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Original Research Paper

Heavy Metals in the Effluent Discharged from Loco and Carriage Workshops, Ajmer, Rajasthan

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ABSTRACT

Heavy metals are widely distributed in the earth's crust, atmosphere, seawater and freshwaters as a result of soil erosion, release of industrial effluents and agricultural practices, etc. Industrial effluents may be considered as one of the major sources of heavy metal pollution. The contamination of groundwater and soil has received great significance during recent years due to the toxicity and accumulation behaviour, which may have an adverse effect on ecosystems and human health. Present study involves analysis of heavy metals and other physicochemical parameters like pH, EC, colour and COD in effluent discharged from Loco and Carriage Workshops, Ajmer. Effluent samples were collected monthly in the year 2007. The study indicates slightly acidic nature of the effluent. Colour of all the effluent samples was black. Oil and grease and COD in all the samples were found higher than the prescribed limits of WHO. Cu and Zn content of all the samples were within the prescribed limits, whereas Cd, Fe and Pb were higher than the prescribed limits.

INTRODUCTION

Though industries promote economy of the country, the pollution caused by them has to be controlled in order to save the environment from degradation. Rapid increase in industrialization has escalated various kinds of pollution in the environment. Industrial effluents can be considered as by-products of modern civilization. Industries are one of the major sources of pollution by discharging their effluents. Industrial activities generate a large number and variety of waste products, which are often discharged untreated. The quality and quantity of various effluents vary with the industry and the kind of process employed (Deora & Suhalka 2006). In recent years, contamination of groundwater and soil is increasing in frequency and severity due to various industrial discharges. Industrial effluents may contain a large number of inorganic and organic compounds which are harmful to living organisms. The present study includes the analysis of heavy metals in the effluent discharged from Loco and Carriage Workshops, Ajmer. The Loco workshop was started in 1877 for repairs and manufacture of steam locomotives. At present the repair work of diesel locomotives is done in this workshop. The Carriage workshop was started in the year 1887. In this workshop complete maintenance work is carried out for coaches and wagons. At present the area around these is densely populated including colleges, schools and hospitals. The contamination of groundwater and soil by heavy metals has received great significance during recent years due to the toxicity and accumulation behaviour. The major source of contamination includes discharge of sewage and effluents on land and runoff water. Amongst all the sources of pollution, the heavy metals deserve special attention as they are turning the environment quite unsuitable for human health. The present work has been carried out to analyse the heavy metals and other physicochemical parameters in the effluent discharged from Loco and Carriage Workshops, Ajmer.

MATERIALS AND METHODS

The effluent samples were collected from Loco & Carriage Workshops Ajmer. Geographically the city is located between 26°20'N to 26°33'N latitude and 74°35'E to 74°43'E longitude at an elevation of about 486 m.s.l. The workshops are situated in heart of the city.

Effluent samples were collected in clean sterilized plastic bottles every month during the year 2007. Standard methods (APHA 1995, Trivedy & Goel) were followed for metal analysis using Atomic Absorption Spectrophotometer. Along with heavy metals some physicochemical characteristics like pH, EC, colour and COD were also determined.

RESULTS AND DISCUSSION

The results of the study are presented in Table 1 and Figs. 1 to 3 and compared with WHO permissible limits (WHO 1977).

pH: The pH of the effluent ranged between 6.35 and 6.75. pH is one of the important parameters of water whose determination facilitates a quick evaluation of acidic and alkaline nature of water. The desirable pH of water ranges between 7.14 to 8.5 as per WHO. The mean pH value in study is 6.56 ± 0.13, which indicates slight acidic nature of the effluent water.

Electrical conductivity (EC): The EC values ranged from 1305-1614 micromho with mean EC value of 1461 ± 101 micromho. High EC values are due to high amount of TDS in the effluent water.

Colour: All the samples of the effluent were black in colour with suspended particles in them.

Oil & grease: High amount of oil and grease was observed in the effluent samples. The permissible limit of oil and grease in the effluent water is 10mg/L as prescribed by WHO. The amount of oil and grease of the samples ranged between 18.02 mg/L to 25.85 mg/L. The mean value of oil and grease was 21.81 ± 2.74 mg/L. All the samples showed values of oil and grease higher than the permissible limit of 10mg/L.

COD: Values of COD of the samples ranged from 200.5 mg/L to 248.5 mg/L with mean value of 223.13 ± 15.37 mg/L. All the samples showed values of COD higher than the permissible limit of 120 mg/L as prescribed by WHO.

Copper: Copper is a common substance that occurs naturally in the environment. The copper in the environment has expanded due to industrial activities. Copper does not breakdown in the environment and bioaccumulate in plants and animals. Long-term exposure to copper can cause irritation of the nose, mouth and eyes, and causes headaches, stomachaches, dizziness, vomiting and diarrhoea.

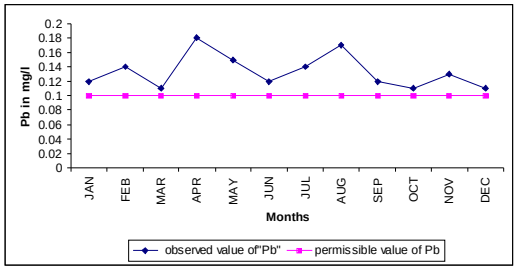

Fig 1: Comparison of observed value of Pb in effluent samples with the permissible limit.

