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Study of Volume Reduction by Reverse Osmosis and Evaporation of Waste Water

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Abstract— Now a days the problem of various industry effluents is disturbing river and environment. Industry effluent is one of the important biologically degradable wastewater streams, having typical characteristics. It is to be treated efficiently. Here application of evaporation and reverse osmosis technique for volume reduction of textile mill effluent.
Keywords— evaporation, reverse osmosis, volume reduction, effluent

I. INTRODUCTION

Water was once called as a Renewable Resource. However, in today's context, water can be rightly put under the borderline group of resources, which are available for the moment, but their future availability may be questionable. This current sorry state of affairs faces us. However, there still may be a way out. By pursuing suitable techniques and using the knowledge and experience of technically sound professionals, water resources can be rejuvenated. It is however more important that in addition to the development of the technical know – how in the subject, people need to be made aware regarding the importance of the resource. Developed countries are the most important culprit in the scenario. The developed countries have a cumulative 1/5th of the world's population, but they use more than 70% of the world's resources, causing a major imbalance in the world.

II. LITERATURE SURVEY

Literature survey for proposed work includes some mark able points as follows:

A. *Eeswaramoorthi, (2010)* designed a process for zero discharge treatment for textile effluent, wherein, he observed that Membrane Bioreactor is the best suitable primary treatment process for textile effluent. However, irrespective of the type of textile effluent, the treatments which are necessary to be incorporated in a treatment system design for textile effluent are:
   1) *Suspended solids removal system,*
   2) *Oil and Grease removal system*
   3) *Equalization*
   4) *Adjustment of pH*
   5) *BOD5/COD Reduction*
   6) *Colour Removal*

B. *Vinodhaetal. (2013)* Studied the use of Membrane Bioreactor for the decolorization of red CLB dye from textile effluent. They observed that the reactor performance was very high with removal efficiencies ranging between 93% to 97%. After 6days, there was complete removal of colour. The developed laboratory scale prototype utilizing an available membrane module showed good result and hence an excellent membrane based biological treatment system for textile wastewater can be devised for a larger scale application.

Patel et al., (2013) carried out a performance evaluation of the effluent treatment plant for Narol textile industry cluster in Ahmadabad, Gujarat. They concluded that at present, effluent treatment plant of textile industry in narol textile cluster have low performances. The main reasons for plant failure are:

1) *Overloading to the existing treatment plant's capacity.*
2) Lack of skill for operation and maintenance for ETPs.
3) The operating conditions are different from designed values.

They also observed that lack of adequate equalization leads to fluctuations in quantities and quality of effluent in various treatment units of ETP, due to which the treatment unit may not perform as desired. Poor performance of primary and secondary settling units often leads to overall poor performance of ETPs.

III. METHODOLOGY

The waste water to be treated is preferable to textile one, because the nature of same is alkaline in nature. So to reduce the COD,

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BOD we are adopting evaporation and reverse osmosis technique. The inlet and outlet sample of the textile industry is taken and the experiment is carried out.

A. EXPERIMENTAL SETUP

1) Multiple effect evaporators is generally a vertical cell in which stainless steel tubes mounted. Some evaporator systems works on falling liquid film theory which means that the tubes are not filled up with liquid but a liquid film on inner surface of tube is established. To develop such film, the liquid is trickled in the form of drops through a perforation plate in such a way that the drops fall on the internal periphery of tubes and makes a liquid film which moves down throughout the length of the tube. The tube is heated with the help of steam. This technique is reported to enhance evaporation efficiency. In the evaporation process concentrated liquid is collected at the bottom of evaporator, which is sent to next stage evaporator. Thus the fresh liquor is added only to the first stage evaporator. Similarly steam is also applied to the first evaporator. The next stage evaporator gets steam from previous one. During evaporation, the liquid is re-circulated till it achieves desired concentration of salt or specific density. The vapors and spent steam are connected to condenser. Because of the vacuum in evaporators created by condenser, liquid evaporate sat low temperature. Use of evaporators reduces effluent volume. Also; the evaporation leads into increased concentration of salts in the stream making their recovery more viable wherever intended.

