2000 Annual Report

MICHIGAN

Pulp & Paper Pollution Prevention Program

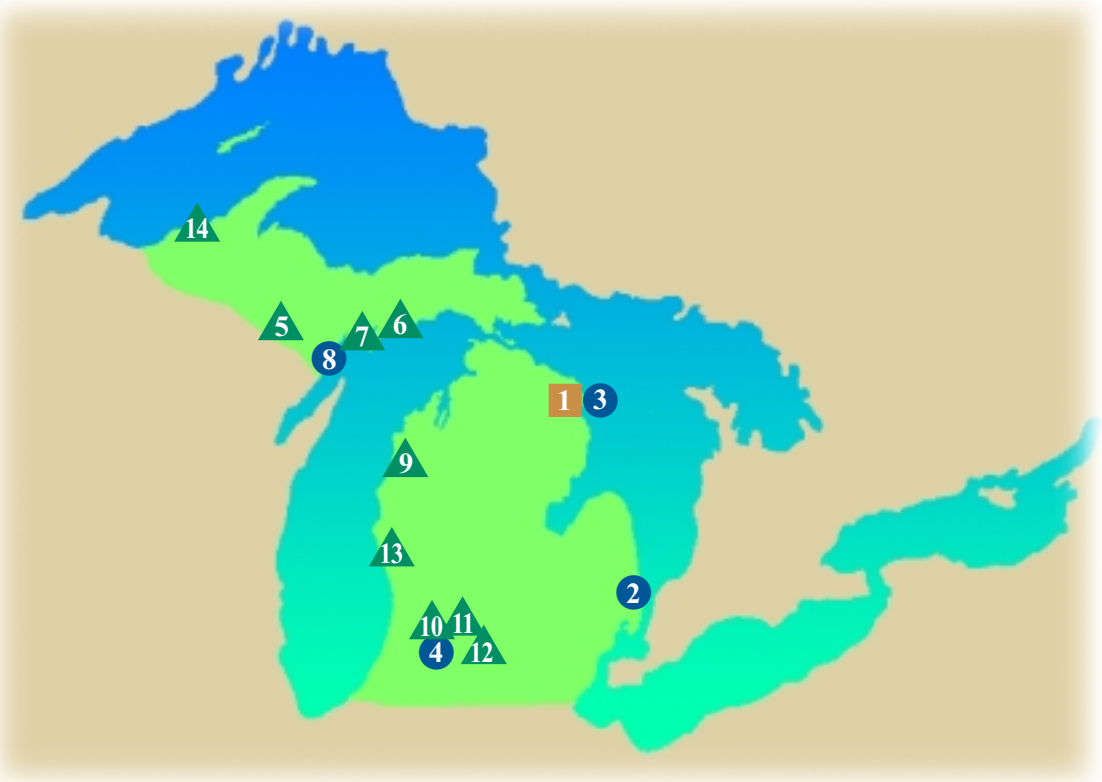
Michigan Pulp & Paper Environmental Council

Michigan Department of Environmental Quality

A Partnership Between the
Michigan Pulp & Paper Environmental Council and the
Michigan Department of Environmental Quality

photo by Dan Urbanski www.quietlywild.com

Michigan Pulp and Paper Pollution Prevention Program Participants



■ Hardboard ▲ Pulp and Paper ● Paper

■	1	ABT Co., A Louisiana-Pacific Co.	Alpena
●	2	Domtar, Eddy Specialty Papers	Port Huron
●	3	Fletcher Paper Co.	Alpena
●	4	Graphic Packaging Corp.	Kalamazoo
▲	5	International Paper Co.	Quinnesec
▲	6	Manistique Papers, Inc.	Manistique
▲	7	Mead Corporation	Escanaba
●	8	Menominee Paper Co.	Menominee
▲	9	Packaging Corporation of America	Filer City
▲	10	Paperboard Division, Menasha Corp.	Otsego
▲	11	Plainwell Papers Co.	Plainwell
▲	12	Rock-Tenn Company	Battle Creek
▲	13	SAPPI Fine Paper NA/S.D. Warren	Muskegon
▲	14	Smurfit-Stone Container Corp.	Ontonagon

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Welcome

For those of you familiar with us, "Hello again!" For those of you who may not know us yet, "Welcome to the Michigan Pulp and Paper Pollution Prevention Program, or P5." This program is a voluntary effort by the Michigan pulp and paper industry that promotes pollution prevention activities. Fourteen pulp and paper companies currently participate in this program, representing approximately 75% of the state's production. In this, our Year 2000 Annual Report, we invite you to join us as we reflect on our progress.

The pulp and paper industry employs over 21,000 Michigan residents. The annual payroll is approximately $840 million, with an additional $5 billion spent each year for goods and services. The P5 program enables our industry to improve the environmental quality of our beautiful state as well as the communities in which we operate. Proactive P5 philosophies also enhance the long term business sustainability of the industry.

The P5 partnership between the Michigan Pulp and Paper Environmental Council (MPPEC) and the Michigan Department of Environmental Quality - Environmental Assistance Division (MDEQ-EAD) began in 1996, as a cooperative effort to foster an open environment for pollution prevention. In order to participate in the P5, members must adhere to the following requirements:

- Commit annually to P5 in writing,
- Develop and adopt a written pollution prevention policy,
- Establish annual P5 goals,
- Maintain records of pollution prevention activities, and
- Participate in technology transfer.

The P5 Annual Report shares the industry progress towards pollution prevention with members of the pulp and paper industry as well as the public.

Since the inception of P5, member mills have achieved significant reductions of air, water, and solid waste emissions. In this past year, the industry has also achieved reductions of *Nonylphenol ethoxylates* (NPE), a chemical of concern in Michigan, from our wastewater effluent.

On behalf of the participating P5 companies, we thank you for supporting our efforts. We are proud of our past accomplishments, and plan to actively pursue both the short- and long-term P5 goals we have set for the future.

Pollution Prevention Goals

The P5 member mills recognize and believe in the importance of safeguarding natural resources and our global environmental heritage. We are committed to the protection of the health, safety, and environment of our employees and our communities. We believe environmental goals can and should be consistent with economic health and strive to manage our businesses based on a long-term environmental perspective. The P5 program is intended to find cost-effective ways to minimize the environmental impact from the pulp and paper industry's manufacturing processes.

This program encompasses air emissions, wastewater discharges, and solid/hazardous waste disposal. The P5 program is our effort to voluntarily go beyond regulation to demonstrate our commitment to the environment. Member companies, in partnership with the MDEQ, annually commit to a common cause to learn from each other, provide technical support, and obtain environmental results that otherwise may not have been achieved. Recycling, source reduction, process efficiency improvements, chemical substitutions, and source elimination are some of the primary means by which this group attains its environmental goals. The MDEQ makes the P5 accomplishments known to other industry segments via technology transfers to assist in their P2 efforts, as well as further benefit the environment.

Goal Development

Each participant sets goals annually based on its specific objectives and priorities. Using the Areas of Focus below as a guide, individual mills develop short- and long-term pollution prevention goals that not only benefit the environment but also are technically and economically feasible. These voluntary goals may be either quantitative or qualitative in nature.

Areas of Focus

Minimize:

- *Nonylphenol ethoxylates* in effluent
- Elemental chlorine usage
- Mercury emissions
- Hazardous materials and wastes
- Air emissions
- Energy usage
- Water usage
- PCB regulated electrical equipment usage
- Solid waste to landfill

Promote:

- Recycling
- Environmental management system development
- P5 participation

"We are investigating the use of a computer-based system for environmental training of our employees, which will make the training more flexible and accessible."

Goal Performance

Quantitative goals are aggregated to create industry-wide goals. Progress towards these industry-wide goals is measured annually. Current performance in addressing each of the Areas of Focus is provided below.

➢ *Nonylphenol ethoxylates* (NPE) *in effluent*

Nonylphenol ethoxylates (NPE) are common in some materials used by the pulp and paper industry. Nonylphenol (NP) is a byproduct of NPE manufacture and a biodegradation product of NPE. NP has been identified as a suspected endocrine disrupter, a chemical that may interfere with normal hormone function, and therefore has become a compound of concern in the Great Lakes.

The MPPEC with funding from the MDEQ, Office of the Great Lakes, Michigan Great Lakes Protection Fund, undertook a project to understand the magnitude of NP/NPE in Michigan (see Appendix D). The three objectives of this project included: identifying NPE containing products and successful substitution alternatives, reducing the loading of NP/NPE to the waters of the State of Michigan and proving pollution prevention can be as effective as departmental policy.

