BULLETIN OF POLLUTION PREVENTION

no. 3 Great Lakes United--a binational coalition for the Great Lakes/St. Lawrence ecosystem fall 1991

In the Beginning: Zero Discharge in Pulp and Paper

by Gord Perks, Greenpeace

If the zero discharge effort is ever to make serious inroads in the Great Lakes Basin, it will probably start in the region's pulp and paper mills. Paper-making is the largest source of persistent toxic chemicals directly discharged to the Lakes. These chemicals are almost entirely *organochlorines*, which are created by the use of chlorine compounds to bleach processed wood, called *pulp*, to make it whiter.

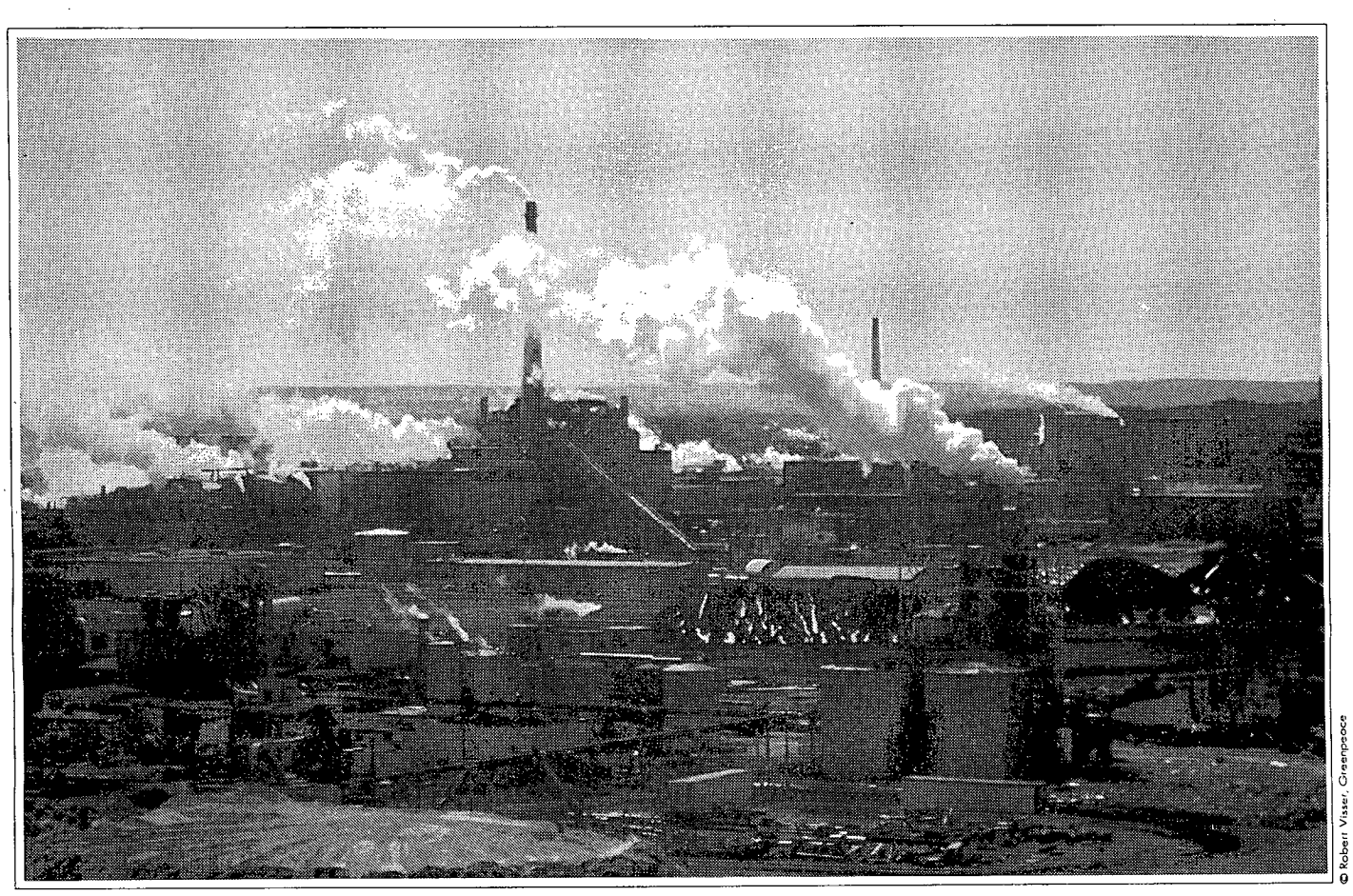
Little change has taken place in Basin pulp and paper mills so far. The E.B. Eddy mill in Espanola, Ontario, has announced plans for a pilot project that will substitute ozone, a form of oxygen, for chlorine in the bleaching process. The mill was a pioneer in the 1970s of a process that bleaches pulp with oxygen in a first stage to reduce the need for chlorine in later stages.