2) Osmosis is a natural phenomenon in which a solvent (usually water) passes through a Semi permeable barrier from the side with lower solute concentration to the higher solute Concentration side. As shown in Figure 1a, water flow continues until chemical potential Equilibrium of the solvent is established. At equilibrium, the pressure difference between the two sides of the membrane is equal to the osmotic pressure of the solution. To reverse the flow of water (solvent), a pressure difference greater than the osmotic pressure difference is applied (see Figure 1b); as a result, separation of water from the solution occurs as pure water flows from the high concentration side to the low concentration side.

This phenomenon is termed reverse osmosis (it has also been referred to as hyper filtration).

A reverse osmosis membrane acts as the semi permeable barrier to flow in the RO process, allowing selective passage of a particular species (solvent, usually water) while partially or completely retaining other species (solutes).The concentrated solution discharged as waste from the RO system is referred to as REJECT, while the cleaner solution coming through the product end is called as PERMEATE.

The driving force for the development and use of RO membranes is the advantages that these have over traditional separation processes such as distillation, extraction, ion exchange, and adsorption. Reverse osmosis is a pressure-driven process so no energy-intensive phase changes or potentially expensive solvents or adsorbents are needed for RO separations. Reverse osmosis is a process that is inherently simple to design and operate compared to many traditional separation processes. Also, simultaneous separation and concentration of both inorganic and organic compounds is possible with the RO process.

