7. Have appropriate environmental controls been applied?

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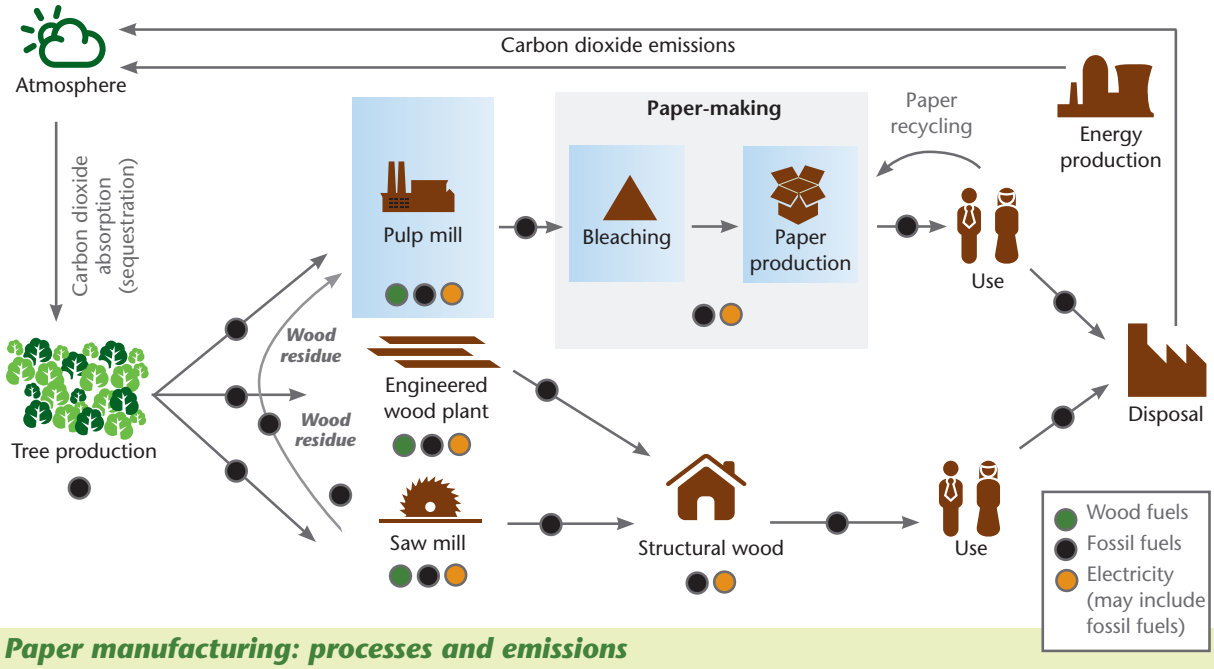
Different types of pollution can occur in many different places along the supply chain for wood and paper-based products (Figures 10 and 11). The amount and intensity of emissions depend on the type, condition and capacity of the equipment causing pollution, and the location of the discharge points. The degree of deviation (i.e., lack of compliance) from legally established emission thresholds is also an important factor, and the opportunity for continuous improvement exists.

Figure 10. Examples of emissions in paper-based products



Paper manufacturing: processes and emissions

Fiber production: separates fibers from other compounds through mechanical and chemical processes.

Mechanical: energy-intensive processes that apply physical pressure to convert wood into pulp. Result in high pulp yields; fibers provide smooth printing surface but they are not strong.

Chemical processes: chemicals dissolve other compounds to extract and bond fibers. Fibers are more flexible and stronger than those from mechanical processes.

Emissions: mostly water-borne emissions including sulfur compounds, BOD, suspended solids, COD, AOX, and VOCs. Most input chemicals (e.g., sulfur and sodium compounds) can be recovered for reuse.

Bleaching: eliminates remaining compounds from the pulp, increases brightness and increases absorbency. Fibers used for printing and writing papers, tissue paper or top of board papers undergo bleaching.

Bleaching substances that can be used:

- Chlorine-based compounds
- Sodium or calcium hypochlorite as well as sodium hydroxide
- Oxygen, ozone
- Hydrogen peroxide

Emissions: potential pollutants released to the air and water include chlorinated organic and inorganic compounds, AOX, and VOCs.

Paper-making: produces a continuous and uniform thread of paper. Process involves:

- Pulp is diluted in water and sprayed into a fast-moving, continuous screen.
- Water is drained by gravity and pumps, and the pulp forms a fiber mat.
- The fiber mat passes through a series of rollers and cylinders to extract water, compress and reduce thickness and produce a smooth surface.

