SECTION 8

DEVELOPMENT OF CONTROL AND TREATMENT OPTIONS

8.1 Introduction

This section describes the combinations of pulping and bleaching technologies, in-process water conservation practices, and end-of-pipe wastewater treatment that the Agency configured as technology options for consideration as bases for the following regulations:

- BPT (best practicable control technology currently available);
- BCT (best conventional pollutant control technology);
- BAT (best available technology economically achievable);
- NSPS (new source performance standards);
- PSES (pretreatment standards for existing sources); and
- PSNS (pretreatment standards for new sources).

These regulations establish quantitative limits on the discharge of pollutants from industrial point sources. As explained in the preamble and in Section 12 of this document, EPA decided not to promulgate the proposed regulations for BPT and BCT. BPT and BCT limitations for the pulp and paper industry, therefore, are based on the formerly promulgated BPT and BCT limitations. EPA is promulgating BAT, NSPS, PSES, and PSNS today. The applicability of the various regulations is summarized below:

	Direct Discharge	Indirect Discharge	Existing Source	New Source	Conventional Pollutants	Toxic and Nonconventional Pollutants
BPT	X		X		X	
BCT	X		X		X	
BAT	X		X			X
NSPS	X			X	X	X
PSES		X	X			X
PSNS		X		X		X

All of these regulations are based on the performance of specific technologies but do not require the use of any specific technology. The regulations applicable to direct dischargers are effluent limitations guidelines which are applied to individual facilities through NPDES permits issued by EPA or authorized states under Section 402 of the CWA. The regulations applicable to indirect dischargers are standards, and are administered by local permitting authorities (i.e., the government entity controlling the POTW to which the industrial

wastewater is discharged). The pretreatment standards are designed to control pollutants that pass through or interfere with POTWs.

8.2 Toxic and Nonconventional Pollutants

The toxic and nonconventional pollutants consist of AOX, chloroform, 2,3,7,8-TCDD, 2,3,7,8-TCDF, and 12 chlorinated phenolic compounds. Regulations are being promulgated for these pollutants for mills in the Bleached Papergrade Kraft and Soda (Subpart B) and Papergrade Sulfite (Subpart E) subcategories.

8.2.1 Bleached Papergrade Kraft and Soda Subcategory (BPK)

EPA developed four options to reduce wastewater discharges of toxic and nonconventional pollutants. Two options focused on elemental chlorine-free bleaching technologies and two focused on totally chlorine-free bleaching technologies. The ECF options are identified as Option A and Option B. The TCF options are identified as TCF-peroxide and TCF-ozone. Each option is described in the following sections.

8.2.1.1 BPK Option A

Option A consists of conventional pulping followed by complete substitution of chlorine dioxide for elemental chlorine, as well as the nine elements identified below:

(i) Adequate chip thickness control;

(ii) Closed brown stock pulp screen room operation, such that screening filtrates are returned to the recovery cycle;

(iii) Effective brown stock washing, i.e., washing that achieves a soda loss of less than or equal to 10 kg Na_2SO_4 per ADMT of pulp (equivalent to 99 percent recovery of pulping chemicals from the pulp);

(iv) Use of TCDD- and TCDF-precursor-free defoamers (water-based defoamers or defoamers made with precursor-free oils);

(v) Elimination of hypochlorite, i.e., replacement of hypochlorite with equivalent bleaching power in the form of additions of peroxide and/or oxygen to the first extraction stage and/or additional chlorine dioxide in final brightening stages;

(vi) Use of strategies to minimize kappa factor and TCDD- and TCDF-precursors in brown stock pulp;

(vii) High shear mixing to ensure adequate mixing of pulp and bleaching chemicals;

(viii) Oxygen and peroxide enhanced extraction, which allows elimination of hypochlorite and/or use of a lower kappa factor in the first bleaching stage; and

(ix) Efficient biological wastewater treatment, achieving removal of 90 percent or more of influent BOD_5.

8.2.1.2 BPK Option B

Option B is identical to Option A, with the addition of extended delignification (oxygen delignification and/or extended cooking). In a slight change from the definition of the proposed option, EPA has defined Option B not only in terms of the presence of extended delignification technology (i.e., oxygen delignification or extended cooking) but also by the pre-bleaching kappa number achieved by extended delignification. EPA defines extended delignification as the operation of such technologies that result in a kappa number of 20 or less for softwoods and less than 13 for hardwoods. Sections 7.2.3 and 7.2.6 contain more detailed descriptions of each technology.

8.2.1.3 TCF-Peroxide

EPA evaluated a peroxide-based TCF bleaching option which is performed without the use of chlorine, sodium hypochlorite, calcium hypochlorite, chlorine dioxide, chlorine monoxide, or any other chlorine-containing compound. This option contains all but two of the elements listed for Option A. The two elements not included in this option are: 1) use of dioxin- and furan-precursor-free defoamers, and 2) strategies to minimize kappa factor and TCDD- and TCDF-precursors in brown stock pulp because the option uses peroxide, and not chlorine-based, bleaching. For the purpose of estimating costs, the TCF-Peroxide option included anthraquinone pulping and oxygen delignification to achieve unbleached pulp kappa numbers of 10 for softwood and 6 for hardwood.

8.2.1.4 TCF-Ozone

EPA evaluated an oxygen-based TCF bleaching option which is performed without the use of chlorine, sodium hypochlorite, calcium hypochlorite, chlorine dioxide, chlorine monoxide, or any other chlorine-containing compound. This option contains all but two of the elements listed for Option A. The two elements not included in this option are: 1) use of dioxin- and furan-precursor-free defoamers, and 2) strategies to minimize kappa factor and TCDD- and TCDF-precursors in brown stock pulp because the option uses ozone and peroxide, and not chlorine-based, bleaching. For the purpose of estimating costs, TCF-ozone option included anthraquinone pulping and oxygen delignification to achieve unbleached pulp kappa numbers of 10 for softwood and 6 for hardwood.

8.2.2 Papergrade Sulfite Subcategory (PS)

EPA had proposed a TCF bleaching option for all PS mills. Some commenters questioned the achievability of TCF bleaching to produce all the existing PS products. In response to these comments, EPA divided the PS subcategory into three segments:

A) Calcium, magnesium, or sodium sulfite pulping;

B) Ammonium sulfite pulping; and

C) Production of pulp and paper at specialty-grade sulfite mills. These mills produce 25 percent or more pulp with a high percentage of alpha cellulose and high brightness for end products such as plastic molding compounds, saturating and laminating products, and photographic papers or these mills produce 50 percent or more pulp with 91 ISO brightness and above.

After the proposal, EPA focused on one option for each segment. Each option has the following elements in common:

(i) Use of TCDD- and TCDF-precursor-free defoamers (water-based defoamers or defoamers made with precursor-free oils);

(ii) For segments with ECF bleaching, elimination of hypochlorite, i.e., replacement of hypochlorite with equivalent bleaching power in the form of additions of peroxide and/or oxygen to the first extraction stage and/or additional chlorine dioxide in final brightening stages; and

(iii) Efficient biological wastewater treatment.

Segment A (calcium, magnesium, or sodium sulfite) includes:

` Totally chlorine-free bleaching (bleaching with peroxide);
` Oxygen and peroxide enhanced extraction; and
` Improved pulp cleaning.

Segment B (ammonium sulfite) includes:

` Complete substitution of chlorine dioxide for chlorine;
` Peroxide enhanced extraction; and
` High shear mixing.

Segment C (specialty-grade sulfite) includes:

` Complete substitution of chlorine dioxide for chlorine;

` Oxygen and peroxide enhanced extraction; and
` High shear mixing.

Thus, EPA has developed one option for each PS subcategory segment.

8.2.3 Point of Compliance Monitoring

EPA is requiring mills in Subparts B and E to demonstrate compliance with effluent limitations guidelines and standards on dioxin, furan, 12 chlorinated phenolic pollutants, and (for Subpart B mills) chloroform inside the discharger's facility at the point where the wastewater containing those pollutants leaves the bleach plant. EPA is also requiring indirect dischargers in Subpart B to demonstrate compliance with AOX pretreatment standards at the bleach plant. For direct dischargers, EPA is authorized by the Clean Water Act and EPA's regulations at 40 CFR Parts 122.44(i), 122.45(h), and 125.3(e) to specify an in-plant point of compliance monitoring for technology-based limitations. For indirect dischargers, EPA relies on 40 CFR Part 403.6(d), which prohibits dilution to achieve a categorical pretreatment standard. Hereafter, EPA refers to the limitations and standards for which compliance must be demonstrated in-plant as "in-plant limitations."

As set forth in more detail below, EPA is establishing in-plant limitations on bleach plant effluent because limitations imposed on those pollutants at the point of discharge are impractical and infeasible as measures of the performance of process technologies representing the technology-based levels of control. Moreover, in-plant effluent limitations are consistent with the MACT standards for chloroform, which independently require achievement of BAT limitations on dioxin, furan, chloroform, the 12 chlorinated phenolic pollutants, and (for indirect dischargers) AOX at the bleach plant in order to ensure that the removals represented by the MACT technology floor -- complete substitution of chlorine dioxide for elemental chlorine and elimination of hypochlorite -- are attained.

EPA's data show that mills using the model BAT, NSPS, PSES and PSNS technologies for Subparts B and E are able to achieve at the bleach plant concentrations of dioxin and the 12 chlorinated phenolic pollutants at levels below the minimum levels of currently available analytical methods. Furan concentrations, in turn, are very near the analytical minimum levels at Subpart B mills using the applicable model technologies and are below the minimum level for Subpart E mills using the model technologies corresponding to the segments in that Subpart. (At the end of the pipe, furan cannot be detected by available analytical methods in the effluent of many Subpart B mills.)

Because only 10 to 40 percent of the wastewater discharged by mills in Subpart B originates in the bleach plant, the concentrations of pollutants in the mills' final effluent would be one-tenth to two-fifths of their concentrations at the bleach plant. Substantial dilution can also occur at Subpart E mills. In the biological wastewater treatment system, the pollutants may be present but in concentrations below the applicable analytical minimum levels. When they are discharged to receiving streams, however, dioxin and furan bioaccumulate in aquatic organisms.

Were EPA to allow compliance monitoring of the final effluent, no way would be available to determine whether the bleach plant effluent has been adequately controlled, or whether the effluent has simply been diluted to below the analytical minimum level by other flows. Diluting pollutants in this manner rather than preventing their discharge is inconsistent with achieving the removals represented by the technology-based levels of control, and hence with the purpose of the resulting limitations and standards. Dilution is also inconsistent with the goals of the Clean Water Act in general. Sections 101(a) and 301(b)(2)(A). While no mill is required to install EPA's model technologies, establishing limitations at the bleach plant is the only way EPA can ensure that none of these pollutants will be discharged at concentrations greater than the levels achievable through implementation of the best available technology. See E.I. du Pont de Nemours & Co. v. Train, 430 U.S. 112, 129 (1977).

With respect to the 12 chlorinated phenolic pollutants, EPA acknowledges that these pollutants could be degraded by biological treatment of the facility's combined wastewater. However, the same process technologies necessary to address dioxin and furan also reduce the levels of chlorinated phenolic pollutants to concentrations below minimum levels at the bleach plant. Commenters have supplied no data showing that the chlorinated phenolic pollutants should or indeed, as a practical matter, could be segregated from the dioxin- or furan-bearing wastestreams in order to fully use a mill's secondary treatment system. Nor is there any assurance that BAT limitations for these pollutants, if monitored at the end of the pipe, would be achieved by treatment rather than simply by the effects of dilution. See 40 CFR Part 122.45(h). Thus, EPA concludes that it is appropriate to require compliance monitoring for the limitations and standards on the 12 chlorinated phenolic pollutants at the point they most easily can be achieved and measured -- at the bleach plant.

In the case of chloroform, in-plant limits at Subpart B mills are authorized by 40 CFR Part 122.45(h) (for direct discharging mills) and 40 CFR Part 403.6(d) (for indirect discharging mills) because they offset the effects of dilution, in this case, the occurrence of uncontrolled volatilization. (Section 403.6(d) prohibits indirect dischargers from employing dilution as a substitute for treatment.) Limitations and standards at the point of effluent discharge are impractical and infeasible because chloroform would be lost as air emissions in wastewater conveyances and treatment facilities (e.g., collection boxes and aeration tanks). (For a discussion of the volatility of chloroform at Subpart B and E mills, see DCN 03815 and DCN 09323.) Such incidental air stripping not only would cause chloroform to be present in the final effluent at levels below detection (thus complicating compliance monitoring), but it also would be inconsistent with the model technology EPA has used as a basis for its limits. See CWA Section 301(b)(2)(A), 304(b)(2)(A) & (B). As is the case with dilution, EPA would have no way of knowing whether reductions in wastewater discharges are being achieved by application of BAT- or NSPS-level technologies or by air emissions (or dilution) in the wastewater conveyance and treatment facilities. In-plant limitations for chloroform also allow EPA to evaluate the environmental effectiveness of each mill's treatment and process technologies, information that could assist EPA at a later date in revising these effluent limitations guidelines and standards as the Clean Water Act contemplates. See CWA Section 308(a)(1). Moreover, in other regulatory contexts, EPA recognizes that dilution includes not only mixing a pollutant of concern with other

wastestreams, but also mixing it with excess air in the form of uncontrolled volatilization. See 52 FR 25760, 25778-79. Volatilization, like dilution, does nothing to remove, destroy, or immobilize pollutants, and for this reason is not in itself a form of treatment. Id. at 25779. The policy reasons supporting that principle in the hazardous waste context similarly apply here.

Finally, EPA is setting effluent limitations and standards at the bleach plant in order to avert the non-water quality environmental impacts caused by the volatilization of chloroform to the air and in order to be consistent with its Clean Air Act determination that the MACT floor for chloroform consists of bleach plant process modifications, i.e., complete chlorine dioxide substitution and elimination of hypochlorite as bleaching agents. Specifically, EPA is requiring under the Clean Air Act that chloroform emissions be controlled by complying with the BAT requirements for all regulated pollutants. See 40 CFR Part 63.445(d). Therefore, EPA has determined under its Clean Air Act authority that bleach plant technologies -- and bleach plant limitations on dioxin, furan, chloroform, the 12 chlorinated phenolics, and (for indirect dischargers) AOX -- are necessary to regulate air emissions of chloroform. The situation presented here is very different from the situation EPA faced when promulgating effluent limitations guidelines and standards for the organic chemicals, plastics, and synthetic fibers industrial category in 1987. See 52 FR 42522, 42658-62. In that rulemaking, the issue before EPA was whether to use in-plant limitations and standards to regulate air emissions of certain volatile and semi-volatile pollutants; EPA chose not to set in-plant requirements for that purpose because it determined that the regulation of such emissions was best accomplished in a Clean Air Act proceeding, which EPA was commencing at that time. See id. at 42560-62. In contrast, EPA in this rulemaking integrated its decision-making under the Clean Water Act and the Clean Air Act expressly to address these cross-media issues. (Indeed, the statutory provisions authorizing establishment of BAT limitations and NSPS, PSES, and PSNS specifically require EPA to consider non-water quality environmental impacts in promulgating such limitations and standards.) Taking into account both the air and water objectives of these Cluster Rules, EPA therefore concludes that it is highly appropriate for EPA to set effluent limitations and standards under the Clean Water Act to correspond to and support its concurrent regulation of air emissions under the Clean Air Act.

As noted above, EPA is requiring indirect dischargers subject to Subpart B to demonstrate compliance with AOX pretreatment standards at the bleach plant. (EPA is not specifying a point of compliance monitoring for AOX for direct discharging mills in Subpart B in this rule.) Like the pretreatment standards for dioxin, furan, chloroform, and the 12 chlorinated phenolic pollutants, the pretreatment standards for AOX are based exclusively on process changes. EPA expects that removals achieved by indirect dischargers employing the PSES or PSNS model technology (or its equivalent), in combination with removals achieved by biological treatment systems at POTWs, will be comparable to the AOX removals achieved by direct dischargers complying with BAT limitations or NSPS. Because biological treatment is not part of the PSES or PSNS model technology, EPA concluded that an end-of-pipe standard for AOX would simply reflect the effects of dilution, not treatment. Dilution is expressly prohibited by EPA's pretreatment regulations as a substitute for treatment. See 40 CFR Section 403.6(d). Therefore, EPA determined that the only practicable way of enforcing that provision and,

incidentally, measuring the effectiveness of a discharger's chosen PSES and PSNS technology is to require mills to demonstrate compliance with the AOX pretreatment standard at the bleach plant.

EPA received comments inquiring why EPA believed it was infeasible to measure compliance with a limitation of below the minimum level (or "<ML") at the end of the pipe, but not infeasible to measure compliance with the same <ML limitation at the bleach plant. (This comment is relevant to EPA's limitations and standards for dioxin and the 12 chlorinated phenolic pollutants, which are expressed as <ML at the bleach plant, but not to furan and chloroform, which have numeric values.) EPA concludes that the answer to this question lies in the fact that bleach plant effluent is not subject to dilution by other wastestreams. An effluent limitation of "<ML" measured at the end of the pipe (after the dioxin-bearing wastestream is diluted by a factor ranging from 2 to 10) is simply not equivalent to an effluent limitation of "<ML" measured at the bleach plant. Indeed, EPA's policy basis for establishing in-plant limitations rests largely on those differences. First, as required by CWA Section 304(b)(2)(A), bleach plant limitations of "<ML" represent, "in terms of amounts of constituents . . ., the degree of effluent reduction attainable through the application of the best control measures and practices achievable including treatment techniques, <u>process and procedure innovations, operating methods</u>, and other alternatives . . ." (emphasis supplied). A limitation of "<ML" at end-of-pipe could simply represent the degree of effluent reduction attainable through the effects of dilution; no assurance is given that the quantities of the pollutant -- in terms of mass -- have been reduced. Nor does a feasible way exist of determining the efficacy of the chosen treatment technology. Second, in-plant limitations in this rulemaking come closer to realizing the national goal of eliminating the discharge of pollutants. Although, for example, dioxin levels measured at end-of-pipe and dioxin levels measured at the bleach plant both would fall below the minimum level, dioxin-bearing wastestreams that are measured at "<ML" at the bleach plant and <u>then</u> diluted with other non-dioxin bearing wastewater may result in lower ultimate dioxin discharges than end-of-pipe limits alone could ensure. The same is true of furan and the chlorinated phenolic pollutants. Thus, requiring compliance monitoring at the bleach plant for these pollutants is far more consistent with the CWA's direction that BAT limitations "result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants" than the approach of requiring monitoring at the end of the pipe. See CWA Section 301(b)(2)(A). Finally, the environmental significance of in-plant versus end-of-pipe limits is very different, even though the receiving water receives, in both cases, amounts of the pollutants that are below the applicable minimum levels. Certain pollutants, like dioxin, are dangerous even in immeasurably small concentrations. To put this fact in perspective, EPA notes that the water quality criteria for dioxin is 0.013 ppq; in contrast, the minimum level at which current analytical methods can reliably measure dioxin is 10 ppq. Thus, even if the amount of dioxin in a mill's effluent is below 10 ppq, measured at the end of the pipe, the discharge could still result in pollutant loadings that are far greater than the quantities the water quality criterion deems acceptable to the environment. In contrast, if compliance is monitored at the bleach plant prior to dilution, EPA is assured that the pollutant loadings that are ultimately discharged are no greater than contemplated by the model technologies (if still unmeasurable). EPA is also aware that dioxin persists in the aquatic ecosystem and bioaccumulates in the food chain, thus

presenting long-term risks to human health, aquatic life and wildlife; consequently, each unit of mass removed from wastewater effluent is beneficial to the environment. For these reasons, EPA believes it has acted reasonably in interpreting the Clean Water Act to require dischargers to demonstrate compliance with technology-based limitations and standards at the bleach plant in this instance.

EPA exercised this authority in the effluent limitations guidelines and standards EPA promulgated in 1984 for the nonferrous metals manufacturing point source category (secondary aluminum smelting subcategory) as can be found in 40 CFR Part 421.32(e) (BAT), Part 421.34(e) (NSPS), Part 421.35(e) (PSES), Part 421.36(e) (PSNS); see 49 FR 8742, 8758-59. Under those regulations, dischargers must demonstrate compliance with the BAT limitations, new source performance standards, and pretreatment standards for total phenolics "at the source," which EPA defined as "at or before the commingling of delacquering scrubber liquor blowdown with other process or nonprocess wastewater." 40 CFR Part 421.31(c); see 49 Fed. Reg. at 8758-59. EPA based this decision on the possibility of significant dilution. See 49 Fed. Reg. at 8758-59. As explained in the preamble of that rule, EPA was concerned there, as here, that plants would be able to meet the limits for these toxic organic pollutants through dilution because, as is the case here, the pollutants are present in wastewater only from certain unit operations and in concentrations that could be reduced below analytical detection levels after commingling with other process wastewater. 49 Fed. Reg. at 8758-59; 48 Fed. Reg. 7032, 7056 (Feb. 17, 1983). EPA concluded that requiring compliance at the end of the pipe would contravene the strong policy of the Clean Water Act that pollutants be removed, not diluted, and for that reason proposed limitations on internal wastestreams. This provision was not contested and continues to apply today.

EPA received support from commenters, including at least one state, for its proposal to establish in-plant limitations in the Cluster Rules. The state commenter supported the use of in-plant limitations for dioxin and other pollutants as a way of ensuring that these pollutants have been "eliminated." While EPA cannot say on today's record that mills using chlorine or chlorine-containing compounds as part of their bleaching processes have "eliminated" dioxin discharges (even if the effluent is reported at below the applicable minimum level for dioxin), EPA agrees for the reasons set forth above that bleach plant limitations are necessary in order to ensure that limitations expressed as "<ML" are not achieved simply by dilution.

Industry commenters raise four principal objections to EPA's decision to impose limitations on certain pollutants at the point where the wastewater containing those pollutants leaves the bleach plant. First, they assert that the Clean Water Act authorizes EPA to regulate only discharges to waters of the United States and that EPA is overstepping this authority in imposing limits on internal wastestreams. Second, commenters assert that internal limitations may ignore or fail adequately to account for reductions in pollutant loadings that will occur before discharge, such as reductions attributable to secondary treatment. Third, commenters assert that limitations on internal points in effect constitute an unwarranted and unauthorized specification of technology and in effect may force a discharger to ignore or under-utilize expensive end-of-pipe treatment technologies, such as secondary treatment. Fourth, commenters

assert that, even if EPA possessed the legal authority to regulate internal wastestreams, EPA has failed to identify any exceptional circumstances that would justify in-plant limitations.

