Wastewater Treatment in Pulp and Paper Mill

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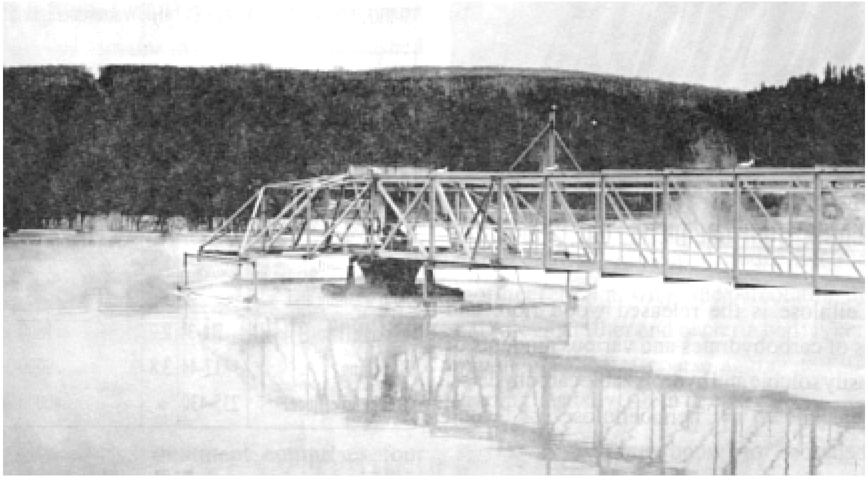

Pulp and paper have a very important role in society. They are used for many purposes in the home, commerce, industry and for education and communication. The raw material is mainly virgin plant fibres though an increasing amount of recycled fibres,f rom waste papers are being used, In 1980 the world production of paper and board was 130 millon tonnes. In addition the growth rate of the industry in Asia/Australia, Latin Amerca and Africa is high and their relative share is likely to increase (1)

The major portion of the pollution from papermaking originates in the pulping process Raw materials are reduced to a fiburous pulp by either mechanical and chemical means. The bark is mechacnically or hydraulically removed from wood before it is redu ced to chips for cooking grinding the wood on large emery or sandston wheels and then carrying it by water through screens. (2,3)

This type of pulp is low-grade. Usually highly colored, and contains relatively short fibres. It is mainly used to manufacture nondurable paper products such as newspaper. The screened bark effluent contains fine particles of bark and wood and some d issolved solids. Additional sources of waster from wood preparation are the pressing of rejects prior to burning and floor drainning. (3)

Wastewater from Chemical Pulp Production

Cellulose is the released wood fibre and consists of carbohydrates and various amounts of other easily soluble and hydrolyzable carbohydrates. These are known as "hemicellulose" or "wood polysaccharose" or "wood gum"

The wood chips are boiled with an appropriate reagent in order to get the incrustants (such as lignin, etc.) out of the wood without damaging the fibres.

Two processes are used for this purpose:

-The acid or sulfite process
-The alkaline soda or sulfate process.

Wastewater from Sulfite Pulp Production

The sulfite process is used for low-resin woods, and also when a light colored pulp is required, especially when the pulp is to remain unbleached. This process is used, for example, almost exclusively for the manufacture of viscose.

To manufacture sulfite pulp, wood chips are boiled at pressure in large iron digesters with calsium sulfite, ammonium sulfite, magnesium sulfite or sodium sulfite, During this process, condensates from containing valuable raw materials (Table 1.)

Table 1 Waste loads and waste-water Quantities in Sulfite pulp and paper mill
Sulfite Pulping and Treatment

Waste loads, in 1b/ton of product			
Sulfite Pulping	BOD	pH	Wastewater quantities gal/ton
Blow tower	116	2.7	1900
Condensated	47	2.6	1100
Uncontrolled loquor	53	2.4	7500
Acid plant wastes	10	1.2	300
Boiler blowdown	22	11	100
Pulp screening	8	5.6	1700-14300
Pulp washing and thicking	7.4-34	2.9	1800-1500
Bleaching	17-44	3.8	9000-3000
Total miil effluent	235-430	-	40000-70000

Sulfite pulping and tratment

In Sulfite pulping the most water pollution are spent liquor, codensates, bleach plant effluents and accidental discharges. During the sulfite cooking process, the dissolution of organic substances increases as the pulp yield decreases. Sulfite yield (kg of pulp/kg of wood chips) range between 35% and 90%. Low yields (35%-45%) are normally associated with the dissolving sulfite process, intermittent yields (45%-75%) with paper and newsprint sulfite processes and high yields (75-95%) with sulfite chem i-machanical processes (eg. chemical thermal mechanical, CTMP).

