Compact and Controlled Water Management System for P&P Industry

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During the last decades water management and effluent control has gained a continuously increasing attention in the pulp and paper industry. Though water pollution has been greatly reduced, tighter regulations force paper and pulp mills to lower even more their effluent discharge. The design speed of new paper machines has doubled in a short period, and, at the same time, there is a need to improve the economic efficiency of the production processes as well as the quality of the produced products. Today, mills are in a situation where most raw materials are efficiently recovered and fresh water consumption is limited. More and more water cycles in the Paper mills are being closed. In recent years there has been a remarkable development in water treatment techniques. This makes it possible, today, to use such process arrangements, which have not been possible earlier. The new approach to water management is based on separate, compact and controlled water treatment modules inside the different process loops. How much can we lower fresh water consumption? When is additional water purification needed? What type of purification techniques are needed, and where, when the product line efficiency and product quality has to be kept high? The solutions, how the paper manufacture answers the above-mentioned questions are presented in this paper. The water management systems at Holmen Paper, Papelera Peninsular in Spain, at M-Real Kirkiniemi Mill in Finland, in UPM Kymmene Mill in Finland and Domsjo Mill in Sweden are presented and the results achieved are described.

Keywords: Closed water cycles, Effluent treatment, Membrane technology, Pulp and Paper, Process water treatment, Microflotation.

INTRODUCTION

Environmental aspects or availability of raw water are the main driving forces for closing the water systems. Today the pulp and paper industry has to find new solutions to decrease the fresh water consumption, because, like the demands for better product quality and increased use of recycled fibres, require better process water quality, in order to keep machine runnability high.

Reduction in water consumption often reduces energy and improves yield. It often also increases mill white water temperature, which improves water drainage at wire section and gives higher dry solid concentration after the press section. This reduces drying energy costs and increases paper machine drying capacity.

Closure of water systems increase impurity concentrations in white water, which results in decreased retention and increased consumption of retention chemicals, corrosion, poor dewatering together with runnability problems and reduced product properties. Water management is the answer to eliminate these problems.

The basic idea is simple. Effluent load has to be minimized to an acceptable level. Instead of improving effluent treatment, a more profitable alternative in most cases is raw material recovery and water recycling inside the mill process. The load is easier and cheaper to minimise when effluent volumes are smaller.

Optimization of basic process is the key to controlled and compact water management at pulp and paper production. Increased impurity content is eliminated, which is, reduced to the acceptable level by using additional internal water treatment techniques.

The goal is to master the whole equipment, machines and processes to the very finest details. It is an understanding that ranges from fresh water treatment, through optimizing internal water circulations, to the purification of effluent waters.

Minimized effluent volumes are achieved by reducing the fresh water consumption, but disadvantages are eliminated by combining state-of-the-art technologies and solutions in the right way.

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Optimisation of Basic Process

Water consumption in general has been lowered significantly during the past decades. Depending on the system closure additional water treatment is needed or not. A lot can be done by following basic process arrangements. Steps to controlled water management, figure 1, describes the most important process arrangements, which has to be taken into account, before additional water treatment is worthwhile and can effect the final paper quality and machine runnability as it should.

The reduction of fresh water consumption starts by optimizing the main process itself. This means that basic rules has to be followed step by step. In the early steps one needs to consider where process waters can be safely used instead of raw water. For instance, some chemical dilutions and paper machine showers can be safely changed to use clarified white water.

When water consumption levels are down to 10 m^3/t, it comes a time, when basic process arrangements need additional water treatment by side, and new solutions for water recycling are needed to ensure good machine runnability and good product quality.

Too often it turns out that money is wasted: The paper manufacture has invested in some additional water treatment system, but the basic process arrangements have not been optimized first. In those cases water treatment costs unnecessarily increase the production costs.

Independent Kidneys

Water treatment kidneys are quite commonly accepted all over the world. The only question is, where and when to use the kidneys, and, how to arrange the process connections. Metso Paper water treatment solutions are based on independent Kidneys in the Paper Mill and Pulp Mill. Water is purified inside the separate process loops in the paper mill and pulp mill, but with common reject and sludge treatment connected to efficient biological treatment. Extra filtrate from the pulp and paper mill and filtrate from reject treatment pressing are treated with biological treatment. Depending on the system closure, less or more water is recycled back to the pulp mill after biological treatment, figure 2.

