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"Physico-Chemical analysis and detection of Heavy Metals in water through electro plating Industries by ICP-AES technique"

Dr. Pradeep P. Talware
Associate Professor, K.A.M.Patil Arts, Comm. and Kai. Annasaheb N.K.Patil Science Senior College, Pimpalner, Tal-Sakri. Dist-Dhule. Maharashtra. (INDIA)

Abstract: ***The physico-chemical properties and detection of heavy metals (Viz. Pb, As, Cd, Ni, Cu, Fe, Zn, Cr) and their accumulation have been studied in electroplating industrial waste water. This work describes the detection of concentration of these metals in industrial waste water by ICP-AES (Inductively Coupled Plasma Atomic Emission Spectroscopy) technique. In electroplating industrial waste water samples Pb, As, Ni, Cu, Fe, Cr are detected while Cd, Zn, As, Cu are detected in trace amount in some samples. For the accumulation of metals by the waste water samples were collected and analysed. This concentration of metals is due to various electro plating industries. The waste water samples were collected from MIDC, Ambad, Nashik. Maharashtra. At this point the soil is getting polluted by the disposal of different electro plating industrial waste water. Detected some of the metals are toxic.***

Keywords: Accumulation, Heavy Metals, ICP-AES, waste water, detection, physico-chemical

I. INTRODUCTION

Industrial growth is an essential feature of the developing country. Without industrial growth a nation can not stand amongst the global scenario. Due to this rapid industrialization environmental pollution is becoming the most challenging threat to human beings (1,2). Pollutants in various forms are thrown into the nearby areas by industries. These pollutants pollute the air, soil, surface water as well as ground water (3). The industrial activities have contributes quantitatively as well as qualitatively to the large increase in the discharge of metallic pollutants into environmental sink. The heavy metals present in industrial effluents interact with organic and inorganic species and form complexes. Insoluble complexes are deposited on the surface of the soil but soluble complexes formed have a tendency to percolate through the soil (4) which affects the quality of the ground water and soil.

For this study the samples were collected from MIDC, Ambad, Nashik located in Maharashtra. In this industrial area most of the industries are electroplating industries which are being discharged the effluent into open places. Most of the industrial waste water are containing organic, inorganic matter and hazardous metals (5). These heavy metals and organic compounds affect the quality of soil and ground water of the area. The heavy metals like Pb, As, Cd, Ni, Cu, Fe, An and Cr and some water soluble pollutants percolate into the ground water (6). Due to industrialization and urbanization pollution growth all the sources of water are either polluted or contaminated (7). Release of treated and untreated industrial effluents in unplanned manner is one of the major causes of water pollution. The effluents which are released into various surfaces water bodies not only affect the water quality and soil but also pollute the ground water due to percolation of some water soluble pollutants (8).

The main objectives are to understand and evaluate water quality to control and minimize the incidence of pollutant oriented problems and to provide water of appropriate quality of various water users ass urban water supply, irrigation water, municipal water supply etc. In order to keep the quality of water at an optimal level, continuous periodical monitoring of water quality parameters is necessary. So that appropriate steps may be taken for water resources management practices (9). In this area no such type of study was reported so far, therefore this study was undertaken to detect and identify metals present in effluents which are being polluted at MIDC, Ambad, Nashik, Maharashtra (INDIA).

II. MATERIALS AND METHODS

1) *Sampling Technique:* The waste water samples were collected from MIDC, Ambad, Nashik (Maharashtra) INDIA. The samples were collected in well sterilized and pre cleaned plastic bottles with tight lid and adding 5 ml nitric acid for preserving the metals in the samples (10**).**

2) *Metal Analysis:* The 100 ml of waste water samples were acidified by adding 10 ml of conc. HCl and 5 ml of conc. HNO3 and evaporated this mixture on hot plate or sand bath up to 20 ml**.** Further to this mixture again add 5 ml of conc. HCl and 2.5 ml of conc. HNO3. Again evaporate this mixture on sand bath or on hot plate up to 5ml, cool this mixture and then make this volume up to 100 ml by adding conductivity water. Then this extract of waste water samples were used for the determination of heavy metals Pb, As, Ni, Cu, Fe, Zn and Cr. The concentration of these metals was determined by ICP-AES technique at Ashwamedh Engineers and consultants, Wadala Pathardi road, Indira Nagar, Nashik, Maharashtra (11).