The Red Rock mill in Domtar, Ontario, which is financially troubled, has been running tests on bleaching with hydrogen peroxide instead of chlorine. However, little of Red Rock's pulp production is bleached, although, because it is mixed with other, unbleached pulps, the bleached output is a crucial component of the mill's overall operation. At 50 tonnes a day the mill's bleached production scarcely compares to the many pulp mills that bleach 1000 tonnes daily. Accordingly, the Red Rock mill may not be able to find economies of scale for the new technology. Environment Canada listed the mill as a zero discharge project at the 1991 International Joint Commission's Biennial Meeting.

There is only slightly more promising news elsewhere in North America. The Howe Sound Pulp and Paper mill at Port Mellon, British Columbia, has installed a system that allows operators to omit the use of chlorine dioxide. This compound is rapidly replacing pure chlorine as the pulp-makers' bleach of choice because it produces fewer organochlorine by-products. Howe Sound's first batch of chlorine-free pulp was produced in late October for sale to companies in Germany, where demand for chlorine-free papers is becoming very strong. A Union Camp mill currently under construction in Franklin, Virginia, will allow use of zero discharge production processes. Both projects will provide an example for Great Lakes pulpers.

The disappointing progress toward zero discharge in the Great Lakes pulp and paper industry as a whole is distinct from its progress in lowering its level of discharges. Great Lakes mills have reduced their collective release of persistent toxic substances by almost half from an estimated high of 600 million pounds a year in 1986. However, this progress can obscure the crucial issue in pulp and paper toxic pollution: there is no need for *any* organochlorine discharges because there is no economic or technical need for chlorine in bleaching.

Much of the improvement in the industry's discharge levels is due to investment in oxygen and other "pre-bleaching" technology. This investment will be useful for eventual zero-discharge production. The industry is also making large investments in end-of-pipe discharge-reduction technologies such as the construction of "aerated lagoons." The lagoons substantially improve the quality of effluent for a number of elements of pulp and paper-making discharge, but estimates of their ability to reduce discharged organochlorines range from a mere 20 percent to a still-insufficient 50 percent. In any case, only one third of that reduction is truly eliminated, in the form of conversion to relatively neutral salts. The other two thirds is merely transferred to air, via evaporation, and to land, via absorption into lagoon sludge, which is eventually landfilled, land "spread" or incinerated.



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The Proctor & Gamble and James River pulp and paper mills, Green Bay, Wisconsin, 1987

For forty years the most significant (and organochlorine-producing) segment of the pulp and paper industry--"kraft" pulping, which accounts for almost 75 percent of Great Lakes pulp production--has marketed its product on the basis of virtually one quality: brightness. Kraft pulpers are extremely reluctant to jump into chlorine-free production because all chlorine-substitution processes produce less-bright pulp. There are a number of methods available to minimize and even eliminate this problem, and European makers are fully embracing the effort to do so, but the North American industry is stubbornly resisting pressure to join them.

This is very unfortunate, since it is so unnecessary. Because the European example has been unconvincing to both pulp and paper makers and higher levels of government on this continent, Greenpeace hired an economist to analyze the economic impacts of implementing chlorine-free processes in Great Lakes pulp and paper mills. The study, currently in the last stages of review by professional peers, concludes that there would be no net economic harm to the industry. Some mills would be shut, but this would be the result of ongoing concentration in the industry, the trend toward integrated mills, and the current marginal status of many mills. On the plus side, the industry would be in a good position to compete in the European market for chlorine-free paper products.

European Advances

The pace of movement toward zero discharge in North America's pulp and paper industry has been snail-like, but tremendous progress has been made in Europe. Its example is pointing the way for more sweeping changes on this continent. Sweden's ASPA mill and Spain's ENCA operation already produce non-chlorine-bleached kraft pulp acceptable for almost every use. Those plants are just the tip of the iceberg. Virtually the entire European pulp and paper industry is in the process of long-term planning for conversion to chlorine-free production

The ASPA mill pre-bleaches pulp with oxygen and bleaches with hydrogen peroxide in a process, known as the Lignox system, that produces no organochlorine byproducts. The mill's design allows further bleaching with chlorine dioxide, but apparently ASPA operators are now regularly foregoing this stage in order to capture Europe's growing chlorine-free markets. ASPA's kraft output is used for traditional paper products such as office and magazine papers. ENCA's mill uses a slightly different hydrogen peroxide system to produce chlorine-free kraft "fluff," which is used to make diapers and coffee filters. A second Swedish mill has begun to convert to the Lignox system and others have reportedly tested it.

