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Agency

Region 10
1200 Sixth Avenue
Seattle WA 98101

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Program Planning & Evaluation

September 1992

EPA

Model Pollution Prevention Plan for the Kraft Segment of The Pulp and Paper Industry

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MODEL POLLUTION PREVENTION PLAN

FOR
THE KRAFT SEGMENT OF
THE PULP AND PAPER INDUSTRY

September 1992

Prepared for

U.S. EPA Region 10
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Seattle, Washington 98101

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Science Applications International Corporation
606 Columbia Street NW, Suite 300
Olympia, Washington 98501

Amendola Engineering, Inc.
Lakewood, Ohio

TABLE OF CONTENTS

1.0 PROJECT OVERVIEW 1
1.1 PURPOSE 1
1.2 ORGANIZATION OF THE REPORT 1

2.0 INTRODUCTION TO POLLUTION PREVENTION 3
2.1 WHAT POLLUTION PREVENTION IS 3
2.2 BENEFITS OF POLLUTION PREVENTION 5
2.3 HOW POLLUTION PREVENTION IS ACCOMPLISHED 6
2.4 POLLUTION PREVENTION FOR THE PULP AND PAPER INDUSTRY 8

3.0 ORGANIZATIONAL AND MANAGEMENT FRAMEWORK 9
3.1 MANAGEMENT COMMITMENT 9
3.2 POLLUTION PREVENTION TEAM 9
3.2.1 Pollution Prevention Awareness 10
3.2.2 Incentives and Barriers to Pollution Prevention 11
3.2.3 Tracking 12
3.3 ENVIRONMENTAL FORWARD PLANNING PROCESS 12
3.3.1 Five Year Environmental Forward Plan 12
3.3.2 Environmental Audits 14
3.4 SOURCES OF ADDITIONAL INFORMATION 14

4.0 WOOD YARD OPERATIONS 16
4.1 OPTION NO. A-1: RAW MATERIAL SELECTION 17
4.2 OPTION NO. A-2: LOG FLUME RECYCLE 18
4.3 OPTION NO. A-3: DRY DEBARKING 19
4.4 OPTION NO. A-4: CHIP QUALITY CONTROLS 20
4.5 OPTION NO. A-5: CHIP THICKNESS SCREENS 21
4.6 OPTION NO. A-6: STORM WATER CONTROL 22

5.0 PULPING AND CHEMICAL RECOVERY 23
5.1 OPTION NO. B-1: EXTENDED DELIGNIFICATION 24
5.2 OPTION NO. B-2: CLOSED SCREEN ROOM 26
5.3 OPTION NO. B-3: LIQUOR SPILL PREVENTION AND CONTROL 27
5.4 OPTION NO. B-4: IMPROVED BROWNSTOCK WASHING AND NEW BROWNSTOCK WASHING SYSTEMS 28
5.5 OPTION NO. B-5: USE OF DEFOAMERS AND PITCH DISPERSANTS 29
5.6 OPTION NO. B-6: STEAM STRIPPING OF FOUL CONDENSATES 30
5.7 OPTION NO. B-7: TRS CONTROLS FOR HIGH VOLUME, LOW CONCENTRATION AND LOW VOLUME, LOW CONCENTRATION VENTS 31
5.8 OPTION NO. B-8: CONVERSION OF RECOVERY BOILERS TO LOW ODOR DESIGN 32
5.9 OPTION NO. B-9: RECOVERY BOILER OPERATIONS FOR LOW ODOR EMISSIONS 33
5.10 OPTION B-10: USE OF WEAK WASH FOR SCRUBBING FLUID IN AIR POLLUTION CONTROL SYSTEMS 34
5.11 OPTION NO. B-11: LIME MUD DIVERSION BASIN 35
5.12 OPTION NO. B-12: OXYGEN DELIGNIFICATION 36

5.13 OPTION NO. B-13: USE OF ANTHRAQUINONE IN PULPING PROCESS . . . 37
5.14 OPTION NO. B-14: BENEFICIAL REUSE OF LIME SLAKER GRITS AND GREEN LIQUOR DREGS. 38
5.15 OPTION NO. B-15: UTILIZATION OF POWER BOILER ASH. 39

6.0 PULP BLEACHING 40
6.1 OPTION NO. C-1: CHEMICAL CONTROLS 41
6.2 OPTION NO. C-2: CHEMICAL MIXING 42
6.3 OPTION NO. C-3: SPLIT ADDITION OF CHLORINE 45
6.4 OPTION NO. C-4: CHLORINE DIOXIDE SUBSTITUTION 46
6.5 OPTION NO. C-5: ENHANCED EXTRACTION 47
6.6 OPTION NO. C-6: REPLACEMENT OF HYPOCHLORITES 48
6.7 OPTION NO. C-7: OZONE BLEACHING 49
6.8 OPTION NO. C-8: COUNTER-CURRENT, JUMP STAGE WASHING 50
6.9 OPTION NO. C-9: BLEACH PLANT VENT CONTROLS 51

7.0 PULP DRYING AND PAPERMAKING 52
7.1 OPTION NO. D-1: FIBER AND WHITE WATER RECOVERY WITH SAVEALLS 53
7.2 OPTION NO. D-2: REUSE OF VACUUM PUMP SEAL WATER 54
7.3 OPTION NO. D-3: RECOVERY OF STEAM CONDENSATES 55
7.4 OPTION NO. D-4: CHEMICAL SUBSTITUTIONS 56

8.0 WASTEWATER TREATMENT 57
8.1 OPTION NO. E-1: IMPROVED SLUDGE DEWATERING 58
8.2 OPTION NO. E-2: SLUDGE UTILIZATION AS HOGGED FUEL 59
8.3 OPTION NO. E-3: ODOR CONTROL 60
8.4 OPTION NO. E-4: REUSE OF TREATED EFFLUENT 61

9.0 REFERENCES 62

1.0 PROJECT OVERVIEW

1.1 PURPOSE

In accordance with the Pollution Prevention Act of 1990, EPA is actively pursuing and encouraging development of pollution prevention programs in U.S. industries. The pulp and paper industry comprises one of the largest industries within Region 10, as well as the United States as a whole. The pulp and paper industry was selected for this study because of its involvement in several major environmental programs administered by EPA. This effort is viewed as an opportunity for Federal and state governments to work in a partnership with industry to develop a plan that will benefit both industry and the environment. This effort is being funded and conducted as a pilot project under EPA's Industrial Pollution Prevention Project (IP3), one of EPA's "2% set-aside" pollution prevention initiatives.

The purpose of this project is to provide EPA with a model pollution prevention plan for the pulp and paper industry, focused specifically on the bleached kraft segment. This plan is a compilation of pollution prevention options that could be implemented at bleached kraft mills to achieve reductions in waste generation or waste toxicity, and increase in-plant reuse and recycling of waste materials. Several pollution prevention options are presented for each major process area within the bleached kraft process. Not all of the options described could be implemented at any one mill, nor would every option be advantageous at a given mill. The application of a particular alternative must be evaluated specifically for each mill. Feasibility, implementation costs, and engineering details will vary widely from one facility to the next.

This model plan was developed after a thorough pollution prevention opportunity assessment and implementation plan were developed for the Simpson Tacoma Kraft Mill in Tacoma, Washington. The results of that effort are documented in the EPA publication entitled *Pollution Prevention Opportunity Assessment and Implementation Plan for Simpson Tacoma Kraft Company, Tacoma, Washington*, August 1992 (EPA No. 910/9-92-027).

1.2 ORGANIZATION OF THE REPORT

The first three sections of this report provide general background information on pollution prevention. In the subsequent sections are presented numerous pollution prevention options applicable to various processes in kraft pulping, bleaching, and papermaking. Section 2.0 provides an introduction to pollution prevention, describing how EPA defines pollution prevention and what types of activities are included within that definition, what benefits pollution prevention provides, and how pollution prevention is accomplished. Section 3.0 presents an organizational and management framework for establishing a pollution prevention program, describing the importance of management

commitment, the establishment of a pollution prevention team, and tracking the performance of pollution prevention projects after implementation.

Section 4.0 addresses pollution prevention options for wood yard operations. Pollution prevention alternatives applicable to pulping and chemical recovery operations are presented in Section 5.0. In Section 6.0, pollution prevention options for pulp bleaching are covered. Alternatives in the pulp drying and papermaking operations are provided in Section 7.0. Section 8.0 addresses pollution prevention activities within the area of wastewater treatment. The references used in the development of this document are listed in Section 9.0.

2.0 INTRODUCTION TO POLLUTION PREVENTION

2.1 WHAT POLLUTION PREVENTION IS

The ultimate goal of pollution prevention is to reduce present and future threats to human health and the environment. In EPA's Industrial Pollution Prevention Project (IP3), "pollution prevention" is defined as "the use of processes, practices, or products that reduce or eliminate the generation of pollutants." This means that pollution prevention is to be thought of as the elimination of the sources of pollution through one or more of the following:

- Product reformulation
- Process modification
- Improved housekeeping and management practices.

Where elimination of the source of pollution is not possible, some form of recycling, i.e., in-house, closed-system measures which return (potential) pollutants for reuse within a production process, may be pollution prevention.

