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A Study of Alum in Removal of Total Dissolved Solids - Effluent Waste Water

S. Kumaraguru[1], Thaminum Ansari[2]
[1]*Department of Chemistry, Government Thirumagal Mills College, Gudiyattam– 632602, Tamil Nadu, India*
[2]*Department of Chemistry, Muthurangam Government Arts College,Vellore– 632002, Tamil Nadu, India*

***Abstract:** In these days, there are increasing of industries such as food industries, palm oil industry, mining industry, steel industry, leather industry, etc. They have contributed pollution to our environment. These kind of industries discharge waste effluent water with very high concentration of dissolved salts and other metals. This can be treated by wastewater plant and by membrane process. This process is characterized by high treatment efficiency, optimal and it is also very low cost when compared with other water treatment. The river palar was considered much to meet the requirements of the industries. In Tamilnadu, more than 536 small scale ad 41 large scale industries are there. It occupies the first place in its percentile share i.e. 53.3 %. Many leather industries discharge wastewaters that carry very high concentration of dissolved solids and other metals treated by wastewater plant. This system is characterized by high treatment efficiency, optimal and very low cost when compared with other water treatment. Waste effluent water was being collected from nearby tanneries of Vellore district. The main aim of this research is to examine that by adding the chemical precipitants such as Alum salts in the effluent water to eliminate efficiency of TDS upto70%(i.e. exactly 69.11%) in the treatment system can be improved. The major advantage of reducing TDS is to improvise the life of membrane which is used. Membrane Technology (RO) is used for further treatment process. The treated water can be efficiently used for agriculture purposes.*

***Key words:** Industrial Wastewater, Membrane Technology, TDS and Alum salt*

I. INTRODUCTION

Almostall industries discharge water containing wastes from some stage of their manufacturing process, but industrial wastes are not same in every case. It differs from industry to industry[1]. In Tamilnadu, Vellore district is one of the important place of leather Industries in which Hide and Skins were traded the most. Much of the export consists of raw hides and skins. In 1973, the Dr.Seetharamiah committee, set up by the Government of India, recommended the export of raw hide and skins should be banned and the strongly recommended to restrict the export of semi –processed leather.

The ultimate aim was to export only finished product. These recommendations was accepted to improve the foreign exchange I flow ad thousand people were employed with the help of legislation and partly with a system of incentives, banned the export of raw hided and skins and discouraged the export of semi-processed leather. This accelerated the growth of tanneries. Once Chennai was the major center for hides and skins. Many new leather processing units were founded very close to the city. The state government provided opportunities to the industrialists to set up new leather industries. One such region was the belt in the Vellore district of Tamiladu, which was a good example to the phenomenal growth of the leather industry.

The river palar was considered much to meet the requirements of the industries. In Tamilnadu more the 536 small scale ad 41 large scale industries are there. It occupies the first place in its percentile share i.e. 53.3 %.(According to the report o the capacity utilization and scope for modernization in India Tanning Industry, Central Leather Research Institute, Adyar Chennai, 1990). Over the years the ground water in the areas where the tanneries are located, has becomeworsly polluted. Each and every tone of hide and skin tanned require over 40,000 liter of water. The household requirements of at least 2500 people. The pollution control authorities have been following their routine procedures in bringing the pollution from the tanneries under control.

II. OBJECTIVES OF THE STUDY

A. To reduce TDS In effluent waste water
B. To maintain PH value balanced
C. To maintain TST
D. To reuse the effluent water

III. LIMITATION OF THE STUDY

The analysis was done only in effluent water collected from the tannaries, Vellore district.Effluent waste water was collected to reduce TDS.

IV. COAGULATION OF WATER

The process of coagulation is used to remove colloidal particles from waste water .In waste water treatment process, coagulation means the treatment of water with reagents **so** as to remove colloidal and coarse dispersed impurities. Since colloidal particles of a given substance carry same charges, they are very stable and cannot be easily coagulated or consolidated into coarse formations. These charges can, however be removed by mutual coagulation of two collides whose particles are of opposite charges [1].

