The production of pulp

Pulp mills process timber in order to obtain the main raw material for paper production: pulp. They are usually large factories located close to where timber is cut, that is to say, near forests or monoculture tree plantations, from where the logs can be easily transported, thus cutting costs.

Basically, wood comprises lignin and cellulose fibres and the first step to obtain pulp is to crush the solid wood. Depending on the processes used, two types of pulp are to be distinguished.

* Mechanical pulp. Mechanical processes crush wood and release the fibres. This process turns up to 95 per cent of the wood into pulp, but keeps the lignin, which gives the paper a brown or yellow tint. This type of pulp is mainly used for newspapers and other products where the quality of the print is not too important.

* Chemical pulp. Solid wood is first broken down into small wood chips, which are then processed with chemicals, followed by a process of refinery. Chemical extraction separates the lignin from the cellulose, that remains as the final product. This is achieved by means of hydrolysis (a reaction using water) under high temperature, using chemicals and a large amount of energy. Depending on the chemicals used, different processes can be identified: 1) the Kraft or sulphate process (presently the most commonly used), which cooks the wood chips with caustic soda; 2) the sulphite process (that predominated in the paper industry from the end of the nineteenth century until the middle of the twentieth century) which cooks the wood chips in an acid solution; and 3) the chemical thermo-mechanical process, where the chips are steam-heated and then treated with chemicals before crushing them.

Depending on the process and the type of wood used, different kinds of pulp are obtained: long fibre (from conifers) and short fibre (other tree species, with some exceptions). The importance of this difference regarding paper is that the long fibre paper is more flexible, and is therefore generally used for newspaper. Pulp produced both through mechanical or chemical processes, usually requires bleaching. There are various types of bleaching: 1) using chlorine gas (also known as elemental chlorine); 2) elemental chlorine-free (ECF) using chlorine dioxide (within this technique ECF has also been developed using ozone in the initial stages of the bleaching process and chlorine dioxide in the final stages, and “improved” ECF, which eliminates most of the lignin that gives the yellow colouring before bleaching, thus reducing the use of energy and chemicals for the process); and 3) “Totally Chlorine Free” (TCF), that is to say, bleaching without chlorine compounds, using oxygen and hydrogen peroxide or ozone.

The public discussion on pulp bleaching started in the mid-eighties. The analysis revealed a high concentration of AOX (a parameter measuring the total concentration of chlorine linked to organic compounds in wastewater) in pulp plant effluents, and later dioxins were also found. Dioxin is the common name for a family of chemical compounds (there are 77 different forms of dioxins), showing similar properties and toxicity; they appear as a result of thermal processes involving organic products with chlorine and have serious effects on health and the environment, heightened by their persistence and accumulation.

The world production of bleached chemical pulp has increased over the past 15 years from 56 million to close on 90 million tons. According to 2002 figures, approximately 20 per cent of the world pulp production is chemically bleached using the traditional chlorine gas and about 75 per cent is bleached with chlorine-dioxide by the ECF process, while just a little over 5 per cent is bleached by the TCF process.

- The problems of pulp mills

Pulp mills are increasing in size and production capacity, worsening the impacts of their industrial process that already presents serious environmental risks. Some risk factors can be identified:

* Size (scale)

Today's pulp mills are mega-factories and their very size makes them a risk. In an industrial process using so many toxic chemicals, any small detail that is altered, any small release is magnified because of the scale of the factory. Furthermore, toxic chemical releases may be small as compared to the volumes processed, but not with the magnitude nature can support. The effluents from a large 600.000 metric ton plant are approximately 1000 litres per second.

* Smell (emissions)

Emissions into the air by pulp mills (from the incineration of tons of residue left over from the process and used in energy generation) contain cancerigenic chemicals (chlorinated phenolics, polycyclic aromatic hydrocarbons and Volatile Organic Compounds), oxidized sulphur compounds causing damage to vegetation, compounds causing hormone imbalance (such as the chlorinated phenols) and reduced sulphur compounds causing the classical penetrating "rotten egg" smell that becomes a problem for the surrounding inhabitants. Recent epidemiological studies show evidence of possible effects on health caused by exposure to these compounds at levels usually present near a pulp mill. A Finnish study (The South Karelia Air Pollution Study) shows that exposure to bad-smelling sulphur compounds increases the risk of acute respiratory infections.

* Problems with the production of bleaching agents

Many chemical bleaches are reactive and dangerous to transport and for this reason must be made in situ or near by. This is the case of chlorine dioxide (Cl02), an extremely reactive greenish yellow gas that explodes easily, representing a major threat to the workers and the neighbouring inhabitants in the event of an accident. Another agent used, elemental chlorine (Cl2), is very toxic. It is a greenish gas that is corrosive in the presence of dampness.

