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Studies on Industrial Effluents Quality with Reference to Heavy Metals Content

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This paper reports the heavy metal content in some industrial effluents from Gujarat Industrial Development Center (GIDC) area of Ankleshwar. The effluent in the area is discharged into sewer and finally goes to river and then goes to Arabian Sea. The metals like Fe, Cr, Cd, Ni, Cu, Mn, Zn, As, Al and Hg, B, Be, Sb, Mo were determined by inductively coupled plasma atomic emission spectroscopy (ICP-AES). The results are compared with WHO and Indian standards.

Key Words: Industrial effluents, Heavy metal contents, ICP-AES.

INTRODUCTION

Heavy metals in aquatic environment can become toxic to aquatic organisms and can also reach to human being *via* food chain as bioaccumulation. It might be expected that the discharge sewage and domestic origin entered into the coastal water bodies modify the quality of water and soil and accumulated as sediments containing toxic heavy metals.

Ankleshwar GIDC is biggest industrial zone of Gujarat state. As on date there are about 1200 industries consisting of chemicals, plastics pesticides, pharmaceuticals, rubber and packaging, textiles, engineering, petroleum products, bulk drugs, *etc.* are located in the industrial area. Hence present study was proposed to asses the heavy metals in the industrial effluent discharged in sewer in the Ankleshwar GIDC (Gujarat).

EXPERIMENTAL

Different type of industries generate different type of effluents. Hence the sampling stations were so chosen that they represent the different kinds of industries. The sampling stations are as follows: **Site-1:** Makson Fine Chemical Ltd., **Site-2:** Asian Paints Ltd., **Site-3:** Pragati Chemicals Ltd., **Site-4:** Ficom Organics Ltd., **Site-5:** A-One Chemicals Ltd., **Site-6:** Shree Sairang Chemicals. **Site-7:** Mugat Dye Chemical Ltd., **Site-8:** Shree Sham Dyes and printing Industries, **Site-9:** Mixed Industrial Effluent from Pipeline Near Lupin, **Site-10:** Mixed industrial effluents from sewer near Lupin industry.

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The study was carried out from June 2006. The samples were collected between 8.00 to 10.00 AM and 7.00 to 9.00 PM. The standard methods of sample collection preservation and analysis were adopted as per APHA[1]. The samples were collected and analyzed within 48 h. The Elico pH meter and conduct meter are used for pH and conductivity measurement respectively. Perkin-Elmer AAS-200 used for metal content estimation. Double distilled water and AR Grade chemicals were used for the analysis. The heavy metals were determined with the help of ICP-AES using HNO_3-HCl and 4 N HNO_3 extract.

RESULTS AND DISCUSSION

The results obtained are shown in Table-1 for both seasons (pre monsoon and post monsoon). It is very difficult to demarcate toxic metals from essential one. In fact, any metal could become toxic if ingested in sufficiently large amounts. However, it is possible to sort out those metals which are not beneficial and at the same time show severe toxicity even at a very low concentration.

TABLE-1
CONCENTRATIONS OF THE HEAVY METALS PRESENT IN THE INDUSTRIAL EFFLUENTS COLLECTED FROM DIFFERENT SAMPLING STATIONS OF GIDC ANKLESHWAR, GUJRAT

Sites	Seasons	Fe	Cu	Zn	As	Mn	Cr	Ni	Sb	Se	Pb	Hg	Cd	Mo
S1	Premonsoon	0.20	0.4	0.5	1.0	2.7	0.1	3.3	ND	ND	ND	ND	ND	ND
	Postmonsoon	0.30	0.3	0.4	0.9	1.1	0.1	3.1	ND	ND	ND	ND	ND	ND
S2	Premonsoon	0.50	0.5	0.5	0.9	51.1	0.2	4.4	ND	ND	ND	ND	ND	ND
	Postmonsoon	0.50	0.7	0.4	0.9	0.5	0.1	3.9	ND	ND	ND	ND	ND	ND
S3	Premonsoon	1.70	0.6	0.5	0.7	0.7	0.1	5.6	ND	ND	ND	ND	ND	ND
	Postmonsoon	1.50	0.6	0.2	0.6	0.7	0.2	4.8	ND	ND	ND	ND	ND	ND
S4	Premonsoon	0.03	0.3	0.4	0.7	1.5	0.1	4.0	ND	ND	ND	ND	ND	ND
	Postmonsoon	0.02	0.8	0.3	0.5	1.2	0.1	3.7	ND	ND	ND	ND	ND	ND
S5	Premonsoon	0.30	5.6	0.8	0.9	1.9	0.2	1.8	ND	ND	ND	ND	ND	ND
	Postmonsoon	0.30	2.3	0.7	0.8	1.2	0.1	1.6	ND	ND	ND	ND	ND	ND
S6	Premonsoon	1.7	0.4	0.5	0.7	0.8	0.1	7.7	ND	ND	ND	ND	ND	ND
	Postmonsoon	1.6	0.3	0.3	0.6	0.6	0.1	7.4	ND	ND	ND	ND	ND	ND
S7	Premonsoon	0.01	0.3	0.4	0.5	0.3	0.1	3.7	ND	ND	ND	ND	ND	ND
	Postmonsoon	0.2	0.2	0.3	0.4	0.4	0.1	3.0	ND	ND	ND	ND	ND	ND
S8	Premonsoon	0.9	0.4	0.4	0.7	0.5	0.2	4.5	ND	ND	ND	ND	ND	ND
	Postmonsoon	0.1	0.3	0.3	0.6	0.3	0.01	4.0	ND	ND	ND	ND	ND	ND
S9	Premonsoon	0.5	2.5	0.8	0.7	16.6	0.2	4.7	ND	ND	ND	ND	ND	1.4
	Postmonsoon	0.5	0.9	0.7	0.5	4.9	0.1	4.2	ND	ND	ND	ND	ND	1.2
S10	Premonsoon	2.9	5.3	1.4	0.7	4.2	0.1	3.9	ND	ND	ND	ND	ND	3.6
	Postmonsoon	2.8	1.1	1.2	0.6	3.2	0.11	3.5	ND	ND	ND	ND	ND	3.1

