THE PULPING PROCESS

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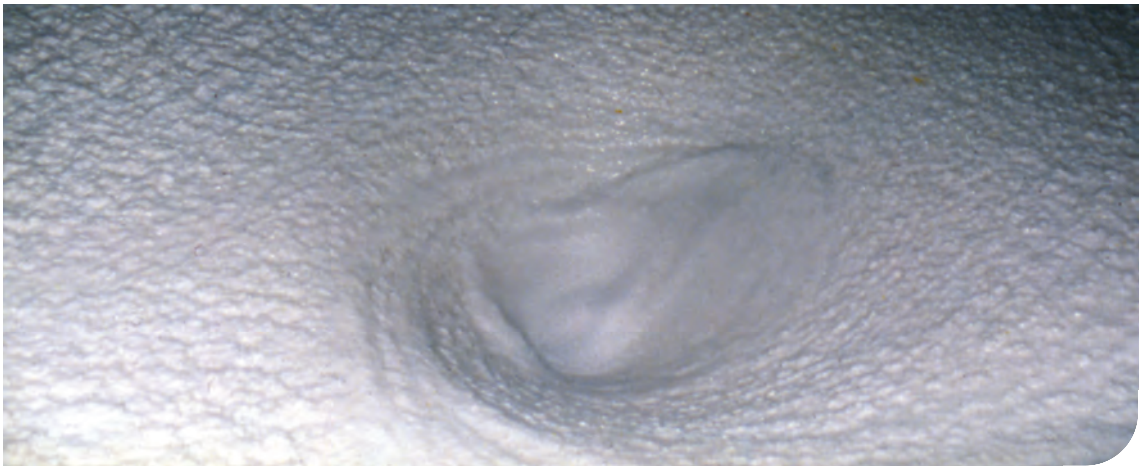


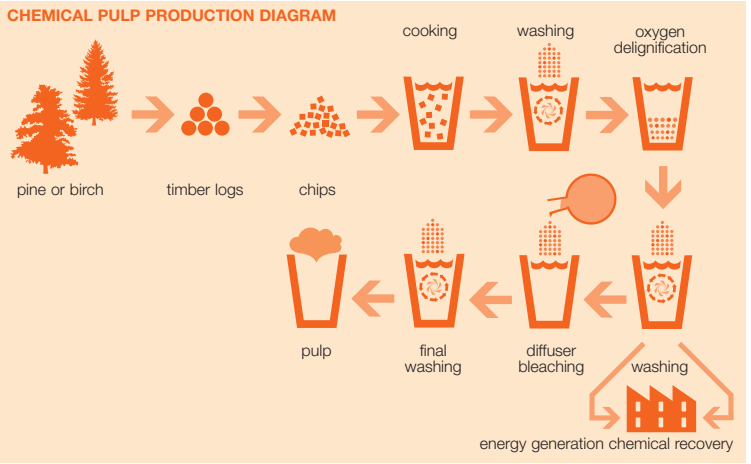
KEY FACTS

Cellulose fibre makes up 40% - 45% of wood. Fibres are separated from wood and from waste paper and board by pulping

When wood is pulped by chemical processes, the remaining wood components are used to provide energy. About 50% of the energy used world-wide by the paper and board industry is from this naturally sustainable source

Pulp produced from wood by chemical processing is brown in colour. The bleaching process results in a chemically pure, white, pulp. Bleaching processes today do not use chlorine gas and do not produce toxic waste products

Fibres in wood can also be separated by mechanical processes. The cellulose fibres in recovered paper and board are separated by agitation in water



Different pulping processes for wood (virgin fibre) and recovered paper/board (recycled fibre)

What is wood pulp?
Wood pulp is cellulose fibre separated from wood by "pulping". Cellulose fibre makes up 40-45% of the dry weight of wood. The rest comprises lignin, a hard brittle material which binds the fibres together, hemicelluloses and small amounts of wood resins.

Fibres in spruce and pine are ribbon shaped. In dimensions they are approximately 3-4mm long and 30µm wide. They are called "long" fibres to distinguish them from the "short" fibres found in birch, which are approximately 1.0-1.5mm in length.

What is mechanical pulp?
The first process in pulping wood is to remove the bark, which is then either used as a horticultural product or as a source of energy in the mill.

