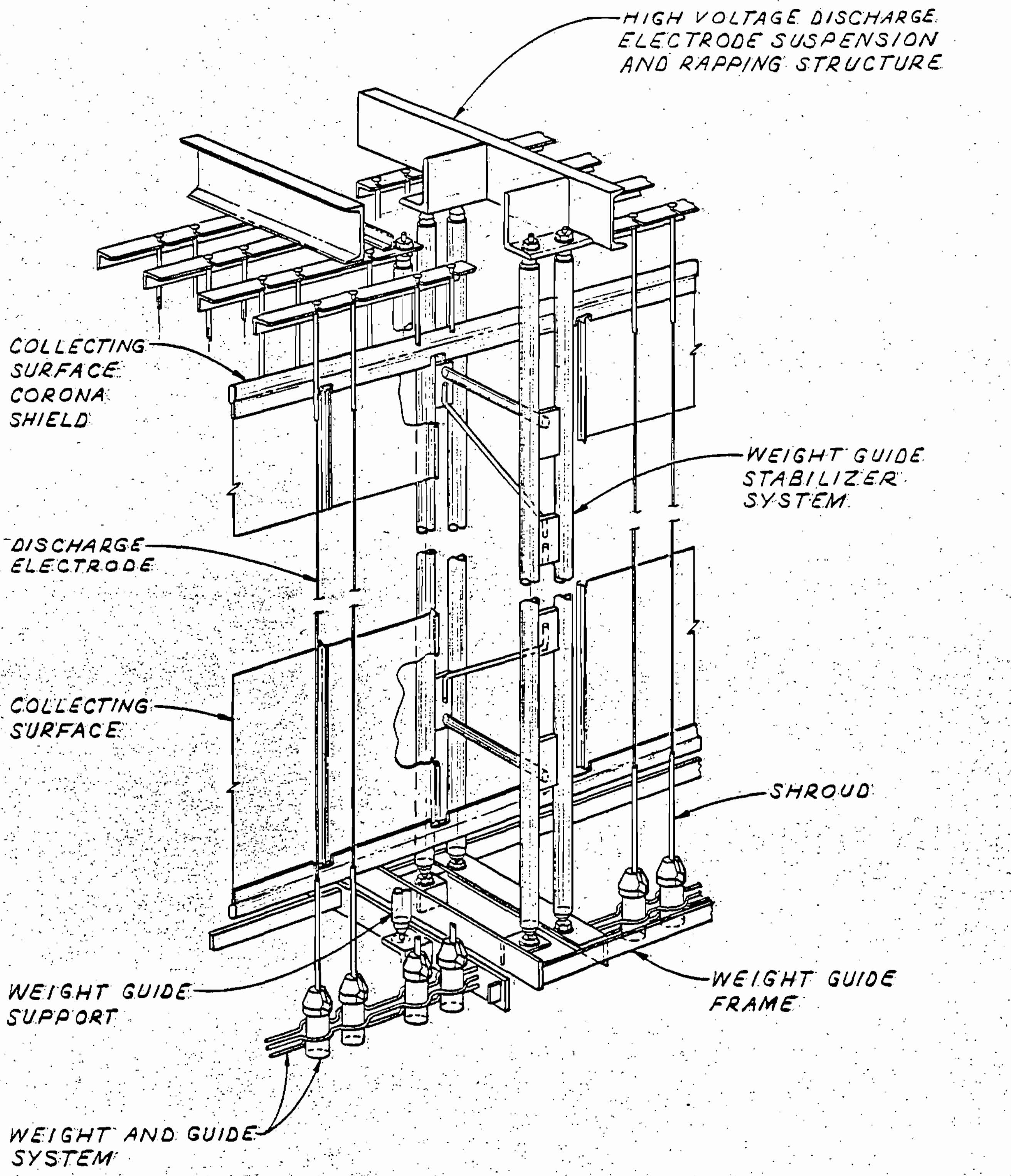
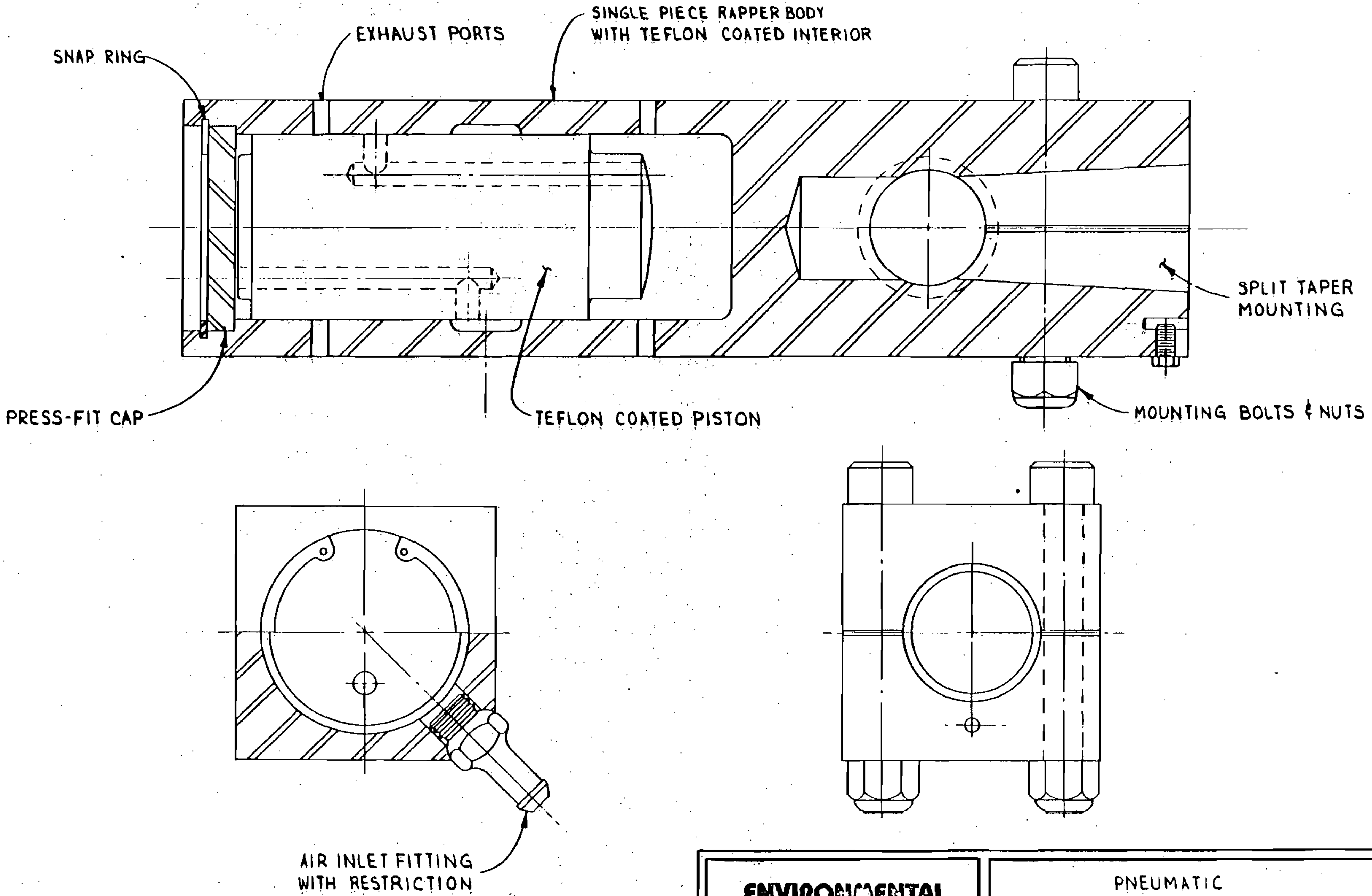


ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

DISCHARGE ELECTRODE SUPPORT AND STABILIZER SYSTEM

DWG. NO. 1037

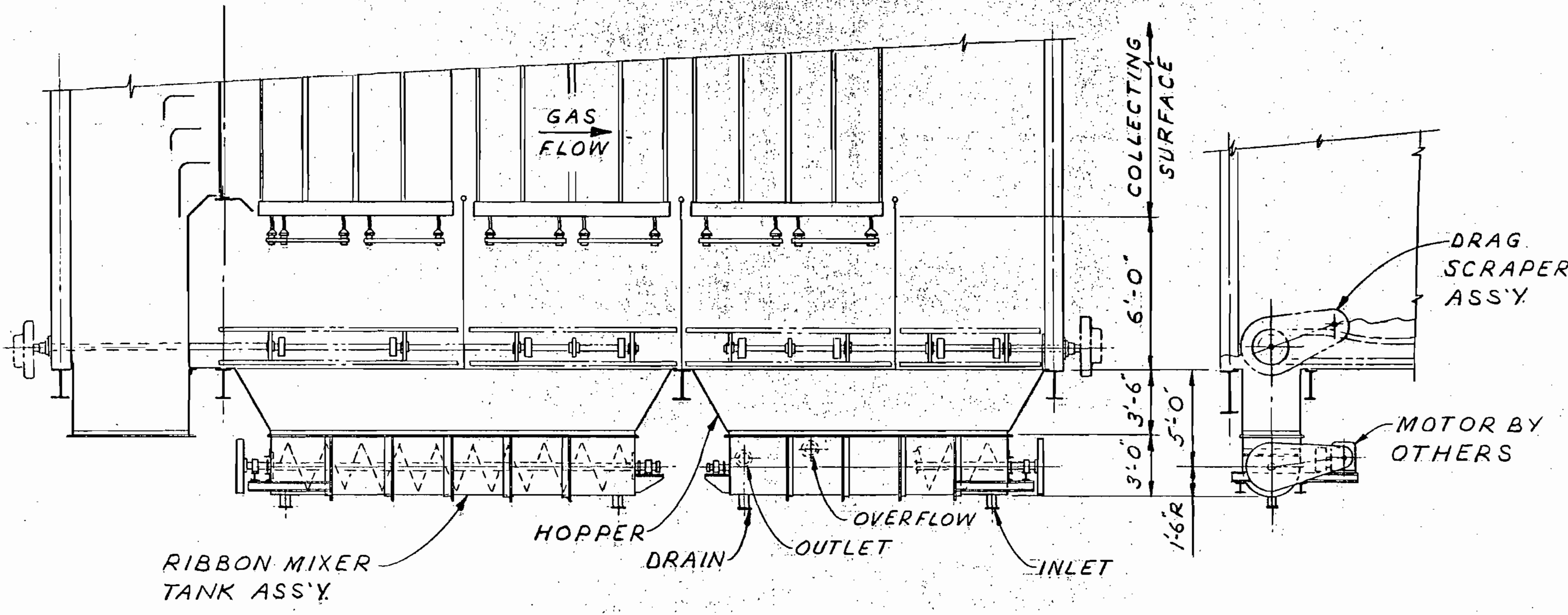
F.W.E. 1-76



ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

PNEUMATIC
RECIPROCATING RAPPER

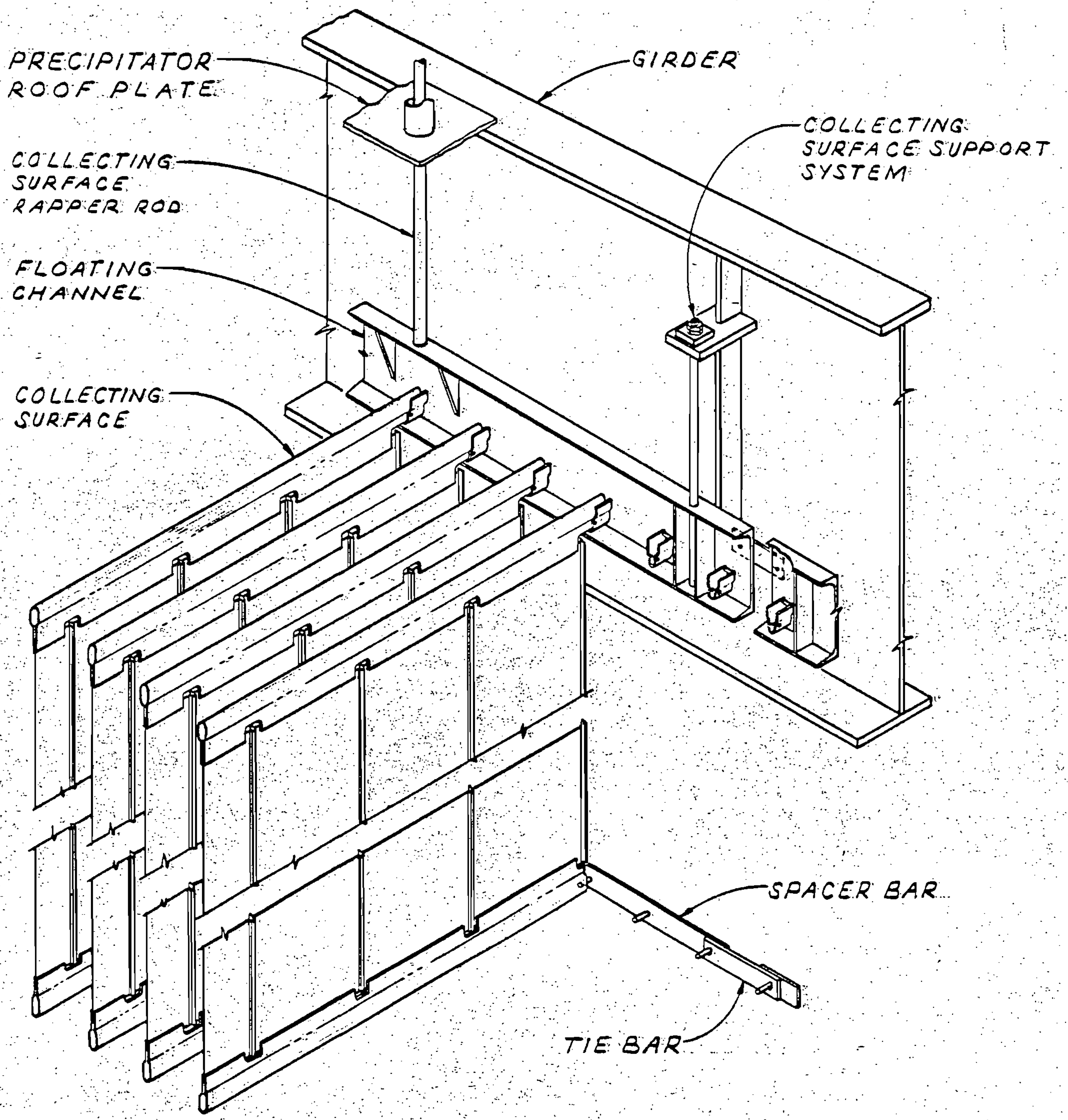
DWG. Nº 1030



ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

TYPICAL
RIBBON MIXER TANK
ARRANGEMENT

DWG. NO. 1027

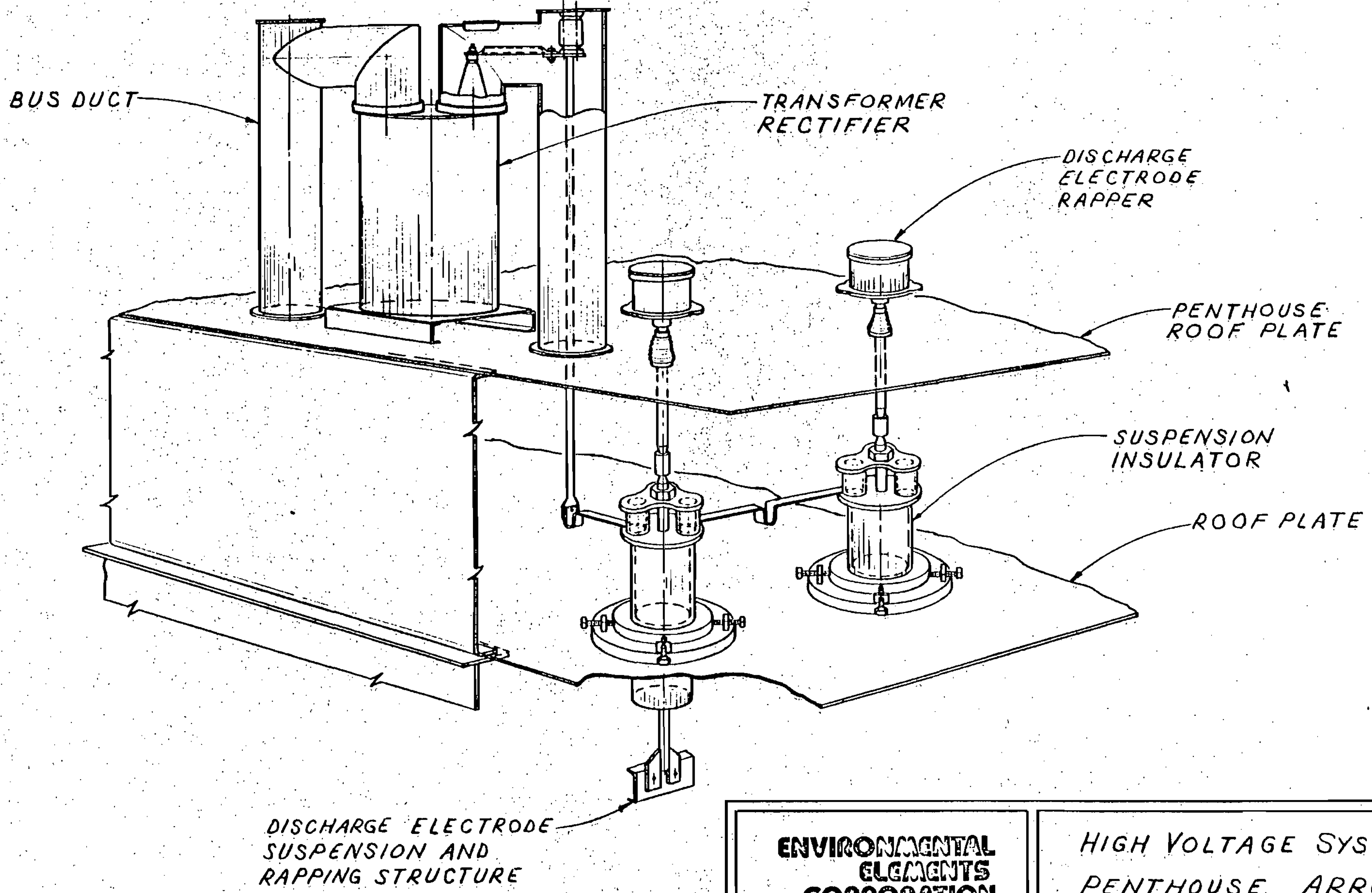


**ENVIRONMENTAL
ELEMENTS
CORPORATION**
Subsidiary of Koppers Company, Inc.

SUSPENSION ARRANGEMENT
ROLL-FORMED
COLLECTING SURFACE

DWG. NO. 1026

rme 1-76

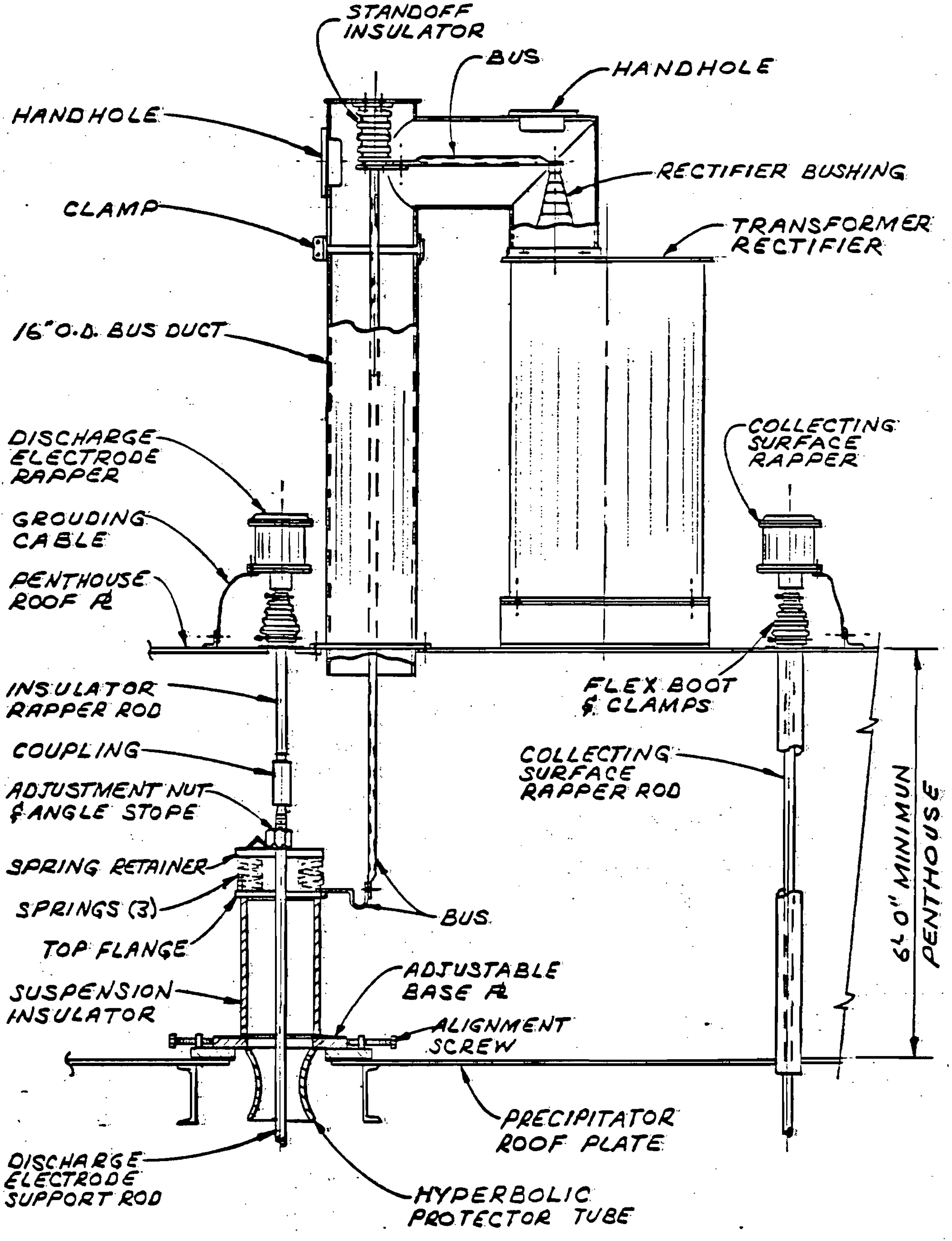


ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

HIGH VOLTAGE SYSTEM
PENTHOUSE ARRG'T.