Emissions: chemicals are used to create special properties (gloss, color, water resistance, etc.) and to facilitate the paper-making process. Emissions include particulate waste, organic and inorganic compounds, COD, and acetone.

Recycling: involves two major steps:

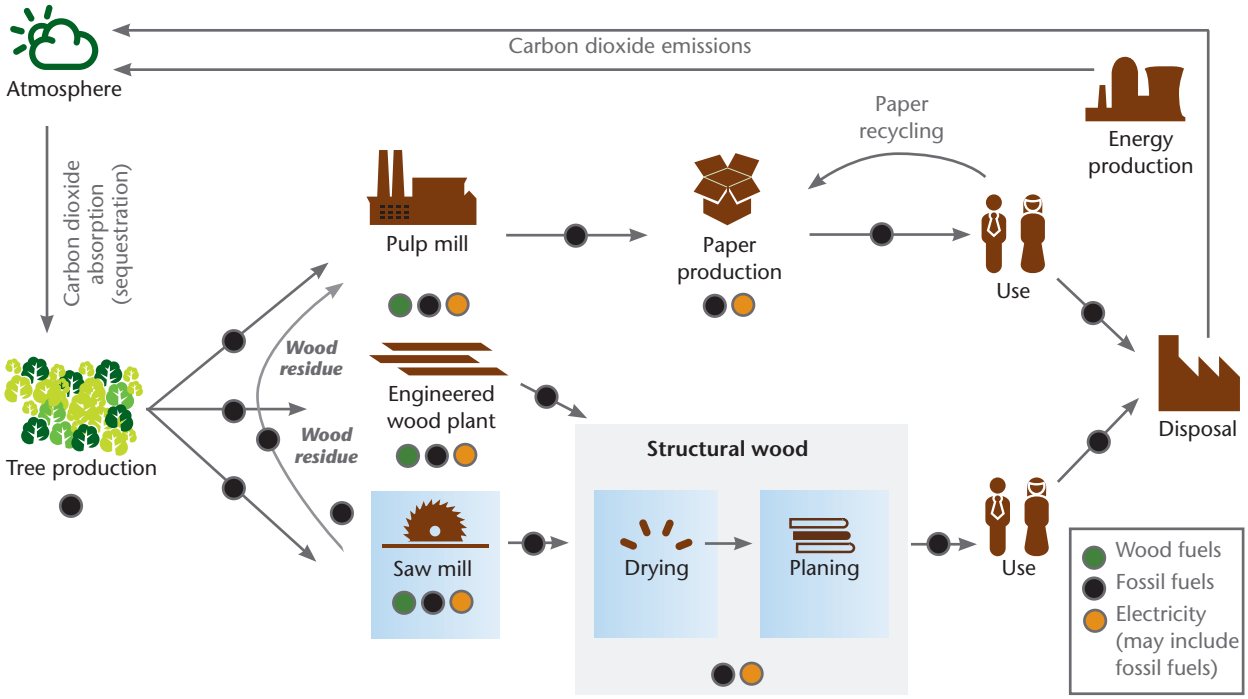
- Re-pulping: separating fibers from other substances (i.e., dirt, plastic, wax in specialty paper) and from each other. Sulfur, formaldehyde, naphthalene and sodium compounds are used to facilitate the process.
- De-inking: removing the ink from the paper and from the pulp mix by washing, flotation, or a combination of both. Chemicals used include sodium compounds, hydrogen peroxide, calcium chloride, soaps and fatty acids.

Recovered fibers can also be bleached separately or during re-pulping.

Emissions: mostly water-based, including printing inks, adhesive components, fats, resins and AOX.

Examples of different emissions from different processes in paper-making. Dots representing energy do not quantify amount or proportion of energy inputs. Based on Holik, 2006; EPA, 2002; Paper Task Force, 1995.

Figure 11. Example of emissions in solid wood products



Sources: Milota, et al., 2005. The study was for production of dimension lumber in the Western and Southern U.S.

Dimensional lumber manufacturing: processes and emissions

Sawing: log storage and breakdown of raw logs into rough green lumber.

Water is used to wet the logs when they are sorted prior to being sawn.

Water-based chemicals such as paints, anti-stain treatments and others are used, although their volumes are not considered highly toxic or hazardous.

Emissions: dust, VOC, Acetaldehyde, Formaldehyde and methanol can be emitted to the air. Solid emissions such as sawdust, bark, chips, and rough green lumber are considered co-products, and are often burned for energy production or sold/used for other industrial processes such as paper-making.

Drying: the removal of water and moist content. Drying enhances performance, minimizes changes in the dimension (contraction or expansion), improves strength, reduces weight, facilitates processing and treatment, and reduces decay.

