

Pulping effluents in the aquatic environment

Data compilation and scientific panel report

E. J. Eysenbach, L. W. Neal, and J. W. Owens

An independent and international panel of environmental toxicologists and scientists found that fully treated pulping effluents from well managed bleached mills have little or no adverse impact on receiving waters.

Recent environmental concerns in Sweden, specifically addressing aquatic damage in the Baltic Sea, have renewed the attention being given to pulp mill effluents, especially those containing bleaching compounds. The Swedish observations have been widely reported, and various environmental and regulatory groups in the United States have questioned whether pulp bleaching practices in North America are compatible with healthy aquatic ecosystems downstream of pulp mills.

Procter & Gamble, with the counsel and assistance of the National Council for Air and Stream Improvement (NCASI), brought together an internationally recognized scientific panel to address the impact of pulp mill effluents upon the aquatic environment. Their report has brought significant insight and objective assessment to this issue.

The panel

In general, the purpose in convening a scientific advisory panel is to obtain an outside and independent assessment of an issue, question, or body of data. The Procter & Gamble Co. has frequently used such groups to review product safety and testing programs. Therefore, the value of the panel's deliberations rests on the selection of independent scientists with (a) strong credentials in relevant fields, (b) an objective approach, and (c) skills both to share their understanding and to work toward consensus. The company's role is to provide the panel charge and the body of data. Although company representatives observe the panel discussions and may occasionally ask or respond to questions, they do not try to influence the panel's conclusions.

Members of the Panel on Pulping Effluents and aspects of their expertise are shown in Table I. Because of the issues to be addressed, the group's expertise was strongly

I. Members of the scientific panel and their related expertise

Paul M. Mehrle, Jr. Panel Chairman Columbia, Mo.	Chlorinated pesticide toxicity
Kenneth L. Dickson University of North Texas Denton, Tex.	Freshwater aquatic toxicology
Rolf Hartung University of Michigan Ann Arbor, Mich.	Animal and environmental toxicology
Robert J. Huggett Virginia Institute of Marine Science College of William and Mary Gloucester Point, Va.	Estuarine aquatic toxicology
Donald J. McLeay Don McLeay and Associates, Ltd. Vancouver, B.C., Canada	Aquatic toxicology and pulping effluents
Aimo Oikari University of Joensuu Joensuu, Finland	Aquatic toxicology
John B. Sprague J.B. Sprague Assoc. Ltd. Guelph, Ont., Canada	Aquatic toxicology, kraft pulping

weighted toward aquatic toxicology. Much work on this subject has been conducted outside of the United States, making it appropriate to have assembled a group of international composition.

Data compilation

The compilation of all publications and studies which might be relevant to pulping effluents in the aquatic environment was a monumental undertaking involving review of over 2000 published and 250 unpublished papers and documents. Sirrine Environmental Consultants was asked to compile the information, to prepare summaries and bibliographies, and to provide an organized set of pertinent information for the panel members.

Each member was given a seven-volume set of the

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summaries with original documents attached.

The information was assembled under four subcategories:

1. Biological impact characteristics
2. Effluent characteristics and treatment
3. Fate and transport of effluent components
4. Pulping process chemistry.

Some documents were of broad application and were included in an Overview section.

In addition to the published material, the data compilation also included extensive unpublished field and laboratory studies. Pulp producers throughout the United States voluntarily provided the studies associated with their effluent discharges. Although some of these studies were conducted in response to agency requests, many were conducted voluntarily by the industry. The consultant prepared brief summaries and extracted the study conclusions from all of the industry reports for inclusion in the database. The full reports were also made readily available to the panel.

Scientific panel charge

The objective for any expert panel review needs to be very specific, and a charter stating a limited number of carefully structured questions is given to the panel for their consideration. The members are asked to consider the questions in light of their experience and of the data or information provided. The following formal charge or set of questions was given to the Panel on Pulping Effluents:

- Various methods and end points have been used to assess the impact of pulp mill effluents on the aquatic environment. Diversity of species, population, reproduction, growth rate, histopathology, enzyme induction, blood chemistry, and other parameters have been used to measure the health of aquatic ecosystems.

Which of these methods and end points are most useful for evaluating the compatibility of wastewaters with a healthy aquatic community?

What data are necessary to establish that such compatibility exists?

- Some investigators have concluded the total amount of chlorinated organic compounds is a major factor in the toxicity of bleached pulp mill effluents.

Are the existing data sufficient to support a conclusion that chlorinated organics from untreated pulp mill effluents are largely responsible for the adverse environmental effects observed in the Baltic Sea and elsewhere?

