Resources and Environment. 2011; 1(1): 13-19
DOI: 10. 5923/j.re.20110101.02

Toxicity Study of Heavy Metals Pollutants in Waste Water Effluent Samples Collected from Taloja Industrial Estate of Mumbai, India

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Abstract The present research work deals with the assessment of pollution due to toxic heavy metals in the industrial waste water effluents collected from Taloja industrial belt of Mumbai. The study reveals that dyes, paints, pharmaceutical and textile industries are some of the major industries contributing to the heavy metal pollutants in the surrounding aquatic environment. It was observed that paint manufacturing industries are the major contributors of toxic Cr, Zn and Pb amounting to 35.2, 33.1, and 31.4 mg/L respectively. It was also observed that major contribution of Cu (33.3 mg/L) was from dyes manufacturing units, while maximum Fe concentration of 12.8 mg/L was found in effluent samples released from textile industries. The concentration of Cd and Ni was found maximum in effluent samples collected from pharmaceutical industries amounting to 35.8 and 33.6 mg/L respectively. The overall results point out high concentration of toxic heavy metals in the effluent samples collected from different industries. These industrial effluents will pollute the near by water bodies affecting the growth of vegetation and aquatic life. These toxic heavy metals when released in aquatic environment will enter the food chain through bio-magnification causing various health problems in humans. The results of the present investigation point out the need to implement common objectives, compatible policies and programmes for improvement in the industrial waste water treatment methods.

Keywords Industrial Effluent; Industrial Pollution; Toxic Heavy Metals; Quantification; AAS; Health Hazards; Water Pollution; Taloja Industrial Area; Mumbai

1. Introduction

During the past few decades Indian industries have registered a quantum jump, which has contributed to high economic growth but simultaneously it has also given rise to severe environmental pollution. Consequently, the water quality is seriously affected which is far lower in comparison to the international standards. Waste water from manufacturing or chemical processing industries contributes to water pollution. Industrial waste water usually contains specific and readily identifiable chemical compounds. It is found that one-third of the total water pollution comes in the form of effluent discharge, solid wastes and other hazardous wastes. Out of this a large portion can be traced to the processing of industrial chemicals and to the food products industry. The surface water is the main source of industries for waste disposal. Untreated or allegedly treated effluents have increase the level of surface water pollution up to 20 times the safe level in 22 critically polluted areas of the country. It is found that almost all rivers are polluted in most of the stretches by some industry or the other[1-3]. Although all industries in India function under the strict guidelines of the Central Pollution Control Board (CPCB) but still the environmental situation is far from satisfactory. Different norms and guidelines are given for all the industries depending upon their pollution potentials. Most major industries have treatment facilities for industrial effluents. But this is not the case with small scale industries, which cannot afford enormous investments in pollution control equipment as their profit margin is very slender. As a result in India there are sufficient evidences available related with the mismanagement of industrial wastes[4-8]. Most of these defaulting industries are petrochemical industries, sugar mills, distilleries, leather processing industries, paper mill, agrochemicals and pesticides manufacturing industries and pharmaceutical industries. Consequently, at the end of each time period the pollution problem takes menacing concern. The problem of water pollution has become still worse due to toxic heavy metals[9,10]. The increasing trend in concentra

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Published online at http://journal.sapub.org/re

-tion of heavy metals in the environment has attracted considerable attention amongst ecologists globally during the last decades and has also begun to cause concern in most of the major metropolitan cities. Untreated or allegedly treated industrial effluents and sewage water contains variable amounts of heavy metals such as arsenic, lead, nickel, cadmium, copper, mercury, zinc and chromium[11, 12], which have the potential to contaminate crops growing under such irrigation. These heavy metals have a marked effect on the aquatic flora and fauna which through bio-magnification enter the food chain and ultimately affect the human beings as well. Heavy metal pollution is an ever increasing problem of our oceans, lakes and rivers. Incidence of heavy metal accumulation in fish, oysters, sediments and other components of aquatic ecosystems have been reported globally[13-23]. These toxic heavy metals entering in aquatic environment are adsorbed onto particulate matter, although they can form free metal ions and soluble complexes that are available for uptake by biological organisms[23]. The metals associated with particulate material are also available for biological uptake[24], and are deposited in estuarine sediments[25]. Once deposited, binding by sulfides and/or iron hydroxides immobilizes trace metals until a change in redox or pH occurs[18,19]. Thus, surfical sediments, particularly the fine fraction, accumulate trace metals and provide a means for evaluating the long term accumulation of contaminants[20, 21].