Because changes in water content result in strain and stress, wood must be dried under controlled circumstances to avoid bending, crackling or twisting. Chemicals can be used to treat lumber depending on the end-product, including fire retardants, paints and finishes.

Emissions: common emissions include organic lubricants, solid particles, dust, and VOCs. Because of their volume, emissions of inorganic compounds are not considered highly toxic or hazardous.

Planing: the removal of excess wood to produce lumber with pre-determined dimensions and relatively smooth surfaces using planers, conveyers and other equipment.

Plastic film, cardboard corners and steel strapping are used to package the product. Use of other materials such as paints (for end sealing) is minor.

Emissions: coarse dust, VOCs, wood-shavings and chips.

Example of different emissions in the manufacturing of dimensional lumber. Dots representing energy do not quantify amount or proportion of energy inputs. Based on Milota et al., 2005. See box 11 for description of pollutants.

Types of pollution include:

- **Emissions to air**
  - **Energy-related emissions** resulting from the combustion of wood and fossil fuels to generate power.
  - **Processing emissions** resulting from processes such as pulping, bleaching, pressing, evaporating, and the chemical recovery systems.
- **Solid emissions**
  - Sludge from wastewater treatment plants.
  - Ash from boilers.
  - Miscellaneous solid waste, including wood, bark, non-recyclable paper, and rejects from recycling processes.
- **Emissions to water** – large amounts of water are needed to carry the fibers through each manufacturing step in making paper products.
- **Noise** – a concern in the immediate vicinity of a mill. Its impact depends on the proximity of human settlements and the mitigation measures taken.

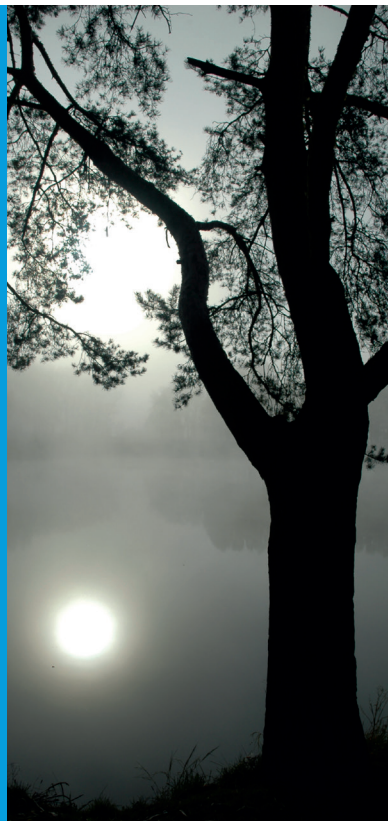
More information on pollutants commonly associated with manufacturing of wood and paper-based products can be found in Box 15.

Bleaching can be a potentially major source of pollution (Box 16). Most of the global paper industry has phased out the use of Elemental Chlorine (EC) as a bleaching agent; however, some facilities still use it. The prevailing bleaching systems are Elemental Chlorine Free (ECF) and Enhanced Elemental Chlorine Free (EECF). Totally Chlorine Free (TCF) bleaching may be an option for certain products, although it tends to use more fiber and produce a lower quality product.

The law is the formal reference for what constitutes an acceptable level of emissions in a country. No international agreement on acceptable levels of emissions exists, but some multilateral and bilateral lending institutions have established policies based on Environmental Impact Assessments (EIA).

Factors to consider regarding pollution

- **Engaging in dialogue with landowners, trade associations and NGOs can be useful as they are often familiar with specific issues and local circumstances.**
- **The emission of pollutants is often specific to the country and the site. Some countries are more stringent in their regulation of emissions. Continuous improvement should be the goal; although compliance may not always be enough (e.g., in cases where requirements are not stringent) therefore holistic environmental impact reductions are also a goal. Adherence to the relevant and local regulations and/or international lending standards can be used as a proxy to assess a company's procurement policy requirements.**
- **Best management practices in the forest industry to deal with pollution include:**
  - **Minimizing the generation of effluents, air emissions and solid waste through better technology**
  - **Increasing reuse and recycling of waste materials**
  - **Increasing rates of chemical recovery from pulping and bleaching processes**
  - **Use of high-efficiency washing and bleaching equipment**
  - **Elimination of uncontrolled discharges of wastewater and solid waste due to equipment lack or failure, human error, or maintenance procedures**
  - **Usage of ECF, TCF, and EECF bleaching systems**
  - **Time-bound plans and management systems to minimize impacts from specific toxic pollutants.**



