

# Advances in twin wire washer and effluent treatment plant design

Dewan Deepak\*

---

## ABSTRACT

Twin Wire Washers and Anaerobic digestors are becoming necessary for agro based pulp mills. Twin wire presses promise a better washed pulp at a substantial saving in power and capital cost. High rate anaerobic digestors, on the other hand, give a substantial benefit by way of cost effectiveness. For the first time pulp mills can talk about a return On capital on effluent treatment plants. The paper describes advances of such systems.

---

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

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 at a large cost in capital and energy. Alternatives to conventional treatment have therefore been looked for, viz : Closed water System and High rate Anaerobic treatment (Biogas).

### Closed Water System :

In the closed water system, no water and therefore no dissolved or filterable substances, or any bacteria, or any toxic material is discharged into receiving stream. Any solid brought into the plant with raw materials must leave either with sludge or the finished product.

This system is very suitable for mills based on secondary fibres, and economically and ecologically very attractive. The primary and secondary closure of water circuit is already practised by Indian Mills through fan pump and taking excess water for dilutions in pulp mill. The tertiary closure is now being increasingly practised by Flotation Clarifier also called

Saveall. The excess water containing fibres is clarified and the recovered fibres fed back into production and recovered water for dilutions and showers. As both water and fibres are reused, in the process the flotation clarifier is called SAVE-ALL.

### Flotation Clarifier :

The design of the clarifier is in the shape of a circular pan tank. The influent is mixed with air dissolved in partly recycled clarified water and flocculants, just before entry into the clarifier tank. Special provision is made in tank to reach quiescent stage quickly. The dissolved air comes out as micro-bubbles, which enmesh the flocs formed by fibres and flocculants, carrying them to the top of clarifier. The heavy particles settle down leaving clear water in middle. The equipment is small in size and can be located anywhere.

### BIOGAS :

Anaerobic wastewater treatment of Agricultural residue based pulp mill Black liquor could become necessary, as it generates surplus energy, instead of

---

\*President, Dewan Kraft Systems Pvt. Ltd.  
N-127, Greater Kailash-I, New Delhi-1

consuming energy as in conventional Effluent treatment plants. High Rate Anaerobic reactors not only save valuable energy by reducing requirement of aeration substantially, but save FUEL as well, by burning methane produced in the boiler.

A number of competing high rate anaerobic reactors have emerged in the past decade. They are broadly categorised as under

Contact reactors

Anaerobic Filters

Sludge Bed Reactors (UASB)

Fluidised Bed reactors.

A number of reactors use more than one principle and are called mixed reactors.

At present the largest number of High Rate Anaerobic Reactors working successfully in the world on Industrial Wastes are UASBs. Upto 20 Kg COD/ $m^3.d$  can be loaded on a UASB working on Black Liquor from an Agricultural Residue based Mill. This would imply 1000  $m^3$  reactor for a 10 TPD pulp mill and 3000  $m^3$  reactor for a 30 TPD pulp mill. This is in contrast with  $2 \times 6200 m^3$  reactors required for a 30 TPD mill if Contact type reactors were used.

The cost saving is significant as Electricity required to destroy one ton COD by Aerobic means would be 1100 Kwh, whereas by UASB it would be 15 Kwh only. In addition 0.4 to 0.5  $m^3$  of methane is available for every Kg. COD destroyed, with an energy of 5400 Kcal/ $m^3$ .

A number of Paper Mills in the country have been forced to invest in Electric Generators. As biogas is being used to run gen-sets the paper industry can use biogas for this purpose, leading to substantial savings.

The technology for Anaerobic Digestion is fairly well established. The reactor can be easily controlled. Simple procedures and ordinary training to Mill Chemists would suffice to control these reactors. The potential benefits indicate that Anaerobic reactors could nullify the burden on the mill for ETP running costs.

The advantages are :—

- (a) The digestors can be built in concrete in rectangular shape.
- (b) they can be modular, and extra capacity can be added easily.
- (c) investment is lower, as they have a high loading rate, with an efficient 3 phase settler. Also No imports needed.
- (d) sludge recirculation and/or mechanical agitation are not needed.
- (e) low power requirements.
- (f) sufficient buffering provided, for digester to withstand peaks of hydraulic and solid loading and temperature fluctuations.

## Aerobic Treatment

A vast amount of funds have been spent on waste water treatment. This will eventually result in significant improvements in the quality of water of most of our rivers, streams and near shore areas. But as a whole results are still far from satisfactory. The reason is that the technical equipments, design of plant and management of the biological life is not adequate.

