Closed Water Effluent Treatment System For A Duplex Board Mill In India Based On Wastepaper

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SUMMARY

Thus as can be seen that the closed cycle concept follows the "in-plant" approach, and water is treated and reused within the plant on each individual processes and machines. This is in contrast to conventional effluent treatment systems, where all waters are lumped togethor and then treated.

The paper industry is one of the largest industrial water users. This industry has therefore been under increasing pressure to reduce the pollution discharges with waste water.

The conventional effluent treatment plant for paper mills comprises of primary clarifier followed by biological treatment. This system is able to remove biodegradable pollutants, but only at a large cost in capital and energy. The recurring cost of chemical additives to sustain the Biological population is an added burden to the cost of operation.

Alternatives to biological treatment systems have therefore been looked for. One such system is 'closed water system in paper mills based on secondary fibres'. In the closed water system, no water and therefore no dissolved or filterable solids, or any bacteria, or any toxic material is dischrged into recieving streams. Any solids brought into the plant with the waste paper and other additives, must leave either with sludge or with the final product.

This system is particularly successfull for paper mills based on secondary fibres A CIOSED SYSTEM for final effluent treatment is economically and ecologically a more attractive proposal. It is attractive economically, because the capital cost is less. It is further attractive because the operating cost is lower than that of biological treatment systems.

Speaking from the environment angle, the CLOSED WATER SYSTEM is certainly more elegant as no water is discharged and therefore
no dissolved substances,
no suspended materials,
no bacteria,
and no toxic materials are
discharged into water recieving streams.

It certainly makes more sense, as paper is being produced from waste-paper, so other than solids brought into the plant with waste paper, no other discharge should take place. And these solids should leave the plant either with sludge or with the final product.

Before the details of closed water effluent treatment system are given, one more short coming of biological treatment systems is highlighted, which has so far been largely ignored :—

Codventional Biological treatment effluent systems in paper mills can give a high suspended solids and BOD_5 load in plant effluent after treatment, when they are upset, leading to sludge bulking problems. The two principal types of sludge bulking problems in paper mills lead to (a) the growth of filamentous organisms, (b) the formation of swelling biological flocs through the addition of bound water to the cells so that their density is reduced.

The conveniional effluent treatment in paper mills based on biological treatment are used by :—

1. Wide fluctuations in waste water pH.
2. inadequate food to micro-organism ratio (F/M).
3. absence of certain necessary trace elements in waste water.
4. inadeqnate mean cell residence time.
5. internal plant overloading.
6. poor sedimentation clarifier operation.

The author therefore urges the pollution boards

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not to push small paper mills based on secondary fibres, toward a system, which is not only prohibitively expensive, but also fails in the longer run. Instead a far more elegant solution is proposed, which not only makes common sence, but is also a far more attractive proposal.

The concept is not new, and paper mills based on waste paper in Europe and elsewhere closed their systems a decade ago. Some mills even had a full fledgee effluent treatment system, which they closed down when they implemented the closed cycle concept.

For closed cycle concept an "in-plant" approach is taken. This means that the water is treated and reused within the plant on each individual processes and machines. The basic operations in the process itself are the heart of pollution problem.