The organic substances released in the cooking operation are separated from the pulp in washing and screening departments. The spent cooking liqour contains volatile organic compounds, which flash to the condensate when the pressure in the digester i s lowered or when the spent liquor is evaporated.

For 210 kg wood chips, 1000 sulfite solution are needed. In an 8 to 24 hour cooking process the cooking solution dissolves between 5 and 65% (depending on the sulfite process) of the wood constituents. When the extraction is complete, the spent boili ng solution (the so-called coriginal solutione) is drained off. However, residual amount of the solution remains in the fiber, and is washed out with large amounts of rising water (30 to 40 times as much as the actual boiling solution). The spent solution s, together with the washing waters, from the sulfite waste liqours. Other waste water come from the bleaching plants. They contain chlorine or hypochlorite.

Wastewater Treatment in Sulfite Pulp and Paper Process

Conventional treatment comprises four stages of treatment (Fig. 1)

1. Preliminary treatment
2. Primary or physical treatment (sedimentation)
3. Secondary or biological treatment (activated sludge, aerated 1 agoons or biofiltration)
4. Sludge treatments (sludge dewatering)

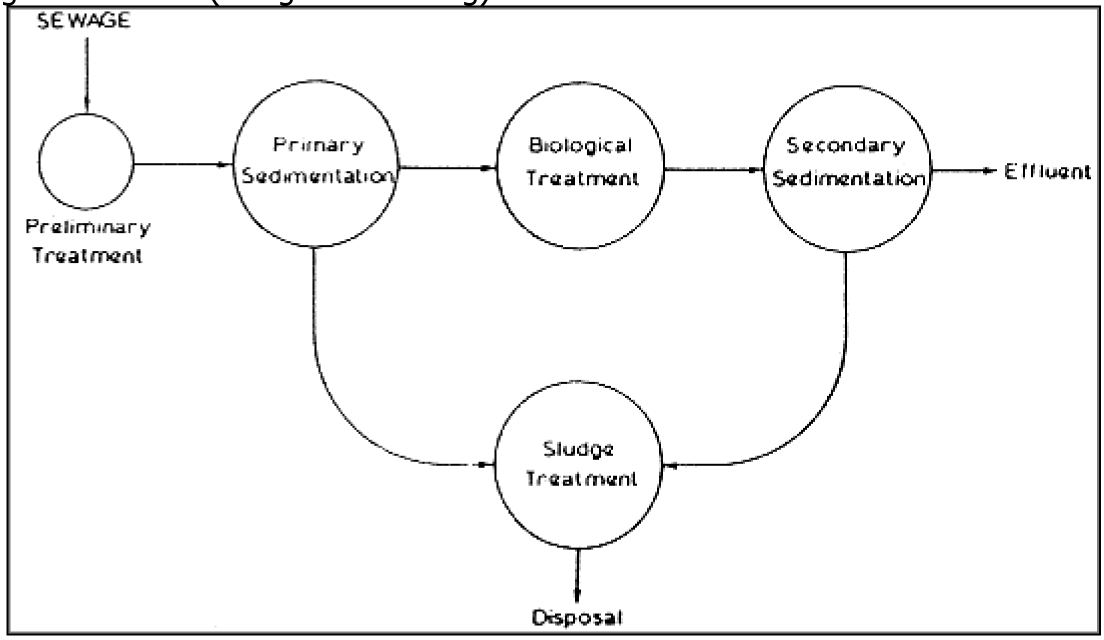

Figure 1 Diagram for conventional sewage treatment

Sedimentation is the gravitational separation of a suspension in to its component solid and liquid phases. In the primary sedimentation of sewage there are two aims:

To produce high degrees of both clarification and thickening. Clarification is the removal of solids from the liquid phase (Figure 2). A high degree of clarification is required to reduce the load on the secondary (biological) treatment plant.