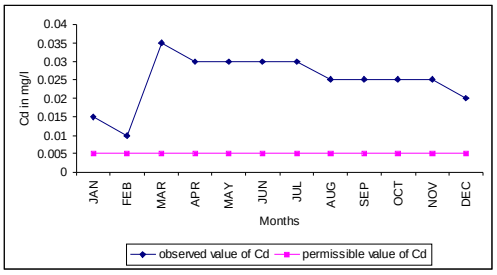

Fig 2: Comparison of observed value of Cd in effluent samples with the permissible limit.

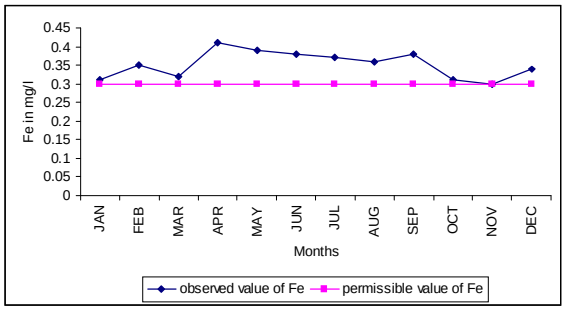

Fig 3: Comparison of observed value of Fe in effluent samples with the permissible limit.

The concentration of copper in the effluent ranged between 0.01mg/L and 0.025 mg/L. The mean value of copper was 0.018 ± 0.007 mg/L. All the samples showed concentration of copper within the limits of 3.0 mg/L prescribed by WHO.

Zinc: It is the 23rd most abundant element in the earth's crust. The dominant ore is zinc blende, also known as sphalerite. Large concentrations of zinc may cause eminent health problems, such as stomach cramps, skin irritations, vomiting, nausea and anaemia. Very high levels of zinc can damage the pancreas and disturb the protein metabolism, and cause arteriosclerosis. The concentration of zinc in effluent samples was found to be in the range of 0.155 mg/L to 0.535 mg/L. The mean value of zinc was 0.239 ± 0.117 mg/L. The standard limit of zinc in effluents prescribed by WHO is 5.0 mg/L. All the samples analysed were found within the limit.

Lead: It works as a toxicant that can exert adverse effects on humans. Systems known to be susceptible to adverse effects of high exposure include neurological, reproductive, renal and haematological. Children are more sensitive than adults to the effects of lead. The concentration of lead in all the samples ranged between 0.11 and 0.18 mg/L with a mean value of 0.135 ± 0.022 mg/L. All the samples showed concentration of lead higher than the standard limit of 0.1mg/L prescribed by WHO.

Cadmium: It can reach over great distances when it is present in sludge. The cadmium-rich sludge can pollute surface waters as well as soils. A high exposure of cadmium causes the excretion of essential proteins and sugars from the body and kidney damage. The concentration of cadmium in the samples ranged between 0.01 and 0.03 mg/L. The mean value of the cadmium was 0.025 ± 0.007 mg/L. The standard limit of Cd prescribed by WHO is 0.005 mg/L. All the samples showed higher concentration of Cd than the prescribed limit.

Table 1: Monthly and mean data of the effluent analysis from Loco and Carriage Workshop for the year 2007.

Months	pH	EC	Colour	Oil & Grease	COD	Cu	Zn	Pb	Cd	Fe
Janary	6.45	1457	Black	19.75	217	0.015	0.195	0.12	0.015	0.31
February	6.35	1368	Black	21.7	221.5	0.01	0.155	0.14	0.01	0.35
March	6.65	1305	Black	18.63	243	0.025	0.219	0.11	0.035	0.32
April	6.75	1404	Black	24.95	241	0.015	0.241	0.18	0.03	0.41
May	6.55	1538	Black	19.2	231.5	0.025	0.165	0.15	0.03	0.39
June	6.45	1586	Black	18.02	207.5	0.01	0.17	0.12	0.03	0.38
July	6.55	1614	Black	19.55	224.5	0.025	0.205	0.14	0.03	0.37
August	6.7	1395	Black	24.45	200.5	0.01	0.42	0.17	0.025	0.36
September	6.45	1357	Black	23.02	217	0.025	0.535	0.12	0.025	0.38
October	6.75	1535	Black	22.05	248.5	0.021	0.218	0.11	0.025	0.31
November	6.45	1554	Black	25.85	205	0.015	0.185	0.13	0.025	0.3
December	6.6	1417	Black	24.55	220.5	0.01	0.155	0.11	0.02	0.34
Mean	6.56	1460.83	-	21.81	223.13	0.017	0.239	0.133	0.025	0.352
SD	0.13	101.105	-	2.74	15.37	0.007	0.117	0.023	0.007	0.036

All the values except pH & EC are in mg/L (EC = micromho/cm). SD = Standard deviation

Iron: Iron is believed to be the tenth most abundant element on the earth. Most of the iron is found in various iron oxides, such as the minerals haematite, magnetite and taconite. Iron may cause conjunctivitis, choroiditis and retinitis if it contacts and remains in the tissues. The concentration of iron in the samples ranged from 0.3 to 0.41 mg/L. The mean value of iron was 0.352 ± 0.03 mg/L. All the samples presented values of iron higher than the standard limit of 0.3mg/L prescribed by WHO.

CONCLUSION

The higher quantities of oil and grease, COD, Cd, Pb and Fe in the samples suggest that the effluent discharged without proper treatment may adversely affect the soil and groundwater quality.

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