EPA disagrees with the first comment that it lacks the legal authority to impose limitations on internal wastestreams. EPA's regulation at 40 CFR Part 122.45(h) explicitly authorizes such limitations on a case-by-case basis; that regulation, which was promulgated in 1979, has been upheld by both U.S. Courts of Appeals that considered it. See Public Service Company of Colorado, Fort St. Vrain Station v. EPA, 949 F.2d 1063 (10th Cir. 1991); Texas Municipal Power Agency (TMPA) v. EPA, 836 F. 2d 1482 (5th Cir. 1988). EPA believes it is reasonable to exercise this case-by-case authority on a subcategory-wide basis because EPA's record shows that every permit writer is likely to encounter the same facts that EPA has identified to justify these in-plant limitations; indeed, no commenter has come forward with information demonstrating that the removals expected by the effluent limitations and standards for dioxin, furan and chloroform can be achieved by treatment after the bleach plant, or that the 12 chlorinated phenolic pollutants can be segregated from other wastestreams to avoid the problem of dilution. For these reasons, EPA foresees no situation at this time when a permit writer would reach a different conclusion on an individual permit basis. If over time, however, mills are able to demonstrate that they can achieve the applicable removals at the end of the pipe by treatment rather than by dilution or volatilization, or if new, approved analytical methods make it feasible to demonstrate compliance with the limitations or standards measured at the end of the pipe (taking dilution into account), then EPA will consider amending the rule to authorize those dischargers to demonstrate compliance at the end of the pipe rather than at bleach plant.

Commenters do not deny that, as a consequence of bleach plant operations, an "addition" of pollutants occurs to navigable waters or that such "addition" constitutes a discharge of pollutants subject to Clean Water Act regulation. However, they assert that EPA is authorized to control that "addition" only at the point at which the pollutant physically enters the receiving water. EPA disagrees that the Clean Water Act must be read so narrowly -- especially when applied to technology-based limitations. To the contrary, Congress defined the term "effluent limitations" to mean "any restriction" on "quantities, rates, and concentrations of . . . constituents which are discharged from point sources into navigable waters." Section 502(11). The term "discharge," in turn, applies to "any addition," and is to be broadly construed. Section 502(12); see United States v. Earth Sciences, Inc., 599 F.2d 368, 374 (10th Cir. 1979); SED, Inc. v. City of Dayton, 519 F. Supp. 979, 989 (S.D. Ohio 1981). Like section 301(a)'s prohibition on the discharge of "any pollutant," these definitions authorize EPA to impose any reasonable form of restriction on pollutants that will "eventually" be discharged into waters of the United States. Public Service Company of Colorado, 949 2d at 1065; see TMPA, 836 F. 2d at 1488-90. As the Fifth Circuit recognized in upholding EPA's internal wastestream rule, "it is sometimes necessary to regulate discharges within the treatment process to control discharges at the end." TMPA, 836 F.2d at 1488. The authority to establish effluent limitations thus includes, where appropriate, the authority to impose limitations on internal wastestreams. This authority is especially broad when, as here, the in-plant restrictions are designed to promote the Act's goals of eliminating, and not simply diluting or dispersing, pollution in effluent through technology-based limitations. See Chevron, U.S.A., Inc. v. NRDC, 467 U.S. 837, 843-44, 861 (1984); see,

e.g., Sections 101(a)(1), 101(a)(3), 301(b)(2)(A). The legislative history of the Clean Water Act also emphasizes that dischargers are not to employ dilution as an alternative to treatment.

Establishment of in-plant limitations is also authorized by section 402(a)(2), which directs EPA to prescribe conditions for NPDES permits to assure compliance with the requirements of section 402(a)(1), including section BAT limitations promulgated under section 301. See TMPA, 836 F.2d at 1489; Montgomery Environmental Coalition v. Costle, 646 F.2d 568, 586-87 (D.C. Cir. 1980). As the D.C. Circuit recognized, EPA's broad authority under section 402(a)(2) includes the authority to regulate inflows to treatment works, e.g., in the form of moratoria on sewer hook-ups to POTWs. Montgomery Environmental Coalition v. Costle, 646 F.2d at 588. EPA also relies on the regulation prohibiting the use of dilution to meet categorical pretreatment standards, 40 CFR Part 403.6(d), for authority to impose in-plant limitations on indirect dischargers.

EPA also acknowledges comments asserting that EPA lacks authority to regulate internal wastestreams because they are not waters of the United States. Because EPA is not basing its authority on the possible status of internal wastestreams as waters of the United States, this additional argument by commenters requires no response.

EPA acknowledges that the U.S. Court of Appeals for the District of Columbia Circuit recently ruled that EPA lacks the legal authority to impose "water quality-based standards upon internal facility waste streams." American Iron and Steel Institute (AISI) v. EPA, 115 F.3d 979, 996 (D.C. Cir. 1997). The issue arose in the context of a challenge to EPA's regulations implementing the Great Lakes Critical Programs Act, 33 U.S.C. Part 1268. In its regulations, EPA promulgated a procedure, applicable only to states in the Great Lakes System, that provides that when a permit includes a water quality-based effluent limitation below the level of quantification, the permit must also require the permittee to develop and conduct a pollutant minimization program (PMP), which includes among other things, a control strategy. See 40 CFR Part 132 App. F, Procedure 8.D. Procedure 8.D.1. states that the goal of a PMP is "to reduce all potential sources of the pollutant to maintain the effluent at or below the Water Quality Based Effluent Limitations." It further states that the control strategies should be "designed to proceed toward the goal of maintaining all sources of the pollutant to the wastewater collection system below the WQBEL." See Procedure 8.D.3. Industry litigants challenged these provisions, claiming that they would be used to set internal waste stream WQBELs. The Court held that although EPA has the authority to require monitoring of internal wastestreams, see AISI, 115 F.3d at 995, the Clean Water Act does not authorize EPA to require compliance with a WQBEL at a point inside the facility and thereby deprive a permittee of the ability to choose its own control system to meet the WQBEL, see id. at 996. Therefore, the Court vacated Procedure 8.D. "insofar as it would impose the point-source WQBEL upon a facility's internal waste streams." Id.

EPA does not believe that decision controls here. First, the court did not consider or rule upon the regulations upon which EPA bases the in-plant limitations for these Cluster Rules, to wit, 40 CFR Part 122.44(i), 122.45(h), 125.3(e), and 403.6(d). Therefore, those

regulations, upheld by the Fifth and Tenth Circuits, continue to have force and effect. Second, the AISI court did not consider the question whether EPA has authority to regulate internal wastestreams in the context of technology-based controls. Unlike water quality-based effluent limitations, which are calculated to ensure that water quality standards for the receiving water are attained, technology-based limitations and standards are derived to measure the performance of specific model technologies that EPA is required by statute to identify. In identifying these technologies, EPA is directed to consider precisely the type of internal controls that are irrelevant to the development of water quality-based effluent limitations, such as the processes employed, process changes, and the engineering aspects of applying various types of control techniques. See CWA Sections 304(b)(2)(B), 306(a)(1), 307(b) & (c). Indeed, EPA's regulations must identify the degree of effluent reduction attainable through the application of BAT-level process and procedure innovations, operating methods, and other control measures and practices for the subcategory being regulated. CWA Section 304(b)(2)(A). Limitations applied at the bleach plant represent the degree of effluent reduction EPA has determined is attainable by the BAT, NSPS, PSES, and PSNS model technologies. Thus, they are consistent with the long-recognized principle that technology-based limitations are intended to reflect, for each industrial category or subcategory, the "base level" of technology (including process changes) and to ensure that "'in no case . . . should any plant be allowed to discharge more pollutants per unit of production than is defined by that base level." E.I. du Pont de Nemours & Co. v. Train, 430 U.S. at 129, quoting S. Rep. No. 414, 92d Cong., 1st Sess 50, reprinted in A Legislative History of the Water Pollution Control Act Amendments of 1972, at 1468 (1973).

EPA also rejects as inapposite the commenters' second objection -- that in-plant limitations may ignore or fail adequately to account for reductions in pollutant loadings that will occur after the bleach plant but before discharge, such as reductions attributable to secondary treatment. Under Sections 301(b)(2) and 304(b)(2), EPA is required to establish effluent limitations guidelines and standards that reflect, for example, the best available technology economically achievable for the particular pollutants of concern. While the model BAT and NSPS technologies for Subcategory B includes secondary biological treatment to address AOX loadings, the model BAT and NSPS technologies for dioxin, furan, chloroform and the 12 chlorinated phenolic compounds (and, for PSES and PSNS, AOX) consist exclusively of a sequence of in-plant processes, including improved brown stock washing, elimination of hypochlorite and complete substitution of chlorine dioxide for elemental chlorine, which are employed at the pulp mill and the bleach plant. The bleach plant limitations and standards codified today thus fully account for the model technologies and processes upon which they were based. In EPA's view, these processes, not end-of-pipe biological treatment, represent the best, most efficient methods of minimizing the discharge of dioxin, furan, chloroform, the 12 chlorinated phenolics, and (for indirect dischargers) AOX, and moving toward the ultimate BAT goal of eliminating their discharge altogether. See CWA Sections 101(a)(1) and 301(b)(2)(A). Moreover, commenters have failed to supply any data demonstrating that dioxin and furan can be effectively treated by biological treatment processes. Results of the Five-Mill Study and the 104-Mill Study show that dioxin and furan are not removed by biological treatment systems at direct discharging BPK and PS mills (8,9). Rather, these pollutants were found to either partition to the secondary sludge of a biological treatment system or pass through untreated. The partitioning

was neither consistent nor predictable. (If dischargers ultimately can make this showing, EPA would consider amending the regulation.) With respect to the 12 chlorinated phenolic compounds, EPA acknowledges that these pollutants can be treated using biological treatment. However, as noted above, the same process technologies necessary to address dioxin and furan also, as an ancillary matter, reduce the levels of chlorinated phenolics to nondetectable concentrations at the bleach plant. Moreover, without bleach plant limitations on these pollutants, EPA would have no assurance that limitations are being achieved by treatment rather than simply dilution, and that the pollutants are being removed.

EPA also disagrees with the third comment. Contrary to the commenters' assertions, the establishment of in-plant limitations does not have the effect of unlawfully dictating a particular technology or process. While EPA's model technologies indisputably rely on a particular sequence of process changes, which is expressly authorized under section 304(b)(2)(A)&(B), mills remain free to develop and implement any combination of processes and technologies, including but not limited to chemical substitution, to achieve the limitations and standards. The only "treatment" essentially precluded by the in-plant limitations and NSPS, PSES, and PSNS is dilution of bleach plant effluent with effluent from other mill processes, which is not BAT/NSPS and, in the case of pretreatment standards, is explicitly prohibited by other regulations. See 40 CFR Part 403.6(d).

EPA concludes that commenters' fourth objection also has no merit. They argue that EPA's determination in this rulemaking that end-of-pipe limitations BAT on pulp and paper effluent are infeasible or impracticable is inconsistent with 1990 guidance to permit writers that characterized such limitations as appropriate. EPA disagrees with commenters' interpretation of that guidance. Entitled "Strategy for the Regulation of Discharges of PHDDs and PHDFs from Pulp and Paper Mills to Waters of the United States" (May 21, 1990) (DCN 03960), the guidance specifically urged permit writers to impose limitations on dioxin at the bleach plant when measuring discharges of those pollutants at the end of the pipe was impracticable or infeasible. This guidance was consistent with EPA's custom of giving the permit writer discretion to determine the appropriate point of regulation on a case-by-case basis and reflected EPA's belief at the time that some mills could demonstrate dioxin removals by wastewater treatment facilities. DCN 03960 at 20. Based on the data assembled as part of this rulemaking, however, EPA has determined that no mills today have made that showing. Therefore, as discussed in more detail above, EPA concluded that it is appropriate to impose in-plant limitations on dioxin on a categorical, rather than case-by-case, basis.

Several commenters also challenge EPA's finding that chloroform volatilizes en route to and during wastewater treatment, although they offer no data to contradict the data and analyses supporting EPA's conclusion. Indeed, EPA's data show that chloroform levels are easily quantified at the bleach plant but cannot be reliably measured in the final effluent. These data refute some commenters' unsupported assertion that chloroform levels can be reliably measured at the end of the pipe. EPA has found that bleach plant chloroform loadings are lower at mills that have greater contact between bleach plant filtrates and air (e.g., mills that use high air flow vacuum drum washers) compared to those mills that have less air contact (e.g., low air

flow pressure diffusion washers or compaction baffle washers). This suggests that much of the chloroform generated in the bleach plant is easily stripped by exposure to air. Thus, EPA has concluded that the majority of chloroform removed in biological treatment systems is removed by air stripping, not biological degradation. NCASI studied air and water concentrations of chloroform around four bleached kraft mill wastewater treatment systems and concluded that "significant reductions in aqueous chloroform concentrations were observed across flumes and other points of turbulence in the treatment system. Typically the majority of the chloroform was removed in the first third of the effluent treatment systems." (NCASI Technical Bulletin 642, DCN 09323).

In addition, EPA disagrees with comments asserting that volatilization is not an "exceptional circumstance" justifying limitations on internal wastestreams. While EPA agrees that volatilization is not listed as an "exceptional circumstance" identified in the internal wastestream rule to justify in-plant limitations, see 40 CFR Part 122.45(h)(2), EPA notes that the list is merely illustrative and not exhaustive. Moreover, volatilization is reasonably equivalent to the dilution example provided in the regulation, insofar as the particular pollutant is reduced to non-quantifiable levels for reasons unrelated to treatment. See supra. Therefore, EPA believes that volatilization, like dilution, constitutes an exceptionable circumstance within the scope of 40 CFR Part 122.45(h).

Finally, EPA disagrees that EPA lacks the legal authority to consider air impacts when setting BAT effluent limitations. EPA is clearly authorized under Section 304(b)(2)(B) to consider non-water quality environmental impacts when choosing BAT and, consequently, setting effluent limitations based on that model BAT technology. See also CWA Sections 306(b)(1)(B), 307(b) & (c). It follows therefore that EPA can take non-water quality environmental impacts into account when choosing the point of regulation for its BAT limits. Indeed, the legislative history and case law interpreting this statutory authority emphasize that EPA was not to achieve effluent reductions at the expense of other environmental media. See, e.g., BP Exploration & Oil, Inc. v. EPA, 66 F.2d 784, 800-02 (6th Cir. 1995); Weyerhaeuser Co. v. Costle, 590 F.2d 1011, 1052-53 (D.C. Cir. 1978). Thus, in this instance, not only is chloroform reliably and feasibly measured at the bleach plant (when this is not the case at the end of the pipe), but in-plant limitations also prevent adverse air impacts that might ensue from end-of-pipe limits. Finally, chloroform's volatile nature and the significance of air impacts from volatilization is evidenced by EPA's decision to impose MACT standards for chloroform at the bleach plant.

8.3 Conventional Pollutants

EPA proposed revised effluent limitations guidelines for control of conventional pollutant discharges via the following regulations: BPT, BCT, and NSPS. This section provides a description of EPA's approach to control option development for conventional pollutants for the proposed rule, revisions to EPA's approach and data set used to develop the control options, revised control option performance levels for the final rule, and descriptions of the technology bases for the final conventional pollutant control options.

8.3.1 Approach to Option Development

Secondary treatment includes biological or chemical processes used to remove suspended and soluble organic matter from wastewater. Secondary treatment, in conjunction with good water conservation practices, constitutes the technology basis for the current conventional pollutant limitations for bleached papergrade kraft and soda mills and papergrade sulfite mills. With the exception of one bleached papergrade kraft mill that discharges to territorial seas of the United States and one which uses land disposal for its primary treated waste, all of the direct-discharging bleached papergrade kraft and soda mills and direct-discharging papergrade sulfite mills operate secondary biological wastewater treatment systems. Secondary biological wastewater treatment removes organic matter through biochemical oxidation. Activated sludge systems and aerated/non-aerated basin systems are the most commonly used biological processes. As needed, secondary biological treatment in the pulp and paper industry is preceded by pretreatment (e.g., equalization, neutralization, cooling) and primary treatment (e.g., clarifiers) for the removal of settleable solids.

Tertiary treatment is advanced treatment, beyond secondary biological treatment, to remove particular contaminants. Common tertiary treatment operations in municipal and industrial wastewater treatment systems are the removal of phosphorus by alum precipitation, removal of toxic refractory organic compounds by activated carbon adsorption, and removal of TSS by multimedia filtration. Tertiary treatment is not common in the pulp and paper industry.

The Agency proposed to develop effluent limitations guidelines for conventional pollutants based on secondary biological wastewater treatment with appropriate water use and reuse because almost all direct-discharging mills used secondary treatment. Elements of a secondary biological wastewater treatment train, as practiced in the pulp and paper industry, may include (but are not limited to):

- Equalization;
- Neutralization;
- Precooling;
- Primary sedimentation;
- Nutrient addition;
- Aeration;
- Addition of flocculants to secondary clarifiers to improve settling;
- Multi-basin systems, some of which act as polishing ponds; and

` Mixed or hybrid treatment systems (activated sludge and basin systems operated in series or parallel).

Some of the aerated stabilization basin treatment systems in use in the industry cover large areas. Some mills operate their treatment systems to meet water quality-based discharge limitations. Other treatment systems were enlarged in an add-on manner as the capacity of the mill increased over time. The Agency considers all of these scenarios as typical of pulp and paper industry wastewater treatment practice, and included all of them in characterizing pulp and paper industry secondary biological wastewater treatment performance.

The proposed revised effluent limitations guidelines were developed in seven steps:

1. Identification of mills representing the performance of secondary wastewater treatment in each subcategory;

2. Analysis of the performance (in terms of production-normalized final effluent BOD_5 load) of the representative mills to determine "the average of the best existing performance";

3. Identification of combinations of in-process flow reduction and end-of-pipe wastewater treatment used by the industry to achieve these performance levels;

4. Estimation of the cost of applying these identified technologies at mills that do not currently achieve "the average of the best existing performance";

5. Estimation of the benefits of applying the identified technologies, in terms of the reduction in the mass of conventional pollutants discharged;

6. Comparison of the estimated costs and benefits; and

7. Review of non-water quality environmental impacts.

The remainder of this section describes Items 1, 2, and 3: the identification of mills representing secondary treatment performance, the determination of conventional pollutant control option performance levels, and identification of technologies used by the industry to achieve the conventional pollutant control option performance levels.

8.3.2 Identification of Mills Representing Secondary Wastewater Treatment Performance in Each Subcategory

To identify mills representing the performance of secondary wastewater treatment in each subcategory, the Agency began with the list of mills that responded to the 1990 census questionnaire (1) and deleted mills from the list that were not considered representative of secondary biological treatment system design, operation, and performance as practiced by mills in each subcategory. Deleted mills included primarily indirect-discharging mills and "multiple" subcategory mills (discussed below).

Ideally, only mills with all of their final off-machine production in a single subcategory would be used to represent the performance of secondary biological wastewater treatment for that subcategory. After application of the mill selection parameters, both the Bleached Papergrade Kraft and Soda and the Papergrade Sulfite subcategories included few or no mills with all of their production in a single subcategory, reflecting the actual composition of the U.S. pulp and paper industry (a typical mill has operations in more than one subcategory). To account for this situation, while at the same time reflecting the characteristics of the principal subcategory at a mill, the Agency chose to use mills with a large percentage of their final production in a single subcategory to represent the subcategory. For the Bleached Papergrade Kraft and Soda Subcategory, the Agency selected a final production cut-off of 85 percent within this subcategory for a mill to be considered representative of the subcategory. For the Papergrade Sulfite Subcategory, the Agency selected mills with papergrade sulfite pulp comprising 37 to 96 percent of their final production.

8.3.2.1 Summary and Analysis of Comments Submitted Concerning Identification of Mills Representing the Performance of Secondary Biological Wastewater Treatment

Several comments were submitted concerning the selection of mills representing the performance of secondary biological wastewater treatment. Commenters expressed concern that EPA used several mills to represent the Bleached Papergrade Kraft and Soda Subcategory that commenters believed had wastewater treatment operations that are not common practice in the industry, or that commenters believed achieved performance levels better than those levels achieved by the BPT/BCT technology basis. Specific issues are described below.

- EPA included mills with multiple basins, particularly holding and polishing ponds, that have residence times longer than those typical in the industry.

- EPA included mills with equalization of wastewater prior to secondary biological treatment, which were asserted not to be common industry practice.

EPA included mills that have mixed treatment systems (i.e., treatment systems including both activated sludge treatment and basins), which was asserted as not common industry practice.

EPA included mills that have chemically assisted clarification to enhance pollutant removals, which was asserted not to be common industry practice. In particular, mills using unusually large amounts of coagulant should have been excluded.

EPA included mills that discharge to water quality limited streams.

Because several commenters criticized EPA for using mills with "atypical" treatment to represent the subcategory, the Agency undertook an analysis to determine what constituted typical wastewater treatment for the Bleached Papergrade Kraft and Soda Subcategory. To describe "typical" wastewater treatment at bleached kraft mills, EPA reviewed and summarized the treatment systems for all direct-discharging mills that have the highest percentage of their production in the bleached kraft subcategory. EPA also analyzed treatment operation and performance data in response to the commenters' criticisms mentioned above. Data used for the analysis were obtained from mill responses to the 1990 census questionnaire and supplemental data from comments and site visit reports, where available. Note that for this analysis, treatment performance is measured by final effluent production-normalized loads, consistent with development of BPT/BCT performance levels, not treatment efficiency (i.e., percent removal) or effluent concentrations. The results of these analyses are discussed in the rulemaking record (2) and are summarized below.

Basin System Residence Times - EPA analyzed the relationship between total basin (aerated plus non-aerated basins) residence time versus effluent BOD_5 and TSS loads by plotting residence time versus load. The plots do not suggest any obvious relationship between basin residence time and treatment performance; the best performing mills have a wide range of residence times. BOD_5 and TSS loads were also plotted versus aerated basin residence time. These plots also show that no well-defined correlation exists between aerated basin residence time and performance.