Mechanical pulping simply means that fibre separation is achieved by subjecting the wood to crushing/grinding pressure. The wood may be in the form of logs, in which case the pulp is known as "groundwood pulp", or it may first be converted into small chips approximately 25mm square and known as "refiner mechanical pulp". The heat generated softens the lignin and results in fibre separation. The pulp is then screened and cleaned and any remaining fibre clumps are reprocessed.

Wood chips may be preheated with steam to assist the refining process in which case the pulp is known as "thermomechanical pulp" or TMP, and when limited chemical pretreatment is also applied it is called "chemi-thermomechanical pulp" or CTMP.

The colour of mechanical pulp is the same as that of the wood from which it is derived. Using the option of chemical treatment reduces the amount of lignin and this results in lighter coloured pulp. In principle this treatment is a type of bleaching and the chemical treatment can be varied depending on the level of whiteness and degree of lignin reduction required.

What is chemical pulp?
In chemical pulping, debarked logs are chipped and treated with chemicals under heat and pressure. This process dissolves the resins which bind the fibres together in the wood. There is a choice of chemical process. The Kraft, or Sulphate, process is by far the more widely used nowadays because of its ability to process all the commonly used species of wood and its high rate of chemical recovery.

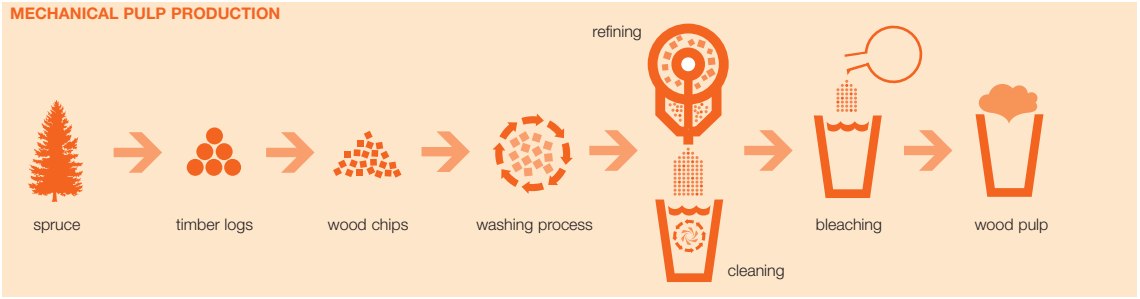
The Sulphite process also dissolves the non-fibrous components of the wood. In both processes the non-fibrous components are used to provide energy for pulping and for both pulp and cartonboard manufacture in integrated mills.

What is meant by bleaching?
Chemically separated fibres are frequently bleached in the pulp mill to remove the last traces of lignin and any other residual material. Bleached pulp is white in appearance and pure cellulose in content even though individual fibres are colourless and translucent.

Bleaching is no longer carried out with chlorine gas. Today the most widely used process is ECF (elemental chlorine free). This replaces chlorine with successive treatments of oxygen, hydrogen peroxide and chlorine dioxide. The by-products are simple and harmless and identical with compounds which occur naturally in sea water.

Another process is known as TCF (totally chlorine free) where the chemicals used are oxygen and hydrogen peroxide.

Is bleaching necessary?
Whilst the use of bleached chemically separated fibre is not necessary for all grades of paper and board, it is used when specific appearance and performance needs have to be achieved. When used in cartonboard bleached fibres provide strength and durability, particularly when used in the external layers. Bleached chemical



pulp has a white appearance. When used as a surface layer in the manufacture of cartonboard it can be printed, varnished, coated and laminated to achieve the required appearance.

Bleached cellulose fibre is chemically pure so that it is suitable for the packaging of many products in either direct contact or in close proximity. This is particularly important where products are flavour or aroma sensitive.

What is meant by the AOX level?
AOX is a measure of the organic chlorine material in the discharge from a pulp mill operating a bleaching process. Though the levels discharged from mills in Europe are extremely low as a result of the process changes which have been made AOX is not a measure of environmental impact. This is because the measurement does not give any indication of the types, and hence the toxicity, of compounds which are present. The compounds present today are simple, harmless compounds with no adverse environmental effects.

What is recycled pulp?
Recycled pulp is pulp made from paper and board, including cartonboard and carton waste, which has been used and then recovered by waste collection schemes.

Fibre separation is achieved by mechanical agitation in water. Pulp made in this way is known as recycled pulp, recycled fibre, recovered fibre, waste paper fibre or, simply, secondary fibre.