Pollution prevention methods can be grouped into two main categories: source reduction and onsite recycling. Source reduction is any activity that reduces or eliminates the generation of waste at the source. One example of source reduction is the use of oxygen delignification. This process results in the removal of lignin prior to bleaching thus reducing the amount of bleaching chemical used and the resultant chlorinated organic compounds formed. The lignin removed is returned to the recovery cycle where the organics are burned for energy recovery and the inorganics recovered for reuse. Another example is the substitution of chlorine dioxide for chlorine in pulp bleaching operations, and control of the application of those chemicals. This practice has resulted in significant reductions in the amounts of chlorinated compounds, including dioxins, in the product and in process effluents. Recycling includes the reuse or reclamation of used materials or by-products and returning them to the process. Within a pulp mill, for example, process chemicals contained in the black liquor are recovered and reused in the pulping process, and lignin solids are burned for energy recovery.

There are many ways that source reduction can be implemented, including process changes, raw material substitution, waste stream segregation, material handling improvements, and loss prevention procedures. Furthermore, there are many ways that materials can be reused or reclaimed, either within the manufacturing process or externally through commercial markets. (The latter is not considered pollution prevention.) Figure 1 depicts the categories of waste minimization techniques, including offsite recycling (Ref. A)*. EPA recommends the exploration of source reduction options first, to minimize the generation of waste, and recycling options second, to maximize the reuse of materials.

* See references at end of Section 3 (p. 14).

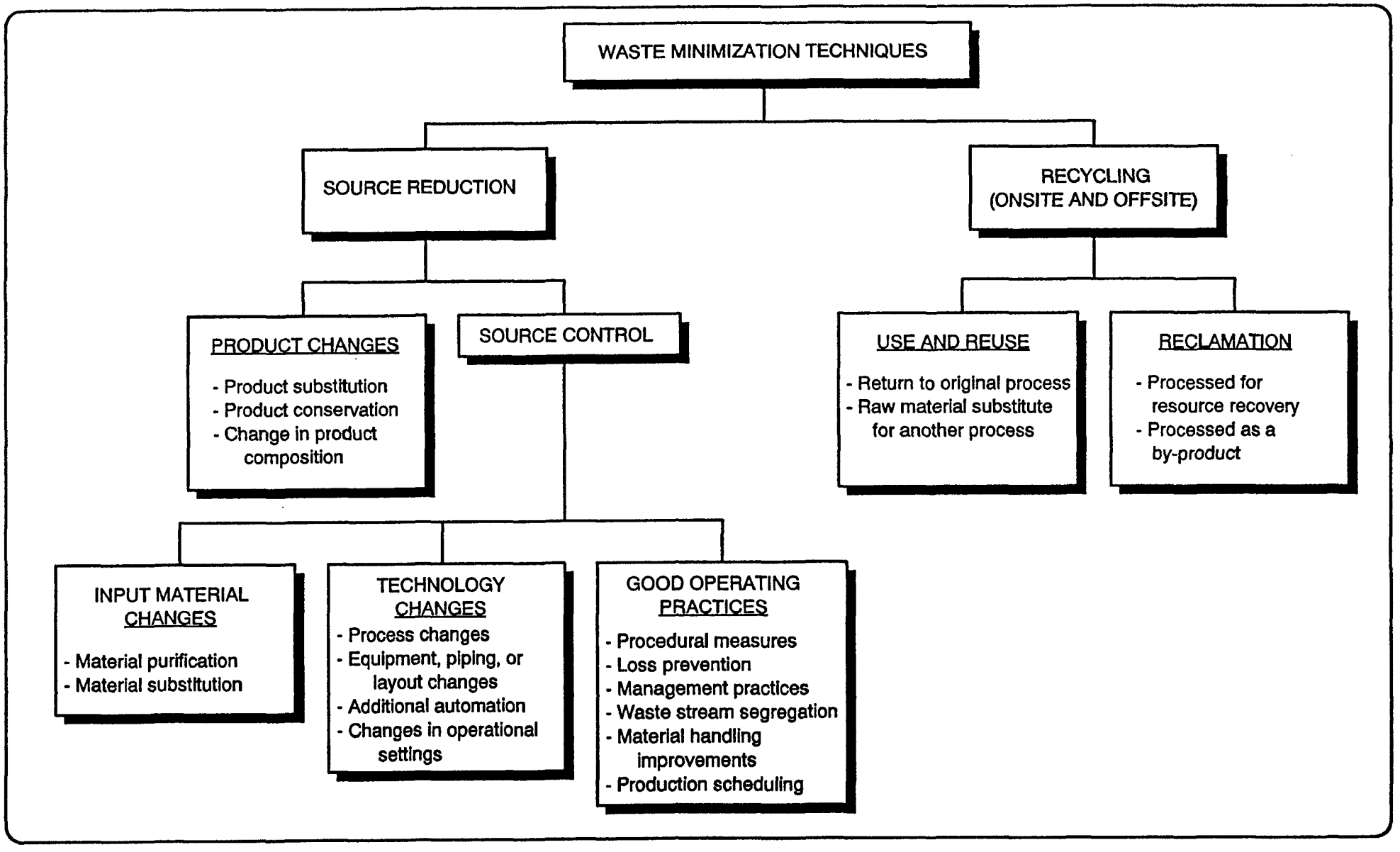

Figure 1

WASTE MINIMIZATION TECHNIQUES
(Source: Ref. B)

EPA makes a distinction between pollution control measures that are applied only after wastes are generated and source reduction methods. Offsite recycling, waste treatment, volume reduction through concentration or compaction of wastes, dilution, and transferring contaminants from one environmental medium to another are not considered pollution prevention methods by EPA.

In making this distinction, EPA is not discouraging the use of offsite recycling, such as the return of used consumer paper as secondary fiber in pulp production. The agency considers this an excellent waste management activity but not pollution prevention. Collecting contaminants in one medium and transferring them to another is likewise not, by itself, a pollution prevention measure. One example of this is the collection of particulate emissions from combustion process exhaust, and subsequently landfilling the filter cake. Pollution prevention is focused more directly on the reduction of particulate generated or in reducing its toxicity.

Pollution prevention applies to all types of waste, both hazardous and non-hazardous, to discharges to all environmental media: air, surface water, soil, and ground water. Consideration of toxicity, waste designation, and handling costs is important in the evaluation of pollution prevention alternatives as will be discussed later.

2.2 BENEFITS OF POLLUTION PREVENTION

The ultimate regional benefit of widespread implementation of pollution prevention will be the maintenance of a safer, healthier environment in which to live. But there are also many benefits of pollution prevention to each waste generator that chooses to implement waste reduction methods. These may include:

- Reduced waste handling costs (including storage, labor, pretreatment, packaging, transportation, and documentation)
- Reduced material procurement costs
- Reduced worker health and safety risk
- Reduced risk of civil and criminal liability
- Enhanced public image of the company
- Protection of local public health and the environment

The cost effectiveness of pollution prevention measures applied within manufacturing processes, equipment and vehicle maintenance shops, and other industrial activities has been demonstrated in hundreds of cases over the past several years. A company with an aggressive, ongoing pollution prevention program may acquire an important competitive advantage through the reduction of its operating costs. Moreover, liability risk can be significantly reduced through waste minimization and

* See references at end of Section 3 (p. 14).

material toxicity reduction measures. Civil liability for the "cradle to grave" responsibility for hazardous waste can be dramatically decreased when a company makes a commitment to waste reduction strategies. According to EPA, workers' compensation costs and risks are directly related to the quantity of hazardous materials produced (Ref. B)*. Thus, minimization of hazardous materials use and production will reduce worker health and safety risk and reduce workers' compensation claims.

Finally, a pollution prevention program, coupled with public and employee education, can generate goodwill in the community, enhance a facility's public image, and foster a higher level of concern for the environment in individuals. In a company where management is committed to providing a safe work environment and environmentally protective practices, employees are likely to feel more positive about their employer. Likewise, the community will recognize and appreciate the efforts of a company that improves its environmental performance by reducing wastes, reducing the toxicity of materials, products, and waste streams, and in avoiding excessive or wasteful consumption of materials and energy. Thus, an effective pollution prevention program in concert with a program to inform employees and the community can enhance a company's public image and improve consumer marketing performance.

2.3 HOW POLLUTION PREVENTION IS ACCOMPLISHED

The implementation of pollution prevention in a given facility or portion of a facility requires first an assessment of pollution prevention opportunities. The assessment process is illustrated in Figure 2 (Ref. A)*. In this assessment, what wastes are generated, how they are generated, and what the waste streams consist of must be determined. Data on materials procurement costs, waste disposal costs, and other waste management costs are gathered. Once this body of data is collected, waste streams should be prioritized for further study, based on consideration of regulatory requirements, waste management costs, waste quantity, hazardous characteristics of the waste, potential for pollution prevention, and available budget. A detailed assessment of the highest priority waste streams can then be performed. This analysis may involve further data gathering within the plant as well as the identification of pollution prevention options. For each of the options identified, the feasibility of implementation must be evaluated for its potential technical, environmental, and economic merit. This includes engineering requirements, equipment and installation costs, operation and maintenance costs, an estimate of waste reduction and other environmental benefits, timing, training requirements, safety considerations, product quality, availability, and many other considerations. A cost-benefit analysis for each option should be performed.

The results of the pollution prevention assessment should be documented in a report. The report should include the considerations used in evaluating feasibility of the options proposed and results of the feasibility analysis. In addition, the report may include a discussion of possible performance measures for evaluating the project after implementation, and a qualitative evaluation of indirect or intangible costs and benefits associated with the identified alternatives.

* See references at end of Section 3 (p. 14).