In a recent development, Finnish pulp and paper makers appear poised to move wholesale into a combination of hydrogen peroxide and "enzyme" pulp bleaching. Although it is chlorine-free, biobleaching, as enzyme bleaching is also called, has not received endorsement by environmentalists (and is not likely to) because it involves genetic engineering. There is no way to know in advance the effect of discharging to water hundreds of thousands of pounds of man-made biological chemicals designed to attack the common organic structures found in wood. With other processes already developed or in development with environmental effects that are both known and treatable, there is no need to take risks with genetically engineered materials.

European Market

Leaving aside the more substantial interest in environmental affairs on the part of European governments, the principal reason for Europe's progress toward zero-discharge pulp and paper making lies in a change in attitude by the continent's paper consumers. For example, virtually the whole of the gigantic German magazine publishing industry has asked suppliers to provide a chlorine-free version of the lightweight, coated paper used in slick magazines like *Time* magazine here in the United States. Germany is even planning import restrictions on chlorine-bleached pulp.

Progress in Germany was not achieved without some public prodding, however. A number of groups and public figures played a role in the current anti-chlorine climate in that country. One of Greenpeace's more successful efforts was the printing of 300,000 copies of a magazine called "Das Plagiat" ("The Plagiarism") in close imitation of Germany's most popular weekly news magazine, *Der Spiegel*. Greenpeace distributed copies all over Germany to prove that chlorine-free processes could produce the sophisticated paper used in such magazines. Greenpeace then moved a leftover roll of that paper (weighing four tonnes) into the lobby of the headquarters of *Der Spiegel*'s owners until the company pledged to make every effort to move to the use of chlorine-free paper.

In Sweden, Austria, and the United Kingdom environmental groups have successfully used consumer pressure on retail products such as coffee filters and diapers as a lever to change industry practices. As a result, debate in the European pulp and paper industry has shifted away from whether a firm can afford to switch technology to whether it can afford not to.

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North American Market

A few Canadian firms that sell to Europe--the biggest are Howe Sound Pulp and Paper, Fletcher Challenge, and MacMillan-Bloedel--are under pressure to eliminate chlorine. Oddly enough, most of these firms are located all the way across the country, in British Columbia, due to the kinds of trees found in western Canada.

But the vast majority of the pulp produced in the Great Lakes region is sold to the American market, which unfortunately has almost entirely neglected the issue of asking for chlorine-free products. The few consumer items marketed in North America on the basis of being chlorine-free (for example, the Loblaws supermarket chain's "green" line of diapers, hygienic pads, coffee filters and other items) are in fact often free only of pure chlorine. They are bleached with chlorine dioxide.

Although public and corporate demands have not yet been strong enough to have a significant impact on the thinking of North America's pulp and paper makers, other forms of market pressure may soon help solve the problem. The majority of bleached kraft pulp has traditionally been sold to paper companies as a raw commodity; producing mills have had little idea whether the pulp would be used for photocopy or tissue paper. This has meant that the pulp had to be both of great strength and of great brightness, even though only a tiny percent of the products made from kraft pulp needs both qualities.

But paper markets are beginning to segment, and pulps are now more frequently being made to have specific properties. This market fragmentation may allow some producers out of the strength/brightness dilemma, permitting them to move away from chlorine for pulps where there is little disadvantage to doing so. With some jiggering of processes and management, this can include most pulps. The two Great Lakes mills that are investigating chlorine-free pulp production belong to integrated companies that make both pulp and paper, allowing easier coordination of the two kinds of manufacturing.

Paper-Making

There are five basic stages in the production of paper products:

- Turning harvested wood into chips;
- Milling chips into pulp, either mechanically or chemically;
- Bleaching pulp to make it whiter;
- Converting pulp into various grades and shades of paper; and
- Making paper into a finished product.

The first three stages are carried out in pulp mills, the fourth in paper mills (sometimes the two kinds of mills are integrated into single operations), the fifth by printers and packagers. Each of these stages (and the hidden sixth step of disposal after use) has significant environmental costs, but it is bleaching that produces the greatest load of persistent toxic chemicals.

The mechanical pulping process involves steaming or grinding the chips, producing pulp with short (and therefore weak) fibres that are not very white. Because they retain a large amount of a wood substance called *lignin*, a glue attached to wood's white cellulose fibres, mechanical pulp yellows with exposure to light. Mechanical pulping accounts for about 5 percent of world pulp production.