III. RESULT AND DISCUSSION

1) *Physico-chemical Analysis:* The results of the physical and chemical analysis of the waste water samples are described in the table-1.

Table-1: Physico-Chemical properties of industrial waste water from M.I.D.C. Ambad Nashik, Maharashtra.

Sr.No.	Properties	Sample1	Sample2	Sample3	Sample4
1.	Colour	Brown	Yellow	Green	Dark Green
2.	pH	7.0	12.3	6.52	1.0
3.	Electrical Conductivity (at 25^{o}C) in micro mhos/cm	5760	45200	5020	168100
4.	Total Dissolved Solids (TDS) (mg/L)	3100	31190	3110	114300
5.	Total Hardness (as $CaCO_3$) (mg/L)	600	1800	2840	820

2) *Hydrogen ion Concentration (pH):* pH was found to be alkaline as well as acidic in the samples. The two samples were found between 6.5 to 7.0. WHO has recommended maximum permissible limit (MPL) of pH from 6.5 to 9.2 (9). One of the sample contains the pH of 12.3 which is highly alkaline in nature., While one sample contains pH 1.0 which is highly acidic. pH values found in different samples are different and within suitable range as per BIS limits (10).

3) *Electrical Conductivity (EC):* Electrical Conductivity is the measure of mineral content, was found varying from 5020 to 168100 micromhos/cm in the waste water samples., which reveals that the EC values for all waste water samples were greater than the desirable limit 250 micromhos/cm of BIS as well as the maximum permissible limit 750 micromhos/cm.

4) *Total Dissolved Solids (TDS):* TDS indicate the general nature of water quality or salinity. Water containing more than 500 mg/lit. (Desirable limit of BIS) of TDS is not considered desirable for drinking water supplies, but in some unavoidable conditions 2000 mg/lit is also allowed (Shrinivas et al, 2000). In present investigation, TDS values greater than maximum permissible limit of 2000 mg/lit. The very high values of TDS is due to industrial effluents.

5) *Total Hardness:* Hardness is very important parameter in decreasib=ng the toxic effects of poisonous elements. Water hardness is caused primarily by the presence of cations such as calcium and magnesium and anions such as carbonates, bicrbonates, chlorides and sulphates in water. Water hardness has no known adverse effects, however some evidences indicates its role in heart diseases (Schroeder, 1960). Te hardness is found to be in the range of 600 to 2840 mg/lit which is greater than desirable limit 300 mg/lit as well as maximum permissible limit 600 mg/lit.

The results obtained by ICP-AES analysis of industrial waste water samples were given in table-2.

Table-2: Concentration of heavy metals in industrial waste water samples:

Heavy Metals / Samples	Lead Pb mg/L	Arsenic As mg/L	Cadmium Cd mg/L	Nickel Ni mg/L	Copper Cu mg/L	Iron Fe mg/L	Zinc Zn mg/L	Chromium Cr mg/L
Sample-1	49.4	0.600	<0.002	36.5	57.2	246	1.95	1356
Sample-2	<0.008	2.69	<0.002	0.5	0.29	<0.06	<0.05	4345
Sample-3	0.893	<0.005	0.004	688	<0.02	5.93	6.07	5.14
Sample-4	368	26.5	1.23	53.8	26.5	14128	149	18299

The above result table-2 clearly indicates the concentration of heavy metals in the effluents. The concetration of Cadmium in first two samples were in only trace amount detected. In sample-3 concentration of copper is detected in trace amount. In sample-2 Iron and Zinc were detected in very small quantity/. In sample-1 Lead, Nickel, Copper, Iron and Chromium were found in higher concentration. In sample-2 Lead, Arsenic, Nickel, Copper, and Iron were found in minor concentration while Chromium id found in large concentration. In sample-3 only Nickel found in higher concentration while other metals like Pb, As, Cd, Cu, Fe, Zn were found in moderate concentration. In sample-4 metals like Pb, Ni, Fe, Cr were found in large concentration and As, Cd, Cu and Zn were found in moderate concentration (12).