Polishing/Holding Ponds - EPA ranked mills in order of both effluent BOD_5 and TSS loads, distinguishing between mills with and without polishing/holding ponds. A mill was considered to have a polishing/holding pond if the last treatment unit in its wastewater treatment system before discharge was a non-aerated basin. The rankings indicate that use of polishing/holding ponds is common practice - 46 percent of mills have at least one such pond - and that mills without polishing ponds perform as well (or as poorly) as mills with polishing ponds.

Several mills have large holding ponds to control effluent flow during low flow seasons. Data from one mill that controls effluent flow indicate that performance was approximately the same when the holding pond was bypassed as when it was used, suggesting that holding ponds function as flow-control devices, not treatment units (3).

Equalization - EPA ranked mills in order of both effluent BOD_5 and TSS loads, distinguishing between mills with and without equalization. Equalization in the industry is used predominantly prior to activated sludge treatment to dampen the effect of shock loads on activated sludge systems which are more sensitive to upsets than basins. The rankings indicate that approximately 15 percent of activated sludge systems industry wide and 20 percent of bleached kraft activated sludge systems have equalization, and that mills without equalization achieve the same level of performance as mills with equalization.

Mixed Treatment Systems - EPA ranked mills in order of both effluent BOD_5 and TSS loads, distinguishing between mills with and without mixed treatment systems. More than one-third of bleached papergrade kraft activated sludge systems and about 24 percent of activated sludge systems industry wide are mixed systems, indicating that mixed systems are common. The range of treatment performance at mills with mixed treatment systems is comparable to the range at mills without mixed treatment systems.

Chemically Assisted Clarification - EPA ranked mills in order of both effluent BOD_5 and TSS loads, distinguishing between mills with and without chemically assisted clarification. Mills having chemically assisted clarification achieve BOD_5 and TSS levels across a smaller and overall lower range than mills without chemically assisted clarification; however, the three and six best performing mills in terms of BOD_5 and TSS, respectively, do not use chemically assisted clarification.

EPA further investigated treatment systems that include addition of coagulants/ flocculants to secondary clarifiers to learn more about why this chemical addition was practiced. Data used for the analysis included NCASI's 1993 survey of coagulant used at 33 bleached kraft mills (4) and phone contacts with nine mills (5). Based on this analysis, EPA determined that the secondary biological wastewater treatment systems of two mills are not considered typical secondary treatment as practiced by the Bleached Papergrade Kraft and Soda Subcategory because they added very high quantities of chemicals (i.e., chemical addition costs in excess of $5,000 per day) for the removal of color--a treatment that is not necessary to achieve the proposed TSS limitations. Treatment performance data for these systems were eliminated from the data set used to characterize typical treatment effluent loadings of conventional pollutants.

Discharge to Water Quality Limited Streams - Simply because a mill is required to meet water quality-based effluent limits for BOD_5 and/or TSS does not mean that its treatment system is atypical. Unusual equipment or unusual operating practices do not appear to be required to meet the water quality-based effluent limits. Rather, secondary biological treatment systems are capable of discharging at levels that will achieve water quality-based effluent limits in certain streams.

Based on these analyses, EPA believes that it would be inappropriate and arbitrary to eliminate mills from the secondary wastewater treatment performance data set simply because they operate wastewater treatment systems with relatively long aerated basin residence times, or

operate common biological treatment components such as polishing/holding ponds, equalization, mixed treatment systems, or chemically assisted clarification.

8.3.2.2 Adjustments to the Selection of Data to Represent the Performance of Secondary Biological Wastewater Treatment

This section discusses the adjustments EPA made after proposal to the selection of data used to represent the performance of secondary biological wastewater treatment. Adjustments include revisions to the performance data, clarification of the conventional pollutant control option technology bases, and revision of the data selection methodology for the Papergrade Sulfite Subcategory.

Revisions to the Performance Data

One mill was not used to represent secondary wastewater treatment effluent loads for the Bleached Papergrade Kraft and Soda Subcategory during the development of the proposed conventional pollutant limitations because it was incorrectly classified as having less than 85 percent of its production in the subcategory. In fact, 100 percent of its production is bleached kraft. Therefore, performance data for this mill were included in the development of the final secondary biological wastewater treatment performance levels for the Bleached Papergrade Kraft and Soda Subcategory.

EPA determined that the production data used at proposal to characterize the loadings from another mill were not correct. This sulfite mill sold virtually all of its production in the form of slush pulp to a neighboring paper mill (that had no other source of pulp). The effluent from the two mills was combined for treatment. For the proposed rule, EPA evaluated the performance data for the combined wastewater treatment system based on the combined final production from both mills (i.e., slush pulp and pulp sold off-site from the pulp mill plus paper from the paper mill) consistent with the methodology used for other combined wastewater treatment systems in the industry. Because the pulp is transported to the second mill as slush pulp, EPA determined that a more appropriate methodology for evaluating performance data for this combined wastewater treatment system would be to use the total off-machine production from the two mills (i.e., pulp sold off-site from the pulp mill and paper from the paper mill). With this change, more than 85 percent of the combined mill final production was derived from sulfite pulp manufactured at the mill complex.

EPA determined that one mill whose data were used at proposal to represent the performance of the proposed conventional pollutant control options for the Papergrade Sulfite Subcategory was not representative of the subcategory as a whole because it treats wastewater from liquor by-products manufactured on site. Because this mill is unique among papergrade sulfite mills, performance data from this mill were eliminated from development of the final secondary biological wastewater treatment performance levels for the Papergrade Sulfite Subcategory.

Clarification of the Conventional Pollutant Control Option Technology Basis

As discussed previously, EPA further investigated treatment systems that include addition of coagulant/flocculants to secondary clarifiers. Based on this analysis, EPA determined that the secondary biological wastewater treatment systems at two mills are not considered typical secondary treatment as practiced by the Bleached Papergrade Kraft and Soda Subcategory because of the addition of large quantities of chemicals for the removal of color. Treatment performance data for these two systems were eliminated from the data set used to characterize typical treatment effluent loadings of conventional pollutants for this subcategory.

EPA also further evaluated wastewater treatment operations at one mill to determine whether the treatment system represents typical secondary biological wastewater treatment for the Papergrade Sulfite Subcategory. This facility uses a high rate activated sludge treatment system to treat only a portion of their total mill wastewater effluent. The facility decided to treat only a portion of its wastewater flow due to land availability limitations, and treats only the most concentrated BOD_5 wastewater streams to a higher removal efficiency. The treated effluent is then combined with the untreated wastestream resulting in a combined effluent which meets the facility's permit limitations. This practice of treating only the most concentrated wastewater streams results in a great reduction in the size of the wastewater treatment facility required, saving both space and cost. Because the total effluent BOD_5 load discharged from this facility is less than the current effluent limitations guidelines which were the basis for the design of the wastewater treatment facility, EPA considers this treatment system to be representative of the performance attainable through secondary treatment as typically practiced at similar facilities, and considers performance data from this facility as appropriate for use developing the conventional pollutant control option performance levels.

Data Selection Methodology for the Papergrade Sulfite Subcategory

The Papergrade Sulfite Subcategory is characterized by mills whose final production is often comprised of a large portion of purchased pulp. For the proposed rule, BPT and BCT option performance levels for the subcategory were calculated using data from mills with 37 to 96 percent on their final production in the subcategory in order to expand the population of data used. This approach was a relaxation of the criteria used for other subcategories which included data from only mills with at least 85 percent of their final production in the subcategory.

After proposal, EPA reassessed the impact of purchased pulp on the final effluent BOD_5 load at papergrade sulfite mills. EPA performed further analyses of the data set, after incorporating the revisions discussed above, to evaluate the relationship between final effluent BOD_5 and TSS loads and the percentage of sulfite production at each mill. EPA determined that mills with 85 percent or more of final off-machine production derived from sulfite pulp produced on site discharged substantially higher BOD_5 loads from secondary biological wastewater treatment than mills with less than 85 percent of final off-machine production derived from sulfite pulp produced on site. Consequently, EPA revised the methodology used to identify mills

representing the performance of secondary wastewater treatment for the Papergrade Sulfite Subcategory to include a final production cut-off of 85 percent for this subcategory.

Final List of Mills Identified as Representing Secondary Biological Wastewater Treatment

Tables 8-1 and 8-2 present the final list of mills identified as representing secondary wastewater treatment performance for both the Bleached Papergrade Kraft and Soda and the Papergrade Sulfite Subcategories, respectively. Using performance data from these mills, EPA calculated final conventional pollutant control option performance levels for both subcategories as discussed in the following subsection.

8.3.3 Control Options and Performance Levels

EPA's methodology for calculating conventional pollutant control option performance levels is described in Section 9.2.3 of the Proposed Technical Development Document. This methodology is unchanged from the proposed rule with the exceptions described below.

8.3.3.1 BPT

For the proposed rule, EPA developed two options based on the average of the best existing performance. These options were:

Option 1: The performance level representing the average of the best 90 percent of mills in each subcategory; and

Option 2: The performance level representing the average of the best 50 percent of mills in each subcategory.

Although the Agency has the statutory authority to revise BPT, the Agency also has the discretion to determine whether to revise BPT effluent limitations guidelines in particular circumstances. For the final rule, the Agency is exercising its discretion not to revise BPT for conventional pollutants for Subpart B and E at this time.

8.3.3.2 BCT

For the proposed rule, EPA developed four options based on the best conventional pollutant control technology. These options were:

Option A.1: The performance level represented by the best-performing mill in each subcategory assuming the baseline performance is equal to the proposed BPT Option 2;

Option A.2: Multimedia filtration assuming the baseline performance is equal to the proposed BPT Option 2;

Option B.1: The performance level representing the average of the best 90 percent of mills in each subcategory assuming the baseline performance is equal to current industry performance; and

Option B.2: The performance level representing the average of the best 50 percent of mills in each subcategory assuming the baseline performance is equal to current industry performance.

Two of these options, Options A.1 and A.2, assumed the baseline performance to be equal to the proposed BPT Option 2. Because EPA has decided not to revise BPT limitations for conventional pollutants, these two BCT options are no longer applicable. Therefore, for the final rule for the Bleached Papergrade Kraft and Soda Subcategory, EPA only considered BCT Options B.1 and B.2, known now simply as BCT Options 1 and 2.

For the final rule for the Papergrade Sulfite Subcategory, EPA revised the BCT development methodology to include only one treatment option as follows:

Option 1: The performance level representing the average performance of all mills identified as representing the performance of secondary wastewater treatment for the subcategory.

EPA believes this revision is appropriate since the revised data set for this subcategory contains performance data from only three mills.

The proposed BCT option performance levels and the final BCT option performance levels are listed below. The best performing mills whose long-term average production-normalized mass loadings were used to calculate BCT Options 1 and 2 performance levels for the Bleached Papergrade Kraft and Soda Subcategory and BCT Option 1 performance levels for the Papergrade Sulfite Subcategory are indicated in Tables 8-1 and 8-2, respectively.

Bleached Papergrade Kraft and Soda Subcategory
Long-Term Average Loads

BCT Option	BOD_5 Performance Level (kg/OMMT)		TSS Performance Level (kg/OMMT)	
	Proposed	Final	Proposed	Final
Option 1	2.65	2.73	4.46	4.40
Option 2	1.57	1.73	2.72	2.72

Papergrade Sulfite Subcategory
Long-Term Average Loads

BCT Option	BOD_5 Performance Level (kg/OMMT)		TSS Performance Level (kg/OMMT)	
	Proposed	Final	Proposed	Final
Option 1	4.97	7.05	5.46	8.37
Option 2	3.60	Not Applicable	4.74	Not Applicable

8.3.4 Description of Technology Bases

For the proposed and final rules, the conventional pollutant technology bases include two components, good water conservation practices and secondary biological wastewater treatment. These two technology components are discussed in detail in Section 9.2.5 of the Proposed Technical Development Document.

8.4 BAT

After re-evaluating technologies for mills in the Bleached Papergrade Kraft and Soda Subcategory, EPA determined that the model technology for effluent limitations guidelines based on BAT should be Option A. The key process technology for Option A is complete (100 percent) substitution of chlorine dioxide for chlorine, along with other in-process technologies and existing end-of-pipe biological treatment technologies listed in Section 8.2.1.1. Section 7 contains a description of the pollution prevention technologies considered for Option A. The reasons for EPA's selection of Option A as the basis of BAT for the Bleached Papergrade Kraft and Soda Subcategory are stated in the preamble.

The basis for BAT for the three segments of the papergrade sulfite subcategory is as described in Section 8.2.2, i.e., the option that EPA developed for each segment also serves as the basis for BAT for each segment.

8.5 BPT

Although the Agency has the statutory authority to revise BPT, the Agency also has the discretion to determine whether to revise BPT effluent limitations guidelines in particular circumstances. For the final rule, the Agency is exercising its discretion not to revise BPT for conventional pollutants for Subpart B and E at this time.

8.6 BCT

EPA evaluated two technology options for BCT for the Bleached Papergrade Kraft and Soda Subcategory and one technology option for the Papergrade Sulfite Subcategory.

EPA is not revising BCT limitations for these subcategories because more stringent effluent limitations for conventional pollutants did not pass the BCT cost test.

8.7 NSPS

NSPS for conventional and toxic and nonconventional pollutants are discussed below.

8.7.1 Conventionals

For the control of conventional pollutants in the proposed rule, EPA considered the best demonstrated end-of-pipe treatment. The performance level for this option was equivalent to that for proposed BCT Option A.1 (the performance level represented by the best-performing mill in each subcategory).

For the final rule for the Bleached Papergrade Kraft and Soda Subcategory, the Agency considered two options as follows:

Option 1: The performance level represented by the best-performing mill in the subcategory (equivalent to the proposed NSPS option); and

Option 2: The performance level representing the average of the best 50 percent of mills in the subcategory (equivalent to BCT Option 2).

For the final rule, EPA selected NSPS Option 2 because the Agency determined that the performance of the single best mill does not account for all sources of process-related variability in conventional pollutant generation and treatability expected in the entire subcategory, including raw materials (i.e., furnish), process operations, and final products. In selecting the final NSPS technology basis for conventional pollutants, EPA found it necessary to consider the secondary wastewater treatment performance of the best 50 percent of existing mills in this subcategory in order to ensure that the resulting standards reflect the full range of processes and raw materials to produce the full range of products covered by this subcategory. Therefore, EPA is promulgating NSPS for the conventional pollutants BOD_5 and TSS, based on efficient biological treatment achieving removal of 90 percent or more of influent BOD_5 and is retaining the pH NSPS promulgated in 1982.

For the final rule for the Papergrade Sulfite Subcategory, the Agency concluded that data in the record are not representative of the performance that can be achieved in the papergrade subcategory as a whole. Therefore, the conventional pollutant limitations in the 1982 NSPS regulation will be retained in the final NSPS regulations.

8.7.2 Toxics and Nonconventionals

For bleached papergrade kraft and soda mills, the Agency focussed its analysis on Option B as the technology basis for defining NSPS for toxics and nonconventional pollutants. This option includes all the elements of Option A with the addition of oxygen delignification and/or extended cooking. Section 8.2.1.2 describes this key difference between Option A and Option B (Sections 7.2.3 and 7.2.6 contain more detailed descriptions of each technology).

EPA received comments that NSPS should be based on TCF bleaching technologies and flow reduction technologies such as those technologies that form the basis of the Voluntary Advanced Technology Incentives Program Tiers II and III. EPA does not intend that NSPS should prevent the manufacture of any products currently made by the U.S. pulp and paper industry. Thus, EPA assumed at proposal, and continues to assume that the same grades of pulp will be made by new source mills as are made by existing mills. In addition, these new source mills will produce pulp for the same range of paper and paperboard products as do existing pulp producers. As discussed in this section, EPA has determined that data available in the record are not sufficient to confirm that TCF bleaching processes are technically demonstrated for the full range of products made with bleached kraft pulp. For the majority of applications, the most important bleached kraft pulp quality requirements are strength and brightness. EPA's record discussed in Sections 8.7.2.2 to 8.7.2.4, confirms that fully bright and strong kraft pulps can be made using TCF bleaching processes (7,8). EPA however, lacks data on the use of TCF for certain applications with other quality requirements, specifically:

Tissue, which requires soft, absorbent pulp, with good runnability on tissue machines; and

Food-grade liner board, which requires pulp with low extractives content to prevent taste and odor transfer.

The data are not sufficient to confirm that pulp made with TCF processes is or is not feasible for these applications, i.e., EPA does not have sufficient data to establish subcategories based on end products for which TCF pulp is usable. EPA is inviting interested parties to supply more data on the full range of products currently made with TCF-bleached kraft pulps. EPA will evaluate these data, and determine whether to propose revisions to NSPS based on TCF and, if appropriate, flow reduction technologies.

EPA evaluated TCF bleaching as part of the technology basis for the Voluntary Advanced Technology Incentives Program. EPA has identified a "Toward-TCF" option as one of the technology bases of Incentive Tier II, and a TCF option as one of the technology bases of Incentive Tier III. See the Voluntary Advanced Technology Incentives Program Technical Support Document for additional detail on these options.

The basis for NSPS for the three segments of the papergrade sulfite subcategory is the same as the basis for BAT as described in Section 8.2.2.

8.7.2.1 Properties of Paper Products

Paper is made from pulp fiber and fiber fragments bonded together into a web-like structure. Paper is typically made from a mixture of two or more different types of fibers representing different wood species and/or different pulping methods. Paper also contains non-fibrous components such as starch, clay, titanium dioxide, and a variety of other additives. Prior to forming into paper, wood fiber undergoes a mechanical process called beating. The objective of beating is to cause structural changes in the pulp fibers, such as, development of new fiber surfaces; fiber cutting, which modifies the fiber size distribution; and partial dissolving of polysaccharides from the fiber wall. The properties of the final paper product are determined to a large extent by the composition and qualities of the furnish, such as:

Pulp wood species;
Pulping method (kraft, sulfite, mechanical, etc);
Beating conditions; and
Fillers and additives.

The shortcomings of one component of a furnish are compensated for by adjustments in the other components. For example, hardwood fibers are relatively small and form a paper that is smooth and dense, but not very strong. Softwood fibers are longer and contribute to the strength of the finished paper. In general, bleached kraft pulps are important components of many paper products because they contribute strength and brightness.

8.7.2.2 TCF Bleaching at Metsä-Rauma and SCA-Östrand

By the end of 1996, two mills were producing exclusively TCF pulp that was fully bright and fully strong. The SCA-Östrand pulp mill in Timrå, Sweden began to produce TCF pulp in May 1995 and stopped all production of ECF pulp in June 1996. The Metsä-Rauma pulp mill, in Rauma, Finland was constructed in 1994-1996, and began to produce TCF pulp in 1996. Full details of the history and operations of these mills are available in the record (7,8). Characteristics of the TCF softwood pulp produced at Metsä-Rauma and SCA-Östrand are presented below, with characteristics of oxygen delignified ECF softwood pulp, for comparison.

TCF Pulp Manufactured at SCA-Östrand and Metsä-Rauma				
Product	**Wood Type**	**Brightness (ISO)**	**Tensile Strength (Nm/g)**	**Tear Strength (Nm^2/kg)**
Oxygen Delignified ECF[1]	SW	88.7 to 89.4	70	14.2 to 15.1
Östrand TCF (7)	SW	88	80	up to 13
BotniaVerde 85 (8)	SW	~85	70	over 15
BotniaVerde 88 (8)	SW	87.1 to 90.7	70	13.7 to 14

BotniaVerde is the trademark for Rauma's TCF pulps.

As discussed below, the 75 to 85 ISO TCF softwood pulp made at SCA-Östrand is used in the manufacture of wood-containing printing papers (lightweight coated and supercalendared papers), while 88+ ISO TCF softwood pulp is used to manufacture fine paper. Similarly, the lower brightness TCF pulp made at Metsä-Rauma is used in the manufacture of wood-containing printing papers, while the high brightness TCF pulp, BotniaVerde 88, is used in the manufacture of wood-free fine papers.

8.7.2.3 EPA Concludes that TCF Bleaching is An Available, Demonstrated Technology for Some Products

After examining the data available from SCA-Östrand and Metsä-Rauma, EPA has determined that TCF bleaching is an available, demonstrated technology for the production of high brightness and high strength hardwood and softwood kraft pulps used for the manufacture of wood-containing printing papers and wood-free fine papers.

8.7.2.4 EPA Concludes that Its Record is Not Sufficient to Determine if TCF Bleaching is an Available, Demonstrated Technology for All Products

Data available to EPA about the use of TCF-bleached kraft pulp for various paper products is summarized in Table 8-3. EPA has determined that these data are not sufficient to confirm that TCF bleaching processes are technically demonstrated for the full range of products made with bleached kraft pulp. EPA lacks data on the use of TCF kraft pulp for certain applications with other quality requirements, specifically:

> Tissue, which requires soft, absorbent pulp, with good runnability on tissue machines; and

[1]From: (9), Table 13. Data taken from Malinen, R., T. Rantanen, R. Rauronen, and L. Toikkanen. "TCF Bleaching to high brightness-bleaching sequences and pulp properties," International Pulp Bleaching Conference Proceedings, CPPA, Montreal, 1994.

> Food grade, which requires pulp with low extractives content to prevent taste and odor transfer. EPA has no data on the extractives content, after TCF bleaching, of kraft pulp made from wood species that U.S. manufacturers use for food grade liner board.

Further, EPA concludes that the data are not sufficient to determine if pulp made with TCF processes is or is not feasible for these applications, i.e., EPA does not have sufficient data to define a range of product specifications that can be made with TCF-bleached kraft pulp, and thus is not able to define a subcategory for which TCF bleaching is an available, demonstrated technology.

8.8 PSES

Under the CWA, EPA is authorized to establish categorical pretreatment standards for existing sources and new sources that discharge pollutants that *pass through* POTWs or *interfere with* treatment processes or sludge disposal methods at POTWs. EPA's definition of POTW pass through is presented in a January 28, 1981 Federal Register Notice. The Federal Register Notice defines pass through for the purposes of developing national categorical standards as follows:

> "In determining whether a particular pollutant is passing through the POTW and is, therefore, appropriately subject to regulation through categorical pretreatment standards, the Agency compares POTW removal with removal obtained by a direct discharger. A pollutant will be deemed to pass through a POTW, and will thus be characterized as incompatible, where the average treatment provided by POTWs nationwide does not realize the same percentage of removal of the regulated parameter as would be required of direct dischargers with national effluent standards for that pollutant. Thus, if in order to comply with their direct discharge BAT standards, direct dischargers in Category Y were required to remove 85 percent of pollutant X, then POTWs must achieve an average of at least 85 percent removal of pollutant X in order to avoid the conclusion that pollutant X presents a Pass-Through problem."

