Water Conservation in Pulp and Paper Industry by Micro Plate Settler

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Abstract

Present Study is oriented in signifying the application of Micro plate settler for pulp and paper effluent streams. Major four streams where MPS finds its application are Wash water from Wet Cleaning (Agro based Industries), Machine back water, Black Liquor and Pulp mill Effluent. Successful installation of MPS has been installed for wheat straw wash water, Machine back water at Shreyans Industries Ltd. and Eco Tech respectively. Suspended and Organic load were reduced to the tune of 70-85% and 30-33% for wheat straw wash water undergoing anaerobic treatment. The underflow consistency reached as high as 2.3% thereby making sludge treatment very easy.

Successful trial of MPS was also made at Yash Paper for Double Decker filterate resulting in cutting down the suspended impurities to the tune of 95% and organic impurities in the form of particulate to the tune of 25-50% with the aid of polyelectrolyte dosing and underflow consistency of recovered fibre 2-2.5%. Pilot plant study of MPS was also installed at Star Paper Mill, for Machine back water (Writing Printing) and TSS of less than 50 ppm were achieved and the full scale MPS of capacity 120 m^3/hr is installed recently and its performance evaluation in terms of its underflow consistency and TSS is in consideration. Excellent settling area, low retention time and low footprint area are some of its key features

Keywords: Micro Plate settler (MPS), Wash water, Machine back water, Black Liquor, Pulp Mill Effluent.

Introduction

Micro plate settler used for the separation of solid, from liquid streams by the virtue of its high settling area, the concept based on hazens law i.e. the setlling of suspended solids is the function of settling area. Development of Inclined plate settlers, Tube settlers and Micro plate settlers finds its design from the roots of hazens law only. Micro plate settler designed by Sharad Projects (I) Ltd finds its vast application in pulp and paper industry, water industry, Textile industry, Pharmaceutical industry and many more, where large streams of effluents are generated from different processes, operations with high Suspended loads. Some of the streams from pulp and paper industry (both Agro based and Wood based) where Micro plate Settler finds its vast application are mentioned below:

- Wash water from wet Cleaning (Agro based Industries).
- Machine back water.
- Black Liquor.
- Effluents from pulp mill Effluent.

Due to stringent norms formulated by Central Pollution Control Board for both water consumption and wastewater discharge makes it mandatory to recycle effluent after its proper treatment keeping in view the desired characteristics of effluent at process and existing characteristics of the effluent before treatment which is covered in following sections.

Effluent Streams

The major four Effluent streams for pulp and paper industry mentioned above are discussed in detail keeping in view of its characteristics and application of Micro plate settler for the same.

Wash water from wet cleaning

It is necessary to treat the agro based material like wheat straw or baggasse at wet cleaning plant to remove impurities like sand, stones and chlorides before being taken to pulping.

Proper washing ensures effective operation of the following processes and unit operations. For industries having Soda recovery like Shreyans the first in Asia to go with it, will help effective functioning of Evaporators and Fluidized reactors converting Weak black liqour to soda (Na_2CO_3), as the removal of impurities like sand and chloride will not form high scales on the tubes of evaporators and accumulation of sand in pipelines, Fluidized bed and Venturi Scrubber.

Wash water Characteristics from wheat straw process is discussed in Table 1. After Installation of Micro plate settler following outlet parameters were achieved as discussed in Table 2. As observed from Table 3, average 80% of the suspended load is removed with excellent underflow consistency of 1.5-2% compared to 1% of consistency in Conventional clarifiers without the aid of any polyelectrolyte,

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Table 1: Inlet Parameters of Wheat straw wash water.				
Parameters	Unit	Maximum	Average	Minimum
pH	-	7.5	7.1	6.7
Chlorides	mg/l	1800	1400	1000
TSS	mg/l	4500	3500	1600
COD	mg/l	5300	4400	3500

Table 2: Effluent Parameters of wheat straw wash water.				
Parameters	Unit	Maximum	Average	Minimum
pH	-	7.5	7.1	6.7
Chlorides	mg/l	1800	1400	1000
TSS	mg/l	700	600	380
COD	mg/l	3700	3000	2400

Table 3: Removal efficiency by MPS for Wheat straw wash water.	
Parameters	Removal (Percentage)
TSS	70-85
COD	30-33

therefore making the sludge handling and stabilization operations easy. 20-30% of the treated effluent can be recycled thereby cutting down the fresh water consumption by 20-30%. COD reduction to the tune of 30% i.e. 30% of particulate COD reduction reduces the load on ETP and therefore large savings in power owing to aeration in Activated Sludge Process.

