Optimizing Costs in 'Zero Liquid Discharge' Textile Unit – A Case Study by FICCI

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"Application of Commonsense and Logical Practicing can save substantial Water & Wastewater Management costs with minimal Investments and are equally important as advanced Technologies"

Managing water and wastewater has become a 'costly affair' for most of the industries due to non-availability of freshwater, increased water & energy costs, treatment costs and stringent environmental regulations. In many States, Industries are not allowed to discharge any effluent from their premises. As a result the Industries in these regions have adopted advanced wastewater treatment schemes with Reverse Osmosis (RO) to reuse its treated wastewater. The RO reject management is done by evaporating the rejects using combination of Multi Effect Evaporator, Crystallizers and solar ponds. Today, many industries have achieved 'Zero Liquid Discharge' by adopting latest technologies, however in this exercise they are bearing a recurrent substantial 'Operation & Maintenance' costs which directly affects the overall 'cost of production'. It's been observed that these 'Zero Liquid Discharge' plants have significant potential for further improvements to achieve substantial cost savings. The areas of improvement can be identified by conducting detailed Water & Wastewater Audits through logical reasoning and practicing.

FICCI Study – Identified Potential of 15% freshwater reduction and 7% reduction in Treatment Costs in 'Zero Liquid Discharge' Textile Unit with minimal investments having payback period less than 1.6 years

FICCI has conducted a detailed 'Water & Wastewater Audit' in one of the Textile Unit located near Baruch, Gujarat which is practicing 'Zero Liquid Discharge' to meet the state regulations. Although the studied Textile unit has achieved the 'Zero Liquid Discharge' and are able to reuse its treated effluent, however during the FICCI study it was observed that there were various basic issues and problems with the existing water & wastewater management system which are being overlooked and can be solved with logical practicing and reasoning.

FICCI identified various opportunities to reduce the 'cost of treatment of RO Plant' in addition to freshwater savings. The key issues, FICCI observations and recommendations made to the unit are discussed in this article which has the potential to reduce the overall freshwater consumption by 15%

and reduction in wastewater treatment costs by 7% with minimal investments having simple payback period less than 1.6 years.

Water & Wastewater Management Costs of the 'Zero Liquid Discharge' Textile Unit

The total water consumption of the unit was 5155 m3/day out of which about 41% is fresh water from Municipal Corporation, 34% is recycle/return water and about 25% is treated RO water as shown in fig 1. The annual cost of water and wastewater management of the unit was about Rs 10 Crore which includes water cess, pumping cost (energy) and Operation & Maintenance of wastewater treatment plant with RO scheme.

It is observed that about 82% of the total annual water & wastewater Management cost of the unit is spent for running the Effluent Treatment Plant with RO scheme as shown in fig 2. The unit cost of freshwater from municipal corporation was about Rs. 22.25/m3 whereas the cost of RO treated was calculated to be about Rs 137/m3.

Fig 1- Percentage Share of Total intake Water (5155 m3/day)

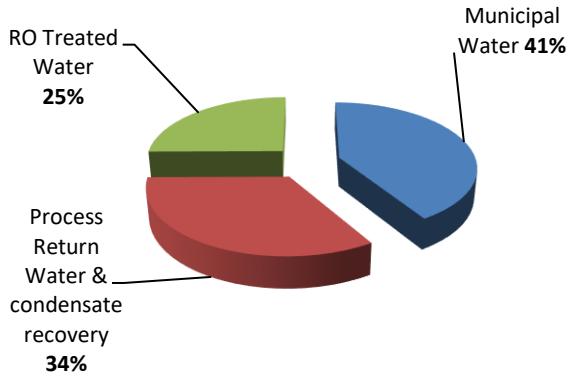
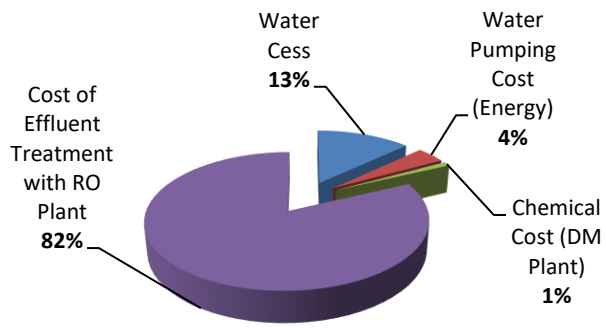