To run these plants adequately to meet the pollution standards, suggestions are frequently made by the consultants, to make new investment in far larger dimensions of ETP. New Technology could also be of considerable help.

## New Technology :

### 1. Bioflock :

This is an active substance which can be used for biological purification of wastewater. The effects become noticeable after a short period of time. After Bioflock is applied for 6 to 12 weeks a sturdy and vigorous bacteria strain has been established which has the ability to degrade organic substances.

## 2. Non-Clog Fine Bubble Diffusers :

These fine bubble diffusers can be added to aeration tank at a very low capital investment to enhance the aeration. These are about a meter long and rectangular in shape, with c.s. of 120 mm × 120mm. These are laid at the bottom of the aeration tank and have a 25 mm connection for feeding in of compressed air. The air is generally compressed by twin lobe rotary compressor or a centrifugal compressor. As there is complete flexibility of locating these diffusers, the aeration of tank can be increased, without changing the existing arrangement.

## 3. Lamella Clarifiers

To increase the efficiency of existing primary and secondary clarifiers, Lamella packs can be used to enhance their clarifying ability. The beneficial effect of the presence of inclined surfaces in a vessel designed for sedimentation has been known for a considerable period of time. It was, however, only in 1960's that the simple application of lamella separator received full industrial attention. A considerable data has been gathered by the manufacturers of such devices to cater to all kind of industrial needs.

## Sludge Management

One of the most troublesome problems facing the pulp & paper industry is sludge disposal. Most sludges are thin aqueous suspensions of waste material. Their makeup generally depends on the type of mill, whether it is waste-paper based, agro-based etc. Sludges are at present being sent to sludge beds by most mills, and occupy a lot of land and are unpleasant to manage.

## Belt Filter Press

Some mills attempt to dewater sludges by mechanical means, like centrifuge, vacuum methods. One of the latest method for doing the same is by Belt Filter Press

Sludges are hard to dewater because of the hydrous nature of the fine pulp fibres that form their main organic constituent. These fibres are highly swollen and have almost colloidal gel structure. The freeness of the

fibres is low because of intrinsic hydrophilicity of the fibre polysaccharides, cellulose, and hemicelluloses. The situation is aggravated by kaolin, pigments, starches, dextrans, and similar materials.

Most mills therefore practice disposal by landfill. It may, however, become increasingly difficult and costly to obtain and maintain ample sites for landfilling. Some legislation in this regard in near future cannot also be ruled out.

Some of this regulation may be about (a) questions of soil stability (b) land use (c) spoilage of land by formation of impenetrable clay sticks (d) poor drainage in some areas that causes uncontrollable runoff and related pollution phenomena.

There is therefore a need for new and effective methods of sludge disposal. All Belt Presses are based on principle of draining large quantities of water using hydrostatic pressures. In Belt Press optimal dewatering of sludge is done by applying a steadily increased surface pressure and making use of shear forces in straining zone, pre-pressing zone and re-pressing zone. The advantages are (i) low energy requirement (ii) very little space requirements (iii) low operating cost (iv) no elaborate foundation (v) low capital cost (vi) low maintenance (vii) time taken for dewatering 2-5 minutes (adjustable).

## Modern Effluent Treatment Plant

A modern Effluent treatment plant for treatment of effluent from 50 TPD agricultural residue mill utilising the modern concepts as recommended by the committee at International workshop organised by UNIDO & CPPRI at New Delhi in September 1991 consists of

- (a) ANAEROBIC REACTOR (UASB) generating biogas and reducing BOD by 90%
- (b) CONVENTIONAL aerobic treatment (or one using non-clog fine bubble diffusers and lamella clarifiers,
- (c) using flotation clarifiers to recover fibres and reuse water
- (d) using belt filter press for dewatering of sludge

Table 1 gives the rating table for dewatering devices.

Performance Of Dewatering Devices :

TABLE-1

PARAMETER	Weight factor	Centrifuge		Vacuum Filler		Belt Filler Press		Pressure Filler	
		Rating	Weight	R	W	R	W	R	W
		R	W	R	W	R	W	R	W
Capital cost	7	3	21	2	14	4	28	1	7
Installed cost	5	2	10	1	5	4	20	3	15
O&M Cost/gr	6	4	24	2	12	3	18	1	6
HP	3	3	9	2	6	4	12	2	6
Cake Solids	8	1	8	2	16	3	24	4	32
Noise	2	3	6	2	4	4	8	2	4
Conditioners	4	3	12	2	8	1	4	7	28
Solids capture	8	2	16	3	24	4	32	4	32
<b>TOTAL SCORE</b>			106		89		146		130

**Conclusion :** The rating table shows that **Belt Filter Press** is comparatively more advantageous in comparison with other dewatering devices.