The problem of environmental pollution due to heavy metals has begun to cause concern now in most of the major metropolitan cities in India and Mumbai is not an exception to it. The present day by day increasing tremendous industrial pollution[13-23] has prompted us to carry the systematic and detail study of pollution due to toxic heavy metals in soil samples collected from Taloja Industrial estate which is considered as one of the fastest developing industrial belt of Mumbai.

2. Materials and Methods

2.1. Area of Study

The study was carried at the Taloja industrial area which is one of the most rapidly developing and heavily polluted industrial belts of Mumbai. The industrial area is spread over 863.18 hectares of land consisting of about 600 large and medium scale industries like engineering units, steel processing industries, chemical units, paints, pharmaceutical units, textile industries etc. The study area lies between latitude 19°3'39"N longitudes 73°6'57"E. The main water source for the industrial consumption is Maharashtra Industrial Development Corporation. The industrial area utilizes about 45,000 m^3/day of fresh water. The effluent discharge, treated and untreated amounts to 28,750 m^3/day i.e., 64% of the total industrial effluents. This has created health hazards not only for local population but also resulted in disturbances of aquatic life of the Kasardi River flowing near the industrial area[3].

2.2. Climatic Conditions

The weather of the study area is typical coastal sultry and humid. The average rainfall records from 1,500 mm to 2,000 mm. The place experiences the onset of the monsoon in the month of June and experiences monsoon till the end of September. The average temperature recorded varies from 25 to 42 degrees.

2.3. Requirements

All the glassware, casserole and other pipettes were first cleaned with tape water thoroughly and finally with de-ionized distilled water. The pipettes and burette were rinsed with solution before final use. The chemicals and reagent were used for analysis were of analytical reagent grade. The procedure for calculating the different parameters were conducted in the laboratory.

2.4. Sampling of Industrial Waste Water Effluent and Sample Preparation

The industrial waste water effluent samples were collected randomly twice in a month in morning, afternoon and evening session from different industries like engineering industries, paper mills, fine chemical manufacturing industries, dyes industries, paint industries, pharmaceutical industries, petrochemical industries and textile industries of Taloja Industrial belt. For each type of industry three representative units was selected. The samples were collected every alternate month from February 1999 to November 2000. The sampling was done in three shifts i.e. morning shift between 07:00 a.m. to 09:00 a.m., afternoon shift between 02:00 p.m. to 04:00 p.m. and evening shift between 07:00 p.m. to 09:00 p.m. Polythene bottles of 2.5 L and 2.0 L were used to collect the grab water samples (number of samples collected, n = 19). The bottles were thoroughly cleaned with hydrochloric acid, washed with tape water to render free of acid, washed with distilled water twice, again rinsed with the water sample to be collected and then filled up the bottle with the sample leaving only a small air gap at the top. The sample bottles were stoppard and sealed with paraffin wax. Water samples (500 mL) were filtered using Whatman No. 41 (0.45 μm pore size) filter paper for estimation of dissolved metal content. Filtrate (500 mL) was preserved with 2 mL nitric acid to prevent the precipitation of metals. The samples were concentrated to tenfold on a water bath and subjected to nitric acid digestion using the microwave-assisted technique, setting pressure at 30 bars and power at 700 Watts[26,27].

2.5. Heavy Metal Analysis by AAS Technique

The analysis for the majority of the trace metals like chromium (Cr), cadmium (Cd), nickel (Ni), zinc (Zn), copper (Cu), lead (Pb) and iron (Fe) was done by Perkin-Elmer ASS-280 Flame Atomic Absorption Spectrophotometer. The calibration curves were prepared separately for all the metals by running different concentrations of standard solutions. A reagent blank sample was analyzed and subtracted from the samples to correct for reagent impurities and other sources of errors from the environment. Average values of three replicates were taken for each determination.