Of the 780 process chemicals used by the 17 study participants, 60 products were identified by the vendors as containing NPE. Participants performed substitution trials to replace NPE containing products. Sampling of participating mills' effluent occurred before and after substitution trials.

Concentration and loading of NPE decreased significantly for mills that had successfully implemented product substitutions. Additionally, concentration and loading of NP decreased significantly for the industry. Four of the participants were unable to utilize substitutes at this time because no technologically or economically feasible substitution products are currently available.

➢*Elemental chlorine usage*

Kraft mills are reducing the amount of elemental chlorine used in bleaching pulp. Elemental chlorine will be eliminated from all kraft mills by 2001 per the USEPA Pulp and Paper Maximum Achievable Control Technology (MACT) Standard, commonly known as the Cluster Rule. Other mills have been voluntarily reducing or eliminating the use of elemental chlorine as a biocide in water and wastewater treatment.

➢*Mercury emissions*

Several companies have instituted programs to identify and eliminate mercury-containing devices such as certain thermostats, manometers and electrical switches and have instituted recycling programs for fluorescent and mercury-vapor lights.

➢*Hazardous materials and wastes*

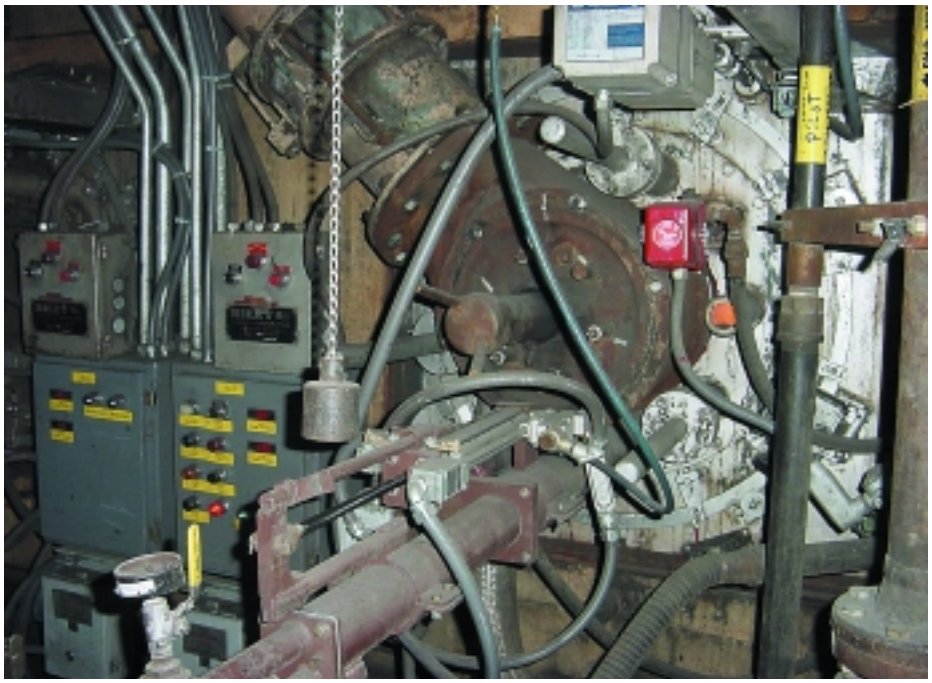
Hazardous waste generation has been reduced substantially through changes in the raw materials and processes employed at the mills, such as the replacement of organic solvents with water-based products for the degreasing of machine parts. Other voluntary projects have involved optimizing the use of phosphoric acid in wastewater treatment to reduce the amount of phosphorus in mill discharges, and the lowering of the levels of metals such as zinc and aluminum in wastewater bioresiduals.

➢*Air emissions*

Efforts continue to reduce the air emissions of volatile organic compounds (VOCs) and other chemicals such as nitrous oxides through raw material substitutions and improvements in boiler operations.

➢*Energy usage*

One mill has implemented an energy conservation program that identifies activities and equipment whose efficiency could be improved and then makes the necessary modifications. Another mill recently began a project in which a capacitor bank is being replaced to reduce the mill electrical demand.



"Voluntary installation of low-NOx burners in our boiler has reduced annual NOx emissions by over 250 tons."

"We have eliminated the storage and use of anhydrous ammonia at the mill."

➢*Water usage*

Many mills engage in on-going projects to reduce water usage through enhanced recycling and fiber recovery. Efforts include the reuse of cooling water in the papermaking process, the screening of paper machine "whitewater" to allow reuse, and more water-efficient washing of pulp.

➢*PCB regulated electrical equipment usage*

Since 1997, P5 participants have reported the removal of 29 PCB regulated transformers. By the end of 1998, thirteen of the fourteen P5 partners had completely eliminated PCB regulated transformers. Five remaining transformers are scheduled to be addressed in 2000 with a proposal to address the final two in 2001.

➢*Solid waste to landfill*

Projects continue at several mills to minimize the landfilling of solid wastes such as wastewater bioresiduals and boiler ash by finding practical uses for the materials. Common alternatives for bioresiduals are composting, land application, and use as an alternative fuel. Boiler ash is used in the manufacture of bricks and concrete products.

➢*Recycling*

Several mills have programs to recycle items such as batteries, used solvents, office and computer paper, as well as the fluorescent and mercury vapor bulb recycling programs previously mentioned. Other programs sponsored by P5 participants include community wide recycling programs for office papers, and recycling of glossy papers with donation of the proceeds to local schools for the purchase of computer equipment.

➢*Environmental management systems* (EMS) *development*

Most P5 partners either have environmental management systems in place or are in the process of implementing one. An EMS involves developing and implementing procedures to identify, control, and monitor potential environmental impacts by systematically analyzing manufacturing operations.

➢*P5 participation*

The P5 partners welcome Plainwell Paper of Plainwell Michigan as a new member. The participation of Georgia-Pacific in Kalamazoo and Consolidated Papers, Inc. Niagara Division in Dickinson County will be greatly missed, however, as it was necessary for them to withdraw their membership for this year.

ACCOMPLISHMENTS-
1999 SHORT TERM (1 YEAR) GOALS

The following P5 goals represent the reduction commitment and actual reductions achieved through specific P5 efforts for 1999.

AIR EMISSIONS

Isopropanol →	1 ton/yr	1.3 tons/yr

WASTEWATER

Water Use →	360* mil gal/yr	351 mil gal/yr
Solids (TSS) Loading →	1,879 tons/yr	8,757 tons/yr
Nutrient Discharge →	7.4 tons/yr	2.1 tons/yr

*Goal originally stated as 600 mil gal/yr, but due to the loss of a P5 participant the goal was adjusted to to reflect current P5 member commitments.

HAZARDOUS MATERIALS

Chlorine Use →	1.5	0 tons/yr
Aluminum in Biosolids →	0.5	0.85 tons/yr
H3PO4 Use →	0.75 tons/yr	2.76 tons/yr

SOLID WASTE LANDFILLED

Biosolids, Beneficial Use →	15,900 tons/yr	18,168 tons/yr
Use/Recycle Mill Reuse →	1,710 tons/yr	1,259 tons/yr

Although not all of the goals were met, in most cases significant progress was noted.

Year 2000 Short Term (1 Year) Target Goals

To maintain the momentum of the P5, the following short-term industry goals have been established for the coming year:

- Increase the amount of universal waste recycling by 1.05 tons
- Eliminate the use of five PCB regulated electrical transformers
- Reduce:
  - Water usage / wastewater discharge by 125 million gallons per year
  - Sewer losses by 5,680 tons
  - Air emissions (VOCs) by 9 tons
  - Hazardous materials by 7.25 tons
- Beneficial use / recycle of 16,490 tons of residuals

Examples of qualitative goals submitted by the participants for the Year 2000 include:

- Initiate a training program to enhance the environmental awareness of all mill employees
- Sponsor and participate in local wildlife habitat rehabilitation programs
- Investigate beneficial use opportunities for mill wastewater biosolids
- Study alternative uses for used oil
- Establish an improved tracking system for raw materials that contain volatile organic compounds (VOCs) or hazardous air pollutants (HAPs)

"Our mill has continued to reduce water use, most recently by installing a filtration system and by making pulp washing more efficient."

