Heavy metal concentration in effluent discharge of pharmaceutical industries

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ABSTRACT

Presence of heavy metals in industrial effluent is major concern of environmental pollution. The objective of this study was to determine the concentrations of heavy metals present in the industrial effluents released openly without prior treatment in the Lote-Pershuram industrial area in Ratnagiri district. The distribution of heavy metals like Iron, Copper, Cadmium, Chromium and Lead were investigated for samples collected from six different sites. The concentrations of heavy metals were found in variable amount. In effluent samples Cadmium and Lead were not found but concentration of other metals was above the permissible limits of WHO. The highest concentration of Chromium was 1.72 mg/L at site S_2 while lowest 0.647 mg/L at S_4, highest for Copper was 2.30 mg/L at S_2 and lowest 0.072 mg/L at S_1 and for Iron it was 6.62 mg/L at S_5 and 19.38 mg/L at S_6. This study reveals that effluent from pharmaceutical industries was highly polluted; there is urgent need to follow adequate effluent treatment methods before their discharge to surface water for reducing their potential environmental hazards.

Key words: cadmium, chromium, effluent, heavy metal, water pollution

INTRODUCTION

In India the environmental pollution through industrial effluent has become a cause of concern at various levels (Chauhan *et al,* 2000). The air, soil and water pollution by industrial effluent are associated with various diseases and could be reason for the current shorter life expectancy (WHO, 2002; 2003). The sewage effluents from industries contain moderate amounts of metallic cations. The study of mobility of toxic metals in industrial effluent (Kazi *et al,* 2005) was determined by various techniques. When toxic substances enter into water bodies, they get dissolved or lie suspended in water or get deposited on the bed. This results in the pollution of water whereby the quality of the water deteriorates, affecting aquatic ecosystems. Long term irrigation of such effluent affects on soil quality (Olaniya *et al,* Brar *et al,* 1997). Pollutants can also seep down and affect the groundwater deposits.

Effluents from pharmaceuticals or chemical industries (Volesky, 1994) contribute to water pollution. Industrial Effluents usually contains specific and readily identifiable chemical compounds. In India most of large scale industries have effluent treatment plant facilities, but a number of small and medium sized industries do not have adequate effluent treatment facilities. Such industries cannot afford enormous investments in pollution control equipment as their profit margin is very slender. The effects of water pollution are not only devastating to people but also to animals, fish and birds. Polluted water is unsuitable for drinking, recreation, agriculture and industry. It diminishes the aesthetic quality of lakes, rivers and ground water supplies. More seriously, contaminated water destroys aquatic life and reduces its reproductive ability. Eventually, it is a hazard to human health. Nobody can escape the effects of water pollution. So we proposed to study the amount of heavy metals pollution found in the industrial effluents released openly in the Lote Parshuram Industrial Area.

MATERIAL AND METHODS

Lote Pershuram industrial area is located in Ratnagiri district of Maharashtra near to west coast and 23 km away from Chiplun city. The various small, medium and large size industries like pharmaceutical, agrochemical, dyes and paints etc. are grown up during last two decades. This area comprises near about 75 % small scale industries. Some of them are releasing their effluent openly behind the company wall. Samples were collected from middle point of six different sites and denoted as S_1 to S_6.

Effluent samples were collected in plastic containers previously cleaned by washing in non-ionic detergent, rinsed with tap water and later soaked in 10% HNO_3 for 24 hours and finally rinsed with deionised water prior to usage.

The samples were labeled and transported to the laboratory, stored in the refrigerator at about 4^0C prior to analysis. Standard procedures (APHA, 1995 and Trivedi and Goel, 1986) were followed during analysis. All chemicals and reagents used were of analytical grade and obtained from BDH laboratory. Atomic Absorption Spectrophotometer instrument (Perkin Elmer) was used for analysis. Heavy metals readily form complexes with organic constituents; therefore, it is necessary to destroy them by digestion with strong acids. Digestion destroys the organic matter, removes interfering ions and brings metallic compounds in suspension to solution. Sample was prepared by digesting 50 ml sample of waste water with 10 ml of conc. HNO_3. The heating was continued and then small portion of HNO3 was added until the solution appeared light colored and clear. Finally sample was allowed to cool and diluted up to mark with distilled water before filtering into 50-ml standard flask, labeled and used for analysis.

RESULTS AND DISCUSSION

The heavy metal concentration in effluent sample analyzed found in varying amount which are summarized in table 1.

Table 1. Heavy metal concentration in effluent samples of six different sites.

Sampling site	Fe(mg/L)	Cu(mg/L)	Cd(mg/L)	Cr(mg/L)	Pb(mg/L)
S_1	13.42	0.072	ND	1.72	ND
S_2	15. 22	2.30	ND	1.26	ND
S_3	7.23	0.34	ND	2. 34	ND
S_4	11.32	0.65	ND	0.647	ND
S_5	6.62	1.67	ND	0.998	ND
S_6	19.38	1.84	ND	1.223	ND

ND- Not detected

The concentrations of heavy metals in effluents samples were found in variable amount. The samples from various sites contain some metals above permissible limits of WHO while concentrations of some heavy metals such as Cd and Pb were totally absent. The absence of Cadmium and Lead could be due to the absence of the metals from the raw material in use at the time of sample collection. Lead poisoning could cause abdominal pain, loss of appetite, insomnia and constipation (Hrsak *et al*, 2000). Severe kidney as well as brain damage has been reported on long term exposure (Momodu and Anyakora, 2010).

Chromium is an essential nutrient for humans its shortage may cause heart conditions, disruptions of metabolisms and diabetes. But the uptake of too much chromium can cause problems to health (Moore, 1991). Numerous industrial applications raised chromium to very important economic element. The health hazards associated with exposure to chromium are respiratory problems, a lower ability to fight disease, birth defects, infertility and tumor formation (Coquery and Wekbourn, 1999).The toxicity of chromium is dependent on its oxidation state. The metal form is of low toxicity but hexavalent form is toxic. In present study chromium concentrations appear to be higher than the normal acceptable contaminant level according to WHO standard with the highest value of 1.72 mg/L at site S_1 while lowest value was 0.647 mg/L at S_4. The higher concentration of chromium attributed to application of chromium compounds as a catalyst in many industrial applications. Iron is non toxic and an essential element in human nutrition.

The result showed that iron concentration varies from 6.62 mg/L to 19.38 mg/L.

The soil of konkan region is rich in the hematite ore of iron which could be the reason for contamination in effluent and leads to rise in concentration of iron. The maximum concentration was found at S_5 and minimum was at S_6. Copper compounds have been widely used in industrial processes and agriculture. Copper plays an important role in biological and chemical processes in the environment (Sharma *et al*, 1988). In present study elevated copper concentrations beyond the WHO limit were found. The highest concentration of copper was observed at site S_1 with 2.30 mg/L while lowest was observed at site S_2 with 0.072 mg/L concentration. The values of trace metals are in accordance with Akan *et al, (*2007) and Bichi and Anyata (1999).

CONCLUSION

The higher concentrations of metal in industrial effluent indicate negligence of industries towards waste-water treatment. Various small scale and some major industries from Lote Pershuram MIDC release their effluent openly which may leads to contamination in the local water body and cause serious health hazards. This study reveals that effluent from pharmaceutical industries was highly polluted; there is urgent need to follow adequate effluent treatment methods before their discharge to surface water for reducing their potential environmental hazards.

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