Based on this guidance, pass through is determined by comparing the average treatment provided by POTWs nationwide (expressed as a percentage removal) to the average treatment provided by direct discharging bleached papergrade kraft and soda (BPK) and papergrade sulfite (PS) mills that control pollutants to the level of BAT (or NSPS, for new sources).

The ten indirect discharging facilities in the BPK and PS subcategories each contributes the majority of flow or pollutant loadings to a POTW. EPA refers to these POTWs as

"industrial POTWs." A list of these mills and their corresponding industrial POTW is shown in Table 8-4.

At proposal, using very limited data, EPA concluded that biological treatment systems used at these POTWs were not designed to the same standards as the biological treatment systems installed and operating at direct-discharging BPK and PS mills. As a result, EPA concluded that the treatment systems at direct discharging mills achieve greater removals of BOD_5 and TSS than are achieved by the industrial POTWs, that is, BOD_5 and TSS *pass through* the industrial POTWs. By extension, EPA concluded that other pollutants more difficult to biodegrade than BOD_5 (such as AOX, dioxin, furan, and other chlorinated compounds) also pass through the industrial POTWs.

In order to prevent pass through, EPA determined that PSES (and PSNS, for new sources) were necessary. EPA proposed PSES and PSNS based on the same technologies that it used as the basis for BAT and NSPS, respectively. EPA also proposed that compliance with these standards be demonstrated at the same points as it proposed for BAT and NSPS. That is, EPA proposed PSES and PSNS for dioxin, furan, 12 chlorinated phenolic compounds, and certain volatile compounds and required compliance monitoring at the bleach plant effluent. In addition, EPA proposed PSES and PSNS for AOX, COD, and color and required compliance monitoring at the point of discharge to the industrial POTW. These proposed standards would have required indirect-discharging mills to construct complete secondary treatment facilities duplicating the treatment systems currently operated by POTWs. In 58 FR at 66123-66125, (December 17, 1993) EPA also discussed other PSES options intended to obviate the need for complete secondary treatment at the indirect discharging mills.

Several commenters on the proposed PSES reported that POTWs adequately treat BOD_5 and TSS from pulp mill wastewaters. Further, commenters asserted that POTWs also remove AOX from pulp mill wastewaters. These commenters concluded that pretreatment standards for BOD_5, TSS, and AOX set at the point of discharge to the POTW are unnecessary.

As discussed below, EPA reviewed the comment submittals and other available data and determined that they could be used for a pass-through analysis for conventional pollutants. EPA had no data characterizing POTW removals of the toxic and nonconventional pollutants considered for regulation (other than AOX). Such data were not provided by the commenters and were not available from other sources. Because available data were sufficient, however, to indicate that POTW and mill treatment system control of BOD_5 and AOX appear to be comparable, EPA used mill treatment system data to characterize POTW removals of toxic and nonconventional pollutants.

The remainder of this section makes the following points:

1) The control of BOD_5, TSS, and AOX by biological wastewater treatment systems at POTWs receiving BPK and PS mill wastewaters appears to be

comparable to the control provided by biological wastewater treatment systems at direct discharging mills (8.8.2).

2) EPA concluded that BOD_5 and TSS do not pass through POTWs (8.8.2).

3) Because (as presented in 8.8.2) POTW and mill treatment system removals of BOD_5 and AOX appear to be comparable, EPA assumed that the treatment of other pollutants generated at BPK and PS mills (i.e., dioxin, furan, chlorinated phenolic compounds, and chloroform) in POTWs is comparable to their treatment in mill-operated biological treatment systems (8.8.3).

4) Dioxin and furan are not removed in mill treatment systems, thus, EPA concludes dioxin and furan pass through POTWs (8.8.3).

5) Chloroform is extremely volatile and as such is air stripped during conveyance to and initial stages of biological wastewater treatment, thus EPA considers chloroform to pass through POTWs (8.8.3).

6) Model BAT technologies remove all 12 of the chlorinated phenolic compounds to concentrations less than the minimum level at the bleach plant. Mill treatment systems achieve less removal, thus, EPA concludes that the 12 chlorinated phenolic compounds pass through POTWs (8.8.3).

7) Model BAT technologies reduce AOX discharges by approximately 82 percent of the AOX generated at a conventionally operated bleach plant. Mill-operated biological treatment systems achieve only 43 percent removal, thus, EPA concludes that AOX passes through POTWs (8.8.3).

8) Limited data characterizing the performance of biological treatment systems receiving PS wastewaters appear to indicate that control of BOD_5 and TSS is similar to the control provided by treatment systems receiving BPK wastewaters. For the purpose of conducting a pass-through analysis, EPA assumed that the treatment of other pollutants generated at PS mills (i.e., dioxin, furan, chlorinated phenolic compounds, and chloroform) in POTWs is comparable to their treatment in mill-operated biological treatment systems treating BPK wastewaters (8.8.4).

9) As discussed in Section 8.8.4, below, EPA concluded that dioxin, furan, chlorinated phenolic compounds, chloroform, and AOX pass through POTWs for segments of the Papergrade Sulfite Subcategory for which it is setting BAT limitations at this time.

EPA's pass-through determinations are summarized in the following table. EPA is establishing PSES and PSNS for the pollutants it has determined pass through POTWs.

Pollutant	Bleached Papergrade Kraft and Soda Subcategory	Papergrade Sulfite; Calcium, Magnesium, or Sodium Segment	Papergrade Sulfite; Ammonium Segment	Papergrade Sulfite; Specialty-Grade Segment
dioxin	*pass through*	*pass through*	*pass through*	*pass through*
furan	*pass through*	*pass through*	*pass through*	*pass through*
chlorinated phenolics	*pass through*	*pass through*	*pass through*	*pass through*
chloroform	*pass through*	*pass through*	*no determination*	*no determination*
AOX	*pass through*	*pass through*	*no determination*	*no determination*
BOD_5	*does not pass through*	*does not pass through*	*does not pass through*	*does not pass through*
TSS	*does not pass through*	*does not pass through*	*does not pass through*	*does not pass through*

8.8.1 Performance of End-of-Pipe Secondary Biological Treatment Systems

EPA compared pollutant control provided by direct-discharging mill biological treatment systems and POTWs accepting similar wastewaters. Because BOD_5 control is the primary objective of secondary treatment, secondary treatment systems are designed for optimal BOD_5 removal and may not be optimized for TSS removal. TSS are generated during biological treatment, thus TSS percent removal must be considered along with BOD_5 removal and final effluent TSS concentrations, to completely evaluate the performance of a secondary biological treatment system. Data available to EPA indicate that the removals of BOD_5 and AOX at direct-discharging mill treatment systems and POTWs accepting similar wastewaters appear to be comparable. TSS control is also similar.

POTWs - Summaries of removals achieved by secondary biological treatment systems operated by POTWs receiving BPK and PS mill wastewaters are presented in Table 8-5. The removals presented in Table 8-5 were calculated from data provided in comments on the proposed rule, and from EPA's Permit Compliance System (PCS). Table 8-5 also presents the average removals achieved by secondary biological treatment systems supplied by NCASI in comments on the proposed rule (DCN 20026 A31).

Commenters supplied BOD_5, TSS, and AOX data for the ten POTWs receiving BPK or PS mill wastewaters, as shown below:

Pollutant	Number of POTWs for which Average Pollutant Removals were Submitted	Number of POTWs for which Influent/Effluent Data were Supplied to Support Average Pollutant Removals
BOD_5	5	3
TSS	3	2
AOX	4	2

The average removals for each pollutant for the POTWs were calculated by first arithmetically averaging all data supplied for each POTW in comment submittals and from EPA PCS data (as presented in Table 8-5). (Note that the low AOX removal data from the Jackson County Port Authority were deleted before the average for this facility was calculated because the treatment system was disrupted during sampling due to changes in the process at the mill.) Then, average pollutant removals for all POTWs were arithmetically averaged to yield one average pollutant removal for each pollutant. These averages were compared to the NCASI data (presented in Table 8-6) and to average pollutant removals from direct-discharging BPK mills.

Mill Treatment Systems - For the purpose of comparing the performance of POTWs and mill biological treatment systems, EPA used data from three mills employing Option A technology and four mills employing Option B technology for which treatment system influent and effluent data were available. EPA combined these data because it believed that treatment system removals of BOD_5, TSS, and AOX did not differ significantly between mills using Option A and Option B pulping and bleaching technologies. The average removals were calculated by arithmetically averaging removals achieved by the three Option A mills (Georgia-Pacific's Brunswick and Leaf River mills (see Record Section 21.6.1.3) and the James River Wauna Mill (see Record Section 21.6.1.5)) and the removals from four Option B mills sampled by EPA (12).

Comparison - Table 8-7 shows a comparison of pollutant removals between POTWs receiving BPK wastewaters and treatment systems operated by direct-discharging BPK mills. These results are also summarized in the table below.

Average Treatment System Removals (percent)				
		BOD_5	**TSS**	**AOX**
POTW	Average	93 (6 POTWs)	86 (5 POTWs)	49 (4 POTWs)
	Range	86 to 97	56 to 95	41 to 58
NCASI POTWs	Average	94.3 (9 POTWs)	80.5 (9 POTWs)	53.4 (6 POTWs)
	Range	86 to 98.8	4[a] to 98.5	30 to 100
Mill Treatment Systems	Average	95	74	49
	Range	91 to 98 (5 mills)	31 to 98 (6 mills)	11 to 78

[a]Without this value, the range of TSS removals reported by NCASI is 77 to 98.5 percent. The POTW reporting this low removal has a relatively low influent concentration (55 mg/L), contributing to the low percent removal.

These data appear to indicate that the removals of BOD_5, TSS, and AOX achieved by secondary biological treatment systems at these industrial POTWs are comparable to the removals achieved by secondary biological treatment systems operated by direct-discharging BPK mills. The comparability of the effectiveness of POTW and mill-operated biological treatment systems in the control of TSS is further supported by TSS effluent concentrations. EPA compared the POTW final effluent TSS concentrations reported by NCASI to the concentrations achieved at 32 bleached kraft mills EPA used to characterize the performance of biological treatment. POTW TSS effluent concentrations ranged from 4.5 to 56 mg/L, and averaged 31 mg/L. Mill treatment system TSS effluent concentrations ranged from 4.6 to 140 mg/L, and averaged 55 mg/L. EPA concluded that BOD_5 and TSS *do not pass through* POTWs and thus is not promulgating PSES or PSNS for BOD_5 or TSS. EPA's pass-through determination for AOX is described in 8.8.3 below.

8.8.2 Bleached Papergrade Kraft and Soda Pass-Through Analysis for PSES and PSNS

EPA compared the pollutant removals achieved by BPK mills implementing the model BAT technologies (process changes and biological wastewater treatment) to the pollutant removals achieved by biological wastewater treatment systems treating BPK mill wastewater. As discussed above, EPA had data from POTWs treating BPK and PS wastewater for three pollutants (BOD_5, TSS, and AOX). For the purpose of conducting the pass-through analyses discussed below, EPA assumed that the treatment of other pollutants generated at BPK and PS mills (i.e., dioxin, furan, chlorinated phenolic compounds, and chloroform) in secondary biological treatment systems at POTWs is comparable to their treatment in mill-operated end-of-pipe secondary biological treatment systems. This assumption is reasonable because:

1) The majority of the wastewater flow and pollutant loading at these POTWs is contributed by BPK or PS mills; and

2) The data indicate that the control of BOD_5, TSS, and AOX pollutants in POTW treatment systems receiving BPK and PS mill wastewaters appears to be comparable to the control of these pollutants by biological treatment systems at direct discharging mills.

Commenters supplied AOX removal data for four POTWs. EPA, however, chose to use its database of mill treatment system AOX removals to characterize POTW performance. EPA chose to use its database because it had full information to evaluate the accuracy, precision, and representativeness of its data. This approach was reasonable because the data supplied by commenters showed that removals of AOX in POTWs were similar to removals in mill treatment systems. The conclusions of EPA's pass-through analysis are presented below for each regulated toxic and nonconventional pollutant.

Dioxin and furan - Results of the Five-Mill Study and the 104-Mill Study show that dioxin and furan are not removed by biological treatment systems at direct-discharging BPK and PS mills (13,14). Rather, these pollutants were found to either partition to the secondary sludge of a biological treatment system or pass through untreated. The partitioning was neither consistent nor predictable. In contrast, as discussed in Section 9.0 of this document, EPA estimated that for BPK mills, the model BAT technology would remove 91 percent of the baseline bleach plant loading of dioxin and furan. In addition, EPA estimated that the model NSPS technology would remove 93 percent of the baseline bleach plant loading of dioxin and furan. Compared to the 0.0 percent removal of dioxin and furan achieved by biological wastewater treatment systems employed by POTWs, the model BAT and NSPS technologies achieve substantially greater removals. For this reason, EPA concluded that dioxin and furan pass through POTWs.

Dioxin and furan that remain untreated are discharged to receiving streams. In contrast, mills implementing the model BAT technologies achieve substantial reductions of dioxin and furan prior to secondary biological treatment. EPA found that in bleach plant wastewaters dioxin is removed to less than the minimum level, and furan is removed to less than the minimum level or to concentrations slightly above the minimum level. EPA also has determined that use of the model BAT technologies and compliance with limitations for these pollutants at the bleach plant will reduce concentrations of dioxin and furan in sludges from those found in the Five-Mill and 104-Mill Studies to levels near the minimum level for the analytical method for solids (15).

As a result of EPA's finding that dioxin and furan pass through POTWs, EPA is promulgating PSES and PSNS for these pollutants. In addition to preventing pass through of dioxin and furan, PSES and PSNS will also reduce possible interference with a POTW's sludge disposal options. The technology basis, numerical limitations, and point of compliance for PSES are equivalent to BAT while PSNS is equivalent to NSPS.

Chloroform - Chloroform is an extremely volatile compound, with a Henry's Law Constant[1] of 3.39×10^{-3} atm/gmole/m3 (slightly less volatile that benzene, toluene and the xylene isomers, but more volatile than isopropyl ether or diethyl ether). The more volatile a pollutant, the higher its Henry's Law Constant, and the less likely that it will be treated by a POTW. The pollutant is likely to be volatilized as it flows to the POTW, in either the piping system, the head works, or the collection systems at the POTW. When the pollutant volatilizes before treatment, the amount of pollutant influent to the POTW and therefore the amount being biodegraded at the POTW is reduced. EPA considers that very volatile compounds pass through POTWs because a significant portion of the compound is air stripped and not biodegraded by the POTW.

NCASI studied air and water concentrations of chloroform around four bleached kraft mill wastewater treatment systems and concluded "significant reductions in aqueous chloroform concentrations were observed across flumes and other points of turbulence in the treatment system. Typically, the majority of the chloroform was removed in the first third of the effluent treatment systems" (16). NCASI's finding confirms EPA's position that volatile compounds such as chloroform are air stripped, not degraded in POTWs. EPA has consistently refused to regard transfers of pollutants from wastewater to air as treatment. Thus, EPA concludes that chloroform removal in POTWs approaches 0 percent.

EPA compared the negligible chloroform removal achieved in POTWs to the percent removal expected from a mill using the model BAT technologies. EPA made this evaluation based on bleach plant effluent loadings, summarized below.

Mill Type	Bleach Plant Effluent Chloroform Loading (g/kkg)
Conventional bleaching (hypochlorite and various levels of chlorine dioxide substitution)	> 140
Model BAT Technologies (6,17)	3.09
percent removal	>98

EPA concluded that chloroform removals at mills implementing the model BAT technologies are vastly greater than the removal achieved by POTWs (>98 percent compared to approaching 0 percent); chloroform, therefore, *passes through* POTWs. As a result of EPA's findings that chloroform passes through POTWs, as well as because of potential unacceptable non-water quality environmental impacts from air emissions, EPA is promulgating PSES and PSNS for chloroform. The technology basis, limitations, and point of compliance for PSES and PSNS are equivalent to BAT.

[1]Henry's Law Constants reflect the partitioning of chemical compounds between a liquid phase (in this case water) and a gas phase. A compound with a high Henry's Law Constant has a high vapor pressure and a low solubility in water and thus will preferentially partition to air.

Chlorinated phenolic compounds - EPA determined that chlorinated phenolic compounds pass through POTWs. This determination is based on data in the record (18,19,20) showing that the model BAT technologies remove all 12 of the chlorinated phenolic compounds to concentrations less than minimum levels for these pollutants in bleach plant wastewaters, prior to end-of-pipe biological wastewater treatment. In comparison, mills employing conventional pulping and bleaching technologies were found to discharge one or more of the chlorinated phenolic pollutants at measurable levels (6).

To assess whether the chlorinated phenolic compounds pass through, EPA used the total subcategory baseline and option discharge loading estimates presented in Section 9 of this document. EPA used this approach in order not to overstate the removals of pollutants reduced to concentrations less than analytical method minimum levels. Loadings of pollutants measured at less than the sample-specific detection limit were estimated using one-half the minimum level of the analytical method (see Section 9.2.1). If EPA had assumed that loadings of compounds not detected were zero, Option A (the model BAT technology) and Option B (the model NSPS technology) would achieve 100 percent removal of chlorinated phenolic compounds.

The following table summarizes EPA's estimated removals of chlorinated phenolic compounds. EPA assumed, based on an NCASI study (21), that 45 percent of the estimated bleach plant load was removed in biological treatment systems. As discussed in Section 8.8.2 and in Section 9.3, EPA has assumed that POTW removals will be the same as removals achieved by mill-operated wastewater treatment systems. EPA estimated the baseline load of chlorinated phenolic compounds discharged by the BPK subcategory prior to the imposition of new limitations and standards. EPA also estimated the overall chlorinated phenolic compound removals achieved by the model BAT technologies (Option A) and the model NSPS technologies (Option B). (See Section 9.3.1.)

Overall Chlorinated Phenolic Compounds Removals at Baseline and for Model Technologies

	Bleach Plant Effluent Loading (kg/yr)	Treated Effluent Loading (kg/yr)	Removal of Baseline Bleach Plant Loading (Percent)
Baseline	100,000	55,000	45
Model BAT Technologies (Option A)	18,000	10,000	90
Model NSPS Technologies (Option B)	14,000	7,900	92

Source: Table 9-24 of this document.

For the model BAT technologies (Option A), the estimated bleach plant chlorinated phenolic compounds loading is 18,000 kg/year and the final effluent chlorinated phenolic compounds loading is 10,000 kg/year. Similarly, for mills using the model NSPS technologies (Option B), the estimated bleach plant chlorinated phenolic compounds loading is 14,000 kg/yr and the final effluent chlorinated phenolic compounds loading is 7,900 kg/yr.

To assess whether chlorinated phenolic compounds pass through, EPA compared the overall percent removal achieved by biological wastewater treatment systems treating the estimated baseline bleach plant loadings to the percent removal expected if the BPK subcategory mills implemented the model BAT technologies (Option A). Option A includes well-operated biological treatment. The calculated baseline removal is 45 percent (comparing 100,000 to 55,000 kg/yr). The BAT removal is 90 percent (comparing 100,000 to 10,000 kg/yr). The BAT removal includes the combined effect of the chlorinated phenolic compounds reduction attributable to in-plant process changes and the chlorinated phenolic compounds removal due to biological treatment. Furthermore, the estimated subcategory bleach plant loading (18,000 kg/yr) for Option A is lower than baseline treated effluent load without Option A technology. Therefore, EPA concluded that because overall chlorinated phenolic compounds removals with implementation of the model BAT technologies are substantially greater than the removals achieved by POTWs, chlorinated phenolic compounds *pass through* POTWs.

Similarly, EPA compared the overall percent removal achieved by biological wastewater treatment systems treating the estimated baseline bleach plant loadings to the percent removal expected if the BPK subcategory mills implemented the model NSPS technologies (Option B). Option B includes well-operated biological treatment. Again, the calculated POTW removal is 45 percent (comparing 100,000 to 55,000 kg/yr). The NSPS removal is 92 percent (comparing 100,000 to 7,900 kg/yr). Furthermore, the estimated subcategory bleach plant loading (14,000 kg/yr) for Option B is lower than baseline treated effluent load with neither Option A nor Option B technology. Therefore, EPA concluded that because overall chlorinated phenolic compounds removals with implementation of the model NSPS technologies are substantially greater than the removals achieved by POTWs, chlorinated phenolic compounds from new sources also *pass through* POTWs.

As a result of EPA's finding that the 12 chlorinated phenolic compounds pass through POTWs, EPA is promulgating PSES and PSNS for those pollutants. The technology basis, limitations, and point of compliance for PSES are equivalent to BAT while PSNS are equivalent to NSPS.

AOX - EPA also determined that AOX passes through industrial POTWs. EPA bases this conclusion on its review of data (presented and discussed below) comparing the removals of AOX achieved by POTWs treating wastewater from mills using conventional bleaching to the AOX removals achieved by direct dischargers meeting limitations based on the model BAT process technologies. The mills using the model BAT process technologies consistently achieve far greater AOX removals than indirect discharging mills using conventional bleaching technologies that discharge to industrial POTWs. Therefore, in the absence of PSES, the affected industrial POTWs cannot achieve the same overall removals of AOX as achieved by direct dischargers complying with the BAT limitations for AOX. The same is also true when considering removals achieved by new sources complying with NSPS. Thus, EPA concludes that AOX passes through POTWs and is setting pretreatment standards for AOX for existing and new indirect-discharging mills.

The following table lists final effluent AOX loadings for three softwood bleach lines sampled by EPA (during the short term study sampling program) that use conventional bleaching (e.g., less that complete chlorine dioxide substitution). The average bleach plant AOX loading for these three mills is 2.8 kg/kkg (kilograms of AOX per metric ton of unbleached pulp entering the bleach plant). This AOX loading is used in the following discussion to represent the typical bleach plant AOX loading from a softwood mill using conventional pulping and bleaching technologies.