Special Efforts

MPPEC Technology Transfer

Through P5 efforts, the MPPEC is working together to minimize the pulp and paper industry's impact on Michigan's environment. An important part of MPPEC's strategy to achieve this mission is through effective technology transfer. Sharing of key learning experiences between participants, and educating the public, government agencies, suppliers and others on industry efforts, increases the overall effectiveness of these Pollution Prevention efforts. Information exchange is, of course, a two way street, and MPPEC eagerly receives information from other industry sectors that may also benefit the pulp and paper industry and ultimately the environment. The education process can take the form of workshops specific to the pulp and paper industry. Joint projects may be undertaken by industry and EAD as a part of this program. The NPE reduction project is a good example of how the industry sector in Michigan worked towards the reduction of this material, and then shared the information with other mills or other industry sectors attempting to reduce or eliminate NPE.

The MPPEC is currently designing a website that would not only contain important information about the P5 mission and accomplishments in the paper industry, but would also provide members a means of exchanging information on P5, technologies and important environmental news. This degree of integration has not been possible before, and the MPPEC wants to take full advantage of the power of the Internet for both distributing and receiving information that supports their mission.

Data QA/QC

Quality assurance and control of the data for the P5 is critical to the integrity of the program. The data is used to report trends and goal progress, and to guide mills in their selection of P2 goals. Historical data on waste generation and environmental releases is submitted annually by participants under P5. This data is exhaustively compared against existing databases of the MDEQ, specifically the Air Quality Division (AQD) Emissions Inventory, Toxic Release Inventory (TRI), Hazardous Waste Manifest Inventory, and National Pollution Discharge Elimination System (NPDES) reports for wastewater. Quality assurance work was done by NCASI most recently for the 1998 data, which is presented for the first time in this report. Historical data for earlier years (1987 through 1997) has been subject previously to the QA comparison with MDEQ databases. The table of historic data contained in this report may reflect progress on goals established in previous years (see Appendix C).

There are no MDEQ databases available for direct comparison against progress or accomplishments reported on P5 numeric goals. However, QA is conducted on goal progress through discussions with individual mills to confirm the reductions and to understand how the P2 was achieved. The QA work is an ongoing effort. Note that the historic data runs one year behind the goal accomplishment reports.

Outreach

MDEQ staff and P5 members were active in 1999 promoting the benefits of joining the partnership. During the year, representatives from mills, public agencies, and academia have requested information on how the partnership was formed. The NCASI regional meeting in May 1999 provided an excellent conduit for sharing the success of the P5 with other members of the pulp and paper industry. MPPEC members gave P5 presentations at workshops, conferences, and training sessions to promote participation in other P2 programs currently active throughout the State of Michigan.

About the Partners

Michigan Pulp and Paper Environmental Council (MPPEC)

MPPEC is an association of environmental professionals from eighteen pulp and paper mills in Michigan committed to protecting and enhancing our natural resources and the environment. Fourteen MPPEC member mills currently belong to the P5. The MPPEC has worked diligently since 1994 on environmental issues affecting the pulp and paper industry. The MPPEC also acts as a communication link with MDEQ, the Environmental Protection Agency, State Legislators, Trade Associations such as the American Forest and Paper Association and the National Council for Air and Stream Improvement, Inc., as well as other P2 organizations such as the Wisconsin Paper Council.

MDEQ Environmental Assistance Division (EAD): The EAD is a non-regulatory division that provides environmental outreach and assistance to industry, business organizations, and the public. It oversees information and assistance programs leading to improvement in environmental quality through an emphasis on pollution prevention. EAD's primary program areas are in education and outreach, financial assistance, pollution prevention, and technical assistance.

Acknowledgements

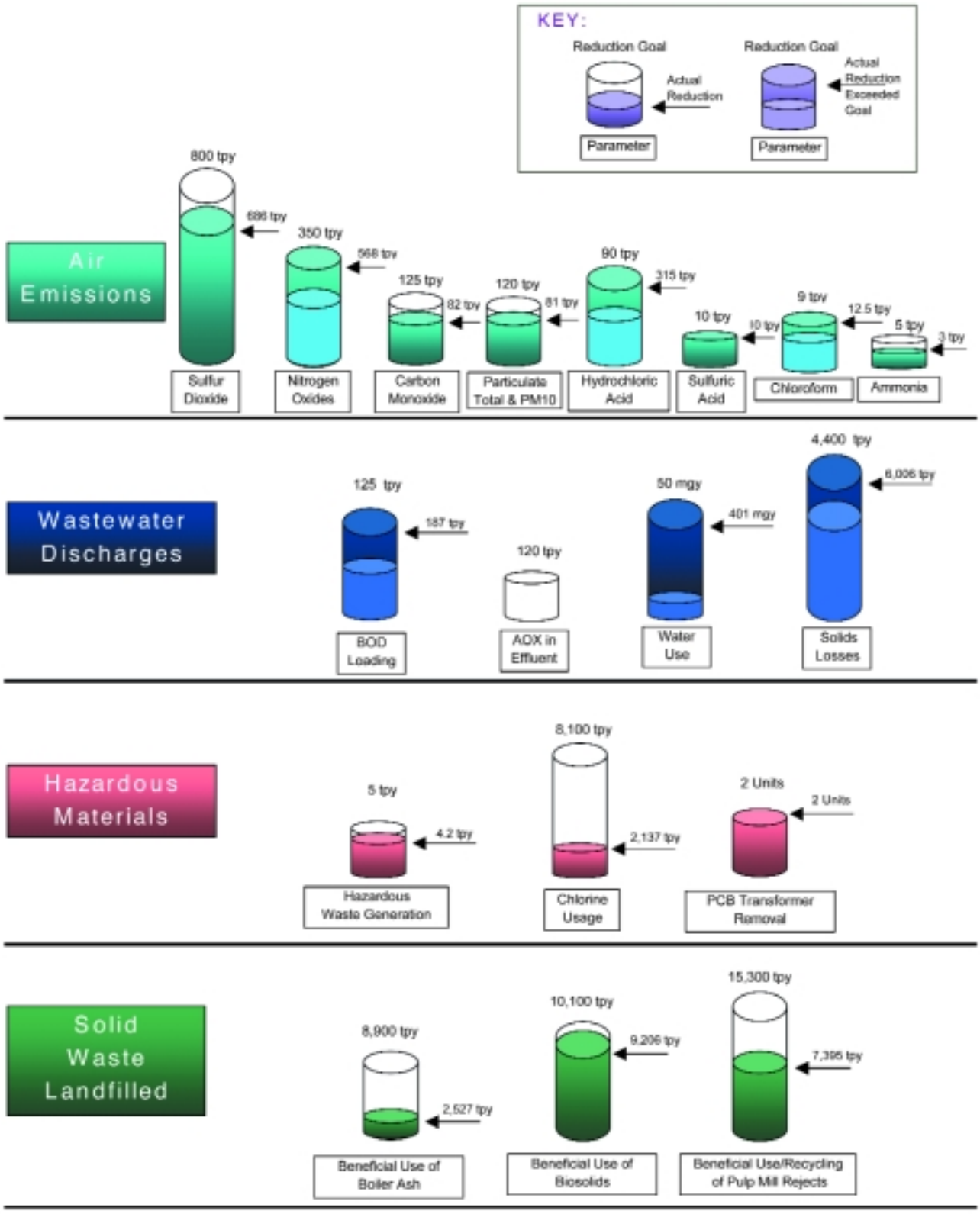
National Council for Air and Stream Improvement, Inc. (NCASI): NCASI was founded in 1943 to provide environmental research for the forest products industry. NCASI also provides technical support on policy and regulatory issues for the industry. NCASI consolidates the individual mill's P5 information into industry wide goals for this report, provides the historical trends, and maintains the historical environmental database on the participating facilities. The P5 sincerely appreciates their diligent efforts in processing all of the data for the Annual Reports.

U.S. Environmental Protection Agency (EPA): The EPA provided the seed grant funding to initiate the Michigan Pulp and Paper Pollution Prevention Program (P5).

For more information about the P5 partnership, please contact Wendy Fitzner, Michigan Department of Environmental Quality, Environmental Assistance Division, P.O. Box 30457, Lansing, MI 48909-7957, (517) 373-8798 or (800) 662-9278, or contact the Michigan Pulp and Paper Environmental Council, PMB 187, 2743 East Grand River, East Lansing, MI 48823.

Appendix A: Progress- Long Term (2-5 Year) Goals

The following P5 goals represent the reduction commitment for the years 1997 through 2002. Reductions achieved due to P5 efforts, as of 12/99, are reported as progress.



