

Elemental Chlorine-Free (ECF):

What the Experts Say

January 1997

Elemental Chlorine-Free (ECF) bleaching — based on chlorine dioxide— is the superior choice for pulp and paper manufacture. New science, a proven environmental track record, and strong market demand demonstrate that ECF is without rival in terms of pollution prevention, resource conservation, and product quality.

"Chlorine dioxide is a solution to dioxin and other persistent, bio-accumulative, toxic substances in mill waste water." 1

Dr. Robert Huggett, U.S. EPA Assistant Administrator, Research & Development

"ECF is an excellent example of enlightened industrial response to an environmental concern and should be embraced by the environmental community." 2

**Professor Don Mackay,
University of Toronto Institute
for Environmental Studies**

"We were especially pleased that the 'best available technology' selected for the papergrade kraft mills was an Elemental Chlorine-Free (ECF) technology." 3

**Carol Browner, U.S. EPA
Administrator**

Chemistry

While chlorine dioxide has "chlorine" in the name, its chemistry is very different from that of chlorine gas...

- Chlorine gas (Cl_2) is made up of two chlorine atoms. Chlorine dioxide (ClO_2) is composed of one chlorine atom and two oxygen atoms. It is roughly 50 percent oxygen by atomic weight.

- During the pulp bleaching process, chlorine tends to combine with lignin (the substance that holds the wood fibres together) to create chlorinated organics that end up in mill waste water.

In contrast, chlorine dioxide typically breaks apart the lignin, leaving behind organic compounds that are water soluble and very similar to those occurring naturally in the environment. 4

"The substitution of chlorine dioxide for elemental chlorine in the first stage of the bleaching process reduces the discharge of chlorinated organic compounds." 5

Paper Task Force Report

Dioxin Elimination

The science is compelling: the ECF process prevents pollution. It virtually eliminates dioxin in mill waste water...

"...pulp and paper industries in both countries are converting to elemental chlorine-free technology and secondary effluent treatment, resulting in a significant reduction in adsorbable organic halogen (AOX) effluents and approaching the virtual elimination of dioxin and furans." ⁶

International Joint Commission

"...the recent effort of the industry to deal with the dioxin problem can be regarded as a salutary example to other industries..." ⁷

Barry Commoner et al., Center for the Biology of Natural Systems

Totally Chlorine-Free (TCF)

bleaching, based on such chemicals as ozone and hydrogen peroxide, was once promoted as environmentally superior to the ECF process. Yet, ...

"Research carried out at universities in Gothenburg and Stockholm showed that effects of waste water from bleaching plants on water organisms is the same, irrespective of the bleaching method. And the National Swedish Environment Protection Board refuses to classify the chlorine free method as more environmentally friendly."

Svenska Dagbladet, Stockholm, Sweden

"There is no appreciable environmental difference between TCF and ECF" ⁹

International Institute for Environment and Development

Eco-system Recovery

With the virtual elimination of dioxin in mill waste water, the U.S. EPA has recorded significant improvements in aquatic eco-systems...

•Since 1990, environmental and health authorities in 13 states have lifted fish consumption advisories for dioxin on a total of 17 waterbodies downstream of U.S. pulp mills. ¹⁰

•According to an analysis of U.S. EPA and state environmental and health authority data, dioxin advisories on waterbodies downstream of U.S. pulp mills now number only 18—about one percent of the nation's total 1,740 waterbodies under all types of fish consumption advisories. ¹¹

•The U.S. EPA predicts that all remaining dioxin advisories downstream of U.S. pulp mills should be lifted following completion of the industry's conversion to ECF bleaching. ¹²

"Contamination of fisheries by dioxin/furan releases in pulp mill effluents has stopped and significant environmental improvements achieved. Approximately 46 percent of commercial fisheries previously closed by dioxin contamination in coastal areas of British Columbia have now been reopened." ¹³

Environment Canada and Health Canada

Resource Conservation

ECF pulp provides for strong paper products and its manufacture places a lower strain on precious forest resources...

- ECF bleached pulps have a higher tear and fiber strength compared to TCF pulps. ¹⁴

"ECF bleaching allows production of kraft pulps that meet the highest requirements with respect to strength, brightness, brightness stability, cleanliness, etc." ¹⁵

Jan Rennel, Jaakko Pöyry Consulting AB, Stockholm, Sweden

- Studies indicate that TCF pulp manufacture may increase wood consumption up to 10% more than an ECF process. ¹⁶

"Wisaforest claims it requires 6% more wood to make a ton of TCF pulp than ECF pulp. This was confirmed at the Enocell mill. All of the mills that produced any TCF pulp noted its lower strength properties." ¹⁷

Gerry Boudreau, TAPPI Journal

Market Response

Demand for ECF pulp has dramatically increased over the last six years...