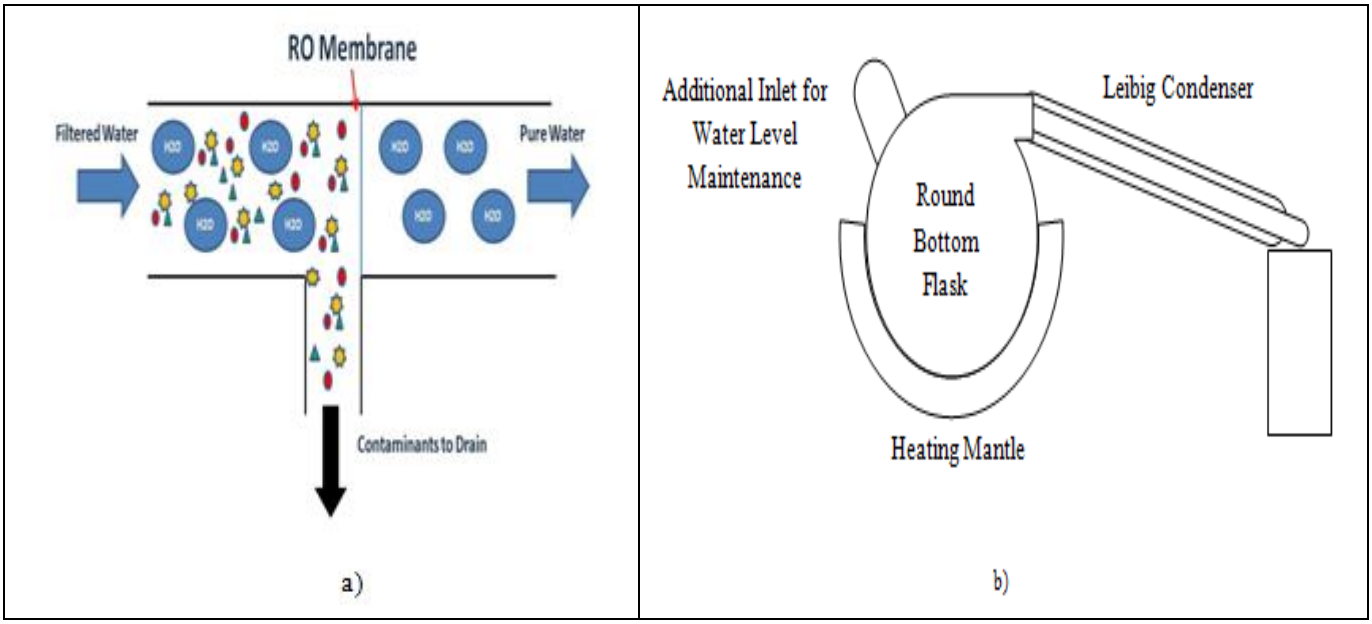

Fig 1. Experimental set up of a) RO membrane b) Evaporation

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IV. RESULT AND DISCUSSION

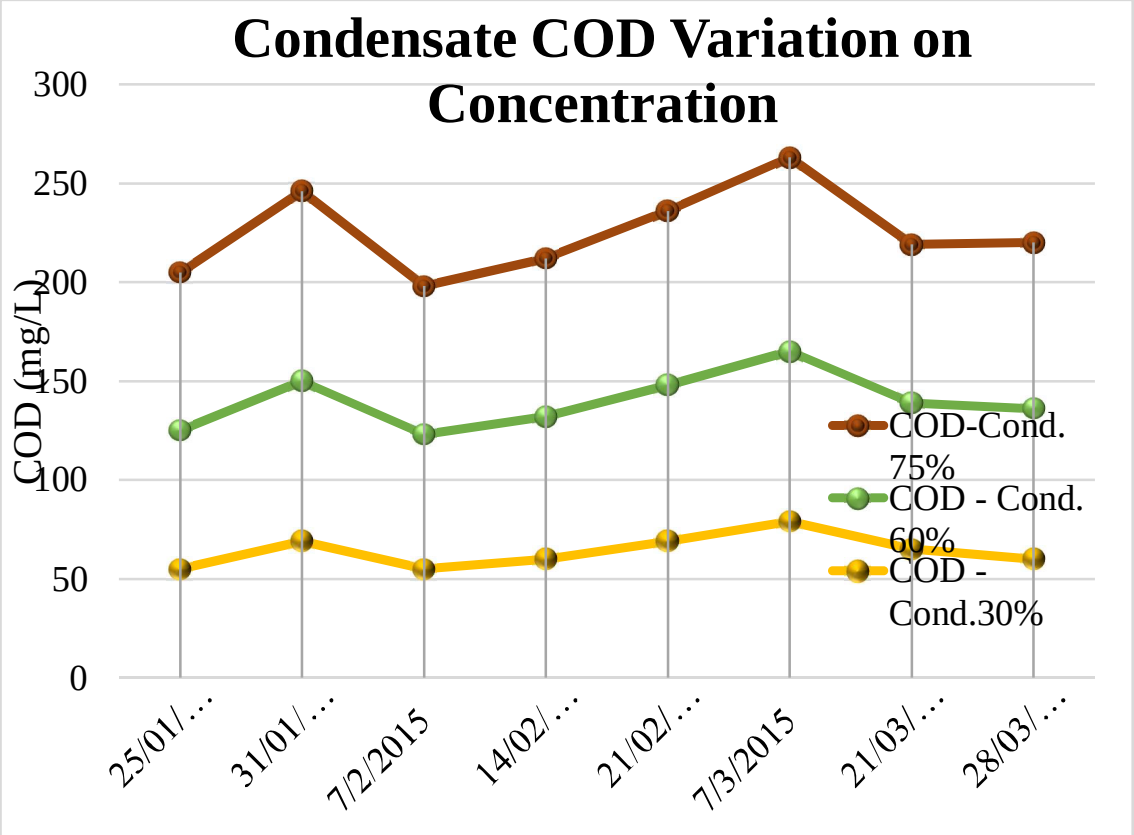
A modified Volatile Acid Apparatus was used as a lab scale plant for the assessment of the volume reduction of textile effluent. The analysis was carried out for 3 main samples and additional subsamples. The detailed legend of the analysis is:

A. INLET Sample
B. Concentrate (Conc.) Sample (Initial Sample Volume – 500 ml)
C. Concentrate at 30% Reduction (350 ml of 500 ml)
D. Concentrate at 60% Reduction (200 ml of 500 ml)
E. Concentrate at 75% Reduction. (125 ml of 500 ml)

The efficiency was kept at 75% maximum since, as per the RO manufacturers, the efficiency of an RO system is between 65 – 75% on a practical scale.