By using independent kidneys system, and total counter-current process connections mixing of different water qualities are inhibited and harmful substances are not spread out into different parts of the paper production line. Whole water system is much more easier to control and water purification can be done more effectively and economically.

Paper Mill Water Concept

Paper and pulp mills can be categorized depending on the fresh water consumption at the mill. In the mills with high or normal fresh water consumption levels, good runnability and paper quality can normally be achieved without any additional Kidneys in the paper mill. Anyway, it is necessary to follow a step by step program. Internal Kidneys are needed only, if runnability for some reason is expected to be too low.

When achieving low or extremely low fresh water consumption levels, the only way to handle the process from the beginning to the final product, is to know, how and where to purify the process.

Figure 3 describes typical fresh water consumption levels for different paper grades [m^3/ ton final paper], and actions to be done in the paper mill, when closing the water system.

Membrane Filtration in Water Treatment

Membrane technology has been used for decades for instance in the dairy industry. The applications in the pulp and paper are still considered new and not yet so much used.

Membrane filtration is a pressure driven separation method. Depending on membrane pore size and separation efficiency it can be classified into:

Ultrafiltration (UF) is suitable for removal of colloidal material, agglomerates and big molecules. It can also separate all bacteria, which is a very important feature. The average pore size of ultrafiltration membrane is 0,05

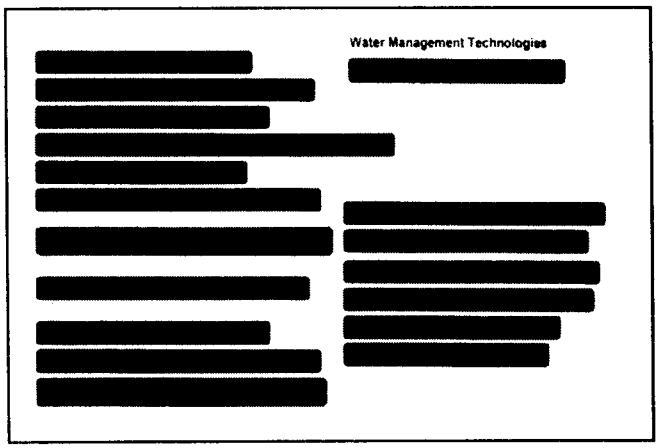

Figure 1 Steps to Controlled Water Management

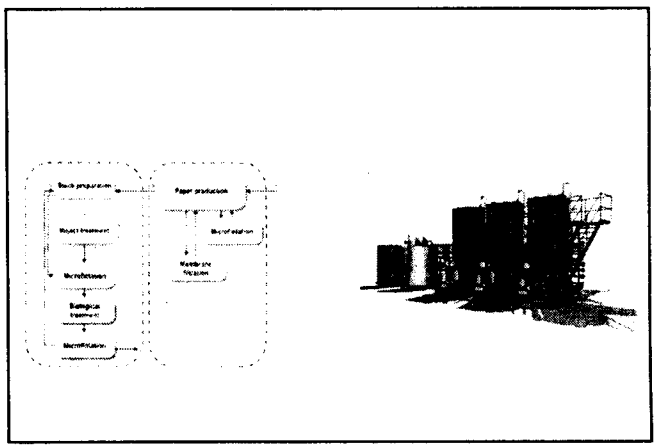

Figure 2 Independent Kidneys (like ultrafiltration) and counter-current principle

