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Elemental Chlorine-Free (ECF):

What the Experts Say

Elemental Chlorine-Free (ECF) bleaching -- based on chlorine dioxide -- is the superior choice for pulp and paper manufacture. The 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, former 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, former member of the International Joint Commission,
the Great Lakes Science Advisory Board and its Virtual Elimination Task
Force**

"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, former U.S. EPA Administrator

To find out more about what other experts say on ECF, choose from the following topics:

- [Chemistry](#)
- [Dioxin Elimination](#)
- [Eco-System Recovery](#)
- [Resource Conservation](#)
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Chemistry While chlorine dioxide has "chlorine" in its 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 fibers 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

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

"A notable accomplishment occurred when the pulp and paper industry changed its process for pulp bleaching by substituting chlorine dioxide for elemental chlorine. This substitution virtually eliminated the production of dioxins from pulp and paper mills." [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 trumpeted 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 plant 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." [8]

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 and Environmental Canada 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 21 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]

"Releases to effluents from the pulp and paper sector have been reduced to below the measurable concentration level as per the [Canadian Environmental Protection Act] regulations, which in keeping with the objective of virtual elimination. For this sector, for release to water, no additional work is recommended."

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

Environment Canada and Health Canada [14]

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.

"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 2.5 % more than an ECF process. [16]

"The magazine paper makers (LWC) stated they required 10% more additional softwood kraft when running TCF and TCF product had inferior reinforcing properties (~10%)." [17]

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

- ECF pulp production in the U.S. has increased by more than 2,000 percent since 1990. It now commands 75 percent of the U.S. bleached chemical pulp market. [\[18\]](#)
- Worldwide, ECF production is expected to top 53 million tons in 2000. That's 2/3rds of the world market. TCF production, in contrast, has stalled at 6 percent of the world market and remains less one percent of the U.S. production. [\[19\]](#)

"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." [\[19\]](#)

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

- Former TCF mills in Germany and Sweden are converting to ECF production to meet market demand. [\[20\]](#) [\[21\]](#)
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Notes

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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 TCF-Bleaching," Proceedings, 1994 International Pulp Bleaching Conference, Vancouver, BC, June 1994.
5. Paper Task Force, "Paper Task Force Recommendations for Purchasing and Using Environmentally Preferable Paper," Project Synopsis, Dec. 1995, p. 14.
6. International Joint Commission (IJC). 10th Biennial Report on Great Lakes Water Quality. July, 2000
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 the 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 (NLFWCA), June 1996, and state environmental and health authority data.
11. Ibid.
12. U.S. EPA, Regulatory Impact Assessment of Proposed Effluent Guidelines and NESHAP for the Pulp, Paper, and Paperboard Industry, Nov. 1993, EPA-821-R-93-020.
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14. Environment Canada and Federal and Provincial Task Force on Dioxins and Furans. *Dioxins and Furans and Hexachlorobenzene Inventory of Releases*. A report prepared for the Federal-Provincial Advisory Committee for the Canadian Environmental Protection Act (CEPA-FPAC). January 1999.
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17. Bradley, M., "Why Would Pulp and Paper Makers Consider Integrating Life-Cycle Assessment Into Their Businesses." 1998 Paptac Annual Meeting. Montreal, Quebec.

18. AET Pulp Production Report
19. Dr. Karl Heinz Haller, Zellstoff Pöls AG, Pöls, Austria, "A Decision in Favour of ECF: What a Decision in the German-Speaking Area!" Proceedings, 1996 International Non-Chlorine Bleaching Conference, Orlando, FL, March 1996, p. 10.
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