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STUDY OF PHYSICO - CHEMICAL PARAMETERS OF WASTE WATER FROM DYEING UNITS IN AHMEDABAD CITY

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ABSTRACT

The present study was undertaken on the physico - chemical parameters of wastewater from different dyeing units in Agra city, India. Standard procedures were adopted to calculate the physical properties and trace elements in water samples. Wastewater was analyzed for various water qualities like pH, TDS, Alkalinity, Hardness, COD, Sulphate, Na+, K+ etc. The results arrived were compared with Indian Standards for drinking water to check out their pollution level. Elements and their impact to health of humans are discussed. The results from the analysis of dyeing wastewater show that most of the parameters were much higher than the MPL and the presence of toxic heavy metals as Pb, Cr, Cd, and Zn in the water samples. Hence the flow of this dyeing wastewater into the river causes the serious pollution problems. A perspective of environmental pollution associated with various dyeing units and its remedies are described.

INTRODUCTION

The textile industries and dyeing units occupies a unique place in the industrial map of India and are centered around most cities. These are major user of water. Dyeing units consume a large amount of water; consequently generate an equally large quantity of effluent. These effluents contain various organic dyestuffs, chrome dyes and various types of chemicals.

The dyeing operations release considerable amount of toxic effluents. The complex aromatic frame work of dyes and presence of heavy metals induce toxicity in particular and they may be mutagenic, teratogenic or carcinogenic (Karthikayan, 1990). Dyes are reported to cause considerable variation in the water characteristics like pH, colour, BOD, and COD (Karthikayan, 1990).

Although natural dyes are available, most of the dyes used in various industries are synthetic organic dyes. Synthetic dyes are more difficult to be removed because of their origin and mainly of their complex aromatic molecular structures, resist fading on exposure to sweat, soap, water, light or oxidizing agents (Meenambal, *et al.* 2006) Colour in wastewater is an obvious indicator of water pollution.

Ahemdabad has many small dyeing units in different areas. Most of the dyeing units located within the city limits discharge their effluents without any treatment into the nearby water body. These effluents with wastewater discharged into the river Yamuna which is the main source of drinking water in Agra. Drinking water supplies drawn from the river pol-

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luted by dyeing wastewater may become unfit or otherwise unsuitable for human consumption due to odour, colour, turbidity, presence of chemicals etc. The potential for hazards arises from chemical toxicity, presence of acids, alkalis and various organic pollutants (Dutta, 1994). In the present study the samples of dyeing units effluent were collected and analyzed for various physico-chemical parameters.

MATERIALS AND METHODS

All the samples were collected from the various dyeing units in Agra after dyeing the clothes. From each sampling site, samples were collected two times at interval of one week during 10.00-11.00 am in September and October 2007. The sampling sites in Ahemdabad are Vatva, Narol, G1DC. Wastewater collected in precleaned and sterilized polyethylene bottles of one litre capacity by following the standard procedures. These samples were analyzed for physico-chemical parameters like pH, Conductivity, TDS, COD, Phosphate, etc, Solutions were prepared from AR grade chemicals and in double distilled water. The standard analytical methods were used to measure the parameters.

RESULT AND DISCUSSION

In India, only few people (about 12%) get clean drinking water, the rest people quench their thirst from polluted water bodies, due to which a lot of people get affected or die of various diseases every year. Results obtained during physico-chemical analysis of wastewater samples are given in Table 1. The wastewater is coloured and ranging from red to violet due to use of various dyes. pH is the intensity of the acidity or alkalinity of water. The pH values were slightly higher than the prescribed limit and ranged from 8.41-9.80 in the wastewater samples. The Maximum Permissible Limit (MPL) and Desirable Limit (DL) of pH for drinking water is 6.5-8.5. Beyond DL the water will affect the mucous membrane and /or water supply system. Electrical Conductivity shows the concentration of ions in the water. In samples it varies from 7700-34620 μmhos/ cm. The MPL of EC for drinking water is 400 μmhos/cm. Temperature of the samples varies from 75°- 85°C, which was taken at the site immediately after collecting the samples.

Hardness of water is due to Ca and Mg .It is caused by divalent metallic cations, such cations are capable of reacting with soap to form precipitate and scale. In collected water samples the hardness ranges from 650-25000 mg/L due to Ca. The MPL of hardness for drinking water is 200 mg/L. Alkalinity in water is caused due to presence of carbonates, bicarbonates and hydroxides. The MPL of alkalinity for drinking water is 600 mg/L. In collected samples it ranges from 1500-20000 mg/L, which is too high to pose any serious disease related to skin and gastric problem. The high alkalinity is a function of ion exchange that is Ca ions are replaced by Na ions and later contributed to alkalinity.

Chloride is the best indicator of pollution and it is the most troublesome anion for irrigation in the sense that it is toxic to the plants . The MPL of chloride is 1000 mg/L for drinking water. Chloride concentration ranges from 84-280 mg/L, which is within the DL (25 mg/L) for chloride. COD or Chemical Oxygen Demand is the amount of Oxygen required to oxidize all the oxidizable organic matter in a water sample. Thus it is an oxygen demand by chemicals present in water. The MPL of COD for drinking water is 6 mg/L. In collected samples it ranges from 77.2 - 3520 mg/L, which is much higher than the MPL and easily raises the pollution level of the river.

Na" concentration in the study area varies from 730-1220 mg/L indicating that the concentration of . Na+ is higher than the MPL 200 mg/L for drinking water. Na+ in excess creates congestive heart, liver or kidney failure, toxaemias of pregnancy and the premenstrural syndrome also involve oedematous condition (Lohani, 2005). K+ being the most mobile cation apart from an involvement in metabolic processes. These ions participate in nerve impulse conductive via the brain (Forstner and Wittmann, 1979). The analytical results show that the concentration of K+ varies from 37-53 mg/L in the samples. Thus the obtained values are lower than the MPL (200 mg/L) for K+ in drinking water.

