Research Journal of Recent Sciences ____ ISSN 2277-2502
Vol. 3(**ISC-2013**), 58-61 (**2014**) *Res. J. Recent. Sci.*

Treatment Study of Dyeing Industry Effluents using Reverse Osmosis Technology

Vijayageetha V.A.[1], Pandia Rajan A.[2], S.Philip Arockiaraj[2], Annamalai V. [1], Janakarajan V.N.[3], Saravana Balaji M.D.[4] and Dheenadhayalan M.S.[2]

[1]Dept of Physics, Chikanna Govt Arts College, Tiruppur, INDIA
[2]Department of Chemistry, GTN Arts College, Dindigul, INDIA
[3]Perundurai Medical College, Perundurai, INDIA
[4]RVS Dental College, Sulur, Coimbatore, INDIA

Available online at: www.isca.in, www.isca.me
Received 7th January 2014, revised 6th February 2012, accepted 14th March 2014

Abstract

Reverse Osmosis has been successfully applied on a large scale throughout the world for the treatment of effluent and the polluted water. The Arab countries and some other affluent countries have the credit of successfully running such large scale plants without minding for the cost factor involved in such projects. Here the polluted effluent is treated using R.O technology in order to remove the pollutants. It is a pressure driven membrane desalination process. The process is also known as hyper filtration. It is heartening to note that this process has undergone the most rapid development of any desalination technique. The fluids of different concentrations in a tank are separated by a membrane; the dilute solution will flow through the membrane into the concentrated solution. It is called osmosis. To affect a reverse process of osmosis, a pressure is applied in excess of the osmotic pressure to the concentrated solution. Now the flow is reversed from the concentrated solution to the dilute solution. It is "reverse osmosis". It is always remembered that, whether it is osmosis or reverse osmosis only the flow of water take place from one side to the other side. It is because the semi permeable membrane can allow only smaller molecules like that of water to pass through it. The basic types of membranes in use are. i. Cellulose acetate, ii. Polyamide, iii. Thin Film Composite Membranes. Reverse osmosis has been successfully applied on a large scale for the treatment of effluent and the polluted water. In the present study the dyeing effluent are treated using RO plant and treatment can be recommended to all dyeing. The same reverse osmosis method can also be applied to other industry effluent.

Keywords: Dyeing effluent, treatment, reverse osmosis technology.

Introduction

The textile dyeing industry consumes large quantities of water and produces large volumes of wastewater from different steps in the dyeing and finishing processes. In dyeing textiles, ecological standards are strictly applied throughout processing from raw material selection to the final product. This has become more critical since the German environmental standards regarding dye effluents became effective[1].

The textile dyeing wastewater has a large amount of complex components with high concentrations of organic, high-color and changing greatly characteristics. Owing to their high BOD/COD, their coloration and their salt load, the wastewater resulting from dyeing cotton with reactive dyes are seriously polluted. As aquatic organisms need light in order to develop, any deficit in this respect caused by colored water leads to an imbalance of the ecosystem. Moreover, the water of rivers that are used for drinking water must not be colored, as otherwise the treatment costs will be increased. Obviously, when legal limits exist (not in all the countries) these should be taken as justification. Studies concerning the feasibility of treating dyeing wastewater are very important.

Reverse Osmosis has been successfully applied on a large scale throughout the world for the treatment of effluent and the polluted water. The Arab countries and some other affluent countries have the credit of successfully running such large scale plants without minding for the cost factor involved in such projects. Here the polluted effluent is treated using R.O technology in order to remove the pollutants[2, 3].

Reverse osmosis membranes have a retention rate of 90% or more for most types of ionic compounds and produce a high quality of permeate[4-6]. Decoloration and elimination of chemical auxiliaries in dye house wastewater can be carried out in a single step by reverse osmosis. Reverse osmosis permits the removal of all mineral salts, hydrolyzed reactive dyes, and chemical auxiliaries. It must be noted that higher the concentration of dissolved salt, the more important the osmotic pressure becomes; therefore, the greater the energy required for the separation process.