DWG. NO. 1024A

F.M.E 1-76

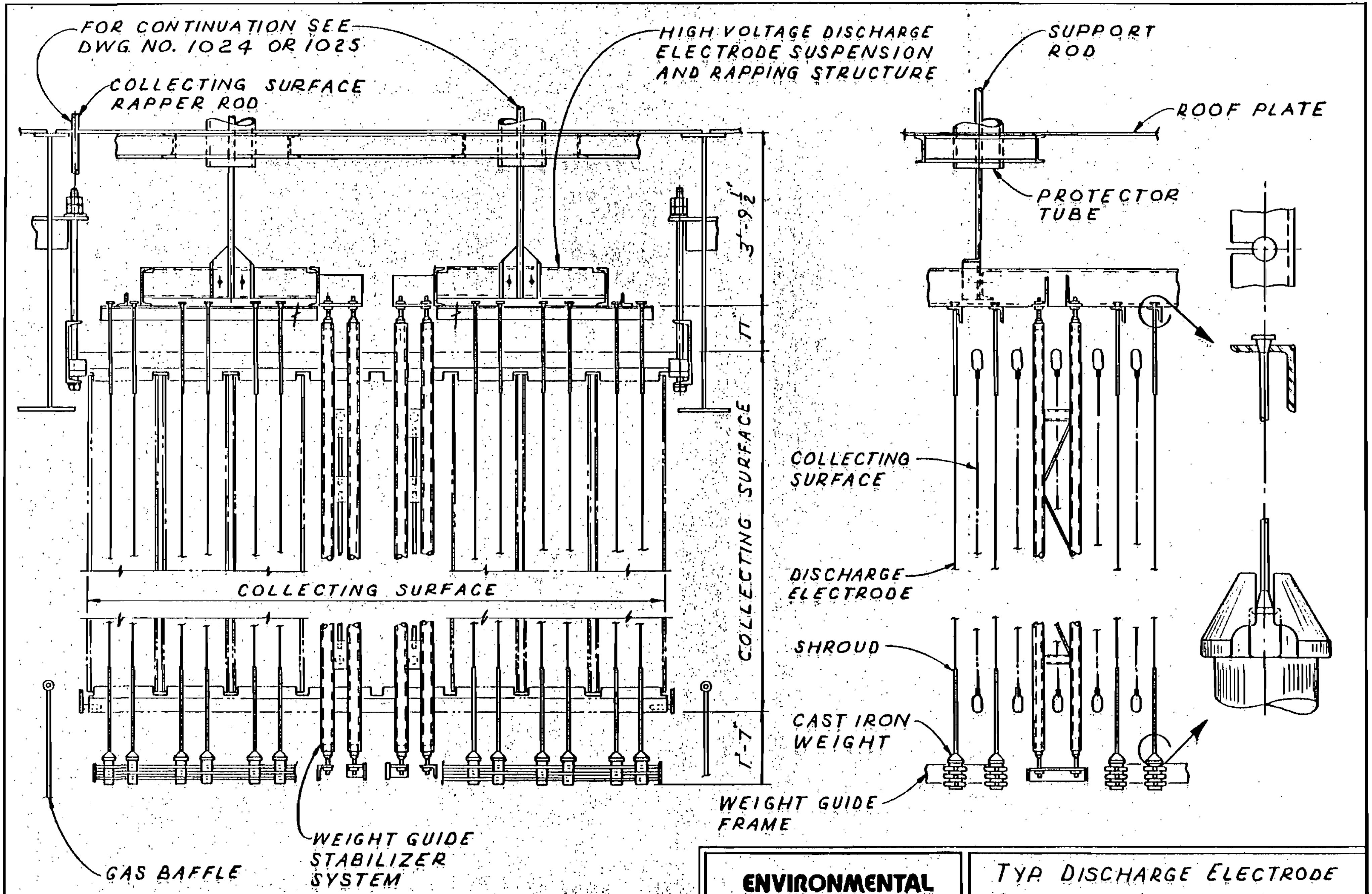


ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

HIGH VOLTAGE SYSTEM
PENTHOUSE ARR'G'T.

DWG. № 1024

F.W.E. 7-76

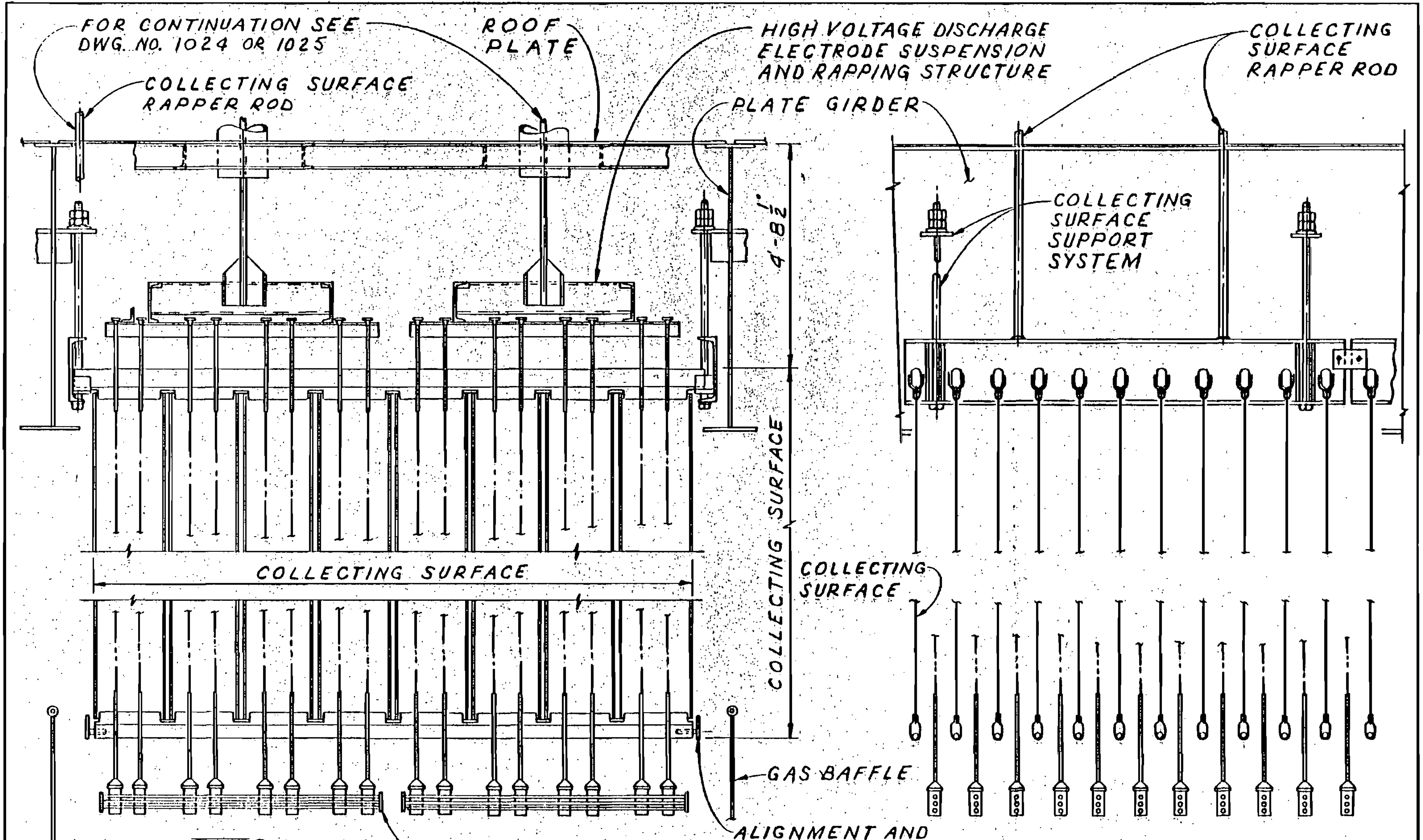


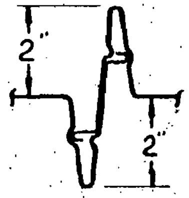
ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc

TYP DISCHARGE ELECTRODE SUPPORT ARRANGEMENT— DOUBLE ELECTRICAL FIELD

DWG. NO. 1023

F.W.E. 1-76





SECTION THRU PLATE

F.W.E. 1-76

ENVIRONMENTAL ELEMENTS CORPORATION
Subsidiary of Koppers Company, Inc.

TYP. COLLECTING SURFACE SUPPORT ARRANGEMENT - DOUBLE ELECTRICAL FIELD

DWG. NO. 1022

9. An application fee of $20, unless exempted by Section 17-4.05(3), F.A.C. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

Smelt Dissolving Tanks

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?
[XX] Yes [ ] No

Contaminant	Rate or Concentration
Particulate Matter	0.2 lb/ton black liquor solids (dry weight)
Total Reduced Sulfur	0.0168 lb/ton black liquor solids (dry weight)

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy) [XX] Yes [ ] No

Contaminant	Rate or Concentration
Particulate Matter	0.1 g/kg (0.2 lb/ton) black liquor solids
Total Reduced Sulfur	0.0084 g/kg (0.0168 lb/ton) black liquor solids

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration
Particulate Matter	0.2 lb/ton black liquor solids (dry weight)
Total Reduced Sulfur	0.0168 lb/ton black liquor solids (dry weight)
Sulfur Dioxide	Proper process control and wet scrubber

D. Describe the existing control and treatment technology (if any).

1. Control Device/System: See Item E
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:
5. Useful Life:
6. Operating Costs:
7. Energy:
8. Maintenance Cost:
9. Emissions:

Contaminant	Rate or Concentration

*Explain method of determining D 3 above.

10. Stack Parameters

a. Height: ft. b. Diameter: ft.

c. Flow Rate: ACFM d. Temperature: °F

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1. Particulate Matter/TRS

a. Control Device: Mist Eliminator Pad

b. Operating Principles: Fine wire mesh screen collects condensed gases, screen is backflushed with water sprays.

c. Efficiency*: 80 percent (literature) d. Capital Cost: $100,000 each

e. Useful Life: 20 years f. Operating Cost: $50,000/yr/scrubber

g. Energy*: 50 kw h. Maintenance Cost: $15,000/yr/scrubber

i. Availability of construction materials and process chemicals:

Good

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

Provides relatively low collection efficiency.

