EPA's proposed cluster rule: The end of end-of-pipe

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EPA's proposed regulations for the pulp, paper, and paperboard industry cover both air and water emissions. Their goal is to drive the industry to make process changes instead of end-of-pipe and add-on controls.

EPA has recently proposed regulations for the pulp and paper industry with these stated goals:

- Attaining significant reductions in pollutant releases to air and water
- Reducing the cost of compliance and promoting compliance planning by the industry
- Promoting pollution prevention
- Emphasizing multimedia pollution control.

To meet these goals, EPA formed a regulatory "Cluster" group to jointly develop Clean Water Act and Clean Air Act regulations for the pulp and paper industry.

Although the Cluster was charged with optimizing approaches to solving environmental problems, the only real practical benefit to industry is that efforts to respond and comply with both new regulations can be combined. In fact, EPA points out that if mills make process changes to reduce or eliminate chlorine use—which would reduce chlorinated hazardous air pollutants (HAPs)—the result would be more emissions of nonchlorinated HAPs with no net benefit.

The proposed regulations are a new Subpart S to 40 CFR 63, National Emission Standards for Hazardous Air Pollutants (NESHAPs), for the pulp and paper industry, as well as revised process wastewater effluent limitations (40 CFR 430, The Pulp, Paper and Paperboard Point Source Category). The proposed regulations were published in the Federal Register with a preamble that describes the technical and economic methodologies used to develop them *(1)*. The preamble is a summary of six different background documents prepared by EPA. The background documents contain 2000 pages of technical and economic information and calculations *(2-7)*.

This article assumes that interested individuals have read the proposed regulations and preamble. It presents highlights of the regulations, accompanied by supporting information from the background documents not included in the preamble. It offers readers some additional insight into the rationale for the regulations to enable them to better prepare to respond successfully.

Scheduled implementation and required compliance

EPA published proposed regulations Dec. 17, 1993, and requested comments through April 18, 1994. The regulations are expected to be promulgated in the fall of 1995, according to schedules provided by EPA at their public meetings held in 1993.

The proposed NESHAP regulations specifically state that compliance is required within three years of promulgation, and an additional year can be granted if equipment changes are required. Therefore, compliance would have to be achieved by the end of either 1998 or 1999. Note that EPA is still in the process of developing NESHAP for combustion emission sources, expected to be proposed at the end of 1994, which would be promulgated at the same time as the currently proposed NESHAP.

EPA has not yet determined compliance requirements for the proposed effluent guidelines, but a likely scenario would be that as current permits expire, the new limits would be applied. However, state agencies may hold up permit renewals while the new regulations are in the process of being promulgated, which might result in few permits being renewed in 1995. Alternatively, some mills might be granted permit renewals conditional on making equipment changes to comply with the new limits in accordance with a negotiated compliance schedule. Therefore, since present permits are usually for five years, mills could expect to have from 1996 to 1999 to achieve compliance.

I. Subcategorization and current effluent BOD_5 loadings

Current Subpart	*Current subcategory name*	*Number of mills*	*Production normalized final effluent BOD_5 loadings (kg BOD_5/OMMT)* Average	Range	*Proposed Subpart*
F	Dissolving kraft	3	5.39	nd	A
G	Market bleached kraft	6	2.06	1.06-4.37	B
H	BCT (board, coarse, tissue) Bleached kraft	3	2.45	1.62-2.93	B
I	Fine bleached kraft	6	1.99	0.26-7.40	B
P	Soda	1	nd	nd	B
A	Unbleached kraft	8	1.63	0.56-2.47	C
D,V	Unbleached kraft and semichemical	1	0.29	0.29	C
B	Semichemical	1	9.41	9.41	F
J, U	Papergrade sulfite	2	4.53	1.97-7.09	E
K	Dissolving sulfite	5	27.74	nd	D
B	Semichemical	1	9.41	9.41	F
M	GW-thermomechanical	1	0.35	0.35	G
N	GW-CMN (coarse, molded, newspapers)	1	0.56	0.56	G
O	GW-fine papers	4	1.04	0.53-2.37	G
L	GW-chemimechanical	1	0.65	0.65	G
Q	SF deink fine papers	5	2.00	0.20-4.67	I
Q	SF deink tissue papers	13	3.12	0.65-7.63	I
Q	SF deink newsprint	0	—	—	I
T	Tissue from wastepaper	13	2.27	0.05-4.68	J
E	Paperboard from wastepaper corrugating medium	20	0.56	0.05-1.46	J
E	Paperboard from wastepaper noncorrugating medium	2	0.53	0.27-0.79	J
W	Wastepaper—molded products	2	0.87	0.39-1.35	J
—	Other non-deink	10	2.78	0.49-7.52	J
A*	Builders' paper and roofing felt	1	0.65	0.65	J
R	NI fine papers—wood fiber furnish	3	1.18	0.64-1.46	K
R	NI fine papers—cotton fiber furnish	2	5.47	0.96-9.98	K
X	NI lightweight—lightweight papers	1	2.11	2.11	K
X	NI lightweight—electrical papers	0	—	—	K
S	NI tissue papers	1	0.22	0.22	L
Y	NI filter and nonwoven papers	7	2.26	0.61-6.74	L
Z	NI paperboard	0	—	—	L
—	Other NI paper	4	1.72	0.33-3.09	L

