StoraEnso

Purely vital Water

Water is vital

Pure paper from pure water

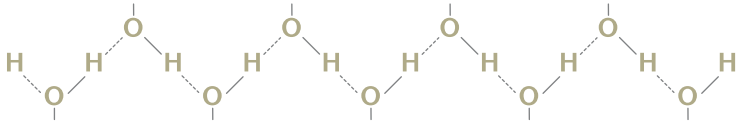
Stora Enso aims to improve environmental performance through an integrated approach, where process management and process controls are purposefully enhanced to protect the environment.

Technologies such as dry debarking, process water recycling, effective emissions monitoring, safety and recycling systems, and cooling towers for biological waste water treatment are all gradually being adopted to improve water management.

Water is vital in paper production, as it acts as a bond between the fibres. It is also used for transport, cleaning, cooling, lubrication and as an energy source in the form of steam.

During the whole papermaking process the paper machine fabrics and the pulp are washed several times. The water used to make high quality paper must also be of high quality, especially in the final stages of production. The fresh water used in the papermaking process has to be cleaned before use. Process water is typically reused several times in other flow systems, either directly or after purification.

When water evaporates from the moist paper web, the hydrogen bonds are formed between the fibres, holding the paper structure together.



Water resources

Regional differences

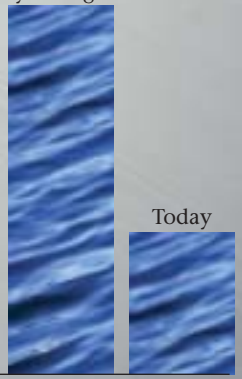
Water is obtained from various sources in different geographical regions. In Central Europe, where fresh water is in short supply, water from rivers and groundwater reserves is used for paper production. In the Nordic Countries water resources are more abundant, and process water is obtained from rivers and lakes.

In Stora Enso's mills, purified fresh water is used in paper machine showers, in the application of additives, and in the coating stage of the papermaking process. This process water can then be reused for pulping and washing, raw material handling, and bleaching.

More from less

Over the last 30 years the amount of water needed to produce the newsprint for your daily newspaper has gone down from 10 litres to 2.5–6 litres.

(see page 14 for more details)



Minimising water usage

Improvements case by case

On the following pages examples are presented of how Stora Enso's mills have saved water by improving production processes and using new technology. The same improvements cannot always be made everywhere, because each paper mill needs to find individual solutions in accordance with their specific technical level, machinery, products, raw materials and water supply.

Getting the whole picture

As mills have continued to use water more and more efficiently, the concept of a completely closed water cycle has been envisaged. This would be very hard to realise in practice, however. Fresh water will most likely always be needed for papermaking, since the process water and equipment inevitably become contaminated with organic and inorganic compounds released by fibres and other raw materials. These compounds have a negative effect on paper quality, increase the need for chemicals, and make processes difficult to control.

Increasing the extent of water cycle closure at paper mills means that the organic and inorganic materials that are currently removed at waste water treatment plants will have to be removed from the process water internally. At a certain point, the benefits achieved by closing the water cycle reach a peak, after which harmful side effects occur such as the increase of energy consumption and emissions. It is therefore more important to adopt a holistic approach which takes into account all the environmental issues at a mill. This approach is known as total site integration.

Cleaner water

Hylte Mill, Sweden

Hylte Mill's new waste water treatment plant has dramatically reduced discharges of oxygen-demanding substances (COD) into the River Nissan. Surveys have revealed that the mill does not have any significant impact on oxygen levels downstream.

Unpleasant odours have sometimes bothered the mill's neighbours in the past, but the adoption of the latest treatment methods has helped to solve this problem. The cleaning process now consists of three mechanical stages, two biological stages and a chemical treatment stage.