Bleach Plant Loadings for Mills With Conventional Pulping and Bleaching

Mill	Furnish	Bleach Sequence	Approximate Chlorine Dioxide Substitution (Percent)	Bleach Plant AOX Loading (kg/kkg)
A	softwood	C/DEopDD	50	1.6
B	softwood	C/DEHED	60	2.4
C	softwood	C/DEDED	30	4.3
			Average	2.8

The following table summarizes the overall removal of the conventional bleaching AOX load (2.8 kg/kkg) achieved by biological wastewater treatment, and achieved by the model BAT technologies (Option A) and the model NSPS technologies (Option B).

Overall AOX Removals for Conventional Bleaching and Option Mills

Mill Type	Long-Term Average Bleach Plant Effluent AOX Loading (kg/kkg)	Long-Term Average Treated Effluent AOX Loading (kg/kkg)	Removal of Conventional Bleach Plant Loading (Percent)
Conventional Bleaching	2.8	1.6	43
Model BAT Technologies (Option A)	1.3	0.51	82
Model NSPS Technologies (Option B)	0.77	0.21	93

Final effluent AOX loadings were not available from the three mills for which bleach plant AOX loadings are presented. Using other data collected at proposal, EPA determined that the final effluent AOX loading after secondary biological treatment for conventional bleaching mills is 1.6 kg/kkg (22). For mills using the model BAT technologies (Option A), the average bleach plant AOX loading is 1.3 kg/kkg and the final effluent AOX loading is 0.51 kg/kkg (6,17). Similarly, for mills using the model NSPS technologies (Option B), the average bleach plant AOX loading is 0.77 kg/kkg and the final effluent AOX loading is 0.21 kg/kkg (6,17).

To assess whether AOX passes through, EPA compared the overall percent removal achieved by a biological wastewater treatment system treating bleach plant effluent from a mill using a conventional bleaching technology, to the percent removal expected from a mill using the model BAT technologies (Option A). Option A includes well-operated biological treatment. (For the reasons discussed in Section 8.8.2, EPA has assumed that POTW loadings would be comparable to the mill treated effluent loadings presented above.) The calculated POTW removal is 43 percent (comparing 2.8 to 1.6 kg/kkg). The BAT removal is 82 percent (comparing 2.8 to 0.51 kg/kkg). The BAT removal includes the combined effect of the AOX reduction attributable to in-plant process changes and the AOX removal due to biological treatment. Furthermore, the average bleach plant loading (1.3 kg/kkg) for a mill employing Option A is lower than treated effluent from secondary biological treatment without Option A technology. Therefore, EPA concluded that because overall AOX removals at mills implementing the model BAT technologies are substantially greater than the removals achieved by POTWs, AOX *passes through* POTWs.

Similarly, EPA compared the overall percent removal achieved by a biological wastewater treatment system of treating bleach plant effluent from a mill using a conventional bleaching technology, to the percent removal expected from a mill using the model NSPS technologies (Option B). Option B includes well-operated biological treatment. Again, the calculated POTW removal is 43 percent (comparing 2.8 to 1.6 kg/kkg). The NSPS removal is 93 percent (comparing 2.8 to 0.21 kg/kkg). Furthermore, the average bleach plant loading (0.77 kg/kkg) for a mill employing Option B is lower than treated effluent from secondary biological treatment with neither Option A nor Option B technology. Therefore, EPA concluded that overall AOX removals at mills implementing the NSPS process technologies are substantially greater than for mills without these technologies. Therefore, EPA concluded that because overall AOX removals at new source mills implementing the model NSPS technologies are greater than the removals achieved by POTWs, AOX from new sources also *passes through* POTWs.

As a result of EPA's findings that AOX passes through POTWs, EPA is promulgating PSES and PSNS for AOX. The technology basis for PSES is equivalent to the model BAT technologies, except the PSES basis does not include biological wastewater treatment. Similarly, the technology basis for PSNS is equivalent to the model NSPS technologies without biological wastewater treatment. Because secondary biological wastewater treatment is used at industrial POTWs, neither the model pretreatment technology for PSES nor PSNS includes secondary biological wastewater treatment.

The pretreatment standards promulgated today for AOX reflect the AOX loadings present in the bleach plant wastewaters prior to biological treatment at direct-discharging mills that employ model process technologies. EPA expects that AOX reductions achieved by indirect dischargers employing the PSES or PSNS model process technology, in combination with removals achieved by biological treatment systems at industrial POTWs, will be comparable to the overall removals achieved by direct dischargers complying with BAT limitations or NSPS. AOX limitations based on the performance of the PSES/PSNS process technology are appropriately set, and compliance demonstrated, at the bleach plant, prior to mixing with other wastestreams.

8.8.3 Papergrade Sulfite Pass-Through Analysis

For the purpose of establishing BAT and NSPS limitations for the Papergrade Sulfite (PS) subcategory, EPA divided the subcategory into three segments: (a) calcium, magnesium, or sodium sulfite pulping; (b) ammonium sulfite pulping; and (c) specialty-grade sulfite pulping. To conduct a pass-through analysis for the PS subcategory, EPA compared the pollutant removals achieved by PS mills implementing the model BAT technologies for each segment, to the removals achieved by biological wastewater treatment systems treating pulp mill wastewater. Commenters provided EPA with data from one POTW treating PS wastewater for only three pollutants: AOX, BOD_5, and TSS (see Table 8-6). For the purposes of conducting the pass-through analyses discussed below, EPA assumed that the treatment of pollutants generated by PS mills in POTWs is comparable to the treatment of these pollutants in mill operated treatment systems treating BPK wastewaters. This assumption is reasonable because the limited data characterizing PS mill treatment systems show that removals of pollutants are similar to the removals in BPK mill treatment systems.

Calcium, magnesium, or sodium sulfite pulping - For the calcium-, magnesium-, or sodium-based segment, the model BAT technology is based on TCF bleaching. Mills employing this model technology will achieve the maximum possible reduction in the discharge of chlorinated pollutants from bleaching. Because chlorine or chlorine-containing bleaching chemicals are not used, chlorinated pollutants are not generated during bleaching. EPA concluded that dioxin, furan, the 12 chlorinated phenolic compounds, chloroform, and AOX removals at mills implementing the model BAT technologies are greater than the removals achieved by POTWs. EPA finds that TCF bleaching will reduce AOX discharge loads from the 1 to 3 kg/kkg typically found at conventional bleaching mills to less than minimum levels, even at indirect-discharging facilities with no on-site biological treatment. This reduction is greater than 99 percent, which far exceeds the AOX reduction that can be demonstrated by POTW treatment. Thus EPA concludes that these pollutants all pass through POTWs.

EPA is establishing PSES and PSNS for AOX (expressed as below the minimum level of the analytical method) for mills in this segment of the Papergrade Sulfite Subcategory, with the limitation expressed as less than the minimum level. One reason EPA is not establishing specific pretreatment standards for dioxin, furan, the 12 chlorinated phenolic compounds, or chloroform is that when AOX is controlled to this level, these pollutants will not be generated by calcium, magnesium, or sodium sulfite bleaching processes.

Ammonium sulfite and specialty-grade sulfite segments - EPA concluded that dioxin, furan, and the 12 chlorinated phenolic pollutants pass through or interfere with POTW operations for the ammonium and specialty-grade segments for the same reasons described in Section 8.2.3, for the BPK Subcategory (i.e., EPA concludes that dioxin, furan, and the 12

chlorinated phenolic compounds from PS mills will be removed to the same extent in POTWs as dioxin, furan, and the 12 chlorinated phenolic compounds from BPK mills). The BAT and NSPS model technologies for both the BPK and PS Subcategories (ammonium and specialty-grade segments) are based on ECF bleaching process technologies. As a result of EPA's finding that dioxin, furan, and the 12 chlorinated phenolic compounds pass through POTWs, EPA is promulgating national pretreatment standards for new and existing sources for those pollutants for those segments. The technology basis, numerical limitations, and point of compliance for PSES and PSNS are equivalent to BAT for these segments.

With respect to chloroform and AOX in the ammonium and specialty-grade segments of the PS Subcategory, EPA has insufficient data at this time to characterize the performance of the model BAT technologies (12). EPA needs these data to conduct a pass-through analysis. When these data become available, EPA will make pass-through determinations and (if warranted) will set pretreatment standards for chloroform and AOX.

8.9 PSNS

For bleached papergrade kraft and soda mills, EPA is promulgating PSNS based on the model technology for NSPS, which is Option B, excluding effective biological treatment (which is presumed to occur at the receiving POTW). The basis for PSNS for the three segments of the PS subcategory is the same as the basis of BAT and NSPS for these mills, as described in Section 8.2.2.

8.10 References

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Table 8-1

Mills Representing the Performance of Secondary Wastewater Treatment Bleached Papergrade Kraft and Soda Subcategory

Observation Number	Final Conventionals Option 1 Mill? (Y/N)	Final Conventionals Option 2 Mill? (Y/N)	Long-Term Average BOD_5 Effluent Load (kg/OMMT)	Long-Term Average TSS Load Effluent (kg/OMMT)	Wastewater Treatment Type
1	Y	Y	0.26	0.24	B
2	Y	Y	0.61	1.31	S
3	Y	Y	0.70	2.23	S
4	Y	Y	1.06	2.74	S
5	Y	Y	1.16	3.97	S
6	Y	Y	1.45	2.11	B
7	Y	Y	1.55	1.40	B
8	Y	Y	1.60	3.11	S
9	Y	Y	1.60	3.48	B
10	Y	Y	1.92	2.29	B
11	Y	Y	1.98	2.25	B
12	Y	Y	2.42	1.95	B
13	Y	Y	2.57	5.44	S
14	Y	Y	2.80	2.05	B
15	Y	Y	2.97	3.04	B
16	Y	Y	3.02	6.07	B
17	Y	N	3.25	8.43	S
18	Y	N	3.16	3.55	B
19	Y	N	3.35	7.01	B
20	Y	N	3.57	9.16	B
21	Y	N	3.58	4.60	S
22	Y	N	3.68	7.13	B
23	Y	N	3.78	8.37	S
24	Y	N	4.34	8.73	B
25	Y	N	4.34	3.31	B
26	Y	N	4.82	2.91	B
27	Y	N	5.41	9.67	B
28	Y	N	5.53	6.88	B
29	Y	N	5.55	4.56	B
30	Y	N	5.69	9.64	S
31	N	N	5.70	8.62	B
32	N	N	6.68	9.79	B

B - Mills that operate secondary wastewater treatment in basins.
S - Mills that operate secondary wastewater treatment in activated sludge systems or a combination of activated sludge systems and basins.

Table 8-2

Mills Representing the Performance of Secondary Wastewater Treatment Papergrade Sulfite Subcategory

Observation Number	Long-Term Average BOD_5 Effluent Load (kg/OMMT)	Long-Term Average TSS Load Effluent (kg/OMMT)	Wastewater Treatment Type
1	nd	nd	nd
2	nd	nd	nd
3	nd	nd	nd

nd - Not disclosed to prevent compromising confidential business information.

Table 8-3
Data Available on the Use of TCF-Bleached Kraft Pulp

Major Product Type	Bleached Kraft Pulp Contribution	Key Bleached Kraft Pulp Qualities	TCF Kraft Data?
Newsprint (wood-containing)	up to 25% semi-bleached SW kraft used for reinforcement	Strength	no; but LWC properties exceed the quality needed for newsprint
Magazine Printing (wood-containing, uncoated, super-calendared)	up to 30% bleached or semi-bleached SW kraft	Strength	yes: Östrand (7)
Light Weight Coated (wood-containing, e.g.,catalog grade)	40 - 50% bleached chemical pulp for strength	web strength, uniformity, low freeness	yes: Östrand and Metsä-Rauma (7,8)
Uncoated Free Sheet (wood free; e.g., office paper)	>90% bleached kraft, HW&SW mixed at variable proportions, for strength and brightness stability	Strength, high brightness and brightness stability,HW for light scattering power (opacity), and formation	yes: Ostrand and Metsä-Rauma (7,8)
Coated Wood-Free and Other Fine Graphics Papers	up to 70% HW kraft for uniformity	Same as uncoated free sheet and more HW for uniformity of base sheet	yes: Sodra (10)
Packaging Papers	SW kraft for strength	strength, stretchability (from high shrinkage potential)	yes: Wisaforest reports food contact sackgrade can be made from 100% TCF pulp (11)
Tissue: -cellulose wadding -facial & napkin -toilet -towel	added for strength; must not detract from absorbency, softness, runnability contributed by sulfite or CTMP pulps or secondary fiber	strength, absorbency, softness	None identified in record
Board Grades	top layer made from bleached SW&HW kraft for printability and tensile strength	strength, brightness	None identified in record
Food-Grade Liner Board	bleached kraft of semi-bleached with bleached kraft overlay for strength mechanical pulp needed for stiffness	strength, extractives-free to prevent migration of odor and taste	None identified in record

HW - hardwood
SW - softwood
CTMP - chemi-thermo-mechanical pulp

Table 8-4
POTWs Receiving Chemical Pulp Mill Wastewaters

POTW Name	POTW Permit No.	Location	Mill Discharging to the POTW
Bleached Papergrade Kraft and Soda Subcategory			
Gulf Coast Waste Disposal Authority	TX0052591	Pasadena, Texas	Simpson Pasadena Paper Co.
Muskegon County Wastewater Management System	MI0027391	Muskegon, Michigan	S. D. Warren (SAPPI)
Upper Potomac River Commission	MD0021687	Westernport, Maryland	Westvaco Corporation (Luke, MD mill)
City of St. Helens	OR0020824	St. Helens, Oregon	Boise Cascade Corporation
Jackson County Port Authority	MS0002674	Pascagoula, Mississippi	International Paper Co. (Moss Point, MS)
Western Lake Superior Sanitary District	MN0049786	Duluth, Minnesota	Potlatch Corporation (Cloquet, MN mill)
Bay County Wastewater Treatment Plant	FL0002631	Panama City, Florida	Stone Container Corporation*
Erie City Wastewater Treatment Facility	PA0026301	Erie, Pennsylvania	International Paper Co.
City of Port St. Joe Wastewater Treatment Plant	FL0020206	Port St. Joe, Florida	St. Joe Forest Products Co.*
Papergrade Sulfite Subcategory			
Peshtigo Joint Wastewater Treatment Plant	WI0030651	Peshtigo, Wisconsin	Badger Paper Mills, Inc.

*Also produces unbleached kraft pulp

Table 8-5
Pollutant Removals at POTWs Receiving Chemical Pulp Mill Wastewaters
(Calculated from Comment Submittals and EPA Permit Compliance System Data)

POTW Name	BOD5	TSS	AOX	COD	COLOR
Bleached Papergrade Kraft and Soda Subcategory					
Gulf Coast Waste Disposal Authority Pasadena, Texas	*	*	*	*	*
Muskegon County Wastewater Management System (Muskegon, Michigan)	*	95%(PCS**)	*	*	*
Upper Potomac River Commission (Westernport, Maryland) No influent/effluent data provided in DCNs 20030 or 20021.	94.4% for 1993(DCN 20030-UPRC comments; DCN 20021-Westvaco comments)	93.0% for 1993 (DCN 20030-UPRC comments; DCN 20021-Westvaco comments)	44.6% for 1993 (DCN 20030-UPRC comments; DCN 20021-Westvaco comments)	72.2% for 1993 (DCN 20030-UPRC comments; DCN 20021-Westvaco comments)	12.1% for 1993 (DCN 20030-UPRC comments; DCN 20021-Westvaco comments)
City of St. Helens (St. Helens, Oregon) Influent/effluent data provided in DCN 20099.	86% (PCS**); 90% for 7/93-6/94 (DCN 20099-City of St. Helens comments)	*	41% for 7/93-6/94 (DCN 20099-City of St. Helens comments)	*	*

Table 8-5 (Continued)

POTW Name	BOD5	TSS	AOX	COD	COLOR
Jackson County Port Authority (Pascagoula, Mississippi) Influent/effluent data supplied in DCN 12724; no influent/effluent data supplied in DCN 20042; influent/effluent data supplied in DCN 13832.	90% for 1993 (DCNs 12724 and 20042-Port of Pascagoula comments)	56% for 1993 (DCNs 12724 and 20042-Port of Pascagoula comments)	20% for 11/93 (DCN 12724-Port of Pascagoula comments-Note that treatment system disruption occurred because of process changes; 51% for 3/95 through 11/95 (DCN 13832-IP data submittal (see Attachment 2B)	47% for 1993 (DCNs 12724-Port of Pascagoula comments)	*
Western Lake Superior Sanitary District (Duluth, Minnesota) No influent/effluent data supplied in DCNs 20028 or 20044.	97% (PCS**); 97.4% for 2/94 (DCN 20028-Potlatch comments); 96.7% for 1993 (DCN 20044-Western Lake SD comments)	93% (PCS**) 97.8% for 2/94 (DCN 20028-Potlatch comments); 94.9% for 1993 (DCN 20044-Western Lake SD comments)	58% for 3/94 (DCN 20028-Potlatch comments)	81% for 3/94 (DCN 20028-Potlatch comments); 80% (DCN 20044-Western Lake SD comments)	36% for 3/94 (DCN 20028-Potlatch comments); 30% (DCN 20044-Western Lake SD comments)
Bay County Wastewater Treatment Plant (Panama City, Florida) No influent/effluent data supplied in DCN 20066A1.	95% (DCN 20066A1-Stone Container comments)	*	*	*	*
Erie City Wastewater Treatment Facility (Erie, Pennsylvania)	*	*	*	*	*
City of Port St. Joe Wastewater Treatment Plant (Port St. Joe, Florida)	92% (PCS**)	92% (PCS**)	*	*	*

Table 8-5 (Continued)

POTW Name	BOD5	TSS	AOX	COD	COLOR
Papergrade Sulfite Subcategory					
Peshtigo Joint Wastewater Treatment Plant (Peshtigo, Wisconsin)	94% (PCS**)	62% (PCS**)	*	*	*

* = No data available.
** = Calculated from Environmental Protection Agency Permit Compliance System (PCS) data, included in Attachment 2A.

Table 8-6
National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI) Data Pollutant Removals at POTWs Receiving Chemical Pulp Mill Wastewaters

	Conventional Pollutant Removals (Average Removals)		Nonconventional Pollutant Removals (Average Removals)		
	BOD5	**TSS**	**AOX**	**COD**	**Color**
Bleached Papergrade Kraft and Soda mills	94.3 %* (for 9 mills) 94.6 % *** (for 7 mills) 93 % **** (for 5 mills)	80.5 %* (for 9 mills) 90 %* (for 8 mills--after removing one mill with unusually low TSS removal)	53.4 %** (for 6 mills) 44.6 %***** (for 6 mills)	81.6 %** (for 6 mills) 74.7 %***** (for 5 mills)	-4.8 %** and ***** (for 4 mills)
Papergrade Sulfite mill (one mill)	95 %*	84 %*	25.9 %**	no data available	no data available

All data presented are from NCASI comments "An Analysis of the Relative Performance of POTW and Paper Industry Wastewater Treatment Systems on Conventional and Non-Conventional Pollutants," April 1994, DCN 20026 A31:

* = Appendix B, page 3. Calculated by arithmetically averaging removal data reported in table.
** = Appendix B, page 4. Calculated by arithmetically averaging removal data reported in table.
*** = page 5, Table 2. Influent/effluent data used for this table not presented.
**** = page 6, Table 3. Influent/effluent data used for this table not presented.
***** = page 8, Table 5. Influent/effluent data used for this table not presented.

Note that the subcategories of the mills used to calculate the averages in Tables 2, 3, and 5 are not specified. Therefore, the papergrade sulfite mill could be included in these averages. Average influent/effluent data for the 10 POTWs were presented in Appendix B.

Table 8-7
Comparison of Pollutant Removals at POTWs Receiving Wastewaters from Bleached Papergrade Kraft and Soda Mills and Direct-Discharging Bleached Papergrade Kraft and Soda Mills

Pollutant Removal Percentages	BOD5	TSS	AOX
POTWs Receiving Wastewaters from Mills in the Bleached Papergrade Kraft and Soda Subcategory*			
Average	93 (6 POTWs)	86 (5 POTWs)	49 (4 POTWs)
Range	86 to 97	56 to 95	41 to 58
NCASI Data for POTWs Receiving Wastewaters from Mills in the Bleached Papergrade Kraft and Soda Subcategory from DCN 20026 A31 Appendix B, page 3-4			
Average	94.3 (9 POTWs)	80.5 (9 POTWs)	53.4 (6 POTWs)
Range	86 to 98.8	4 to 98.5	30 to 100
Direct-discharging Mills in the Bleached Papergrade Kraft and Soda Subcategory - 7 Mills (Combination of 3 Mills with Option A Technology Basis and 4 Mills with Option B Technology Basis***)**			
Average	95	74	49
Range	91 to 98 (5 mills)	31 to 98 (6 mills)	11 to 78

* Averages were calculated by arithmetically averaging the removal data for each POTW in Table 2 and then arithmetically averaging the removals for all POTWs (Note: Low AOX removal data from Jackson Co. Port Authority due to treatment system upset were excluded from average).

** Averages were calculated by arithmetically averaging removal data from 1995 data supplied by Georgia-Pacific Corporation for the Brunswick and Leaf River mills (see Record Section 21.6.1.3) and by James River for the Wauna mill (see Record Section 21.6.1.5) and then arithmetically averaging the removals for the three mills.

*** Averages were calculated by arithmetically averaging the removal efficiencies from EPA-sponsored sampling data for 4 mills. The sampling was conducted in 1993-1994. Data are presented in the June 1996 "Summary Report for Pulp and Paper Mill Sampling Program" in Record Section 21.6.2 DCN#13968.

SECTION 9

POLLUTANT REDUCTION ESTIMATES

9.1 Introduction

After the 1993 proposal of effluent limitations guidelines and standards for the pulp and paper industry (58 FR 66078), EPA updated the calculation of effluent loadings reductions for each bleached papergrade kraft and soda mill and each papergrade sulfite mill potentially subject to those guidelines and standards to establish a new baseline of mid-1995. In addition, EPA revised and simplified the methodology used to estimate the baseline. These revised estimates were reported in the July 1996 Notice of Data Availability (61 FR 36835). After the notice, EPA recalculated the effluent loadings reductions using the same methodology and the same base year of mid-1995, but made minor changes in loadings for a few particular mills (consistent with cost model changes). For the final loadings estimates presented here, EPA also revised the methodology used to interpret concentration measurements for TCF bleaching processes reported as less than the method minimum level.

