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Quality of Well Water from Tarapur Industrial Zone

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The present investigation deals with a study of industrial waste water on underground water used for various domestic uses. Water quality index and various physico-chemical parameters of the selected well water and effluents from neighbouring industries were evaluated. An indication of higher concentration of certain heavy metals in the effluent and their subsequent effect on well water was critically examined. The study indicates that well water contains higher concentration of toxic metals like Cr, As, Pb, Cd, Zn and Ni. A suitable method was suggested for the Effluent Treatment Plant (ETP). The users of well water were also informed about the toxicity and its consequences with respect to health hazards.

INTRODUCTION

The world's groundwater reservoirs are probably the planet's most important freshwater resource. There is nearly 97.5% salt water in the world and 2.5% fresh water. Many people depend on fresh water supplies from ground water. It provides water for domestic use for a large part of the Indian population. It is one of the major sources of drinking water in the villages and rural areas of the country. It also provides the essential source of water for irrigation and small scale industries. The availability of ground water depends on the rate at which it is recycled by hydrological cycle than on the amount that is available for use at any moment in time. In most parts of the country finite supply of fresh water is put to heavy use. Industrial wastes, sewages and agricultural run-off can overload ground water with chemical wastes and nutrients and make the water-supply toxic[1].

Effective management of water resources and control of pollution are becoming increasingly important for sustainable development and human welfare[2]. The term pollution is defined as the deterioration in the chemical, physical and biological properties of water by human and industrial activity[3]. The industrial activity discharges waste containing hazardous chemicals on the open ground which may pollute the nearby ground water. A survey was conducted for the specified rural area near the industrial zone to identify various locations of ground water which might have been affected due to seepage of waste effluent from the industries.

Tarapur industrial zone was selected for the purpose of investigation. Many illiterate industrial workers live near the industries and use well-water for their

domestic activities. Sometimes they use this water for drinking purpose. It was worth examining these water resources for various water quality parameters and ascertain their quality with respect to drinking water.

EXPERIMENTAAL

Sampling: Sampling stations were located in the nearby small residential quarters and were selected as representative for the entire industrial zone. Samples were drawn from three different wells during the first week of every month and preferably in the morning hours. One litre of sample was collected from each sampling station in a polythene container previously washed with 6 N nitric acid.

Water Quality Parameters: The major water quality parameters considered for the examination are pH, specific conductance, total alkalinity, total hardness, dissolved oxygen (DO), BOD, COD, chlorides, sulfates, nitrates and metal ions like iron, copper, manganese, zinc, lead, chromium, arsenic, nickel and cadmium. It is important to determine MPN of coliforms in the water sample. These parameters have been determined by standard methods[4].

Water samples were analyzed for metal ions by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) at RSIC, I.I.T., Mumbai, The metals were estimated in the sample by aspirating the sample solution directly into the plasma of the instrument. The instrument was standardized for the individual elements. Calibration curve was obtained for every metal ion using standard solution. Standard stock solutions were prepared by dissolving appropriate quantity of pure metallic salts. The minimum concentration of metal which could be detected by the instrument was 10 ppb.

The results of all the above experimental findings are summarized in Tables-1 and 2. All these water quality parameters are represented using bar diagram in Figs. 1–3.

TABLE-1
METAL ION CONCENTRATION IN WATER SAMPLES

Metal Ions	Station I	Station II	Station III
Fe	2.000	2.330	2.450
Cu	0.510	0.435	0.092
Mn	0.097	0.093	0.085
Zn	0.056	0.078	0.086
Pb	0.043	0.039	0.034
Cr	0.161	0.155	0.265
As	0.123	0.094	0.075
Ni	0.031	0.032	0.040
Cd	0.010	ND	ND

All quantities are in ppm.

TABLE-2
WATER QUALITY PARAMETERS

Parameters	Station I	Station II	Sation III
pH	5.57	6.08	5.81
DO	3.01	4.35	4.52
MPN	1.25	0.83	0.94
Alkalinity	89	103	119
Sp. cond.	605	128	245
Hardness	250	233	215
BOD	110	121	178
COD	143	185	209
TDS	1215	1824	1735

All quantities are in ppm.