The chemical pulping process involves boiling (*cooking* in industry parlance) wood chips in either sodium sulphite or sodium sulphate. Both processes produce pulps with longer (and therefore stronger) fibres than mechanical pulps, and both do a good job of removing lignin.

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Great Lakes effluent inflow at a Canadian pulp and paper mill, 1990

Sulph*ite* pulp, which makes up about 7 percent of the world market, is whiter than sulphate pulp when it enters the bleaching operation. Sulph*ate* pulp, commonly called *kraft* pulp, from the German word for "strong," is, logically, much stronger. Kraft pulp's strength allows it to be used for almost any product. It can also be made from softwood trees, which other processes find more difficult to convert into strong pulp. For these and other reasons, kraft pulp is far and away the most popular pulp sold, accounting for 77 percent of the world market.

The drawback of kraft pulping is that sulphate cooking darkens it. The pulp can be used as is for brown paper bags and cardboard boxes, but for most uses it must be heavily bleached. Packaging, magazine and other printing paper, and even consumer products such as tissue paper and diapers are some of the products made from bleached kraft pulp. Ninety percent of kraft pulp is bleached.

A third form of chemical pulping, *dissolving pulping*, which accounts for about 7 percent of the world market, modifies sulphite and kraft pulping processes to produce an almost pure form of cellulose used to make such unlikely products as cellophane and rayon. However, this requires the most intense bleaching of all the pulping processes.

Paper-Making Discharges

The total discharge of organochlorines into the Great Lakes from pulp and paper plants is estimated by Greenpeace researchers at about 350 million pounds per year as of late 1990. No official figures are available because only Canada has ever compiled statistics on pulp and paper discharges of organochlorines as a whole. In the United States paper makers need only report the discharge of the more notorious organochlorines, such as dioxin.

In the pulping process chlorine combines with unwanted organic material in pulp to form more than a thousand compounds, most of them foreign to nature. Only 300 of these chemicals have been studied; several hundred components of paper-making effluent therefore remain of unknown composition and effects. This is particularly disturbing because many of the compounds studied so far have turned out to be both persistent in the environment and toxic in extremely small quantities. Dioxin is only one of many paper-making by-products of this type. Most of the persistent toxic chemicals banned in the last few years are organochlorines, including DDT, PCBs, chlordane, and toxaphene.

It should not be forgotten that many if not most of the elements of paper-making effluent can be found in very small quantities in the paper product. When this paper is used to contain food, as milk cartons are, this fact becomes a serious concern for human health.

Non-Chlorine Bleaching

Bleaching whitens pulp by removing or altering lignin and a few other substances found in wood. Lignin has two negative qualities for paper-makers: it is yellow, and it gets darker when exposed to light. Chlorine and its compounds attack only the lignin and other substances, leaving the cellulose fibres untouched. Unfortunately, all non-chlorine bleaching chemicals--generally oxygen, ozone, or hydrogen peroxide--attack the fibre as well as the lignin, weakening the pulp.

Non-chlorine pulp manufacturers thus must choose to use a lot of substitute chemicals, producing weaker, fully bright pulps, or less substitute chemicals, producing darker, full-strength pulps. Fortunately, the degree of trade-off will likely lessen as non-chlorine bleaching technology is advanced and technical managers develop better methods to control the bleaching process. There are also advanced ways of brightening paper through the use of fillers mixed with the pulp and coatings applied after it is made into paper. These technologies are currently in a state of rapid development. Coatings and fillers already make up a third by weight of some papers, like magazine stock, and this percentage is expected to grow substantially in coming years.

Mechanical pulp is weak, so it is especially suitable for making papers like newsprint that do not require great strength during the printing operation. Such papers usually do not need to be very white and are often used for only a short time, so it is possible to obtain satisfactory results with a bleaching agent far less powerful than chlorine, usually hydrogen peroxide, which changes the structure of the lignin, whitening it, but does not remove it.

Sulphite pulp mills were once as chlorine-dependent as kraft mills, but over the last four years virtually the whole industry has converted to chlorine-free bleaching, mostly of the hydrogen peroxide type. All non-chlorine bleaching technologies weaken the pulp somewhat, but since sulphite pulp is far brighter than kraft pulp to begin with, and because its end products are not as strength-dependent, sulphite pulping is much less sensitive to the technological problems of moving to chlorine-free production.

The products made from dissolving pulp require such purity, which can only be obtained by drastic bleaching, that one would think it a lost cause to attempt to produce it without chlorine. However, almost as if to prove that anything can be done if it is environmentally necessary, Norway's Borregard Industries has managed to develop a peroxide dissolving pulp that the Swedish Svenska firm uses to make rayon.