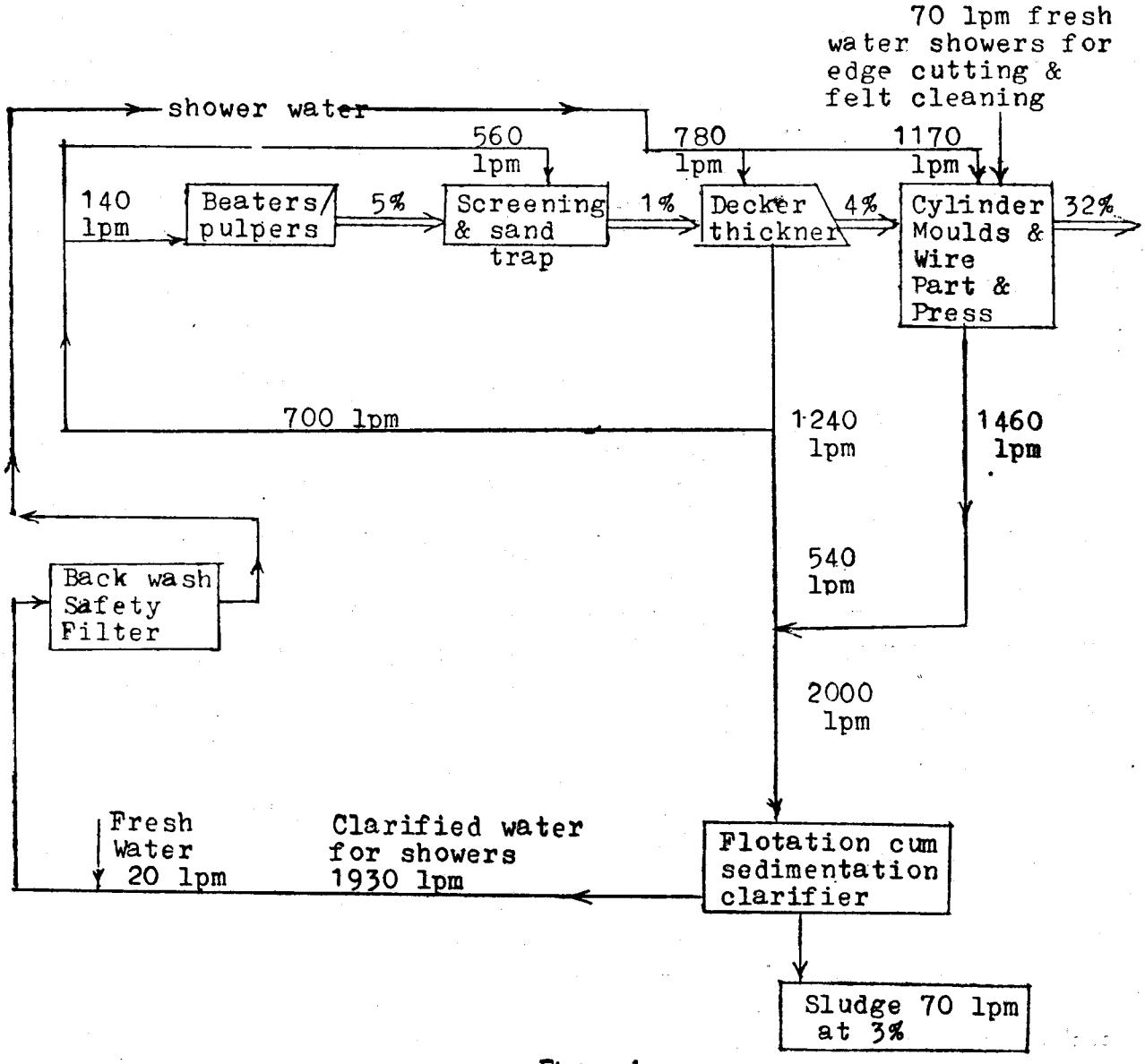
Iet us examine each source for a 10 TPD Duplex board mill based on waste-paper, from where water is generated and its treatment.

Domestic Use : 45 lpm/person/day is assumed to be average. The number of people is assumed to be 120. Thus total water for domestic use will be 5400 litres/day. This water can treated in a septic tank with grease trap and then led to a sand filter. The design of septic tank and sand filter is standard and beyond the scope of this paper.

Water from individual processes in pulp & paper mill

For production of duplex board, two complete parallel lines exist for pulp mill and approach flow. The equipment is beaters/pulpers, followed by vibratory screens, rifflersand trap, gravity thickner, and in approach flow-centricleaners and pressure screens.

The water circuit is given in figure 1, and the water system closure is shown. The material balance is given in table 1.



Figure—1

Secondary and tertiary closure of 10 tpd duplex board mill leading to closed water system..... water balance.

As can be understood from the water balance shown in fig. 1, that tertiary closure is practiced through closure of shower water by clarifying the excess water through (a) Flotation cum sedimentation clarifier (b) back wash safety filter.

The primary and secondary closure of water circuit is already practised by Indian mills. The primary circuit closure is thraugh fan pump. And the secondary closure is by taking the excess water for dilutions in pulp mill and elsewhere. What is needed is the tertiary closure and that is done here by clarifying and then safety filtering the excess water and then taking the same to showers in pulp and paper mill.

MATERIAL BALANCE

	Actual Material Input	Excess Material	Material Retained in Production
White cuttings	415 Kg/ton	104 Kg/ton	311 Kg/ton
White record	890 Kg/ton	267 Kg/ton	623 Kg/ton
Talcum	100 Kg/ton	34 Kg/ton	66 Kg/ton
Total.....	1405 Kg/ton	405 Kg/ton	1000 Kg/ton
Input of waste-paper has 12% moisture and produced duplex board is assumed to have 7% Moisture loss=5%	65 Kg/ton	65 Kg/ton	

Therefore actual ammount of waste/ sludge produced due to bailing rope, cleaning, and by flotation cum sedimentation clarifier=.....340 Kg/ton of production

For 9 tons of production the sludge=3060 Kg/day

Assuming bailing rope to be 60 Kg., Sludge=3000 Kg/day

Table—1

Material Balance for 10 TPD Duplex Board Mill Based on Waste-Paper, which gives the basis for water balance shown in fig. 1

The excess water remaining after primary and secondary closure works out to be 2000 lpm. This is taken to a pit, where the Flotation Clarifier can clarify the same. Clarity is generally below 50 ppm. This clarified water is again stored in a pit for reuse in the mill for closure of tertiary circuit. Extra pits are provided for both excess water and clarified water, which are normally empty. They come in operation at the time of upsets of board mill when extra water will flow out. This is the heart of a closed cycle concept, which is to keep sufficient capacity of empty tanks, which get filled during an emergency.