nd = not disclosed
* 40 CFR 431

Revised 40 CFR 430, Proposed Effluent Limitations Guidelines and Standards

Subcategorization

Previous regulations placed pulp and paper mills in one of 33 categories. The new rules reduce the number of categories to 12. All mills will be grouped into one of the following categories:

A Dissolving kraft

B Bleached Papergrade Kraft and Soda

C Unbleached Kraft

II. Best Management Practices (BMP) costs

	Pulping liquor spill prevention and control			
	Capital, US$ million		Annual O & M, US$ million/yr	
Subcategory[a]	*Avg/mill*	*Total*	*Avg/mill*	*Total*
Dissolving kraft	1.5*	4.5	-0.5	-1.5[b]
Bleached papergrade Kraft and soda	1.5*	37	-0.5	-10.0[b]
Unbleached kraft	1.5*	27	-0.5	-9.0[b]
Dissolving sulfite	0.75	3.8	0	0
Papergrade sulfite	0.75	6.3	0	0
Semichemical	0.25	4.8	0.05	0.9
Nonwood chemical pulp	0.25	3	0	0
Industry total	0.4	86	-0.1	-22.0[b]

[a] Costs for mills with operations in more than one subcategory have been apportioned based upon annual production in each subcategory to which BMP apply.

[b] Negative operating costs represent net cost savings resulting from recovery of pulping liquor chemicals and energy.

*Major upgrade; minor upgrade estimated to cost $750,000.

III. Comparison of existing and proposed end-of-pipe limits

	Avg. monthly BOD, lb/mdt		Avg. monthly TTS, lb/mdt	
Category	*Existing*	*Proposed*	*Existing*	*Proposed*
Unbleached kraft	5.6	4.38	12.0	6.9
Bleached papergrade kraft	14.2	4.38	25.8	7.78
Non-deink secondary fiber	3.0-14.2*	1.068	5.0-18.4*	1.562
Deink secondary fiber	18.8	4.32	25.9	4.58

*Varies depending on furnish and product

D Dissolving Sulfite

E Papergrade Sulfite

F Semichemical

G Mechanical Pulp

H Nonwood Chemical Pulp

I Secondary Fiber Deink

J Secondary Fiber Non-deink

K Fine and Lightweight Papers from Purchased Pulp

L Tissue, Filter, Nonwoven, and Paperboard from Purchased Pulp.

Preparation of a BMP Plan is required for mills in categories A, B, C, D, E, F, and H, as explained below.

EPA based the formation of the new subcategories on effluent BOD loading as reported by mills in the 1989 questionnaire. Normalized effluent BOD loadings were determined by EPA and are summarized in **Table I** *(2)*.