Effluents from many North American bleached pulp mills contain some chlorinated organic compounds. Are the data describing the environmental effects of these effluents and the conditions under which they are discharged adequate to support the conclusion with the maintenance of healthy aquatic communities?

In the absence of chlorinated organic chemicals, what adverse effects might be expected from untreated or primary-treated pulp mill effluents (e.g., from chemi-thermomechanical pulp production)?

- Some studies have reported an association between pulp

effluents from Swedish bleached pulp mills and adverse effects on the aquatic community in the Baltic Sea. Other studies, conducted on effluents and receiving waters of North American mills, indicate that bleached pulp effluents can be discharged without adverse impact on the aquatic environment.

In light of the difference between the mills and the environmental situations in Sweden and North America, discuss the relevance of the Swedish findings to pulp mills in North America.

Discuss the importance of effluent quality and receiving water conditions in explaining these apparently different findings.

After reviewing the database for several weeks, the panel convened for 3½ days of intense discussion. They worked systematically through the questions and prepared a draft report representing their consensus views. Over the next several weeks they completed the final report through reviews by correspondence with the chairman.

Scientific panel conclusions

The scientific panel concluded it is very difficult to generalize about the impact on the aquatic environment. Controlling variables appear to be the quality and quantity of the effluent relative to the physical, chemical, and biological characteristics of the receiving waters. It is not possible to simplistically characterize the potential or impact with a single parameter such as chlorinated organics.

Additional key conclusions were as follows:

- Appropriately treated effluents from well designed and operated North American bleached kraft mills show little or no adverse impact on aquatic life in the receiving waters.
- Based on North American studies, acute or chronic effects are unlikely to occur when effluents which have received effective biological treatment are diluted to concentrations of 5 - 10%.
- The available data show no marked difference in toxicity to aquatic life of bleached versus unbleached pulp mill effluents.
- The available data do not support a conclusion that chlorinated organic compounds discharged from bleached pulp mills are largely responsible for the damage to the aquatic environment observed in Sweden.
- Given the differences in processes, effluent treatment practices, and characteristics of the receiving waters, it is inappropriate to directly extrapolate from the Swedish experience any conclusions about the North American situation.
- In the panel's judgment, a tiered risk assessment approach involving the integration of information from laboratory and field investigations would be an effective means of establishing cause-effect relationships.

Follow-up

The company has made the panel report widely available. It has been distributed broadly to members of industry, to some agency representatives, and to other scientists in

related fields. A copy may be obtained by contacting any of the authors of this paper.

In addition, NCASI has published the data compilation summaries and bibliographies as Technical Bulletins No. 572 and No. 573. We hope this summary, especially the information previously unpublished, will be useful to the industry and to regulators in making future decisions. We believe the panel review has brought much needed perspective and understanding to the data concerning bleaching effluents and chlorinated organics.

Although the conclusions of the review reflect favorably on the results obtained with well designed and operated pulp mills, the pulp and paper industry continues to seek ways to further diminish the potential for adverse impact on the environment.

Procter & Gamble and other members of industry are committed to the protection of the environment. For perspective, chlorinated organics measurements were taken as part of the "104-mill study" (expanded dioxin database by industry-EPA agreement). The median for U.S. pulp mills with biological treatment was an effluent discharge of 2.2 kg AOX/ton of bleached pulp produced, which is fairly close to the Swedish objective of 1.5 kg AOX/ton by 1992. Not only has secondary treatment assured lower levels of AOX, but also the industry has made a large investment to understand the generation of chlorinated organics and to investigate alternative process technologies. Many companies are making such process changes, within the constraints of product attributes such as pulp strength, even though discharged levels of chlorinated organics are relatively low.

In addition to process investigations, the industry environmental research arm, NCASI, has taken study recommendations of the scientific panel into account in planning future studies. They plan to develop a better understanding of biomarkers and to help industry to better integrate field and laboratory studies using multiple end points. These will include data on the health of in-stream biota, bioassay and biomarker data, and information on the presence, fate, and significance of specific chemicals. In addition, studies are underway at NCASI to better characterize the chemicals that comprise AOX in pulp mill wastewaters and to improve scientific understanding of the fate and significance of these chlorinated chemicals in the environment.

To summarize, the Panel on Pulping Effluents reviewed and assessed the available data on the impact of pulping effluents on the aquatic environment and concluded that effluent from pulp mills can be compatible with a healthy environment. The industry, however, is responding to public concerns in the area of discharge of chlorinated organic materials. This is evidenced both in efforts to reduce the generation of chlorinated organics and to continue to improve techniques to assess environmental impact. □

Received for review Feb. 1, 1990.

Accepted April 13, 1990.

Presented at the TAPPI 1990 Environmental Conference.

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