Kraft pulping is the heavy hitter in the pulping industry. Since kraft technology creates almost three-fourths of the world's pulp, redesign of kraft bleaching processes to omit the use of chlorine is the long ball in pulp and paper zero-discharge efforts. The most important concern in designing non-chlorine kraft bleaching methods is to minimize the need for that bleaching. All non-chlorine chemicals reduce the strength of kraft pulp, which can only be weakened to a limited degree if it is to be used in operations like high-speed magazine printing, which requires tremendous strength.

Designers of non-chlorine kraft bleaching processes therefore focus their efforts in three areas:

- Cooking the pulp so that it requires less bleaching (for example, an advance called "extended cooking" has recently been improved on with a method called "modified continuous cooking");
- Using less bleach during the bleaching stages (principally by improving "extraction," the removal of free-floating lignin and other waste between stages); and
- Modifying methods of using non-chlorine chemicals (such as manipulating the pressure and concentration of the chemicals in the pulping mixture) so that they do less damage to the cellulose.

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The Pollution Prevention Project is funded by the Great Lakes Protection Fund and the Canadian Institute for Environmental Law and Policy.
The Bulletin of Pollution Prevention is funded by the Great Lakes Protection Fund.

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Industry Response

Most Great Lakes mills are not moving toward eliminating the use of chlorine. They are simply responding to existing or anticipated regulation, which in both Canada and the United States is focused on limiting the emission of dioxins and furans. To meet these regulations, most Great Lakes mills are employing or planning to employ so-called "virtual elimination" technology. Its elements are:

- Replacing existing chlorine gas bleaching with chlorine dioxide bleaching. This reduces organochlorine discharges by half and drives levels of 2,3,7,8 dioxin and 2,3,7,8 furan under the limits of detection in effluent;
- Adding secondary treatment, which diverts between 20 and 50 percent of organochlorines to a combination of air, sludge, and conversion to inorganic salts. The sludge is usually dumped on land; and
- Adding an oxygen "pre-bleach." This is an essential step on the way to eliminating chlorine. However, it cannot replace chlorine independently. This step is being added in only a few mills.

Pulp and paper makers want regulation to be based only on levels of waterborne discharge, not on the original use of persistent, toxic chemicals or their precursors (chemicals that combine to become persistent and toxic during the production process or during or after discharge).

The industry claim is that chlorine is essential to the pulp-making process, and that in any case there is no need to stop using chlorine because its toxic byproducts can be limited to "acceptable" levels in effluent. To sugarcoat the idea of acceptable levels of persistent toxic substances, the industry commonly refers to it as "virtual elimination in effluent."

The European example shows that chlorine is unnecessary for bleaching any but the most specialized of papers, for which chlorine-free methods have yet to be developed.

The idea of acceptable levels of discharge can be dismissed almost as easily. The concept is the underpinning of objections to discharge regulation by all industry, but it has no application in the context of pulp-and paper-making: bleaching effluent contains just too many compounds that are both harmful in quantities almost below measuring and likely to remain in the environment unaltered for decades.

Furthermore, it is only reasonable to think that there are many more such compounds among the two-thirds of organochlorines in bleaching effluent not yet studied. Applied to bleaching effluent, "acceptable levels of discharge" is just another way of saying "no news is good news."

Under the industry's idea of an effective regulatory system, the allowed level of most chemical discharges would be slightly below what has been proved toxic; for the most dangerous compounds, the allowed limits would be set below what has proved detectable. Chemicals not proved to be toxic would not be regulated.

Unfortunately, the record of toxicity studies is that their conclusions are often revised downward every few years, sometimes by orders of magnitude. As for compounds not yet studied, bleaching produces so many that it would be impractical to prove which of them are toxic in anything less than decades. Even that effort would be possible only if a government research programs many, many times more active than today were put into effect. Knowledge about dioxin, which is only barely adequate, has cost about $5 billion. We would bankrupt ourselves attempting such study of all the chemicals produced in pulp and paper making.

In any case, environmental history has generally been one of finding out that chemicals are substantially more dangerous than originally thought after they have already been permitted into the environment in large quantities. Lead is a good example of this process. Its level of generally recognized toxicity in the environment has been reduced to less than a thousandth of that considered problematic in the early 1970s.

To base regulation on proving which organochlorines are toxic and at what levels is really to argue against a comprehensive effort to protect human or wildlife health from these chemicals. Organochlorines are already well-known to be very dangerous.