RO Treatment of various Wastewaters: Reverse osmosis has also been applied to a variety of other wastewaters. It is used RO membranes to remove contaminants (calcium, magnesium, zinc, sulfate, chloride, ammonia and others) in blast-furnace scrubber water, allowing recycle of the product water[7] and also discussed the use of RO to treat coal mining drainage (containing mostly sodium salts); TDS removals from the permeate were high[8]. It described a process in which RO was integrated with other treatment systems to remove contaminants from a complex industrial wastewater[9], this wastewater contained contaminants from semiconductor manufacturing lines and plating baths as well as cooling tower blowdown and other facility wastewaters. The treatment process allowed recycle of the product water, reduced operating costs, and compliance with environmental regulations. Reverse osmosis has also been used to demineralize cooling tower blowdown in the power generation industry [10,11].

Principle of Reverse Osmosis: It is a pressure driven membrane desalination process. The process is also known as hyper filtration. It is heartening to note that this process has undergone the most rapid development of any desalination technique. The fluids of different concentrations in a tank are separated by a membrane; the dilute solution will flow through the membrane into the concentrated solution. It is called osmosis.

Reverse Osmosis: To affect a reverse process of osmosis, a **pressure is applied in excess of the osmotic pressure to the concentrated** solution. Now the flow is reversed from the concentrated solution to the dilute solution. It is "reverse osmosis". It is always remembered that, whether it is osmosis or reverse osmosis only the flow of water take place from one side to the other side. It is because the semi permeable membrane can allow only smaller molecules like that of water to pass through it.

Membranes used in Reverse Osmosis: The Reverse osmosis process operates at ambient temperature by sufficient pressure being applied to a saline water to overcome the osmotic pressure and to force fresh water through a semi-permeable membrane at a realistic rate[3]. The membranes are ideally speaking permeable only to water but in practice a small amount of salt transfer also occurs. The basic types of membranes in use are. i. Cellulose acetate, ii. Polyamide, iii. Thin Film Composite Membranes.

Composite membranes employ a thin film of polyamide or similar desalting layer formed upon a porous substrate of a material such as polysulfonate. The cellulose acetate and polyamide membranes are formed a one stage process. Here an outer thin dense active layer is supported by a thick porous layer of the same material. The cellulose acetate membrane is cast into a supporting fabric to provide mechanical strength for handling. The polyamide hollow fibers are not thicker than a human hair and are self supporting.

Results and Discussion

The Results of the various physico-chemical analysis of the dyeing effluent before and after the treatment using RO plant and the effluents samples were collected at the study area.

Working of Reverse Osmosis Treatment Plant

Stage No.	Filtration	Material	Benefit
1	Pre-Filter	Poly propylene yarn wound	Removes Suspended particles
2	Sediment Filter	Poly Propylene melt blown	Removes Suspended particles
3	Pre-RO carbon Cartridge	Silver impregnated Activated carbon	Removes excess chlorine and organic impurities
4	Reverse Osmosis	Thin film composite (TFC) (0.0001 micron)	Reduces TDS, hardness, pesticides, heavy metals like arsenic, lead and mercury. Removes micro organisms like bacteria, virus and protozoa cysts.
5	Post-RO carbon cartridge	Silver impregnated activated carbon	Inhibits growth of bacteria, removes residual organic impurities and revives the original taste of water.

Comparative Table-1
Physical and chemical analysis of the dyeing effluent before and after the treatment using RO System

S. No.	Physical Parameters	Standard -A	Dyeing effluent analysis S-1	Effluent after treatment with R.O. system S-2
1.	Appearance	-	Blackish	Clear
2.	Odour	Nil	Bad Smell	Colorless
3.	Turbidity % NT Units	1	660	2
4.	Total dissolved solids mg/L	500	**8903**	**149**
5.	Electrical Conductivity in Micro mhos/cm	-	**13093**	**220**
6.	pH	6.5-7.5	7.03	7.57
7.	Alkalinity pH	_	0	0
8.	Total Hardness as $CaCO_3$ mg/L	200	**1840**	**80**
9.	Calcium as Ca mg/L	75	368	16
10.	Magnesium as Mg mg/L	30	221	10
11.	Sodium as Na mg/L	-	1600	12
12.	Iron Total as Fe mg/L	0.1	**3.58**	**0.07**
13.	Ammonia as NH_3 mg/L	-	0.18	0.04
14.	Potassium as K mg/L	-	450	3
15.	Nitrite as NO_2 mg/L	-	0.3	0.01
16.	Nitrate as NO_3 mg/L	-	48	4
17.	Chloride as CI mg/L	200	3200	44
18.	Sulphate on SO_4 mg/L	200	413	5
19.	Fluoride as F mg/L	1	2.4	0.4
20.	Phosphate as PO_4 mg/L	-	6.25	0.06
21.	Tidly's Test 4 hrs as O_2		1.88	0.12

Table -2: Column-1(S1): The Dyeing effluent analysis reveals that all the parameters are above the standard limit as per CPHEEO.