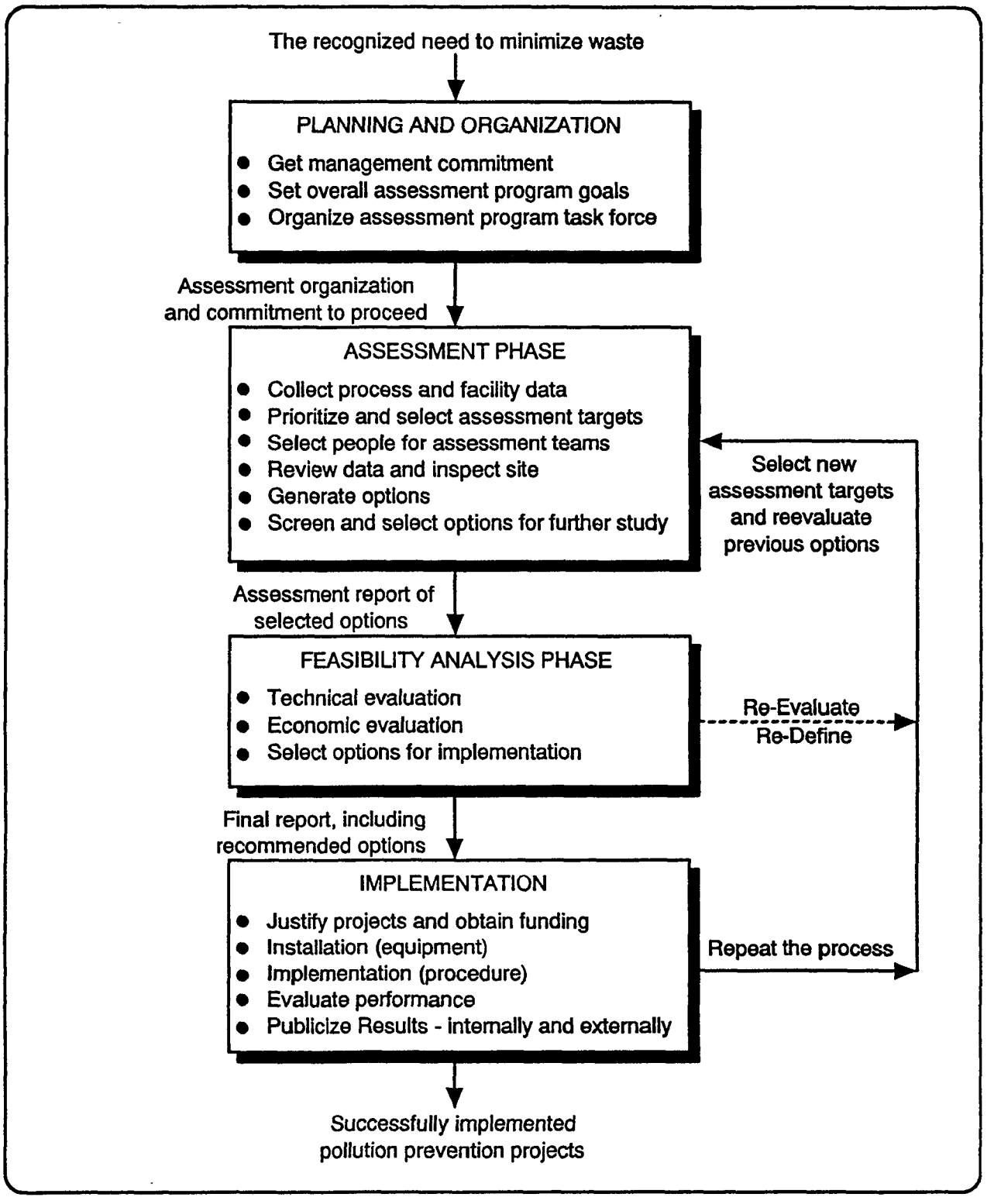

Figure 2

THE POLLUTION PREVENTION ASSESSMENT PROCEDURE

A selection of options to be implemented becomes the basis for the next step, developing an implementation plan. The plan needs to describe which pollution prevention projects will be conducted, identify key roles and responsibilities, and establish a schedule for implementation. Implementation will require procurement of funding, planning, design, materials procurement, construction or installation, operator training, and possibly changes in company policies and procedures.

After a project has been implemented, an evaluation of its effectiveness should be conducted and compared to the anticipated economic, environmental, and technical parameters evaluated during the assessment process. Modifications may be required for projects where expectations have not been met. More important, this post-audit information can enhance the evaluation and implementation of subsequent pollution prevention projects.

Due to the dynamics of technological progress, regulatory development, our increasing knowledge of particular compounds' effects on the environment and human health, and the demands of competitive enterprise, pollution prevention needs to be an ongoing activity at any facility. Implementation of a one-time pollution prevention project will not ensure continuing advantages over time. Thus, the establishment of an ongoing pollution prevention program is the key to continued appreciation of the benefits of waste reduction practices. Establishment of such a program is the subject of Section 3.0.

2.4 POLLUTION PREVENTION FOR THE PULP AND PAPER INDUSTRY

In this report, particular emphasis has been given to source reduction alternatives in the major process areas of kraft pulping. A few options are presented that are not pollution prevention according to the strict EPA definition, but that are worthwhile offsite recycling or waste management alternatives. For each option represented, a description of the technology or method is provided with a general range of costs, a statement regarding its applicability, the environmental benefits, and useful reference articles. The intent of this guide is to assist during the assessment process and provide a starting point for the evaluation of alternatives that may be applicable within a particular pulp mill. Further study involving an engineering analysis, refined cost estimates, and calculation of anticipated environmental benefits will be necessary in most cases to determine whether a particular alternative will provide the desired benefits at a particular facility. Unique aspects of individual pulp plants must be considered for the opportunities and hindrances they bring to source reduction/pollution prevention for that facility. Age of plant, layout, power costs, etc., all become factors unique to a particular plant and must be considered when reviewing options.

* See references at end of Section 3 (p. 14).

3.0 ORGANIZATIONAL AND MANAGEMENT FRAMEWORK

Experience in various industries over the last 10 years has shown that there are four keys to successful implementation of a pollution prevention program. First is the commitment by management to make pollution prevention a priority. Second is the involvement of personnel at many levels and from all of the relevant components of the manufacturing process in an organization specifically created to establish an ongoing pollution prevention effort. Third is the identification of incentives and barriers to pollution prevention within the plant, company, and corporation. Fourth is the establishment of an effective planning tool that can incorporate changes in environmental regulations, market climate, and corporate reorganizations.

3.1 MANAGEMENT COMMITMENT

In a production-oriented corporate culture, if workers are expected to incorporate waste minimization practices into their daily efforts, they need to know that pollution prevention is an important goal of the company, beginning at the top. Workers will recognize this commitment in decisions made by management, in new projects selected for implementation, in corporate policies, and in company newsletters and training.

A corporate policy statement regarding pollution prevention can be broad and simple, such as the one adopted by E.I. DuPont in 1980 (Ref. C)*: "to minimize the generation of waste to the extent that is technically and economically feasible." Or, the policy could be more specific, such as a commitment to:

> Establish an ongoing pollution prevention program to reduce wastes and discharges to all environmental media; initiate a program of employee awareness activities; form a committee to address specific pollution prevention challenges, perform regular assessments of waste generating processes and practices, and track discharges and emissions; develop an incentive program to foster environmentally protective attitudes and innovation; and to consider pollution prevention benefits in every capital project proposed for funding.

3.2 POLLUTION PREVENTION TEAM

The primary objective of a pollution prevention team is to define or establish a successful system within the corporate framework that works to achieve the cost effective minimization of waste, and includes, representation and support from all the vital components of the manufacturing process. It

* See references at end of Section 3 (p. 14).

is critical, therefore, that personnel who understand the plant's processes, and that personnel who control or influence financial decisions are resident on the team. In addition, a pollution prevention manager or team leader should be designated and the roles, responsibility, and authorities of this position must be clearly defined.

The most important functions of a pollution prevention team are to enhance awareness of pollution prevention and to identify what needs to be done. The team is the primary arena for sharing ideas regarding pollution prevention opportunities, and is responsible for gathering and sharing information both inside and outside the mill. Internal communication will include both the identification of potential projects and sharing knowledge of anticipated costs and benefits. Communications external to the mill are important for enhancing the public image of the company as a good environmental player, and for demonstrating to other companies that pollution prevention is a viable strategy and may provide a competitive advantage.

Listed below are possible functions of a pollution prevention team:

- Enhance awareness of pollution prevention
  - Employee training
  - In-house communications
  - External communications

- Identify pollution prevention goals, targets, obstacles, and projects
  - Define objectives
  - Identify obstacles to pollution prevention
  - Review objectives with management
  - Establish plans
  - Procure resources and support

- Tracking
  - Conduct audits
  - Establish accounting system
  - Summarize progress
  - Recognize achievements

3.2.1 Pollution Prevention Awareness

Just as environmental awareness has been significantly raised over the past 20 years, so too the concepts and importance of pollution prevention can become widely known. If a pulp mill is to reap the maximum benefits from establishing a pollution prevention program, sharing information with all of the mill employees is a key factor. This can be accomplished in a number of ways. Pollution

* See references at end of Section 3 (p. 14).

prevention can be included in new employee orientation. The corporate policies on pollution prevention can be included in the employee handbook. Job training can incorporate pollution prevention methods such as good housekeeping and preventive maintenance.

Pollution prevention should be made part of job performance evaluations for individual employees. Pollution prevention objectives could be communicated through this program, and personnel rewarded for achievement of pollution prevention milestones and development of innovative pollution prevention approaches.

The employee newsletter could be used to publicize pollution prevention concepts and to share success stories. Articles describing past projects and ongoing efforts to reduce waste within the mill could be featured. The annual report could likewise highlight the pollution prevention success stories at the facility.

