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Absorption of Chloride from Electroplating Industry Effluent Using Bacteria

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The present study deals with the absorption of chloride from electroplating industry effluent using bacteria. Physico –chemical characteristics such as pH, electrical conductivity, total solids, total dissolved solids, suspended solids, hardness, sodium, potassium, calcium, sulphate, chloride, dissolved oxygen, BOD, COD and zinc were estimated. Different concentration (0.2,0.4,0.6,0.8 & 1.0 ml) of bacterial species such as *Pseudomonas aeruginosa, Pseudomonas flourescens, Bacillus subtilis* and *Bacillus magaterium* along with the electroplating industry effluent was incubated in a shaker for 18, 20, 22 and 24 hours. Among the four bacterial species *Pseudomonas fluroescens* had higher capacity of chloride absorption.

Key words: Absorption, chloride, electroplating industry effluent, bacteria.

Water is the basic and primary need of all vital life process on this planet. It is adversely affected both quantitatively and qualitatively by all kinds of human activities. Today most of the inland water bodies of world receive millions of liters of sewage, domestic waste, industrial and agricultural effluents containing substances varying in characteristics from simple nutrients to highly toxic substances. Pollution of water is responsible for number of mortalities and incapacities in the world. During the last four decades, as a consequence of rapidly expanding industrialization and excessive population growth most of our rivers, lakes, streams and other water bodies are being increasingly polluted. Most of the industries are discharging their wastes without proper treatment thereby affecting the environment adversely (Verma *et al.,* 1977). The release of waste water into the water bodies affects flora and fauna (Nampoothery & Sasidharan, 1976). Among the major industries, electroplating industry release large quantities of inorganic pollutants like chlorides and heavy metals like zinc, nickel and chromium which will contaminate surface and underground water sources. Among the different pollutants, the chloride content is very high in electroplating effluent. Chloride content not only contaminates the surface and underground water but also the soil. Conventional methods such as precipitation, ion exchange, adsorption, reverse osmosis, electro dialysis and crystallization are used to remove the chloride and pollutants from industrial waste waters (Dean *et al.,* 1992). These techniques may

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be technically inapplicable or very expensive from economic point of view. The use of microbial cells as biosorbents of toxic inorganic pollutants is a potential alternative to conventional methods used to decontaminate liquid wastes (Kasan & Baecker, 1989). The studies related to the use of bacterial species and their efficiency of absorbing chloride from electroplating industry effluent is totally wanting. Hence the present study was conducted.

MATERIAL AND METHODS

Electroplating industry effluent was collected in polythene cans from BSA, Electroplating powder coatng, Jaihindpuram, Madurai, Tamilnadu, India and transported to the laboratory for analysis. The bacterial species were sequentially enriched in nutrient agar medium. Bacterial species cultures were maintained in nutrient agar medium. Then the nutrient broth was prepared and kept for sterilization at 121°C for 15 minutes. Then the bacterial species was inoculated in to the enrichment broth. The medium composition was maintained and utilized for the growth and mass culture of *Pseudomonas aeruginosa, Pseudomonas flourescens, Bacillus subtilis* and *B. magaterium*. The four bacterial species were collected from Department of Biology, Gandhigram Rural University.

The physico- chemical parameters such as pH, total solids,totaldissolved solids, total suspended solids, total hardness, sodium, potassium, calcium, sulphate, chloride, dissolved oxygen, BOD, COD and zinc were estimated (APHA, 1992). The bacterial species were treated with the electroplating industry effluent after the mass culture. The bacterial species were introduced into 100 ml effluent in different concentrations such as 0.2, 0.4, 0.6, 0.8 and 1 ml in order to observe the chloride absorption capacity. Initial chloride content was estimated and also the chloride content after introduction of the bacterial species with the electroplating industry effluent in a shaker for about 18, 20, 22 and 24 hrs was estimated. The difference in the absorption capacity of chloride was found out and ability of the absorption capacity of bacterial species was observed.

