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PHYSICO-CHEMICAL CHARACTERIZATION OF THE EFFLUENTS OF SHETAKARI SAHAKARI SUGAR FACTORY Ltd. KILLARI (MAHARASHTRA) AND ITS IMPACT ON NEAR BY GROUND WATER RESOURCES

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ABSTRACT

The effluent and ground water quality viz. temp, pH, E. C., TDS, alkalinity, arsenic, fluoride, D.O., COD, chloride, total hardness, phosphate, sulphate, nitrate and BOD of the Shetakari Sahakari Surag Factory Ltd. Killari Ta. Ausa Dist. Latur and nearby dug well and bore wells were studied for the pre- and post - monsoon seasons of 2008. The analysis has shown the non-contamination of the ground waters. The ground water at the Killari station was recorded to have different physico-chemical parameters within the prescribed limits for drinking, cleaning cloths and agricultural purposes.

Key words: Sugar factory, Dug well, Bore well, Water effluents.

INTRODUCTION

Killari, Dist. Latur is a small town located at the south-east corner of the state of Maharashtra. It hosts Shetakari Sahakari Sugar Factory. The nearby ground waters of dug wells and bore wells are the major sources of drinking, cleaning cloths and agriculture and hence, it was thought to study the impact, if any, of the effluents of the said Sugar factory. The present study aims to find different physico-chemical parameters of the effluents of the said factory and water of the near by ground water resources (dug well and bore well) in order to find out the suitability or non-suitability of these ground waters for human and agricultural uses.

EXPERIMENTAL

Meterials and methods

The effluent and water samples (dug wells and bore wells) were collected in clean

polythene bottles. The suspended matter of the water samples was removed by the filtering thorough Whatman paper No. 42 before analysis. The nitrates were estimated by phenol disulphnic acid method[1]. The standard methods were used for other analytical estimations also. For the analysis of water, common and essential parameters like pH, E.C., hardness, BOED, COD, DO, TDS, alkalinity, Ca^{+}, Mg^{2+}, Na^{+}, K^{+}, etc. were selected as per drinking water specifications of BIS, (1993)[2]. Conductivity measurements in all the samples were also done to assess the contribution of ions in quality of water. The parameters like pH. E. C., BOD, COD, hardness and free chlorine were analysed at sampling sites. The other parameters were analysed in the laboratory as per the standard methods of water and waste water (APHA-1992)[3] pH and conductivity were measured by pH meter and portable conductivity bridge, respectively. The concentrations of SO_4^{2-} and NO_3^{-} were measured using a spectrophotometer. The other parameters were measured by standard volumetric methods as per APHA (1985) and Trivedy and Goel[4]. Different methods used for analysis of water samples are given in Table 1.

Table 1: Methods employed for examination of physico-chemical parameters

S. No.	Parameter	Method employed
1	pH	pH Metry
2	E.C.	Conductometry
3	Total dissolved solid (TDS)	Conductometry
4	Chloride	Argentometry titration
5	Alkalinity	Titrimetry
6	Hardness as Ca	EDTA titration
7	Hardness as Mg	EDTA titration
8	Sulphate	Turbidimetry
9	DO and BOD	Wrinkless
10	COD	Reflux method
11	Mg	Flame photometry
12	SO_4^{2-}	Colorimetry
13	NO_3^{-}	Spectrophometry

RESULTS AND DISCUSSION

The results of physico-chemical analysis for pre- and post- monsoon seasons of 2008 for the effluents and the ground waters (dug wells and bore wells) are presented in Table 2.

Table 2: Values of the different parameters of the samples of pre/post monsoon seasons of 2008

Parameter	Dug well		Bore well		Effluent	
Temp. (^oC)	31/ 31	32.3/ 31.8	32.2/ 31.5	32.2/ 32.0	32.4/ 31.8	32.4/ 32.2
PH	6.89/ 6.70	6.95/ 6.8	6.84/ 6.71	6.84/ 6.78	3.85/ 3.75	3.86/ 3.81
EC (mmh)	0.510/ 0.490	0.555/ 0.500	0.814/ 0.789	0.854/ 0.760	1.496/ 1.31	1.523/ 1.511
TDS alkalinity (mg/L)	49/46	50/48.6	85/83	84/83	154/152	152/150
OH alkalinity (mg/L)	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil
CO_3 alkalinity (mg/L)	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil
HCO_3 alkalinity (mg/L)	500/400	500/450	300/250	350/330	500/465	500/470
Arsenic (mg/L)	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil
F (mg/L)	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil
DO (mg/L)	2.6/2.4	2.5/2.4	2.9/2.6	2.8/2.65	3.1/2.9	3.0/2.9
COD (mg/L)	7580/ 7120	7680/ 7600	6800/ 6222	6960/ 6900	157400/	157600/ 156580
Cl (mg/L)	35.01/ 32.05	35.45/ 34.90	778.08/ 698.01	794.08/ 1833.00	1900.01/ 1833.00	18078.85/ 18000
Total hardness (mg/L) as $CaCO_3$	7.9/7.4	8.0/ 7.8	23.9/ 23.3	24.5/24	214.1/ 208.3	212.5/ 210.1

