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PHYSICO-CHEMICAL CHARACTERISTICS OF GLASS INDUSTRIES WASTE WATER IN FIROZABAD DISTRICT (U.P), INDIA

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ABSTRACT

The present study deals with an analysis of physico-chemical characteristics of waste water effluent from glass industries in Firozabad district U.P. Water samples were collected from nine different sites in Firozabad district during the study period and analyzed for temperature, pH, TDS, electrical conductivity, alkalinity, acidity, total hardness, BOD, COD, Na+, K+, Cl-, F-, nitrate, phosphate, sulphate, and heavy metals. The results were compared by WHO and ICMR standards showed that some parameters have higher value while few were negligible.

INTRODUCTION

Water is an essential natural resource for all the living things. Water is not only the most important essential constituent of all animals, plants, and other organisms but it is also pivotal for the survivability of the mankind in the biosphere (Bathusa Mibrahim 2007).Toxic waste water from industrial town flows into drains and finally in river causing chronic problem to people living in vicinity of these system (Prebha and Salvapathy 1997). The objective of this paper is to review the quality of water with respect to heavy metals along with other related water quality parameters in Firozabad district U.P. The city is famous for its bangles and is also known as "SUHAG NAGRI".

Two types of glass units are established in Firozabad, glass bangles and glass ware. The glass bangle industry shows a rapid growth pattern than glass wares. Industry by 50 % increase. Simultaneously employment pattern shows a similar increase from 30 % to 55.5 %. Other units like glass beads, hollow glass wares, glass toys, chandeliers etc. show a very little increase.

Through the glass factories are scattered all over the city, yet they are mainly spread up to 15–20 km of Firozabad. The industries are located in south-west, south-east, and southern part of the town. The chemicals used for coloring glasses are mainly the metallic oxides. The heavy metals dissolved into the water when the workers clean the equipment and the floor of the factory. This waste can be seen in the sediments of nearby river of district. In Firozabad the domestic waste from each building along with the effluent of small scale industries is disposed off into the open drains and gutters which ultimately enter into the holy Yamuna River is hardly 8 km away from the city. Consequently, the problem was taken when effluents of these industries goes into the water system (aquatic environment) and change the physico-chemical quality of water and make it unfit for drinking and other uses. When concentration of heavy metals in water crosses the permissible limit the water is said to be

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polluted. The waste created by the glass manufacturers contains many of the heavy metals used to color the glass. Excess of heavy metals may cause various adverse effects in human body.

MATERIALS AND METHODS

Many glass industries and small plants are located in Firozabad district in U.P. The present study was carried out to analyze the water samples collected from different sites. The sampling points were Tehsil road, Rehna road, Jalaser road, Bhau ka Nagla, Prakash Talkies, Kashmiri gate, Bus stand, C. L. Jain College, Jain temple chauraha. Water samples were collected from the main drain of the industry. The water samples generally were collected in pre-rinsed clean one liter polythene bottle having double stopper facility to its full capacity without entrapping air bubbles inside. When the water samples from all the monitoring stations were received, systematic analyses of the water samples were undertaken. Analysis was completed within 48 hours. The chemicals used were AR grade. Temperature, pH, electrical conductivity, fluoride was measured by thermometer, digital pH meter (NIG 333), digital conductivity meter (NDC 736), Ion selective electrode (ISE). Sulphate Phosphate, Nitrate by UV-Visible spectrophotometer, acidity alkalinity, total hardness, DO, BOD, COD, chloride was measured by titration method. Na+ and K+ ions were estimated by flame photometer and heavy metals (Pb, Cd, Fe, Cr, Ni) by atomic absorption spectrophotometer (AAS).

RESULTS AND DISCUSSION

The Firozabad district in U.P. has a proud glass making tradition. Different varieties of glass in Firozabad district is known in India for its quality, artistry, and unique design. Unfortunately, to produce such type of glass requires the use of many process and materials that have an adverse effect on the environment. Results obtained during the analysis of waste water from glass industry have been mentioned in Table 1. All results are fluctuated when compared to WHO and ICMR standards for drinking water.