Best management practice (BMP) plans

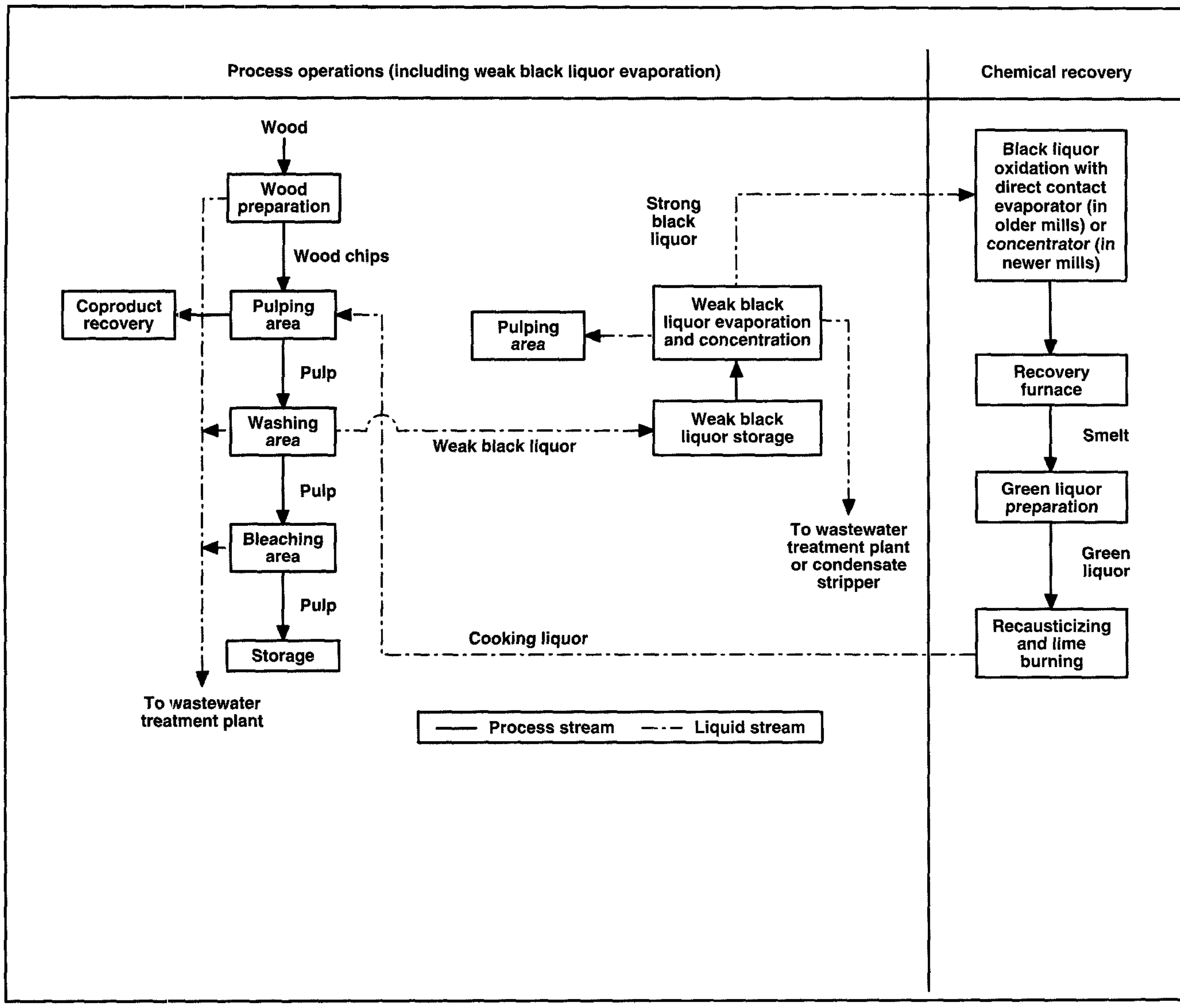
The seven categories of mills identified above will be required to develop best management practices (BMP) plans to prevent and control pulping liquor spills. These s pills are assumed by EPA to result in discharges to wastewater treatment systems that significantly reduce the treatment facility's effectiveness and efficiency in quantifiable amounts. However, the only quantitative data EPA has to correlate effluent reduction benefits to pulping liquor spill prevention and control is from one Canadian kraft mill with a reported 27 percent reduction in BOD.

EPA has assumed that mills that require moderate or major BMP upgrades will reduce BOD by 2.5 or 5.0 kg/OMMT (6 or 12 lb/OMT), respectively. The costs associated with BMP upgrades were estimated by EPA for the affected subcategories, as indicated in **Table II** *(2)*.

Each BMP plan must be submitted to EPA for approval and implemented within two years of promulgation. The plan must contain the following key elements:

- Engineering analyses
- Engineered controls and containment
- Work practices
- Preventive maintenance
- Dedicated monitoring and alarm systems

1. EPA breakdown of emission points in typical kraft pulping and bleaching processes



- Surveillance and repair programs
- Employee training.