Flotation cum sedimentation clarifier

The design of the clarifier is in the shape of circular pan tank. The influent is mixed with the air dissolved in partly recycled clarified water and flocculants, just before entry into the clarifier tank. Special provision is made into the tank so that a queisent stage is reached. The dissolved air comes out as microbubbles, and enmeshes in flocs formed by flcoculant and fibres and fillers, carrying them to the top of clarifier tank. The heavy sand particles settle down to the bottom of clarifier tank, leaving the clear water with less than 50 ppm suspended particles.

Thus three clear fractions are obtained viz. (i) floated fibres and fillers along with flocculant (ii) clarified water in the middle with 50 ppm or less of suspended particles (iii) heavy particles like sand at

the bottom. The floated material is taken out by a double scoop; the clarified water by tubes with a longitudinal slot cut in it; and the sedimented material by wipers which sweep the bottom and put the sedimented material in a sump from where the same can be purged by an automatic purge valve. Thus the Flotation cum sedimentation clarifier also acts as a fractionator.

The floated fibre and fillers could be good enough to be re-used in the bottom layer of duplex board. This would lead to fantastic savings for the Mill, as would be further discussed under economy.

Back Wash Safety Filter

This device is of a very compact design and has all the internal parts made of stainless steel. A drum made of stainless steel ribs and having a 100 mesh stainless steel wire mesh covering, is divided in four sectors. Through a teflon seal at the bottom clarified water enters into three sectors and is filtered. The mat that forms on the wire mesh helps in filtering even finer. The builtup of pressure is indicated by a differential pressure switch which sounds an alarm when critical pressure is reached. The operator than rotates the filter drum bringing the unused fourth sector into operation. At the same time he opens the back wash filter vrlue. Every half minute the operator rotates the filter drum by 90°, and backwashes each sector in turn. Thus for two minutes every shift operator attention would be recquired to backwash this very compact safety filter.

The suspended particles in filtered clarifed water would be less than 10 ppm. If further protection of showers is recquired then the showers can be provided with rotory brushes mounted on a shaft inside the shower pipe, which can be rotated from a handle, cleaning shower holes when desired.

Water for steam generation

For 10 TPD production steam generation is assumed to ce 4 ton/tons of production, Assuming 40% condensate the water recquirement works out to eb 24 cubic meters, per day.

Refiner Cooling Water and vacuum pump sealing water

This is calculated to come to 400 lpm. This water is generally clean enough and after lagooning and filtering can be recirculated into refiner cooling and pump sealing. A device can be provided to skim off the oil and grease that may accumalate.

Fresh Water is also needed in edge and tail cutters on the paper machine. This water is, however, recirculated througe the clarifier and goes into making up the water recquirement. A short fall of 20 lpm is also added as fresh water to clarified water (please see fig. 1)

Economy

The total cost of machinery, pumps and civil construction of closed cycle effluent treatment system is estimated to be Rs. 7.5 Lacks. This is far cheaper than the conventional effiuent treatment system, which along with all machinery, accessories and civil construction is estimated to cost Rs. 22.0 Lacks.

The cost of operation of closed cycle effluent treatment is estimated to be Rs. 1500/- per day. This includes the cost of flocculants, electric power, wages for operators, maintainence, and interest on capital. It is estimated, however, that 2.5 tons of material can be recovered per day for bottom layer. The rests of 0.5 tons per day is discharged to sludge beds for drying. This material will be discharged through the purge valve of flotation cum sedimentation clarfier.

Assuming the cost of recovered material for bottom layer to be Rs. 3000/ton, the total recovery will be 2.5 x 3000=Rs. 7500/day. After deducting the cost of operation (7500—1500) a nett income of Rs. 6000 results per day, which is equal to Rs. 20 Lacks per year. In contrast the conventional effluent treatment will cost at least Rupees 8 Lacks per year in running cost apart from the higher capital investment. Thus the closed cycle effluent treatment adds substantially to operating economy of the mill.