### Twin Wire Washing Of Pulp

Agricultural residues differ from forest based raw materials in morphological and physicochemical characteristics, and processing depends on nature of fibres, raw material and fibre process system, cooking, bleaching, refining etc. The washing of pulp is an important step in the processing of these fibres. Efficient washing of pulp results in lower soda loss, less carryover reduced volume of spent liquor resulting in lower energy and capital demands for further treatment of black liquor.

The washing efficiency is defined as the amount of sodium or lignin removed when the liquor in the pulp pad has been replaced by an equal volume of clean water, divided by the total amount of these solutes removed. In all commonly used industrial pulp washers, washing is achieved by dilution/extraction, by displacement, or by a combination of these two principles.

Dilution/extraction, the oldest method of pulp washing, consists of diluting the pulp slurry with weaker liquor, followed by thickening of the slurry by filtering or pressing. This method to remove all solutes requires either (a) infinite repetitions or (b) removing all liquid in dewatering stage and preventing solute re-absorption. This is clearly not possible.

In displacement washing, wash water passes through the pulp pad as if a piston was pushing out liquor. Although there is mixing of the wash water & liquor, slow diffusion of solutes, and sorption of solutes on pulp fibres; still for the same amount of wash water displacement washing is more efficient than dilution/extraction. The current trend in pulpmills is to use counter current multistage vacuum drum washers for pulp washing. The disadvantages as compared to Belt Filter Press (also displacement washing), are (i) high dilution factor (ii) large filter surface area (iii) high consumption of energy (iv) low consistency of filter cake (v) frequent requirement of cleaning of surface (vi)

frequent breaks in continuous mat pickup for agro residues like rice wheat straw and bagasse.

It may be noted that (i) an increase in pad thickness significantly improves washing efficiency (ii) increasing superficial velocity also helps within limits (iii) the effect of temperature and inlet consistency is minimal on washing efficiency. The washing efficiency is also dependent on consistency at which washing actually takes place. It is more important to have good displacement at a high consistency than to have counter current washing.

The advantages of Belt Filter Press (double wire washer) are numerous

- (a) The washing efficiency of BFP is superior to conventional four stage filter drum wash system.
- (b) At comparable washing efficiency BFP requires only half the water.
- (c) The power consumption of BFP is 1/4th of drum washers.
- (d) The capital cost is about 1/3rd, as the equipment does not require elaborate civil structures, big wash liquor tanks etc.
- (e) Washing efficiency upto 90% can be achieved without addition of wash water, because of high consistency achieved at the press zone.
- (f) In the wedge zone of the double wire washer, the total dissolved solids filtrate is very close to dissolved solids in the liquor from blow tank.

There is, therefore, sufficient scope for the Indian paper industry to utilise the double wire washer for agro based mills for energy conservation, less capital investment, higher output and less chemical losses. One such twin wire washer is already in production in an Indian Paper Mill for 40 TPD bagasse. Another for 50 TPD rice straw will come soon in production.

## References :

- Silver Jubilee International Seminar IPPTA, New Delhi-1989
- 1 A new economical approach to pulp washing..... Deepak Dewan.
  - 2 Application of Double wire belt washer concept for efficient washing of agricultural residue pulp .....S Bhaskar et al
  - 3 Modernisation & renovation of the Paper Industry .....Sunil Goel et al
  - 4 Anaerobic treatment by UASB of Agro Mill Black liquor.....Deepak Dewan
  - 5 Experience and results of first anaerobic treatment plant for pulp mill effluent at Pudumjee Pulp & Paper Mills Ltd , Theregaon Pune..... V.D. Khonolkar et al
  - 6 Increasing Efficiency of Effluent Treatment Plant .....Deepak Dewan
  - 7 Advances in Sludge Management..... Deepak Dewan
  - 8 Making Profit out of Pollution Control..... Deepak Dewan,  
Environment Issue, 22nd Dec. 1990, Economic Times, Delhi
  - 9 Environmentally beneficial Waste Treatment..... Deepak Dewan  
Environment Issue, 22nd Dec. 1990, Economic Times, Delhi.
  - 10 Advances in treatment of Black Liquor from Agro Based Pulp Mills.....Deepak Dewan..... National Workshop on Chemical Recovery in Agro Paper Mills 91.