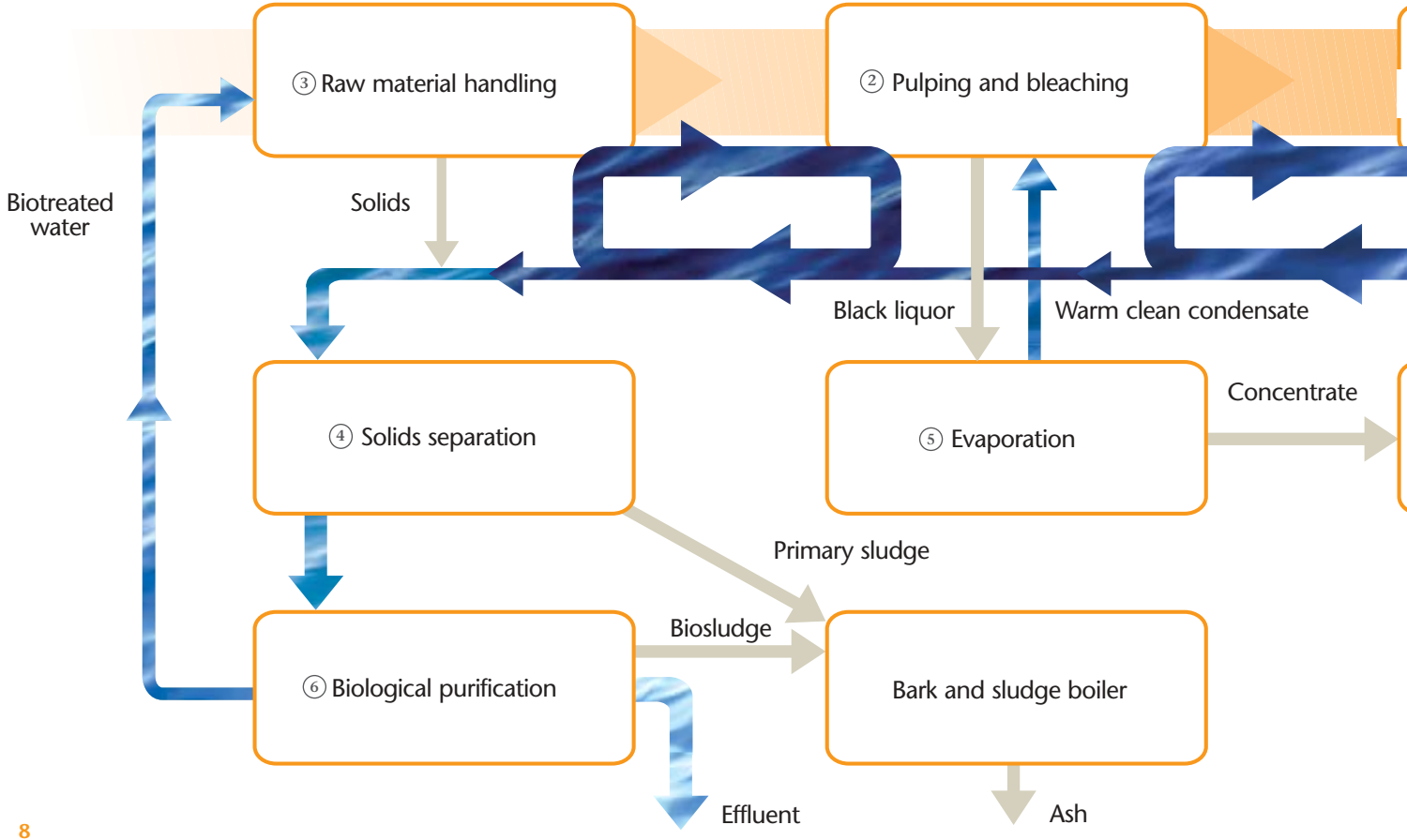
The right water

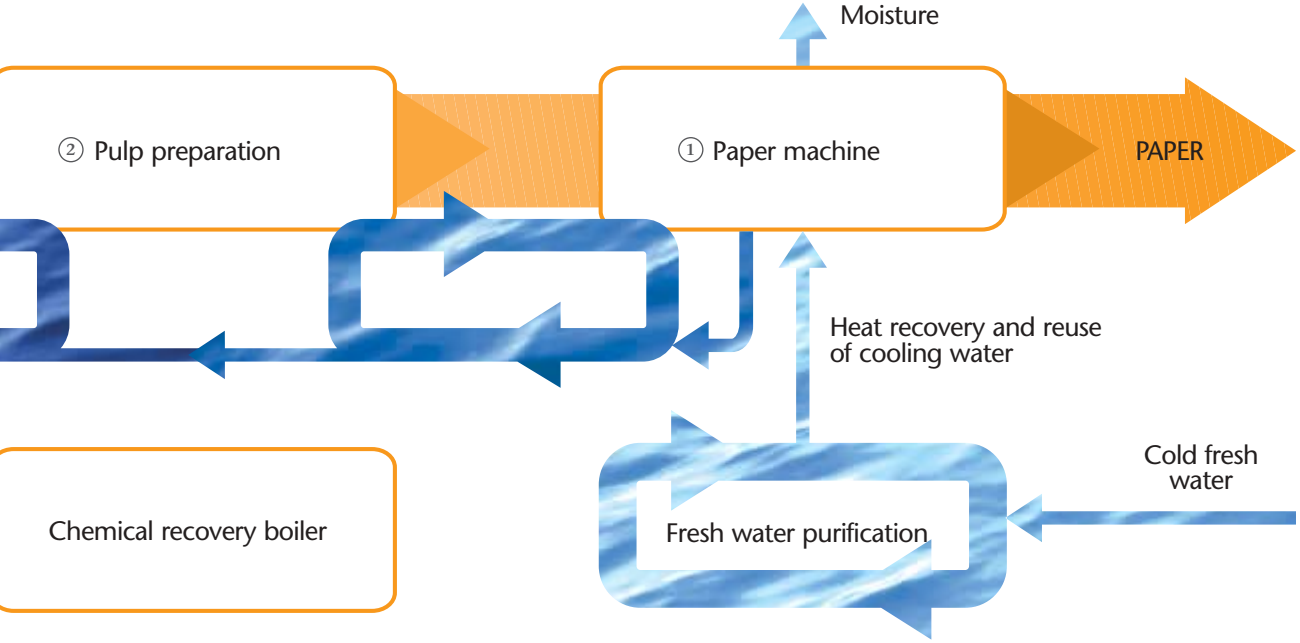
in the right place at the right time

Giant washing machines

The water used in the different stages of the papermaking process has to be of the right temperature and quality for different purposes. The main types of water are cooling water, process water, displacement water and effluent water.

The illustrations on the following pages show how water runs through the system of a mill. In the diagram the fibre flows from left to right, but the water (blue arrows) circulates in the opposite direction. The process works like a series of giant washing machines reusing the same water.


③ Raw material handling
② Pulping and bleaching
Biotreated water
Solids
Black liquor
Warm clean condensate
④ Solids separation
⑤ Evaporation
Concentrate
Primary sludge
Biosludge
⑥ Biological purification
Bark and sludge boiler
Effluent
Ash


Moisture
② Pulp preparation
① Paper machine
PAPER
Heat recovery and reuse
of cooling water
Chemical recovery boiler
Fresh water purification
Cold fresh
water

① Fresh water is fed into the paper machine showers, which need pure water.

② In the production stage water is purified to remove contaminants. Overflow is reused in pulp preparation, pulping and bleaching.

③ Process water from paper and pulp mills and water recovered from biological effluent treatment can be further used in raw material handling processes such as wood debarking and waste paper pulping.

④ Water treatment equipment, such as screens, flotators and clarifiers, are used to separate solid contaminants from the process water.

⑤ Enriched process water is fed into evaporators to separate dissolved materials and recover chemicals. The clean condensate is used for washing, and the concentrate is incinerated in chemical recovery boilers.

⑥ Solids and dissolved material are separated from waste water by biological effluent purification. Biotreated water can be reused in waste paper pulping, for instance. The separated sludge is dewatered and incinerated in boilers to produce steam and electricity.

Less waste water, more paper

Veitsiluoto Mill, Finland