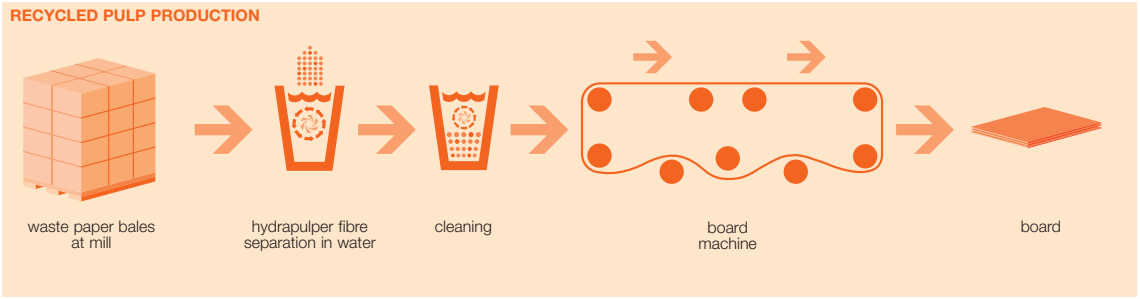
What energy sources are used in the production of pulp, paper and cartonboard?
Chemical pulping results in a by-product which is used as an energy source for pulping and, where appropriate, bleaching. In integrated mills, where paper or board is made at the same site, the wood by-products also provide energy in the form of electricity and steam, for the manufacturing process. This energy source is, therefore, renewable and sustainable. It accounts for around 50% of the energy consumed in pulp, paper and cartonboard manufacture.

Mechanical and fibre recycling both use energy to separate the fibres. This energy may be generated on-site or supplied from external sources. For on-site generation, several mills have installed combined heat and power (CHP) plants which are much more efficient compared to power stations supplying a national grid. The energy source is most likely to be fossil fuel based (oil, coal or natural gas) although, depending on the location, hydroelectric, nuclear, wind or biofuel sources may also be used.

Combined heat and power generation is used in 90% of European mills. The CHP process provides savings in fuel consumption of the order of 30-35% compared with conventional means of power production and distribution.

Why is water used in pulping?
Water is used in mechanical and chemical pulping to separate, process and transport primary or virgin fibres, i.e. fibres made directly from wood. Water is also used in the recycling of fibres from recovered paper and board.

After use the water is treated to meet the local regulations and returned to nature. There is a trend to use less water and, even to close water systems in virgin pulp mills, thereby reducing the demand and the environmental impact of water use. CEPI has stated that water consumption in European mills has been reduced by a third in the course of a recent 10 year survey.



What are the advantages of cartonboard made from virgin fibres?
Cartonboard made from primary, or, virgin, fibres is generally whiter, smoother and has a less pronounced surface structure than cartonboard made mainly from recycled fibres. It can be up to 25% lighter for the same strength and therefore reduce the overall weight of the carton.

Fibres made directly from wood are more “consistent”. This consistency means that cartonboard made from virgin fibre readily meets the needs of food and pharmaceutical packaging and wherever the products packed have sensitive flavours and aromas.

What are the advantages of cartonboard made from recycled fibres?
Cartonboard made from recycled fibre utilises valuable recovered waste paper and board which would otherwise be discarded into landfill sites or disposed of by other means.

Energy and material resources were invested in the paper or board when it was first made and hence recovering and recycling as fibre is therefore an efficient use of those resources.

Cartonboard made mainly from recycled fibres can also be more cost effective as it utilises a lower cost raw material with the minimum necessary amount of more expensive virgin fibres.

How is used paper and board selected for recycling as cartonboard?
Used paper and board is selected for recycling according to the quality of the fibre. This depends on the type of fibre and how the fibre was processed previously - whether mechanically or chemically, bleached or unbleached and whether it has already been recycled.

Fibre quality will also be significantly influenced by the way the paper or board was recovered and the ways in which it was printed, converted and used.

How is the quality of recovered paper and board graded?
Recovered paper and board is graded according to the definitions listed by CEPI and BIR published in 1999.

This describes 57 grades of recovered paper and board. The list includes several cartonboard grades. It differentiates the waste in terms of the type of cartonboard, which takes into account the fibre composition, the extent of the print coverage, whether it is of post consumer or industrial/commercial origin and whether it is associated with other materials, such as plastic coatings.