"We plan to reduce electric-power use by installing a new bank of capacitors."

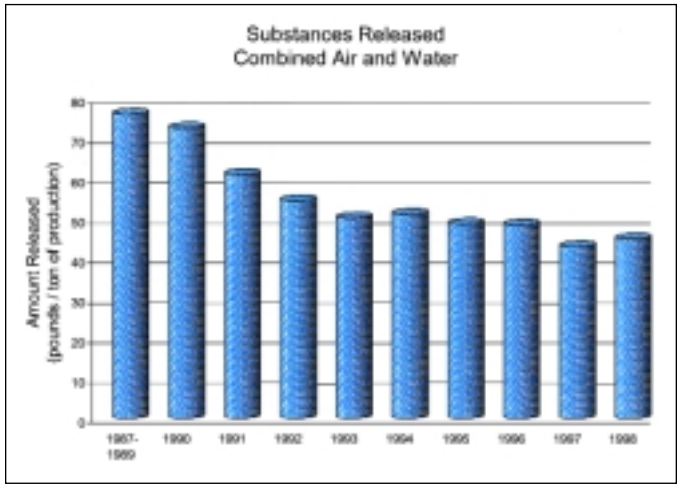
"Over 3000 used fluorescent lights and 1000 pounds of batteries were recycled in 1998."

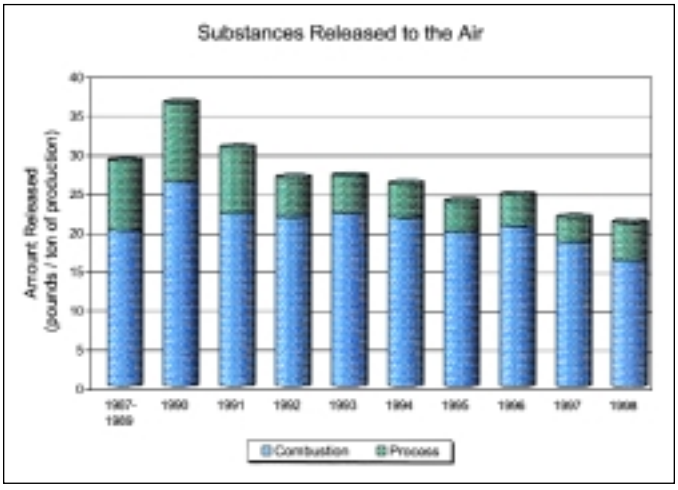
"A study into possible alternatives for the beneficial use of wood ash has been initiated."

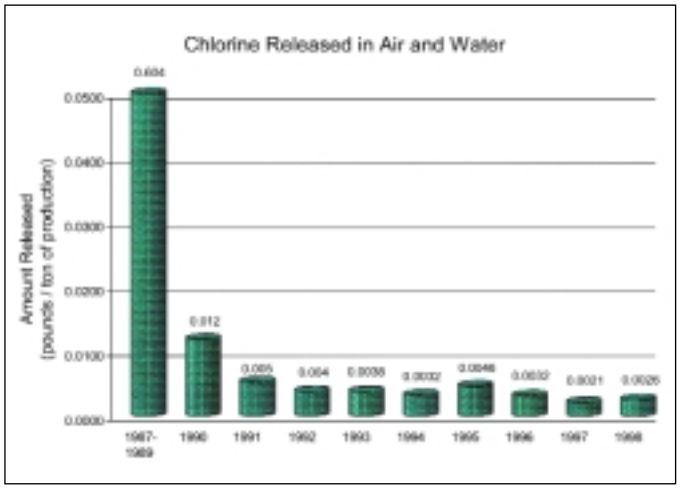
Appendix B: Historical Perspective (Trends)

Participating mills have been submitting data annually under the P5 so that environmental trends for the pulp and paper industry in Michigan can be tracked. The most recent data covers the year 1998. As with data for prior years, the 1998 data set was compared, supplemented, and confirmed using MDEQ databases including: Air Quality Division Emissions Inventory, Toxic Release Inventory, hazardous waste manifest records, and National Pollutant Discharge Elimination System reports for wastewater. A summary of the compiled data is provided in Appendix C. The data from 1987 through 1989 was averaged to provide a baseline.

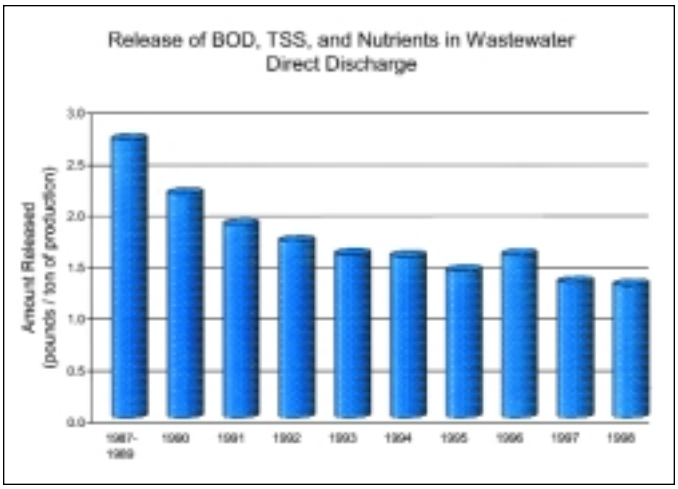
Improvement in environmental performance is shown by the data in Appendix C, some of which is presented graphically here. Annual production of pulp and paper increased by more than 27 percent since the late 1980's. At the same time, combined air and water discharges declined by 21 percent on a mass or absolute basis, and by 41 percent when expressed on a normalized or production (pounds of substances emitted per ton of production) basis. The following reductions also occurred as expressed on a production basis: hazardous waste generation by 69 percent, water use (wastewater volume) by 29 percent, total emissions of substances to air by 27 percent, total discharges of substances in wastewater by 57 percent, and solid waste landfilled by 24 percent.

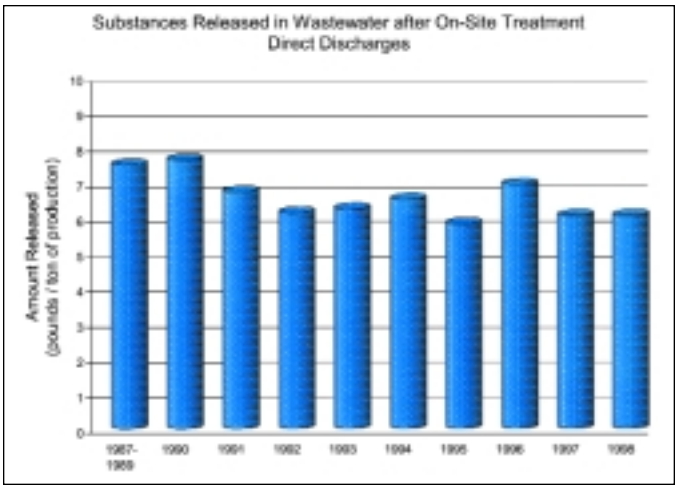


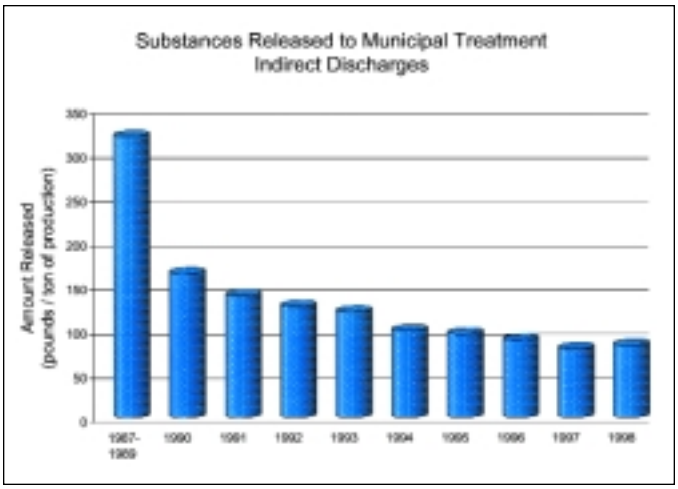


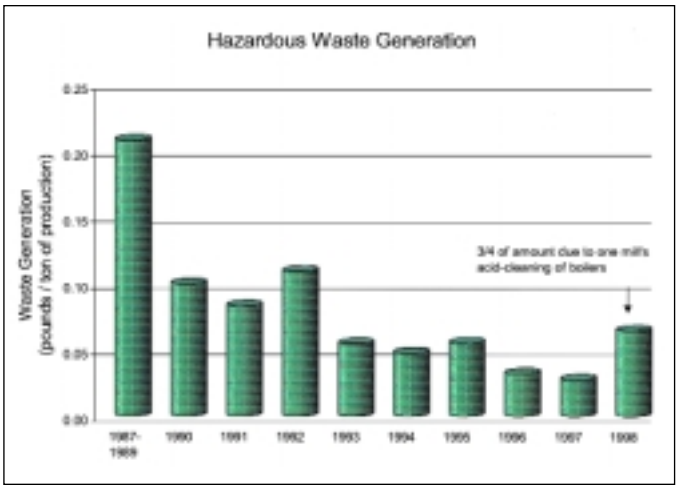



Wastewater Volume
Combined Direct and Indirect Flows
Volume
(gallon / ton of production)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1987-1989
1990
1991
1992
1993
1994
1995
1996
1997
1998