Mills in the Bleached Papergrade Kraft and Soda and Papergrade Sulfite Subcategories will be subject to revised discharge limitations based on BAT or revised PSES. EPA is promulgating BAT limitations and PSES for TCDD, TCDF, chloroform, 12 chlorinated phenolic compounds and AOX. The 12 chlorinated phenolic compounds include trichlorosyringol, 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, 3,4,5-trichlorocatechol, 3,4,5-trichloroguaiacol, 3,4,6-trichlorocatechol, 3,4,6-trichloroguaiacol, 4,5,6-trichloroguaiacol, tetrachlorocatechol, tetrachloroguaiacol, 2,3,4,6-tetrachlorophenol, and pentachlorophenol.

Indirect dischargers subject to Subpart B must demonstrate compliance with PSES for all regulated pollutants at the bleach plant; direct dischargers subject to Subpart B must demonstrate compliance with BAT limitations for all regulated pollutants (except AOX) at the bleach plant.

EPA is promulgating BAT limitations and PSES for a subset of these pollutants for the Papergrade Sulfite Subcategory (Subpart E). For mills in the calcium-, magnesium-, or sodium-based sulfite pulp segment, EPA is promulgating BAT limitations and PSES for AOX only, with compliance demonstrated at the end of pipe. For mills in the ammonium-based sulfite pulp and specialty-grade pulp segments, EPA is promulgating BAT limitations and PSES for the same pollutants covered by Subpart B except for chloroform and AOX, with compliance demonstrated at the bleach plant.

EPA had proposed limitations for COD and color. The in-plant process changes that form the bases of the BAT limitations, PSES, and BMPs, reduce final effluent COD and color loadings. For this reason, EPA estimated the effluent loadings reductions for COD and color. For reasons stated in the preamble, EPA intends to develop COD limitations for kraft and sulfite mills in a future rulemaking and EPA has decided not to develop a national regulation for

color. Instead, permit writers are expected to continue to develop local color effluent limitations based on applicable water quality standards.

This section describes the approach used to estimate the baseline mass (kg/yr) of these pollutants in bleach plant effluents and final effluents discharged from bleached kraft and soda and papergrade sulfite mills. The estimates are based on information available from each mill as of mid-1995. This section also describes the estimate of pollutant mass that would be discharged after implementation of the technology options EPA considered in selecting the basis of the final effluent limitations guidelines and standards. The difference between the baseline mass discharge and the mass that would be discharged after implementation of a technology option is referred to here as the pollutant reduction. Pollutant reductions were estimated for all the pollutants named above.

At present, 96 mills are subject to these regulations. Eighty-six mills discharge wastewater directly and are regulated under BAT; 10 mills discharge wastewater indirectly and are regulated under PSES. (See Section 4 for more details about the number and type of mills.) For Subparts B and E, the BAT limitations and PSES are identical for all regulated pollutants except AOX. Loadings and reductions calculated for indirect-discharging mills are included in subcategory and industry totals. Of the ten indirect-discharging mills, nine are in the Bleached Papergrade Kraft and Soda Subcategory and one is in the Papergrade Sulfite Subcategory.

For those pollutants for which all Subpart B and E mills must demonstrate compliance at the bleach plant (i.e., all pollutants identified above except AOX in the case of direct dischargers), EPA calculated baseline loadings, loadings after implementation of the technology options, and pollutant reductions based on bleach plant effluent data. For AOX, EPA made the estimates described above using final effluent data (i.e., after secondary treatment at the mill’s wastewater treatment plant or at a POTW). EPA employed this approach even for indirect-discharging mills in Subpart B (which must demonstrate compliance with the AOX pretreatment standard at the bleach plant) because EPA expects that the combination of pretreatment for AOX consistent with the promulgated AOX standard, coupled with additional removals achieved by the POTW, will produce the same final effluent loading reductions achieved by direct-discharging facilities subject to Subpart B.

A series of computer programs was used to calculate production-normalized mass loadings of each pollutant from EPA or industry-supplied mill sampling data. The production-normalized loadings were then incorporated into a series of spreadsheets. The series of spreadsheets estimates a baseline pollutant discharge rate (kg pollutant/kkg brown stock pulp into bleaching) for each mill and compares these loads to production-normalized loadings that would be achieved after implementation of the technology options. After making this comparison, the production-normalized loadings and the pollutant reductions are multiplied by each mill's annual brown stock (unbleached pulp) production to convert to units of kg/yr.

9.2 Pollutant Loading Calculations and Data Sources

EPA does not have data from each mill subject to Subpart B or E that characterizes the discharge of all pollutants for which EPA is establishing limitations and standards. Instead, EPA calculated pollutant loadings using data characterizing the generation of these pollutants by a variety of pulping and bleaching technologies. EPA also used information about the pulping and bleaching technologies in place at each mill.

The data used to calculate production-normalized pollutant loadings were derived from six sources:

1) Short-term studies (1988-1993);

2) EPA/industry long-term variability study (1991-1992);

3) Self-monitoring data (supplied by mills subject to Subparts B or E);

4) Data collected by EPA and industry since the proposal of these regulations;

5) The 1994 NCASI dioxin survey; and

6) Bleach plant chloroform data collected by NCASI.

The short-term sampling database contains the results of two- to three-day sampling episodes at thirteen mills. These sampling episodes took place in 1988 through 1993. The long-term variability study database contains the results of intensive sampling efforts at eight mills in 1991 and 1992. The self-monitoring database contains the results of analyses performed by individual mills which were collected from responses to Question 49 of the EPA 1990 National Census of Pulp, Paper, and Paperboard Manufacturing Facilities Questionnaire (reflecting the period from 1985 through 1991). The data collected by EPA and industry since the proposal of these regulations were mainly from mills using complete substitution of chlorine dioxide for chlorine, including mills using extended cooking and/or oxygen delignification. EPA also collected data from three mills using TCF bleaching. The 1994 NCASI dioxin survey is, in part, a tabulation of end-of-pipe effluent loadings for TCDD and TCDF reported by mills during 1994, or in earlier years if the mill did not analyze for these pollutants during 1994.

9.2.1 Pollutant Loading Calculations

The data in each database are used to calculate production-normalized pollutant loadings for the bleach plant and/or final effluent for each mill. Three types of data are needed to calculate a production-normalized loading: a pollutant concentration, a wastewater flow rate, and a brown stock pulp flow rate. For example, the concentration of AOX in the final effluent from a mill may be 15,000 ` g/L. The final effluent flow rate from this mill may be 25,000 m^3/day. The

brown stock pulp flow rate into bleaching for this mill may be 1,200 kkg brown stock pulp/day (kkg/day). These data are used to calculate daily (kg AOX/day) and production-normalized (kg AOX/kkg brown stock pulp) mass loadings for the final effluent for this mill.

Daily Mass Loading	$15{,}000\ \frac{\mu g}{L} \times 1{,}000 \frac{L}{m^3} \times 25{,}000 \frac{m^3}{day} \times 10^{9}\ \frac{kg}{\mu g} \quad 375 \frac{kg}{day}$
Production-Normalized Mass Loading	$\frac{375\ \frac{kg}{day}}{1{,}200\ \frac{kkg}{day}} \quad 0.313\ \frac{kg}{kkg}$

Another example is shown below for a bleach plant effluent. Depending on the mill, the bleach plant effluent may be characterized by one or more separate samples. At some mills, all bleach plant wastewaters are discharged to a single sewer. For these mills, production-normalized mass loadings are calculated as in the previous example. More commonly, however, bleach plant wastewaters are discharged to two separate sewers: one that handles acidic wastewaters (e.g., discharges from chlorine, chlorine dioxide, hypochlorite, and ozone stages) and one that handles alkaline wastewaters (e.g., discharges from extraction stages). At these mills, separate samples of acid and alkaline sewers (or filtrates that are discharged to sewers) were collected and analyzed. For these mills, EPA calculated separate mass loadings for each pollutant in each sewer for each day and then summed the production-normalized loadings to obtain a "bleach plant effluent" loading for that day, as shown below. The flow rates of the acid and alkaline sewers are usually measured (or estimated) separately, but only one brown stock production value is applicable to the calculation.

	Chloroform Concentration (	**Wastewater Flow Rate (m^3/day)**	**Brown Stock Pulp Flow Rate (kkg/day)**
Acid Filtrate	25	18,000	1,200
Alkaline Filtrate	15	15,000	
Acid Filtrate Mass Loading	$25\ \frac{\mu g}{L} \times 10^3\ \frac{L}{m^3} \times 18{,}000\ \frac{m^3}{day} \times 10^{-9}\ \frac{kg}{\mu g}\quad 0.450\ \frac{kg}{day}$		
Alkaline Filtrate Mass Loading	$15\ \frac{\mu g}{L} \times 10^3\ \frac{L}{m^3} \times 15{,}000\ \frac{m^3}{day} \times 10^{-9}\ \frac{kg}{\mu g}\quad 0.225\ \frac{kg}{day}$		
Bleach Plant Mass Loading	$0.450\ \frac{kg}{day}\quad 0.225\ \frac{kg}{day}\quad 0.675\ \frac{kg}{day}$		
Production-Normalized Bleach Plant Mass Loading	$\frac{0.675\ \frac{kg}{day}}{1{,}200\ \frac{kkg}{day}}\quad 5.625 \times 10^{-4}\ \frac{kg}{kkg}$		

The results of some chemical analyses were reported as less than a sample-specific detection limit, for example, less than 10
agents, pollutant mass loadings were estimated using one-half the minimum level of the analytical method. In the previous example, if chloroform was not detected in the alkaline filtrate, because 10
loading of 6.25×10^{-5} kg/kkg of chloroform in the alkaline filtrate. For mills using TCF bleaching, EPA assumed that chlorinated pollutants were not present. In the previous example if chloroform was not detected at a TCF-bleaching mill, the mass loading was assumed to be zero.

Separate computer programs are used to calculate the production-normalized mass loadings for each sampling database. EPA determined that separate computer programs were necessary because of differences in the sampling programs in organization, objectives, amount of data collected, and type of data collected, resulting in databases with different formats. A brief description of the loadings calculations for each sampling program is provided in this section. More details on each sampling episode and production-normalized pollutant loading calculations are provided in separate documents in the EPA rulemaking record for these regulations.

9.2.2 Data Sources

The data sources used to calculate production-normalized pollutant loadings are described in the following sections.

9.2.2.1 Short-Term Studies

For the short-term studies, loadings for each pollutant were calculated at the bleach plant and the final effluent for 11 mills. These sampling episodes were either two or three days in length. Specific details varied from mill to mill. Depending on the mill, sampling location, and pollutant, two- or three-day composite samples were collected, three consecutive 24-hour composite samples were collected, or three nonconsecutive 24-hour composite samples were collected. Where multi-day composite samples were collected, average wastewater and brown stock pulp flow rates for the multi-day period were also obtained. Where 24-hour composite samples were collected, 24-hour average wastewater and brown stock pulp flow rates were obtained. From these data, EPA calculated an average pollutant mass loading for each stream at each mill regardless of the number of days of samples collected or the number of analytical measurements available. EPA calculated each mass loading based on between one and three analytical data values.

For the short-term studies, EPA performed a preliminary review of the data quality associated with each of the 11 mills and discarded from the database some individual analytical data points that did not meet the criteria of the preliminary review (1). A second review was performed by EPA's Sample Control Center (SCC) for four mills (of the 11) that represented technology options EPA considered at proposal (2). SCC used the same data quality review criteria for data from the short-term sampling episodes as for the variability study.

9.2.2.2 EPA/Industry Long-Term Variability Study

The long-term variability study consisted of nine 24-hour composite samples collected in the summer of 1991 and nine 24-hour composite samples collected in the winter of 1991-92 at eight mills. Like the short-term sampling episodes, the average wastewater and brown stock pulp flow rates were obtained for each 24-hour sampling period. Again, SCC reviewed the quality of the individual analytical data points and discarded from the database the analytical results that did not meet the method quality control criteria (3). In general, when data were not discarded, 18 data points were available for each pollutant at each sampling point. From the available data, an average mass loading was calculated for each pollutant, at each sampling point, for each mill.

9.2.2.3 Self-Monitoring Data

The self-monitoring data consisted of a wide range of analyses varying from one pollutant in one stream at some mills to many pollutants in many streams at other mills. The analytical results submitted by each mill for various pollutants in various streams over the period

from 1985 through 1992 were entered into a database. Average annual flow rates for each mill (bleach plant effluent, final effluent, and brown stock pulp) and fiber furnish and other operating data were obtained from responses to EPA's 1990 Census Questionnaire (reflecting data for 1989) and follow-up letters for mills that made subsequent process changes (primarily reflecting data for 1990 and 1991, but also 1992 for some mills). Because of changes in the industry's pulping and bleaching practices since 1985-92 and the availability of more recent data, EPA limited the use of the self-monitoring data. Self-monitoring AOX data were used to estimate the baseline loadings of mills that have not made any major process changes in recent years.

9.2.2.4 Data Collected Since Proposal of the Regulations

Since the December 1993 proposal of these regulations, EPA, NCASI, and various mills have collected additional wastewater monitoring data. Most of the data were collected at mills using complete substitution of chlorine dioxide for chlorine (ECF bleaching) on at least one bleach line. Some of the mills also used extended cooking, oxygen delignification, and/or TCF bleaching.

Many of these additional studies followed the format of the short-term studies, i.e., three consecutive days of sampling at the bleach plant and final effluents with analysis of the samples for the pollutants proposed for regulation at each sampling point. However, specific details varied from mill to mill and several mills collected samples over longer periods of time.

A thorough review of the results of the pollutant analyses was performed by SCC for all results submitted with supporting quality assurance/quality control data. SCC reviewed the pollutant analytical data quality and discarded analytical results that did not meet method quality control criteria. SCC used similar data quality review criteria for data from these sampling episodes as for the long-term variability study. From the resultant database, EPA calculated an average pollutant concentration or mass loading for each stream at each mill. The results of the SCC review were reported in a series of quality assurance data review memoranda which can be found in Section 21.6 of the docket supporting these regulations.

Since proposal, EPA also received some final effluent AOX data from bleached papergrade kraft mills in Alberta, Canada. While some of these data were used to develop the AOX limitations for each option, these data were not used to estimate the baseline AOX loadings of the industry.

9.2.2.5 1994 NCASI Dioxin Survey

Each year since the 104-Mill Study (4) was conducted in 1988, NCASI has asked each mill for its most recent TCDD and TCDF data for bleached pulps, final mill effluents, and wastewater treatment sludges. If a mill does not respond to the request in a particular year, NCASI uses data from a previous year for its annual compilation. EPA used the final effluent

data from the 1994 survey to estimate the baseline discharges of TCDD and TCDF for the industry (5). The list of currently operating bleached papergrade kraft and sulfite pulp mills in NCASI's 1994 survey matches the list in EPA's baseline database (reflecting mid-1995 operations). The survey also includes data for dissolving kraft and dissolving sulfite mills which EPA did not use in the analysis reported here.

NCASI calculates effluent mass loadings using detected concentrations or one-half the reported detection limits. (Note that this approach is slightly different than the approach EPA used to make a separate estimate using its own database and one-half of the minimum level for non-detect values.) NCASI reports results in units of milligrams/day. EPA multiplied the detected concentrations or one-half the reported detection limits by the 1994 average daily wastewater discharge for each mill (as reported in the survey) and by 350, an estimate of the number of days that each mill produced bleached pulp. After several unit conversions, EPA reported results in units of g/yr of TCDD and TCDF discharged by each mill.

9.2.2.6 NCASI Bleach Plant Chloroform Data

In December 1988, NCASI published Technical Bulletin No. 558, which presented total bleach plant chloroform generation rates for a variety of kraft and sulfite bleaching sequences (6). The report also provided information that could be used to estimate the bleach plant effluent chloroform loading. These data were used to supplement EPA's sampling data for the bleach sequences studied.

9.3 Industry Baseline Pollutant Loadings

In support of the 1993 proposal, EPA developed a procedure for estimating the baseline bleach plant and final effluent pollutant mass loadings for each mill. The procedure used all available data from each mill. EPA created a model with which to estimate loadings where data were not available. The model estimated the average pollutant loadings achieved by mills using several combinations (one combination for each option evaluated for each subcategory) of pulping and bleaching technologies. Even though the procedure was complicated and labor-intensive, EPA received few public comments on this baseline estimation procedure.

Instead, commenters objected to EPA's use of data dating, in some cases, to the 1988 104-Mill Study, to characterize the industry's 1993 pollutant discharges. As discussed above, EPA has addressed this comment by updating the estimate of the baseline pollutant loadings. Changes to the baseline estimate include:

Updated data collected by EPA, NCASI, and individual facilities;

Limited use of self-monitoring data dating from 1985-1992 (where more recent data were not available); and

Incorporation of the results of NCASI's 1994 Dioxin Survey into the analysis, made available to EPA in late 1995.

EPA has simplified the baseline estimation procedure used at proposal. The revised procedure uses three models to reflect process technology status and thereby estimate the baseline loadings for all mills. These models replace the complicated baseline-estimation procedure used at proposal where sampling data were used to represent the mills from which sampling data were available, and models were used to fill data gaps for mills from which no data (or out-of-date data) were available. The three models were developed for different pollutant groups:

1) AOX, chlorinated phenolic compounds, TCDD, and TCDF;
2) Chloroform; and
3) COD and color.

EPA determined that separate models were necessary because, for each group of pollutants, different process criteria more accurately predict pollutant loadings. For example, for final effluent AOX loads, the furnish pulped, the use of extended pulping technologies, and the percent chlorine dioxide substitution were strongly related to the pollutant loading. The three models are summarized below, and are described in detail in subsequent sections.

Model	Pollutants	Main Process Criteria Predictive of Pollutant Loadings
1	AOX, chlorinated phenolic compounds, TCDD, TCDF	Furnish pulped; Extended pulping status; Percent ClO_2 substitution
2	Chloroform	Hypochlorite use; Percent ClO_2 substitution
3	COD, color	Screen room status; Pre-bleaching kappa number

9.3.1 AOX, Chlorinated Phenolic Compounds, TCDD, and TCDF

The model used for AOX, chlorinated phenolic compounds, TCDD, and TCDF ("AOX model") is shown in Table 9-1. Each bleach line at each papergrade kraft and sulfite mill was assigned to one of the eleven baseline groups. These groups are similar to the groups used at proposal to estimate baseline loadings (although fewer groups exist now than at proposal). The groups are based on the furnish pulped, extended pulping equipment in place, pre-bleaching kappa number achieved, and bleach sequence of each bleach line.

Because a mill may have more than one type of bleach line, assigning a complete mill to a group is more subjective than assigning a single bleach line. Sixteen of the 84 mills in the Bleached Papergrade Kraft and Soda Subcategory for which EPA estimated pollutant reductions operate with bleach lines in more than one group. In these cases, judgment was used to select a group that would result in the best estimate of the combined mill effluent.

EPA assigned the AOX model groups at the same time that EPA made preliminary estimates of the costs of compliance with the revised options. Because capital costs are related to equipment, group assignments were based on pulping equipment in place rather than strict adherence to the pre-bleaching kappa number ranges reported in Table 9-1.

AOX Group F was formed to aggregate the data from mills that did not achieve the kappa numbers expected from the pulping technologies they employ. Three softwood bleach lines with some form of extended delignification and ECF bleaching did not achieve kappa numbers as low as expected for mills in Group H. (EPA believes that these mills were not operating optimally.) Conversely, two hardwood mills achieved kappa numbers lower than expected. As shown in Table 9-2, to estimate AOX baseline loads, these bleach lines were grouped with bleach lines employing no extended pulping and ECF bleaching (i.e., Groups E and F were combined).

9.3.1.1 AOX

The average AOX loadings for papergrade kraft and sulfite baseline groups are summarized in Table 9-2. Sampling data were not available for all the groups identified in Table 9-1; therefore, several groups identified in Table 9-1 were consolidated (as shown in Table 9-2). EPA assumed that the effluent characteristics from mills in groups with similar bleach plant operating conditions were similar. EPA also used self-monitoring data to characterize the effluent AOX loadings for the consolidated Group A, B, and C.

In general, the AOX baseline loadings listed in Table 9-2 represent the average of the values available from mills producing either hardwood or softwood but not from mills producing both hardwood and softwood. Average final effluent AOX production-normalized loadings were also calculated for mills in each group (where data were available) that produce both hardwood and softwood, and usually fell within the range of the values listed above. However, the only data available from mills in Groups G and I were from mills producing both hardwood and softwood, so this loading (0.38 kg/kkg) was applied to both the hardwood and softwood columns in Table 9-2. For TCF mills (Group K), final effluent AOX loadings were assumed to be zero.

In the baseline model, each mill was designated as a mill normally producing only hardwood, only softwood, or as a mill producing both hardwood and softwood. Mills producing only hardwood or softwood were assigned the baseline loadings listed in Table 9-2 (in accordance with its assigned grouping). Mills producing both hardwood and softwood were assigned a baseline loading by multiplying the loadings listed in Table 9-2 by the percent of hardwood and

softwood brown stock pulp that is bleached at each mill. (The hardwood and softwood brown stock pulp rates that were used here were also used in the compliance cost model.) For these mills, the baseline loadings would be between the two loadings listed for mills in each consolidated AOX group.

9.3.1.2 TCDD, TCDF, and the 12 Chlorinated Phenolic Compounds

EPA used the same AOX model but a slightly different procedure to estimate the baseline loadings of TCDD, TCDF, and the chlorinated phenolic compounds. These pollutants are not consistently detected in pulp mill effluents, particularly at higher levels of chlorine dioxide substitution or at TCF mills. The mills that use extended delignification technologies have lower bleach plant effluent flows than mills using conventional pulping because they have modernized and use less water to wash pulp more efficiently. To account for these flow differences, EPA estimated average bleach plant concentrations of TCDD, TCDF, and chlorinated phenolic compounds. The concentrations were calculated by averaging any detected values with the number of non-detected values multiplied by one-half the minimum level of the analytical method for each pollutant. For example:

$$\left[a \quad b \quad c \quad \left(n\frac{ML}{2}\right)\right]\frac{1}{n \quad 3} \qquad \text{average concentration}$$

where a, b, and c are detected concentrations, n is the number of results reported as "not detected", and ML is the minimum level for the analytical method. The ML for the analytical method was used rather than using various sample-specific detection limits (some of which may be greater than the method ML, due in most cases to reduced sample volume), in order to simplify the procedure. This calculation was used for all data except for TCF mills, EPA assumed that the concentration and loading of these pollutants at TCF mills was zero.