Zero Discharge

Zero discharge is the only comprehensive way to protect the ecosystem on which Great Lakes humanity is so dependent. This is why Annex 12 of the Great Lakes Water Quality Agreement declares that, "The philosophy adopted for control of inputs of persistent toxic substances shall be zero discharge." Annex 12 also declares that the intent of the programs outlined in the annex is to "virtually eliminate input of persistent toxic substances," a straightforward acknowledgment that leakage from 50 years of toxic landfilling and other nonpoint sources of pollution will never be completely brought under control.

Unfortunately, industry has seized on this phrase, "virtual elimination," as if it were the governing ideology of Agreement-based pollution regulation. The reason is clear. Being non-quantitative, "virtual elimination" allows industry to argue for convenient emission levels: "below detection" or "environmentally acceptable." This bypasses the undeniable bottom line: small releases build up to huge quantities in sediment and wildlife.

Since the introduction of the zero discharge philosophy at the 1978 renegotiation of the Great Lakes Water Quality Agreement, environmentalists have greatly refined the concept. It now encompasses the activities needed to actually bring zero discharge into effect. These activities have two major components: pollution prevention and sunset permitting.

Pollution Prevention

The traditional method of mediating pollution problems is pollution control, which captures some toxic waste in filters and attempts to dispose of it safely, or at least more safely. This method is seriously flawed for two principal reasons. To capture wastes and dispose of them often ends up merely delaying contamination or transferring contaminants to another place. The tall smokestacks built to reduce power-plant air pollution in local communities were quite effective; unfortunately, neighboring regions paid the price of increased acid rain. In like manner, waste incineration of toxic sludge transforms a water discharge into a smaller air emission and an ash deposit in a landfill. That deposit will eventually leak into the surrounding water table or else require expensive containment. Pollution control does not stop contamination of the environment. It delays contamination by transferring pollutants from one medium to another.

In any case, because emissions are cut but not eliminated by the various filtering processes, contamination of the environment is merely slowed. With growth in population and per-capita consumption, reduced rates of contamination eventually end up generating the same or even increased actual levels of discharge.

Pollution control of pulp and paper discharges manifest all these faults. Official U.S. "best available technology" for pollution control of pulp-and paper-making discharges specifies the construction of aerated lagoons to drastically reduce non-persistent substances, and convert a small amount of persistent organochlorines into inorganic salts that are neutral in effect if not benign. But a substantial amount of organochlorines are merely deposited in lagoon sludge, which is

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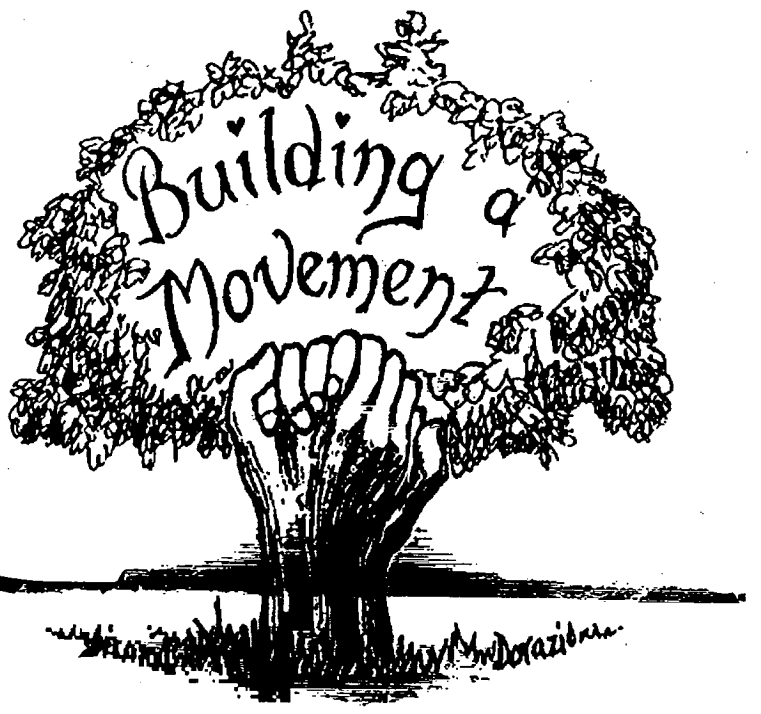

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Baby Steps to Zero Discharge in Lake Superior

by Karen Murphy

September's meeting of the International Joint Commission witnessed the release by the United States, Canada, Ontario, Minnesota, Michigan, and Wisconsin of the long-awaited "Bi-National Program to Restore and Protect the Lake Superior Basin."

The governments claim that the program responds to the IJC's 1989 call to establish Lake Superior as a zero-discharge demonstration area. By and large, however, the actions described in the program are a recitation of existing regulatory programs supplemented by new initiatives that propose protection for only limited areas of the lake.

