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IMPACT OF INDUSTRIAL EFFLUENT OF PAPER MILL ON PHYSICO-CHEMICAL PROPERTIES OF SOIL

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ABSTRACT

Metal contamination has been recognized as a serious/major environmental concern due to their toxic effect. As the heavy metals are not biodegradable, hence there is a need to develop such a remediation technique, which should be efficient concern. This is only possible if a comprehensive study of sewage water and heavy economical and rapidly deployable in a wide range of physical settings is made keeping in view this aspect a study on industrial effluents of paper-mill at Saharanpur. The concentration of trace metals like Mn, Ni, Pb and Zn were determined by flame atomic absorption spectrophotometer (FAAS) by atomizing aqueous samples in air-acetylene flame. Hollow cathode lamps of individual metals were used to produce respective lines. For the characterization of heavy metals of paper mill effluents, some heavy metals like Zn, Cu, Ni and Pb were analyzed

KEYWORDS :*Industrial effluent, Paper Mill.*

INTRODUCTION

Environmentally India is heading towards serious problem of pollution due to industrialization, population growth and unconscious attitude towards the environment. At presently, environmental protection is the prime concern of the society. Due to lack of sewage treatment plants, generally untreated sewage effluents are released either on agricultural land for irrigation or disposed of in nearby water bodies in India. Most of the paper and pulp industries discharge their insufficiently treated waste water into the river or stream which results in serious problems for aquatic life [1]. In general, sewage effluents from industries and municipal origin contain applicable amounts of plant nutrients and variable amount of metallic salts and ions. Treated industrial waste water could be used safely and effectively with proper precautions to increase the soil productivity [2]. In addition to these constituents, effluents also contain some trace metals like Hg, Pb, and Cr etc. Untreated industrial effluents contain higher amounts of Cd, Pb, Zn, Cu, Mn and Fe and enhance the concentration of the heavy metals in irrigated surface soils [3]. The effluents are generally alkaline in reaction with high chemical and biological oxygen demands. Thus, the effluents

discharge into the water systems make the water unfit for irrigation and potable use and create health hazards. Studies on the effect of paper mill effluent on various crops have been carried out by various investigators [4, 5, 6, 7, 8]. In order to add more information in the existing knowledge it has been reported that there is delay, retard and decline of germination of rice seeds and seedling growth with paper mill effluent retreatment in comparison to control [9]. Typically in India around 75% of total fresh water supplied to pulp and paper industries emerges as waste water. In comparison to other industries fresh water requirement in pulp and paper industry is quiet high (150-200 m^3) per ton of product [10]. Long-term irrigation with such effluents increases organic carbon content and heavy metals accumulation in soils and the great chances of their entrance in food chain and this ultimately causes significantly health concern. Untreated industrial effluents contain higher amounts of Cd, Pb, Zn, Cu, Mn and Fe and enhance the concentration of the heavy metals in irrigated surface soils [3]. Although, application of sewage effluents are reported to be beneficial in increasing crop yield and reducing fertilizer requirement, but some other studies showed that metals like Mn, Ni, Cu, Pb and Zn enter in the food chain through their application in soil and this ultimately causes health concern significantly. Thus, it is highly necessary to study the composition of sewage waters and heavy metals accumulation from mill with the help of advanced techniques. Therefore, this present study is intended to characterize the waste water of Hindon river and industries like paper mills.

MATERIAL AND METHODS

Apparatus:

Atomic absorption Spectrophotometer (Model-4129 Hyderabad made) equipped with micro processor along with monitor, printer and autosampler was employed to determine the concentration of trace metals in solution.

Chemicals:

All the metals and chemical reagents, used were of high purity (99.9%) and spectroscopic grade. The water was distilled and deionized. Nitric acid (GR) 'Pro analyzed grade' manufactured by E Merck India limited which was distilled to make it free from metallic impurities, was used for analysis of trace metals.

Study Area:

Saharanpur a city located in UP is undergoing rapid urbanization and industrialization. The waste water generated from diverse industries is subjected to primary and secondary treatment at the individual industry itself. The climate of the city is humus but healthy and is subjected to extremeness of cold and hot. The minimum and maximum temperature recorded in the city varied from 2 degree to 38 degree celsius. The areas under study have been chosen amongst the most industrialized area. Almost in all parts of Saharanpur city and adjacent areas a large number of industries have come up during last two decades. All the wastes from domestic, municipal and industries are discharged in 'Hindon river which covers the whole city and neighboring localities. This direct use of the wastewater by the farmers necessitates evaluation of the quality of the water to determine the effects on the fertility of the soil and quality of vegetables grown on it. Hindon river receives industrial and domestic wastes from various sites and seepage of this water affects groundwater.

Collection of Samples:

Waste water samples were collected from different sites from industrial area of Saharanpur city.

Samples were collected in good quality screw capped high-density presterilized polypropylene bottles of 2 litres capacity labeled properly and analysed in the laboratory for trace metals by Atomic Absorption Spectrophotometer (AAS). The selected heavy metals (Ni, Cu, Pb, Zn, Mn) were analyzed.