Effluent limits—BPT/BCT

In developing effluent limits for conventional pollutants (BOD and TSS), EPA determined that more than 80% of direct discharging mills had secondary treatment. Therefore, best practicable control technology currently available (BPT) was determined to be secondary treatment. Specific limits were arrived at based on the performance of the average of the best 50% of mills in each subcategory. EPA's analysis of best conventional pollutant control technology (BCT) determined that BPT is BCT. The only exception was the mechanical pulp subcategory, where effluent limits were determined based on multimedia filtration (BCT), which was determined by EPA to be "cost reasonable" compared to BMP.

Generally, all existing mills will face lower discharge limits for conventional pollutants. The magnitude of the reductions vary, depending on the category of the mill. These limits are termed effluent or end-of-pipe limits because they apply to the final discharge from the wastewater treatment system. **Table III** *(1)* presents a comparison of the existing and proposed end-of-pipe limits for several categories of mills.

For direct discharging mills with only primary treatment, the new limits will require an upgrade of existing treatment facilities to some form of secondary treatment or advanced secondary treatment. For mills with secondary treatment that are not achieving "the average of the best," upgrades to secondary treatment systems will be necessary. EPA performed its cost calculations, described in **Table IV** *(2)*, based on the following upgrades:

IV. Costs of upgrades required to meet BOD_5 and TSS levels for BPT/BCT

Upgrade	*Number of mills*	*Avg. capital cost/mill ($ 000)*	*Annual O&M cost/mill ($ 000)*
Basin upgrades			
Additional aeration	12	26	18
Additional aeration and facultative lagoon	4	645	126
Facultative lagoon	54	1,193	155
Two lagoons	6	748	109
Polishing pond	33	364	46
Polishing pond and additional aeration	34	1,247	74
Polymer addition	2	2	15
Activated sludge upgrades			
Additional aeration tank volume	45	1,742	78
Additional clarification	48	958	79
Additional aeration	3	20	11
Polymer addition	46	2	161
Operational modifications	4	0	0
Incremental sludge handling and disposal	24	74	0

Note: Mills that share wastewater treatment systems are counted as one mill in this table.

V. Summary of estimated national baseline emissions from chemical and semichemical pulping and bleaching operations

Major pollutants	*Emissions (mg/yr)*
Total HAP	170,000
Total VOC	830,000
Total reduced sulfur	350,000
Methanol	120,000
Hexane	18,000
Toluene	14,000
Methyl ethyl ketone	6,000
Chloroform	3,300
Chlorine	2,800
Formaldehyde	2,100
Acetaldehyde	2,000
Methylene chloride	1,200
Propionaldehyde	700
Acrolein	700
Acetophenone	60
Hydrochloric acid	59
Methyl chloroform	22
Carbon disulfide	8

Note: Based on process operation emission points only (chemical recovery sources other than evaporation are not included; see Fig. 1).

Activated sludge treatment systems.

- Additional aeration tank volume
- Additional secondary clarification (after activated sludge aeration tanks)
- Additional aeration
- Polymer addition
- Operational modifications
- New primary clarification (for mills with no wastewater treatment in place).

Basin treatment systems.

- Additional aeration in existing basins
- New aerated facultative lagoon
- New aerobic aerated lagoon followed by new aerated facultative lagoon
- New polishing pond
- Polymer addition.

In addition to facility upgrades, EPA estimates that 59 mills (out of 290) will have to reduce flow to achieve BPT performance levels because of poor water conservation practices.

EPA estimates the costs to comply with the proposed effluent limits for conventional pollutants will put three mills out of business, eliminating 1100 jobs.

Effluent limits—BAT/PSES and NSPS/PSNS

For new and existing mills that produce bleached pulp, the new regulations establish additional limits for the effluent from the bleach plant and end-of-pipe for toxics and nonconventional pollutants. EPA applied limits to bleach plant effluent to eliminate the possibility of compliance achieved by diluting bleach plant wastewaters with the large wastewater flows from the rest of the mill.