3. Results and Discussion

The experimental data on heavy metal content in waste water effluent samples collected from different industries of Taloja industrial estate of Mumbai for the assessment years 1999 and 2000 is presented in Tables 1 and 2. The two years (biyearly) average values of heavy metal content in mg/L for different industries are graphically represented in Figure 1.

A number of elements are normally present in relatively low concentrations, usually less than a few mg/L, in conventional irrigation waters and are called trace elements. Heavy metals are a special group of trace elements which have been shown to create definite health hazards when taken up by plants. Under this group are included, Cr, Cd, Ni, Zn, Cu, Pb and Fe. These are called heavy metals because in their metallic form, their densities are greater than 4 g/cc.

The biyearly average Cr content in waste water samples was found to be minimum of 16.9 mg/L in effluent samples collected from dyes industries and maximum of 35.2 mg/L in effluent samples collected from paint industries (Figure 1), which was very much higher than the permissible limit of 0.05 mg/L set by *WHO*[28]. Cr compounds are used as pigments, mordents and dyes in the textiles and as a tanning agent in the leather. The experimental data indicates that paint manufacturing industries are the major source for release of toxic Cr metal in surrounding aquatic environment. Acute toxicity of Cr to invertebrates is highly variable, depending upon species[29]. For invertebrates and fishes, its toxicity is not much acute. Cr is generally more toxic at higher temperatures and its compounds are known to cause cancer in humans[30]. The toxic effect of Cr on plants indicate that the roots remain small and the leaves narrow, exhibit reddish brown discoloration with small necrotic blotches[31].

Cd is contributed to the surface waters through paints, pigments, glass enamel, deterioration of the galvanized pipes etc. The biyearly average Cd content in water samples was found to be minimum of 23.3 mg/L and 23.8 mg/L in the effluent samples collected from dyes and paper mill industries respectively, while maximum Cd content was found to be 35.8 mg/L in the effluent samples collected from pharmaceutical industries. The second largest contribution (32.8 mg/L) of Cd metal was due to the effluent from paint manufacturing industries (Figure 1). The experimental values indicate that pharmaceutical and paint manufacturing industries are the major source for release of toxic Cd in the surrounding water bodies. The values obtained were found to be extremely higher than the permissible limit of 0.01 mg/L set by *WHO*[32] and also according to *USPH* standards. There are a few recorded instances of Cd poisoning in human beings following consumption of contaminated fishes. It is less toxic to plants than Cu, similar in toxicity to Pb and Cr. It is equally toxic to invertebrates and fishes[29].

Table 1. Heavy Metal Content in Effluent Samples Collected from different Industries of Taloja Industrial Estate of Mumbai.