V. COAGULATION IN WASTE WATER TREATMENT

In water treatment technology ferrous sulphate ($FeSo_4.7H_2O$),aluminiumsulphate ($Al_2(SO_4)_3.18H_2O$) and ferric chloride ($FeCl_3$) are used as coagulants. They are used as 5-10% solutions. When a coagulant such as aluminiumsulphate is added to water, it undergoes hydrolysis according to the equation

$Al_2(SO_4)_3 + 6H_2O \rightleftharpoons 2Al(OH)_3 + 3H_2SO_4$

The acid being formed is neutralized due to water alkalinity.

$$H^+ + HCO^-_3 \rightarrow CO_2 + H_2O$$

The hydrolysis of aluminiumsulphate gives complex ions whose charge depends on th p^H of the medium. The products of hydrolysis of $Al_2(SO_4)_3$ in order of their increasing p^H are given below.

$Al_2(SO_4)_3$

$[Al(H_2O)_6]^{3+}$

$[Al(H_2O)_5(OH)]^{2+}$

$[Al(H_2O)_4(OH)_2]^{+}$ — p^H less than 4

$[Al_6(OH)_{15}]^{3+}$ $[Al_8(OH)_{20}]^{4+}$ — p^H 4 to 5

$[Al(H_2O)_3(OH)_3]$ — p^H 5.5

$[Al_2(OH)_7]^-$

$[Al(OH)_4]^-$ — p^H greater than 7

of all hydrolysis products, the most important are the coordination compounds with 6 and 8 atoms. These forms a reticular positively charged with neutral particles $[Al_2(OH)_5Cl]$ ad promote coagulation of natural water[1].

VI. MODE OF OPERATION

Effluent waste water was collected from the nearby tanneries. It was equally taken in five beakers i.e approximately 100ml of water in each beaker. First beaker was added with 1 percent of alum.5 percent alum was added in second beaker, In third 10 percent was added.. In fourth and fifth 20percent and 50percent of alum was added. According to the addition of 50percent alum in fifth beaker,

the TDS level was constantly reduced but there was a increase in its P^H level. The solutions become acidic media. To reduce the P^H level (acidic nature) 5percent of NaOH was added to the solution. After these processes the solution become base media.P^H level is 8.1(due to the addition of NaOH). Atlast, 1percent of HCL was added to make the PH value to attain normal level. Now the TDS level and PH level were balanced. The process of standardization is over. Alum acts as a good coagulant in the reduction of TDS.Refer to the graph given below (a)

VII. MEMBRANE TECHNOLOGY: RO PROCESS

[2] Membrane technology has become a dignified separation technology over the past decennia. The main force of membrane technology is the fact that it works without the addition of chemicals, with a relatively low energy use and easy and well-arranged process conductions. Membrane technology is a generic term for a number of different, very characteristic separation processes. These processes are of the same kind, because in each of them a membrane is used. Membranes are used more and more often for the creation of process water from groundwater, surface water or wastewater. Membranes are now competitive for conventional techniques. The membrane separation process is based on the presence of semi permeable membranes. The principle is quite simple: the membrane acts as a very specific filter that will let water flow through, while it catches suspended solids and other substances. There are various methods to enable substances to penetrate a membrane.[3]In addition, RO process are equipped to remove remaining undissolved particles. The process undergone in beakers were successful. After the completion of standardization process. The waste water were being collected in large barrels, required amount on $CaCO_3$,NaOHad HCL were added to reduce the TDS and P^H level. Atlast, RO process was used to make the water clean that can be used for further purpose. The permeates of these RO treatment systems are more than 70-85%recovery and the rejects are 15-35%.rejects are generally containing more TDS i.e.20,000mg/L.Orgaic pollutants of tannery effluent will cause rapid scalling and befouling to the RO membrane consequently reduction I flux rate and performance. This process also enhances the maintenance cost of the technology. The salt content are widely reduced by 91.1%. Waste water system offered should be low cost in the developing countries like India. The maintenance and operation of RO is moderate when compared with other technology.