Cont…

Parameter	Dug well		Bore well		Effluent	
Calcium hardness (mg/L) As $CaCO_3$	7.3/7.0	7.5/7	20.3/ 19.5	19.5/19	106.3/ 105.3	102.5/ 100.5
Mg – hardness (mg/L) as $CaCO_3$	0.6/0.43	0.5/0.3	3.6/ 03.8	5/5	111.0/ 105.09	110/ 99.6
-- PO_4^{3-} (mg/L)	0.000498/ 0.000859	0.000575/ 0.00049	0.00280/ 0.00268	0.00282/ 0.00265	0.028/ 0.021	0.03/ 0.026
SO_4^{2-} (mg/L)	22 /19.5	20/19.7	318/303	315/300	218/212	215/201
NO_3^- (mg/L)	2/1	2/1.7	4.3/4.0	4.5/3.8	7.8/7.75	8/6.99
BOD (mg/L)	268/259	280/255	122/117	120/106	1880/ 1868	1900/ 1825

The temperature was found to be within the permissible limits of WHO[5] and ISI[6]. The values of pH showed weak acidic nature of the ground waters. This shows that carbonates or bicarbonates and some other salts percolate into the ground stream. The EC is within the normal range. EC is mainly a measure of salinity, which greatly affects the taste and thus, has significant impact on its use[7] The amount of total dissolved solids (TDS) was within permissible limits. The probable increase in TDS of the ground waters might be due to pollution by effluents[1]. In the present study, the total hardness of effluents was found to range between 208-244 ppm, which is above the WHO[5] and ISI[6] permissible limit but total hardness in the water of the dug well and bore well have been found within the permissible limits. According to Dufur and Backer's classification, water with hardness value of 180 ppm is considered to be very hard. Total hardness due to concentration of Ca and Mg ions is expressed in calcium carbonates. The use of lime in sugar processing and its discharge in effluents may have resulted in higher concentrations of $CaCO_3$.

The bicarbonate as $CaCO_3$ values in general were well above the WHO standards. The free CO_2 entering the system is converted into bicarbonates (APHA – 1912). Values of the sulphates were found higher due to discharge of sugar mill effluents[7]. The nitrates and phosphates were well within the permissible limits.

BOD is a measure of organic biodegradable materials in water. The present study shows much higher values of BOD for effluents, dug wells and bore well waters. As per WHO / ISI standards, the water with BOD less than 5 ppm. is potable and useful for

drinking purposes. The COD values were also high than the permissible range. The higher values of COD may be due to the presence of chemically oxidisable oraganic matter[8].

The values of DO were 2.8 at an average. The organic pollutants present in the effluents create an oxygen demand[4].

CONCLUSION

The present study revealed that the dug well and bore well waters are heavily polluted by the sugar mill effluents The chemical parameters like EC, TDS, TH, BOD, COD, presence of HCO_3^-, As, Cl^-, NO_3^- and SO_4^{2+}, were higher for effluents and lower for the ground waters as compared to WHO and ISI standards. DO values were low, showing high degree of organic load. In these circumstances, to maintain the water quality of the dug wells and bore wells and make them safe for the drinking as well as agriculture, necessary measures should be taken to treat the waste (effluents) of the sugar factory before discharge. Strict monitoring of the effluent treatment plants must be done so as to control pollution of the ground waters.

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REFERENCES

1. N. Mani Vasakam Physico-Chemical Eramination of Water Sewage and Industrial Effluents, Pragati Prakashan, (1984) p. 42.
2. BIS (1993).
3. APHA (1992) Standard Methods for the Examination of Water and Waste Water. APHA, AWWA, WPCF, Amer Publication Health Assoc., Washington, DC.
4. R. K. Trivedy and Goel, Chemical and Biological Method for Water Pollution Studies, Environmental Publication, Karad (1986).
5. WHO (1984) International Standards for Drinking Water.
6. ISI (1983) India Standards, Specification for Drinking Water ISI 1050.

7. R. D. Sentil Kumar, R. Narayana Swamy and K. Ramkrishnan, Pollution Studies on Sugar Mill Effluent, Physico-Chemical Characterstics and Toxic Metals. Poll Res., **20 (1)**, 93-97 (2001).

8. J. B. Moyle, Limnology of Water Supply and Waste Disposal, Amercican Asso. Adv. Science (1949).

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