Release of BOD, TSS, and Nutrients in Wastewater
Direct Discharge
Amount Released
(pounds / ton of production)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1987-1989
1990
1991
1992
1993
1994
1995
1996
1997
1998


Substances Released in Wastewater after On-Site Treatment
Direct Discharges
Amount Released
(pounds / ton of production)
10
9
8
7
6
5
4
3
2
1
0
1987-1989
1990
1991
1992
1993
1994
1995
1996
1997
1998


Substances Released to Municipal Treatment
Indirect Discharges
Amount Released
(pounds / ton of production)
350
300
250
200
150
100
50
0
1987-1989
1990
1991
1992
1993
1994
1995
1996
1997
1998


Hazardous Waste Generation
Waste Generation
(pounds / ton of production)
0.25
0.20
0.15
0.10
0.05
0.00
3/4 of amount due to one mill's
acid-cleaning of boilers
1987-1989
1990
1991
1992
1993
1994
1995
1996
1997
1998

APPENDIX C: COMPILED HISTORICAL DATA

	Average 1987- 1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Production										
Market Pulp (million tons)	0.329	0.352	0.293	0.307	0.285	0.346	0.330	0.326	0.336	0.238
Paper (million tons)	1.17	1.29	1.48	1.60	1.71	1.74	1.81	2.14	2.10	2.15
Paperboard (million tons)	1.00	1.03	1.02	1.05	1.17	1.25	1.20	0.897	0.989	0.799
Total (million tons)	2.50	2.67	2.80	2.96	3.16	3.33	3.34	3.36	3.43	3.18
Air Emissions – Combustion										
Criteria Air Pollutants (million lbs)	39.3	63.7	56.9	60.9	66.4	68.0	62.5	64.8	59.2	48.8
Criteria Air Pollutants (lbs/ton)	29.5	25.0	21.2	20.6	21.0	20.4	18.7	19.3	17.3	15.3
Other Emissions (million lbs)	2.55	2.99	2.44	3.08	3.75	4.05	3.61	4.36	4.23	2.73
Other Emissions (lbs/ton)	1.25	1.36	1.05	1.33	1.50	1.31	1.17	1.30	1.23	0.859
Total (million lbs)	41.8	66.7	59.4	64.0	70.2	72.0	66.1	69.2	63.5	51.5
Total (lbs/ton)	19.9	26.2	22.1	21.6	22.2	21.6	19.8	20.6	18.5	16.2
Air Emissions – Process										
Criteria Air Pollutants (million lbs)	16.5	23.7	20.1	11.8	11.6	11.3	9.81	10.7	8.03	12.6
Criteria Air Pollutants (lbs/ton)	17.2	15.5	12.2	5.67	4.95	4.25	3.30	3.41	2.64	3.96
Other Emissions (million lbs)	2.44	2.20	2.68	3.43	3.71	3.36	3.34	2.78	2.87	2.94
Other Emissions (lbs/ton)	1.45	1.11	1.25	1.39	1.44	1.13	1.17	0.972	1.04	1.00
Total (million lbs)	18.9	25.9	22.8	15.2	15.3	14.6	13.1	13.5	10.9	15.6
Total (lbs/ton)	8.99	10.2	8.50	5.14	4.83	4.39	3.94	4.00	3.18	4.89
Total Air Emissions										
Total (million lbs)	60.7	92.6	82.2	79.2	85.5	86.7	79.3	82.6	74.4	67.1
Total (lbs/ton)	28.9	36.4	30.6	26.8	27.0	26.0	23.7	24.6	21.7	21.1
Wastewater – Direct Discharge										
BOD/TSS (million lbs)	15.0	18.0	16.5	16.1	15.8	17.1	16.4	19.0	16.2	15.0
BOD/TSS (lbs/ton)	11.0	7.85	6.81	6.21	5.81	6.06	5.86	7.01	5.96	6.04
Other Discharges (million lbs)	1.10	1.04	1.13	1.03	1.16	1.27	1.38	1.57	1.79	1.68
Other Discharges (lbs/ton)	0.546	0.450	0.468	0.406	0.464	0.490	0.469	0.529	0.601	0.606
Total (million lbs)	16.1	19.1	17.6	17.1	17.0	18.4	17.8	20.6	18.0	16.7
Total (lbs/ton)	7.49	7.63	6.71	6.12	6.23	6.50	5.81	6.93	6.04	6.04
Wastewater - Indirect Discharge										
BOD/TSS (million lbs)	103	80.5	69.0	62.5	54.5	60.8	60.4	55.3	50.6	54.8
BOD/TSS (lbs/ton)	313	160	134	122	117	91.9	87.7	81.7	71.8	76.2
Other Discharges (million lbs)	2.02	1.57	1.71	2.03	1.32	4.19	4.71	4.08	4.10	4.06
Other Discharges (lbs/ton)	7.23	4.21	4.17	5.51	5.63	7.87	8.73	15.7	15.6	14.7
Total (million lbs)	105	82.1	70.7	64.5	55.8	65.0	65.1	59.4	54.7	58.9
Total (lbs/ton)	319	163	138	126	119	98.2	94.6	87.8	77.6	81.8
Total Wastewater Discharges										
Total (million lbs)	121	101	88.3	81.6	72.8	83.4	82.9	79.9	72.8	75.6
Total (lbs/ton)	55.1	37.9	31.6	27.6	23.0	25.0	24.8	23.8	21.2	23.7
Combined Air/Water										
Total (million lbs)	182	194	171	161	158	170	162	163	147	143
Total (lbs/ton)	76.1	72.5	61.0	54.4	50.0	51.1	48.6	48.4	42.9	44.8
Solid Waste (landfilled)										
Wastewater Treatment Sludge (1000 tons)	78.4	100	272	266	253	281	221	204	189	155
Boiler Ash (1000 tons)	83.0	117	86.7	71.8	134	133	140	189	156	153
General Trash (1000 tons)	25.4	27.1	27.4	34.0	62.5	69.6	90.1	76.5	77.5	77.8
Wood Waste (1000 tons)	11.1	09.8	10.0	16.9	17.9	13.8	12.6	23.9	24.6	13.1
Other Wastes (1000 tons)	32.7	37.2	35.0	30.4	31.7	29.8	38.6	27.1	36.8	28.6
Total (1000 tons)	231	291	432	419	500	528	503	521	484	428
Total (tons/ton)	0.177	0.182	0.161	0.147	0.164	0.165	0.151	0.155	0.141	0.134
Hazardous Waste (generated)										
Corrosive (1000 lbs)	96.6	15.5	4.04	16.8	2.95	17.6	11.4	43.8	31.7	128
Ignitable (1000 lbs)	94.7	106	154	223	106	79.4	69.0	37.2	20.0	12.7
RCRA Listed (1000 lbs)	0.961	1.76	4.39	6.44	9.44	18.0	7.66	5.67	11.8	16.2
Reactive (1000 lbs)	0	0	0	0.0250	0	0	0	0	0	0
TCLP Toxic (1000 lbs)	0.270	6.40	2.58	12.0	33.5	37.5	88.9	13.3	10.2	9.85
Total (1000 lbs)	193	130	165	258	152	152	177	100	73.6	167
Total (lbs/ton)	0.208	0.0996	0.0830	0.109	0.0544	0.0475	0.0550	0.0319	0.0275	0.0643

EXPLANATION OF DATA

Historical data are based on available information from the 14 mills currently participating in P5 and were generated from a combination of monitoring data (direct measurement), mass balance calculations, published emission factors, and other methods such as engineering calculations or best engineering judgment. There were data gaps for some substances at some facilities, particularly for the earlier years (e.g., the 1980's). Hence, the lack of data in the earlier years may mean that some reductions achieved since 1987 have been underestimated. Rather than present the data for each year of the first three years, 1987 through 1989, average values for those years are shown. For data expressed on a production basis (e.g., lb/ton), only the production from mills that reported a value for that substance(s) was employed in the calculation. Emission factors, EPA/DEQ reporting requirements, analytical quantification limits, and other bases for estimates may change periodically. For these and other reasons, the data are subject to change.