The capacity of Veitsiluoto Mill's biological waste water treatment plant has been greatly increased, thanks to the completion of a second aeration basin and primary clarifier. Sludge handling and the existing aeration basin have also been improved, and the renewal of the whole waste water control system has also involved the installation of another secondary clarifier. These expansions have doubled the aeration capacity at Veitsiluoto and increased the daily waste water handling capacity from 39 000 m^2 to 60 000 m^2.

Paper production at Veitsiluoto Mill will rise considerably now that the fine paper machine no. 3 has been rebuilt. The introduction of a new hydrogen peroxide bleaching process at the groundwood mill will increase the COD loads reaching the mill's biological treatment plant, but thanks to the improvements at the treatment plant, waste water discharges will still be reduced despite the increase in paper production.

Using more recovered paper

Sachsen Mill, Germany

Sachsen Mill's most important raw material is recovered paper, mainly in the form of used newspapers and magazines. The recovered paper is repulped and purified in a modern flotation de-inking plant, and processed into recycled newsprint on a 10-metre-wide twin-wire paper machine. The water needed for this process is pumped to the mill from the nearby River Mulde. Before it enters the paper machine, the water is thoroughly purified in a multistage process including chemical precipitation, flocculation and filtration.

The water cycle

Sachsen Mill's water cycle operates on the counterflow principle. This means that the fresh water goes primarily to the paper machine, where the need for high quality water is the greatest. The two-stage flotation de-inking process to remove printing inks from recovered paper only uses water that has already passed through the paper machine. The various subsidiary water cycles are carefully separated from each other, and equipped with integrated purifiers. Cooling water is reused as process water instead of being directly released into the waste water flow. Heat exchange takes place in the cooling towers.