Industries	Heavy Metals (mg/L)	Year-1999							Year-2000						
		February	April	June	August	October	December	Average	January	March	May	July	September	November	Average
Engineering	Cr	27.9	31.6	27.2	24.9	27.5	38.7	**29.6**	30.9	34.6	40.2	27.5	20.7	28.5	**30.4**
	Cd	24.9	30.7	25.5	20.4	27.8	26.4	**26.0**	22.7	28.4	34.9	27.5	15.6	17.1	**24.4**
	Ni	14.9	20.1	20.1	10.5	20.1	24.0	**18.3**	19.6	23.6	27.4	24.0	16.2	18.1	**21.5**
	Zn	27.0	31.6	27.1	20.0	24.0	31.4	**26.9**	26.9	29.5	32.1	25.2	20.0	26.2	**26.7**
	Cu	21.6	26.3	26.2	12.9	15.2	23.2	**20.9**	19.1	24.3	32.4	20.1	13.8	19.5	**21.5**
	Pb	21.6	22.8	19.9	11.8	13.2	17.0	**17.7**	19.2	23.0	27.4	20.4	17.1	19.4	**21.1**
	Fe	7.6	8.7	8.0	6.2	6.2	7.1	**7.3**	7.0	9.6	11.5	8.3	6.0	6.8	**8.2**
Paper Mill	Cr	35.0	40.0	30.0	32.5	29.5	45.3	**35.4**	28.3	27.9	39.3	26.9	18.9	26.1	**27.9**
	Cd	21.1	23.2	19	14.5	23.0	19.2	**20.0**	27.3	27.8	31.2	31.9	21.9	25.1	**27.5**
	Ni	15.3	21.4	20.9	11.2	13.2	20.5	**17.1**	21.7	27.2	29.7	24.8	21.2	23.5	**24.7**
	Zn	27.0	32.2	25.6	19.7	21.1	24.7	**25.1**	21.9	37.3	42.6	29.3	23.7	28.2	**30.5**
	Cu	28.2	31.5	29.5	19.7	21.4	30.4	**26.8**	29.2	33.4	37.5	22.8	19.3	27.1	**28.2**
	Pb	17.4	23.2	21.3	14.3	17.3	16.3	**18.3**	23.7	27.2	31.2	23.8	20.3	22.9	**24.9**
	Fe	7.0	7.9	6.9	5.3	6.0	6.4	**6.6**	6.1	7.9	4.9	6.3	5.7	6.4	**6.2**
Fine Chemicals	Cr	22.1	32.1	37.3	29.3	26.3	27.5	**29.1**	29.2	28.3	33.0	19.6	20.1	25.7	**26.0**
	Cd	33.9	41.2	43.2	29.9	26.3	28.9	**33.9**	30.2	25.3	41.4	15.2	29.1	31.7	**28.8**
	Ni	29.7	32.7	31.9	21.8	20.3	27.3	**27.3**	34.2	27.3	37.6	13.3	12.1	25.9	**25.1**
	Zn	28.1	29.8	27.8	20.7	22.2	26.2	**25.8**	31.1	20.4	37.7	18.3	19.7	22.7	**25.0**
	Cu	25.2	29.4	29.9	19.3	21.2	22.7	**24.6**	22.9	24.6	26.1	15.5	18.3	23.1	**21.8**
	Pb	26.0	37.2	36.7	28.5	27.7	28.3	**30.7**	27.4	19.2	35.3	21.4	19.2	24.1	**24.4**
	Fe	7.9	9.9	8.2	6.3	6.9	7.6	**7.8**	7.2	7.9	8.6	7.9	6.1	7.6	**7.6**
Dyes	Cr	14.5	18.2	12.5	9.2	13.2	20.3	**14.7**	17.3	19.5	23.4	18.7	14.7	21.6	**19.2**
	Cd	32.2	37.1	34.3	17.3	29.1	29.4	**29.9**	17.5	18.6	21.3	17.8	10.8	14.3	**16.7**
	Ni	19.4	25.5	21.0	17.6	21.0	25.2	**21.6**	8.4	9.3	12.7	7.7	5.6	7.5	**8.5**
	Zn	39.2	61.3	29.7	21.2	37.3	41.8	**38.4**	17.2	19.2	21.5	14.6	8.3	13.7	**15.8**
	Cu	21.3	17.6	21.0	16.3	19.7	17.5	**18.9**	36.7	61.3	77.0	44.2	31.9	34.9	**47.7**
	Pb	15.2	24.5	20.7	9.3	11.0	14.3	**15.8**	19.7	37.2	46.3	34.8	25.7	29.6	**32.2**
	Fe	5.4	5.4	5.3	4.5	4.1	4.6	**4.9**	7.3	7.9	8.8	7.4	6.0	7.5	**7.5**

Table 2. Heavy Metal Content in Effluent Samples Collected from different Industries of Taloja Industrial Estate of Mumbai