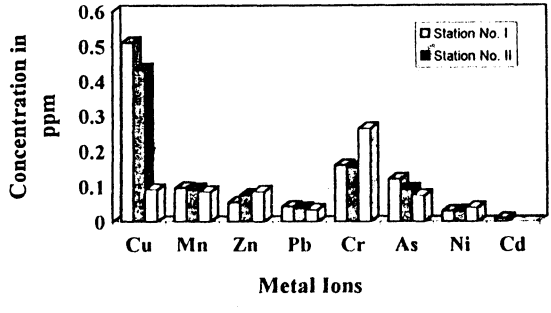

Fig. 1. Metal ion concentration in water samples

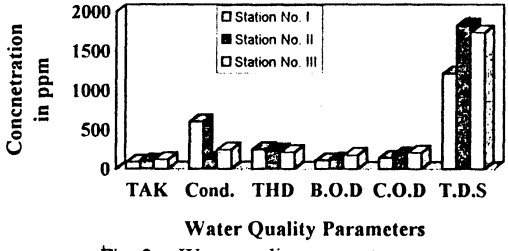

Fig. 2. Water quality parameters

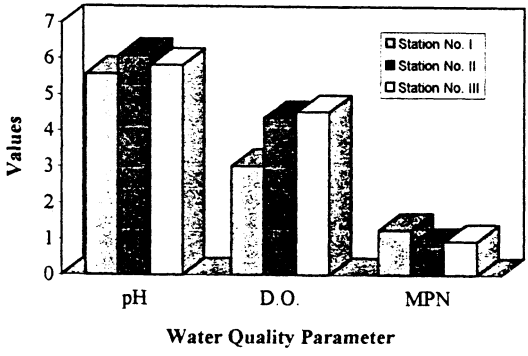

Fig. 3. Water quality parameters

RESULTS AND DISCUSSION

The values reported in the Tables-1 and 2 are the average of duplicate analysis performed for every sample collected. It can be seen that pH of the water at all the three stations were slightly acidic. The acidic character of the water may be due to some mineral sources of the nearby area and the atmospheric pollutants due to industrial activities[5].

The total alkalinity of the water is about 100 ppm. The discharge of waste effluents from industries is responsible for high alkalinity. However, variations in the value of total alkalinity can be related to the minerals of the earth's crust. Similarly, total hardness of the well water ranges between 215–250 ppm. The abnormal value of total hardness is due to discharges from paper, textile and chemical industries[6].

Clear surface water is normally saturated with 7.6 ppm of dissolved oxygen at 30°C[7]. DO determines the quality of drinking water. It gives aesthetic taste to it. The value of DO depends on physical, chemical and biological activities of the water sources[8]. The DO level of the sample is much below the limiting value (4.0 ppm). It is certainly due to the overload of effluent and increased density of phytoplankton, which lowers the DO level.

The tolerance limit for BOD and COD is 10 ppm for good quality of drinking water. The water samples from all the three stations indicate that water has very high value of BOD and COD. These values are much above the limiting values indicating danger for domestic uses.

The average total solids in the water were found in the range 1215–1835 ppm, indicating the presence of many ionic salts. This can be further supported by the very high value of specific conductance of all the samples. A critical examination suggests that chlorides, sulfates and nitrates of the metal species are the major cause of higher values of conductance. The discharges from various industries affect the water quality to a great extent.

Most of the trace element contaminants are abundantly present in the water samples. The concentrations of these elements are abnormally high and restrict the use of water for any domestic purpose. Site factors are also important in deciding the probable metal content in the well water. It was found that the amount of Cu and Pb is alarmingly high due to leaching of waste discharge from an industry dealing with manufacturing of plumbing fixtures. Similarly, effluents from leather and electroplating industry have contributed to higher concentration of Cr, N and Zn. The chemical and dyestuff manufacturing industries[9] have discharged an excess of As, Fe and Cd metal toxicity.

It is therefore suggested that the water from these wells should be totally abandoned and alternative arrangements for water supply should be made available to the local people. Basically these are people from the lower socio-economic class and we require to educate them. The national concern for the rapidly increasing pollution of water sources clearly in reflected in the passing of Water Act of 1974. Successful implementation of this legislation depends upon proper understanding of the causes and problems caused by water pollution. It is necessary to develop a suitable technology to protect at least drinking water, not

only against biodegradable organic and biological pollutants but also against the non-biodegradable wastes and toxic inorganic compounds.

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