Machine back water

In sensitive applications like paper making, a general rule of thumb is the further along the process you get, the more expensive it becomes to separate the solids or fibre from liquid stream. In the wire section where natural drainage of water occurs by gravity which is collected in rich wire tank. Vacuum pump in the wire part and press section sucks water from the sheet. This stream of effluent is rich in fibre which should be recovered from the liquid stream for recycling of both backwater and fibre. Several technologies available for this treatment which include Disc filter or Dissolved Air floatation. The comparison of these technologies with Micro plate settler for Machine backwater is shown in Table 4.

Table 4: Comparison of MPS with Disc filter and DAF for Machine Back water Treatment.			
Description	Micro Plate Settler MP-S	Disc Filter	DAF
Application	To handle Paper Machine Back Water/ ETP Water/Decker Water.	To handle Paper machine / Pulp Mill Excess Water	To handle paper machine excess water
Process	High Settling area of plates.	By Multiple stage screen.	By Flotation Air Dissolving system.
Power	2 – 5 HP (For Flow: 100 m^3/hr).	50 HP (For Flow: 100 m^3/hr).	70 HP (For Flow: 100 m^3/hr).
Recovered Stock	Consistency is uniform throughout the operation.	Require thickener to maintain uniform consistency.	Consistency may vary with variation in air pressure & chemical dosing.
Outlet Consistency of Recovered fibre	3.0 – 4.0 %	3.0 – 4.0 %	2.0 – 3.0 %
Water Quality at outlet	Almost clear water (100%) with less than 100 ppm.	Water clarity in three streams 1) 55% clear water (100-250 ppm) 2) 20% cloudy water (400 ppm) 3) 25% super clear water (50-100 ppm)	Water with less than 100 ppm. No cloudy stream. Total oulet water clarity will be same.
Inlet Consistency	It can handle 0.1 to 0.7 %	It can handle 0.8 % (extra addition of sweetener for maintaining 0.8% consistency, if input consistency is 0.2-0.3%)	It can handle 0.1 to 0.7 %
Installation	Installation is very easy (At ground level).	Required higher floor level of +10m. And seal pit/chests are also required.	At Normal Floor. May be at 2-4.0 m height. Recovered fibre & clarified water are added directly to the chests by gravity.
Shower water	Not Required	Required- about 300 LPM.	Not Required
Chemical	Required for better results.	Not Required.	Required.
Consumable	No consumable (Media gives longer life), Almost zero maintenance.	Filter cloth need to be replaced.	No clothing required & ADT has to be changed
Installation Cost	Very Low cost	High cost	Low cost
Air Pressure	Not Required	Not Required	6 – 7.5 kg/cm2
Maintenance	Not Required or very less.	Required	Required
Man Power	Not Required	Required	Required
Advantage	All the fibre settles down and can be automatically (Pneumatic valve) recovered.	No sedimentation, Layer formation on membrane.	Sedimentation cum flotation.
Cost	Low Capital Cost	Very High Capital Cost	High Capital Cost

Table 5									
Inlet Parameters			Outlet Parameters			Underflow		Reduction (%)	
pH	TSS (mg/l)	COD (mg/l)	pH	TSS (mg/l)	COD (mg/l)	pH	TSS (mg/l)	TSS	COD
5	2360	4240	5	180	3920	5	20000	92	7.5
5	1760	4240	5	140	2880	5	18500	92	32
3	3120	5280	3.2	420	2240	3.2	13000	86	57
5	3840	5840	4.5	640	4560	4.8	21680	83	22

From the above Table 4 it is clear that the high consistency of recovered fibre of the order of 3-4% compared to 2-3% in DAF, and very low Suspended solids in the liquid stream, both liquid stream and recovered fibre can be reused again in the process. The liquid stream could be used for dilution of pulp in stock preparation.