Thickening the removal of liquid from the solid or sludge phase. A high degree of thickening is desirable so that sludge handing and treatment (which usually accounts for 30-50% of the total cost of conventional treatment) is minimized.

The liquid effluent from primary sedimentation tanks is treated in aerated lagoons, biofilter or most commonly activated sludge treatment. The biofilter (also known as the percolating, thickling or biological filter and bacteria bed) is cercular or r ectangular bed of coarse aggregate (30-60 mm grading), usually 1.8m deep.

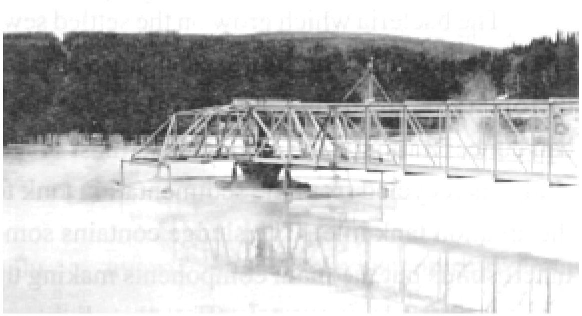

Figure 2 Primary clarifier at **TEMBEC,** Temiscaming, **QUEBEC**

On these surfaces a microbial film develops and the bacteria,which constitute most of the film, oxidize the sewage as it floe past. As the sewage is oxidized the microbial film grows.

settled sewage + oxygenfifi ----> oxydized effluent + new bacterial cells

Some of the new cells so formed are washed away from the film by the hydrulic action of the sewage. These cells exert a high BOD and must be removed before the effluent is finally discharged. This is achieved in secondary sedimentation tanks. The cla rified effluent is discharged usually to river and sludge pumped to the sludge treatment unit.

Activated sludge is the conventional alternative to biofiltration. Settled sewage is led to an areation tank where oxygen as suppiled either by mechanical agitation (Fig. 3) or by deffused aeration.

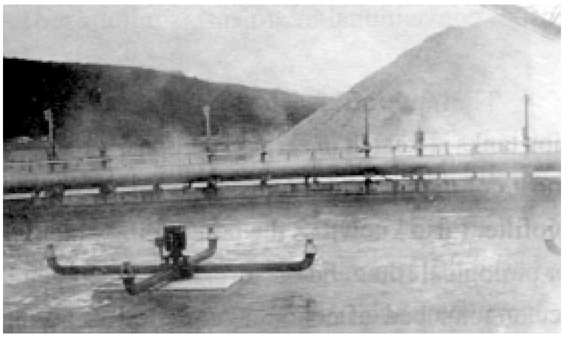

Figure 3 Surface reactor at **TEMBEC,QUE**

The bacteria which grow on the settled sewage are removed in a high rate secondary sedimentation tank. In order to maintain a high cell concentration in the aretion tank, most of the sludge is recycled from the sedimentation tank to the areation tank inlet. The sludge contains some innert solids but the main components making up its loose,flocculent structure (Fig. 4) are living or active bacteria and protozoa hence the name "activated sludge". (6,7)

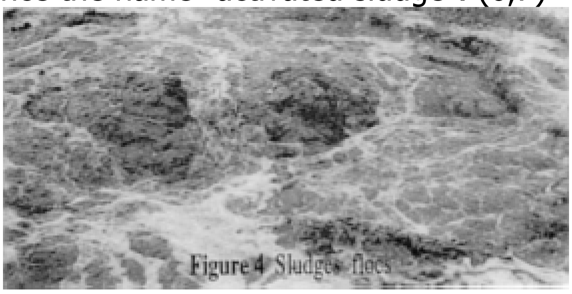

Figure 4 Sludges flocs

Sludges are most commonly treated by dewatering process to produce a cake that has optimal handing properties and solids content for subsequent processing of disposal.

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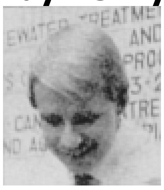

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