* Effluents and water pollution

The enormous demand for water in pulp mills may reduce the level of water and the effluents may increase the temperature, a critical issue for the river ecosystem. Generally, mills are installed near a watercourse with a good flow where they can get their supply (at a lower cost) and also discharge their effluents. The pulp industry is the second largest consumer of chlorine and the greatest source of direct discharge of toxic organochlorines into watercourses.

Pulp production processes that can potentially cause more pollution are the chemical methods, in particular those producing Kraft pulp, as the effluents may contain organic compounds present in the pulp and chlorine compounds that when combined can form a series of toxic products such as

dioxins, furans and other organochlorines (also known as Absorbable Organic Halogens/AOX), each having different degrees of toxicity. The serious problem with these compounds is that their capacity for biodegradation is very limited, meaning that they remain in the biosphere for many years after they are no longer being released, building up over time in the tissues of living organisms (bioaccumulation). This means that concentrations in the fatty tissue of superior organisms (including human beings) are higher than the concentrations present in the environment where they were exposed, making this an important human health problem. According to the US Environmental Protection Agency (EPA), exposure to minute levels of dioxin (measured in trillionths of a gram) can result in alterations of the human immune system and of endocrine hormone activity, including the regulation of sex steroids and growth, and inheritable genetic changes. Not forgetting, of course, cancer. Among the major sources of dioxin emissions is elemental chlorine pulp bleaching.

In the case of the effluents of chlorine dioxide bleached pulp, these contain chloroform, chlorinated acids and sulfones. Chlorine dioxide bleaching produces large amounts of chlorate, which acts as a herbicide. It has been proven that although effluents are more biodegradable than with the elemental chlorine technique and that the presence of organochlorines has been reduced, they continue to be produced and to affect the environment. Although liquid effluents are less toxic than they were ten years ago, they are still dangerous because they are persistent pollutants, that is to say, that they are permanently accumulating and do not degrade.

Furthermore, in addition to the effects of organochlorines, towards the end of 1994 the conviction took shape that substances contained in wood become problem compounds during the pulp extraction process, as fish affected by effluents from the production of bleached and non-bleached pulp showed toxic effects. Dissolved wood substances, chemical residues and compounds produced by reactions between chemical substances and wood substances produce pollutants that may reduce the oxygen levels in the watercourses where they are released and prove lethal to fish.

Effluents from the bleaching process generally contain between 40 and 50 kilos of organic substances (mainly lignin) per ton of pulp. Studies carried out in Canada and Sweden at the end of the eighties and beginning of the nineties on the chronic effects of effluents from pulp mills on fish in the nearby watercourses, revealed reproductive alterations, increased metabolism and changes in the structure of fish stocks. Other studies revealed genetic damage, hormone changes, liver alterations, cell function problems, changes in blood composition, skin and brachia lesions and reactions by the fishes' immunological system. A study carried out in 2003 revealed that 80 per cent of the female Gambusia fish living in a river downstream from a pulp mill were shown to be partially masculinised (alterations in the anal fins, a feature related with masculine hormone activity), and 10 per cent of the fish were totally masculinised. Although the researchers did not identify a specific male hormone compound in the pulp mill effluent, later tests produced a variety of reactions in the male hormone receptors.

On the basis of these problems, there is reason to wonder whether the aforementioned risks related to pulp and paper mills are justified in the name of some general welfare, whether this activity aims at meeting genuine human needs or has contributed to alleviate poverty. According to the following reports and testimonies, the answer is no. Pulp mills are just one link in the chain of an unsustainable "development" pattern which allows big economic interests to secure their power.

Article based on information provided by: the consultant, Rune Leithe Eriksen, e-mail: rune@rle.se ; Chemical Engineer Camilo Barreiro, e-mail: camilobarreiro@yahoo.com ; and information from: "Industria del papel y de la pasta de papel: sectores basados en recursos biológicos", Enciclopedia de Salud y Seguridad en el Trabajo, http://www.mtas.es/insht/EncOIT/pdf/tomo3/72.pdf ;

“Compuestos Organoclorados como Contaminantes Persistentes: el caso de las dioxinas y los bifenilos policlorados”, http://es.geocities.com/pirineosjuan/organoclorados.html ; “The Case Against Chlorine Dioxide”, Miranda Holmes, Georgia Strait Alliance and Delores Broten, Reach for Unbleached, http://www.bcen.bc.ca/bcerart/Vol7/thecasea.htm , “Missing Monitoring What should be monitored but isn't”, Reach for Unbleached!, http://www.rfu.org/MonMiss.htm ; “Towards a Sustainable Paper Cycle”, prepared for the World Business Council for Sustainable Development by the International Institute for Environment and Development (IIED), 1996 ; “Causes for Concern: Chemicals and Wildlife”; prepared for WWF by Valerie Brown, M.S., December 2003, http://www.wwf.org.uk/filelibrary/pdf/causeforconcern01.pdf ; “Trends in World Bleached Chemical Pulp Production: 1990-2002”, http://aet.org/reports/market/aet_trends_2002.html