Industries	Heavy Metals (mg/L)	Year-1999							Year-2000						
		February	April	June	August	October	December	Average	January	March	May	July	September	November	Average
Engineering	Cr	27.9	31.6	27.2	24.9	27.5	38.7	**29.6**	30.9	34.6	40.2	27.5	20.7	28.5	**30.4**
	Cd	24.9	30.7	25.5	20.4	27.8	26.4	**26.0**	22.7	28.4	34.9	27.5	15.6	17.1	**24.4**
	Ni	14.9	20.1	20.1	10.5	20.1	24.0	**18.3**	19.6	23.6	27.4	24.0	16.2	18.1	**21.5**
	Zn	27.0	31.6	27.1	20.0	24.0	31.4	**26.9**	26.9	29.5	32.1	25.2	20.0	26.2	**26.7**
	Cu	21.6	26.3	26.2	12.9	15.2	23.2	**20.9**	19.1	24.3	32.4	20.1	13.8	19.5	**21.5**
	Pb	21.6	22.8	19.9	11.8	13.2	17.0	**17.7**	19.2	23.0	27.4	20.4	17.1	19.4	**21.1**
	Fe	7.6	8.7	8.0	6.2	6.2	7.1	**7.3**	7.0	9.6	11.5	8.3	6.0	6.8	**8.2**
Paper Mill	Cr	35.0	40.0	30.0	32.5	29.5	45.3	**35.4**	28.3	27.9	39.3	26.9	18.9	26.1	**27.9**
	Cd	21.1	23.2	19	14.5	23.0	19.2	**20.0**	27.3	27.8	31.2	31.9	21.9	25.1	**27.5**
	Ni	15.3	21.4	20.9	11.2	13.2	20.5	**17.1**	21.7	27.2	29.7	24.8	21.2	23.5	**24.7**
	Zn	27.0	32.2	25.6	19.7	21.1	24.7	**25.1**	21.9	37.3	42.6	29.3	23.7	28.2	**30.5**
	Cu	28.2	31.5	29.5	19.7	21.4	30.4	**26.8**	29.2	33.4	37.5	22.8	19.3	27.1	**28.2**
	Pb	17.4	23.2	21.3	14.3	17.3	16.3	**18.3**	23.7	27.2	31.2	23.8	20.3	22.9	**24.9**
	Fe	7.0	7.9	6.9	5.3	6.0	6.4	**6.6**	6.1	7.9	4.9	6.3	5.7	6.4	**6.2**
Fine Chemicals	Cr	22.1	32.1	37.3	29.3	26.3	27.5	**29.1**	29.2	28.3	33.0	19.6	20.1	25.7	**26.0**
	Cd	33.9	41.2	43.2	29.9	26.3	28.9	**33.9**	30.2	25.3	41.4	15.2	29.1	31.7	**28.8**
	Ni	29.7	32.7	31.9	21.8	20.3	27.3	**27.3**	34.2	27.3	37.6	13.3	12.1	25.9	**25.1**
	Zn	28.1	29.8	27.8	20.7	22.2	26.2	**25.8**	31.1	20.4	37.7	18.3	19.7	22.7	**25.0**
	Cu	25.2	29.4	29.9	19.3	21.2	22.7	**24.6**	22.9	24.6	26.1	15.5	18.3	23.1	**21.8**
	Pb	26.0	37.2	36.7	28.5	27.7	28.3	**30.7**	27.4	19.2	35.3	21.4	19.2	24.1	**24.4**
	Fe	7.9	9.9	8.2	6.3	6.9	7.6	**7.8**	7.2	7.9	8.6	7.9	6.1	7.6	**7.6**
Dyes	Cr	14.5	18.2	12.5	9.2	13.2	20.3	**14.7**	17.3	19.5	23.4	18.7	14.7	21.6	**19.2**
	Cd	32.2	37.1	34.3	17.3	29.1	29.4	**29.9**	17.5	18.6	21.3	17.8	10.8	14.3	**16.7**
	Ni	19.4	25.5	21.0	17.6	21.0	25.2	**21.6**	8.4	9.3	12.7	7.7	5.6	7.5	**8.5**
	Zn	39.2	61.3	29.7	21.2	37.3	41.8	**38.4**	17.2	19.2	21.5	14.6	8.3	13.7	**15.8**
	Cu	21.3	17.6	21.0	16.3	19.7	17.5	**18.9**	36.7	61.3	77.0	44.2	31.9	34.9	**47.7**
	Pb	15.2	24.5	20.7	9.3	11.0	14.3	**15.8**	19.7	37.2	46.3	34.8	25.7	29.6	**32.2**
	Fe	5.4	5.4	5.3	4.5	4.1	4.6	**4.9**	7.3	7.9	8.8	7.4	6.0	7.5	**7.5**