Fig 2 - Percentage Share of Annual Water & Wastewater Management Costs (Rs 10 Crore/Year)

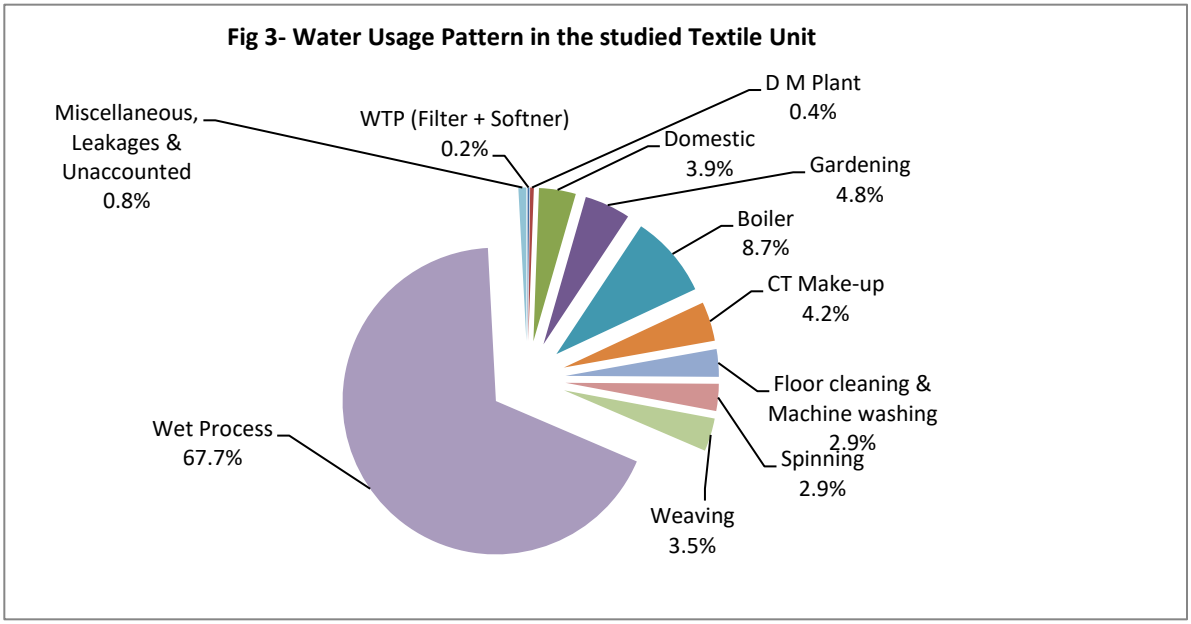


Water Consumption Pattern of the Unit

The studied unit consumes about 5155 m3/day of water and manufactures about 8150 MT of cotton textile fabric per annum and produces a wide range of premium textiles – from suiting and shirting to fine fabrics and household linen. The unit consists of three Production lines, one Spinning section, one Weaving section and one dying section (wet process). Detailed field studies were conducted to prepare the water & wastewater balance of the unit. The unit's water consumption pattern was also established to identify the major water consuming areas as shown in fig 3.