Temperature is basically important for the chemical and biological reactions of organisms in water. The temperature of the water samples lies between (24-25 °C). pH showed the acidity and basic characters of water. pH recorded for waste water was ranged between 4.2-7.4. Total dissolved solid consists of inorganic substances. The main constituents of TDS were calcium, sodium, magnesium, bicarbonates, chlorides, sulphates. The potability of water with a TDS less than 600 mg/L is generally considered to be good whereas at TDS levels greater than 1200 mg/L drinking water becomes increasingly unpalatable (WHO, 1984). In water samples TDS were observed (423-961 mg/L).

Electrical conductivity of water is directly proportional to its dissolved minerals matter contents. Conductivity shows much variation from 100-1850μmhos/cm in nine water samples.Total hardness of water is due to the presence of bicarbonates, sulphates, chloride and nitrates of Ca and Mg. The standard limit for total hardness is 200-300 mg/L as per ICMR and Indian standards. Total hardness recorded for waste water is ranged from 40-260 mg/L. Hardness has got no adverse effect on human health. Water with hardness above 200 mg/L may cause scale deposition in the water distribution system and more soap consumption.

Alkalinity value in the 9 water samples ranged between 900-2500 mg/L. The alkalinity value less than 200 mg/L is the permissible value as per WHO and BIS water quality standards of drinking water. Acidity ranged found between 100-2400 mg/L in water samples. COD or chemical oxygen demand is the amount of oxygen required to oxidize all the organic material in a water sample. Thus, it is an oxygen demand by chemicals in water. It ranges 22.8-38.2 mg/L and was found to exceed the ICMR limit 20 mg/L for drinking and other purposes. BOD or biochemical oxygen demand represents the amount of oxygen that microbes need to stabilize biologically oxidizable matter. BOD ranged from 6.4-8.8 mg/L, which was higher than the standard limit given by ICMR 3.0 mg/L.

The range of sodium varied from 9.00-62.00 mg/L in nine water samples. High concentration of sodium can cause cardiac and renal diseases. The guideline value of sodium is 200mg/L which is based on WHO (1984).The analytical results shows that the concentration of potassium varies from 3-53 mg/L of the study area. Potassium is the most mobile cation apart from an involvement in metabolic process. These ions participate in nerve impulse conductive via the brain.

The nitrate content ranged from 0.026 - 0.078 mg/L. The desirable limit of nitrate in drinking water is 50 ppm (WHO, 1984). Concentration of nitrate above 4mg/L can cause Methamagloblnemia (blue baby disease) in children (NRC, 1772). Phosphate is present

Table 1. Physico-chemical characteristics of waste water samples of nine different sites. (For all the parameters except pH and conductivity all the values are given in mg/L).

Parameters	Site 1	Site 2	Site3	Site4	Site5	Site6	Site7	Site8	Site9
Temp.	25^{0}C	24^{0}C	25^{0}C	25^{0}C	24^{0}C	25^{0}C	25^{0}C	25^{0}C	25^{0}C
pH	7.4	5.2	4.2	7.2	5.4	6.4	6.2	5.4	5.2
TDS	423	939	494	424	885	425	470	961	911
E.C. (µmhos/cm)	1300	1850	1500	1200	1670	1400	1500	100	100
T.H.	40	60	60	160	80	80	70	100	260
Alkalinity	1400	1200	2500	1600	1300	1200	1000	900	2000
Acidity	100	400	200	100	800	1000	200	1000	2400
BOD	8.4	6.4	8.2	8.6	8.8	6.4	7.8	7.6	6.8
COD	23.6	30.0	32.4	22.8	38.2	36.4	36.6	35.6	34.0
Na+	11	12	19	9	16	12	62	35	14
K+	5	11	5	4	8	3	6	53	11
Nitrate	0.071	0.066	0.078	0.037	0.074	0.031	0.028	0.026	0.041
Phosphate	0.019	0.018	0.016	0.021	0.019	0.045	0.029	0.061	0.024
Sulphate	0.321	0.319	0.322	0.306	0.323	0.308	0.306	0.305	0.308
Cl-	781	109	1136	568	1278	568	710	994	923
F-	2.86	3.72	2.59	2.55	2.41	3.85	2.17	4.35	3.34
Pb	0.067	0.465	0.115	0.005	0.514	0.104	0.063	0.034	0.182
Cd	0.103	1.514	0.161	0.035	0.203	0.003	0.033	0.04	0.144
Fe	2.42	23.36	5.14	1.88	22.39	2.33	1.51	1.28	28.57
Cr	0.237	0.608	0.403	0.188	0.578	0.219	0.196	0.23	0.472
Ni	0.219	0.289	0.234	0.2	0.277	0.197	0.222	0.178	0.346