For mills that are not using a totally chlorine free (TCF) process, limits have been set for the bleach plant effluent for 18 compounds including dioxin (TCDD), furan (TCDF), chloroform, acetone, methylene chloride, and various phenolic compounds. For the end-of-pipe effluent, limits have been proposed for Adsorbable Organic Halides (AOX) and Chemical

Oxygen Demand (COD). Different end-of-pipe limits have been set for mills not using chlorine.

EPA arrived at effluent limits in each of the six affected subcategories based on a "best available technology economically achievable" (BAT) determination for existing mills that were, with the exception of the Bleached Papergrade Kraft subcategory, also proposed as new source performance standards (NSPS). One subcategory for which EPA did not propose BAT limits, secondary fiber nondeink, had a proposed NSPS that requires zero discharge.

1. Necessary modifications. To perform its economic calculations, EPA assumed that mills that produce bleached pulp will have to make some of the following modifications, if not already in place, to meet the proposed BAT limits:

- Extended cooking, requiring either a new digester or a retrofit (for Bleached Papergrade Kraft and Soda subcategory)
- An oxygen delignification system, including the necessary white liquor oxidizing equipment and two-stage post-oxygen washing with a leased oxygen generating plant (for all four bleaching subcategories: Bleached Papergrade Kraft and Soda, Dissolving Kraft, Papergrade Sulfite and Dissolving Sulfite)
- Recovery boiler upgrades, required due to a significant increase in recycled organics from the above modifications, which include expanding the boiler bed, modifying the air system, and firing with higher solids
- Two-stage ozone bleaching system with a leased oxygen generating plant (for the Dissolving Sulfite subcategory)
- Improvement of brownstock washing by either adding an additional stage or installing a new washing line if the mill's washing loss is greater than 25 kg Na_2SO_4/mt of pulp (for Bleached Papergrade Kraft and Soda and Dissolving Kraft subcategories)
- High chlorine dioxide substitution requiring a new ClO_2 generator or, if the present generator uses the R3 or SVP process, conversion of the existing generator to R8 or SVP-Lite process (for Bleached Papergrade Kraft and Soda, Dissolving Kraft and Dissolving Sulfite subcategories)
- Conversion of the existing bleaching tower to a peroxide tower and peroxide storage and supply (for Papergrade Sulfite subcategory)
- Peroxide-enhanced extraction requiring peroxide unloading and storage facilities, and piping and controls (for Bleached Papergrade Kraft and Soda subcategory)

VI. Scrubber reduction estimates

Compound classification[a]	*Estimated scrubber removal (%)*[b]	*Estimated reduction (%)*[c]
Chlorine	99	99
High solubility	99	75
Methanol		
Acetone*		
Formaldehyde		
2,4,5-Trichlorophenol		
Pentachlorophenol		
Chlorophenolics		
Hydrochloric acid		
Chlorine dioxide*		
Medium solubility	60	35
Methyl ethyl ketone		
Acrolein		
Acetaldehyde		
Propionaldehyde		
Dichloroacetaldehyde*		
Low solubility	0	0
Chloroform		
Carbon tetrachloride		
Methylene chloride		
Toluene		
1,1,1-Trichloroethane		
Alpha-pinene*		
Beta-pinene*		
Chloromethane		
p-Cymene*		
Average	—	70

[a] Compounds are classified by solubility. High-solubility compounds have solubilities greater than or equal to methanol; low-solubility compounds have solubilities less than or equal to chloroform; medium-solubility compounds were between methanol and chloroform.

[b] Based on a model scrubber designed to remove 99% of the chlorine, 99% of the methanol was removed and less than 1% of the chloroform was removed.

[c] The volatility of the speciated compounds was evaluated, and a fraction emitted was estimated based on the mass removed in the scrubber effluent.

* Not a hazardous air pollutant.

VII. Steam stripper removal efficiencies

HAP compound	*Removal efficiency*[a]
Acetaldehyde	99
Acrolein	99
2-Butanone (MEK)	99
Formaldehyde	99
Methanol	90
Propionaldehyde	99
Total reduced sulfur (TRS)	94[b]

[a] Removal efficiency is based on a steam-to-feed ratio of 1.5 pounds of steam per gallon of wastewater.

[b] Removal efficiency for TRS is based on the average removal efficiencies for hydrogen sulfide, dimethyl disulfide, dimethyl sulfide, and methyl mercaptan.