EXPLANATION OF TERMS

Combustion - Refers to the burning of fuels in boilers to generate power for use in pulp and paper production. Process - Refers to production equipment and processes, such as a paper machine or a kraft lime kiln. Criteria Air Pollutants - This group includes carbon monoxide, nitrogen oxides, sulfur dioxide, PM10 (particulate matter smaller than 10 microns in diameter), and volatile organic compounds. Direct Discharge - Refers to wastewater that is treated by a mill and then discharged to a natural water body such as a river. Indirect Discharge - Refers to wastewater which, usually after partial treatment at the mill, is discharged to a municipal treatment plant for further treatment. Values in the table do not reflect the additional treatment provided by the municipality. BOD - Biochemical oxygen demand, a measure of the biodegradable organic matter present in wastewater. TSS - Total suspended solids. Hazardous Waste - The terms RCRA listed, corrosive, ignitable, reactive, and TCLP toxic are categories of hazardous waste defined by USEPA based on properties of the waste.

Appendix D: Nonylphenol Ethoxylates Pollution Prevention Project

July 2000

Executive Summary

Nonylphenol ethoxylates (NPE) are common in some materials used by the pulp and paper industry. Nonylphenol (NP) is a byproduct of NPE manufacture and a biodegradation product of NPE. NP has been identified as a suspected endocrine disrupter and therefore has become a compound of concern in the Great Lakes.

The Michigan Pulp and Paper Environmental Council (MPPEC) with funding from the MDEQ, Office of the Great Lakes, Michigan Great Lakes Protection Fund, undertook a project to understand the magnitude of NP/NPE in Michigan. The three objectives of this project include: identify NPE containing products and successful substitution alternatives, reduce the loading of NP/NPE to the waters of the State of Michigan, and prove pollution prevention can be as effective as departmental policy.

Of the 780 process chemicals used by the 17 participants, 60 products were identified by the vendors as containing NPE. Participants performed substitution trials to replace NPE containing products. Sampling of each mill's effluent occurred before and after substitution trials.

Concentrations and loading of NPE decreased significantly for mills that had successfully implemented product substitutions. Additionally, concentration and loading of NP decreased significantly for the industry. Four of the participants were unable to substitute at this time because viable substitution products are not yet available.

This study demonstrated importantly that voluntary measures for pollution prevention are possible, productive, and can significantly impact an environmental concern through this cooperative process. This regulatory flexibility is the hallmark of a new and powerful way to bring together stakeholders to work for common goals. The importance for work on NPE was received loud and clear by chemical vendors of these products. NPE and NP compounds are of environmental concern, and substitutions are needed by the industry for environmental purposes. Natural market mechanisms work for individuals that choose to partner with our industry in working on appropriate environmental concerns, and as a result of this particular kind of partnership work, the environment received a direct benefit. Valuable knowledge was gained on how this process works by the MDEQ and the MPPEC, and is documented in this report.

MPPEC would like to formally acknowledge the partners who helped make the success of this project possible in addition to the member mills of the MPPEC: Michigan Department of Environmental Quality - Environmental Assistance Division, Office of the Great Lakes, Michigan Great Lakes Protection Fund, and National Council for Air and Stream Improvement, Inc (NCASI).

Introduction

Nonylphenol ethoxylates (NPnEO, or simply NPEs, where n can be from 1 to 100 ethoxylate units) are common in some materials used by the pulp and paper industry. NPEs are the second largest group of nonionic surfactants used in the U.S. today and have been used successfully for more than 40 years. Although the pulp and paper industry uses only approximately 6% of the NPEs currently sold in the U.S., EPA's Region 5 office has expressed interest in NPEs discharged in effluents from this industry sector. Nonylphenol (NP) is a byproduct of NPE manufacture and also a biodegradation product of NPE. Biodegradation of NPE takes place in wastewater treatment systems. Therefore, NP is present in wastewater discharges. NP has been identified as a suspected endocrine disrupter, and therefore has become a compound of concern in the Great Lakes.

NPE may be present as nonionic surfactants in several products used in the pulp and paper industry, such as drainage aids, felt washing additives, anti-foaming agents, retention aids, latex coating emulsifiers, and deinking aids. Most of these products are used in the paper machine area. These compounds have a long history of use due to their high performance, cost effectiveness, and ability to withstand the harsh conditions encountered in some pulp and paper mill processes.

Objectives

The primary objective of this project was to identify successful substitution alternatives to products currently in use by the pulp and paper industry in order to eliminate the usage and discharge of NPE. Another objective was public benefit by reducing the loading of NP/NPE to the waters of the State of Michigan. Thirdly, this was an effort to show that the use of voluntary pollution prevention (P2) can be as effective as department policy development in addressing emissions of chemicals of concern. This project was made possible by funding from the Office of the Great Lakes, Michigan Great Lakes Protection Fund.

The project was completed in five steps. The first step was to educate pulp and paper mill personnel on the importance of eliminating NPE. This was accomplished by discussing NPE elimination at every Michigan Pulp and Paper Environmental Council (MPPEC) meeting, having a guest speaker from NCASI give a short presentation at a general meeting, and presenting a preliminary finding speech on the subject at NCASI's 1999 Central-Lakes States Regional Meeting.

The second step involved the collection of product usage information to identify which products contained NPE. An independent contractor familiar with the industry was hired to coordinate the collection of information. Utilizing a third party to preserve confidentiality of the mills throughout the project was critical to promoting mill participation. In many cases, mills signed confidentiality agreements with chemical vendors to protect proprietary information on their products.

The third step involved the consultant and the mills working with chemical suppliers to identify cost-effective, technically feasible alternatives to products containing NPE. A detailed discussion of steps two and three is located in the survey section of this report.

Conducting mill trials to evaluate alternative products was the fourth step of this project. A key component of this step included pre- and post-trial effluent testing to evaluate the effectiveness of the alternative products. This occurred between April 1999 and January 2000. Statistical data analysis was performed to determine whether a real reduction in NPE/NP load to State of Michigan waters occurred.

The last step involves technology transfer. MPPEC has pledged to distribute the final report to all pulp and paper mills in Michigan. Additionally, the information gained through this project and presented in this report will be shared during conferences specific to the pulp and paper industry.

Survey

The goal of the survey was to provide information to participating mills regarding products that contain NPE and to identify potential substitution products. The participating mills provided lists of major products used to the independent contractor. These products were generally limited to process chemicals which would be expected to impact wastewater. Mills were also asked to provide a contact person for their supplier.

The best contact for each supplier was determined, and letters were sent to the suppliers. These letters were sent out in March 1999 on behalf of MPPEC identifying the products for which NPE information was sought. Over 100 vendors were identified, supplying more than 780 products to the participating mills.

Vendor responses were directed to the independent contractor, who assembled the results. The contractor also followed up with vendors who were non-responsive to the survey letter.

A total of 14 mills supplied product information for the NPE vendor survey. One mill participating in the overall NPE study did not provide information because NPE was not detected in their wastewater.

Results of the survey are as follows:

1) Sixty products were identified by the vendors as containing NPE (about 8% of the total products utilized by the mills). While the magnitude of NPE content was not specifically requested, some vendors provided this data and indicated NPE contents varying from trace amounts up to approximately 6%. Many of these products contained amounts (<1%) which would not be required to be indicated on Material Safety Data Sheets (MSDS).

2) 604 products were identified by the vendors as being free of NPE (about 77% of the total products utilized by the mills).

3) A total of 116 products were listed as unknown for NPE content. This is due to the following reasons:

- Vendors identified 31 products no longer being sold (or not being sold to this industry)

- One mill provided a list of products late in the project, and their product list did not make it into the letters sent to the vendors. However, some products on the late list were duplicates, and some others were included in follow-up contacts with the vendors.

- The vendor did not respond.