Lead, Nickel and Chromium are common metal contaminante at hazardous waste in effluent. The concentration of Lead in waste water was found in the range of 0.008 to 368 mg/L. Toxic level of lead in human body is 500 mg/L, beyond which it causes anemia, brain damage, vomiting, loss of appetite, its amount more than 800 mg/L in the body causes coma and death. The WHO has set a concentration of 0.1 ppm as a maximum tolerable limit in drinking water (13). The concentration of Arsenic in waste water was found in the range of 0.005 to 26.5 mg/L. Arsenic is accumulative poison, causing vomitting and abdominal pains prior to death. Arsenic is concentrated by organism exposed to it and accumulates long food chains. Arsenic accumulates in hair and nails. Normal level in hair and nails are 1.0 ppm or less (14). During analysis all four samples were detected arsenic in minor proportion. Cadmium is one of the most toxic heavy metal. It is generally released into natural water from metal plating, mining, pigments and alloy industries. It can be spread into the environment through soil and water and brings a chief threat to human health (15). Cadmium causes lung insufficiency, bone lesions and hyper tension (16). Cadmium was detected in trace amount in three samples and only one sample contains 1.23 mg/L as in sample-1. The concentration of Iron was found to be in the range of 0.06 to 14128 mg/L in waste water samples. The concentration of Nickel was found in all samples in the range of 0.5 to 688 mg/L. Nickel is micronutrient for most organisms, but excessive quantities have toxic effects.

Several studies reported that toxicity and carcinogenicity of metal such as arsenic, cadmium, chromium, lead and nickel. Because of their high degree of toxicity, these five elements rank among the priority health significance. They are all systematic toxicants that are known to induce multiple organ damage, even at lower levels of exposure.

It is essential that several million people are exposed to arsenic chronically throughout thw world, especially in countries like Bangladesh, India, Chile, Urugway, Mexico, Taiwan, where the ground water is contaminated with high concentrations of arsenic. Exposure to arsenic occurs via the oral rate (ingesion), inhalation, dermal contact and the parenteral rate of some extent. Contamination with high levels of arsenic os of concern because arsenic can cause a number of human health effects. High concentration of arsenic in drinking water and are displaying various clinicopathological conditions including cardiovascular and peripheral vascular disease, developmental anomalies, neurologic, diabetes, hearing loss, portal fibrosis, hematologic disorders (anemia, leukopenia and eosinophilia) and carcinoma.

Chromium enters into various environmental matrices (air, water and soil) from a wide variety of natural and anthropogenic sources with the largest release from industries include metal processing, tannery facilities, chromate production, stainless steel welding and ferrochrome and chrome pigment production. Hexavalent chromium is a toxic industrial pollutant. Cr(VI) has been found in ground water and surface water at exceding the WHO limit for drinking water of 50 microgram per liter. Cr(VI) heavy metal causes multiorgan toxocity such as renal damage, allergy and asthma and cancer of the respiratory tract in humans. Breathing high level of Cr(VI) can cause irritation to the lining of nose and nose ulcers.

IV. APPLICATIONS

With this analysis we can highlight the urgent need for continuous monitoring of nearby area of electroplating industries of MIDC Ambad, Nashik Maharashtra which will affect on environment.

V. CONCLUSIONS

On the basis of above result table-1 it will be logical to say that the industrial effluent has its impact on the quality of ground water in the nearby area. The detected metals affect the quality of soil and also on aquatic life. Even very low concentration of heavy metals in water bodies may alter the quality of aquatic environment. This can cause physiological, chemical and biological determination of water bodies. Due to non biodegradability of heavy metals their concentration in environment continuously increases. With our analysis we want to highlight the urgent need for continuous monitoring of nearby area of electroplating industries of MIDC Ambad, Nashik Maharashtra which will affect on environment.