VIII. EPA Cluster Rule–AF&PA and EPA contacts

Name	*Company*	*Phone*	*Fax*
Wastewater discharge guidelines			
Donald Anderson	EPA	202-260-7137	
Cathy Marshall	AFPA	202-463-5185	202-463-2423
Hazardous air pollutant regulations			
Rob Kaufmann	AFPA	202-463-2588	202-463-2423
Stephen Shedd	EPA	919-541-5397	
Solid waste/RCRA implications of the proposals			
Amy Schaffer	AFPA	202-463-2585	202-463-2423
Economic issues			
Scott Mathias	EPA	919-541-5130	
Steve Erickson	Boise	208-384-7693	208-384-4841

- Elimination of hypochlorite by replacement with chlorine dioxide (for Bleached Papergrade Kraft and Soda and Dissolving Kraft subcategories).

2. **Modification Costs.** For the largest subcategory, Bleached Papergrade Kraft and Soda (87 mills), EPA calculated a US$ 2 billion capital cost for modifications required to comply with the proposed BAT limits. This cost has been broken down by EPA by the number of mills that will require each necessary modification and the average associated cost, as follows:

Brownstock Washers. New unit required at 5 mills (US$ 18.7 million/mill); upgrades required at 37 mills (US$ 4.3 million/mill).

Oxidative Extraction (Eo). Required at 64 mills (US$ 650,000/mill).

Chlorine Dioxide Generators. 17 mills require generator conversions (US$ 1.8 million/mill); 48 mills will have to add capacity (US$ 4.9 million/mill); 6 mills will require greenfield units (US$ 5.3 million/mill).

New D-Stage Tower and Washer. Required at 27 mills (US$ 17 million/mill).

Extended Cooking Retrofit. Required at 3 mills (US$ 1.8 million/mill).

Oxygen Delignification System. Required at 56 mills (US$ 15.9 million/mill).

Recovery Boiler Upgrades. Required at 55 mills (US$ 850,000/mill).

The proposed regulations also establish much lower pretreatment standards for existing sources (PSES) for 13 mills in four subcategories. These mills, which discharge to an offsite publicly owned treatment works (POTW), will have to meet limits similar to those BAT limits proposed for direct dischargers.

EPA cost calculations indicate that, in the subcategories affected by the proposed BAT/PSES levels, eight mills would close because compliance would be too costly. Of these eight mills, four are bleached paper grade kraft mills, three are paper grade sulfite mills, and one is a dissolving sulfite mill.

New 40 CFR 63 Subpart S, Proposed National Emission Standards for Hazardous Air Pollutants

The purpose of the proposed standards is to reduce emissions of hazardous air pollutants (HAPs) from pulping and bleaching sources in the pulp and paper industry. Major HAPs include methanol, hexane, toluene, methyl ethyl ketone, chloroform, chlorine, formaldehyde, acrolein, and acetaldehyde. **Table V** *(3)* shows the relative annual emissions of these pollutants for the industry as a whole.

Source category

The new air standards will apply to mills that produce chemical pulp from wood and have emissions of any single HAP exceeding 10 tons/year or total HAP emissions exceeding 25 tons/year. Applicable air emissions are those from process operations associated with pulping and bleaching (including process wastewater streams). Chemical recovery process emissions are not included in the proposed regulations; they will be covered by EPA at a later date. **Figure 1** identifies EPA distinction between process operations and chemical recovery operations for a typical kraft mill.

EPA defined "source" broadly to mean a single source which is comprised of all applicable emission points at the mill.

This should make it easier for facilities to make equipment upgrades to comply with the proposed effluent guidelines without triggering "new source" compliance deadlines for NESHAP that apply if a "source" is reconstructed. If a new or reconstructed source is operational after a proposed standard, it must comply with that standard (in this case the proposed NESHAP) by the date of promulgation. Otherwise, the compliance date is three years from the date of promulgation.

MACT floor

The Clean Air Act dictates that EPA must base NESHAP on the maximum degree of emission reduction achievable, not unlike the determination of BPT/BCT to develop effluent levels. Therefore, EPA has determined "maximum achievable control technology" (MACT) for the defined source category, which becomes the technology basis for the proposed NESHAP. The determined MACT is referred to as the MACT "floor," so named because the standards are set at levels at least as stringent as achieved by these "floor" technologies. EPA studied options more stringent than the MACT floor but determined that these options were not cost-effective.