For trial MPS was installed at Yash Papers Ltd. for Double decker filterate and the results obtained are presented in Table 5. From the Table 5 suspended load and organic load were reduced to the tune of 83-92% and 22-57% respectively with polyelectrolyte dosing of only 2-3 ppm.

Pilot Plant study of MPS was also installed at Star Paper Mill, for Machine back water (Writing Printing) and TSS of less than 50 ppm were achieved as a result of which Management of Star Paper Mill decided to install 120 m^3/hr MPS and its performance evaluation in terms of its underflow consistency, outlet TSS is in consideration.

Black Liquor

Black liquor generated from pulp mill section by countercurrent washing of unbleached pulp at Brown-stock washing received from cooking of wheat straw by M.P steam. Fresh water or condensate from multiple effect evaporators is utilized for washing of unbleached pulp through showers to recover cooking chemicals and to obtain satisfactory quality for subsequent processing. The important chemical species in this process are sodium and lignin. In addition TDS is also of concern. Apart from it black liquor also contains high suspended impurities provided if the wet cleaning operation is not efficient, resulting in choking of pipelines and Venturi scrubber at Chemical recovery section. To address this problem, MPS should be installed prior to Multiple Effect Evaporator which would trap the suspended impurities and at the same time owing to its low retention time of the order of 30-35min the temperature of the liquor will also not drop much.

Effluent from Pulp Mill Effluent

Large fraction of the wastewater generation originates from Bleaching of pulp and the characteristics of this effluent stream are function of process and raw material. The quality of paper desired in terms of its brightness, smoothness, strength decides the characteristics of effluent. General Characteristics of effluent from pulp and paper industry is tabulated in Table 6. As can be observed from Table 6, treatment for such effluents require Primary treatment to capture suspended impurities, and hence MPS can replace primary and secondary clarifiers at ETP thereby offering low retention time and footprint area mentioned below.

Micro Plate Setller

Micro plate settlers are settling devices consisting of stacked offset plates made up of stainless steel. They are based on the theory defined by Hazens law that settling depends on settling area rather than detention time. To be self cleaning, plates are set at an angle of 45 to 60° above the horizontal. In MPS cross flow passage is designed for liquid and solid flow. MPS finds its application in Food and Brewery, Textile, Sugar, Pharmaceutical and water industries.

Figure 1: Micro Plate settler

Advantages of MPS

- Low HRT of only 25-30 min makes the unit very compact, light weight with high specific clarification.
- Volumetrically less than 1/5th size of Conventional Sedimentation Clarifier.
- Efficiency 90-95%.
- Low HRT eliminates chances of septicity of fibre.
- Plates are made up of Stainless steel. So it provides a non sticky surface to solids to flow, hence enhances separation efficiency.

Conclusion

From above text we conclude that Micro plate settler will help pulp and paper industry to minimize water input, power input, reduces organic and suspended load on the ETP. Its application at different effluent streams will bring smooth functioning, operation and maintenance of the operations following it and hence large saving in O&M costs.

References

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Table 6: Characteristics of pulp mill effluent [European Commission, 2015, BREF "Pulp & Paper".

Process	Yield	Wastewater volume (m^3/t)	BOD5 (Kg/t)	TSS (Kg/t)	COD (Kg/t)
Mechanical	95-97	15-25	8.5-14	10-30	20-55
Bisulphite	40-90	---	---	---	---
Unbleached	60	40-60	25-50	10-110	---
Bleached	50	50-100	20-60	20-50	35-120
Kraft Unbleached	55	20-80	1-20	0.2-15	7-50
Bleached Normally	45	30-110	0.2-40	0.2-10	4-90
Ozone Bleached	45	---	1-20	---	---
De-inked Pulp	---	15-30	15-20	20-40	---