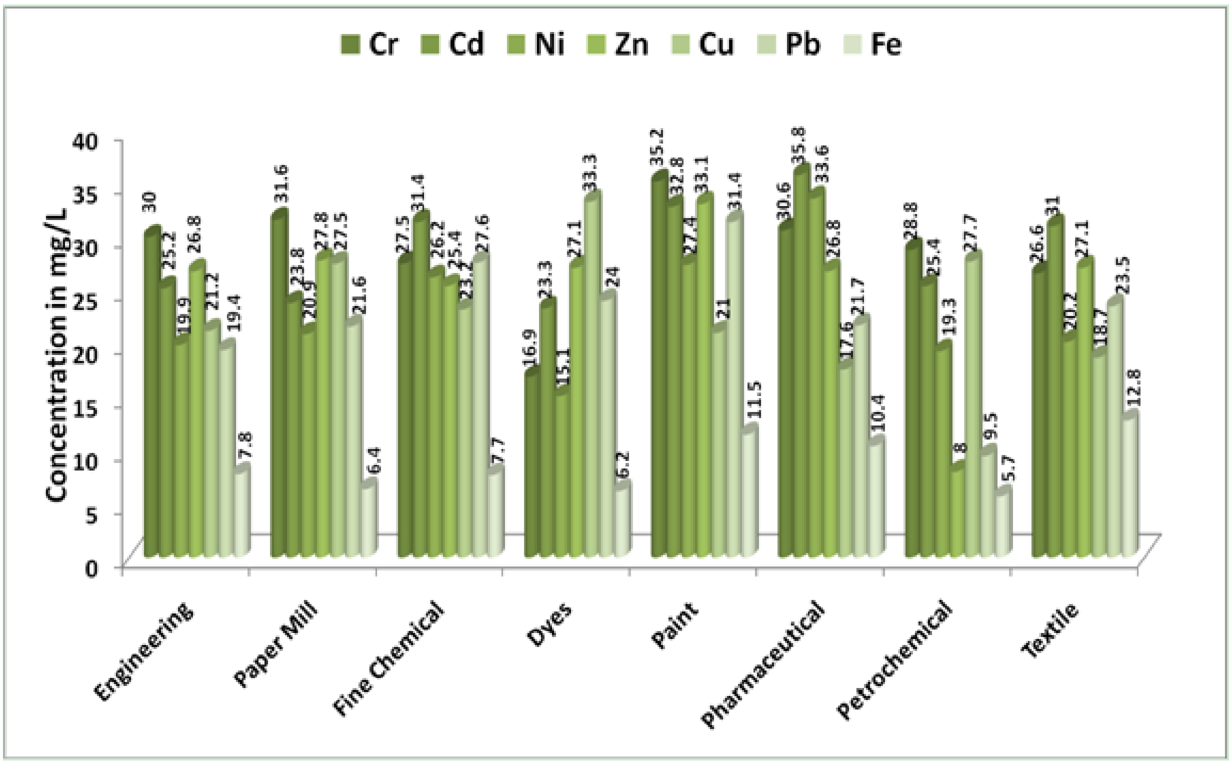

Figure 1. Average variation in Heavy metal content in the waste water effluents released from different industries of Taloja Industrial Estate of Mumbai for the Assessment years 1999-2000.

The biyearly average Ni content in the waste water effluent samples was found to be minimum of 15.1 mg/L in the effluent samples collected from dyes manufacturing industries, while higher concentration of 33.6 mg/L was found in the effluent samples collected from pharmaceutical industries (Figure 1). The results shows that Ni content in the effluent samples collected from paint manufacturing industries was 27.4 mg/L which is the second largest source for contribution of toxic Ni metal in the surrounding aquatic environment. The overall average concentration of Ni in effluent samples collected from different industries where very much higher than the maximum limit of 0.1 mg/L set by *WHO*. Short-term exposure to Ni on human being is not known to cause any health problems, but long-term exposure can cause decreased body weight, heart, liver damage and skin irritation[33]. The carcinogenic action of nickel carbonyl on rat was reported earlier by Sunderman[34]. Ni can accumulate in aquatic life, but its magnification along in food chain is not confirmed.

In the present study, the biyearly average concentration of Zn was maximum (33.1 mg/L) in waste water effluent samples collected from paint manufacturing industries, while minimum concentration of 8.0 mg/L was found in effluents collected from petrochemical industries (Figure 1). It was observed that second largest contribution of toxic Zn metal was from paper mills which contribute to 27.8 mg/L. While a dye manufacturing industries and textile mills each contribute to 27.1 mg/L of Zn. The results of the present investigation indicate that concentration of Zn in different industrial effluent samples was above the permissible limit of 5.5 mg/L as per *USPH* standard. Excessive concentration of Zn may result in necrosis, chlorosis and inhibited growth of plants.