Missing in the "Binational Program" is the measure that defines government seriousness about zero discharge of persistent toxic chemicals into Lake Superior: a freeze on all new and increased releases of chemicals into the lake.

In the United States this could be accomplished by designating the whole of Lake Superior as Outstanding National Resource Waters for persistent toxic pollutants under the U.S. Clean Water Act. On the Canadian side a similar designation could be made through the Canada-Ontario Agreement Respecting Great Lakes Water Quality, as well as under the Canada Water Act.

Of course, this is only the first step that is required. The governments should also have a plan to phase out the use and discharge of persistent toxic substances. This can be started immediately through existing regulatory programs such as the National Pollutant Discharge Elimination System in the United States and through Control Orders in Canada.

United States

In the "Binational Program" the United States government pledges to designate specific areas of the Great Lakes Basin (mostly waters off the shores of national parks, recreational areas and wildlife refuges) as Outstanding National Resource Waters (ONRW). This would have the effect of instituting a freeze on the discharge of persistent toxic chemicals in those areas.

The government also plans to designate all the waters of Lake Superior as Outstanding International Resource Waters (OIRW). Under OIRW "the increased discharge of certain designated persistent bioaccumulative toxic substances will not be allowed without an adequate antidegradation demonstration." Such a demonstration requires proof that proposed new or increased discharges would not further degrade the existing quality of area water.

Although they appear groundbreaking, the U.S. designations have crippling flaws. ONRW designation provides the highest level of protection for water under the Clean Water Act, but the areas to be protected by ONRW status under the program are mainly places where siting of industrial facilities is already prohibited or unlikely to occur. The designation provides an additional layer of protection for waters that are (relatively) pristine, but it does nothing to protect other areas of Lake Superior from existing and new sources of persistent toxic substances.

OIRW designation, slated for the whole of Lake Superior, offers less protection than ONRW status. OIRW designation currently has no meaning under law. The "protection" offered by such a designation hinges on an "anti-degradation demonstration." The tests and standards for anti-degradation are still being defined through the Great Lakes Water Quality Initiative process. The test being used for Lake Superior combines "best available technology" requirements, which are as yet undefined, with socioeconomic considerations. In Wisconsin, for example, one additional job is sufficient demonstration of a socioeconomic need. The OIRW designation does not put a freeze on inputs of persistent toxic substances and it does not prohibit new facilities from discharging persistent toxic substances.

Furthermore, the program targets only nine chemicals--2,3,7,8 TCDD, octachlorostyrene, hexachlorobenzene, chlordane, DDT, DDE and its metabolites, toxaphene, PCBs, and mercury. Several of these chemicals are not even discharged into Lake Superior from point sources. By contrast, the Great Lakes Water Quality Initiative, a process being undertaken by the eight Great Lakes states and the U.S. Environmental Protection Agency to develop uniform water quality criteria, has already identified over 40 persistent, bioaccumulative toxics for immediate action. At a minimum, the program should target those chemicals currently identified in the Initiative process.

The program also fails to address phasing out existing sources of persistent toxic chemicals. The "Binational Program" indicates that industry will be required to develop reduction plans for each new or reissued toxics discharge permit that has an effluent limit below detection (this is the case for dioxin, PCBs and mercury). However, the actual implementation of these reduction plans is not mandatory, nor is it enforceable.

Canada

In the Canadian portion of the plan, the federal government and Ontario pledged to address the issue of special designation during the renegotiation of the Canada-Ontario Agreement. However, no details were given on how special designation might fulfill the IJC's recommendation.

The federal and provincial governments are also developing water quality regulations for pulp and paper mill discharges. The "Binational Program" never clearly delineates how effluent controls will be defined. For example, will the emphasis in pulping be on eliminating the use of chlorine, or on simply reducing organochlorine concentrations in effluent?

The plan does state that the regulations of the Ontario Municipal and Industrial Strategy for Abatement "are being developed to virtually eliminate persistent toxic substances from industrial effluents." The use of the term "virtual elimination" in this manner is very disturbing. It indicates that the aim of the Province is to focus reduction efforts on discharges rather than on the original use of toxic chemicals. Focusing reduction efforts on the end of the pipe merely transfers pollution to different media. For example, increasing treatment of water discharges creates more toxicity in the sludge. The sludge is eventually landfilled or incinerated, transferring toxic contaminants from the original water discharge to land and air.

It is apparent that the giant steps citizens had hoped to achieve for Lake Superior are not forthcoming in the "Binational Program" of the Great Lakes governments. The federal governments have not identified specific actions to establish a freeze on new or increased discharges of persistent toxic substances into the Lake, nor have the governments identified mechanisms for phasing out existing sources of persistent toxic pollutants.