in trace amount in all water samples ranged between 0.016–0.061mg/L. According to Indian standards for drinking water permissible limit for phosphate in drinking water is 1.0 mg/L. High concentration of drinking phosphate can cause Eutrophication and kidney stone with Ca. Sulphate is present in trace amount in all water samples ranged between 0.305 – 0.323 mg/L. According to WHO the maximum permissible limit is 400 mg/L for sulphate. High concentration of sulphate in association with sodium or magnesium in the drinking water might give rise to gastrointestinal irritation. Chloride concentration in waste water samples were ranging from 109–1278 mg/L. Maximum permissible limit of chloride is 250 mg/L as per ICMR and 200 mg/L as per WHO Desirable limit of fluoride is 1.0 mg/L for drinking water. The concentration ranges of fluoride observed in this study were 2.17–4.35 mg/L. High concentration of fluoride can cause adverse effect on human beings. Continuous consumption of water having high fluoride content can cause diseases like Skelton fluorosis, dental carries, and bone diseases.

Iron : Iron is present in hemoglobin and its deficiency can cause anemia. It gives stringent taste to water when water contains iron concentration above the permissible limit 0.33 mg/L (WHO, 1988) in drinking water. The maximum concentration was observed at 28.57 mg/L in site no. 9

Chromium : Permissible limit for chromium are 0.05mg/L ISI (1983) and WHO (1988). No conclusive evidence exists on the toxic effect of chromium in its trivalent state. The adverse effect of chromium is mainly associated with the hexavalent forms which are highly toxic to humans. Maximum concentration was recorded at 0.608 mg/L in site no. 2.

Cadmium : Cadmium pollution resulted in the deterioration of the bones, weakening of joints, extreme pain, and kidney damages and decreases the body weight. In this study the maximum concentration was observed at 1.514 mg/L at site no. 2. Tolerance limit for drinking water is (WHO, 1984) i.e. 0.005 ppm and 0.01 ppm (B.I.S).

Lead : Above the permissible limit lead may be toxic to nervous, renal and digestive system. Maximum concentration was recorded at .514 mg/L in site no. 5. Maximum permissible limit of lead in drinking water has been prescribed as 0.10 ppm by WHO (1984).

Nickel : For nickel the WHO has, however, recom-

mended a maximum concentration of 0.1 ppm for drinking water quality. Several health problems like dermatitis, renal disorders, lung cancer, and laryngeal cancer have been related to high nickel toxicity. Maximum concentration was recorded i.e., 0.346 at site no. 9.

Results show that the effluent of glass industry waste water is highly polluted and it should not send directly in drains without treatment.

CONCLUSION

Most of the physico-chemical parameters were found to be above the permissible limit as per prescribed standards. This indicates that water is to be treated properly before sending it to drains and finally which falls in the holy Yamuna River. To minimize this problem mechanical processing of glass should require recycling of process waters. Glass manufacturing plants should adopt standard pollution control techniques to limit effluent concentrations, such as setting basin/tanks, screening neutralization, and oil water separation.

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