The level and mode of variation of turbidity, colour and suspended solids were found to be largely depending on the amount of organic and inorganic matter in suspension (Jhingran, Fish and Fisheries of India, 1985).

Total Dissolved Solids (TDS) consists of inorganic substances. The principle constituents of TDS are Ca, Mg, Na, bicarbonates, chlorides and sulphates. The palatability of water with a TDS level less than 600 mg/L is generally considered to be good whereas the MPL of TDS for drinking water is 2000 mg/L. Beyond DL (500 mg/L) of TDS the water become unpalatable and may cause gastrointestinal irrigation. In the studied samples the TDS ranges from 3800-30480 mg/L.

The concentration of Sulphate ranges from 4422.313- 11404.758 mg/L in the wastewater Samples. High concentration of sulphate in association with Na or Mg in the drinking water might give rise to gastrointestinal irrigation. According to the standards the MPL of sulphate for drinking water is 400 mg/L. Low concentration is physiologically harmless (Goyal *et al.* 2006). Phosphate is responsible for buffering mechanism. The higher level of phosphate is indicative of eutrophication and pollution. It can also cause kidney stone with Ca. The MPL of phosphate is 1 mg/L and in studied samples its concentration varies from 9.930-13.312 mg/L.

Analyses of the samples from the different dyeing units also show the presence of some heavy metals and toxics. The concentration of Copper ranges from 0.693-24.700 mg/L which is much more than it's MPL for drinking water (0.05-1.5 mg/L). Cu in excess creates gastrointestinal disturbances and green line on the gums. Abdominal accumulation of Cu as a 'genetic defect' is associated with the disease hepto-leuticular degeneration (David *et al.* 1965). Nickel was reported as an essential element for humans, plants and animals much later than other elements (Nielson, 1971). The standards recommended a maximum concentration of Ni is 0.1 mg/L for drinking water. Several health problems like dermatitis, renal disorder, lung earner and laryngeal cancers have been related to Ni toxicity (Paderson, *et al.* 1978). The concentration of Ni in the studied samples was found to vary from 0.001-0.72 mg/L.

Zinc, which is an essential trace metal varied in concentration from 0.058-0.385 mg/L. The drinking water quality standards for Zn are set at 5 mg/L as the safe limit while the MPL for Zn is 15 mg/L. The present study shows the lower concentration of Zn in all samples. The higher concentration of Zn can cause the astringent taste and opalescence in water. Chromium is an essential nutrient, which may be carcinogenic above DT, (0.05 mg/L). The toxicity of Cr complexes depends on the oxidation state of the metal. In animals and man Cr is present in the trivalent state. The concentration of Cr in samples ranges from 0.075-0.318mg/L.

Concentration of heavy metals like Cadmium is present in almost all ground water samples. Many dyers use ground water for dyeing purposes. Its occurrence is divergent in nature. In collected samples Cd ranges from 0.001- 0.019 mg/L, which is not as much to cause any harm to life. In higher concentration, it can damages kidney and cause itaiitai disease. The MPL of Cd for drinking purposes is 0.01 mg/L. Lead concentration in the studied water

Table Analytical results of Physico-chemical parameter (mg/L)

Parameters	S-l	S-2	S-3	S-4	S-5	S-6
Temperature (°C)	84°	80°	70°	80°	85°	80°
Colour	Blue	Violet	Yellow	Red	Green	Black
pH	8.64	8041	9.24	9.80	8.60	8.58
Conductivity (u mhos/cm)	9280	34620	22400	29100	7700	19400
TS	6280	30880	14960	19880	3840	14280
IDS	5440	30480	14100	19240	3800	13320
TSS	840	400	860	640	40	960
Total Alkalinity	4800	20000	4000	10000	2500	1500
Total hardness	4000	25000	650	4000	1500	1000
Chloride	104	131.2	254	280	84	184
Sulphate	5337.27	11404.76	4422.31	5944.32	4480.96	7290.37
Phosphate	12.63	10.69	9.93	12.25	12.48	13.31
COD	3520	1480	111.	1024	1000	6800
Sodium	840	1220	1010	1210	730	1070
Potassium	40	50	44	53	37	52
Cr	0.077	0.156	0.078	0.311	0.075	0.318
Cd	0.008	0.019	0.001	0.004	0.006	0.006
Cu	24.7	4.96	0.693	1.76	1.22	7.59
Pb	0.005	0.194	0.103	0.034	0.059	0.015
Ni	0.001	0.043	0.036	0.020	0.72	0.039
Zn	0.058	0.104	0.385	0.076	0.096	0.080

samples is slightly higher than the DL (0.05 mg/L). It ranges from 0.005-0.194 mg/L. Toxicity of Pb to aquatic life particularly fish and to human being is well documented (Oladimeji 1989). Pb poisoning can cause lassitude, abdominal disorders, anemia, mental retardation and hypertension in human beings (Kaushiketn, 2001).

CONCLUSION

After analysis of physico-chemical parameters of wastewater samples from different sites, it has been observed that some parameters are within the tolerance limit while few were very higher than their MPL, because the samples were collected directly from the dyers after dyeing the cloth. The discharge of these untreated effluents from dyeing units directly into the river can highly raise the pollution level of me water body. Tins water cannot be used for drinking purpose and unfit even for domestic irrigation. To create better environment and protect the ecosystem from further degradation, government should pass legislation for strict compliance of the dyeing units and industries to treat their effluents / recycle at their own cost.

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