Preparation of Samples:

Take small amount of water sample and add 5 ml concentrated HNO_3 and 1 ml of $HClO_4$ (perchloric acid) and evaporate the sample on hot plate in evaporating dish till very small amount is left. To this add 10 ml of distilled water to increase the volume. The digested samples are cooled and the solution is used for the determination of heavy metals. During experimental work precautions were taken into account. Digestion was done carefully as the mixture of organic matter perchloric acid may explode violently. The samples were treated first with nitric acid and then perchloric acid was added to cold solutions. The trace metals copper, lead, zinc, nickel, manganese were analyzed by AAS using air acetylene gas.

Determination of Trace Metals:

The concentration of trace metals like Mn, Ni, Pb and Zn were determined by flame atomic absorption spectrophotometer (FAAS) by atomizing aqueous samples in air-acetylene flame. Hollow cathode lamps of individual metals were used to produce respective resonance lines. Operating of AAS as given in Table-1, were initially optimized prior actual metal estimation. The wavelength of elements varied considerably it was more for Cu and least for Zn. Operating working range was maximum for Pb in comparison to other elements such as Cu, Zn and Ni.

RESULTS:

Table 1: Optimum operating parameters of atomic absorption Spectrophotometer.

Elements	Wavelength	Lamp current	Slit width(nm)	Operating working range	Sensitivity mg/ml	Air flow	CH flow	Burner head
Cu	324.8	3	0.5	1-5	0.025	11.2	0.91	3
Pb	217	5	1	2.5-20	0.06	10.3	1.19	3
Zn	213.9	5	0.5	0.4-1.5	0.008	10.9	0.92	3
Ni	232	4	0.2	1.8-8	0.04	10.9	1.08	4
Mn	279.8	5	0.4	1-4	0.022	11.3	1.10	3

Table 2: Concentration (mg/ml) of Trace Metals in Industrial Effluent of Star paper Mill (Saharanpur).

Concentration of Trace Metals						
	Sample No.	**Cu**	**Pb**	**Zn**	**Ni**	**Mn**
Sampling Station -1	**1**	0.010	0.002	20.889	0.065	0.20
	2	0.108	0.016	16.439	0.046	0.10
	3	0.020	0.013	16.169	0.026	0.30
	4	0.005	0.010	11.329	0.052	0.30
	5	0.009	0.015	24.789	0.039	0.40
Sampling Station -2	**1**	0.086	0.023	26.299	0.039	0.40
	2	0.074	0.019	25.609	0.092	0.00
	3	0.008	0.012	11.399	0.026	0.20
	4	0.054	0.008	25.369	0.091	0.10
	5	0.048	0.020	21.119	0.024	0.15

Table 3: Mean concentration (mg/ml) of Trace Metals in Industrial Effluent of Star paper Mill (Saharanpur).

Area of sample collection	Concentration of Trace Metals					No. of sample analysed
	Cu	Pb	Zn	Ni	Mn	
Sampling Station -1	**0.030**	0.011	17.92	0.045	0.26	**5**
Sampling Station -2	0.054	0.016	21.95	0.054	0.17	**5**

DISCUSSION

The concentration of trace metals Cu, Pb, Zn and Mn in five different samples collected from Star Paper Mill situated at Saharanpur is given in Table-2 and the Mean concentration of each metal has been represented in Table-3. At sampling station 1, the concentration of all 4 trace elements (Cu, Pb, Zn and Ni) was less in comparison to sampling station 2. However, the concentration of Mn was more at sampling station 1 than the sampling station 2.

Large industrialization means more effluents discharged in various water reservoirs. The effluents are usually treated by biological treatment process. However, such treatment systems are not effective for removal of colour, dissolved solids; trace metals etc and the effluents are directly discharged into drains, public sewers, rivers etc. These effluents containing trace metals, when discharged on agricultural land irrigation, increase the metal content of the soils and availability of metals to plants (Cu and Zn) while others (Mn and Pb etc) are hazardous to human health. Repeated application of these effluents containing heavy metals has been shown to increase the concentration of metals in soils and plants. Heavy metals in industrial effluents followed the order Zn>Ni>Cu>Mn>Pb. Concentration of Ni varied from 0.024 to 0.092. It is concluded that the water samples from various areas contain all trace metals. Overall findings indicated that waste waters of the major industries in Saharanpur city were not found good and should not be used for irrigation without prior treatment. Available Literature indicated that diluted form of paper mill effluent could be used for irrigation purpose to enhance production of agricultural crops [11, 12] [9]. The concentration of dilution is varied depending upon the crops. On the other hand, after application of paper mill effluent in different concentrations, the physico-chemical properties of the soil may be changed or it may be toxic to the plants. The present resembles with the observation made by some earlier workers on the occurrence of the high chemical diversity of the organic pollutants in paper and pulp mill waste water, a wide variety of toxic effects on aquatic communities in recipient watercourses [13, 14,15, 16]

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