3.2.2 Incentives and Barriers to Pollution Prevention

Identifying incentives and barriers to pollution prevention is one of the early steps in the establishment of a pollution prevention program. In some cases, this phase precedes the statement of management commitment and the formation of a pollution prevention task force. Once such a team has been established, specific barriers can be identified and subsequently addressed, and incentives to pollution prevention can be used to illustrate the viability of proposed waste reduction alternatives.

In general, there are four basic incentives to pollution prevention:

- Potential to reduce the real costs and risks of generating and managing wastes
- Established corporate policies, procedures, and waste reduction goals
- Improvement in a company's environmental position and public image
- Compliance with legal requirements

Barriers to pollution prevention may be present within a company or inherent in the regulations. Typical barriers include:

- Attitudes about managing wastes
- Lack of upper management support for pollution prevention
- Shortage of capital
- Competing priorities
- Lack of technical personnel
- Lack of information
- Incomplete appreciation for the need to minimize waste
- Resistance to change
- Inflexible regulations that hinder innovation
- Lack of coordination between local, state, and federal agencies

* See references at end of Section 3 (p. 14).

The program or series of activities undertaken by a pollution prevention team can be tailored specifically to address the barriers identified by the team within the facility.

3.2.3 Tracking

In order to measure progress and to help ensure the ongoing success of the pollution prevention program, an accounting system should be established to audit and track pollution prevention accomplishments. This system is analogous to a post-audit performed on a capital project after implementation to compare projected gains in productivity or cost reductions with actual gains or costs. In this way, the company can accumulate experience for better estimating the pollution prevention benefits of future proposed projects.

Tracking can be accomplished in a variety of ways. Initially, pollution prevention gains may be measured using the data collections systems already in place, for example, the Toxics Release Inventory (TRI) data required for SARA Title III compliance. As time goes on, a tracking system that provides more project-specific detailed information may be useful. Companies including DuPont, 3M, and Dow Chemical have instituted sophisticated monitoring of in-plant flows and discharges in order to track progress in waste reduction and to pinpoint processes and areas where further improvement is needed.

3.3 ENVIRONMENTAL FORWARD PLANNING PROCESS

Many corporations have successfully integrated environmental control operations into existing capital appropriation and budgeting processes and operating plans. Others have not. The former are most often operating in an anticipatory mode; the latter usually react to changing events and often find themselves facing compliance problems and unanticipated capital expenses. A model for environmental forward planning has been used successfully by several companies, enabling them to anticipate the activities and expenditures associated with environmental compliance and pollution prevention initiatives. This approach is summarized below.

3.3.1 Five Year Environmental Forward Plan

On an annual basis, the facility prepares a five year environmental forward plan that addresses each element of the mill's environmental program. Figure 3 is an example outline for the forward plan. Environmental projects are listed in terms of those necessary to achieve and maintain compliance (usually non-discretionary), those discretionary projects that would improve compliance status or minimize potential for environmental releases (risk reduction), and discretionary projects that would result in waste reduction. The plan should be prepared and updated annually such that the results can be considered as part of the corporate and mill capital appropriations process. Those priority discretionary projects that are not funded are carried forward year-to-year until funded or dropped from consideration.

* See references at end of Section 3 (p. 14).

I. Executive Summary

II. Certifications

Certifications are provided by mill managers that company environmental policies, applicable laws and regulations, and any applicable industry trade association policies and operation practices have been adhered to . Also, a certification is made that all appropriation requests for capital expenses have had the appropriate environmental review, including pollution prevention and waste minimization. Any exceptions to the certifications are noted.

III. Programs and Issues

Each environmental regulatory program is addressed and all significant issues are reviewed in terms of impact on ongoing operations, including human and financial resource implicaTions.

A. SARA Title III Emissions Reduction Program
B. Air Programs
C. Water Programs
D. Spill Prevention and Control (Oil, chemicals, process solutions)
E. Solid Waste/Hazardous Waste Programs
F. Superfund
G. Groundwater Protection Program
H. PCB Elimination
I. Asbestos Remediation
J. Enforcement Issues (fines, penalties, lawsuits)
K. Future Laws and Regulations
L. Community Concerns and Issues
M. Resource Issues

IV. Financial Implications Summary

A five year expense projection by project is made. Capital expenses are distinguished from mill expense items. The costs for the multi-year projects are distributed to proposed year of expenditure.

V. Exhibits

A. Capital Expense and Appropriation Projection
B. SARA Title III Emissions Summary (five year summary by pollutant)
C. Waste Disposal Quantity and Cost Projections
D. Prior Year Expenditures - Projected vs. Actual
E. Offsite Waste Disposal Site Evaluation
F. Current Year Environmental Project Descriptions (summary project descriptions with cost, pollution prevention and waste minimization benefits)

Figure 3

SAMPLE OUTLINE FOR ENVIRONMENTAL AND POLLUTION PREVENTION PLANNING

* See references at end of Section 3 (p. 14).

3.3.2 Environmental Audits

On a regular basis, such as every year or two, an internal or external environmental audit should be conducted to assess multi-media environmental compliance status and review progress with respect to implementation of environmental forward plan items. A response to the audit findings should be prepared by the mill within 30 days from receipt of the final audit report. Audit action items requiring significant capital spending or long term study are included in the next annual update of the five year environmental forward plan.

This approach provides an appropriate vehicle for implementing pollution prevention projects. This sort of deliberate planning process that allows pollution prevention initiatives to be considered with other production goals and proposed mill expenditures will enhance a company's ability to reap the benefits of pollution prevention implementation.

3.4 SOURCES OF ADDITIONAL INFORMATION

Listed below are the sources of information referenced in the preceding discussion of pollution prevention and some additional helpful references. These will provide a general foundation for the application of pollution prevention concepts to any type of facility. Articles relating specifically to pollution prevention in kraft pulp mills, categorized by major process, can be found in the *Bibliography for Pollution Prevention in the Kraft Pulp and Paper Industry*, produced during this project.

A. U.S. Environmental Protection Agency, July 1988. *Waste Minimization Opportunity Assessment Manual*, EPA/625/7-88/003. Hazardous Waste Engineering Research Laboratory, Cincinnati, OH.

B. U.S. Environmental Protection Agency, May 1992. *Facility Pollution Prevention Guide*, EPA/600/R-92/088. Office of Research and Development, Washington, D.C.

C. Hollod, Gregory J. and William B. Beck. Implementing Waste Minimization Programs in Industry, in *Hazardous Waste Minimization*, Harry Freeman, Ed. McGraw-Hill, 1990.

D. Higgins, Thomas E. Hazardous Waste Minimization Handbook. Lewis Publishers, Inc., Chelsea, MI, 1989.

E. Tavlarides, Lawrence L. Process Modifications for Industrial Pollution Source Reduction. Lewis Publishers, Inc., Chelsea, MI, 1985.

F. Committee to Evaluate Mass Balance Information for Facilities Handling Toxic Substances. Tracking Toxic Substances at Industrial Facilities. National Academy Press, Washington, D.C., 1990.

G. General Electric Corporate Environmental Programs. *Financial Analysis of Waste Alternatives.*

H. U.S. Environmental Protection Agency, December 1991. *Total Cost Assessment: Accelerating Industrial Pollution Prevention through Innovative Project Financial Analysis with Applications to the Pulp and Paper Industry.*

4.0 WOOD YARD OPERATIONS

Covering material selection, log handling, chip preparation, and storm water control.

OPTION NO.	TECHNOLOGY	PAGE
A-1	Raw Material Selection	17
A-2	Log Flume Recycle	18
A-3	Dry Debarking	19
A-4	Chip Quality Controls	20
A-5	Chip Thickness Screens	21
A-6	Storm Water Control	22

4.1 OPTION NO. A-1: RAW MATERIAL SELECTION

Description:	Purchase of wood fiber (round wood, chips, sawdust) that has not been treated with wood preservatives, particularly chlorophenols.
Costs:	Not applicable.
Applicability:	Broad application to all mills that pulp wood fiber and bleach with chlorine or chlorine derivatives.
Benefits:	Eliminate source of CDDs/CDFs and CDD/CDF precursors from fiber supply. Reduced formation of higher chlorinated CDDs/CDFs in bleaching operations. Improved product and effluent quality.
References:	1, 2

4.2 OPTION NO. A-2: LOG FLUME RECYCLE

Description:	Log flume water used to convey logs from log piles to debarkers and chippers is recycled with minimal blowdown to wastewater treatment facilities. Collected bark and fiber is burned in hogged fuel boilers to recover energy values. Currently installed at many kraft mills. An alternate practice is to use treated wastewaters as make-up for the log flumes.
Costs:	Typical costs may range from $100,000 to $500,000 depending upon site-specific retrofit considerations.
Applicability:	Broad application to mills with log flumes.
Benefits:	Water conservation. Reduced discharge loadings of TSS and BOD_5 of up to 750 lbs/day for 3 MGD recycle system.
References:	6

4.3 OPTION NO. A-3: DRY DEBARKING

Description:	Use of dry drum debarkers vs. hydraulic debarkers. Wet debarkers result in significant hydraulic and BOD_5/TSS loadings to wastewater treatment. Most wet debarkers have been replaced with dry debarking systems at kraft and sulfite mills.
Costs:	High Range > $5,000,000
Applicability:	Broad application to kraft and sulfite mills where roundwood comprises fiber supply.
Benefits:	Water conservation (2,000 - 3,000 gallons per ton of wood barked). Reduced raw waste discharge loadings of TSS and BOD_5 (1-10 lbs. BOD_5 and 6-55 lbs. TSS per ton of product). Reduced handling (dewatering) of bark prior to burning in hogged fuel boilers.
References:	6, 7, 15

4.4 OPTION NO. A-4: CHIP QUALITY CONTROLS

Description: Maintain and operate chippers to produce chips of uniform dimensions, with emphasis on chip thickness control. Continued operation and maintenance of chippers to produce quality chips.