RESULTS AND DISCUSSION

The physico- chemical characteristics of the electroplating industry effluent is presented in Table 1. The pH of the electroplating industry effluent was 3. The electrical conductivity of the effluent was high (58.41 ms/cm) indicating the presence of high concentration of ionic substances. The total dissolved solids were very high (9700 mg /l). The contents of sodium , potassium and chloride in the effluent were higher.The chemical oxygen demand (COD) of the effluent was 240 mg / l. Agarwal & Sachan (2003) reported higher value of COD in sugar industry effluent. The BIS permits only 100 mg/l of COD for the disposal to the environment. The biological oxygen demand (BOD) of electroplating industry effluent was 8.08 mg/ l. The permissible limit is only 30 mg/l. The hardness of electroplating industry effluent was 4800 mg/ l. Ahamad & Khan (2003) studied the physico- chemical and toxicological studies of industrial effluents in an around Delhi and reported that the hardness of electroplating industry effluent was 512 mg/ l. The total dissolved solids was 9700 mg/ l.

Table 1. Physico-chemical characteristics of electroplating industry effluent

S. No.	Parameters	Value
1.	pH	3
2.	Electrical conductivity	58.41
3.	Total solids	10400
4.	Total dissolved solids	9700
5.	Total suspended solids	700
6.	Total hardness	4800
7.	Sodium	375
8.	Potassium	99
9.	Calcium	24
10.	Sulphate	2469
11.	Chloride	3692
12.	Dissolved oxygen	7.272
13.	BOD	8008
14.	COD	240
15.	Zinc	7348

Electrical conductivity is expressed as ms/cm.
Other parameters are expressed in mg/l except pH.

Borole & Patil (2004) reported 3400 - 4200 mg/l of total dissolved solids in sugar factory effluent. The effect of different concentrations of *Pseudomonas aeruginosa, Pseudomonas flourescens, Bacillus megaterium* and *B. subtilis* on absorption of chloride from electroplating industry effluent were presented in Table 2. The present study shows that the *Pseudomonas fluorescens* has higher chloride absorption capacity between 20 and 24 hours. Greater the concentration of bacterial species and contact time, greater was the absorption capacity. Vasanthy (2004) reported that more efficiency of chloride absorption was found in bacillus and pseudomonas species.

Table 2. Effect of different concentrations of *Pseudomonas aeruginosa, P. flourescens*, *Bacillus megaterium* and *B. subtilis* on absorption of chloride from electroplating industry effluent

S. No.	Concentration of Bacterial strain (ml)	Initial chloride content (mg/ l)	Chloride absorption in different hours			
			18	20	22	24
1.	*Pseudomonas aeruginosa*					
	0.2	3692	3195(13.46)	2982(19.23)	2698(26.92)	2485(32.69)
	0.4	3692	2982(19.23)	2698(26.92)	2556(30.77)	2272(38.96)
	0.6	3692	2911(21.15)	2485(32.69)	2272(38.46)	1917(48.08)
	0.8	3692	2627(28.85)	2343(36.54)	2059(44.23)	1704(53.85)
	1.0	3692	2556(30.77)	1988(46.15)	1704(53.85)	1491(59.61)
2.	*Pseudomonas flourescens*					
	0.2	3692	3124(15.38)	2769(25.00)	2627(28.85)	2272(38.46)
	0.4	3692	2982(19.23)	2698(26.92)	2414(34.62)	2201(40.38)
	0.6	3692	2840(23.08)	2556(30.77)	2130(42.31)	1846(50.00)
	0.8	3692	2627(28.85)	2485(32.69)	1988(41.15)	1491(59.91)
	1.0	3692	2556(30.77)	2130(42.31)	1704(53.85)	1420(61.54)
3.	*Bacillus megaterium*					
	0.2	3692	3195(13.46)	2982(19.23)	2769(25.00)	2414(34.60)
	0.4	3692	2982(19.23)	2911(21.15)	2698(26.92)	2272(38.96)
	0.6	3692	2911(21.15)	2698(26.92)	2627(28.85)	2130(42.31)
	0.8	3692	2769(25.00)	2627(28.85)	2414(34.62)	1988(48.15)
	1.0	3692	2485(32.69)	2414(34.62)	2272(38.46)	1775(51.92)
4.	*Bacillus subtilis*					
	0.2	3692	3195(13.46)	3053(17.31)	2840(23.08)	2343(36.53)
	0.4	3692	2911(21.15)	2840(23.08)	2485(32.69)	2201(40.38)
	0.6	3692	2840(23.08)	2627(28.85)	2059(44.23)	1988(46.15)
	0.8	3692	2627(28.85)	2556(30.77)	1846(50.00)	1775(51.92)
	1.0	3692	2556(30.77)	2414(34.62)	1775(51.92)	1562(57.69)

Parentage absorption of chloride is given in brackets.

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