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PHYSICO-CHEMICAL CHARACTERISTICS AND WATER QUALITY INDEX OF ELECTROPLATING INDUSTRY EFFLUENT

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ABSTRACT

The present study deals with the Physico – chemical characteristics and Water Quality Index (WQI) of electroplating industry effluent. The physico - chemical parameters such as pH, TDS, Total hardness, magnesium, chloride, sodium and potassium content was above the permissible limits of BIS and are responsible for ground water pollution. The WQI was 53, which showed that the pollution level of the electroplating industry effluent was between slight to moderate in the rating scale and the effluent was not suitable for irrigation.

INTRODUCTION

Increased demand for food and the need to sustain the ever increasing world population have led to massive increase in both agricultural and industrial activities. Today, India is one of the first ten industrialized countries of the world. India, like any other developing country, is faced with problems arising from the negative impact of economic development due to industrial pollution. Rapid progress made in industrialization with out adequate environmental safety measures lead to pollution of water, which, in turn, results in lack of good quality water both for irrigation and drinking purpose. The release of waste waters in to the water bodies affects the flora and fauna (Nampoothery and Sasidharan, 1976 and Singh *et al.* 1996).Industrial effluents have been regarded as a source of pollution because of the lack of efficient treatment and disposal (Srivastava and Pandey, 1999).For effective maintenance of quality, one needs continuous monitoring. For this purpose it is very important to know the physico – chemical characteristics of industrial effluents. Among the major industries, electroplating industries release large quantities of inorganic pollutants like chlorides and heavy metals like zinc, nickel and chromium which will contaminate surface and underground water sources. The studies related to the physico-chemical characteristics and water quality index of electroplating industry effluent was totally wanting. Hence it is programmed to evaluate the quality of electroplating industry effluent.

MATERIALS AND METHODS

Electroplating industry effluent was collected in ten liters polyethylene cans from BSA, Electroplating powder Coating, Jaihindpuram, Madurai, Tamil Nadu, India. Samples were brought to the laboratory and used for the determination of pH and EC in six hours of collection. The other parameters such as TS, TDS, TSS, hardness, sodium, potassium, calcium,

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magnesium, sulphate, chloride, dissolved oxygen, BOD, COD and zinc were estimated (APHA, 1990). The amount of sodium, potassium and calcium has been determined using flame photometer and magnesium by complex metric method. Biological Oxygen Demand was estimated by incubating the water samples at 20 °C for five days in BOD incubator and Chemical Oxygen Demand was estimated by dichromate reflex method.

Water Quality Index (WQI)

The water quality index was calculated to arrive at the level of pollution. However, the WQI is bound to depend on the intended use of water. The standards for surface irrigation of the effluent water recommended (Goel and Sharma, 1996) by BIS for ten parameters chosen for the analysis along with the assigned weights (Punmia, 1977) are shown in the following Table.

S. No.	Parameters *	Standard (si)	Weight (wi)	Unit Weight (wi)
1.	pH	6.0 – 9.0	1	0.04
2.	Electrical conductivity	400	2	0.09
3.	TDS	2100	2	0.09
4.	Total hardness	250	1	0.04
5.	Calcium	75	3	0.13
6.	Magnesium	50	1	0.04
7.	Chloride	600	4	0.18
8.	Sulphate	150	3	0.13
9.	Sodium	25	4	0.18
10.	Potassium	20	2	0.09
				1.0

* All the values are expressed in mg/L except pH and Electrical conductivity.

Water Quality Index was calculated as per Harton (1965) as modified by Tiwari and Mishra (1985). Weights (wi) were assigned to various water parameters indicated in the above Table, which ranged from 1 to 4. According to the role of various parameters on the overall quality, the rating scales were fixed. For example, sodium, chloride and sulphate were important parameters in all the water quality parameters and hence 4 and 3 weights were assigned. The other parameters were assigned according to their importance and incidence in surface irrigation. Even if they present they might not be the ruling factor. Hence they were assigned low weights. The weight (wi) for the ith parameters (I = 1,2, 3,— — — 10 in our case) was calculated from the following relation.

$$Wi = \frac{w}{10} \quad ? \; wi = 1$$

Which ensures that

$$Wi = 1 \qquad i = 1$$

The unit weights were calculated from the relation shown are indicated in the Table. The rating scale for the ten water quality parameters considered here given in the following Table. Each parameter has been divided into five intervals according to the ranges. The quality index (qi) corresponding to each range (varying from 0 to 100) and the extent of pollution corresponding to various value ranges , in descriptive terms, are given in the following Table.