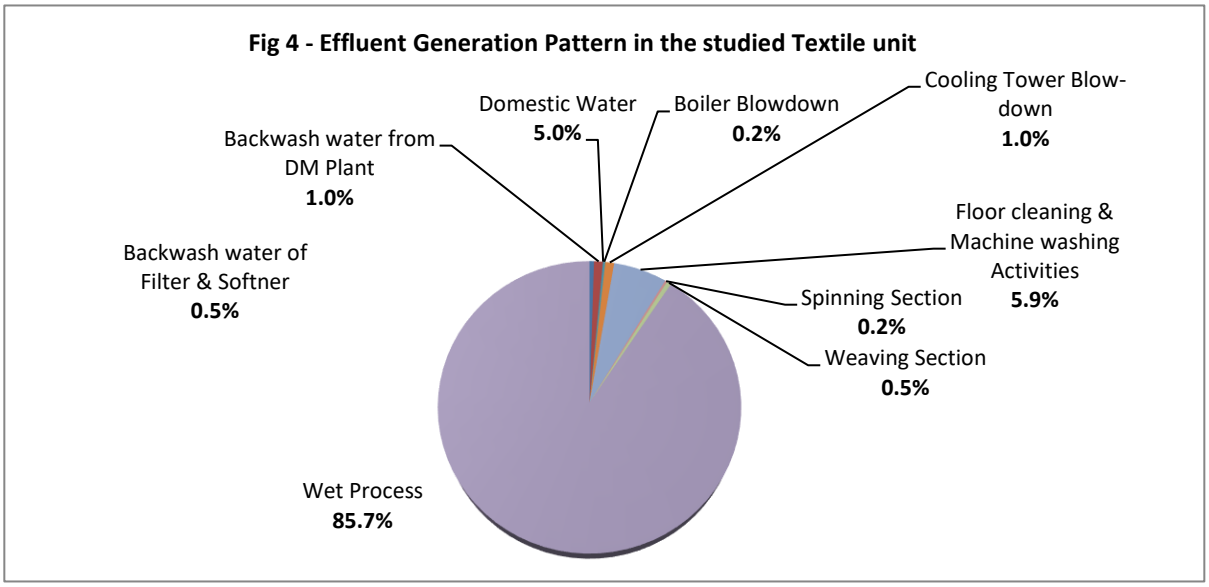
The dying (wet process) was identified as the major water consuming area which alone consumes about 68% of the total water input. The dying section has various water consuming processes like desizing,

rinsing, washing, bleaching, mercerizing, dying etc. The rest 32% of water is consumed in various other areas like boiler, gardening, cooling water make-up, domestic, Floor & machine washing, weaving & spinning etc.



Wastewater Discharge Pattern of the Unit

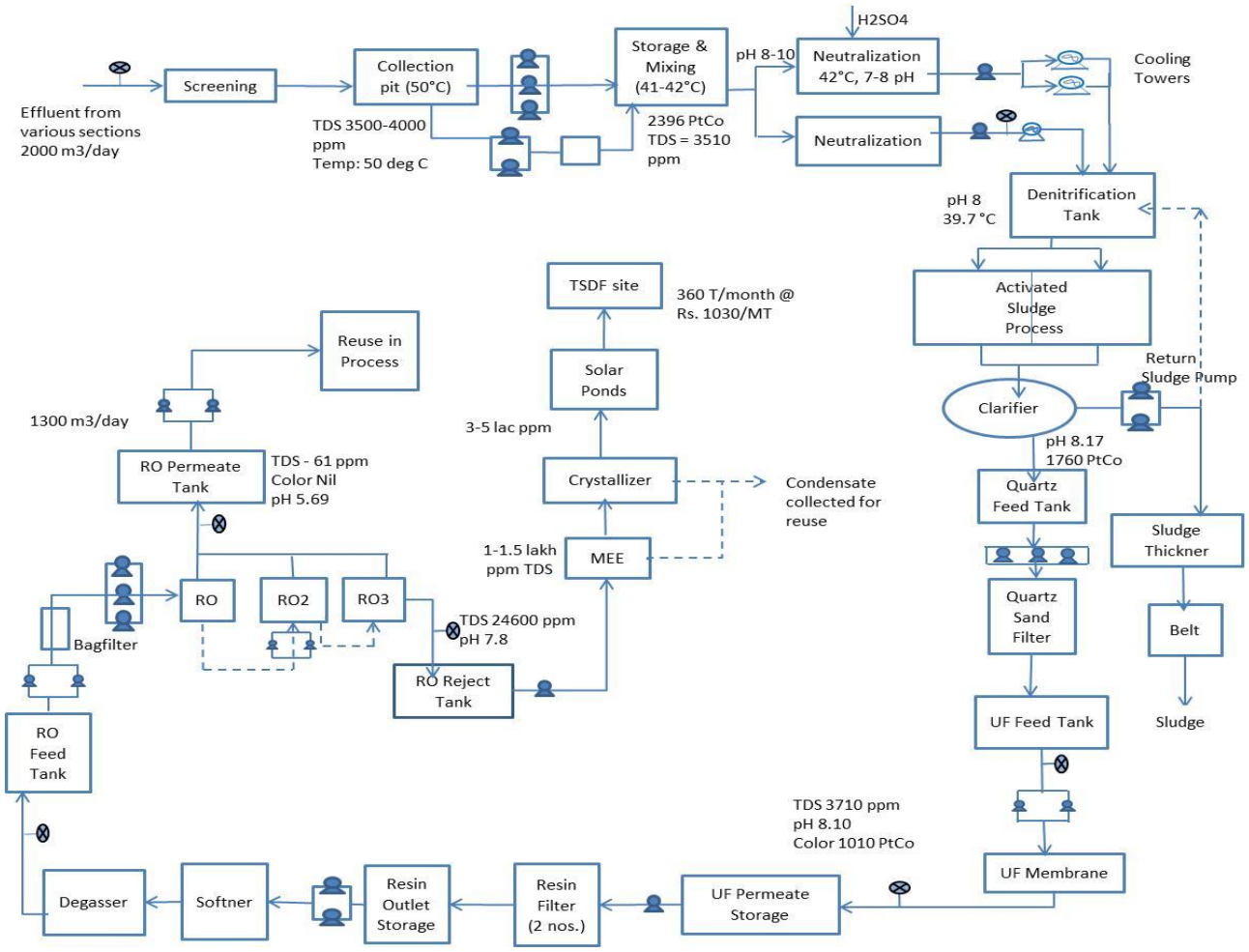
During the study period, it was observed that total effluent generation of the plant is about 2000 m3/day. Wastewater is generated from different sections of the plant which include Wet Process (dying), Floor Cleaning & Machine Washing, Cooling Tower, Boiler, Spinning, Weaving, DM Plant, Water Treatment Plant, etc. The wastewater generation pattern was also established which shows that out of total wastewater about 85% is generated from the wet process (dying section) as shown in figure 4.