To calculate a mass loading, the average group concentration was multiplied by an average production-normalized bleach plant flow rate for the mills in each group. Production-normalized bleach plant flow rates (based on sampling data collected at bleached papergrade kraft mills) are shown in Table 9-3. Although the flow rates were derived from kraft mill data, because of limited sampling data for papergrade sulfite mills, these flow rates were used to estimate pollutant loadings from papergrade sulfite mills. The group average concentrations for TCDD, TCDF, and the 12 chlorinated phenolic compounds are shown in Tables 9-4 through 9-17. Group average concentrations are reported as “ND” when the compound was never detected among the data available for that group of mills. For these cases, a concentration of one-half the minimum level for the compound was used to calculate the mass loading for that group of mills.

EPA calculated average concentrations and production-normalized flow rates using sampling results from mills bleaching either hardwood or softwood but not from mills bleaching a mixture of hardwood and softwood. For mills bleaching a mixture of hardwood and softwood, EPA calculated baseline loadings by multiplying the appropriate concentrations and

flows by the percent of hardwood and softwood brown stock pulp that is bleached at each mill.

After a baseline mass loading was calculated for each bleach line at each mill, the individual pollutant loads were summed for mills with multiple bleach lines to give the total bleach plant pollutant load for the mill. Final effluent mass loadings were calculated from the estimated bleach plant loadings. For TCDD and TCDF, the final effluent loads were assumed to be the same as the bleach plant loads for each mill because EPA's data do not show that TCDD or TCDF are degraded by biological treatment. This method provides an upper-bound estimate of the final effluent loads because some of the TCDF (and perhaps TCDD if present) may adsorb to the sludge.

For the 12 chlorinated phenolic compounds, 45 percent of the bleach plant load at each mill was assumed to be removed in the treatment system (or the associated POTW for indirect discharging mills). The 45 percent removal efficiency was based on an NCASI study of the removal of specific chlorinated phenolic compounds in various wastewater treatment systems (7).

For TCDD and TCDF, a second baseline calculation was made using data compiled by NCASI for 1994. EPA used the NCASI data to calculate effluent mass loadings for each mill using the detected concentrations or one-half the reported detection limits multiplied by the 1994 average daily wastewater discharge for each mill (as reported in the survey) and by 350, an estimate of the number of days that each mill produced bleached pulp. After several unit conversions, the results were reported in units of g/yr of TCDD and TCDF discharged by each mill. (Note that one-half the reported detection limits were used rather than one-half the minimum level because 1) the analytical methods used are not reported and 2) the reported detection limits are generally lower than the minimum level for Method 1613.)

The two dioxin baseline estimates are presented below:

Baseline Final Effluent Discharge from All Bleached Papergrade Kraft and Soda Mills	**Estimate Using Bleach Plant Loads (g/yr)**	**Estimate Using 1994 NCASI Dioxin Survey Results (g/yr)**
TCDD	15.2	13.1
TCDF	115	41.7

The TCDD baseline estimates using the two calculation procedures are very close. The TCDF baseline estimates are not as close because TCDF is occasionally detected just above the method minimum level in some bleach plant effluents but is diluted to concentrations below the minimum level at the final mill effluent. Because of this fact, EPA believes the TCDF baseline estimate based on the bleach plant data is more appropriate.

After July 1996, EPA again recalculated the effluent reductions. The baseline remained mid-1995, but the methodology outlined above was modified slightly. EPA used two different procedures for handling concentrations of chlorinated pollutants reported as less than the detection limit. For mills that used chlorine-containing bleaching agents, EPA used one-half the method minimum level to estimate effluent discharge loadings, i.e., EPA assumed the chlorinated pollutants were present at concentrations too low to measure by current analytical methods. (This approach is the same one used previously for handling non-detected concentrations.) For mills that used TCF bleaching, EPA assumed that chlorinated pollutants were not present; EPA assumed that TCF mills would discharge zero kilograms per year of AOX and the individual chlorinated pollutants (chloroform, TCDD, TCDF, and the 12 chlorinated phenolic compounds).

This minor methodology change affects the baseline discharges for two mills (one kraft and one sulfite) that currently use TCF bleaching sequences and seven mills (one kraft and six sulfite) that are expected to use a TCF bleach sequence after promulgation of these regulations. These same baseline and post-promulgation loading changes were also applied to the 1994 NCASI dioxin profile data (for TCDD and TCDF) for the affected mills to adjust EPA's effluent reduction estimates based on these data in the same manner.

9.3.2 Chloroform

The model used for chloroform is shown in Table 9-18. Kraft and sulfite mills were divided into six baseline groups. The groups are defined by the bleach sequence used at each mill, specifically whether mills used hypochlorite in the bleach sequence and what level of chlorine dioxide substitution was used in the first bleaching stage. For the July 1996 Notice, EPA used the same value for ECF and TCF bleach lines because chloroform was not detected in final effluents from either type of mill. For this recalculation, EPA used the same loading for ECF mills (Group E) but used zero for TCF mills (Group F). Mills with more than one bleach line were assigned a group based on whether hypochlorite was used on any bleach line and what the average production-normalized chlorine dioxide substitution in the first bleaching stage was for all the fiber lines at the mill.

In addition to bleach sequence, the type of washers used in the bleach plant (8) may affect bleach plant effluent chloroform loadings. Bleach plant effluent chloroform loadings are somewhat greater at mills using low air-flow washers (e.g., pressure or diffusion washers) than at mills using high air-flow washers (e.g., vacuum-drum washers). This effect on bleach plant chloroform loadings was not accounted for in the baseline model because EPA does not know what type of washers are used on each bleach line at each mill in the country. In general, most mills use vacuum-drum washers and the most data are available from mills using these washers.

The average bleach plant and final effluent loadings for mills in the various groups are summarized in Table 9-19. For bleach plants, EPA and NCASI data were used (6,9). For final effluents, no NCASI data were available so only EPA data were used. (Note: Although EPA calculated bleach plant effluent chloroform reductions, they were not used directly in the benefit

analyses. Air emission reductions of chloroform were estimated to assess an important non-water quality environmental benefit (see Section 11 of this document) while final effluent pollutant reductions were used to evaluate aquatic environmental impacts.)

9.3.3 COD and Color

EPA proposed limitations for COD and color. The in-plant process changes that form the bases of the BAT limitations, PSES, and the BMPs reduce final effluent COD and color loadings. For this reason, and to fully evaluate the options considered, EPA estimated effluent loadings reductions for COD and color. For reasons stated in the preamble and a separate document (10), EPA intends to develop COD limitations for kraft and sulfite mills in a future rulemaking. EPA also decided not to develop national effluent limitations guidelines and standards for color for Subparts B and E; instead, permit writers must continue to develop site-specific effluent limitations for color as necessary to achieve applicable water quality standards (see 33 U.S.C. 1311(b)(1)(c)).

The model used for estimating baseline COD and color loadings was based on screen room status and pre-bleaching kappa number. EPA assumed that the available final mill effluent loadings were derived from the pulping and bleaching operations at each mill. The model did not specifically account for unusual loadings from papermaking or other on-site pulping (e.g., mechanical or secondary fiber) operations although these operations were used at some of the mills for which data were available.

As shown in Table 9-20, kraft and sulfite mills were divided into four baseline groups. Mills with more than one fiber line were assigned a group based on whether any screen room at the mill was open and on the average production-normalized pre-bleaching kappa number for all the lines at the mill. COD and color baseline loadings and reductions were calculated for pulp mill final effluents, but not for bleach plant effluents. The average final effluent baseline loadings for mills in the four groups are presented in Table 9-21.

9.4 Pollutant Loadings After Implementation of the Control Options

After estimating baseline loadings for each mill, EPA estimated the reduction in pollutants discharged to receiving streams attributable to the three principal BAT and PSES technology options considered by EPA. The long-term average (LTA) performance of each option for each pollutant was subtracted from each mill's baseline discharge. The LTA pollutant loadings for each option are presented in Table 9-22.

See Section 8 for a description of the technology options considered for BAT and PSES for the Bleached Papergrade Kraft and Soda and Papergrade Sulfite Subcategories.

EPA evaluated the performance of each technology option described above by calculating a LTA loading for each pollutant of concern. EPA used data from facilities that employed processes most similar to the technology components of each option. The sampling

data that were used to calculate the performance of each option are presented in a separate document (11). These data were a subset of the data used to develop baseline pollutant loadings. As described previously, for the estimation of baseline, EPA estimated pollutant loadings for several combinations of pulping and bleaching operations in addition to the BAT options.

The LTAs used in these estimates for AOX, TCDF, and chloroform are not exactly the same values as the LTAs used to develop the limitations but they are reasonably close. The reason that EPA employed slightly different LTAs to estimate loading reductions than to calculate limitations is that the two LTAs served difference purposes. EPA used the LTAs for load reductions to help in its evaluation of the technology options being considered; while highly informative, the reductions were not statutory decision criteria. In contrast, EPA refined its LTAs before using them to calculate limitations, because the calculations would lead to the imposition of enforceable permitting and pretreatment requirements. Therefore, EPA concluded that it needed to exercise more analytical rigor in determining the limitations-related LTAs than the LTAs used ultimately for the non-statutory benefits analysis. This document presents the estimated loadings and reductions used to select the options. The final LTAs used to develop the limitations are described in the Statistical Support Document for the Pulp and Paper Industry: Subpart B (12).

The long-term averages for AOX and TCDF used in the pollutant reduction calculations for kraft Options A and B were calculated in early 1997. The AOX LTAs are based on more data than the LTAs presented in EPA's July 1996 Notice. The TCDF long-term average is based on the data presented in EPA's July 1996 Notice.

The chloroform LTA calculated for kraft Option A, 0.0003 kg/kkg (calculated from non-detect results using one-half the method minimum level), was also applied to kraft Option B because chloroform is not expected to be detected in the final effluent from mills with either technology. TCDD and the 12 chlorinated phenolic compounds are also not expected to be detected in the final effluent from kraft Option A or B mills. The LTAs for these pollutants were calculated in the manner described in Section 9.1.2: one-half the minimum level for each pollutant was multiplied by a group-average production-normalized bleach plant effluent flow rate. For kraft Options A and B, the LTA loadings are the same as the baseline loadings for Groups E and H/J, respectively. The COD and color LTAs for kraft Options A and B were calculated by EPA in February 1996 (13).

EPA had little end-of-pipe data with which to calculate LTA pollutant loads for sulfite mills. For the calculation of pollutant reductions, EPA assumed that TCF mills would not discharge any chlorinated compounds, including AOX, and the pollutant concentrations measured at ECF sulfite mills would be similar to those concentrations at ECF kraft mills (i.e., mostly not detected). The sources of data used for sulfite mills are summarized in Table 9-23. For the calculation of pollutant reductions, pollutant concentrations for the sulfite ECF option were transferred from kraft Option A.

Table 9-22 presents the estimated loadings for each pollutant. The loadings in Table 9-22 were subtracted from the baseline loadings to determine the pollutant reductions for

each mill and then were summed for all mills in each subcategory. If the baseline loading for any mill(s) was lower than the option LTA, the removal was set to zero.

9.5 Pollutant Reductions

The pollutant reductions calculated using the methodology described in this document are summarized in Table 9-24. Mill-by-mill estimates are confidential business information (CBI) and are included as such in the CBI portion of the rulemaking record (14). In Table 9-24, for bleached papergrade kraft mills, the column headings in the table differentiate between Options A and B. For papergrade sulfite mills, the same results are shown in each column because only one option was evaluated for each segment: TCF for the calcium-, magnesium-, or sodium-based segment and ECF for the ammonium-based and specialty-grade segments. Note that the values in each column may not add, due to rounding.

For the kraft mill TCF options that were evaluated by EPA, the estimated pollutant reductions for AOX and the individual chlorinated pollutants are the same as the baseline loading estimates, because EPA assumes that these compounds would not be present in measurable quantities in the effluent from these mills. These values are not shown in Table 9-24. For COD and color, EPA would expect the pollutant reductions for the TCF options (including oxygen delignification, closed screen rooms, and improved brown stock washing) to be at least equivalent to those that were estimated for kraft Option B.

9.6 References

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6. Results of Field Measurements of Chloroform Formation and Release From Pulp Bleaching. NCASI Technical Bulletin No. 558. Record Section 2.3.2, DCN 03815, December 1988.

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9. Chloroform Generation at Bleach Plants with Low Molecular Chlorine Usage or Split Chlorination. NCASI Technical Bulletin No. 605. Record Section 2.3.2, DCN 05495, March 1991.

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11. Data Available for Limitations Development for Toxics and Nonconventional Pollutants. EPA, Washington DC, Record Section 22.6, DCN 14494, 1997.

12. Statistical Support Document for the Pulp and Paper Industry: Subpart B. EPA, Washington DC, Record Section 22.5, DCN 14496, 1997.

13. M. Smith. Revised Pulp and Paper LTAs. EPA, Washington DC, Record Section 24.0, DCN 13966, February 20, 1996.

14. Mill-by-Mill Pollutant Loading and Reduction Estimates. Prepared by ERG for EPA. Record Section 22.6, DCN 14501, July 1997.

Table 9-1

Baseline Technology Groups for Bleached Papergrade Kraft and Soda, and Papergrade Sulfite Mills: AOX, Chlorinated Phenolic Compounds, TCDD, and TCDF

AOX Group[a]	Example Bleach Sequence(s)	EC or OD?[b]	Chlorine Used?	Hypo-chlorite Used?[c]	Percent of ClO_2 Used	Kraft Mill Kappas	
						HW	SW
A	CEH[d]	No	Yes	Yes	none on site	> 13	> 27
B	CEHD, CED	No	Yes	Maybe	0 in first stage		
C	C/DEH, C/DEHDED, C/DED, C/DEDED	No	Yes	Maybe	< 70		
D	D/CEDED, D/CEopDEpD	No	Yes	Maybe	70 to 100		
E	DEDED, DEopDD	No	No	No	100		
F	HW: C/DEDED, C/DEoDEP	No	Yes	Maybe	< 100	10 to 13	--
	SW: EC or OD with DEDED, DEopDD	Yes	No	No	100	--	20 to 27
G	EC or OD with C/DEDED, D/CEDED	Yes	Yes	Maybe	< 100	10 to 13	15 to < 20
H	EC or OD with DEDED, DEopDD	Yes	No	No	100		
I	EC and OD with C/DEDED, D/CEDED	Both	Yes	Maybe	< 100	< 10	< 15
J	EC and OD with DEDED, DEopDD	Both	No	No	100		
K	TCF[d]	Maybe	No	No	none		

[a]Groups E and H include the bleached papergrade kraft mills that represent the two ECF options under consideration for that subcategory. Groups E and K include the papergrade sulfite mills that represent the TCF and ECF options under consideration for that subcategory.
[b]EC is extended cooking (e.g., MCC, EMCC, RDH or SuperBatch) and OD is oxygen delignification.
[c]"Maybe" indicates that the pollutant loadings are not significantly different for mills using or not using hypochlorite.
[d]Mills using this bleaching sequence do not usually bleach to full brightness.

Table 9-2

AOX Baseline Loadings

Consolidated AOX Groups	Final Effluent (kg/kkg)	
	Hardwood	Softwood
Kraft A, B, C	1.61	3.00
Kraft D	0.56	1.50
Kraft E, F	0.27	0.39
Kraft G, I	0.38[a]	0.38[a]
Kraft H, J	0.153	0.153
Kraft & Sulfite K	0.00	0.00
Sulfite A	5.82	5.82
Sulfite B, C	1.61	3.00

[a]The only data available from mills in Groups G and I were from mills producing both hardwood and softwood so this loading was applied to both the hardwood and softwood columns.

Table 9-3

Production-Normalized Kraft Bleach Plant Flow Rates[a]

AOX Groups[b]	Type of Mill	Hardwood Mills (m^3/kkg)	Softwood Mills (m^3/kkg)
A, B, C, D, E, F(HW)	Mills Without EC or OD	24.7	37.1
F(SW), G, H, I, J	Mills With EC and/or OD	19.7	24.7
K[c]	TCF Mills	11.6	18.3

[a]The average flow rates presented in this table were derived from bleached papergrade kraft mills. However, these flow rates were used to estimate mass loads of chlorinated phenolic compounds, TCDD, and TCDF from papergrade sulfite mills as well as bleached papergrade kraft and soda mills.
[b]Papergrade sulfite mills fall in groups A, B, C, and K.
[c]These flow rates were not used to calculate the final set of reduction estimates in 1997; instead, EPA assumed that TCF mills discharged no chlorinated organic pollutants.

Table 9-4

TCDD Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (pg/L) Minimum Level = 10 pg/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	5.63	2	70	64.6	12	6
D	5.24	1	41	6.38	3	37
E	ND	0	6	ND	0	29
F	7.80	1	4	ND	0	30
G, I	5.27	1	43	8.09	6	39
H, J	9.54	4	24	ND	0	86
K	ND	0	4	ND	0	10

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-5

TCDF Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (pg/L) Minimum Level = 10 pg/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	6.99	12	60	593	15	2
D	8.83	10	32	6.47	5	35
E	ND[b]	0	6	ND[b]	0	29
F	52	2	3	ND	0	24
G, I	4.87	4	40	7.93	3	41
H, J	10.6	8	20	9.62	13	73
K	ND	0	4	ND	0	13

[a]Papergrade sulfite mills fall in groups A, B, C, and K.
[b]TCDF was not detected at the mills for which data are included in EPA's database but comments on the July 1996 Notice indicate that TCDF is detected at some mills of this type. Therefore, the reductions may be underestimated.

Table 9-6

Trichlorosyringol Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (` g/L) Minimum Level = 2.5 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	12.2	57	25	1.30	1	31
D	16.4	22	22	ND	0	38
E	ND	0	17	ND	0	79
F	20.9	5	8	ND	0	28
G, I	7.63	26	15	ND	0	43
H, J	ND	0	44	ND	0	100
K	ND	0	4	ND	0	5

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-7

2,4,5-Trichlorophenol Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (` g/L) Minimum Level = 2.5 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	ND	0	82	1.80	5	27
D	4.18	5	40	ND	0	38
E	ND	0	17	ND	0	79
F	8.92	5	8	ND	0	28
G, I	ND	0	41	1.35	1	42
H, J	ND	0	44	ND	0	102
K	ND	0	9	ND	0	10

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-8

2,4,6-Trichlorophenol Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (` g/L) Minimum Level = 2.5 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	18.2	59	23	46.3	20	10
D	8.34	31	14	12.8	36	0
E	ND	0	17	ND	0	79
F	25.8	11	2	ND	0	28
G, I	7.42	35	9	44.5	38	7
H, J	ND	0	44	1.36	1	101
K	ND	0	9	ND	0	10

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-9

3,4,5-Trichlorocatechol Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (` g/L) Minimum Level = 5.0 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	8.37	14	56	112	10	17
D	47.8	19	24	82.2	19	17
E	ND	0	17	ND	0	79
F	ND	0	13	ND	0	28
G, I	14.6	17	18	64.3	20	19
H, J	ND	0	44	ND	0	98
K	ND	0	4	ND	0	5

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-10

3,4,5-Trichloroguaiacol Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (` g/L) Minimum Level = 2.5 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	5.61	24	54	36.8	11	20
D	1.55	3	42	49.4	37	0
E	ND	0	17	ND	0	79
F	2.00	1	12	ND	0	28
G, I	7.83	17	23	52.7	27	15
H, J	ND	0	44	ND	0	103
K	ND	0	4	ND	0	5

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-11

3,4,6-Trichlorocatechol Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (` g/L) Minimum Level = 5.0 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	ND	0	54	ND	0	0
D	9.39	24	15	2.96	2	34
E	ND	0	17	ND	0	79
F	ND	0	0	ND	0	28
G, I	2.65	1	30	3.00	5	28
H, J	ND	0	44	ND	0	98
K	ND	0	4	ND	0	5

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-12

3,4,6-Trichloroguaiacol Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (` g/L) Minimum Level = 2.5 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	1.49	6	64	6.33	5	17
D	4.38	17	27	1.72	8	30
E	ND	0	17	ND	0	79
F	3.04	3	10	ND	0	28
G, I	ND	0	35	1.61	5	32
H, J	ND	0	44	ND	0	100
K	ND	0	4	ND	0	5

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-13

4,5,6-Trichloroguaiacol Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (` g/L) Minimum Level = 2.5 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	4.04	17	62	25.9	16	16
D	62.4	19	24	14.0	31	6
E	ND	0	17	ND	0	79
F	8.19	3	10	ND	0	28
G, I	2.97	14	28	10.7	16	24
H, J	ND	0	44	1.27	1	103
K	ND	0	4	ND	0	5

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-14

Tetrachlorocatechol Baseline Concentrations

Consolidated AOX Groups[(a)]	Bleach Plant Effluent (` g/L) Minimum Level = 5.0 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	3.21	5	69	28.1	21	10
D	6.59	13	26	8.57	14	20
E	ND	0	17	ND	0	79
F	10.6	6	7	ND	0	28
G, I	4.55	6	33	9.20	16	26
H, J	ND	0	44	ND	0	100
K	ND	0	4	ND	0	5

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-15

Tetrachloroguaiacol Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (` g/L) Minimum Level = 5.0 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	2.81	4	79	13.9	13	19
D	2.54	2	43	4.31	13	26
E	ND	0	17	ND	0	79
F	8.19	2	11	ND	0	28
G, I	ND	0	38	2.89	5	34
H, J	ND	0	44	ND	0	104
K	ND	0	4	ND	0	5

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-16

2,3,4,6-Tetrachlorophenol Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (` g/L) Minimum Level = 2.5 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	1.63	9	66	ND	0	32
D	1.47	1	43	ND	0	38
E	ND	0	17	ND	0	79
F	ND	0	13	ND	0	28
G, I	1.38	5	36	2.88	4	39
H, J	ND	0	44	ND	0	102
K	ND	0	9	ND	0	10

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-17

Pentachlorophenol Baseline Concentrations

Consolidated AOX Groups[a]	Bleach Plant Effluent (` g/L) Minimum Level = 5.0 ` g/L					
	Hardwood			Softwood		
	Concentration	Detects	Non-detects	Concentration	Detects	Non-detects
A, B, C	ND	0	83	2.26	6	26
D	ND	0	46	2.74	1	39
E	ND	0	17	ND	0	79
F	2.44	1	12	ND	0	28
G, I	2.62	2	42	10.8	1	44
H, J	ND	0	44	ND	0	103
K	ND	0	9	ND	0	10

[a]Papergrade sulfite mills fall in groups A, B, C, and K.

