Zero Liquid Discharge ETP – A Case Study (Part I)

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Abstract

Textile industry a major polluter of water, is passing through continuously increasing pressure from environmental regulations changing and updating time to time. We strongly feel that our textile processing industry should be able to take up these extra pressures about the environmental requirements and sustain our existence globally, some supportive activities are really needed. In this line , we at BTRA Mumbai and Austro water technologies pvt. Ltd have made an attempt to share some basic knowledge and know-how for Zero liquid discharge(ZLD) ETP plant. To share maximum information, we have divided this topic in two parts i.e. part-I compreses basic treatment scheme and inlet effluent characteristics, Part 2 details component of ZLD ETP and their functions to achieve the ZLD.

1.0 Introduction:

The textile industry is mainly concerned with 3 types of pollution viz water, air and soil or land. For every industry, it becomes an important thing to take major steps to minimize the pollution load of water, air and land for the survival of the next generation.

The textile processing industry consumes large quantities of water and produces large volumes of wastewater from different steps in the dyeing and finishing processes. As per one of the studies, it is estimated that the water consumption of the Indian textile industry alone is about 200-250 l/kg cotton cloth [1] of water in comparison to the global best of less than 100 l/kg cotton cloth. Textile dyeing and finishing is the most chemical usage intensive industry and the No. 1 polluter of clean water (after agriculture). More than 3600 individual textile dyes [2] are being manufactured by the Industry today and more than 8000 chemicals [2] in various processes of textile manufacture including dyeing and printing.

During our various studies for water conservation, shop floor audits, water balance and ETP audits, it observed that in a textile process processing house, 16-20 % of total water is consumed in dyeing and 8-10 % in printing. Specific water consumption for dyeing varies from 30 - 50 l/kg of cloth depending on the type of dye used. Dyeing contributes 15% - 20% of the total wastewater flow [2]. Water is also required for Washing of the dyed and printed fabric to achieve washing fastness and bright backgrounds. Washing agents like caustic soda-based soaps; enzymes etc. are used for the purpose. This removes the surplus color and paste from the substrate. Water is also needed for cleaning the printing machines to remove the loose color paste from printing blankets, printing screens & processing vessels. Wastewater from printing and dyeing units is often rich in color [3], containing residues of dyes andchemicals, such as complex components,many aerosols,high chroma,high COD and BODconcentration as well as to degrade materials. The toxic effects ofdyestuffs & other organic compounds, as well as acidic and alkaline contaminants, fromindustrial establishments on the general public, are widely known. Thus, in the form of water, the natural resource depletion is increasing due to increasing industrial demand.

To save and avoid the natural depletion of the water, textile industry should try to recycle the water within process as well as recover from waste water effluent and reach the level of zero liquid discharge (ZLD).

This article describes a typical module for ZLD in a textile plant. It is prepared for the complete treatment systems

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inclusive of effluent characteristics, volume generated and different treatment sections. Part 1 of the paper, discusses the inlet effluent characteristics and general treatment flow chart or scheme used for ZLD

2.0 Effluent characteristics & treatment steps:

2.1 Inlet effluent characteristics

The characteristics of the inlet composite effluent stream will be:

Table: 2.1 : Inlet effluent characteristics

S. No.	Parameter	Value	Unit
1	Colour	Lightly-medium colored	--
2	PH	9 - 11	--
3	Total dissolved solids	6000	mg/l
4	COD	3000	mg/l
5	BOD_5 at 20^0 C	1200	mg/l
6	Total suspended solids	100-200	mg/l
7	Total Hardness as $CaCO_3$	100-150	mg/l
8	Silica as SiO_2	10 - 15	mg/l
9	Chlorides as Cl	3000-4000	mg/l
10	Sulphate as SO4	500-1500	mg/l
11	Total Iron as Fe	1-2	mg/l

2.2 *Treatment steps are explained in the diagram with recovery in each stage:* *Kindly refer page no. 3 for the same*

3.0 Effluent Treatment Plant – Process description

The process selected is Anaerobic, color removal followed by Biological process (Activated sludge process with Diffused Aeration).