Costs: Low ≈ $100,000 capital cost.

Applicability: Broad application to chipping operations captive to kraft mills and chipping performed by contract chippers remote from kraft mills.

Benefits: Improved yield, reduction in rejects and shive content. Allows for more uniform pulping resulting in lower bleach plant chemical consumption and attendant formation of AOX and other chlorinated compounds.

References:

4.5 OPTION NO. A-5: CHIP THICKNESS SCREENS

Description:	Chip screening device designed to produce chips of uniform thickness. Promotes uniform kraft liquor impregnation, higher pulping rates, and lower rejects.
Costs:	$2,000,000 to $4,000,000 for new installations, higher for retrofits.
Applicability:	Broad application to chipping operations captive to kraft mills.
Benefits:	Improved yield, reduction in rejects and shive content. Allows for more uniform pulping resulting in lower bleach plant chemical consumption and attendant formation of AOX and other chlorinated compounds. The industry reports that benefits associated with chip thickness screens are difficult to quantify because relatively small, but important benefits accrue across many process operations.
References:	3, 4, 5, 7

4.6 OPTION NO. A-6: STORM WATER CONTROL

Description:	Curbing, diking, and drainage collection for storm water from chip piles and chip processing areas. Storage and treatment of stormwater in end-of-pipe wastewater treatment facilities.
Costs:	Variable and site-specific
Applicability:	Broad application to chipping operations captive to kraft and sulfite mills.
Benefits:	Reduced discharge loadings of TSS and BOD_5. Eliminates need for separate stormwater permit.

5.0 PULPING AND CHEMICAL RECOVERY

Covering pulping, screening and deknotting, brownstock washing, recovery boilers, power boilers, causticizing, oxygen delignification, and spill prevention and control.

OPTION NO.	TECHNOLOGY	PAGE
B-1	Extended Delignification	24
B-2	Closed Screen Room	26
B-3	Liquor Spill Prevention and Control	27
B-4	Improved Brownstock Washing and New Brownstock Washing Systems	28
B-5	Use of Defoamers and Pitch Dispersants	29
B-6	Steam Stripping of Foul Condensates	30
B-7	TRS Controls for High Volume, Low Concentration and Low Volume, Low Concentration Vents	31
B-8	Conversion of Recovery Boilers to Low Odor Design	32
B-9	Recovery Boiler Operations for Low Odor Emissions	33
B-10	Use of Weak Wash for Scrubbing Fluid in Air Pollution Control Systems	34
B-11	Lime Mud Diversion Basin	35
B-12	Oxygen Delignification	36
B-13	Use of Anthraquinone in Pulping Process	37
B-14	Beneficial Reuse of Lime Slaker Grits and Green Liquor Dregs	38
B-15	Utilization of Power Boiler Ash	39

5.1 OPTION NO. B-1: EXTENDED DELIGNIFICATION

Description: Modification of existing continuous digesters or installation of new batch or continuous digesters to produce brownstock pulp of lower Kappa number. Extended delignification is accomplished by subjecting the fiber to modified time-temperature-alkaline cycles, usually with the same total alkali charge. This is accomplished by modifying continuous digesters to allow for addition of cooking liquor at multiple points (MCC - modified continuous cooking or EMCC - extended modified continuous cooking), or by conducting several liquor exchanges during the pulping cycle for batch digesters (RDH - rapid displacement heating).

Costs: Depending upon site-specific factors including age and configuration of existing continuous digesters, continuous digesters may be retrofitted for MCC or EMCC for $1,000,000 to $4,000,000. The incremental cost of MCC or EMCC for new continuous digesters is generally not significant. The cost of installing a new RDH batch digester system may range from $30,000,000 to 50,000,000, depending upon capacity and site-specific factors.

Applicability: MCC, EMCC, or similar systems can be retrofitted to continuous digesters equipped with separate steaming vessels. RDH pulping usually cannot be retrofitted economically to existing batch digester systems due to the configuration of existing digesters (direct steaming vs. liquor recirculation) and the extensive tank farm necessary for liquor exchanges.

Benefits: Accomplishes greater degree of delignification (Kappa < 19 - 24 vs. 28 - 32 for pine) with recoverable pulping chemicals as opposed to delignification with disposable bleach plant chemicals. Improves energy efficiency by increased recovery of liquor solids. Reduces bleach plant chemical consumption and attendant formation of AOX and other chlorinated compounds, roughly in proportion to Kappa number reduction. Results in less rejects and thus improves pulp yield.

References: 8, 9, 10, 11, 12, 13, 14

5.2 OPTION NO. B-2: CLOSED SCREEN ROOM

Description: Install new or modify existing brownstock pulp screening and deknotting systems such that black liquor is recovered and recycled to recovery system.

Costs: For new closed screening systems, the investment costs may be $10,000,000 to $15,000,000, depending upon capacity. Costs for retrofitting existing screen rooms are variable and site-specific.

Applicability: Applicable to virtually all kraft and sulfite mills.

Benefits: Improved efficiency of the recovery circuit due to increased retention of liquor solids. Reduced demand for make-up chemicals. Reduced raw wastewater loadings of BOD_5 and other organic chemicals associated with kraft pulping. This is due to elimination of spills and overflows.

References: 15

5.3 OPTION NO. B-3: LIQUOR SPILL PREVENTION AND CONTROL

Description: Preventive maintenance programs to ensure proper operation of pumps, tanks, pipelines, and other equipment items in liquor service. Engineered systems to collect and recover leaks, spills, and diversions of weak and strong liquor from pulping and chemical recovery areas. Systems include tank level alarms, curbs and dikes, and storage tanks. Surveillance systems consisting of a written plan including such items as a combination of sewer conductivity monitoring and frequent regular inspection of pulping and chemical recovery areas to detect and repair leaks and spills. Spill response and emergency action plans to recover spills.

Costs: All kraft and sulfite mills have some level of black or red liquor spill prevention and control. Site-specific costs to implement the full program as described above are highly variable and may range from $200,000 to $1,000,000.

Applicability: Applicable to virtually all kraft and sulfite mills.

Benefits: Improved efficiency of the recovery circuit due to increased retention of liquor solids. Reduced demand for make-up chemicals. Reduced raw wastewater loadings of BOD_5 and other organic chemicals associated with pulping by up to 1/3. Reduced fugitive emissions of odor-causing TRS compounds from spills of weak and strong black liquor and reduced emissions of volatile compounds from spills of weak black liquor at kraft mills. Reduction of SO_2 emissions and acid leaks at sulfite mills.

References: 6, 15, 17, 25

5.4 OPTION NO. B-4: IMPROVED BROWNSTOCK WASHING AND NEW BROWNSTOCK WASHING SYSTEMS

Description: Addition of an additional washing stage or stages to existing washing lines; installation of replacement washing systems.

Costs: The addition of a diffusion washer as an additional washing stage may cost in the range of $4,000,000. Replacement washing systems including pulp presses, belt washers, compaction baffle washers, or diffusion washers may cost $15,000,000 to $20,000,000, depending upon capacity and retrofit considerations.

Applicability: Generally applicable to bleached kraft mills with washing losses greater than 15 kg Na_2SO_4 per metric ton of pulp. Applicable to sulfite mills as well to improve washing efficiency.

Benefits: Improved efficiency of the recovery circuit due to increased retention of liquor solids. Washing losses in the range of 5-10 kg Na_2SO_4 per metric ton and less are attainable with new washing systems. Reduced demand for make-up chemicals. Reduced raw wastewater loadings of BOD_5, AOX, and other chlorinated organic chemicals associated with pulping and bleaching. To the extent washer vents are low volume and are controlled, reduced emissions of odor-causing TRS compounds and volatile compounds.

References: 9, 15, 18, 19, 20

5.5 OPTION NO. B-5: USE OF DEFOAMERS AND PITCH DISPERSANTS

Description:	Use of water-based or oil-based defoamers and pitch dispersants free of CDD/CDF precursors.
Costs:	Costs are not significant as this technology is a chemical substitution with limited or no equipment changes. There may be some increased operating costs depending upon costs of replacement chemicals.
Applicability:	Applicable to all unbleached and bleached kraft and sulfite mills.
Benefits:	In bleached kraft mills, reduced formation of CDDs/CDFs and other chlorinated compounds in the bleaching process. In unbleached kraft mills, less deposition of potentially toxic materials in product pulp and wastewater sludges and effluents.
References:	1, 2, 18, 21, 23, 24

5.6 OPTION NO. B-6: STEAM STRIPPING OF FOUL CONDENSATES

Description:	Steam stripping of digester, evaporator and turpentine condensates for removal of total reduced sulfur (TRS) and BOD_5 (methanol, acetone). Steam-to-feed ratios of 15 - 20% are necessary to achieve efficient BOD_5 removal. Stripper overheads are combusted in power boilers. Stripper bottoms are reused for brownstock washing.
Costs:	Depending upon capacity and retrofit considerations, investment costs may range from $2,000,000 to $6,000,000.
Applicability:	Applicable to all unbleached and bleached kraft mills.
Benefits:	Reduced atmospheric emissions of TRS and volatile organic compounds. Reduced BOD_5 raw wastewater loadings by up to one-third at bleached kraft mills, higher at unbleached kraft mills. Water conservation. In bleached kraft mills, less formation of CDDs/CDFs and compounds contributing to AOX.
References:	7, 25, 26, 27, 28, 29, 30, 31