qi – 100 – Ideal limit
qi - 0 - Severe

Other ratings , namely qi – 25, 50 and 75 are intermediate scales between ideal and severe values of

EXTENT OF POLLUTION

S.No.	Parameters	Ideal	Slight	Moderate	Extreme	Severe
1.	pH	6.0–7.5	7.6- 8.0	8.1-8.5	8.5-9.0	> 9.0
2.	EC	0 - 100	101-200	201–300	301–400	> 400
3.	TDS	0-500	501–1000	1001–1500	1501–2100	> 2100
4.	Total hardness	50–100	101–150	151-200	201-250	> 250
5.	Calcium	0-20	21-40	41-60	61-75	> 75
6.	Magnesium	5-15	16-25	26-35	36-50	> 50
7.	Chloride	50–150	151-250	251-400	401–600	> 600
8.	Sulphate	25-75	76-100	101-125	126-150	> 150
9.	Sodium	5-10	11-15	16-20	21-25	> 25
10.	Potassium	5-9	9 -11	11-13	13-20	> 20
	Rating (qi)	100	75	50	25	0

BIS for irrigation purpose. The Water Quality Index (WQI) is the aggregate of the multiplication of qi and wi of the ith parameters.

$$\text{i.e. } WQI = \sum_{i=1} 10\, piwi$$

Based on WQI value the quality status is assigned, i.e. if WQI is 75 – 100 the parameters are in ideal limit as shown in the Table.

Table 1. Physico - chemical characteristics of electroplating industry effluent.

Parameters	Values
pH	3
Electrical conductivity	58. 41
Total solids	10400
Total dissolved solids	9700
Total suspended solids	700
Total hardness	4800
Sodium	375
Potassium	99
Calcium	1760
Magnesium	3240
Sulphate	2. 469
Chloride	3692
Dissolved oxygen	7.272
BOD*	8.08
COD **	240
Zinc	7348

Electrical conductivity ms/cm. Other parameters are expressed in mg/L except pH.
BOD * - Biological Oxygen Demand.
COD **- Chemical Oxygen Demand.

RESULTS AND DICUSSION

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. Nirmala Agarwal and Sachan (2003) reported higher value (15000 mg/L) of chemical oxygen demand in sugar industry effluent. The BIS permits only 100 mg/L for the disposal to the environment. The Biological Oxygen Demand value of electroplating industry effluent was 8.08 mg/L. The permissible limit of BOD is only 30 mg/L for environmental disposal. In the present study the BOD of electroplating industry effluent was within the permissible limit. The hardness of the effluent was 4800 mg/L. Ahamed and Alam (2003) studied the physico -chemical and toxicological studies of industrial effluents in and around Delhi and ground water quality of some areas in Delhi and reported that the Total hardness of electroplating industry effluent was 512 mg/L.

The Water Quality Index (WQI) of the electroplating industry effluent was calculated as a measure of water quality and it is shown in Table 2. The results indicate that out of the 10 parameters studied only two (Electrical conductivity and sulphate) were within the permissible limit of BIS standards, while the other parameters were above the permissible limit. The WQI was 53, which showed that the pollution level of the electroplating industry effluent was be-

Table 2. Water Quality Index of Electroplating industry effluent.

S.No.	Parameters	Value (BIS)	Rating (pi)	Unit weight (wi)	Product (piwi)
1.	pH	6.0 – 9.0	0	0.04	0
2.	Electrical conductivity	400	100	0.09	9
3.	Total dissolved solids	2100	100	0.09	9
4.	Total hardness	250	100	0.04	4
5.	Calcium	75	100	0.13	13
6.	Magnesium	50	0	0.04	0
7.	Chloride	600	0	0.18	0
8.	Sulphate	150	0	0.13	0
9.	Sodium	25	100	0.18	18
10.	Potassium	20	0	0.09	0
			Total Water Quality Index		53

All the values are expressed in mg/L except pH and Electrical conductivity.

tween slight to moderate in the rating scale. Rajan and Paneerselvam (2005) studied the quality of water from 25 villages in tannery effluent affected Dindigul city, Tamil Nadu and reported that only 17 village samples were slightly polluted, only 5 village samples were slight to moderate pollution and 2 village samples were moderate pollution level. It is concluded that all the physico–chemical parameters such as pH , TDS, Total hardness, magnesium, chloride, sodium and potassium content was above the permissible limits of BIS and are responsible for ground water pollution in Madurai city. The effluent water was not suitable even for irrigation.

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