2. Particulate Matter/TRS

a. Control Device: Venturi Scrubber

b. Operating Principles: Exhaust gas stream is passed through throat or orifice where gas velocities are very high. Scrubbing liquid is introduced at throat, causing disposal and impaction and interruption of particulate matter. Cyclone or mist eliminator follows.

c. Efficiency*: 95 percent d. Capital Cost: $210,000 each

e. Useful Life: 5 to 10 years f. Operating Cost: $105,000/yr/scrubber

g. Energy**: 100 kw h. Maintenance Costs: $30,000/yr/scrubber

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

*Explain method of determining efficiency.

**Energy to be reported in units of electrical power — KWH design rate.

3. Particulate Matter/TRS

a. Control Device: Packed Tower

b. Operating Principles: Tower media provides substrate for scrubbing liquid disposal and contact with gases. Contact removes particulate, TRS, and SO_2 from gas stream.

c. Efficiency*: Up to 95 percent d. Capital Cost: $200,000 each

e. Life: 5 to 10 years f. Operating Cost: $100,000/yr/scrubber

g. Energy: 100 kw h. Maintenance Cost: $25,000/yr/scrubber

*Explain method of determining efficiency above.

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space and operate within proposed levels:

4. Particulate Matter/TRS

a. Control Device: Packed tower with mist eliminator

b. Operating Principles: Combined features of individual controls as described above.

c. Efficiency*: 92 to 98 (literature)

d. Capital Cost: $200,000 each

e. Life: 5 to 10 years

f. Operating Cost: $100,000/yr/scrubber

g. Energy: 100 kw

h. Maintenance Cost: $25,000/yr/scrubber

i. Availability of construction materials and process chemicals: Good. Freshwater needed.

j. Applicability to manufacturing processes: Good

k. Ability to construct with control device, install in available space, and operate within proposed levels: Good

F. Describe the control technology selected:

1. Control Device: Venturi Scrubber

2. Efficiency*: 95 percent (literature)

3. Capital Cost: $210,000 each

4. Life: 5 to 10 years

5. Operating Cost: $105,000/yr/scrubber

6. Energy: 100 kw

7. Maintenance Cost: $30,000/yr/scrubber

8. Manufacturer: Flex-kleen, or equivalent

9. Other locations where employed on similar processes: See Item F.10.

a.

(1) Company:

(2) Mailing Address:

(3) City:

(4) State:

(5) Environmental Manager:

(6) Telephone No.:

*Explain method of determining efficiency above.

(7) Emissions*:

Contaminant	Rate or Concentration

(8) Process Rate*:

b.

(1) Company:

(2) Mailing Address:

(3) City:

(4) State:

*Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

Particulate Matter

Smelt Dissolving Tanks (SDT) vent gases are controlled in existing kraft pulp mills primarily by mist eliminator pads or low pressure wet scrubbers. Wet scrubbers exhibit higher removal efficiencies, about 95 percent, than do the mist eliminators which only achieve about 80 percent efficiency. Wet scrubbers can be of the venturi, packed tower, or wet cyclonic type. These scrubbers also display similar capital and annual operating costs due to similar pressure drop (6 to 8 in H_2O), and water usage requirements.

Three federal BACT determinations are known to have been made for new smelt dissolving tanks. In all three of these (copies attached) the NSPS of 0.1 g/kg of black liquor solids fed (0.2 lb/ton) was determined to be BACT for particulate matter. All three achieved these levels through water scrubbing--two with venturi scrubbers and one with a wet impingement scrubber.

Based upon this information, and historic operation at the G-P Palatka mill, two (2) low energy wet venturi scrubbers identical to two now in operation at G-P in Palatka are proposed as BACT for particulate matter emissions (one for each smelt tank vent). The attached test results of these scrubbers show large fluctuations in the measured emission rates. The NSPS level of 0.2 lb/ton black liquor solids has been met on roughly half of the tests. It is believed that by maintaining better control over the operation of the scrubber (e.g., by installing a pressure drop indicator) the NSPS level can be continuously achieved.

Total Reduced Sulfur

Smelt dissolving tank TRS emissions are generally a function of process conditions. The presence of reduced sulfur compounds in the smelt or water feed may cause TRS emissions. The prime control method is the use of water that is low in dissolved sulfides. Therefore, the use of such water in the particulate control device is deemed the best available control technology, and will reduce TRS emissions from the smelt dissolving tanks to 0.0168 lb/ton of black liquor solids (dry weight) fed to the smelt tanks, or less. Of three BACT determinations known to be made to date on smelt dissolving tanks, two included emission limits for TRS. Both determinations resulted in the NSPS level of 0.0084 g/kg (0.0168 lb/ton) of black liquor solids fed (one expressed as 5 ppm TRS), with both achieved by wet scrubbing.

SMELT DISSOLVING TANKS OPERATION

SUMMARY OF PARTICULATE TEST RESULTS

Date	Allowable Emission* (lb/hr)	Smelt Input (lb/hr)	Black Liquor Solids Input† (lb/hr dry)	Measured Emission	
				(lb/hr)	(lb/ton BLS)
9/28/77	30.24	65,319	155,521	7.9	0.10
9/30/77	27.76	54,178	128,995	6.0	0.09
	30.07	63,047	150,112	5.8	0.08
03/78	31.78	89,153	212,269	47.5	0.45
	31.55	85,196	202,848	44.2	0.44
	29.09	58,424	139,105	43.5	0.63
09/78	28.60	56,845	135,345	8.8	0.13
	30.22	65,090	154,976	76.0	0.98
	30.35	66,860	159,190	7.2	0.09
03/79	--	--	--	--	--
	30.40	67,551	160,836	32.0	0.40
	30.08	63,228	150,543	17.6	0.23
09/79	30.80	73,302	174,529	12.6	0.14
	29.99	62,055	147,750	22.2	0.30
	29.99	62,055	147,750	12.1	0.16
03/80	30.50	68,952	164,171	22.0	0.27
	30.55	69,662	165,862	25.1	0.30
	30.50	68,952	164,171	19.2	0.23
09/80	30.34	66,722	158,862	15.1	0.19
	30.53	69,377	165,183	11.5	0.14
	30.38	67,274	160,176	29.7	0.37

* Based on Florida Process Weight Regulation: $E = 17.31\ P^{0.16}$ ($P > 30$ tons/hr).

† Based on 1 lb BLS = 0.42 lb smelt (industry average).

REFERENCES

1. PEDCo Environmental Specialists, Inc. October 1978. Operation and Maintenance of Particulate Control Devices in Kraft Pulp Mill and Crushed Stone Industries. EPA-600/2-78-210.

2. U.S. Environmental Protection Agency. January 1978. Draft Guideline Document: Control of TRS Emissions from Existing Kraft Pulp Mills. EPA-450/2-78-003a.

3. PEDCo Environmental Specialists, Inc. May 1980. Compilation of BACT/LAER Determinations, Revised. EPA-450/2-08-070.

SECTION VII – PREVENTION OF SIGNIFICANT DETERIORATION

Items A – C: See No. 5 Combination Boiler Application

A. Company Monitored Data

1. ________ no sites ________ TSP ________ ( ) SO^2* ________ Wind spd/dir

Period of monitoring ____/____/____ to ____/____/____
month day year month day year

Other data recorded ________

Attach all data or statistical summaries to this application.

2. Instrumentation, Field and Laboratory

a) Was instrumentation EPA referenced or its equivalent? ____ Yes ____ No

b) Was instrumentation calibrated in accordance with Department procedures? ____ Yes ____ No ____ Unknown

B. Meteorological Data Used for Air Quality Modeling

1. ____ Year(s) of data from ____/____/____ to ____/____/____
month day year month day year

2. Surface data obtained from (location) ________

3. Upper air (mixing height) data obtained from (location) ________

4. Stability wind rcse (STAR) data obtained from (location) ________

C. Computer Models Used

1. ________ Modified? If yes, attach description.

2. ________ Modified? If yes, attach description.

3. ________ Modified? If yes, attach description.

4. ________ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables.

D. Applicants Maximum Allowable Emission Data

Pollutant	Emission Rate
TSP	See Section III.C grams/sec.
SO^2	See Section III.C grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description on point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time.

F. Attach all other information supportive to the PSD review.

*Specify bubbler (B) or continuous (C).

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources.

Enhanced social and economic benefits are expected as a result of employing the selected technologies

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology.

LIME KILN

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Lime Kiln No. 5 ☒ New[1] ☐ Existing[1]

APPLICATION TYPE: ☒ Construction ☐ Operation ☐ Modification

COMPANY NAME: Georgia-Pacific Corporation COUNTY: Putnam

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peeking Unit No. 2, Gas Fired) Lime Kiln No. 5 with Venturi Scrubber

SOURCE LOCATION: Street N of SR 216, W of US 17 City Palatka

UTM: East 434.0 North 3283.4

Latitude 29 ° 41 ' 00 "N Longitude 81 ° 40 ' 45 "W

APPLICANT NAME AND TITLE: Roger C. Sherwood, Technical Director

APPLICANT ADDRESS: P.O. Box 919 Palatka, Florida 32077

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Georgia-Pacific Corporation

I certify that the statements made in this application for a Construction permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: Roger C. Sherwood
Roger C. Sherwood, Technical Director
Name and Title (Please Type)
Date: 6-2-81 Telephone No. 904/325-2001

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed: David A. Buff
David A. Buff
Name (Please Type)
Environmental Science and Engineering, Inc.
Company Name (Please Type)
P.O. Box ESE, Gainesville, Florida 32604
Mailing Address (Please Type)
Date: 6-2-81 Telephone No. 904/372-3318

(Affix Seal)

Florida Registration No. 19011

---

[1] See Section 17-2.02(15) and (22), Florida Administrative Code, (F.A.C.)

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

A new 320 ton/day Lime Kiln, No. 5 , with a high energy venturi scrubber, will be constructed. The project will result in full compliance with all applicable emission and air quality control regulations.