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usually disposed of in a landfill, or even by incineration.

A further substantial amount of lagoon-treated pulp-and-paper organochlorines are simply evaporated (*volatilized*, in regulatory parlance). It is worth noting here that although pulp-making is the largest source of persistent toxic discharge to the Lakes, the largest source of persistent toxic *input* to the Lakes is from non-point sources, particularly (and amazingly) air deposition, a substantial portion of which (yet more amazingly) comes from Mexico. This has become clear because, for example, high levels of PCBs, no longer produced in the United States or Canada, continue to turn up in Great Lakes water samples and cannot be accounted for by sediment disturbances.

Lagoon technology reduces persistent toxic pulp and paper discharges by only 50 percent. The rest flows freely into the Great Lakes, where it will last for years, be stirred up from the bottom periodically in the wake of storms, accumulate in the tissues of wildlife and harm their ability to reproduce, and be consumed by people in fish and drinking water.

Pollution prevention is the attempt in regulation and industrial practice to bypass studies of temporary validity, technologies of limited effect, and half-measures with unfortunate trade-offs. A few of the most important pollution prevention techniques developed in the last few years are:

- Chemical substitution, which replaces persistent toxic chemicals in production processes with chemicals that are non-persistent and non-toxic;
- Process change, which alters production processes to eliminate the need for persistent toxic chemicals; and
- Product reformulation, which redesigns products to eliminate the need for persistent toxic chemicals.

Zero-discharge-oriented pulping uses all these techniques. Oxygen, ozone and hydrogen peroxide (and, perhaps someday, substances such as nitrogen oxide and sodium hydrosulphite) are used as substitutes for chlorine. Cooking and extraction modifications and advances in the use of fillers and coatings make the use of those substitute chemicals practical. And market segmentation and mill integration allow a form of product reformulation, in which pulp strength and brightness can be tailored to the needs of the paper it will be made into.

It is important to note that pollution prevention changes can result in cost savings that repay pollution prevention investment within a couple of years, sometimes more quickly. Expensive chemicals can be recycled, or eliminated in favour of cheaper chemicals, and the costs of waste disposal can be reduced or eliminated entirely.

Goods produced without the use of toxic chemicals can often be marketed at a premium on that basis. This is particularly true in the paper industry. Even as pulp prices are falling worldwide, chlorine-free pulps are commanding a premium of between $50 and $80 per tonne.

Sunset Permitting

The second major vehicle for implementing zero discharge policies is sunset permitting. Cost savings, "environmentally safe" marketing, and reduced government oversight are the carrots of pollution prevention. Sunset permitting is the stick.

Traditional pollution control regulators set a legal limit to the amount of a given chemical that can be released in a given place. The impossible job of these regulators is to decide permissible levels of pollution, levels that supposedly will not harm human health. These decisions are inevitably arbitrary.

Sunset permitting simplifies regulators' jobs. They set times by which discharge and/or use of given chemicals must cease, with intermediate deadlines for declining permissible levels of discharge. To do this regulators need only look at the technical and economic feasibility of implementing zero-discharge processes.

The next step to cleaning up and protecting the Great Lakes is to apply zero discharge ideas to a major industry. In doing so, Great Lakes environmentalists and regulators will perfect government programs, regulations and enforcement oriented toward zero discharge, learn how to help along market changes that facilitate zero discharge, and develop means to assure that communities and workers do not bear the brunt of dislocations caused by that transition.

Pulp and paper is the industry of choice for this first step. It is technically ready to implement needed changes, and will not suffer economically in the process.

What Can Be Done Now

The role of environmentalists in the great conversion of pulp and paper will be threefold:

- To hold the line on the definitional issues surrounding zero discharge--it is far different from "virtual elimination";
- To hold the feet of government to the fire in implementing zero discharge programs instead of pollution control programs; and
- To educate American consumers about the urgent need to use chlorine-free paper.

Greenpeace and its friends will soon be holding an international meeting to decide the elements of a concerted campaign to begin putting serious pressure on pulp and paper makers to start making chlorine-free products.

In the meantime, grassroots Great Lakes activists can help reduce persistent toxic pulp-and-paper discharges to the Great Lakes in two major ways:

- Urging programs on government at the local, city, county and state levels to reduce the use of paper and to recycle it; and
- Inserting into procurement policies issued by such bodies clauses that privilege chlorine-free paper as they now often privilege recycled paper.

Using less paper means making and bleaching less pulp (and, of course, destroying fewer trees). And obtaining chlorine-free procurement policies means laying the strongest basis for chlorine-free pulp and paper production: marketplace demand.