EPA's MACT floor was "established on an emission point basis according to control technologies currently in use in the industry at individual emission points and knowledge of the performance capabilities of these control technologies." The control technologies identified were those used by the facility at the 94th percentile level of control (arrived at by taking the median mill of the best performing 12% of mills). However, because there were not enough data for EPA to determine either actual mass emission limits or mass emission reductions, EPA's own estimates of performance capabilities for each technology were assumed to be achievable.

The specific MACTs are separated into three areas: pulping, bleaching, and process wastewater. MACT for all operations begins with enclosing and venting all HAP emission points into a closed vent system. MACT for pulping emissions is combustion of the vented emissions (98% efficiency). For bleaching emissions it is gas scrubbing (99% efficiency). MACT for wastewater is combustion of the vented emissions (98% efficiency) as well as treatment of the wastewater stream by steam stripping (90% efficiency) with the overhead gases vented and combusted.

Vent gas collection and transport system

To control HAP emissions from pulping and bleaching operations using standalone or existing devices, vent streams must be captured and transported to the control device. Typical components of the capture and conveyance system are the hoods or enclosures, pipe or ductwork, the prime mover employed (i.e., fan), gas conditioning equipment (if needed), and safety devices.

Two methods are generally used to capture vent streams: hard-piping and hoods (or enclosures). The method used depends on the emission point type. It will affect the volumetric flow rate and relative organic compound concentration of the vent stream. When an emission point is an enclosed process with a vent, the vent can be hard-piped to a control device, thereby reducing the introduction of ambient air into the vent stream and reducing the vent stream flow rate. Digester gases and evaporator vent gases are examples of vent points that can be hard-piped to a control device.

When an emission point is diffuse or large, such as a washer or knotter, vent emissions may be captured using an enclosure or well-enclosed hood and then hard-piped to a control device. Hood collection efficiency is a function of capture velocity, which depends on the creation of an air flow that is sufficient to capture the contaminated air emitted from the point and draw the air into the exhaust hood. At a constant volumetric air flow rate, hood capture efficiency decreases as the distance between the point and the hood increases. EPA, based on discussions with vendors, believes that enclosures can be constructed to achieve complete capture. A 34% reduction in flow was assumed by EPA when replacing a hood with an enclosure for pulping vent streams.

1. **Pulping operations.** EPA assumes that most mills will have to construct enclosures on knotter and pulp washers to collect HAP emissions. EPA estimated a cost of US$ 320,000 to enclose one washer line with three washer hoods and one enclosure for the knotter. This cost is based on fiber-reinforced plastic, close-fitting panel hood enclosures sized for equipment in a "typical" 1000 tons/day mill. EPA assumes that mills have existing vents for:

- Digester relief gas or turpentine recovery system
- Digester blow gases or NCG system
- Washer foam tank or filtrate tank
- Evaporator NCG and hotwell gases
- Weak black liquor storage tank
- Oxygen delignification blow tank
- Oxygen delignification washer.

To achieve MACT, these vented emissions will have to be conveyed in ductwork to what EPA assumes to be an existing combustion device. The cost for the ductwork is estimated to be US$ 1.25 million, which includes a fan, knockout drum, flame arrester, and rupture discs every 100 feet.

2. **Bleaching operations.** HAPs that are typically emitted from bleaching operations are chlorine, chloroform, and methanol. Potential emission points include all process equipment, beginning with the application of chlorine and chlorine compounds, comprising washer vents, seal tank vents, and tower vents. EPA estimates that it will cost a typical mill venting emissions from C, D, E, and H stages US$ 209,000 to duct these 12 vents to a control device. However, EPA acknowledges that some washers may be hooded or partially open to the atmosphere and could require enclosures, although these costs were not included.

Bleach plant scrubbers

In the preamble to the proposed regulations, EPA identifies a scrubber to be MACT for 99% control of bleach plant HAP emissions. However, in the background documents to the proposed regulations, this is shown not to be possible. **Table VI** *(3)* indicates the anticipated removal efficiency for a countercurrent flow packed absorption tower utilizing caustic absorbing solution. EPA would expect the caustic to originate from the bleach plant extraction stage filtrates (i.e., the caustic sewer), weak wash from the chemical recovery process, white liquor, chemical manufacturing by-product (sodium bisulfite), or fresh caustic solution. The total estimated reduction of HAP emissions is expected to be only 70% by scrubbing alone.