5.7 OPTION NO. B-7: TRS CONTROLS FOR HIGH VOLUME, LOW CONCENTRATION AND LOW VOLUME, LOW CONCENTRATION VENTS

Description:	Collection and combustion of vent streams from brownstock washers, foam tanks, black liquor filters, oxidation tanks and storage tanks, and other TRS containing streams that are not usually collected in non-condensible gas (NCG) systems.
Costs:	Depending upon extent of vent collection, proximity to combustion source and other site-specific factors, investment costs may range from $500,000 to $2,000,000.
Applicability:	Applicable to all unbleached and bleached kraft mills.
Benefits:	Reduced atmospheric emissions of TRS and volatile organic compounds (VOCs). Ten to twenty percent of total mill TRS emissions are associated with these sources.
References:	7, 15, 25, 26

5.8 OPTION NO. B-8: CONVERSION OF RECOVERY BOILERS TO LOW ODOR DESIGN

Description:	Modification of old design recovery boiler to low odor design by elimination of direct contact evaporator, modification of secondary and tertiary combustion air systems, installation of a new economizer section. Often completed in conjunction with moderate expansion of recovery boiler capacity. Old design recovery boilers may account for 60% to 80% of total mill TRS emissions.
Costs:	Highly variable and site-specific. Depending upon initial boiler capacity, expansion of capacity, and extent of rebuild, investment costs may range from $20,000,000 to $40,000,000.
Applicability:	Applicable to all unbleached and bleached kraft mills with old design recovery boilers. Many old design recovery boilers in the United States have been converted to low odor design.
Benefits:	Reduced atmospheric emissions of TRS from recovery boiler by more than 90%. Improved boiler efficiency.
References:	7, 15, 22, 25, 26

5.9 OPTION NO. B-9: RECOVERY BOILER OPERATIONS FOR LOW ODOR EMISSIONS

Description: Operation of recovery boilers within selected operating parameters to minimize TRS emissions. These parameters may include:

- Operating within "critical" loading levels for liquor solids
- Maintaining secondary and tertiary air at greater than 35% of total combustion air supply
- Maintaining excess oxygen between 2.0 and 2.5%
- Maintaining liquor sulfidity as low as possible while maintaining pulp quality
- Maximizing liquor solids within capability of available evaporator system
- Minimizing the content of inerts in the liquor
- Maximizing dispersion of the liquor spray by using and maintaining appropriate liquor spray nozzles

Costs: Variable and site-specific. Many operating parameters can be more closely controlled with little or no investment cost.

Applicability: Applicable to unbleached and bleached kraft mills.

Benefits: Reduced atmospheric emissions of TRS. Improved boiler efficiency.

References: 7, 15, 25, 26

5.10 OPTION B-10: USE OF WEAK WASH FOR SCRUBBING FLUID IN AIR POLLUTION CONTROL SYSTEMS

Description:	Weak wash from the causticizing circuit is used for operation of air emission scrubbers on smelt dissolving tanks, bleach plant and ClO_2 plant vents, lime slakers, and lime kilns. Scrubber water is returned to the causticizing circuit.
Costs:	Variable and site-specific.
Applicability:	Applicable to unbleached and bleached kraft mills.
Benefits:	Water conservation. Reduced atmospheric emissions. Additional recovery of pulping chemicals. Reduced wastewater discharges.
References:	32

5.11 OPTION NO. B-11: LIME MUD DIVERSION BASIN

Description:	Installation of a basin for diversion of lime mud slurries during process upsets and lime mud clarifier maintenance. Lime mud that would otherwise be lost to the mill sewerage system could be recovered.
Costs:	Investment costs should be in the range of a few hundred thousand dollars.
Applicability:	Applicable to unbleached and bleached kraft mills.
Benefits:	Resource recovery. Reduced wastewater loadings, wastewater treatment costs, and reduced sludge disposal costs.
References:	6

5.12 OPTION NO. B-12: OXYGEN DELIGNIFICATION

Description: Pulp processing with oxygen in an alkaline environment subsequent to conventional or extended pulping processes, but prior to bleaching with chlorine and/or chlorine derivatives. For medium consistency systems (10 - 12%), 40 - 45% additional delignification is attainable. For high consistency systems (25 - 28%), additional delignification up to 50% is attainable.

Costs: Retrofit costs are variable and site-specific. Depending upon capacity and site-specific considerations investment costs may range from $10,000,000 - $25,000,000. Recovery boiler constraints may be a limiting factor for mills with no available recovery boiler capacity.

Applicability: Applicable to bleached kraft mills with a moderate amount of available recovery boiler capacity. Generally installed at new bleached kraft mills and as part of major bleach plant rebuilds. Prerequisite for ozone bleaching.

Benefits: Energy conservation. Pulping and bleach plant chemical savings. Chlorine consumption reduced by up to 50%. Reduced formation of color, BOD_5, and chlorinated compounds including CDDs/CDFs, chlorophenols, chloroform, and AOX. Reductions in raw waste loadings as follows from conventional bleaching:

	Conventional Bleaching	Oxygen Delignification
BOD_5	28.0	22.0 kg/ADMT
COD	100.0	70.0 kg/ADMT
COLOR	300.0	100.0 kg/ADMT
AOX	7.9	4.7 kg/ADMT

References: 7, 12, 33, 34, 35, 36, 37, 38, 39, 40

5.13 OPTION NO. B-13: USE OF ANTHRAQUINONE IN PULPING PROCESS

Description:	Use of relatively low charges of anthraquinone in digester ($\approx$ 0.5 kg/metric ton of pulp) to accelerate the pulping process and increase pulp yield. Used selectively to offset increased recovery boiler loading caused by oxygen delignification.
Costs:	Investment costs are not significant. Operating cost increases are significant.
Applicability:	Applicable to bleached kraft mills with recovery boiler limitations where increased pulp yield is desired.
Benefits:	Increased pulp yield. Marginally reduced consumption of bleach plant chemicals and attendant formation of chlorinated compounds. Reduction in effluent color and BOD_5.
References:	7, 41, 42

5.14 OPTION NO. B-14: BENEFICIAL REUSE OF LIME SLAKER GRITS AND GREEN LIQUOR DREGS.

Description:	Collection and dewatering of lime slaker grits and green liquor dregs for beneficial offsite reuse as additives for cement manufacturing. Grits and dregs are gravity dewatered onsite. (Technically not pollution prevention.)
Costs:	Variable and site-specific.
Applicability:	Applicable to unbleached and bleached kraft mills.
Benefits:	Reduced volume of solid wastes requiring landfill disposal. Reduced volume of wastewater treatment sludge requiring disposal where green liquor dregs are washed to mill sewerage system.
References:	32

5.15 OPTION NO. B-15: UTILIZATION OF POWER BOILER ASH.

Description:	Beneficial reuse of power boiler ash as an additive for cement manufacture or as a soil conditioner in combination with wastewater treatment sludge. (Technically not pollution prevention.)
Costs:	Investment costs are low, but variable and site-specific.
Applicability:	Applicable to unbleached and bleached kraft mills.
Benefits:	Minimize solid waste disposal and associated costs.
References:	15

6.0 PULP BLEACHING

Covering chemical controls and monitoring, improved chemical mixing, chlorine dioxide, substitution, enhanced extraction, elimination of hypochlorite, water conservation, and control of air emissions.

OPTION NO.	TECHNOLOGY	PAGE
C-1	Chemical Controls	41
C-2	Chemical Mixing	42
C-3	Split Addition of Chlorine	45
C-4	Chlorine Dioxide Substitution	46
C-5	Enhanced Extraction	47
C-6	Replacement of Hypochlorites	48
C-7	Ozone Bleaching	49
C-8	Counter-current, Jump Stage Washing	50
C-9	Bleach Plant Vent Controls	51

6.1 OPTION NO. C-1: CHEMICAL CONTROLS

Description:	Use of instrumentation to monitor and control application of chlorine and/or chlorine dioxide in the first bleaching stage to maintain chlorine multiple or Kappa factor within ranges where formation of CDDs/CDFs and other chlorinated compounds are minimized.
Costs:	Depending upon type of instrumentation and extent of control systems, costs may range from $150,000 to $500,000.
Applicability:	Applicable to bleached kraft mills.
Benefits:	Minimize use of chlorine and chlorine derivatives and attendant formation of CDDs/CDFs and other chlorinated compounds.
References:	16

6.2 OPTION NO. C-2: CHEMICAL MIXING

Description:	Use of high shear mixers for bleach plant chemical additions to ensure efficient chemical application and to minimize localized over-chlorination which fosters formation of unwanted chlorinated compounds.
Costs:	Depending upon type and size of mixers, costs may range from $200,000 to $500,000.
Applicability:	Applicable to bleached kraft mills.
Benefits:	Minimize use of chlorine and chlorine derivatives and attendant formation of CDDs/CDFs and other chlorinated compounds (see Figures 4 and 5).
References:	43