Effluent Treatment Scheme of 'Zero Liquid Discharge' Textile Unit

The wastewater from textile is highly coloured and difficult to treat due to presence of various dyes, colours, chemicals and high TDS. The primary & secondary treatment alone is not sufficient to remove the impurities from the wastewater especially colour & TDS. The effluent generated by the studied unit has TDS in the range of 3500-4000 ppm and colour in the range of 2300-3000 PtCo. As the plant has to reuse its treated wastewater for process activity, it has installed an 'Effluent Treatment Recycle Plant' with advanced tertiary treatment like Ultra-filtration followed by Reverse Osmosis to remove the colour and reduce the TDS levels and other impurities. It is observed that the biological treatment (Denitrification & Activated Sludge Process) removes only 50-60% of the colour and there is no change in TDS levels. The tertiary treatment (mainly Ultra-filtration and Reverse Osmosis) has reduced TDS up to 61 ppm and removed the colour completely. The rejects from the RO plant are evaporated in MEE & crystallizer. The condensate from the MEE & crystallizer is recovered and reused. The solids from the crystallizer are sent to the solar pond for further drying and the solids from solar pond are sent to TSDF facility. A scheme of the ETRP of the unit is given in Fig 5.

Fig 5 – Effluent Treatment Scheme in Textile Unit to achieve 'Zero Liquid Discharge'



FICCI KEY OBSERVATIONS AND RECOMMENDATIONS

It was observed that the studied Textile unit had already implemented various schemes in order to reduce its Freshwater consumption like Cold Pad Batch dyeing (which consumes about 40-50% less water than conventional dying process), Counter-current washing, Hot water recycling, wastewater treatment and recycling through 'Zero Liquid Discharge Plant'. As a result the Specific Water Consumption (for freshwater use) of the unit was significantly less about 75 m3/Ton. The unit has already achieving the Global Best Benchmark which is 75-100 m3/Ton. However, FICCI analyzed and studied the existing systems and identified key areas of further improvement in the unit leading to 'freshwater reduction' and 'Effluent Treatment Cost reductions'.

The key observations and some of the recommendations implemented by the unit are discussed below.

Cost Savings in the 'Zero Liquid Discharge Plant' by Logical Practicing - Segregation

A. Segregation: Collection of leftover colour & salt solution separately from colour kitchen and Machine Turf and evaporating it directly in MEE/Solar Pond

As the dying section is the main area which generates about 85% of effluent quantity and maximum colour and TDS, a detailed analysis was done to identify the 'point sources' of generation of coloured effluent with high TDS in this section. Logically significant reductions in 'effluent quantity' from this section and reduction in 'colour and TDS' concentrations will directly improve the performance of 'Zero Liquid Discharge' Plant and increase the life of the RO membranes which will reduce the overall 'Operation and Maintenance' Costs of the system.