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction September 1982 Completion of Construction 1985

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

Scrubber - $300,000

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

Not Applicable

E. Is this application associated with or part of a Development of Regional Impact (DRI) pursuant to Chapter 380, Florida Statutes, and Chapter 22F-2, Florida Administrative Code? ____ Yes X No

F. Normal equipment operating time: hrs/day 24 ; days/wk 7 ; wks/yr 51 ; if power plant, hrs/yr ____ ;

if seasonal, describe:

G. If this is a new source or major modification, answer the following questions. (Yes or No)

1. Is this source in a non-attainment area for a particular pollutant?	No
a. If yes, has "offset" been applied?	--
b. If yes, has "Lowest Achievable Emission Rate" been applied?	--
c. If yes, list non-attainment pollutants. --	
2. Does best available control technology (BACT) apply to this source? If yes, see Section VI.	Yes
3. Does the State "Prevention of Significant Deterioriation" (PSD) requirements apply to this source? If yes, see Sections VI and VII.	Yes
4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source?	Yes
5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source?	No

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
$CaCO_3$ (dry)	Particulate	10	47,619	A
Inerts	Particulate	10	2,964	A
Recycle $CaCO_3$	Particulate		11,906	B
Recycle Inerts	Particulate		740	B

B. Process Rate, if applicable: (See Section V, Item 1)

1. Total Process Input Rate (lbs/hr): 63,229

2. Product Weight (lbs/hr): 26,667

C. Airborne Contaminants Emitted:

Name of Contaminant	Emission[1]		Allowed Emission[2] Rate per Ch. 17-2, F.A.C.	Allowable[3] Emission lbs/hr	Potential Emission[4]		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/hr	T/yr	
Particulate	29.3	125.5	NA	29.3*	2,250	9,855	C
Sulfur Dioxide	10.0	42.8	NA	NA	15.0	66	C
Nitrogen Oxides	93.8	402.0	NA	NA	93.8	411	C
VOC	24.0	102.8	NA	NA	27.3	120	C
Carbon Monoxide	500.0	2,142.0	NA	NA	500.0	2,190	C
Total Reduced Sulfur	1.1	4.7	NA	1.1*	37.5	164.3	

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles[5] Size Collected (in microns)	Basis for Efficiency (Sec. V, It5
High Energy Venturi	Particulate	99.7	Submicron	See Attach-
Scrubber, Zurn, or				ment B
equivalent				

* Based upon Federal NSPS.

[1] See Section V, Item 2.

[2] Reference applicable emission standards and units (e.g., Section 17-2.05(6) Table II, E. (1), F.A.C. – 0.1 pounds per million BTU heat input)

[3] Calculated from operating rate and applicable standard

[4] Emission, if source operated without control (See Section V, Item 3)

[5] If Applicable

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
No. 6 Fuel Oil	16.6	16.6	102

*Units Natural Gas, MMCF/hr; Fuel Oils, barrels/hr; Coal, lbs/hr

Fuel Analysis:

Percent Sulfur: 2.5 Percent Ash: 0.1

Density: 7.9 lbs/gal Typical Percent Nitrogen: 0

Heat Capacity: 18,500 BTU/lb 146,000 BTU/gal

Other Fuel Contaminants (which may cause air pollution):

F. If applicable, indicate the percent of fuel used for space heating. Annual Average NA Maximum NA

G. Indicate liquid or solid wastes generated and method of disposal.

Scrubber water reused in process

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: 149 ft. Stack Diameter: 4.33 ft.

Gas Flow Rate: 48,250 ACFM Gas Exit Temperature: 170 °F.

Water Vapor Content: 40 % Velocity: 57 FPS

SECTION IV: INCINERATOR INFORMATION

Not Applicable

Type of Waste	Type O (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq & Gas By-prod.)	Type VI (Solid By-prod.)
Lbs/hr Incinerated							

Description of Waste

Total Weight Incinerated (lbs/hr) Design Capacity (lbs/hr)

Approximate Number of Hours of Operation per day days/week

Manufacturer

Date Constructed Model No.

	Volume (ft)^3	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ________ ft. Stack Diameter ________ Stack Temp. ________

Gas Flow Rate: ________ ACFM ________ DSCFM* Velocity ________ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner [ ] Other (specify) ________

Brief description of operating characteristics of control devices: ________

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight — show derivation.

   See Attachment A.

2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.,) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.

   See Attachment A.

3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).

   See Attachment A.

4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, etc.).

   See Attachment B

5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3, and 5 should be consistent: actual emissions = potential (1-efficiency).

   See Attachment B

6. An 8½" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.

   See Attachment B

7. An 8½" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).

   See PSD report.

8. An 8½" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

   See Combination Boiler #5 Application.

ATTACHMENT A

EMISSIONS ESTIMATES

A. Total Process Product Rate and Input Rate Calculation

1. Assume 20 percent recirculation rate (i.e., only 80 percent of wet end feed will exit as product and 20 percent will be carried out by flue gas and captured by the venturi scrubber). This recycle rate is based on the experience of Rust Engineering Company.

2. The product is 90 percent available lime. This is based on laboratory test results.

3. Basic Equation:

$$\underset{MW=100}{\overset{1.0\#}{CaCO3}} \xrightarrow{Heat} \underset{MW=56}{\overset{0.56\#}{CaO}} + \underset{MW=44}{\overset{0.44\#}{CO2}}$$

4. Total Process Input Rate = 758.7 tons/day = 63,229 lb/hr

5. Basic Equation at 90 percent CaO with Feed Rate of 63,229 lb/hr

$$\underbrace{\overset{3,704\#}{Inerts} + \overset{59,525\#}{CaCO_3}}_{Feed} \longrightarrow \underbrace{\overset{33,334\#}{CaO} + \overset{3,704\#}{Inerts}}_{Product} + \overset{26,191\#}{CO_2}$$

6. Basic Equation at 90 percent CaO with 20 percent Scrubber Capture Recirculation

$$\underbrace{\overset{2,964\#}{Inert} + \overset{740\#}{Inert} + \overset{47,619\#}{CaCO3} + \overset{11,906\#}{CaCO3}}_{Feed} \longrightarrow \underbrace{\overset{26,667\#}{CaO} + \overset{2,964\#}{Inert}}_{Product} + \overset{6,667\#}{CaO} + \overset{5,239\#}{CO_2} + \overset{740\#}{Inert} + \overset{20,952\#}{CO_2}$$

7. Therefore, Product Rate:

26,667 lb/hr = 13.33 tons/hr CaO = 320 tons/days

B. Particulate Matter

Maximum and actual emissions based upon NSPS of 0.13 gr/dscf when liquid fossil fuel is burned. Based on No. 4 lime kiln operation:

26,300 dscfm x 60 x 0.13 ÷ 7,000 = 29.31 lb/hr

Florida process weight regulation: Rate = 63,229 lb/hr ÷ 2,000 = 31.6 tons/hr

$E = 17.31\ P^{0.16}$ = 30.1 lb/hr

NSPS is more stringent.

Actual emissions = 29.3 lb/hr x 24 x 7 x 51 ÷ 2,000 = 125.5 tons/yr

Potential emissions from AP-42, Table 10.1.2-1 (untreated) = 45 lb/ton of air dried unbleached pulp (ADUP). From No. 4 recovery boiler application, unbleached pulp = 150,000 ÷ 3,000 = 50 tons/hr

50 tons/hr x 45 lb/ton = 2,250 lb/hr = 9,855 tons/yr

C. Sulfur Dioxide

Maximum and actual emissions from AP-42, Table 10.1.2-1, with scrubber = 0.2 lb/ton ADUP

50 tons/hr x 0.2 = 10 lb/hr

Actual emissions = 10 x 24 x 7 x 51 ÷ 2,000 = 42.8 tons/yr

Potential emissions from AP-42 without scrubber: 0.3 lb/ton

50 x 0.3 = 15 lb/hr = 65.7 tons/yr

D. Nitrogen Oxides

From TAPPI Conference paper, using largest emission rate for oil firing factor = 0.92 lb/10^6 Btu

Heat input (maximum) = 102 x 10^6 Btu/hr x 0.92 = 93.8 lb/hr

Actual emissions = 93.8 x 24 x 7 x 51 ÷ 2,000 = 402 tons/yr

Potential emissions = 93.8 lb/hr = 410.8 tons/yr

E. VOC

From TAPPI Conference paper, use highest reported emission rate after scrubber, 1.8 lb/ton line produced.

Maximum emissions = 320 tons/day ÷ 24 x 1.8 = 24 lb/hr

Actual emissions = 320 x 1.8 x 7 x 51 ÷ 2,000 = 102.3 tons/yr

For potential emissions, use highest factor before scrubber, 2.05 lb/ton

320 x 2.05 ÷ 24 = 27.3 lb/hr = 119.7 tons/yr

F. Carbon Monoxide

From AP-42, factor is 10 lb/ton ADUP both before and after scrubber.

Maximum emissions = 50 x 10 = 500 lb/hr

Actual emissions = 500 x 24 x 7 x 51 ÷ 2,000 = 2,142 tons/yr

Potential emissions = 500 x 8,760 ÷ 2,000 = 2,190 tons/yr

G. Total Reduced Sulfur

Maximum emissions: Federal NSPS = 8 ppm, dry basis

MW H_2S = 34, 8 ppm = 11,125 ug/m^3

26,300 dscfm x $(0.3048)^3$ m^3/ft^3 x 60 x 11,125 x 10^{-6} ÷ 454 = 1.1 lb/hr

Actual emissions = 1.1 lb/hr x 24 x 7 x 51 ÷ 2,000 = 4.71 ton/yr

For potential emissions, use AP-42 factor for H_2S and reduced sulfur compounds for untreated emissions:

50 tons/hr x 0.75 = 37.5 lb/hr = 164.3 tons/yr

9. An application fee of $20, unless exempted by Section 17-4.05(3), F.A.C. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?
[X] Yes [ ] No

Contaminant	Rate or Concentration
Particulate Matter	0.13 gr/dscf when burning liquid fuel
Total Reduced Sulfur	8 ppm by volume (dry basis)

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy) [ ] Yes [ ] No

Contaminant	Rate or Concentration
Particulate Matter	0.21 gr/dscm (0.091 gr/dscf) @ 10% O_2
Total Reduced Sulfur	8 ppm @ 10 percent O_2

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration
Particulate Matter	0.13 gr/dscf when burning liquid fuel
Total Reduced Sulfur	8 ppm by volume (dry basis)
All other pollutants	Proper kiln design and operation

D. Describe the existing control and treatment technology (if any).

1. Control Device/System: See Item E.
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:
5. Useful Life:
6. Operating Costs:
7. Energy:
8. Maintenance Cost:
9. Emissions:

Contaminant	Rate or Concentration

*Explain method of determining D 3 above.

10. Stack Parameters

a. Height: ft. b. Diameter: ft.

c. Flow Rate: ACFM d. Temperature: °F

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1. Particulate Matter/TRS/SO_2

a. Control Device: Venturi Scrubber with caustic scrubbing water

b. Operating Principles: Gases are passed through throat where high velocities occur and scrubbing solution is introduced. Droplets disperse and impact and scrub particulate and gases. Mist eliminator section generally follows.

c. Efficiency*: 99+ percent d. Capital Cost: $300,000

e. Useful Life: 5 to 10 years f. Operating Cost: $150,000/year (includes depreciation)

g. Energy*: 100 kw h. Maintenance Cost: $50,000/year

i. Availability of construction materials and process chemicals:
Good.

j. Applicability to manufacturing processes: Excellent.

k. Ability to construct with control device, install in available space, and operate within proposed levels:
Good. Has demonstrated compliance with NSPS.