Column-2(S2): Effluent after Treatment with RO: i. The Turbidity is 2 NTU where as the standard as per CPHEEO shows the acceptable limit is 0 NTU. ii. The total dissolved solid value is 147mg/lit which lies below the acceptable limit 500mg/lit. iii. The amount of Magnesium is 40mg/lit, which lies above the acceptance limit 30. iv. For Nitrate the permissible limit is nil but the observed value is 0.03mg/lit. v. For Phosphate also the permissible limit is nil. But the observed value is 6.2mg/lit. So this water is unfit for drinking. vi. The amount of Chloride is 44mg/lit which lies above in the acceptable limit 200mg/lit. vii. The permissible limits for ammonia are Nil. But the observed value of the sample of water is 0.09mg/lit. So the water is unfit for drinking.

Conclusion

Reverse osmosis has been successfully applied on a large scale for the treatment of effluent and the polluted water. In the present study the dyeing effluent are treated using RO plant and treatment can be recommended to all dyeing. The same reverse osmosis method can also be applied to other industry effluent.

Reference

1. Robinson T., Mcmullan G., Marchant R. and Nigam P., Remediation of Dyes In Textile Effluent: A Critical Review On Current Treatment Technologies With A Proposed Alternative, *Colorage,* **44,** 247-255 **(1997)**
2. Ranganathan K., Karunagaran K., Sharma D.C., Recycling Of Wastewaters of Textile Dyeing Industries Using Advanced Treatment Technology and Cost Analysis—Case Studies, *Resources, Conservation And Recycling,* **50,** 306–318 **(2007)**
3. Ramesh Babu B., Parande A.K., Raghu S. and Prem Kumar T., Textile Technology- Cotton Textile Processing: Waste Generation And Effluent Treatment, *The Journal of Cotton Science,* **11,** 141–153 **(2007)**
4. Ghayeni S.B., Beatson P.J., Schneider R.P. And Fane A.G., Water Reclamation from Municipal Wastewater Using Combined Microfiltration-Reverse Osmosis (MERO): Preliminary Performance Data And Microbiological Aspects of System Operation, *Desalination,* **116,** 65-80 **(1998)**
5. Treffry-Goatley K., C.A. Buckley, and G.R. Groves., Reverse Osmosis Treatment and Reuse Of Textile Dye House Effluents, *Desalination,* **47,** 313-320 **(1983)**

6. Tinghui L., Matsuura T. and Sourirajan S., Effect of Membrane Materials And Average Pore Sizes On Reverse Osmosis Separation of Dyes, *Ind. Eng. Chem. Prod. Res. Dev.,* **22,** 77-85 **(1983)**

7. Terril M. and Neufeld R., "Reverse Osmosis Of Blast-Furnace Scrubber Water", *Environmental Progress,* **2,** 121 **(1983)**

8. Hart O.O. and Squires R.C., The Role of Membrane Technology In Industrial Water and Wastewater Management", *Desalination,* **56,** 69 **(1985)**

9. Sinisgalli P. and Mcnutt J., "Industrial Use Of Reverse Osmosis", *Journal AWWA,* 47 **(1986)**

10. Schutte C., Spencer T., Aspen J., and Hanekom D., "Desalination And Reuse Of Power Plant Effluents: From Pilot Plant To Full Scale Applications", *Desalination,* **67,** 255 **(1987)**

11. Bryant T., Stuart J., Fergus I., And Lesan R., The Use Of Reverse Osmosis As A 35,600 M^{-3}/Day Concentrator In The Wastewater Management Scheme At 4640 MW Bayswater/Liddel Power Station Complex - Australia, *Desalination,* **67,** 327 **(1987)**