The effluent generated from the dyeing and washing sections is first collected in a collection tank through a Bar Screen which removes fibrous materials & solid particles. It is then into an Equalization tank with sufficient capacity for homogenization and cooling. The temperature of the effluent should be < 38°C.

The effluent, after proper mixing, homogenization & PH neutralization (7.5 to 8.0) is fed to an Anaerobic Digester, which has retention time of 48 hours. The reduction in COD & BOD expected is 60 -70 % and the color reduction up to: 70 - 80 %. (the remaining COD, BOD and the residual color are reduced in the subsequent Aerobic treatment).

The effluent, after Hybrid Anaerobic Digester is subjected to coagulation by the addition of a polymer-baseddecolourant CRP and PAC and poly electrolyte in mixing channel followed by flash mixture. The coagulated matters are allowed to settle in a primary clarifier having a hopper shaped bottom with a slow speed rack arm inside. Settled matter in the clarifier is sent to sludge drying beds/filter press for dewatering. The clear over flow effluent with an online acid injection for PH neutralization (7.5 to 8.0), is fed to Aeration tank for biological process (which reduces COD, BOD).

Aeration is done using energy efficient diffused aeration system, which results in compact layouts and reduces the power consumption. Air from the blower diffuses through the Diffuser grid. It consists of porous membranes of 12" dia disc type diffusers made of EPDM material. The diffusers are of non-buoyant type, which during shutdown condition contracts to prevent any back-flow.

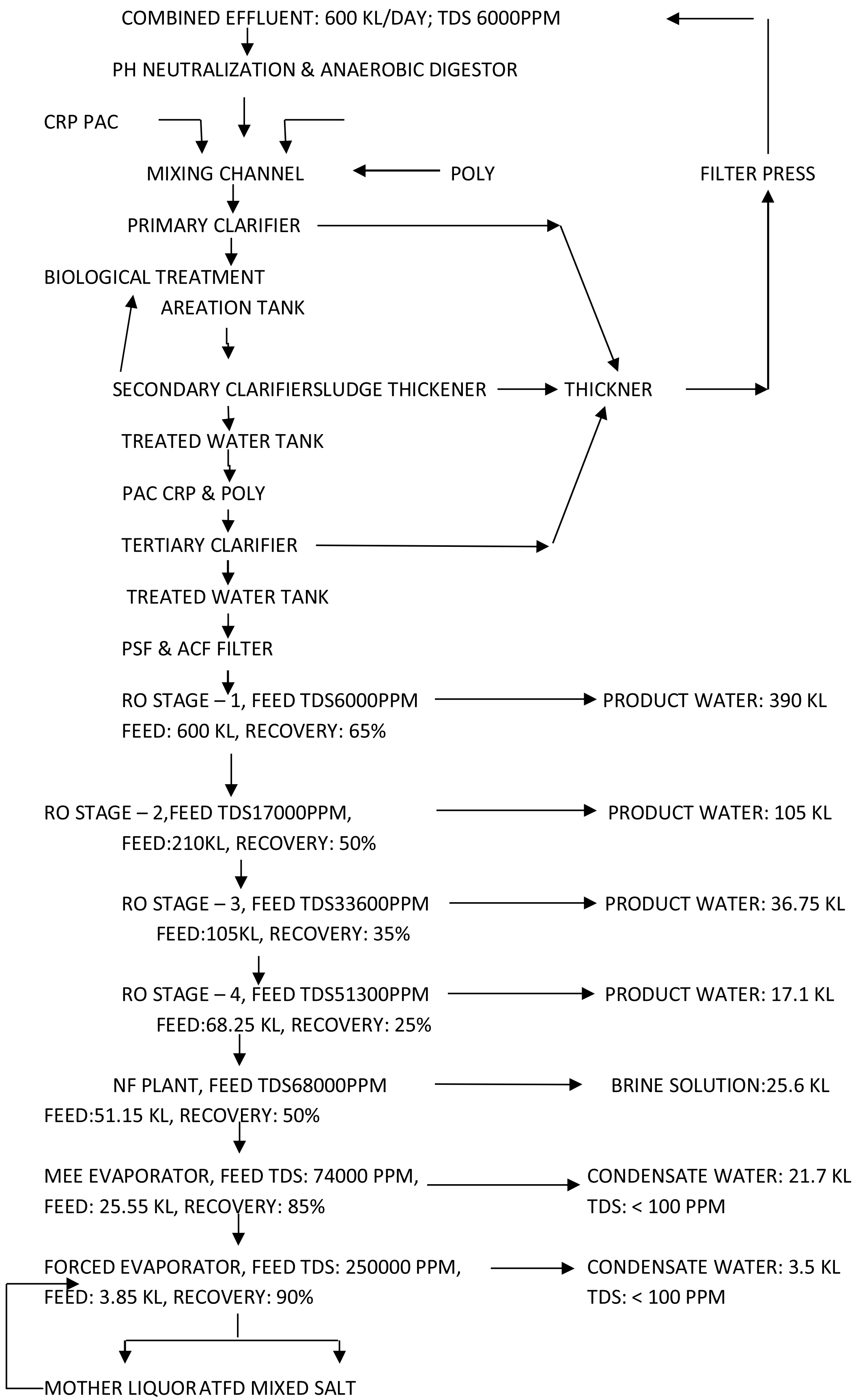
The diffuser is designed to ensure uniform permeability and to produce a flow of fine air bubbles which provides high contact area and more contact time due to slow rise of the bubbles. This makes the system very efficient in terms of oxygen transfer efficiency, less HP for the blower drive and hence loo operational cost.