The unit prepares about 24 shades of coloured cloth per day as per the market demand. For this, 24 different shades of colour solutions are prepared on estimated quantity in the 'colour kitchen' and 24 changeovers takes place on the dying machine. It was observed that about 75 liters of colour is left unused per shade per day (which is about 1800 liters/day) and is drained directly into the effluent treatment plant from the colour kitchen section. This 1.8 KL/day of effluent from colour kitchen is highly coloured (sample tests showed colour upto of 32,80,000 Pt Co) and has very high TDS in the range of 60,000-65,000 ppm.

This 1.8 KL effluent adds about 70% of total colour & TDS load on ETRP. In addition to this load the leftover colour in the Turf of the dying machines and the Global salt which has been used after making a shade is also drained in the effluent treatment plant. Almost entire TDS load and about30-40% of the colour load in ETRP is removed by RO plant as shown in figure 6.

Fig 6 – Discharge of Highly coloured & TDS Effluent from colour Kitchen in the 'Zero Liquid Discharge Plant'

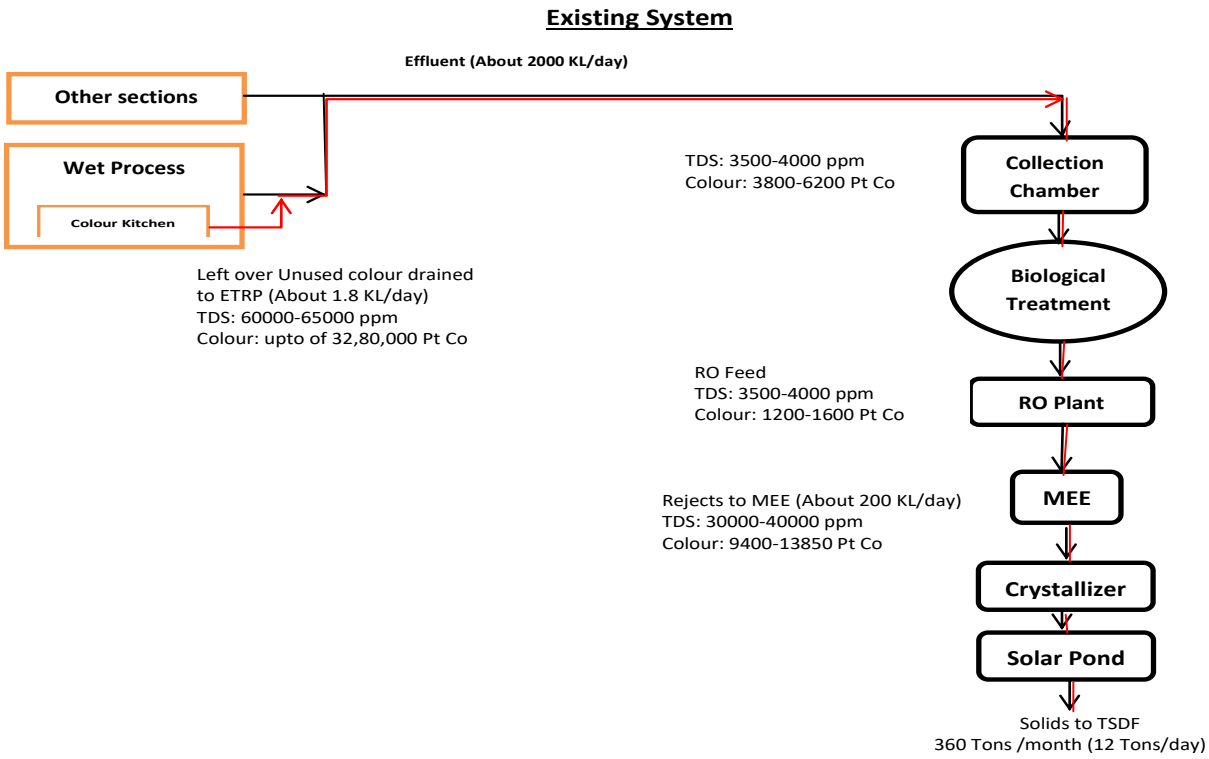
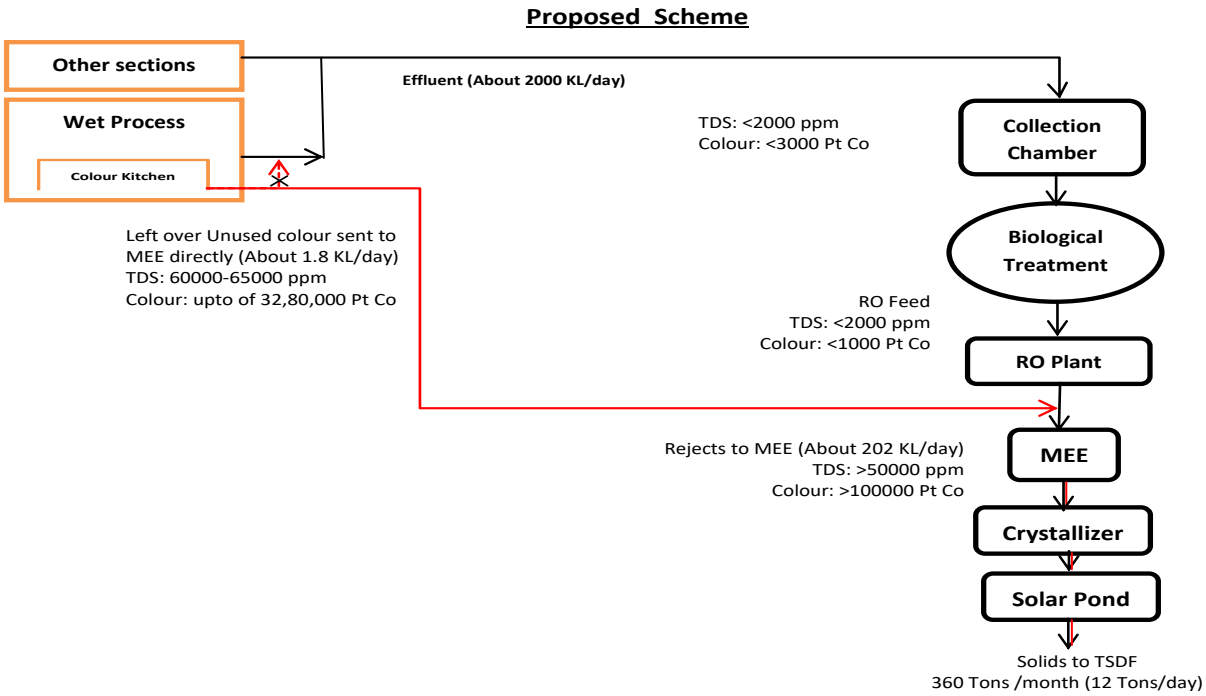


