REMEDIAL STUDY OF IRON INDUSTRY EFFLUENTS USING REVERSE OSMOSIS TECHNOLOGY

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Reverse osmosis (RO) system has been effectively 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 RO technology in order to remove the pollutants. The investigator has taken an attempt has been made to find out in the impact of Iron Industry Effluent and also to know about the quality of Iron Industry effluents after the treatment of using R O plant. Reverse osmosis has been successfully applied on a large scale for the treatment of effluent and the polluted water. In the present study the Iron Industry effluent are treated using RO plant and treatment can be recommended to all Iron Industries. The same reverse osmosis method can also be applied to other industry effluent.

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INTRODUCTION

Since the development of the first practical cellulose acetate membranes in the early 1960's and the subsequent development of thin-film, composite membranes, the uses of reverse osmosis have expanded to include not only the traditional desalination process but also a wide variety of wastewater treatment applications.

RO systems are inorganic and organic pollutants can be removed simultaneously by RO membrane processes. RO processes can considerably reduce the volume of waste streams so that these can be treated more efficiently and cost effectively by other processes such as incineration. In addition, RO systems can replace or be used in conjunction with others treatment processes such as oxidation, adsorption, stripping, or biological treatment to produce a high quality product water that can be reused or discharged.[1-6]

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Applications that have been reported for RO processes include the treatment of organic containing wastewater, wastewater from electroplating and metal finishing, pulp and paper, mining and petrochemical, textile, and food processing industries, radioactive wastewater, municipal wastewater, and contaminated groundwater.[1,6,10,11]

MATERIALS AND METHODS

An attempt has been made to analyse the extent of water pollution by analyzing various water quality parameters for iron industry effluent. The effluent water sample was analysed and compared with the guideline of Bureau of Indian Standards (BIS) limit for drinking water standards. Analysis of physico-chemical characteristics of water samples were undertaken to find the water quality.

Table 1. Analysis of the Water Quality Parameters

Parameter	Method of Analysis
Colour	Visual comparison
Turbidity	Neplo turbidimetry
TDS	Conductivity measurement
Electrical conductivity	Conductivity measurement
pH	pH measurement
Total hardness	EDTA titrimetry
Calcium and magnesium	EDTA titrimetry
Iron	Spectrophotometry
Ammonia	Nessler's method
Nitrite and nitrate	Spectrophotometrs
Chloride	Silver nitrate
Fluoride	Colorimetry
Sulphate	Turbidity method
Phosphate	Spectrophotometry

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.

Table 2. Working of reverse osmosis treatment plant

FILTRATION	MATERIAL	BENEFIT
Pre-filter	Polypropylene yarn wound	Removes suspended particles
Sediment filter	Polypropylene melt blown	Removes suspended particles
Pre-RO carbon cartridge	Silver impregnated activated carbon	Removes excess chlorine and organic impurities
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.
Post-RO carbon cartridge	Silver impregnated activated carbon	Inhibits growth of bacteria, removes residual organic impurities and revives the original taste of water.

Table 3. Physico-chemical analysis of the iron industry effluent before and after the treatment using RO system.

Physical Parameters	BIS-Standards	Iron industry effluent analysis (S-1)	Iron industry effluent after treatment with RO system (S-2)
Appearance	_-	blackish	clear
Odour	nil	bad smell	colorless
Turbidity % NT Units	1	540	4
Total dissolved solids mg L^{-1}	500	6903	129
Electrical conductivity, $\mu ohm^{-1} cm^{-1}$	-	10412	320
pH	6.5-7.5	6.53	7.57
Alkalinity Ph	_	0	0
Total Hardness as $CaCO_3$ ppm	200	940	70
Calcium as Ca ppm	75	268	16
Magnesium as Mg ppm	30	211	11
Sodium as Na mg L^{-1}	-	1600	12
Iron Total as Fe mg L^{-1}	0.1	3.49	0.07
Ammonia as NH_3 mg L^{-1}	-	0.18	0.09
Potassium as K mg L^{-1}	-	360	2
Nitrite as NO_2 mg L^{-1}	-	0.3	0.01
Nitrate as NO_3 mg L^{-1}	-	54	5
Chloride as CI mg L^{-1}	200	2900	42
Sulphate on SO_4 mg L^{-1}	200	313	4
Fluoride as F mg L^{-1}	1	2.6	0.4
Phosphate as PO_4 mg L^{-1}	-	5.25	0.06
Tidly's Test 4 h as O_2	-	1.53	0.12

RESULTS AND DISCUSSIONS

The results of the various physico-chemical analysis of the iron industry effluent before and after the treatment using RO plant and the effluents samples were collected at the study area. The iron industry effluent analysis reveals that all the parameters are above the standard limit as per BIS standards.

The iron industry effluent after treatment with reverse osmosis

The Turbidity is 4 NTU where as the standard as per BIS shows the acceptable limit is 1 NTU. The total dissolved solid value is 129 mg L^{-1}, which lies below the acceptable limit 500 mg L^{-1}. The amount of Iron is 0.07 mg L^{-1}, which lies below the acceptance limit 0.1 mg L^{-1}. For Nitrate the permissible limit is nil but the observed value is 5 mg L^{-1}. For Phosphate also the permissible limit is nil. But the observed value is 0.06 mg L^{-1}. So this water is unfit for drinking. The amount of Chloride is 42 mg L^{-1} which lies below in the acceptable limit 200 mg L^{-1}. The permissible limit for ammonia is nil. But the observed value of the sample of water is 0.09 mg L^{-1}. So the water is unfit for drinking.

CONCLUSION

The effect of chemicals in the industrial effluents affects cultivable land due to the use of polluted water for irrigation. The polluted water stops the growth of plants. This has caused a greater damage to the environment. The pollution of water has threatened the people to a greater extent. The water after treatment using reverse osmosis were tested and analyzed. The physico-chemical parameters of water are within the permissible limit. Hence it is advised to the residents of Iron Industry to install a domestic reverse osmosis plant in order to convert the available ground water to potable waters. The water becomes suitable for drinking purpose with a low TDS of 40 mg L^{-1}. Reverse osmosis has been successfully applied on a large scale for the treatment of effluent and the polluted water.

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