Table 9-18

Baseline Technology Groups for Chloroform

Chloroform Group	Hypochlorite Use	Chlorine Dioxide Substitution
A	Yes	0%
B	Yes	>0%
C	No	<50%
D	No	50 to 99%
E	No	100%
F	No	TCF

Table 9-19

Chloroform Baseline Loadings

Chloroform Group[a]	Bleach Plant (g/kkg)	Final Effluent (g/kkg)
A	220	5.4
B	142	5.4
C	61	1.1
D	19	0.90
E	0.70	0.30[b]
F	0.0	0.0

[a]Papergrade sulfite mills fall in groups A, C, and F.
[b]Calculated from non-detect results using one-half the minimum level.

Table 9-20

Baseline Technology Groups for COD and Color

COD/Color Group	Screen Room Status	Pre-Bleaching Kappa Number
A	Open	` 20
B	Closed	` 20
C	Open	<20
D	Closed	<20

Table 9-21

COD and Color Baseline Loadings for Bleached Kraft and Papergrade Sulfite Operations Only

COD/Color Group[a]	Final Effluent COD Loading (kg/kkg)	Final Effluent Color Loading (kg/kkg)
A	51	89
B	37	85
C	33	60
D	28	43

[a]Papergrade sulfite mills fall in groups A, C, and D.

Table 9-22

Final Effluent Long-Term Average Loadings After Implementation of the BPK and PS Options (kg/kkg)

	Units are kg/kkg where kkg is air-dry metric tons of pulp into bleaching except for COD and color where it is air-dry metric tons of brown stock pulp produced on site.			
Pollutant	**Kraft Option A**	**Kraft Option B**	**Sulfite TCF[a]**	**Sulfite ECF[b]**
AOX	0.512	0.208	0.0	0.512
Chloroform	0.0003	0.0003	0.0	0.0003
TCDD[c]	1.85×10^{-10}	1.25×10^{-10}	0.0	1.85×10^{-10}
TCDF	4.18×10^{-10}	2.83×10^{-10}	0.0	4.18×10^{-10}
Trichlorosyringol[c]	4.63×10^{-5}	3.13×10^{-5}	0.0	4.63×10^{-5}
2,4,5-Trichlorophenol[c]	4.63×10^{-5}	3.13×10^{-5}	0.0	4.63×10^{-5}
2,4,6-Trichlorophenol[c]	4.63×10^{-5}	3.13×10^{-5}	0.0	4.63×10^{-5}
3,4,5-Trichlorocatechol[c]	9.25×10^{-5}	6.25×10^{-5}	0.0	9.25×10^{-5}
3,4,5-Trichloroguaiacol[c]	4.63×10^{-5}	3.13×10^{-5}	0.0	4.63×10^{-5}
3,4,6-Trichlorocatechol[c]	9.25×10^{-5}	6.25×10^{-5}	0.0	9.25×10^{-5}
3,4,6-Trichloroguaiacol[c]	4.63×10^{-5}	3.13×10^{-5}	0.0	4.63×10^{-5}
4,5,6-Trichloroguaiacol[c]	4.63×10^{-5}	3.13×10^{-5}	0.0	4.63×10^{-5}
Tetrachlorocatechol[c]	9.25×10^{-5}	6.25×10^{-5}	0.0	9.25×10^{-5}
Tetrachloroguaiacol[c]	9.25×10^{-5}	6.25×10^{-5}	0.0	9.25×10^{-5}
2,3,4,6-Tetrachlorophenol[c]	4.63×10^{-5}	3.13×10^{-5}	0.0	4.63×10^{-5}
Pentachlorophenol[c]	9.25×10^{-5}	6.25×10^{-5}	0.0	9.25×10^{-5}
All 12 chlorinated phenolics[c]	8.33×10^{-4}	5.63×10^{-4}	0.0	8.33×10^{-4}
COD	38.2	25.5	25.5	38.2
Color	84.5	53.4	53.4	84.5

[a]TCF is the BAT option for papergrade sulfite mills using calcium-, magnesium-, or sodium-based cooking liquor.
[b]ECF is the BAT option for papergrade sulfite mills using ammonium-based cooking liquor, or mills that make specialty-grade sulfite products. (The only difference between the ECF options for these two segments is that the ECF option for the ammonium-based mills includes peroxide-enhanced extraction, while the ECF option for the specialty-grade sulfite mills includes peroxide- and oxygen-enhanced extraction.)
[c]The LTAs for these pollutants for Kraft Options A and B and the Sulfite ECF Option are based on one-half the minimum level for each pollutant multiplied by a group-average production-normalized bleach plant effluent flow rate.

Table 9-23

Sources of Estimated Long-Term Average Pollutant Loadings For Papergrade Sulfite BAT Options

Pollutant	Sulfite TCF[a]	Sulfite ECF[b]
AOX	Zero	Kraft Option A
Chloroform	Zero	Kraft Option A
TCDD & TCDF	Zero	Kraft Option A
Chlorinated phenolic compounds	Zero	Kraft Option A
COD	Kraft Option B	Kraft Option A
Color	Kraft Option B	Kraft Option A

[a]TCF is the BAT option for papergrade sulfite mills using calcium-, magnesium-, or sodium-based cooking liquor.
[b]ECF is the BAT option for papergrade sulfite mills using ammonium-based cooking liquor or those making specialty grade sulfite pulps.

Table 9-24

Summary of Subcategory Loads and Reductions

	Bleach Plant Baseline Load	Final Effluent Baseline Load	Kraft Option A and Sulfite Discharge Load[a]	Kraft Option B and Sulfite Discharge Load[a]	Kraft Option A and Sulfite Reduction[b]	Kraft Option B and Sulfite Reduction[b]
AOX (kkg/yr)						
All Mills		41,000	12,000	6,200	28,000	34,000
All Kraft		36,000	12,000	5,800	24,000	30,000
BAT Kraft		33,000	11,000	5,400	22,000	28,000
PSES Kraft		3,000	910	420	2,100	2,600
All Sulfite		4,400	370	370	4,000	4,000
BAT Sulfite		4,000	370	370	3,600	3,600
PSES Sulfite		380	0	0	380	380
All Direct		37,000	12,000	5,800	26,000	32,000
All Indirect		3,400	910	420	2,500	3,000
COD (kkg/yr)						
All Mills		1,200,000	1,100,000	830,000	130,000	370,000
All Kraft		1,200,000	1,000,000	800,000	110,000	350,000
BAT Kraft		1,100,000	960,000	740,000	100,000	320,000
PSES Kraft		97,000	88,000	65,000	8,900	32,000
All Sulfite		70,000	51,000	51,000	20,000	20,000
BAT Sulfite		59,000	42,000	42,000	17,000	17,000
PSES Sulfite		3,300	2,500	2,500	830	830
All Direct		1,100,000	1,000,000	780,000	120,000	330,000
All Indirect		100,000	90,000	67,000	9,700	33,000

Table 9-24 (Continued)

	Bleach Plant Baseline Load	Final Effluent Baseline Load	Kraft Option A and Sulfite Discharge Load[a]	Kraft Option B and Sulfite Discharge Load[a]	Kraft Option A and Sulfite Reduction[b]	Kraft Option B and Sulfite Reduction[b]
Color (kkg/yr)						
All Mills		2,200,000	2,100,000	1,700,000	55,000	510,000
All Kraft		2,100,000	2,000,000	1,600,000	41,000	490,000
BAT Kraft		1,900,000	1,800,000	1,400,000	38,000	440,000
PSES Kraft		180,000	180,000	130,000	3,400	47,000
All Sulfite		120,000	94,000	94,000	13,000	13,000
BAT Sulfite		120,000	100,000	100,000	14,000	14,000
PSES Sulfite		5,800	5,500	5,500	290	290
All Direct		2,000,000	1,900,000	1,500,000	52,000	460,000
All Indirect		190,000	180,000	140,000	3,600	47,000
Chloroform (kg/yr)						
All Mills	1,400,000	54,000	9,000	9,000	45,000	45,000
All Kraft	1,300,000	48,000	8,800	8,800	40,000	40,000
BAT Kraft	1,200,000	44,000	8,100	8,100	35,000	35,000
PSES Kraft	140,000	4,900	610	610	4,300	4,300
All Sulfite	140,000	5,400	210	210	5,200	5,200
BAT Sulfite	120,000	5,000	210	210	4,800	4,800
PSES Sulfite	14,000	350	0	0	350	350
All Direct	1,300,000	49,000	8,400	8,400	40,000	40,000
All Indirect	160,000	5,200	610	610	4,600	4,600

Table 9-24 (Continued)

	Bleach Plant Baseline Load	Final Effluent Baseline Load	Kraft Option A and Sulfite Discharge Load[a]	Kraft Option B and Sulfite Discharge Load[a]	Kraft Option A and Sulfite Reduction[b]	Kraft Option B and Sulfite Reduction[b]
2,3,7,8-TCDD (g/yr)[c]						
All Mills	16	16	4.5	3.6	12	12
All Kraft	15	15	4.4	3.4	11	12
BAT Kraft	14	14	4.1	3.2	9.9	11
PSES Kraft	1.3	1.3	0.33	0.25	0.92	1.0
All Sulfite	0.78	0.78	0.13	0.13	0.65	0.65
BAT Sulfite	0.78	0.78	0.13	0.13	0.64	0.64
PSES Sulfite	0.0092	0.0092	0.0	0.0	0.0092	0.0092
All Direct	15	15	4.2	3.3	11	11
All Indirect	1.3	1.3	0.33	0.25	0.93	1.0
2,3,7,8-TCDF (g/yr)[c]						
All Mills	120	120	7.9	6.3	110	120
All Kraft	120	120	7.6	6.0	110	110
BAT Kraft	110	110	7.1	5.6	98	100
PSES Kraft	9.5	9.5	0.54	0.43	8.9	9.0
All Sulfite	6.7	6.7	0.30	0.30	6.4	6.4
BAT Sulfite	6.7	6.7	0.30	0.30	6.4	6.4
PSES Sulfite	0.011	0.011	0.0	0.0	0.011	0.011
All Direct	110	110	7.4	5.9	100	110
All Indirect	9.5	9.5	0.54	0.43	9.0	9.1

Table 9-24 (Continued)

	Bleach Plant Baseline Load	Final Effluent Baseline Load	Kraft Option A and Sulfite Discharge Load[a]	Kraft Option B and Sulfite Discharge Load[a]	Kraft Option A and Sulfite Reduction[b]	Kraft Option B and Sulfite Reduction[b]
Trichlorosyringol (kg/yr)[c]						
All Mills	6,800	3,800	680	490	3,100	3,300
All Kraft	6,600	3,600	660	480	3,000	3,100
BAT Kraft	6,000	3,300	610	440	2,700	2,900
PSES Kraft	520	290	49	35	240	250
All Sulfite	270	150	18	18	130	130
BAT Sulfite	250	140	18	18	120	120
PSES Sulfite	20	11	0.0	0.0	11	11
All Direct	6,300	3,500	630	460	2,800	3,000
All Indirect	540	300	49	35	250	260
2,4,5-Trichlorophenol (kg/yr)[c]						
All Mills	1,100	600	550	450	52	150
All Kraft	1,100	580	540	440	43	140
BAT Kraft	980	540	500	410	39	130
PSES Kraft	86	47	43	35	4.6	13
All Sulfite	33	18	9.6	9.6	8.8	8.8
BAT Sulfite	31	17	9.6	9.6	7.7	7.7
PSES Sulfite	2.0	1.1	0.0	0.0	1.1	1.1
All Direct	1,000	550	510	420	46	140
All Indirect	88	48	43	35	5.7	14

Table 9-24 (Continued)

	Bleach Plant Baseline Load	Final Effluent Baseline Load	Kraft Option A and Sulfite Discharge Load[a]	Kraft Option B and Sulfite Discharge Load[a]	Kraft Option A and Sulfite Reduction[b]	Kraft Option B and Sulfite Reduction[b]
2,4,6-Trichlorophenol (kg/yr)[c]						
All Mills	16,000	8,700	680	500	8,100	8,200
All Kraft	15,000	8,500	660	480	7,800	8,000
BAT Kraft	14,000	7,800	610	440	7,200	7,400
PSES Kraft	1,200	650	49	35	600	620
All Sulfite	440	240	18	18	230	230
BAT Sulfite	420	230	18	18	210	210
PSES Sulfite	30	16	0.0	0.0	16	16
All Direct	15,000	8,100	630	460	7,400	7,600
All Indirect	1,200	670	49	35	620	630
3,4,5-Trichlorocatechol (kg/yr)[c]						
All Mills	39,000	22,000	1,400	990	20,000	20,600
All Kraft	38,000	21,000	1,300	950	20,000	20,000
BAT Kraft	36,000	20,000	1,200	880	19,000	19,000
PSES Kraft	2,000	1,100	97	69	1,000	1,000
All Sulfite	1,300	740	36	36	700	700
BAT Sulfite	1,300	730	36	36	700	700
PSES Sulfite	14	7.5	0.0	0.0	7.5	7.5
All Direct	37,000	20,000	1,300	920	19,000	20,000
All Indirect	2,000	1,100	97	69	1,000	1,000

Table 9-24 (Continued)

	Bleach Plant Baseline Load	Final Effluent Baseline Load	Kraft Option A and Sulfite Discharge Load[a]	Kraft Option B and Sulfite Discharge Load[a]	Kraft Option A and Sulfite Reduction[b]	Kraft Option B and Sulfite Reduction[b]
3,4,5-Trichloroguaiacol (kg/yr)[c]						
All Mills	13,000	7,300	670	490	6,600	6,800
All Kraft	13,000	7,000	660	480	6,400	6,500
BAT Kraft	12,000	6,600	610	440	6,000	6,200
PSES Kraft	730	400	49	35	350	370
All Sulfite	470	260	18	18	240	240
BAT Sulfite	460	250	18	18	240	240
PSES Sulfite	9.1	5.0	0.0	0.0	5.0	5.0
All Direct	12,000	6,900	630	460	6,200	6,400
All Indirect	740	410	49	35	360	370
3,4,6-Trichlorocatechol (kg/yr)[c]						
All Mills	2,000	1,100	1,000	910	72	200
All Kraft	2,000	1,100	1,000	890	59	190
BAT Kraft	1,800	1,000	950	830	55	180
PSES Kraft	160	85	81	69	3.9	16
All Sulfite	54	30	17	17	13	13
BAT Sulfite	50	28	17	17	11	11
PSES Sulfite	4.1	2.2	0.0	0.0	2.2	2.2
All Direct	1,900	1,000	960	840	66	190
All Indirect	160	88	81	69	6.1	18

Table 9-24 (Continued)

	Bleach Plant Baseline Load	Final Effluent Baseline Load	Kraft Option A and Sulfite Discharge Load[a]	Kraft Option B and Sulfite Discharge Load[a]	Kraft Option A and Sulfite Reduction[b]	Kraft Option B and Sulfite Reduction[b]
3,4,6-Trichloroguaiacol (kg/yr)[c]						
All Mills	2,100	1,100	590	470	550	670
All Kraft	2,000	1,100	580	460	510	630
BAT Kraft	1,800	1,000	530	430	470	580
PSES Kraft	160	89	46	35	44	54
All Sulfite	87	48	14	14	33	33
BAT Sulfite	84	46	14	14	32	32
PSES Sulfite	2.4	1.3	0.0	0.0	1.3	1.3
All Direct	1,900	1,100	550	440	500	610
All Indirect	160	91	46	35	45	56
4,5,6-Trichloroguaiacol (kg/yr)[c]						
All Mills	8,400	4,600	680	490	3,900	4,100
All Kraft	8,100	4,400	660	480	3,800	4,000
BAT Kraft	7,500	4,200	610	440	3,500	3,700
PSES Kraft	530	290	49	35	240	250
All Sulfite	330	180	18	18	170	170
BAT Sulfite	330	180	18	18	160	160
PSES Sulfite	6.6	3.6	0.0	0.0	3.6	3.6
All Direct	7,900	4,300	630	460	3,700	3,900
All Indirect	530	290	49	35	240	260

Table 9-24 (Continued)

	Bleach Plant Baseline Load	Final Effluent Baseline Load	Kraft Option A and Sulfite Discharge Load[a]	Kraft Option B and Sulfite Discharge Load[a]	Kraft Option A and Sulfite Reduction[b]	Kraft Option B and Sulfite Reduction[b]
Tetrachlorocatechol (kg/yr)[c]						
All Mills	7,800	4,300	1,300	980	3,000	3,300
All Kraft	7,400	4,100	1,300	950	2,800	3,100
BAT Kraft	6,900	3,800	1,200	880	2,600	2,900
PSES Kraft	570	310	93	69	220	240
All Sulfite	350	190	36	36	160	160
BAT Sulfite	340	190	36	36	150	150
PSES Sulfite	5.2	2.9	0.0	0.0	2.9	2.9
All Direct	7,200	4,000	1,200	910	2,700	3,000
All Indirect	570	320	93	69	220	250
Tetrachloroguaiacol (kg/yr)[c]						
All Mills	4,300	2,300	1,200	940	1,200	1,400
All Kraft	4,100	2,200	1,100	910	1,100	1,300
BAT Kraft	3,700	2,100	1,000	840	1,000	1,200
PSES Kraft	340	190	90	69	97	120
All Sulfite	190	100	30	30	72	72
BAT Sulfite	180	100	30	30	70	70
PSES Sulfite	4.6	2.5	0.0	0.0	2.5	2.5
All Direct	3,900	2,200	1,100	870	1,100	1,300
All Indirect	340	190	90	69	100	120

Table 9-24 (Continued)

	Bleach Plant Baseline Load	Final Effluent Baseline Load	Kraft Option A and Sulfite Discharge Load[a]	Kraft Option B and Sulfite Discharge Load[a]	Kraft Option A and Sulfite Reduction[b]	Kraft Option B and Sulfite Reduction[b]
2,3,4,6-Tetrachlorophenol (kg/yr)[c]						
All Mills	1,100	600	590	470	16	130
All Kraft	1,100	590	580	460	7.5	120
BAT Kraft	980	540	530	430	5.5	110
PSES Kraft	87	48	46	35	1.9	13
All Sulfite	31	17	8.8	8.8	8.3	8.3
BAT Sulfite	29	16	8.8	8.8	6.9	6.9
PSES Sulfite	2.7	1.5	0.0	0.0	1.5	1.5
All Direct	1,000	550	540	430	12	120
All Indirect	89	49	46	35	3.4	14
Pentachlorophenol (kg/yr)[c]						
All Mills	2,300	1,200	1,100	930	130	320
All Kraft	2,200	1,200	1,100	910	120	310
BAT Kraft	2,100	1,100	1,000	840	110	290
PSES Kraft	160	85	81	69	3.9	16
All Sulfite	54	30	17	17	13	13
BAT Sulfite	50	28	17	17	11	11
PSES Sulfite	4.1	2.2	0.0	0.0	2.2	2.2
All Direct	2,100	1,200	1,000	860	120	300
All Indirect	160	88	81	69	6.1	18

Table 9-24 (Continued)

	Bleach Plant Baseline Load	Final Effluent Baseline Load	Kraft Option A and Sulfite Discharge Load[a]	Kraft Option B and Sulfite Discharge Load[a]	Kraft Option A and Sulfite Reduction[b]	Kraft Option B and Sulfite Reduction[b]
All 12 Chlorophenolics (kg/yr)[c]						
All Mills	100,000	57,000	10,000	8,100	47,000	49,000
All Kraft	100,000	55,000	10,000	7,900	45,000	47,000
BAT Kraft	94,000	52,000	9,400	7,300	42,000	44,000
PSES Kraft	6,500	3,600	770	590	2,800	3,000
All Sulfite	3,700	2,000	240	240	1,800	1,800
BAT Sulfite	3,600	2,000	240	240	1,700	1,700
PSES Sulfite	100	57	0.0	0.0	57	57
All Direct	98,000	54,000	9,700	7,500	44,000	46,000
All Indirect	6,600	3,700	770	590	2,900	3,000
NCASI 2,3,7,8-TCDD (g/yr)						
All Mills		14	4.5	3.3	9.3	10
All Kraft		13	4.3	3.2	8.8	10
BAT Kraft		12	4.0	3.0	8.2	9.3
PSES Kraft		0.88	0.33	0.23	0.56	0.66
All Sulfite		0.59	0.13	0.13	0.46	0.46
BAT Sulfite		0.59	0.13	0.13	0.46	0.46
PSES Sulfite		0.0025	0.0	0.0	0.0025	0.0025
All Direct		13	4.2	3.1	8.7	8.7
All Indirect		0.89	0.33	0.23	0.56	0.56

Table 9-24 (Continued)

	Bleach Plant Baseline Load	Final Effluent Baseline Load	Kraft Option A and Sulfite Discharge Load[a]	Kraft Option B and Sulfite Discharge Load[a]	Kraft Option A and Sulfite Reduction[b]	Kraft Option B and Sulfite Reduction[b]
NCASI 2,3,7,8-TCDF (g/yr)						
All Mills		45	8.6	6.7	37	38
All Kraft		42	8.4	6.5	33	35
BAT Kraft		41	7.8	6.0	33	35
PSES Kraft		1.1	0.60	0.44	0.44	0.61
All Sulfite		3.4	0.28	0.28	3.2	3.2
BAT Sulfite		3.4	0.28	0.28	3.1	3.1
PSES Sulfite		0.013	0.0	0.0	0.013	0.013
All Direct		44	8.0	6.3	36	38
All Indirect		1.1	0.60	0.44	0.46	0.62

Note: Columns may not add, due to rounding.

[a]For papergrade sulfite mills, results from analysis of only one option is presented for each segment: TCF for the calcium-, magnesium-, or sodium-based segment and ECF for the ammonium-based and specialty-grade segments. The same results are shown in the columns labeled for kraft Options A and B.
[b]Reduction = Baseline Load minus Option Discharge Load (if Option Discharge Load is less than the Baseline Load).
[c]EPA found no measurable differences between Kraft Options A and B in the concentrations of these pollutants in bleach plant effluent. The slightly greater removals of the bleach plant pollutants by Option B mills are a result of the reduced bleach plant flow rates found at mills employing Option B technology.