2.

a. Control Device:

b. Operating Principles:

c. Efficiency*: d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy**: h. Maintenance Costs:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

*Explain method of determining efficiency.

**Energy to be reported in units of electrical power — KWH design rate.

3.

a. Control Device:

b. Operating Principles:

c. Efficiency*: d. Capital Cost:

e. Life: f. Operating Cost:

g. Energy: h. Maintenance Cost:

*Explain method of determining efficiency above.

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space and operate within proposed levels:

4.

a. Control Device

b. Operating Principles:

c. Efficiency*: d. Capital Cost:

e. Life: f. Operating Cost:

g. Energy: h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected: See Item E.I. and Attachment B.

1. Control Device:

2. Efficiency*: 3. Capital Cost:

4. Life: 5. Operating Cost:

6. Energy: 7. Maintenance Cost:

8. Manufacturer:

9. Other locations where employed on similar processes:

a.

(1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

*Explain method of determining efficiency above.

(7) Emissions*:

Contaminant	Rate or Concentration
See Attachment B	

(8) Process Rate*:

b.

(1) Company:

(2) Mailing Address:

(3) City: (4) State:

*Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions*:

Contaminant	Rate or Concentration

(8) Process Rate*:

10. Reason for selection and description of systems:

See following pages.

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*Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

Particulate emissions from most lime kilns at pulp mills are controlled by venturi scrubbers, with pressure drops ranging from 10 inches (in) to 25 in H_2O. A few kilns utilize wet impingement scrubbers, but these generally obtain lower efficiencies. ESP's have been reported to be utilized in Sweden and on a retrofit installation in the United States. Fabric filters cannot be used because of the high moisture content, 25 to 35 percent, in the the exhaust gases. Because of the proven operation of the venturi scrubber in general, and at G-P's Palatka mill in specific (see Attachment B), the venturi scrubber was chosen as BACT. The scrubber will be identical to the one presently in operation at G-P.

Only three BACT determinations are known to have been made to date on lime kilns in the Kraft pulp mill industry. One of 0.21 g/dscm at 10 percent O_2, which is equivalent to 0.091 gr/dscf. This is below the NSPS level of 0.13 gr/dscf. A venturi scrubber with 97 percent efficiency was utilized. In the second, only a mass emission loading was given, with a venturi scrubber with 28 to 30 in H_2O pressure drop and 99.8 percent efficiency specified. In the third, an emission level of 0.12 gr/dscf when burning oil was specified. A venturi scrubber was again chosen as the control technique.

The existing No. 4 lime kiln at G-P presently employs a venturi scrubber with 26 in H_2O pressure drop. The vendor has guaranteed 99.7 percent efficiency on this unit, and calculations show a 98.7 percent efficiency based on AP-42 uncontrolled emission factors. Test data for this scrubber show that the NSPS level of 0.13 gr/dscf has been achieved the majority of the time. However, several individual tests resulted in levels up to 0.20 gr/dscf. Based on the historical test data for this unit at G-P and because the scrubber efficiency is nominally greater than 99 percent, this same scrubber with 26 in pressure drop is chosen as BACT and the NSPS level of 0.13 gr/dscf is proposed as an emission limit.

Because of the extremely low estimated SO_2 emissions from the lime kiln, no add-on SO_2 controls or further reduction in SO_2 levels is deemed appropriate. The maximum estimated SO_2 emission rate is proposed as BACT, considering the effects of SO_2 removal in the kiln and caustic scrubber water.

Little information is available concerning NO_x control techniques for lime kilns at Kraft pulp mills. In the recent NCASI paper (see Combination Boiler application), no correlation was found between NO_x emissions and type of fuel burned (oil or gas). However, a correlation between combustion zone temperature or burned lime temperature and NO_x was found. This is not an unexpected result. As combustion zone temperature increased, so did NO_x emissions in lb/10^6 Btu heat input. This correlation was only investigated for a gas-fired unit. It was theorized that controlling the excess air level and firing rate could reduce combustion temperature and therefore NO_x emissions. Based on this limited data, good firing and operational practices are proposed as BACT for the lime kiln for NO_x. No feasible add-on controls are known to exist for NO_x.

Similarly, little information exists on VOC or CO emissions or control techniques. The NCASI paper demonstrated that VOC emissions from lime kilns are likely due to organics contained in the water used in the process. A wet scrubber was found to reduce VOC emissions slightly in two cases and increase emissions slightly in one case. BACT for both VOC and CO emissions are proposed as good firing and operational practices consistent with product quality.

As described in the preamble to the final NSPS for Kraft pulp mills (Federal Register, Vol. 43, No. 37, February 23, 1978), the NSPS limit for TRS is based on operation at one lime kiln in the United States. This kiln was the only kiln using a combination of efficient mud washing, good lime kiln process operation, and caustic scrubbing. Due to the limited and site specific data utilized to promulgate the NSPS, these control techniques for TRS emissions are considered to represent BACT, with a BACT limit equal to the Federal NSPS of 8 ppm by volume dry basis. This limit is equivalent to approximately 1 lb/hr of TRS emissions. The proposed BACT for the lime kiln is also supported by the final guideline document for TRS emissions from existing Kraft pulp mills. In addition, in the only two BACT determinations for TRS from lime kilns known to date, the NSPS level of 8 ppm was determined to be BACT in both cases.

REFERENCES

1. Dallons, V.J., and Simon, C. Volatile Organic Compound Emissions From Pacific Northwest Pulp and Paper Industry Combustion Sources. NCASI paper presented at 1981 TAPPI Environmental Conference, New Orleans, La.

2. Environmental Specialists. October 1978. Operation and Maintenance of Particulate Control Devices in Kraft Pulp Mill and Crushed Store Industries, PEDC. EPA-600/2-78-210.

3. Final Guideline Document: Control of TRJ Emissions from Existing Kraft Pulp Mills. U.S. EPA, EPA-450/2-78-003b, 1978.

4. Hood, K.T., and Miner, R.A. Nitrogen Oxide Emissions from Combustion Services in the Pulp and Paper Industry. Paper presented at 1981 TAPPI Environmental Conference, New Orleans, La.

5. NO_x Emissions from Combustion Services in the Pulp and Paper Industry. Hood, K.T. and Miner, R.A. NCASI. Paper presented at 1981 TAPPI Environmental Conference, New Orleans, La.

6. Operation and Maintenance of Particulate Control Devices in Kraft Pulp Mill and Crushed Stone Industries, PEDC. Environmental Specialists. EPA-600/2-78-210, October 1978.

7. U.S. Environmental Protection Agency. 1978. Final Guideline Document: Control of TRS Emissions from Existing Kraft Pulp Mills. EPA-450/2-78-003b.

8. Volatile Organic Compound Emissions from Pacific Northwest Pulp and Paper Industry Combustion Sources. Dallons, V.J. and Simon, C. NCASI. Paper presented at 1981 TAPPI Environmental Conference, New Orleans, La.

9. Compilation of BACT/LAER Determinations, Revised. PEDCo Environmental Specialists, Inc. May 1980.

ATTACHMENT B

LIME KILN BACT INFORMATION

Efficiency of scrubber required

Maximum emissions at NSPS = 29.31 lb/hr (Attachment A)

Potential emissions = 2,250 lb/hr (based on AP-42)

Required efficiency = (2,250 - 29.31) ÷ 2,250 x 100 = 98.7%

For this scrubber, Zurn has guaranteed outlet at 28.8 lb/hr

Guaranteed efficiency = (2,250 - 28.8) ÷ 2,250 x 100 = 98.7%

Based on design grain loadings (gr/dscf)

Guaranteed efficiency = (45.69 - 0.11) ÷ 45.69 x 100 = 99.7%

PARTICULATE TEST RESULTS--LIME KILN NO. 4 SCRUBBER

Date	Process Weight (tons/hr)	Allowable Emission (lb/hr)	Actual Emission (lb/hr)	Flow Rate (dscfm)	Grain Loading (gr/dscf)
05/76	20.18	23.3	16.6	--	--
	19.52	22.7	17.2	--	--
	21.16	23.8	14.7	--	--
12/13/76	20.03	23.0	19.8	--	--
12/15/76	14.19	18.3	10.4	--	--
12/29/76	20.39	23.3	8.3	--	--
	21.33	23.9	8.9	--	--
06/08/77	39.45	31.2	11.9	--	--
	35.76	30.7	16.4	--	--
06/09/77	34.86	30.6	13.2	--	--
02/78	28.42	28.6	18.4	25,161	0.085
	29.72	29.4	13.9	24,775	0.065
	27.31	27.9	15.2	24,491	0.072
06/78	28.58	28.7	24.9	22,058	0.132
	25.90	27.0	20.6	19,215	0.125
	26.37	27.3	19.3	14,754	0.153
02/79	32.41	30.2	20.5	23,262	0.103
	32.41	30.2	19.6	22,241	0.103
	32.41	30.2	22.7	17,755	0.149
06/79	--	--	--	20,673	--
	30.21	29.7	18.6	20,670	0.105
	40.53	31.3	11.7	21,334	0.064
12/79	40.53	31.3	42.4	24,079	0.205
	40.53	31.3	19.6	23,701	0.096
	49.33	32.3	17.4	22,208	0.091
06/80	--	--	--	24,833	--
	31.75	30.1	28.1	23,401	0.140
	34.48	30.5	29.5	22,043	0.156
12/80	34.48	30.5	26.3	21,895	0.140
	37.40	30.9	30.8	26,262	0.137
	33.09	30.3	19.8	23,219	0.099

10.1

BACT/LAER CLEARINGHOUSE REPORT

SOURCE TYPE/SIZE: Pulp Mill

NAME/ADDRESS: Boise Cascade St. Helens, Oregon

DETERMINATION DATA: CONDITIONAL/[✓ FINAL]/PENDING for BACT/LAER on NEW/[✓ MODIFIED] SOURCE

KEY DATES: Application-Recd._______, Completed________; Determination-Proposed________, Final 8/10/78

BY: (Agency) EPA Region X Person Paul Boys Phone________

AFFECTED FACILITIES	THROUGHPUT CAPACITY	EMISSION RATE* -UNCONTROLLED	EMISSION LIMITS (Basis)**	CONTROL STRATEGY DESCRIPTION Equipment type, etc.	Eff.
Lime kiln	960T/D@30% H_2O	PM	0.21 g/dscm @10% O_2 (B	Venturi scrubber	97
		CO	4500 ppm@10% 02		
		TRS	8 ppm @ 10% 02 (B)		
		NOx	270 ppm @ 10% 02		

SOURCE OPERATION: BATCH/CONTINUOUS:________hrs/yr; % by Season______ W ______ Sp ______ Su ______ F

NOTES:

* Specify pollutant (PM, SO_2, NO_x, HC, CO or other) and mass emission rate

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, A = Achieved-in-Practice (AIP)