After a residence of 27 hours in the aeration tank the treated effluent water and activated sludge flows to a secondary clarifier where the biomass is allowed to settle. The settled biomass in the clarifier is re-circulated back to the aeration tank to maintain the mixed liquor suspended solids (MLSS) up to the level of 2000-3000 mg/l suitable for the activated sludge process and the excess waste sludge is then sent to sludge drying beds and the dry sludge is used as manure for the plants. The COD & BOD reduction in the activated sludge process has been recorded up to 85%.

The over flow clear water from the clarifier is collected in another tank. This effluent may contain some residual color and fine suspended particles. Addition of CRP and PAC to this effluent will remove the residual color. Addition of these chemicals shall be done by gravity into a mixing channel. The chemical preparation tanks will have agitators.

The effluent is then let into a Tertiary clarifier, which is a circular type tank with a hopper shape bottom for sludge drain off. A low speed racked arm scraps the settled sludge to center of the clarifier and when the valve is opened all the accumulated sludge is drained. Settled matter in the clarifier is sent to sludge tank and filter press for dewatering or sludge drying beds.

2.2 Treatment steps are explained in the diagram with recovery in each stage:



The overflow from the clarifier is collected in a storage tank and passed through a Sand and Carbon filter and 4 stage RO Plants for water recovery. The RO reject is sent to NF Plant for Brine Solution Recovery. The NF reject is sent to MEE (Falling film & Forced Circulation) Evaporator for condensate recovery. The mother liquor from MEE collected is sent to ATFD and the mixed salt recovered is Stored in a closed shed.

It is now proposed to install a pre-treatment followed by MF Plant & 4 stage RO plant for maximum water recovery. To control and reduce the TDS level, there is a RO membrane filtration, which will be discussed in part-II of this paper.

Table 3.1 : Treated effluent characteristics after the media filter:

S. No	Parameter	Treated effluent	Unit
1	PH	6.5 – 7.5	-
2	Total suspended solids	2 – 5	ppm
3	Turbidity	2-5	ppm
4	Total dissolved solids	6000	ppm
5	Total Iron as Fe	< 0.1	ppm
6	BOD	<30	ppm
7	COD	< 100	ppm
8	Heavy metals	Nil	ppm

References:

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