Box 15. Pollutants

Pollutants of interest include:

- Volatile Organic Compounds (VOCs): include a variety of organic chemicals including paints, lacquers, glues and adhesives, by-products of processing wood, and others. VOCs are precursors of ground-level ozone.
- Nitrogen Oxides (NOx): NOx are also precursors of ground-level ozone.
- Formaldehyde: in the atmosphere formaldehyde is rapidly broken down in atmospheric ions; formaldehyde is a component of acid rain.
- Methanol: methanol reacts in the air to produce formaldehyde and other chemicals that are washed out by rain. Methanol is the most common VOC found in the production of wood and paper-based products.
- Sulfur Compounds: in the atmosphere, sulfuric acid contributes to acid rain, and it can be transported large distances from the point of release.
- Volume and Quality of the waste water including:
  - Biochemical Oxygen Demand (BOD) in the water discharge; BOD is the amount of oxygen that micro-organisms consume to degrade the organic material in the water. High levels of BOD can result in the reduction of dissolved oxygen in the water. This may adversely affect aquatic organisms. BOD is usually measured in kilograms per metric ton of pulp.
  - Chemical Oxygen Demand (COD) in the water discharge; COD is the amount of oxidizable organic matter, and it can be used as an indicator of the quantity of organic matter in the water. COD is measured in kilograms per metric ton of pulp.
  - Total Suspended Solids (TSS); measured in kilograms per metric ton.
  - Absorbable Organic Halogens (AOX), including chlorine; there has been heavy pressure to stop using elemental chlorine in the bleaching process because chlorine compounds can react with organics and generate chlorinated compounds (dioxins). Dioxins are persistent substances that have been considered a probable human carcinogen. AOX can be used as an indirect indicator of the quantity of chlorinated organic compound in the effluent. Reductions in the amounts of AOX can be used as an indicator of continued technological improvement. However, AOX from ECF-bleached pulp do not contain highly chlorinated compounds.

Box 16. Bleaching of wood pulp

Wood is a composite material made of cellulose fibers, bonded and made rigid by lignin. To make paper, mechanical and chemical processes are used to separate the cellulose fibers from lignin and other compounds. Wood pulp intended for white paper products undergoes an additional bleaching process to remove residual lignin. Bleaching increases the performance and the brightness of the fibers, increasing their absorbency and turning them from brown to white. In addition, bleaching disintegrates contaminating particles, such as bark, and reduces the tendency of pulp to turn yellow (an important feature for archiving of information).

Elemental Chlorine (EC), combined with small amounts of chlorine dioxide, was the historical bleaching agent of the paper industry. However, EC has been determined to be the source of highly chlorinated organic compounds (dioxins), which are toxic to animal and human health, and are considered a probable human carcinogen. Almost all of the global paper industry has stopped using EC and turned to alternative processes, including:

- Elemental Chlorine Free (ECF) – chlorine dioxide is substituted for EC in the bleaching process; some processes also use additional bleaching agents, such as oxygen and hydrogen peroxide.
- Enhanced Elemental Chlorine Free (EECF) – removes more lignin and other contaminants before bleaching process, through oxygen-based chemicals or prolonged delignification processes.
- Totally Chlorine Free (TCF) – uses oxygen-based chemicals such as ozone and hydrogen peroxide instead of chlorine-based compounds.

TCF bleaching reduces the formation of pollutants but it can also use a greater amount of wood and energy per unit of product; TCF fibers may not entirely satisfy the performance needs of certain products.

Sources: Paper Task Force, 1995; Markets Initiative website (www.marketsinitiative.org) (5/09/07).

Renewable eucalyptus plantations grown in Brazil for the leading global producer of bleached eucalyptus pulp

Traditional bleach

SELECTED RESOURCES: ENVIRONMENTAL CONTROLS

See "Guide to the Guides" chapter for more information on each resource.

Procurement requirements

Dutch Government Procurement Criteria for Timber

European Community Green Purchasing Policy

Green Globes

Japanese Government Procurement Policy

LEED

Mexican Federal Government Procurement Policy

SFI Procurement Objective

Resources to assess requirements

Environmental Footprint Comparison Tool

Environmental Paper Network

EPAT®

FPAC: A Buyers' Guide to Canada's Sustainable Forest Products (the report)

GPN

New Zealand Government Paper Buyers' guidance

Paper Profile

Sustainable Forest Finance Toolkit

Two Sides

Wood for Good

WWF Certification Assessment Tool (CAT)

WWF GFTN

WWF Guide to Buying Paper

WWF Paper Scorecard

WWF Tissue Scoring