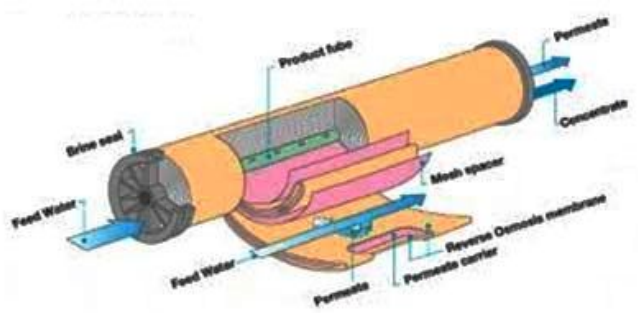
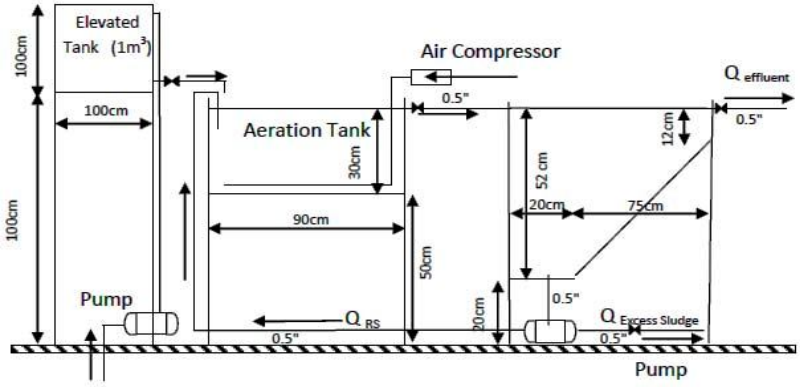


Fig.(1): TM series Element



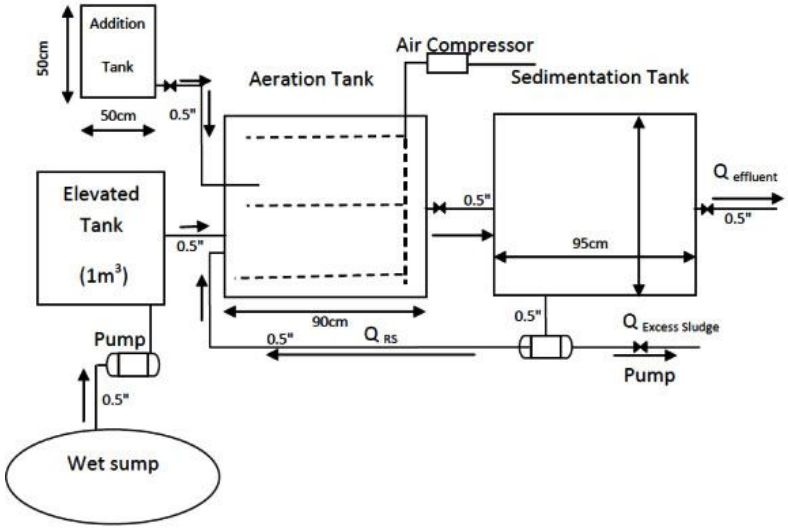


Fig.(2): A-stage process

VIII. OPTION OF OTHER TECHNOLOGY FOR TANNING PROCESS:

Replacement of common salt preservation using enzyme and cold preservation technologies before bringing to tannery that may reduce the TDS as well as consumption.Soaking water in the last tanks may be used in the first tank to minimize water consumption.Applying paddles with drums and adopting low float processing could minimize the use of water.Washing in closed drums instead with running water and prevention of wastage of water from pipes or hoses ect. May be followed for reducing wastewater. Attempts shall be made for de-liming with carbon dioxide instead of ammonium salts. Reduction in consumption of lime and quality of lime shall be improved to minimize pollution load in the wastewater.

IX. USE OF ALUM ININDUSTRIAL WASTE WATER TREATMENT

[4]Historically,alum was used extensively in industries from classical atiquity,during the middle ages. [5]Alum is used to clarify water by neutralising the electrical double layer surrouding very fine suspended particles,allowing them to flocculate(stick together). After flocculation,the particles will be larger enough to settle down and can be removed easily.it is a good chemical flocculant.