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Rev. 5/80

10.1

BACT/LAER CLEARINGHOUSE REPORT

SOURCE TYPE/SIZE: SEMICHEMICAL/KRAFT PULP MILL: 2194 TAD/D

NAME/ADDRESS: INTERNATIONAL PAPER COMPANY, PO BOX 160707, MOBILE, ALABAMA 36616

DETERMINATION DATA: CONDITIONAL/FINAL/PENDING for [✓ BACT]/LAER on NEW/MODIFIED SOURCE

KEY DATES: Application-Recd.________, Completed________; Determination-Proposed________, Final________

BY: (Agency) U.S. EPA REGION VI Person________ Phone________

AFFECTED FACILITIES Power boilers(2)contd	THROUGHPUT CAPACITY	EMISSION RATE* -UNCONTROLLED	EMISSION LIMITS (Basis)**	CONTROL STRATEGY DESCRIPTION Equipment type, etc.	Eff. %
		CO	i 130 lb/hr, and 0.17		
			lb/10^6 Btu,-1 lb/ton coal,		
			2 lb/ton wood and		
			210 lb/10^3 bbl oil.		
Lime Kiln		SO_2	29.9 lb/h (B)	Fires 0.7% S oil max. natural	
				suppression by quicklime	
				absorption, and caustic solu-	
				tion in TSP scrubber	
		CO	700 lb/h (B)	Good process controls	

SOURCE OPERATION: BATCH/CONTINUOUS:________hrs/yr; % by Season ____ W ____ Sp ____ Su ____ F

NOTES:

* Specify pollutant (PM, SO_2, NO_x, HC, CO or other) and mass emission rate

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, A = Achieved-in-Practice (AIP)

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BACT/LAER CLEARINGHOUSE REPORT

10.1

SOURCE TYPE/SIZE: SEMICHEMICAL/KRAFT PULP MILL: 2194 TAD/D

NAME/ADDRESS: INTERNATIONAL PAPER COMPANY, PO BOX 160707, MOBILE, ALABAMA 36616

DETERMINATION DATA: CONDITIONAL/FINAL/PENDING for BACT/LAER on NEW/MODIFIED SOURCE

KEY DATES: Application-Recd.________, Completed________; Determination-Proposed________, Final________

BY: (Agency) U.S. EPA REGION VI Person________ Phone________

AFFECTED FACILITIES Lime kiln (contd)	THROUGHPUT CAPACITY	EMISSION RATE* -UNCONTROLLED	EMISSION LIMITS (Basis)**	CONTROL STRATEGY DESCRIPTION Equipment type, etc.	Eff. %
		PM	61.1 lb/h (B)	Venturi scrubber with 28-30"	99.8
				pressure drop.	
		TRS	8 ppmv, dry, at 10% (N)	Good process controls and	
			O_2	incineration	
Dissolving Tanks (2)		PM	11.3 lb/h ea, and (N)	Water/fume impingement wet	99.8
			0.1 g/kg black liquor	scrubber	
			solids		
		TRS	5 ppmv, dry, at 8% (N)	Good process controls.	
			O_2		
Lime Slaker		PM	2 lb/h (B)	Water/fumeimpingement wet scrubber	99.5

SOURCE OPERATION: BATCH/CONTINUOUS:________hrs/yr; % by Season ______ W ______ Sp ______ Su ______ F

NOTES:

* Specify pollutant (PM, SO_2, NO_x, HC, CO or other) and mass emission rate

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, A = Achieved-in-Practice (AIP)

10.1

BACT/LAER CLEARINGHOUSE REPORT

Page 1 of 3 pages

SOURCE TYPE/SIZE: KRAFT PULP MILL PULPING CAPACITY 1034 TONS/DAY

NAME/ADDRESS: BOISE CASCADE, P.O. BOX 500, WALLULA, WA 99363

DETERMINATION IS: CONDITIONAL/FINAL/PENDING: DATE OF ISSUE: 2/24/78 BASIS:* BACT[1]/LAER/[✓ BACT[2]]
FOR NEW/MODIFIED SOURCE

BY EPA REGION X (Agency) LARRY SIMS AND PAUL BOYS (Person) (206) 442-1106 (Phone)

PERMIT PARAMETERS:

AFFECTED FACILITIES	THROUGHPUT CAPACITY, weight rate	POLLUTANT(S) EMITTED	EMISSION LIMIT(S) AND BASIS FOR**	CONTROL STRATEGY DESCRIPTION	
				Equipment type, etc.	Eff.,%
Recovery boiler (No.2)	238 ADT/day feed or 738,000[a]	TSP	0.44 gr/scf/476 lb/day (N)	ESP	99.5
		SO_2	160 ppm/5424 lb/day (B)	Impinger type wet scrubber	95
		Opacity	35% (N)		
Lime kiln	544 tons/day or 847 ADT	TSP (gas)	0.067 gr/scf/466 lb/day (B)	Venturi scrubber	

NOTES: [a] Pounds black liquor dry solids/day; ADT means Air Dried Tons.
Where no NSP requirement, state standards apply for opacity - 20%

* Circle one. BACT-1 indicates determination made under pre-1977 amendments; BACT-2 indicates post-1977 amendments to CAA.

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, L = LAER, P = PSD Increment

10.1

BACT/LAER CLEARINGHOUSE REPORT

Page 2 of 3 pages

SOURCE TYPE/SIZE: KRAFT PULP MILL PULPING CAPACITY 1034 TONS/DAY

NAME/ADDRESS: BOISE CASCADE, P.O. BOX 500, WALLULA, WA 99363

DETERMINATION IS: CONDITIONAL/FINAL/PENDING: DATE OF ISSUE: 2/24/78 BASIS:* BACT^1/LAER/[✓ BACT^2]
FOR NEW/MODIFIED SOURCE

BY EPA REGION X (Agency) LARRY SIMS AND PAUL BOYS (Person) (206) 442-1106 (Phone)

PERMIT PARAMETERS: AFFECTED FACILITIES	THROUGHPUT CAPACITY, weight rate	POLLUTANT(S) EMITTED	EMISSION LIMIT(S) AND BASIS FOR**	CONTROL STRATEGY DESCRIPTION Equipment type, etc.	Eff.,%
Lime kiln (continued)		TSP (oil)	0.12 gr/scf/906 lb/day (B)		
		Opacity	20% (S)		
		SO_2	5 ppm/19 lb/day (B)		
No.2 Dissolver vent	253 ADT	TSP	71 lb/day (N)	Chemico-type scrubber	
		Opacity	20% (S)		
Decker hood	200 ADT	TSP	0.01 ADT/2 lb/day (B)		
		Opacity	20% (S)		

NOTES:

* Circle one. BACT-1 indicates determination made under pre-1977 amendments; BACT-2 indicates post-1977 amendments to CAA.

** Basis symbols: Use B = BACT, N = NSPS, S = SIP, L = LAER, P = PSD Increment

ZURN

a step ahead of tomorrow

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Date July 2, , 1974

Proposal No. AP-626.

NTURI SCRUBBER

1. DESIGN INLET CONDITIONS

A. Volume	85,000	CFM
B. Temperature	450	°F.
C. Humidity	0.3495	#W.V./#D.G.
D. Dust Loading	45.69	Grs/SCFD
E. Density	0.0377	#/Ft.³

2. DESIGN EXIT CONDITIONS

A. Volume	65,520	CFM
B. Temperature	172	°F.
C. Humidity	0.4596	#W.V./#D.G.
D. Dust Loading	0.1096	Grs/SCFD
E. Density	0.0529	#/Ft.³

3. PRESSURE DROP ALLOWANCES

A. Kiln	1.5	"W.G.
B. Duct Work	1	"W.G.
C. Venturi Throat	26	"W.G.
D. Separator	1.5	"W.G.
E. TOTAL	30	"W.G.

4. WATER REQUIREMENTS

A. Scrubbing Water	1080	GPM
B. Water Evaporated	31	GPM
C. Bleed-Off at 5 % Solids	496	GPM
D. Make-Up Water	527	GPM
E. Water Recirculation	553	GPM

5. MATERIALS OF CONSTRUCTION

A. Venturi Throat	3/16" 316 L Stainless Steel
B. Flooded Elbow	3/16" 316 L Stainless Steel
C. Separator	
D. Duct Work	1/8" 316 L Stainless Steel
E. ~~Stacks~~	

6. PREDICTED PERFORMANCE

Please see enclosed guarantee

7. It is recognized that the performance of the equipment covered in this proposal cannot be exactly predicted for every possible operating condition. In consequence, any predicted performance data submitted are intended to show probable operating results which may be closely approximated but which cannot be guaranteed except as expressly stated in the guarantee clause or clauses in this proposal.

8. Any performance curves submitted are for the PURCHASER'S convenience and the performance indicated thereon is not offered by Zurn Ind. Inc., Air Systems Div., nor to be construed by the PURCHASER, as a proposal of contract obligation.

PERFORMANCE GUARANTEE

Based upon the designed conditions shown in the venturi specification sheet, Zurn Air Systems guarantees that the outlet particulate emissions from its venturi scrubbing system will not exceed 28.8 lbs/hr, which is less than the allowable emission for the stated process under the Florida Air Pollution Code. This is based upon an expected maximum kiln feed rate of 712 tons per day.

This guarantee is based upon a 26" w.g. pressure drop across the venturi throat and an inlet grain loading of no more than 45.69 grains per SCFD of a which a maximum of 7 1/2% by weight is assumed to be soda fume as sodium carbonate.

Based upon a kiln feed rate of 75% of the expected maximum of 712 tons per day, the allowable emission is:

$$E = 3.59\ P^{0.62}$$

$$E = 3.59 \times 22.25^{0.62}$$

$$E = 24.57 \text{ lb/hr particulate emission}$$

Assuming the inlet dust loading to the scrubber also decreases by approximately 75%, Zurn Air Systems will guarantee that the emission from its scrubber system will not the exceed the 24.57 lbs/hr. maximum allowable emission rate. This based upon a 26" w.g. pressure drop at the venturi throat and a soda fume content in the dust of approximately 7 1/2% by weight as sodium carbonate.

Sampling and testing procedures to be used in determining the emission from the system will be in accordance with the Florida Department of Pollution Control Requirements.