F. Condensate (Cond.) Sample
G. Condensate at 30% Reduction (150 ml of 500 ml)
H. Condensate at 60% Reduction (300 ml of 500 ml)
I. Condensate at 75% Reduction (375 ml of 500 ml)

COD



From the above results it is seen that COD value increases as concentration increases from 30%,60%,90%.Such a concentrated waste water should not be discharge directly into the river body, as it disturbs the aquatic life. So as to conserve the biodiversity, CETP,STP are so important

J. pH:

The pH of the concentrate and condensates demonstrated an interesting correlation between the concentration process and the characteristics change. On concentration, the pH of the concentrate increased towards the alkaline range, while the pH of the condensate reduced to the standard optimum range, inclining towards the alkaline phase of the pH range. This inclination can be due to the organic entrainments from the concentrate

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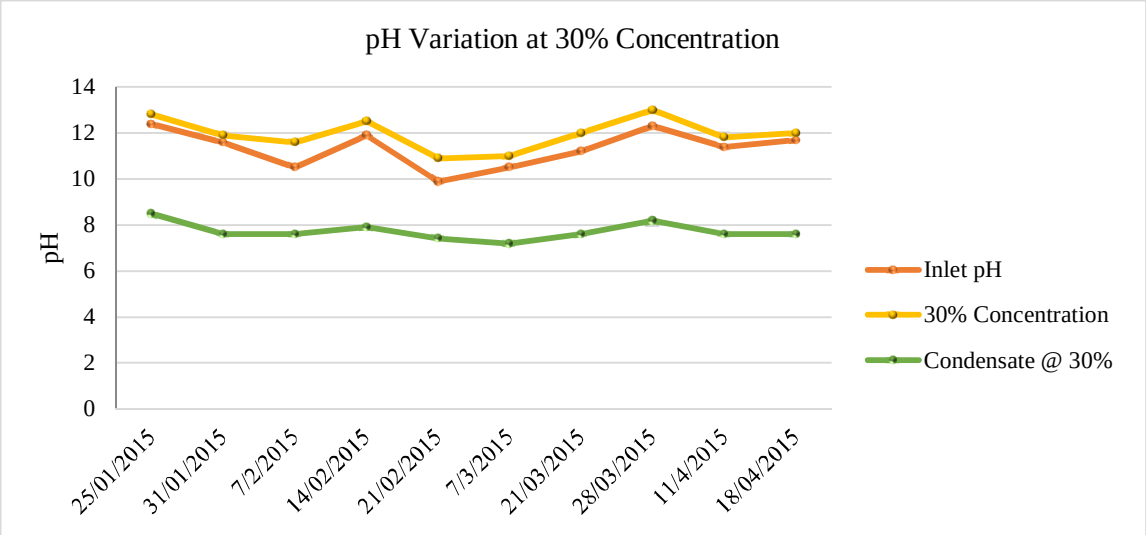

From the above results it is seen that pH of inlet is 14, for 30% condensate it is 8 and increasing. It means that pH level goes from alkaline to neutral.

V. CONCLUSION

The analysis in the present case demonstrated that on concentration of the textile effluent, the COD of the Concentrate increased significantly, while the COD of the condensate was considerably low. COD inlet 2000 and condensate 60-240 mg/l. The pH of the concentrate and condensates demonstrated an interesting correlation between the concentration process and the characteristics change PH of inlet is 14 can be come down to 8.

VI. FUTURE SCOPE

This method may be applicable for the actual site such as CETP, etc also the treated water is used for recycle process, domestic use. So water budget is possible

VII. ACKNOWLEDGMENT

Continuous motivation, guidance and support are the keys to success, so here I would like to express my gratitude to every individual who has contributed to accomplish the task at every step to make it done.