EPA cites NCASI Bulletin 616 as its basis for selecting 99% efficiency. This bulletin covered only chlorine and chlorine dioxide control, for which 99% control was found to be possible. However, HAPs with lower solubility than these compounds cannot be removed at the 99% level, as shown in Table VI. Therefore, EPA considered scrubbing in series with other control options to achieve 99% efficiency.

EPA looked at subsequent combustion of the scrubber off-gas, but this technique results in only marginal improvement to the removal efficiency (75%). Although no option was cited that could achieve 99% reduction, incineration of the bleaching vent emissions followed by scrubbing is expected to reduce organics by 98% and chlorine and hydrochloric acid by 99%. The total cost to install the necessary equipment, including ductwork, was estimated at US$ 4.3 million by EPA.

Wastewater emission steam stripping

In wood pulping, wastewater streams containing HAP compounds are generated. Generally, wastewater passes through a series of collection units before being sent to treatment units. Many of the collection system units are open to the atmosphere and allow some of the HAPs to be emitted to the ambient air. EPA examined possible control devices used to reduce HAP emissions from pulping wastewater points and arrived at steam stripping with vent control as MACT. The proposed regulations describe these MACT requirements in much more detail than is provided for pulping and bleaching emissions.

EPA acknowledges that achievable VOC and HAP emission reductions are highly dependent on wastewater characteristics, such as organic concentration and composition. They are also highly dependent on the design and operation of the stripper, as well as the collection and treatment systems. Steam stripper removal efficiencies ranging from 65% to 99% are cited by EPA in the background document.

Steam strippers are currently used in the pulp industry to reduce TRS and organic compound loading in pulping process and chemical recovery evaporator wastewater or condensates. Typically, steam stripping is applied to condensate streams from the blow tank, turpentine recovery system, and evaporators. Liquid streams from any gas-conditioning equipment used to remove moisture from vent gases may also be stripped to remove organics before being sewered.

The steam stripper design and operating parameters that have the greatest effect on the removal performance of organic compounds are the number of trays (or height of packing) and the steam-to-feed ratio (SFR). In general, the removal efficiency increases as the number of trays (height of packing) increases. EPA specifically requires at least eight trays in the proposed regulations.

Based on responses to an industry survey, EPA determined an average SFR used for controlling pulping wastewater streams of 1.5 lb stream/gal wastewater. The results of theoretical calculations based on this SFR, performed by EPA, predict removal efficiencies of from 90% to 99%, as indicated in **Table VII** *(3)*. Although the proposed regulations do not require a specific removal efficiency unless a steam stripper is *not* used, EPA is proposing to require a 90% removal efficiency for any alternative control.

EPA estimated installation costs to install MACT equipment are based on the assumption that a typical mill would have to steam strip its digester blow tank condensates, evaporator foul condensates, and turpentine recovery wastewaters. EPA assumed that the off-gas would be conveyed to an existing combustion device.

In developing expected capital costs, EPA determined costs for stand-alone strippers and strippers integrated into the evaporator set in response to data that indicated that, of 140 mills, 21 had stand-alone units and 10 had integrated units. Although the capital cost is expected to be the same (US$ 3.5 million), the cost for steam for the stand-alone unit (US$ 2.9 million/year) is more than 10 times the cost for an integrated unit (US$ 250,000).

Title V of the Clean Air Act

All applicable requirements of the proposed NESHAP regulations will ultimately be included in the mill's Title V operating permit. This permit will contain federally enforceable conditions with which the mill must comply. A Title V permit will be required for all sources that emit more than 10 tons/year of any HAP or 25 tons/year of all HAPs. However, sources that emit less than the threshold levels of HAPs will still require Title V permits if emissions are over 100 tons/year for any pollutant or other certain limits for VOCs, CO, or particulate matter in regions with poor air quality.

The information required in a Title V operating permit application will be substantial. It will include the quantification of all regulated pollutants and proposed monitoring to determine compliance. The importance of quantifying emissions cannot be understated, since permit fees will be calculated based on emission rates contained in the permit.

Table VIII provides a list of AFPA and EPA contacts for further information on the proposed cluster rule.

Literature cited

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