When taking into account the products which are no longer sold to the mills, this study provides NPE determinations for 89% of the products identified by participating mills.

Sampling

Seventeen mills participated in both the baseline trials (April 1999) and the substitution trials (January 2000) as part of MPPEC's " P5" effort. There were no additions or dropouts between the two sampling periods. Thirteen of the participating mills were direct dischargers and four discharged effluents from their primary clarifiers to local municipal treatment facilities. All facilities were asked to provide two one-liter samples of a 24 hr composite of their effluent after treatment within designated weeks in April 1999 and January 2000. All samples were packed on ice and shipped via overnight delivery to the laboratory for analysis. Compliance with the sampling guidance was excellent and the laboratory received all samples within the sampling week in good condition and still on ice.

Analytical Procedures

Data/Analysis Technologies, Inc. in Plain City, Ohio, analyzed both sets of samples. This laboratory was formerly part of Triangle Labs of Dublin, Ohio, which had previously performed the analysis for a Wisconsin Paper Council sponsored study on nonylphenol and nonylphenol Ethoxylates. It had demonstrated the ability to separate the array of ethoxylate oligomers found in the nonylphenol ethoxylate formulations and quantitate both the nonylphenol metabolite and residual nonylphenol ethoxylate parent compounds used by the Michigan pulp and paper industry.

Nonylphenol was extracted by steam distillation (Texaco Method No. ST-38.34-94), *Method of Test and Standard Operating Procedure for Determination of Nonylphenol and Nonylphenoxyethanol in Environmental Water by Steam Distillation and High-Performance Liquid Chromatography*, and analyzed by HPLC on a Rainin Microsorb CN column. This method is described in detail in references 1 and 2. Data from the fluorescence signal were acquired on a HP 3500D A/D interface board using HP-G1250C ChemStation software.

Nonylphenol Ethoxylates were subjected to dual column extraction to remove ionic interference using Texaco Method No. ST-38-24-94, *Method of Test and Standard Operating Procedure for Determination of Alkylphenol Ethoxylates in Environmental Water by Extraction and High-Performance Liquid Chromatography.* This method is described in detail in reference 3.

QA/QC

All mills utilized pre-addressed, prepaid, overnight carrier labels with NCASI identified as the shipper. One mill in the study was asked to provide samples in triplicate, which were submitted blind to the laboratory and served as QA/QC samples. The QA/QC samples had a mean nonylphenol concentration of 2.9 µg/L with a range of 2.6 µg/L to 3.2 µg/L for the April samples, and a mean of 1.0 µg/L with a range of 0.71 µg/L to 1.3 µg/L for the January sampling. The nonylphenol ethoxylate results for these samples were not particularly useful for QA/QC purposes because five of the six samples were non-detect and the remaining sample was only slightly above the detection limit.

Previous investigators have shown that the maximum holding time prior to extraction for samples stored on ice is 14 days. In the present studies all samples were received within 24 hours of shipping and extracted within 1 week of receipt.

Nonylphenol

Six method blanks (1 liter of water) were analyzed and all were non-detect at the <0.03 µg/L detection limit. All three of the instrument blanks were also non-detect at the <0.03 µg/L level. There were five lab spikes of 1.5 µg of a nonylphenol/nonylphenol ethoxylate blend in 1 liter of water, which were extracted concurrently with the sample sets. The lab spikes had a recovery range of 66% to 119%, with a mean recovery of 89% at the 1.5 µg/L concentration level.

Nonylphenol Ethoxylates

Five method blanks (1 liter of water) were analyzed, and all were non-detect at the 2.0 µg/L detection limit. The laboratory made an analytical process change which impacted the detection limits between the April 1999 and January 2000 sampling periods. To alleviate HPLC column plugging problems, the lab reduced the sample volume from 1 liter to 0.1 liter, which effectively resulted in a tenfold loss of sensitivity as reflected in the detection limits shown in the table of results. All four instrument blanks were non-detect at the 0.2 µg/L level. There were four lab spikes of 50 µg of a nonylphenol ethoxylate commercial formulation in 1 liter of water. The recoveries ranged from 62% to 104%, with a mean recovery of 82%.

Data Analysis

Data from the two sampling programs were analyzed statistically for evidence that NP and NPE concentration and loading (i.e., effluent flow rate times concentration) had declined from April 1999 to January 2000. Evidence for such trends was examined using data from all mills, and also using data just from mills where product substitutions were successfully implemented by the time of the second sampling. Statistical analysis was also carried out to examine evidence that biological treatment reduces the effluent concentrations of NP and NPE.

To facilitate statistical analysis, all non-detect values were replaced by the reported detection limit and also by zero. Statistical results were essentially identical for both replacement techniques, so only the results for substitution with the detection limit are reported. Averages of triplicate results reported for Mill C were used in all statistical calculations.

The character of the data dictated that a *nonparametric* test be used for the analyses. First, it is unknown how differences in concentrations or loading are distributed statistically (e.g., normal, lognormal), and distribution fitting with such a small sample size is not very powerful. Furthermore, the data are *censored* in that there are non-detects reported. Furthermore, the detection limit for NPE changed by an order of magnitude between the two samplings. All these conditions, unknown distribution, censored data, and variable censoring level, indicate use of nonparametric methods. These methods are usually more powerful (able to detect a difference) than parametric methods when data from non-normal distributions are analyzed.

Levels of significance reported for test results are the probability that the reduction observed in the samples could have occurred by chance alone when there was no actual difference between the populations from which the two samples were drawn. Typically, levels of significance less than 0.05 are considered statistically significant.

All computations were carried out using the computer program Statgraphics® Plus version 2.1 distributed by Manugistics, Inc. of Rockville, Maryland. Details of the statistical analyses follow.

Trends in Concentration and Loading

The analysis for reductions in NP and NPE concentrations and loading between the two sampling periods was done using *paired* data. That is, for each mill the difference between the April 1999 value and the January 2000 value was computed, and subsequent statistical testing was applied to the 17 *differences*. Specifically, the null hypothesis was that the median difference was zero. The alternative hypothesis was that the median difference was greater than zero (i.e., the April 1999 values were larger than the January 2000 values). Testing was done for all mills and also for the subset of mills that had made successful product substitutions by the time of the January 2000 sampling.

The nonparametric test used, the *signed-rank test* (5), does not depend on any assumptions of the population, so lack of knowledge of the distribution of the data should not affect the outcome. Furthermore, because the test is based on ranks rather than actual values, substitution of a value (e.g., the detection limit or zero) for non-detects has little effect on the test's outcome. The signed-rank test is analogous to the *paired-t test*, the main difference being that, like other non-parametric tests, it looks for differences in the median rather than in the mean.

Effect of Treatment

Some effluent samples were not subjected to biological treatment prior to their collection, either because the mill discharged to a publicly owned treatment works or because biological treatment was not necessary to meet existing permit limitations. This afforded the opportunity to examine whether biological treatment causes reductions in NP and NPE effluent concentrations.

For this analysis, data from both sampling periods were pooled, for NP and NPE separately, into two groups: mills with biological treatment and mills without biological treatment. No logical pairing was possible in this analysis. Neither was there any utility in examining loading, because variation in effluent flow rate has a major effect on variation in loading but is essentially unrelated to whether biotreatment is provided or not.

The nonparametric test used to compare the two samples was the *rank-sum test*, sometimes called the *Mann-Whitney test* (5).

RESULTS

Concentration and loading data are presented below along with results of statistical analyses.

Concentration and Loading Data

Table 1 presents the analytical results for NP and NPE concentrations for the two samplings. Loading data are not presented in the table in order to preserve the confidentiality of the identities of the participants.

Table 1. MPPEC NP/NPE (Revised 02/18/00)

Baseline Studies run on 4/99 & Substitution Trials run on 1/00 (all values in µg/l)

Mill Code	NP 4/99	NP 1/00	NPE 4/99	NPE 1/00
A	ND < 0.03	0.8	0.24	ND < 2.0
B	ND < 0.03	ND < 0.03	2.51	2.0
C[a]	3.2	1.3	0.26	ND < 2.0
C[a]	2.9	1.1	ND < 0.2	ND < 2.0
C[a]	2.6	0.71	ND < 0.2	ND < 2.0
D	2.3	1.5	ND < 0.2	ND < 2.0
E[c]	5.4	3.5	61.4	350
F[c]	3.1	1.4	162	230
G	1.9	1.4	105	15
H	2.2	3.7	86	38
I	3.1	2.1	304	210
J[c]	33.3	10	397	1200
K	1.8	2.3	35.7	24
L	2.0	0.8	ND < 0.2	ND < 2.0
M	10.4	8.5	168	15
N	15.2	4.8	2.1	ND < 2.0
O	3.4	13	83.2	19
P	1.1	1.0	14.6	ND < 2.0
Q[c]	111	76.8	243	360

a) Triplicate samples.
b) Note: ND changed from < 0.2 µg/L in the April sampling to < 2.0 µg/L in the January sampling due to an analytical process change to reduce column plugging (went from 1.0 liter sample to 0.1 liter) thus a ten-fold loss of sensitivity.
c) Mills that did not have successful product substitution trials by the January sample date.

