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EVALUATION OF PRETREATMENT PROCESSES FOR ZLD PLANTS FOR TREATING COMPOSITE DYEING EFFLUENT STREAMS

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ABSTRACT

Zero Liquid Discharge (ZLD) Plants, based on Membrane Technologies for reclaiming the resources viz., water and salt, are the emerging strategies for treating composite effluent streams from dyeing industries. The removal of suspended and organic dissolved solids is the pre requisite for the application of membrane based plants, to reclaim inorganic dissolved solids. The removal of COD, TSS, TVS and Color is the primary objective of providing pre treatment, before the effluent is considered to reclaim water or salt, through membrane based plants. The chemical treatment, biological treatment and ozonation are the proven methods for providing necessary pre treatment. On evaluation through laboratory studies on six different methods, their respective merits and demerits are found. Perhaps, ozonation can be concluded as the best available technology for the pretreatment of dyeing effluent in the ZLD plants, for the primary reasons of less sludge and qualified supernatant that can be negotiated in Reverse Osmosis Plants.

GENERAL

The removal of Total Suspended Solids (TSS), Chemical Oxygen Demand (COD) and Color is the primary objective of pretreatment in Zero Liquid Discharge Plants while treating composite dyeing effluent.In Tamil Nadu alone, there are 13 such ZLD plants as common Effluent Treatment Plants are under construction in Tiruppur. And more such plants are in pipeline in the districts of Salem, Erode, Karur and Tirunelveli.

In view of the larger volume of the effluent, stringent disposal standards are being enforced. In view of the requirement for a qualified feed into Reverse Osmosis Plants, the choice of pre treatment should be made properly. Perhaps, the sludge generation rate and the percentage removal of COD and Color are the challenging issues and require critical review on the available technologies for the pre treatment processes.

The present study was made on the available options of pretreatment using complementary combination of primary data from the laboratory analysis of samples and secondary data from the performance

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of the operating treatment plants.

DYEING EFFLUENT CHARACTERISTICS

In the study areas, seven different methods of dyeing are under practice. Samples were drawn and analysed for the required data on pollution parameters.

The changes in the characteristics are largely due to water use pattern (60 to 165 Lit / kg), the chemical nature of dyes and dyestuff and the amount of addition of salt and its characteristics.

Cotton Dyeing - Predominantly, reactive dyes and dye stuffs are used. The Salt addition varies from 5000 mg / Lit to 8000 mg / L. The quantity of water varies from 20 to 32 lit / kg.

Yarn Dyeing - Predominantly, reactive dyes and dye stuffs are used. The Salt addition varies from 6100 mg / Lit to 10,000 mg / L. The quantity of water varies from 82.50 to 165.00 lit / kg.

Cloth Dyeing - Predominantly, reactive dyes and dye stuffs are used. The Salt addition varies from 4000 mg / Lit to 15,000 mg / L. The quantity of water varies from 18 to 110 lit / kg.

The characteristics of effluent streams, as they got analysed on the samples drawn from the different dyeing processes are tabulated in Table 1.1.

PRE TREATMENT PROCESSES

The following methods, which are considered proven and versatile, are evaluated for their effectiveness and removal efficiency.

Table 1. characteristics of dyeing effluent streams

S.No.	Parameters	Cloth Dyeing	Cotton Dyeing		Yarn Dyeing			
			Manual	Cabinet	Cheese	Jigger	Winch	Soft flow
1.	pH	8.5	7.63	6.96	8.83	10.72	7.22	8.2
3.	TSS, mg / L	210	160	384	212	502	264	192
4.	TDS, mg / L	4500	3896	17408	3632	11300	8668	3824
5.	BOD_5, mg / L	190	170	349	120	450	240	108
6.	COD, mg / L	560	450	584	768	950	648	552

Note : All values are expressed in mg / L except pH.

Table 2. performance evaluation of pretreatment processes

Sl. No.	Pretreatment Processes	Performance			Characteristics	
		% TSS Removal	% Color Removal	% COD Removal	Sludge	Supernatant
1.	Lime, Ferrous Sulphate	95	90	85	Colored Sludge, Bulky with Salts	Have multivalent ions with alkalinity residual color and odor.
2.	Hydrogen Peroxide, Ferrous Sulphate	90	95	90	Less Sludge, Colored	Have multivalent ions – residual odor
3.	Chlorine	95	95	95	Very less sludge, possibility for carcinogenic, Organo chlorine compounds	Possibility for free available chlorine
4.	Extended Aeration	80	85	75	Bulky sludge, difficult dewatering characteristics	Microbial contamination residual color and odor.
5.	High rate, pure oxygen system	85	80	85	Bulky sludge, colored, difficult dewatering characteristics	Microbial contamination residual color.
6.	Ozonation	95	95	95	Less sludge	Safe, a better qualified stream to feed Reverse Osmosis Plant at the downstream

Chemical treatment

a. Lime and Ferrous Sulphate
b. Hydrogen Per Oxide and Ferrous Sulphate (Fenton Reagent)
c. Chlorine gas

Biological treatment

a. Extended aeration
b. High rate, pure oxygen systems
· Ozonation

The performance study was carried out on the samples drawn from the operating plants. The removal of Color, Solids, COD and the characteristics of sludge and supernatant were considered as study parameters for the purpose of the performance evaluation.

The results on all methods of pretreatment are tabulated in Table 2.

CONCLUSION

The removal efficiency of different parameters, though vary from one method to other, can be improved by necessary system modifications, process control and plant operation schedules.

Anyhow, in view of the final characteristics of the supernatant and sludge (Table 2), the ozonation process can be adjudged as the best from the available technologies for treating composite dyeing effluent. The feed characteristics are very important for the successful and sustainable operation of the down stream RO plants in any Zero Liquid Discharge Plants. Hence, the above conclusion on the process of ozonation is vindicated and validated.

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