Thorough waste water treatment

Having passed through several cycles of intensive use, the waste water is thoroughly purified before it is returned to the river. The mill's waste water treatment process includes pre-clarification (sedimentation), waste water cooling, biological treatment including an anaerobic process as well as an activated sludge process, and finally a dissolved-air flotation process with precipitation and flocculation stages. Part of the biologically purified waste water is further purified by passing it through sand filters, after which it can be returned to the papermaking process.

Sludge from the solids separation and biological purification stages is incinerated together with sludge from de-inking to produce energy. Ash originating from the fillers and coating pigments in the recovered paper can be used as a raw material in construction.

Using water sparingly makes sense economically as well as ecologically. Through continuous improvements within the integrated recycled fibre plant, Sachsen Mill has succeeded in reducing the use of fresh water to about 12 m^3 per tonne of paper produced, while at the same time increasing total production.

Dramatic reductions

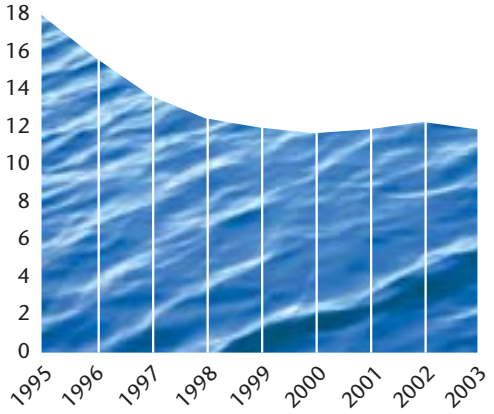
in water use

The weight of the newspaper presented in the example on page 3 is about 250 grammes. On a larger scale, water consumption 30 years ago was about 35–40 m^3 per tonne of paper. Water use has since been reduced dramatically, although the exact figures depend on the raw materials used. Sachsen Mill, for instance, has cut the use of water to 10 m^3 per tonne of paper by using closed water cycles and reuse of cooling water.

The cooling tower technology used at some Stora Enso mills allows the fresh water used for cooling to be repeatedly reused as process water, and then recirculated back through the cooling towers. This reduces heat losses and the need for water treatment, and results in water savings of over 50%.

Total fresh water use

m^3/ t gross production



Glossary

Additives
Pigments and chemicals added to the paper web or fibre and water mixtures in order to enhance the production and properties of the paper.

Biological effluent treatment
Biological treatment using an activated sludge method and clarification is the main process in effluent purification. In the activated sludge stage, oxygen and nutrients are added to the water to support optimum living conditions for the aerobic micro-organisms that transform most of the organic content into sludge for dewatering and incineration. This process greatly reduce the biological and chemical oxygen demand of the effluent.

Chemical recovery boiler
Sodium and sulphur chemicals, used to separate wood fibres in the cooking process, are recovered for reuse in chemical recovery boilers, which incinerate the organic material and drain the chemicals from the base of the furnace.

Clarifiers
Clarifiers are sedimentation tanks used to separate solid particles by gravity. Waste water may pass through a primary clarifier before an activated sludge stage, for instance, and then on to a secondary clarifier. Clarifiers are fitted with scrapers to remove sludge. Sludge from secondary clarifiers is recycled to the activated sludge stage. Excess biosludge and primary sludge is dewatered and incinerated.

Coating
A coating colour paste, consisting of pigments, binders and additives, is spread using blade coating methods on the dry paper web. One side or both sides of the web may be coated with single or double coat layers. Typical pigments are clay and calcium carbonate, while starches and latexes are commonly used binders.

COD (Chemical Oxygen Demand)
A measure of the amount of oxygen needed for the complete chemical oxidation of organic substances in the effluent. Measurement methods, limit values and effluent permits are controlled by the environmental authorities.

Cooling towers
Warm water is sprayed on a hollow plastic structure from above, and as it drips through the structure it meets cool dry air driven upwards. As the air warms, it absorbs moist heat from the water, thereby cooling the water. The cold water is then collected and reused for cooling purposes.

Debarking
Removing bark from logs in rotating drums or with rotary knives.

De-inking
Chemical and mechanical processes used to separate inks from fibres when pulp is made from recovered paper.

Flotators
Compressed air is dissolved in clarified recycling process water. When dispersion water is fed into the main water stream to be purified, air is released, forming micro-bubbles which lift fine solid particles to the surface of a flotation tank. The sludge is then scraped away for dewatering and incineration.

Screens
Machines fitted with slots, holes or fabrics to separate solid impurities from pulp, pigments, additives and water.

Stora Enso Oyj
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