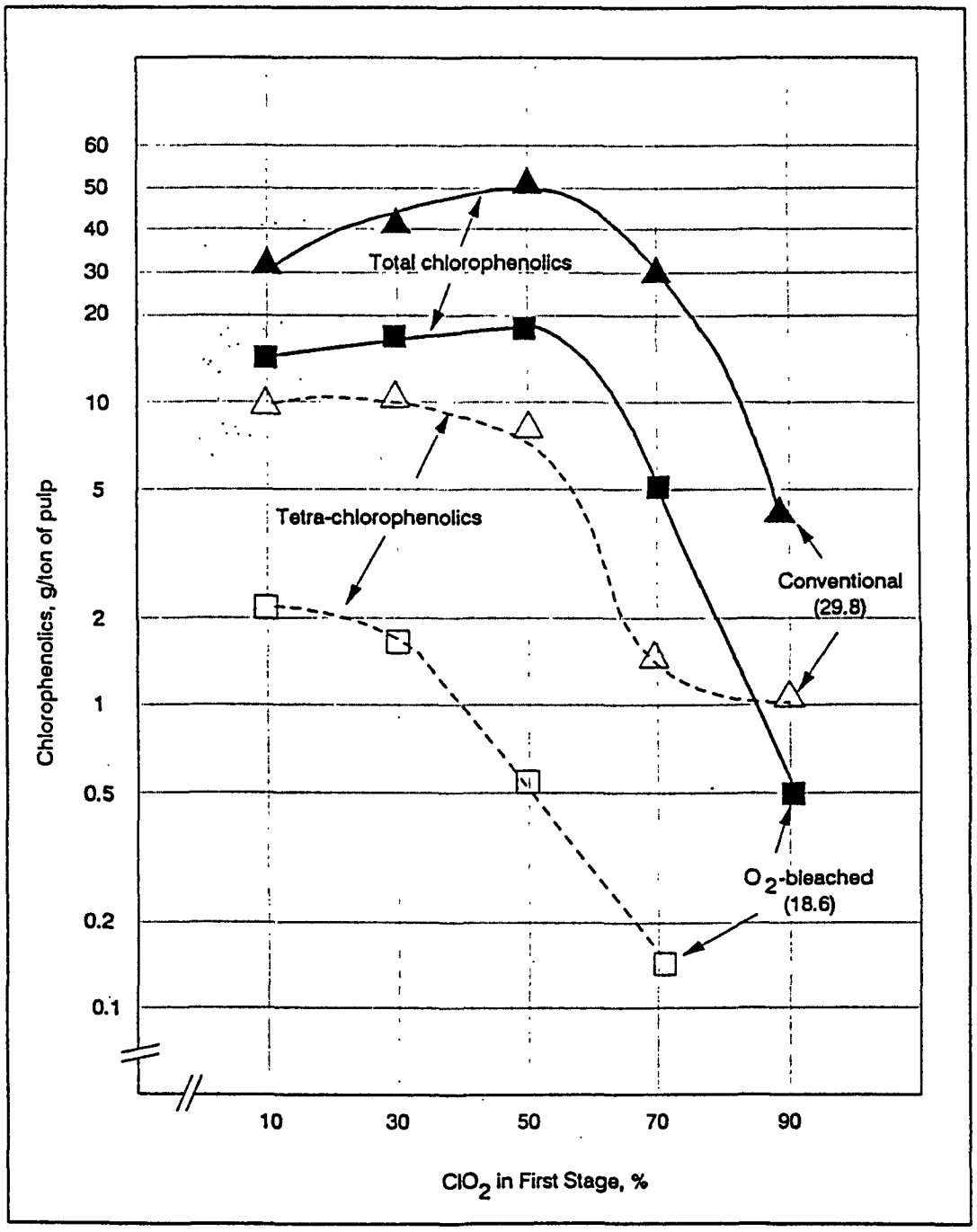

Figure 4

THE EFFECT OF CHLORINE DIOXIDE SUBSTITUTION ON TOTAL AND TETRACHLORINATED PHENOLIC COMPOUND (Ref. 72)

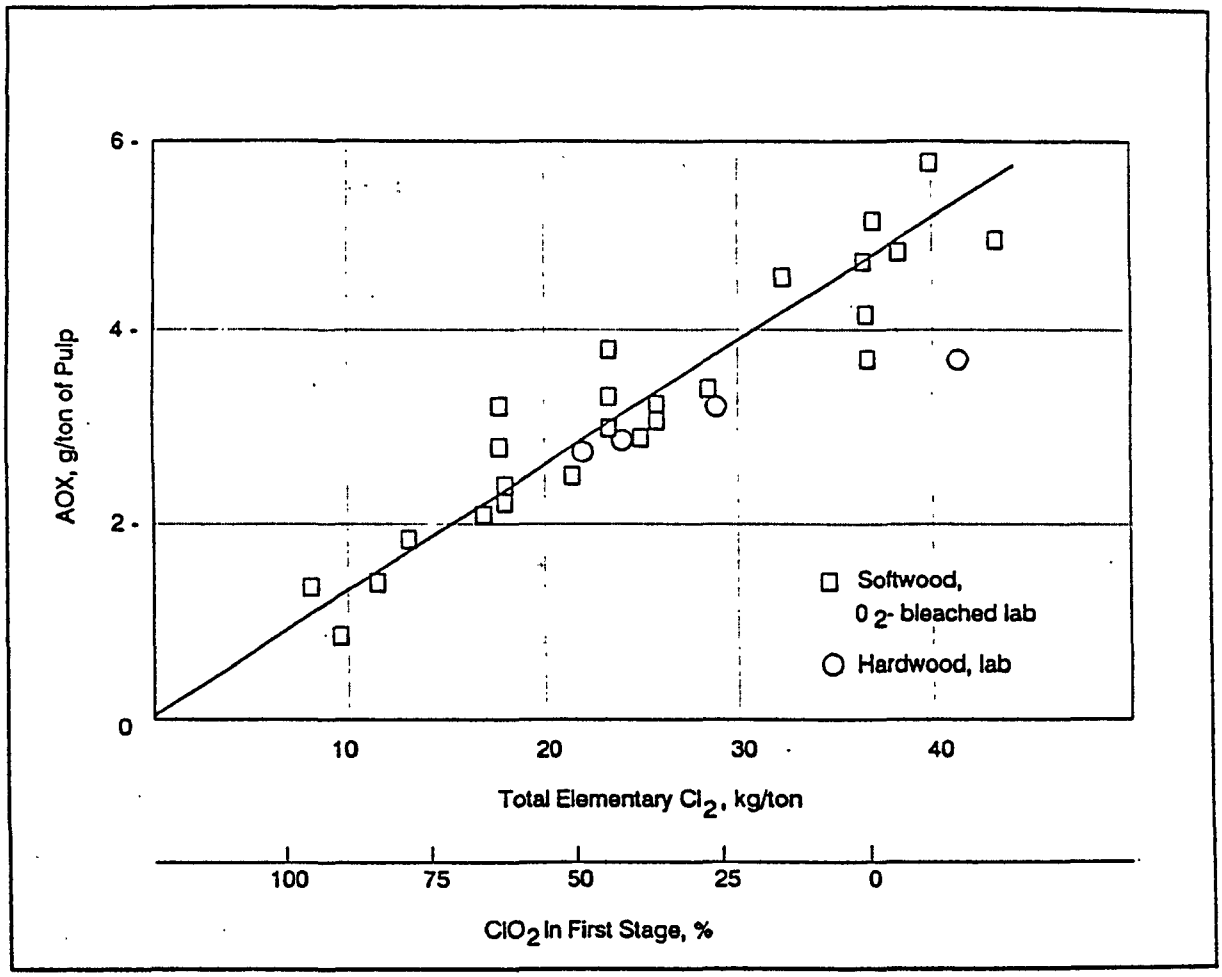

Figure 5

THE EFFECT OF CHLORINE DIOXIDE SUBSTITUTION ON THE FORMATION OF AOX (Ref. 72)

6.3 OPTION NO. C-3: SPLIT ADDITION OF CHLORINE

Description:	Use of multiple additions of chlorine to ensure efficient chemical application and to minimize localized over-chlorination which fosters formation of unwanted chlorinated compounds.
Costs:	Costs for multiple addition points including mixers and controls may range from $3,000,000 to $5,000,000 per mill.
Applicability:	Applicable to bleached kraft mills.
Benefits:	Minimize use of chlorine and chlorine derivatives and attendant formation of CDDs/CDFs and other chlorinated compounds. Not as effective as high rate chlorine dioxide substitution (> 70%) for minimizing formation of chlorinated compounds.
References:	43

6.4 OPTION NO. C-4: CHLORINE DIOXIDE SUBSTITUTION

Description: Use of chlorine dioxide (ClO_2) in place of some or all of the elemental chlorine in the first bleaching stage. ClO_2 is manufactured onsite and applied in solution ahead of the chlorine charge at rates ranging from 5% to 100% of the equivalent amount of elemental chlorine. Application of ClO_2 and Cl_2 is controlled to maintain Kappa factors less than 0.15 to minimize formation of CDDs/CDFs.

Costs: Depending upon capacity, costs for new chlorine dioxide generators may range from $10,000,000 to more than $20,000,000. Existing generators may be upgraded to produce higher quality ClO_2 (less than 2% Cl_2).

Applicability: Applicable to bleached kraft mills.

Benefits: Minimize use of chlorine and formation of CDDs/CDFs and other chlorinated compounds including chlorophenols, chloroform and compounds contributing to AOX. Most effective at high rates of substitution (> 70%) for minimizing formation of chlorinated compounds.

References: 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54

6.5 OPTION NO. C-5: ENHANCED EXTRACTION

Description: Use of oxygen alone or in combination with hydrogen peroxide in bleach plant caustic extraction stages to improve extraction efficiency and delignification. Enhanced extraction is practiced at the majority of bleached kraft mills in the United States.

Costs: Depending upon capacity, costs for installation of oxygen enhanced extraction are moderate (less than $1,000,000). Costs for addition of hydrogen peroxide are minimal (less than $100,000).