- ECF pulp production in the U.S. has increased by almost 2,000 percent since 1990. It now commands almost 40 percent of the U.S. bleached chemical pulp market. ¹⁸

- Worldwide, ECF production is expected to top 34 million tonnes in 1996. That's nearly 50 percent of the world market. TCF production, in contrast, has stalled at 7 percent of the world market and is less than one-half of one percent of the U.S. market. ¹⁹

"The decision for our concept [bleaching strategy] was guided by the expectation that with ECF we would find a market for 100% of our capacity and that this would not apply to TCF." ²⁰

Dr. Karl Heinz Haller, Managing Director, Production/Research & Development, Zellstoff Pöls AG, Austria

"We have found that our ECF sequences give the best results when it comes to effluent, pulp quality, and economy." ²¹

Erik Wikberg, MoDo Paper AB, Sweden

"Paper producers and converters are abandoning TCF, using ECF instead..." ²²

Hans Burmeister, Marketing Director, Södra Cell AB, Sweden

The Alliance for Environmental Technology is an international association of chemical manufacturers and forest product companies dedicated to improving the environmental performance of the pulp and paper industry. For more information, please call LET at 1-900-999-PULP or visit AET's web site on the Internet at <http://aet.org>.

Notes

- 1 Dr. Robert Huggett, testimony given at U.S. Environmental Protection Agency's public hearing on the proposed Cluster Rule for the pulp and paper industry, Washington, DC, Feb. 10, 1994.
- 2 Don Mackay, "A Perspective on the Sources and Fate of Organochlorines," paper presented at the Organochlorine Consortium meeting, Toronto, ON, June 1994, p.5.
- 3 Carol Browner, "The Cluster Rule: A Step Forward," PaperAge, July 1994, p. 26.
- 4 Dahlman et al., "On the Nature of High Molecular Weight Effluent Materials from Modern ECF- and TCFBleaching," Proceedings, 1994 International Pulp Bleaching Conference, Vancouver, BC, June 1994.
- 5 Paper Task Force Report, Paper Task Force Recommendations for Purchasing and Using Environmentally Preferable Paper," Project Synopsis, Dec. 1995, p. 14.
- 6 International Joint Commission, Eighth Biennial Report on Great Lakes Water Quality, June 6, 1996, p. 30.
- 7 Commoner et al., "Dioxin Fallout in the Great Lakes: Where It Comes From; How to Prevent It; At what Cost (Summary)," Center for the Biology of Natural Systems, June 1996.
- 8 "Chlorine-free Pulp is Not Better for the Environment," Svenska Dagbladet, Sept. 23, 1996, (translated from the Swedish).
- 9 "A Changing Future for Paper," International Institute for Environment and Development, commissioned by the World Business Council for Sustainable Development, 1996, p. 7.
- 10 U.S. EPA National Listing of Fish and Wildlife Consumption Advisories, June 1996, and state environmental and health authority data.
- 11 Ibid.
- 12 U.S. EPA, Regulatory Impact of Assessment of Proposed Effluent Guidelines and NESHAP for the Pulp, Paper, and Paperboard Industry, Nov. 1993, EPA-821-R-93-020.
- 13 Environment Canada and Health Canada, Chlorinated Substances Action Plan: Progress Report, Oct. 1996.
- 14 Ek et al., "The Role of Metal Ions in TCF Bleaching of Softwood Kraft Pulps," Proceedings, 1994 TAPPI Pulping Conference, San Diego, CA, Nov. 1994.
- 15 Jan Rennel, Jaakko Pöyry Consulting AB, Stockholm, Sweden, "TCF — An Example of the Growing Importance of Environmental Perceptions in the Choice of Fibres," Nordic Pulp and Paper Research Journal, No. 1/1995, p. 32.
- 16 Douglas W. Reeve, "Technology Prospects for Elemental Chlorine Free (ECF) Bleaching, paper presented at the American Forest and Paper Association's 1995 Annual Paper Week Conference, New York NY, March 13, 1995, p.5
- 17 Gerry Boudreau, "Pulp Safari — Finland the Information Hunt," TAPPI Journal, Sept. 1996, p.78.
- 18 AET, "Trends in World Bleached Chemical P1 Production: 1990-1994 March 1996, p. 2.
- 19 Ibid.
- 20 Dr. Karl Heinz Haller, Zellstoff Pöls AG, Austria, "A Decision Favor of ECF: What Decision in the Germs Speaking Area!" Proceedings, 1996 International Non-Chlorine Bleaching Conference, Orlando, FL, March 1996, p.10.
- 21 Ahlenius, L., Alftan C., Uhlin, L., and Wikberg, E., MoDo Pa AB, Sweden, "Closing Up a TCF Bleach Plant Proceedings, 1994 International Pulp Bleaching Conference Vancouver, BC, June 1994.
- 22 Hans Burmeister, Marketing Director, Sodra Cell AB, Sweden Responze From Sodra Cell, Autumn 1995, p.