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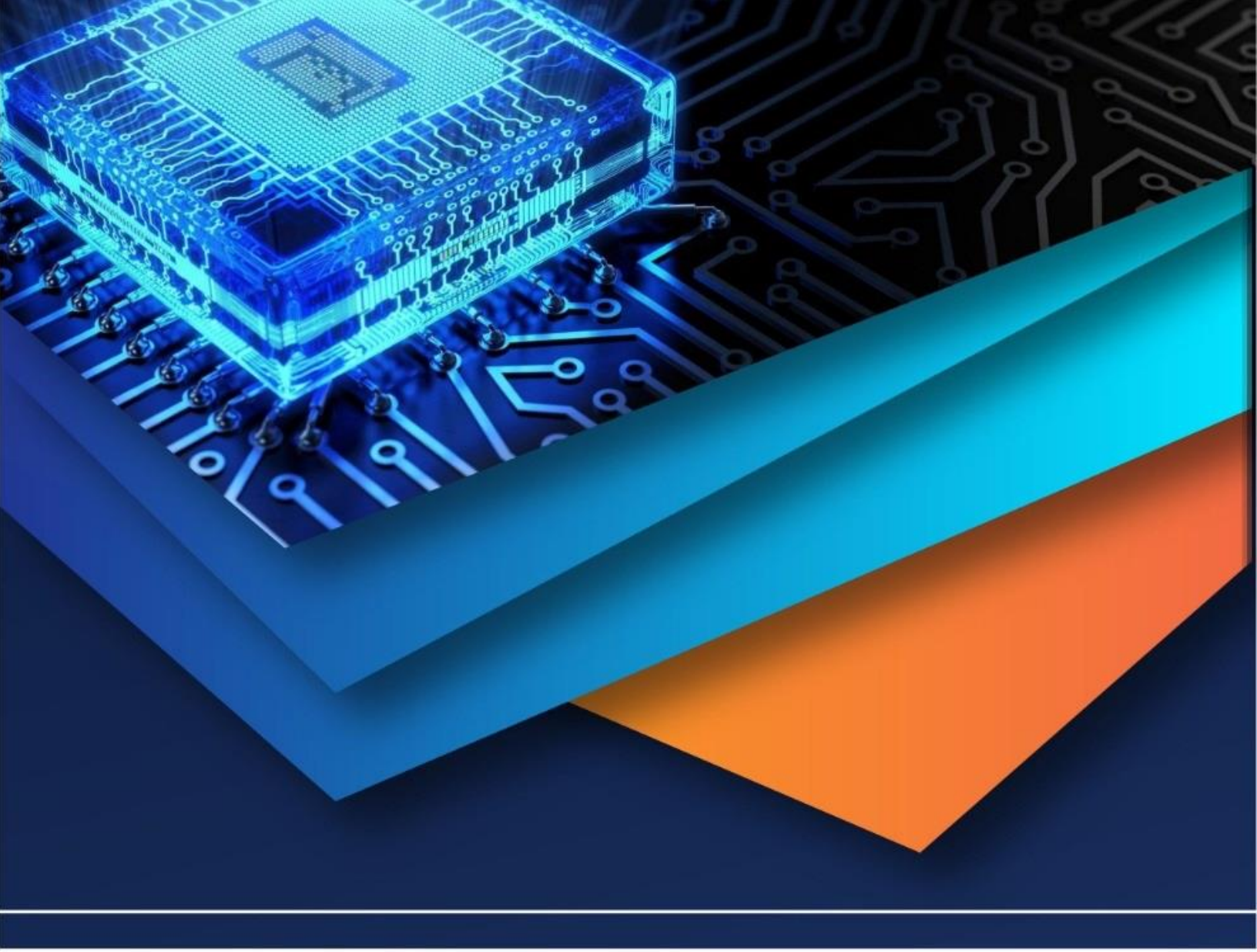

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