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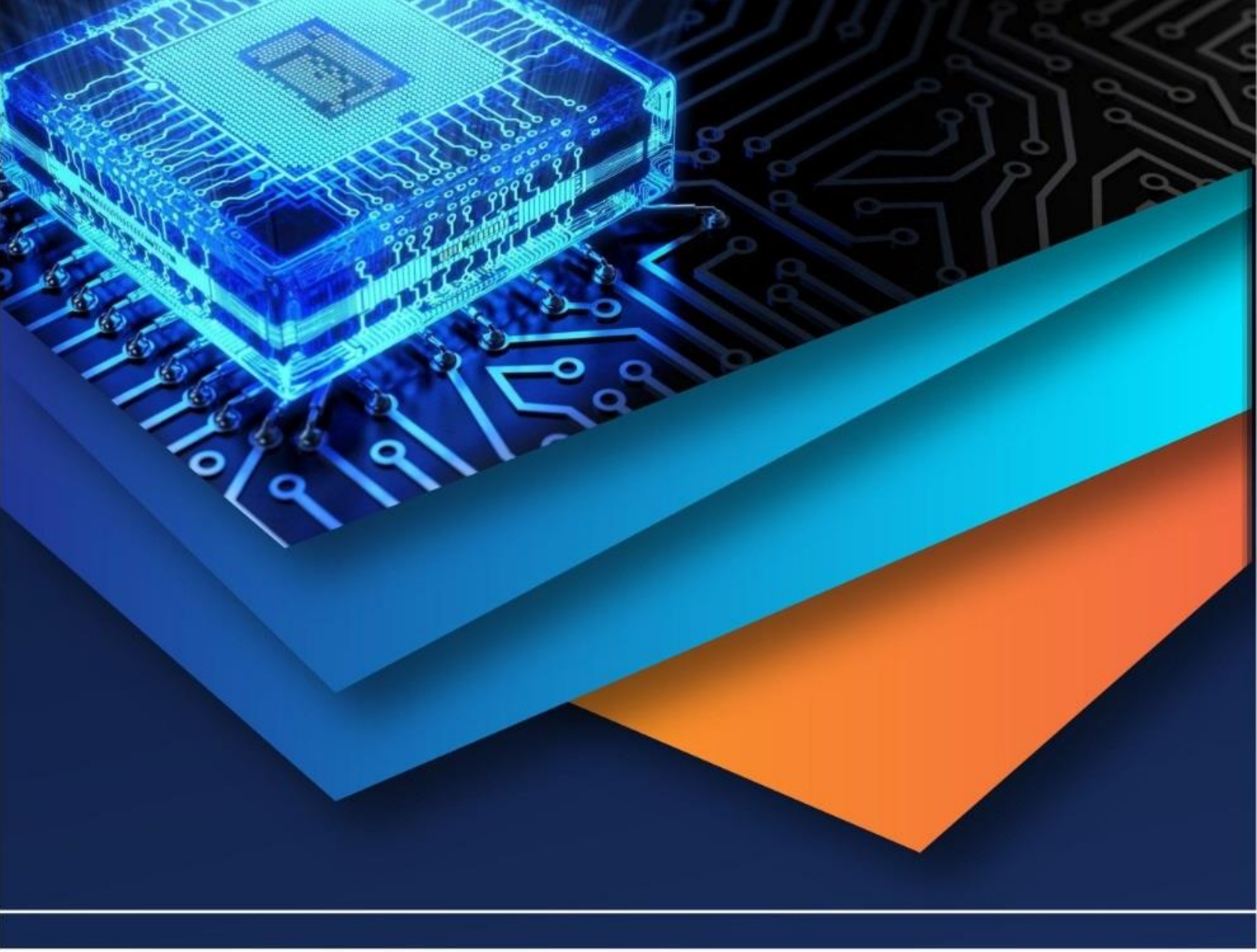

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