Toxicity of Heavy Metals Pollutants in Textile Mills Effluents

Vipul Bhardwaj, Paresh Kumar, Gaurav Singhal

Abstract- Environmental problems of the textile mills are mainly cause by discharge of wastewater. The main pollutants come in textile effluents from dyeing and finishing processes, in effluents heavy metals are present. To assess the pollution impact of textile effluents, eight textile industries effluent samples have been collected and analyzed their heavy metals concentrations like Cupper (Cu), Chromium (Cr), Cadmium (Cd), Iron (Fe), Lead (Pb), Nickel (Ni), Zinc (Zn) and Arsenic (As). In this study, the concentration of each of the metals varies in textile effluent Sample S1 to S8 with the following ranges: Cupper (Cu) between 0.17 – 0.28 mg/l, Chromium (Cr) 0.11 mg/l to 0.21 mg/l, Iron (Fe) 0.39 mg/l to 0.90 mg/l, Lead (Pb) 0.02 -0.10 mg/l, Nickel (Ni) 0.11– 0.22 mg/l, Zinc (Zn) 0.11 -0.51 mg/l, Cadmium (Cd) determined 0.01 mg/l only in two samples, whereas Arsenic (As) was not determined in all the samples. It is concluded that the effluent samples of textile industries were highly polluted and serious problem for living being and ecological environment.

Keywords- TC

1 INTRODUCTION

extile This one of the main industries for the developing countries like India. These textile industries consumes large amount of water in its varied processing operations [6]. Environmental problems of the textile industry are mainly causes by discharges of wastewater [3].

Textile processing employs a variety of chemicals depending on the nature of the raw material and product [1]. Some of these chemical are different dyes, detergents, acids, soda, enzyme and salts. Water containing these harmful constituents are toxic to many water organisms [9] do imparts extremely disagreeable colour and odour. Thus the presence of these pollutants in water has been of major concern because of their high toxicity [11]. Dyes contributed to overall toxicity at all process stages. Dyeing units of these industries consumes a large amount of water and simultaneously generate equally large quantity of effluent.

These effluents contain a large amount of various organic, inorganic dyes and various chemicals including traces of heavy metals ions. These heavy metals produce undesirable effects and toxicity even if they are present in extremely minute quantities, on human and animal life [10].

Toxic effects of heavy metals on human safety are very well known: negative effects on metabolism, damages to organs, heart disease, disorder to nervous system and allergies. Moreover, the accumulation of heavy metals in body tissues and binding to enzymes may disrupt the correct functioning of the cells, with tumors [8], and mutations [5] development [2]. There is overall potential to be toxic even at relatively minor levels of exposure. The toxicity of metals most commonly involves the brain and the kidney but other manifestations occur and some metals, such as arsenic are clearly capable of causing cancer. An individual with metals toxicity, even if high dose and acute, typically has very general symptoms, such as weakness or headache.

Heavy metals particularly, lead (Pb), chromium (Cr), Cadmium (Cd), Copper (Cu) and Nickel (Ni) are widely used for the production of color pigments of textile dyes. These heavy metals which have transferred to the environment are highly toxic and can bio accumulate in the human body, aquatic life, and natural water-bodies and also possible trapped in the soil [7]. Exposure to metals can occur through a variety of routes. Metals may be inhaled as dust or fume; they may also be ingested involuntarily through food and drink [4]. The amount that is actually absorbed from the digestive tract can vary widely, depending on the chemical form of the metal and the age and nutritional status of the individual. Once a metal is absorbed, it distributes in tissues and organs [4]. The main aim of this study is to evaluate the contents of trace metals like Cu, Cr, Cd, Fe, Pb, Ni,

Zn and As in eight textile industries effluent in Delhi NCR, determined by Atomic Absorption spectrometry (Hitachi, Z-8100).

2 MATERIALS & METHODS

Eight textile effluent samples were collected from the various textile industries in Delhi NCR, India. Effluent

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samples were collected in polyethylene bottles previously cleaned by washing in non-ionic detergent, rinsed with deionized water and then soaked in 10% (w/v) nitric acid solution for 24 hours and finally rinsed with deionized water prior to usage.

Samples were preserved using conc. nitric acid solution and transferred immediately to the Laboratory for the analysis. All the samples were stored at 4^0C in the refrigerator. Heavy metals like Cupper (Cu), Chromium (Cr), Cadmium (Cd), Iron (Fe), Lead (Pb), Nickel (Ni), Zinc (Zn) and Arsenic (As) were analyzed in effluent samples by Atomic Absorption Spectrophotometer. Atomize the samples and determine their absorbance. All the used chemical reagents were of analytical reagent grade like Merck, Sigma etc.

3 Results & Discussion

Heavy metals such as lead (Pb), chromium (Cr), cadmium (Cd) and copper (Cu) are widely used for production of colour pigments of textile dyes. In this study, eight different textile effluents samples, collected from Delhi NCR were analyzed for heavy metals. Metals like Cupper (Cu), Chromium (Cr), Cadmium (Cd), Iron (Fe), Lead (Pb), Nickel (Ni), Zinc (Zn) and Arsenic (As) were analyzed by Atomic Absorption Spectrometry, results (in mg/l) are shown in Table-1.

Cadmium, iron, copper, manganese, zinc and nickel were chosen as representative trace metals whose levels in the environment represent a reliable index of environmental pollution. Most of the problems arise from trace metal complex dyes which could be extracted from the fabrics by sweat solutions.

Cupper is essential element for the human metabolism system. As per table 1, the value of Cupper metal was recorded from 0.17 – 0.28 mg/l for untreated effluents of eight textile industries of Delhi NCR, sample S6, S4 and S8 show quite high concentration of cupper 0.26mg/l, 0.27mg/l and 0.28 mg/l respectively.