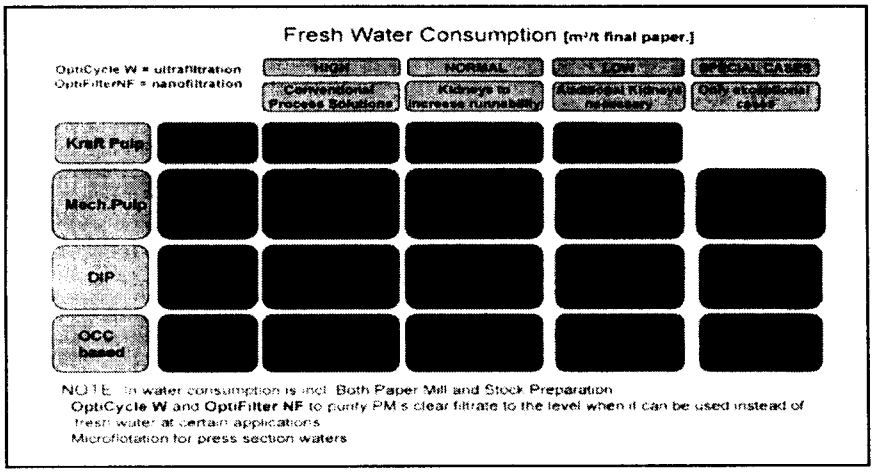

Figure 3 Paper Process Concept

µm.

Nanofiltration (NF) is suitable for removal of molecules having a molecule weight over 300 g/mol (nanometer size) and hard salts, for instance calcium. Thus it can be used for instance for softening of raw water.

Ultrafiltration is an efficient method, amongst others, for removing microstickies. It removes efficiently bacteria and reduces the consumption for biocides. Cationic demand (anionicity) is reduced typically more than 50% thus lowering the chemical costs. Ultrafiltrated water is suitable to be used in washing showers and for dilution of chemicals.

Ultrafiltrated water is excellent for high-pressure showers used for fabric cleaning. Some operators have even claimed that ultrafiltrated water at headbox showers is more suitable than the mill raw water!

Ultrafiltration Cases

OptiFilter CR ultrafiltration-Case Holmen Paper Papelera Peninsular Mill, Spain

Holmen Paper Madrid, chose OptiFilter CR ultrafiltration system to decrease the fresh water consumption from 9 to 7 m^3/ton of paper. Capacity of the ultrafiltration unit is 800-900 m^3/d, producing solid and bacteria free water, which is then used to replace fresh water at certain applications.

M-Real Oyj, Kirkiniemi Mill, in Finland

Kirkiniemi Mill is one of the biggest integrated paper mills in Northern Europe, with a production of 350 000 tons/year magazine paper, 300 000 tons/year fine paper and with own mechanical pulp production.

First CR-filter was installed in 1994 for full-scale tests. Based on the experience from this, today you can find totally 16 units from the mill.

At paper machine PM 3, totally 9 units ultrafilters has been installed. The last step has been to finalize the purification with 1 unit of nanofilter system, which has been installed after the ultrafilters. The capacity of the ultrafilter is 5400 m^3/d and nanofilter 860 m^3/d.

The water consumption in this mill has been reduced today to be on the level about 5 m^3/ton, including mechanical pulping.

UPM Kymmene Tervasaari Mill, in Finland

The latest reference in Finland for ultrafiltration units is at UPM Kymmene Tervasaari mill. Paper mill produces special paper from kraft. The driving force to install an ultrafiltration system was to reduce the fresh water consumption easily.

4 units were installed and started autum 2005.

Total capacity of the ultraclear permeate is 150 m^3/h, which is produced to be used at the paper machine wire section high pressure and some low pressure showers.

Domsjo Mill, Sweden

Though the environment has been a major driver also in this case, other significant benefits have been gained as well.

Domsjo mill produces and sells sulphite pulp throughout the world. Their production capacity is 220,000 tonnes a year.

The mill installed three new cross-rotational ultra-filtration units in December 2000. The initial reason for this was the idea of replacing fresh water used in cooking with treated process water. They have achieved very good results. The feed of cooking liquor to evaporation has decreased by 10 m^3/cook ,which equals a production of 20 tons of pulp per day. Improved yield of resin compounds has increased the production of resin oil by approximately 7 tons per day. The improved washing result and lower resin content in the process waters has improved the pulp quality

CONCLUSIONS

By combining state-of-the-art technologies and solutions in the right way, water consumption and environmental load of paper mills can be remarkably reduced. Ultrafiltration technology has high potential in helping to improve paper machine runnability and to decrease fresh water consumption.

Tight mill closure requires a new way of thinking. The best methods combine pulping department, paper machine and effluent treatment operations. These solutions need a mill wide technical and economical thinking. It should be kept in mind that savings or losses through mill runnability and product quality are much more critical for mill profitability than what water treatment costs are. With wisely organised water management one has the possibility to turn the water costs into savings.