Fig 7 - Collection of leftover colour & salt solution separately from colour kitchen and Machine Turf and evaporating it directly in MEE/Solar Pond



The high colour and TDS in the effluent also adds excess load on the Biological Treatment leading to decreased efficiency and increased O&M costs. The RO membranes may need frequent cleaning & replacements due to this. During discussions it was informed that about 80% of the left over 1800 liters colour can be collected effectively without affecting the work efficiency & production of the plant. Therefore, it was suggested that the highly concentrated coloured & TDS solution form the colour kitchen should be segregated and sent to the existing Multi Effect Evaporator (MEE) directly.

By collection & treating this stream directly into MEE/solar evaporation pond would improve the treatment efficiency of biological system and RO membranes. The life of the membranes and RO treatment efficiency would increase as the entire TDS load & maximum of colour load is removed by existing RO plant. This will reduce the O&M cost of ETRP by 5-10%. It was also suggested to optimize colour & salt solution preparation per shade by using available softwares & precise calculations. It is very important to impart awareness & training to concern officials and to the shop floor workers of the concern department on 'Importance of their role in segregation of this stream from rest of the effluent and its benefits'.

The estimated annual monetary savings by this scheme is about Rs 48 lakhs with simple pay-back period less than 6 months (0.5 years). The estimated investment for the implementation of the suggested scheme was about Rs 15 Lakhs (mainly required for additional piping for collection & directing the effluent to MEE/solar evaporation pond and Awareness & training to officials and to the shop floor workers of the concern department).