TABLE 1
ANALYSIS OF TEXTILE INDUSTRIES EFFLUENTS SAMPLES BY AAS

Sample in *mg/l*	Textile Industries Effluent Samples							
	S 1	S 2	S 3	S 4	S 5	S 6	S 7	S 8
Cupper (Cu)	0.21	0.20	0.19	0.27	0.22	0.26	0.17	0.28
Chromium (Cr)	0.18	0.20	0.13	0.16	0.21	0.11	0.16	0.18
Lead (Pb)	0.06	0.02	ND	0.03	0.09	0.07	0.10	0.08
Nickel (Ni)	0.13	0.18	0.19	0.22	0.16	0.11	0.15	0.16
Iron (Fe)	0.39	0.41	0.90	0.75	0.65	0.55	0.44	0.84
Zinc (Zn)	0.11	0.35	0.41	0.51	0.31	0.29	0.25	0.50
Cadmium (Cd)	ND	0.01	ND	ND	ND	0.01	ND	ND
Arsenic (As)	ND	ND	ND	ND	ND	ND	ND	ND

***AAS:** Atomic Absorption Spectrophotometry*

In the current study, Chromium concentration varies in eight samples from 0.11 mg/l to 0.21 mg/l, where sample S5 0.21mg/l, S2 0.20 mg/l show highest value of Cr.

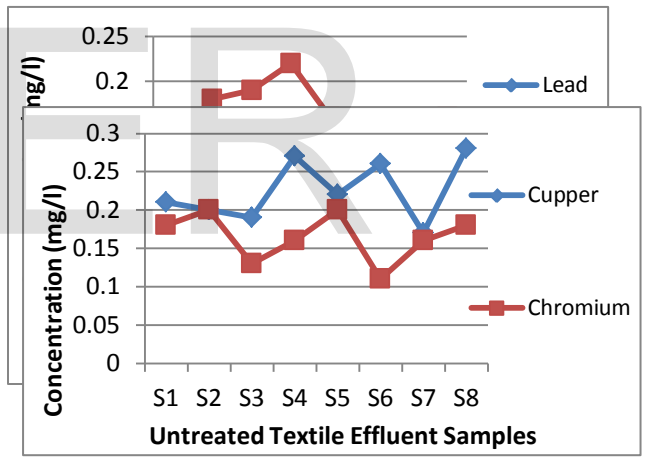

Figure 1: Comparison of Cupper (Cu) and Chromium (Cr) metals (mg/l) in textile effluent samples.

Lead is a major chemical pollutant of the environment and is highly toxic to humans. In the current study, Lead (Pb) found in all eight textile industries effluents, ranges of Pb in S1 – S8 were 0.02 – 0.10 mg/l whereas in sample S3 Pb not determined. Lead is harmful and toxic for the kidney cardiovascular and is transported through the blood [4].

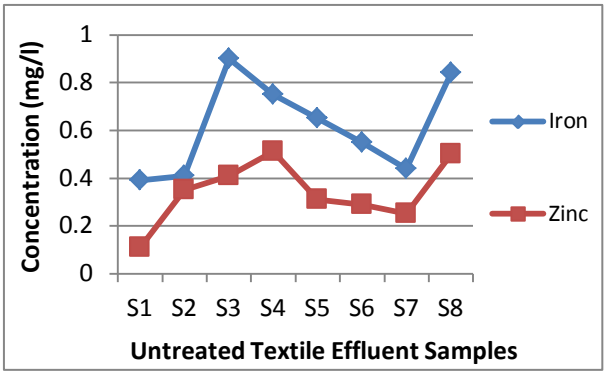

Figure 2: Comparison of Lead (Pb) and Nickel (Ni) metals (mg/l) in textile effluent samples.

Figure 3: Comparison of Iron (Fe) and Zinc (Zn) metals (mg/l) in textile effluent samples.

Nickel-induced toxicity and carcinogenicity, with an emphasis on the generation and role of reactive oxygen species is reviewed. Nickel Concentration in textile effluent samples varies from 0.11 mg/l to 0.22 mg/l. Iron toxicity is also associated with joint disease (arthropathy), arrhythmia, heart failure, increased atherosclerosis risk, and increases in the risk of liver, breast, gastrointestinal, and hematologic cancers. The values of Iron metal were recorded 0.39 mg/l to 0.90 mg/l in untreated eight textile effluent samples.

In Textile effluent samples, S3 sample show highest value of Fe 0.90 mg/l and whereas in sample S8 and S4 show 0.84 mg/l and 0.75 mg/l respectively.

The concentration of Zinc was found in ranges of 0.11 – 0.51 mg/l. Zn is also essential element for the human being.

Cadmium is a very toxic and carcinogen metal for human. Cadmium was detected only two samples (S2 and S6) out of eight textile effluent samples; both textile effluent samples have concentration 0.01 mg/l respectively. Cadmium accumulates in the human body affecting negatively several organs: liver, kidney, lung, bones, placenta, brain and the central nervous system [4].

Heavy Metal Arsenic is toxic and carcinogen can cause cancer of the skin, lungs, liver and bladder [4]. In the current study, Arsenic is not determined in any textile industries effluent sample.

4 Conclusion

The release of untreated textile mills effluent may leads to contamination is the local water body and cause serious health hazards. This study reveals that effluent from textile mills was highly polluted and without adequate treating of effluents discharge to surface water may increase their potential environmental hazards. The use of textile effluents for irrigation practices may create various health hazards to human beings and damaging effects on crop plants. The reuse of such effluents without proper treatment should be strictly prohibited.

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