All the values expressed in mg/L.
ND for Sb, Cd, Mo is less than 0.1 mg/L. and in Pb, Se, Hg is less than 1 mg/L.

The iron is the fourth most abundant element in the earth crust iron is mainly used in alloy industries, building construction and also in pharmaceutical industries.

The TLV for iron is 3-0 mg/L and it is observed to be ranging from 0.02 to 2.9 mg/L. An immediate cause of death from inorganic iron compounds is respiratory failure diarrhoea, loss of body weight were some of the symptoms. Chromium is also used in alloy and painting industry. It is present in variable oxidation states and varying from 0.1 to 0.2 mg/L. The chromium salts are carcinogenic. The oxygen in water might taken up by the trivalent chromium. This leads to the inversion of trivalent to hexavalent chromium[2]. The hexavalent chromium compounds are strong oxidizing agents therefore much toxic due to their irritant and corrosive properties and higher rate of absorption[3].

Cadmium is used in industries like electroplating and Ni-Cd batteries. Organic cadmium compounds acts as catalyst. Though the TLV is 2.0 mg/L. Cd content is less than 0.1 mg/L. Nicked is used in electroplating. High concentration of Ni are found in fossil fuels. It is present virtually in every kind of sample including water, plants and animal tissues[4,5]. It concentration is found to be very high in al the samples ranging from 1.6 to 7.7 mg/L. except S5, where the TLV is 3.0 mg/L. The toxicity of nickel is basically due to carcinogenic nickel carbonyls.

Zinc is used mainly in alloy industry, also in galvanizing process. The amount of zinc varied from 0.2 to 1.4 mg/L. The TLC for zinc is 5.0 mg/L. Industrial hazards arise from exposure to zinc fumes. Extensive fibrosis of lung ending in teeth due to high exposure of Zn has been reported[6]. Copper is one of the most common metals which is used extensively from domestic utensils to conducting wires, alloys, batteries, *etc*. The amount of copper ranges from 0.2 to 5.6 mg/L. The poisoning is basically due to copper sulphate intake. The cases of copper fever in a paint industry are known[7].

Lead is used in the manufacture of metal products, pigment *etc.* Though TLV is just 0.1 mg/L. Its concentration in the sample is less than 1 mg/L. Anemia, acute abdominal colic, peripheral neuropathy are some carcinogenic of excess lead ingestion. Lead in water mainly comes from lead processing industries, or due to use of lead pipes natural and unreacted water supplies contain about 0.01 to 0.03 mg/L of lead[8].

Mercury is one of the worst offenders as a dangerous pollutant among the heavy metals. Mercury is discharged in the inorganic form from mercury and other metal mines. Man-made sources of mercury include mining and refining processes, paper and pulp industry, caustic soda industries using mercury cell, organo mercuric fungicides and seed disinfectant and mercury electric appliances industries *etc.* TLV or mercury is 0.01 mg/L. The mercury range found in the samples is less than 1 mg/L.

The contaminated area such as Minamata bay in Japan levels as high as 1 to 10 mg/L were observed[9] and Mud of Minamata bay was found to contain 30-40 mg/Kg[10]. Mercury found in industrial effluents in bottom sediments. The manganese content in the samples varied from 0.3 to 51.1 mg/L. The amount of molybdenum ranges from 0.1 to 3.6 mg/L.

Conclusion

It is difficult to trace the exact source of metal contamination as the samples are collected from nearby Lupin. It is observed that about 65 % of the results are above WHO and Indian standards[11]. This effluent gets discharged in the sewer and finally goes to creek. During this process the concerned ecosystem is disturbed. In the area only one common effluent treatment plant is working which takes care of few industries. Hence some new treatment methodologies are recommended for checking the effluent quality.

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