Collection of leftover colour & salt solution separately from colour kitchen and Machine Turf and evaporating it directly in MEE/Solar Pond – Will reduce the 70% colour & TDS load on the 'Zero Liquid Discharge' plant and will reduce its O&M costs by 5-10%.

Water Savings and Demand Side Management with Minimal investments

B. Use of available RO treated water from 'Zero Liquid Discharge ' plant in boilers instead of demineralized water which will stop DM plant completely

The studied Textile unit had a Demineralizing (DM) Plant for producing Demineralized water for consumption in boilers for steam generation. About 250-270 KL/day of filtered water is treated in the DM plant at the cost of Rs 8/KL. The cost of DM plant includes cost of pumping, cost of chemicals (acid/alkali) used for regeneration of DM plant, cost of water used for backwashing and cost of replacement of resin.

However, the unit also had advanced effluent treatment plant with 3-stage RO plant which produces about 1500 KL/day of RO water which is currently used in the process directly. It was observed that the treated RO water quality is good and can be utilized in boilers for steam generation directly. Therefore,

it was suggested to stop the DM plant and utilize the available RO treated water in boilers from existing 'Zero Liquid Discharge' plant. Since the unit is a zero discharge plant, the RO water is available in good quality and reliable quantity which can be utilized in boilers for steam generation.

This will save about 20 KL/day freshwater used for DM plant backwashing and cost of O&M of DM plant like power, chemicals, replacement of resins etc. Additionally, the generation of highly acids & alkali effluent from DM plant backwash will be eliminated which will improve the ETRP efficiency.

For implementing the suggested scheme, additional piping needs to be laid from ETRP RO permeate tank to the boilers for direct usage. The estimated annual water saving from the suggested scheme is about 7160 KL with annual monetary saving of about Rs 8.6 lakhs. The estimated investment is only 5 lakhs towards laying off pipes. The simple payback period of the suggested scheme was less than 1 year.

Use of RO water in boilers for steam generation instead of demineralized water will eliminate use of DM plant and the water consumed in DM plant will be saved. Additionally cost of operation & maintenance of DM plant would also be saved. The unit immediately agreed on the suggested scheme and stared using available RO water in boilers and stopped operating Demineralized (DM) Plant.

C. Optimize freshwater use by putting water efficient spray nozzles on hose pipes used for machine cleaning & washing in the process area and other parts of the plant

It was observed that, the hose pipes which were used for machine cleaning, colour containers washing and floor washing in the process area had high flow rates (22-40 liters/min) which leads to water wastage during washing & cleaning activities. In addition, the hose pipes also lack lacks pressure nozzles. Therefore it was suggested to install water efficient spray nozzles at all hose pipes provided for machine cleaning, tank cleaning & floor washing activities in the process & other plant areas. The hose pipes fitted with efficient spray nozzles uses less water (8-10 liters/min) and are more effective for cleaning purposes. (**Nozzle:** A device with one or more orifices through which the water discharges from the system. The nozzle restricts that area of flow of the fluid, accelerating the water to the required velocity and shaping it to the required flow pattern. Nozzles are also commonly referred to as bits, tips, or orifices). Nozzles are available for many applications in a variety of types, designs, and sizes. It is important to select and use the right nozzle for each task to ensure the safe application and productive use of high pressure washing equipment.

It is estimated about 150 KL of water is required for washing & cleaning activities in the plant including process area. This will reduce the water requirement for cleaning & washing activities in the process area by 30%. Therefore about 45 KL/day of water would be saved per day at very low investment. The estimated Investment is only 1.5 Lakhs with Annual Monetary Saving of Rs 3.58 lakhs and simple Pay Back Period of less than 6 months.

FICCI Water & Wastewater Audit - Conclusion

FICCI studied all the sections of the Textile Unit and suggested various schemes focusing at demand side management; reduction in effluent generation, Treatment cost savings, recycle & reuse opportunities; etc. with the potential of reducing about 15% of fresh water consumption in the plant and 7% reduction in Treatment Costs in 'Zero Liquid Discharge' plant with minimal investments. It is concluded that along with advanced technologies, application of commonsense and logical practicing is equally important for efficient operation and maintenance of water and wastewater management systems.

About the Authors

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