Applicability: Applicable to bleached kraft mills.

Benefits: Minimize use of chlorine and chlorine derivatives for pulp bleaching and attendant formation of CDDs/CDFs and other chlorinated compounds including chlorophenols, chloroform and compounds contributing to AOX. Reduced BOD_5, COD, and effluent color.

References: 12, 35, 38, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64

6.6 OPTION NO. C-6: REPLACEMENT OF HYPOCHLORITES

Description:	Elimination of sodium or calcium hypochlorites in pulp bleaching by replacement with chlorine dioxide.
Costs:	Depending upon capacity, costs for new chlorine dioxide generators may range from $10,000,000 to more than $20,000,000. Existing generators may be upgraded to produce higher quality ClO_2 (less than 2% Cl_2).
Applicability:	Applicable to market and paper grade bleached kraft mills. Application may be limited for certain grades of dissolving kraft. Application may also be limited at mills where bleach plant metallurgy is not compatible with chlorine dioxide.
Benefits:	Chloroform formation reduces at more than 95%. Most effective when hypochlorite is replaced with high purity chlorine dioxide (< 2% Cl_2), and chlorine application in the first bleaching stage is minimized through high rate chlorine dioxide substitution.
References:	44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54

6.7 OPTION NO. C-7: OZONE BLEACHING

Description:	Use of ozone as the primary bleaching agent in place of chlorine. Oxygen delignified pulps would be bleached with ozone followed by conventional extraction and final brightening stages. The first commercial scale ozone bleach line is scheduled for completion during the last half of 1992.
Costs:	Not available at this writing. Investment costs are reported to be higher than for a conventional bleach plant of similar capacity, but bleaching costs are reported to be lower than for conventional or high chlorine dioxide substitution bleaching.
Applicability:	Applicable to market and paper grade bleached kraft mills.
Benefits:	Eliminate formation of CDDs/CDFs, chlorinated phenols and compounds contributing to AOX in the first bleaching stage. Minimize formation and discharge of AOX to the limited extent produced in subsequent chlorine dioxide stages. Allows recovery of ozone and extraction stage filtrates in the recovery circuit. Substantially reduces wastewater discharge loadings of color and BOD_5 form bleach plant.
References:	5, 65, 66, 67, 68, 69, 70

6.8 OPTION NO. C-8: COUNTER-CURRENT, JUMP STAGE WASHING

Description:	Reuse of acid stage filtrates (hypochlorite or chlorine dioxide stages) as dilution and wash water on first bleaching stage (chlorine, chlorine/chlorine dioxide, chlorine dioxide/chlorine, or chlorine dioxide stage), and on log sequence bleach lines, use of filtrate from the second extraction stage on the first extraction stage.
Costs:	Highly variable and site-specific for retrofit installations. Included in new installations.
Applicability:	Applicable to most bleached kraft mills. Applications may be limited at certain mills due to incompatible metallurgy.
Benefits:	Reduce bleach plant wastewater flow by 2,000 to 6,000 gal/ton at conventional bleach plants. Steam and energy savings. Water conservation. Marginal reduction in BOD_5 loadings from the bleach plant.
References:	6, 15

6.9 OPTION NO. C-9: BLEACH PLANT VENT CONTROLS

Description:	Caustic scrubbers for control of chlorine and chlorinated compound emissions from bleach tower vents, washer vents, seal tank vents, and chlorine dioxide plant vents.
Costs:	Highly variable and site-specific for retrofit installations. Included in new installations.
Applicability:	Applicable to bleached kraft mills.
Benefits:	Reduced atmospheric emissions of chlorine and chlorinated compounds. See Use of Weak Wash for Scrubbing Fluid Use in Air Pollution Control Systems, Option No. B-10.
References:	25, 32

7.0 PULP DRYING AND PAPERMAKING

Covering fiber recovery, white water recovery and reuse, steam condensate recovery, and chemical substitutions

OPTION NO.	TECHNOLOGY	PAGE
D-1	Fiber and White Water Recovery With Savealls	53
D-2	Reuse of Vacuum Pump Seal Water	54
D-3	Recovery of Steam Condensates	55
D-4	Chemical Substitutions	56

7.1 OPTION NO. D-1: FIBER AND WHITE WATER RECOVERY WITH SAVEALLS

Description: Use of settling tank, drum, flotation or polydisc savealls to recover and reclaim fiber and white water or brown water from pulp dryers and paper machines. Fiber from savealls is returned to the stock system and subsequently reclaimed as product. Depending upon quality (solids content), cleaned white water or brown water is reused for stock dilution, wire, headbox, grooved roll, trim knockdown, wire knockoff and breast roll showers, consistency regulation, and beaters.

Costs: Highly variable and site-specific for retrofit installations. Included in virtually all new installations. Depending upon capacity and retrofit considerations, costs may range from a few hundred thousand dollars to over $1,000,000.

Applicability: Applicable to unbleached and bleached kraft mills.

Benefits: Increase in yield. More than 90% fiber recovery is possible depending upon type of paper and type of saveall. Water and energy conservation. Flow reductions from 200 to 10,000 gal/ton are possible depending upon type of paper machine and level of white water reuse. Reduced wastewater effluent loadings and reduced wastewater treatment costs. Reduced solid waste disposal costs.

References: 6, 7, 15

7.2 OPTION NO. D-2: REUSE OF VACUUM PUMP SEAL WATER

Description:	Use of cascade systems or recirculating water systems for operation of water ring vacuum pumps.
Costs:	Highly variable and site-specific for retrofit installations. Included in new installations. Depending upon capacity and retrofit considerations, costs may range from a few hundred thousand dollars to over $1,000,000.
Applicability:	Applicable to unbleached and bleached kraft mills.
Benefits:	Water and energy conservation. Reduced wastewater treatment costs. Water savings in the range of 2,000 gal/ton of product are possible.
References:	6, 7, 15

7.3 OPTION NO. D-3: RECOVERY OF STEAM CONDENSATES

Description:	Collection and recovery of steam condensates from pulp dryers and paper machines.
Costs:	Highly variable and site-specific.
Applicability:	Applicable to unbleached and bleached kraft mills.
Benefits:	Reduced boiler feedwater treatment costs. Energy and water conservation.
References:	6, 7

7.4 OPTION NO. D-4: CHEMICAL SUBSTITUTIONS

Description:	Substitution of additives containing toxic chemicals (e.g., urea formaldehyde resins) with those that do not contain such substances.
Costs:	Investment costs should be minimal. Operating cost increases or savings will be a function of the costs of substitute chemicals.
Applicability:	Applicable to bleached kraft pulp and paper mills and non-integrated paper mills.
Benefits:	Reduced handling and emissions of toxic compounds. Potential product quality improvements. Reduced hazardous waste disposal from residuals and packaging.
References:	32

8.0 WASTEWATER TREATMENT

Covering sludge dewatering, sludge utilization, odor control, and reuse of treated effluent.

OPTION NO.	TECHNOLOGY	PAGE
E-1	Improved Sludge Dewatering	58
E-2	Sludge Utilization as Hogged Fuel	59
E-3	Odor Control	60
E-4	Reuse of Treated Effluent	61

8.1 OPTION NO. E-1: IMPROVED SLUDGE DEWATERING

Description:	Use of twin wire presses, screw presses or other mechanical dewatering devices to maximize solids content of dewatered sludges to be disposed of in landfills or incinerated. (Technically not pollution prevention.)
Costs:	Depending upon capacity and retrofit considerations, investment costs may range from a few hundred thousand dollars to over $1,000,000.
Applicability:	Applicable to unbleached and bleached kraft mills.
Benefits:	Reduced landfill disposal of solid wastes. More efficient combustion of lower moisture sludges.
References:	15

8.2 OPTION NO. E-2: SLUDGE UTILIZATION AS HOGGED FUEL

Description:	Dewatering and combustion of primary and secondary wastewater treatment sludge in hogged fuel boilers. Dewatered sludges must contain a minimum of 30% solids, 6,000 BTU/lb and 66.5% organic content to support self-sustaining combustion.
Costs:	Not Available
Applicability:	Applicable to unbleached and bleached kraft mills.
Benefits:	Energy recovery. Reduced landfill disposal of solid wastes.
References:	15

8.3 OPTION NO. E-3: ODOR CONTROL

Description: There are no effective means to control odors emanating from kraft mill sewer systems and wastewater treatment facilities. The most effective means to control such odors are in-plant control measures for steam stripping of foul condensates and black liquor spill prevention and control.

Costs: See Chapter 5.0 - Condensate Stripping (Option No. B-6) and Black Liquor Spill Prevention and Control (Option No. B-3).

Applicability: Applicable to unbleached and bleached kraft mills.

Benefits: Reduced emissions of TRS and volatile organic compounds; reduced odors. Raw wastewater BOD_5 reductions by one-third to more than one-half, depending upon type of mill.

References: See Chapter 5.0 - Condensate Stripping (Option No. B-6) and Black Liquor Spill Prevention and Control (Option No. B-3).

8.4 OPTION NO. E-4: REUSE OF TREATED EFFLUENT

Description:	Treated wastewater effluent can be used for a number of non-critical water applications including make-up to log flume recycle systems, dust suppression on chip piles and roadways, and make-up to fire protection ponds. (Technically not pollution prevention.)
Costs:	Highly variable and site-specific.
Applicability:	Applicable to unbleached and bleached kraft mills.
Benefits:	Water conservation. Reduced effluent discharges (Approximately 300 lbs/day BOD_5 and TSS for each one million gallons per day of effluent flow reduction).
References:	6, 15

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