Table 2 summarizes the loading data. Loading was calculated by multiplying the reported concentration by the effluent flow rate reported for the day of sampling. Loading associated with indirect discharging mills is not included because these do not represent loading to the environment. Note that for both NP and NPE the lower ends of the ranges at both sampling times were calculated by replacing non-detects with detection limits. The actual loading could be as low as zero.

Table 2. Effluent Loading Ranges for NP and NPE (lb/day)

	April 1999		January 2000	
	Low	High	Low	High
NP	0.0004	1.2	0.001	0.4
NPE	0.004	11.7	0.006	8.2

Statistical Analysis of Concentration and Loading Trends

Table 3 presents levels of significance from statistical testing for decreases in NP and NPE concentrations and effluent loading between April 1999 and January 2000. Figures in ***bold italics*** indicate statistically significant reductions (i.e., $p<0.05$).

Table 3. Levels of Significance in Testing for a Decrease in Concentration

Chemical	Mills Included	Concentration	Loading
NP	All	***0.019***	***0.036***
	Substitutes in Place	0.147	0.117
NPE	All	0.388	0.139
	Substitutes in Place	***0.011***	***0.009***

Statistical Analysis of Treatment Effect

In a statistical comparison of biotreated effluents to those that were not biotreated, the concentrations of both NP and NPE were found to be significantly lower in the biotreated effluents ($p=0.0008$ and $p=0.003$, respectively).

SUMMARY

Out the 60 chemical products identified as containing NPE, 28 were replaced by acceptable alternatives. Two are non-process chemicals that do not reach a mill's wastewater stream, and are therefore not of environmental concern. Six are no longer sold to the pulp and paper industry and are therefore not of issue in our industry at this time. It was found that acceptable alternatives are not available at this time for the remaining 24 products. Although not specifically accounted for in the scope of this project, acceptability for substitution or elimination was based on a variety of criteria subject to individual mill need, primarily consisting of acceptability for economic benefit as well as process and product trials for substitution. This study was successful in demonstrating that a large number of substitutions of NPE are possible based on the substitution criteria of the individual member mill process needs. The ability for the member mills to voluntarily significantly impact an environmental concern was demonstrated well through this cooperative process.

Concentration and loading of NPE decreased significantly for mills that had successfully implemented product substitutions by January 2000. Additionally, concentration and loading of NP decreased significantly for all mills over the project period. In January, loading in effluents being discharged to the environment ranged from essentially zero for both compounds to less than a 1 lb/day for NP and less than 10 lb/day for NPE.

Every mill that successfully implemented a product substitution based on voluntary pollution prevention efforts prior to January 2000 either showed a reduction in NPE concentration or remained non-detect. Mills E, F, J, and Q were unable to substitute at this time because viable substitute products are not yet available. These mills are continuing to work with their suppliers to find alternatives. Due to various types of mills and treatment requirements, the effect of biological treatment was reviewed. Biological treatment of effluents appears to cause significant reduction of both NP and NPE**.**

Even though viable substitutes have not been developed for all products, this voluntary pollution prevention project has significantly reduced the loading of a chemical of concern to the waters of the State of Michigan.

Acknowledgements

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Michigan Pulp and Paper Mills

Company	Location	Type of Mill	Products	Output (tpd)	Employs
ABT Co., A Louisiana Pacific Co.	*Alpena*	*Integrated*	*S2S Hardboard*	*400*	*270*
American Fibrit, Inc.	Battle Creek	Integrated	Molded Wood Fiber Products for Autos		
Blue Water Fiber, LP	*Port Huron*	*Pulp*	*Recycled Deinked Market Pulp*	*220*	*29*
Celotex Corp.	L'Anse	Paper	Tile, Panel Board	270	
Converters Paperboard Co.	Rockford	Paper	Boxboard	100	
Crown Vantage, Inc.	*Parchment*	*Paper*	*Specialty Papers*	*400*	*350*
Crown Vantage, Inc.	Ypsilanti	Paper	Colored Papers	50	
Domtar, Eddy Specialty Papers	*Port Huron*	*Paper*	*Specialty Papers*	*280*	*325*
FiberMark, Inc.	Rochester	Paper	Filter Paper	18	
Fletcher Paper Co.	*Alpena*	*Paper*	*Specialty Papers*	*85*	*211*
Fox River Paper Co.	Vicksburg	Paper	Coated Offsets, Text Papers	125	
French Paper Co.	Niles	Paper	Specialty Papers	55	
Georgia-Pacific Corp.	Kalamazoo	Paper	Coated / Uncoated Communication Papers	400	300
Graphic Packaging Corp.	*Kalamazoo*	*Paperboard*	*Coated Recycled Paperboard*	*800*	*390*
Great Lakes Pulp & Fiber	Menominee	Pulp	Bleached Deinked Market Pulp	470	
Great Lakes Tissue Co.	Cheboygan	Paper	Dry-crepe, 1&2 Ply Sanitary Tissue	100	
International Paper Co.	*Quinnesec*	*Integrated*	*Kraft Market Pulp* *Coated Free Sheet*	*1,100* *1,000*	*570*
IPMC Corp.	Detroit	Paper	Lightweight MG, Specialty	175	
Kimberly-Clark Corp.	Munising	Paper	Specialties, Kimdura Synthetic Paper	98	
Manistique Papers, Inc.	*Manistique*	*Integrated*	*Newsprint, Printing & Converting Papers*	*350*	*160*
Mead Corp.	*Escanaba*	*Integrated*	*Coated Book & Publication Papers* *Kraft hardwood pulp*	*1,550* *80*	*1,500*
Menominee Paper Co.	*Menominee*	*Paper*	*MG Paper, Waxed Goods*	*75*	*158*
Michigan Paperboard Co.	Battle Creek	Paper	Combination Boxboard	340	
Packaging Corp. of America	*Filer City*	*Integrated*	*Semichemical Corrugating Medium*	*900*	*300*
Paperboard Div., Menasha Corp.	*Otsego*	*Integrated*	*Semichemical Corrugating Medium & Recycled Linerboard*	*800*	*236*
Plainwell Papers Co.	*Plainwell*	*Paper*	*Coated/Uncoated Book & Cover Base for Self Adhesive Labels*	*280*	
Rock-Tenn Co.	*Battle Creek*	*Paper*	*White Clay Coated & Lined Chip Board*	*370*	*187*
Rock-Tenn Co.	Otsego	Paper	Chip and Board	250	
SAPPI Fine Paper, NA / S.D. Warren	*Muskegon*	*Integrated*	*Machine Coated Book/Cover (Fine Paper)*	*700*	*750*
Simplex Products Division	Constantine	Paper	Chipboard, Test Liner	150	
Simplicity Pattern Co., Inc.	Niles	Paper	Pattern Tissue & Interleaving Papers	73	
Smurfit-Stone Container Corp.	*Ontonagon*	*Integrated*	*Semichemical Corrugating Medium*	*800*	*263*
White Pigeon Paper Co.	*White Pigeon*	*Paper*	*Boxboard*	*200*	
			Total Daily Production in Michigan	**12,799**	**Tons**

Source: 1999 Lockwood Post Directory
MPPEC member in italics.

photo by Dan Urbanski www.quietlywild.com

MICHIGAN 5 Pulp & Paper Pollution Prevention Program

For more information about this partnership, contact the
Michigan Department of Environmental Quality
Environmental Assistance Division
P.O. Box 30457
Lansing, Michigan 48909-7957
1-800-662-9278
or contact the
Michigan Pulp & Paper Environmental Council
PMB 187, 2843 East Grand River
East Lansing, Michigan 48823.

Information about this project can be obtained

through the MDEQ Internet Home Page at:
www.deq.state.mi.us/ead/p2sect/p5.html

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