X. RESULTS AND DISCUSSIONS

The experimental work for this study was carried out in one run without adding salts for a week, to describe the natural performance. Alum salt was added during retention period of 7 days. When 50 percent of alum added to the solution the TDS level was gradually decreased and then in certain stage there was sudden increase in TDS level due to high concentration of alum salt. Though Alum is not much acidic in nature, the high concentration demands increases the TDS level. A disadvantage of aluminum sulphate is its sensitivity to the temperature of the water to be treated. At low temperature aluminum hydroxide forms a strongly hydrated and very stable sol. The increased stability of the sol affects the process of flocculation, and this means high coagulant consumption in winter.

Table (1): Average values of influent TDS and P^H

Alum Salt (mg/L)	TDS	P^H
Zero additives	1852	3.5
100	1756	4.2
150	1523	5.5

200	1011	6.2
250	850	6.9

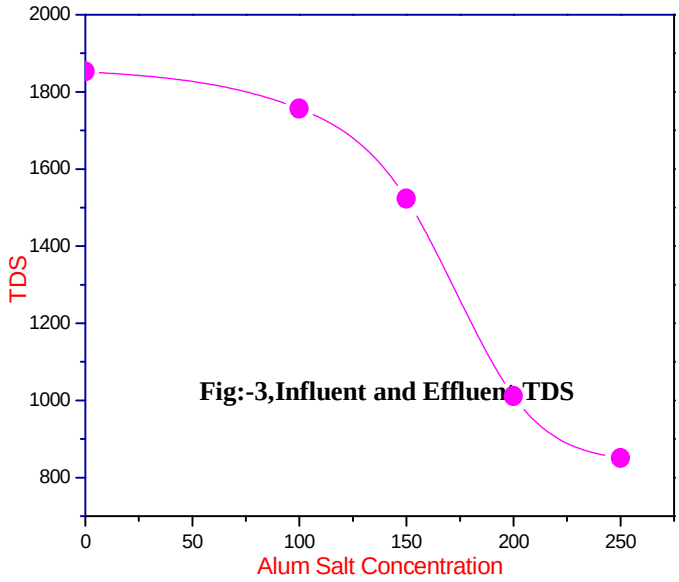


Fig:-3,Influent and Effluent TDS

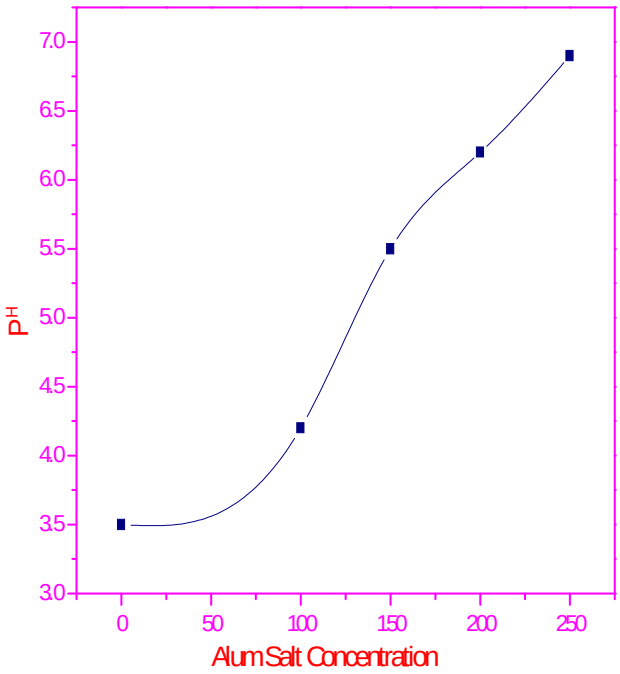


Fig:-4,Influent and Effluent P^H

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XI. CONCLUSION

The main aim of this study is to examine that by adding the chemical precipitants such as Alum salts in the effluent water to eliminate efficiency of TDS in the treatment system can be improved. Membrane process is used for further treatment process.Membrane technology is being used for the large-scale reclamation of wastewater. Success of this new technology depends on proper pretreatment, chemical control and RO membranes that are resistant to fouling. With proper design parameters, certain conventional polyamide membranes and low fouling composite membranes have been shown to have stable flux and rejection over long operational periods, with time between membrane cleanings in excess of 6 months in many cases. This technology will be very important for communities who need to extend their water supply and for industries that require ultra-high quality water for their operation.