From the results it appears that the biyearly average Cu content was minimum of 17.6 mg/L in the effluent samples collected from pharmaceutical industries, while maximum Cu content of 33.3 mg/L was found in effluents from dyes manufacturing industries (Figure 1). It was observed that petrochemical industries and paper mills are the second largest contributors of toxic Cu in the aquatic environment showing respectively 27.7 mg/L and 27.5 mg/L of Cu in their effluent samples. The observed concentration of Cu in the effluent samples collected from different industries were above the permissible limit of 0.05 mg/L set by *WHO* and 1.0 mg/L as per the *USPH* standards. It is important here to note that Cu is highly toxic to most fishes, invertebrates and aquatic plants than any other heavy metal except mercury. It reduces growth and rate of reproduction in plants and animals. The chronic level of Cu is 0.02–0.2 mg/L[29]. Aquatic plants absorb three times more Cu than plants on dry lands[31]. Excessive Cu content can cause damage to roots, by attacking the cell membrane and destroying the normal membrane structure; inhibited root growth and formation of numerous short, brownish secondary roots. Cu becomes toxic for organisms when the rate of absorption is greater than the rate of excretion, and as Cu is readily accumulated by plants and animals, it is very important to minimize its level in the waterway.

Lead is one of the oldest metals known to man and is discharged in the surface water through paints, solders, pipes, building material, gasoline etc. Lead is a well known metal toxicant and it is gradually being phased out of the materials that human beings regularly use. Atmospheric fallout is usually the most important source of lead in the freshwaters [29]. In the present investigation, it was observed that the maximum biyearly average concentration of Pb was 31.4 mg/L in effluent samples collected from paint manufacturing industries, while second largest contribution of 27.6 mg/L was found in the effluents of fine chemical manufacturing industries (Figure 1). The minimum concentration (9.5 mg/L) of Pb was found in the effluent samples collected from petrochemical industries. However in all the cases the concentration of toxic Pb in effluent samples was found to be extremely above the permissible limit of <0.05 mg/L lead in drinking water according to the *USPH* drinking water standards [35]. Acute toxicity generally appears in aquatic plants at concentration of 0.1–5.0 mg/L. In plants, it initially results in enhanced growth, but from a concentration of 5 ppm onwards, this is counteracted by severe growth retardation, discoloration and morphological abnormalities. There is an adverse influence on photosynthesis, respiration and other metabolic processes. Acute toxicity of Pb in invertebrates is reported at concentration of 0.1–10 mg/L[29]. Higher levels pose eventual threat to fisheries resources.

In the present study, the maximum biyearly average concentrations of Fe was 12.8 mg/L in the effluent samples collected from textile industries (Figure 1). It was observed that paint manufacturing industries are the second largest contributor of toxic Fe in aquatic environment having 11.5 mg/L of Fe in their effluent samples. The minimum concentration of Fe (5.7 mg/L) was found in the effluent samples released from petrochemical industries. However, it was observed that the concentration of toxic Fe in effluent samples collected from different industries was very much higher than the permissible limit of 0.3 mg/L. The presence of high concentration of Fe may increase the hazard of pathogenic organisms; since most of these organisms need Fe for their growth[33].

4. Conclusions

Around the world as countries are struggling to arrive at an effective regulatory regime to control the discharge of industrial effluents into their ecosystems, Indian economy holds a double edged sword of economic growth and ecosystem collapse. The present experimental data indicates high level of pollution along Taloja Industrial estate of Mumbai, India. The experimental data suggests a need to implement common objectives, compatible policies and programmes for improvement in the industrial waste water treatment methods. It also suggests a need of consistent, internationally recognized data driven strategy to assess the quality of waste water effluent and generation of international standards for evaluation of contamination levels. The existing situation if mishandled can cause irreparable ecological harm in the long-term well masked by short term economic prosperity.

ACKNOWLEDGEMENTS

The authors are extremely thankful to SAP Productions for developing and maintaining the manuscript template.

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