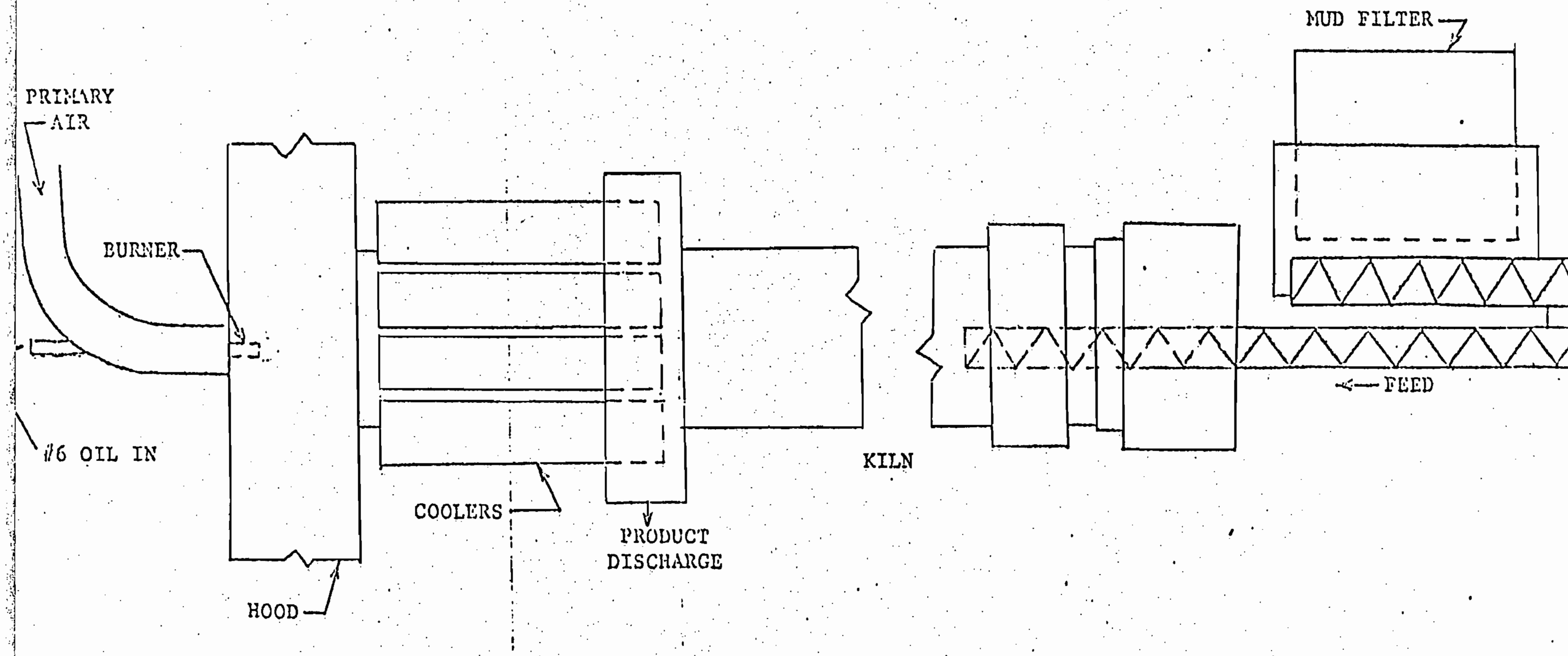
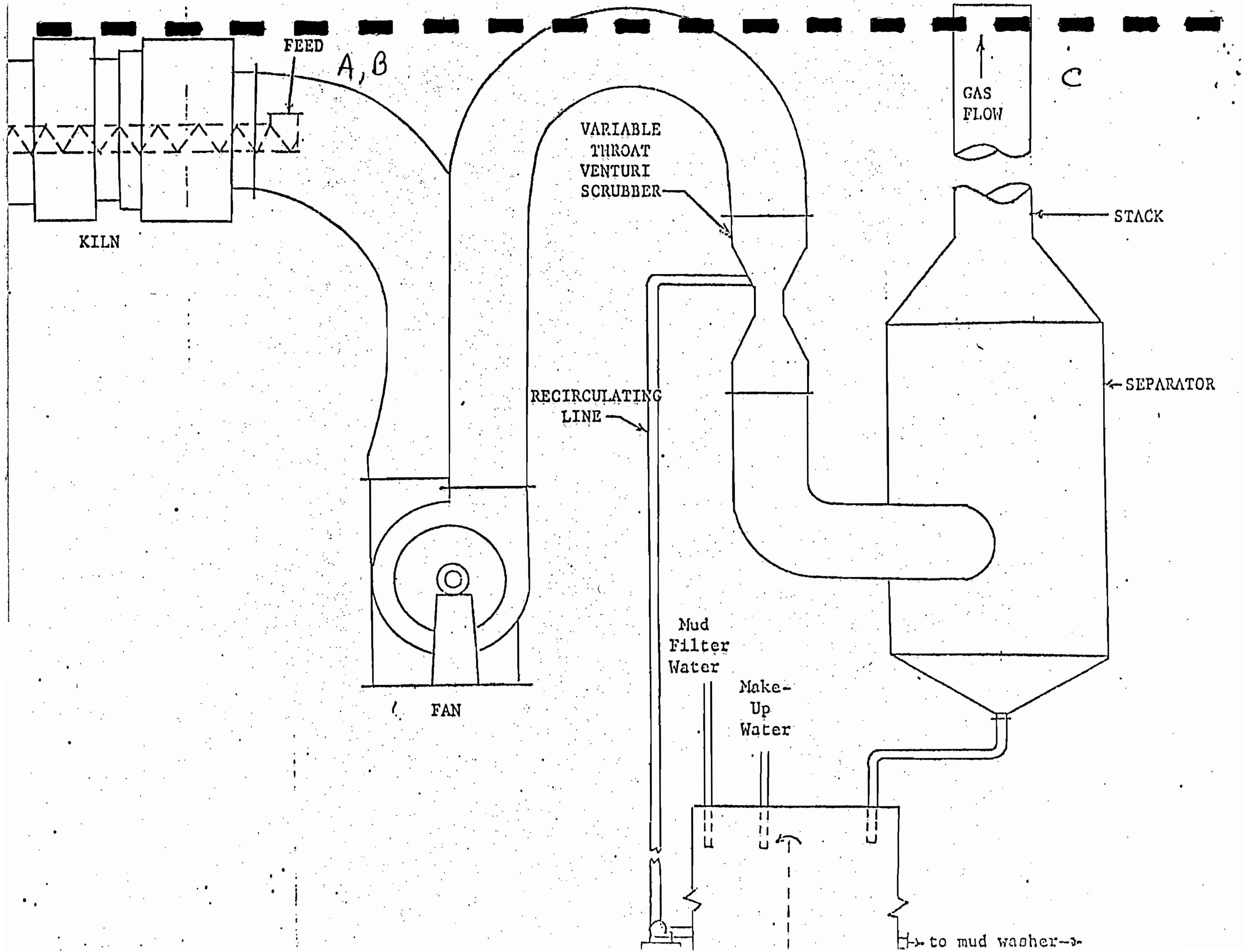

MUD FILTER
PRIMARY AIR
BURNER
#6 OIL IN
HOOD
COOLERS
PRODUCT DISCHARGE
KILN
FEED

FIGURE I


FEED
A, B
C
GAS FLOW
VARIABLE THROAT VENTURI SCRUBBER
STACK
KILN
SEPARATOR
RECIRCULATING LINE
FAN
Mud Filter Water
Make-Up Water
to mud washer

SECTION VII – PREVENTION OF SIGNIFICANT DETERIORATION

Items A – C, See No. 5 Combination Boiler Application

A. Company Monitored Data

1. ________ no sites ________ TSP ________ ( ) SO^2* ________ Wind spd/dir

Period of monitoring ___/___/___ to ___/___/___ (month day year)

Other data recorded ________

Attach all data or statistical summaries to this application.

2. Instrumentation, Field and Laboratory

a) Was instrumentation EPA referenced or its equivalent? ____ Yes ____ No

b) Was instrumentation calibrated in accordance with Department procedures? ____ Yes ____ No ____ Unknown

B. Meteorological Data Used for Air Quality Modeling

1. ____ Year(s) of data from ___/___/___ to ___/___/___ (month day year)

2. Surface data obtained from (location) ________

3. Upper air (mixing height) data obtained from (location) ________

4. Stability wind rose (STAR) data obtained from (location) ________

C. Computer Models Used

1. ________ Modified? If yes, attach description.

2. ________ Modified? If yes, attach description.

3. ________ Modified? If yes, attach description.

4. ________ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables.

D. Applicants Maximum Allowable Emission Data

Pollutant	Emission Rate
TSP	See Section III.C. grams/sec
SO^2	See Section III.C. grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description on point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time. See PSD report.

F. Attach all other information supportive to the PSD review.

*Specify bubbler (B) or continuous (C).

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources.

The selected technologies should have a positive economic and social impact due to increased jobs and taxes.

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology.

APPENDIX B

CALCULATION OF CONTEMPORANEOUS EMISSION REDUCTIONS

APPENDIX B

CALCULATION OF CONTEMPORANEOUS EMISSION REDUCTIONS

Recovery Boilers 1, 2, and 3

Pulp Production

No. 1: 1976 Black Liquor Solids production (BLS) = 340 TPD
340 ÷ 3,000 lbs BLS/ton pulp x 365 x 2,000 = 82,733 TPY pulp

No. 2: 1976 BLS production = 486 TPD
486 ÷ 3,000 x 365 x 2,000 = 118,243 TPY pulp

No. 3: 1976 BLS production = 471 TPD
471 ÷ 3,000 x 365 x 2,000 = 114,594 TPY pulp

Emissions

Particulate AP-42 emission factor = 8 lb/ton pulp
SO_2 AP-42 emission factor = 5 lb/ton pulp
H_2S AP-42 emission factor = 12 lb/ton pulp
Reduced S AP-42 emission factor = 1 lb/ton pulp

	Emissions (TPY)		
Boiler	TSP	SO_2	H_2S+RS = TRS
1	331	207	538
2	473	296	767
3	458	286	745

Smelt Tanks 1, 2, and 3

Pulp Production

No. 1: 1976 Black Liquor Solids production (BLS) = 340 TPD
340 ÷ 3,000 lbs BLS/ton Pulp x 365 x 2,000 = 82,733 TPY pulp

No. 2: 1976 BLS production = 486 TPD
486 ÷ 3,000 x 365 x 2,000 = 118,243 TPY pulp

No. 3: 1976 BLS production = 471 TPD
471 ÷ 3,000 x 365 x 2,000 = 114,594 TPY pulp

Emissions

Particulate factor = 0.25 lb/ton pulp
SO_2 factor = 0.1 lb/ton pulp
H_2S factor = 0.04 lb/ton pulp
RS factor = 0.4 lb/ton pulp

Smelt Tank	Emissions (TPY) TSP	SO_2	H_2S+RS = TRS
1	10	4	18
2	15	6	26
3	14	6	25

APPENDIX C

COMPUTER MODEL PRINTOUTS

(Please see accompanying volume)

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P.O. Box ESE
Gainesville, Florida 32602
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TWX 810-825-6310

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Anchorage, Alaska 99507
(907) 344-5232

ATLANTA
Suite 320
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2200 Northlake Parkway
Tucker, Georgia 30084
(404) 491-9700

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P.O. Box 16612
McWillie Station
Jackson, Mississippi 39206
(601) 982-4792

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7600 Red Road
Suite 128
Miami, Florida 33143
(305) 661-6681

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4315 Pleasant Valley Road
P.O. Box 31528
Raleigh, North Carolina 27612
(919) 781-3000

ST. LOUIS
763 New Ballas Road, South
St. Louis, Missouri 63141
(314) 567-4600

TAMPA
5406 Hoover Boulevard, Suite D
Airport Service Center
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