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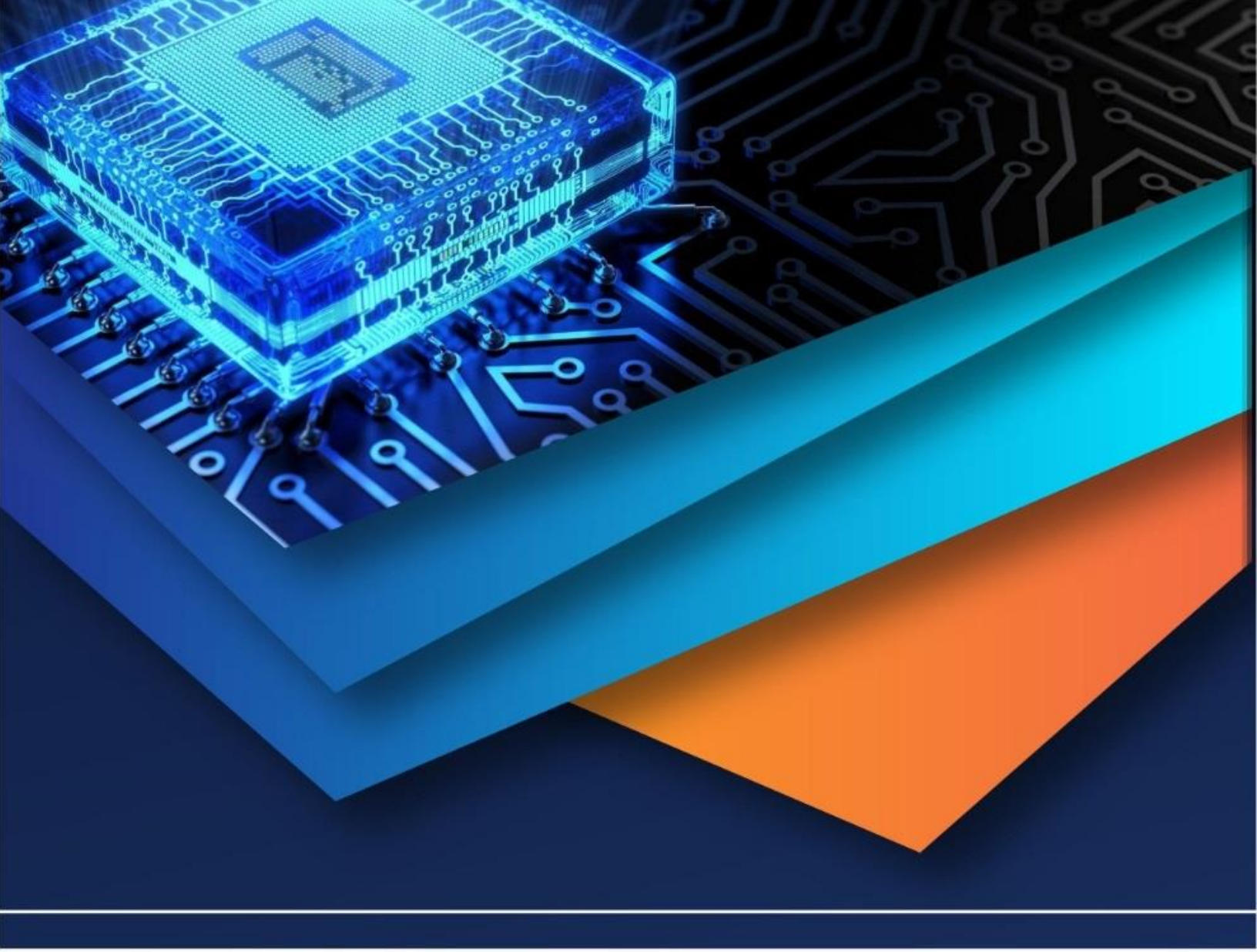

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