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# Physico-Chemical Characterization of Underground Water in Matsya Industrial Area of Alwar City and its Comparison with Underground Water in Sanganer Industrial Area of Jaipur City

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Physico-chemical analysis of water was carried out during a period of two months at seven different sites in Matsya Industrial Area (MIA), Alwar (India). The various physico-chemical parameters such as pH, turbidity, temperature, colour, total alkalinity, total hardness, calcium and magnesium hardness, chloride, sulphate, phosphate, nitrate, fluoride, total dissolved solids, DO, BOD and COD are examined. The minimum and maximum values of concentrations of the various paramcters are found to be high. It may have an adverse effect on the ecosystem thus suggesting an urgent need for proper remedial measures. A comparative study of MIA underground water with underground water of Sanganer town, Jaipur has also been discussed here.

**Key Words: Analysis, Underground water, Matsya industrial area, Sanganer, Tubewell water.**

## INTRODUCTION

Water is the liquid of life and a very important requirement for industrial as well as daily life. It is used directly or indirectly in many industrial plants. But due to some physical impurities like odour, taste, colour, turbidity, water suitable for one industry may not be so for a dissimilar industry or for domestic purposes.

There are two sources of drinking water. One is surface water sources and the other is underground water sources. Underground water comes mainly from the seepage of surface water and is held in the subsoil and in pervious rocks[1]. The use of water is for domestic purposes for industrial applications, as well as for agricultural purposes[2]. Urbanization and industrialization highly affects physico-chemical quality of water. On the other hand, microbiological quality changes due to improper sewage and sanitary system as well as illiteracy. The industrial and domestic water not only affects the water bodies of the area but also exerts an impact on physico-chemistry of ground water; therefore continuous monitoring of water quality is necessary, particularly in the areas of industrial setups[3].

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During the last two decades, many cities of Rajasthan State have grown up as industrial cities. Various studies[4–6] show that the ground water is being contaminated with hazardous substances, particularly in industrial zones. Water of arid areas of Rajasthan is not only blackish but also has alarmingly high concentrations of health affecting constituents, *viz.*, fluoride, nitrate and nitrite. Heavy metals are also present in high concentration level in industrial effluents[7–8].

The aim of this study is to analyze the physico-chemical characteristics of underground water of Matsya Industrial Area of Alwar City, which is sited on Alwar-Delhi Road, about 12 km from the main city, and, secondly, to compare it with the study of underground water of Sanganer town Jaipur[9], which is an industrially developing area of Jaipur, where printing and dyeing are the main industries.

## EXPERIMENTAL

Standard procedures were adopted for the determination of physico-chemical parameters[10, 11]. Physical parameters include colour, conductivity and temperature. Chemical parameters such as pH, TDS, alkalinity, hardness, carbonates, bicarbonates, dissolved ammonia, dissolved $CO_2$ and turbidity were also determined. All water samples (tubewell water) were collected from seven different sites in MIA, Alwar in sterilized glass bottles or in non-metallic equipment (polyethylene bottles) to ensure that they may not get contaminated with heavy metals from storage equipment. The samples were named as TW1, TW2, TW3, TW4, TW5, TW6 and TW7. Samples for analysis were collected using the standard procedure for grab or catch samples in accordance with the standard methods of American Public Health Association (1995). The instruments were used in the limit of precise accuracy and chemicals used were of analytical grade. Tubewell water samples were also analyzed as such.

## RESULTS AND DISCUSSION

Results and chemical parameters of tubewell water samples of MIA, Alwar and Sanganer, Jaipur are tabulated in Table-1.

The TW water samples of MIA were odourless and colourless, whereas tubewell water samples of Sanganer had a light pale colour and soily smell. The pH of MIA samples ranges from 6.9 to 8.3 which is less than that of Sanganer samples (7.7 to 8.2)[9]. Although slight alkalinity is there in both cases, but it does not cause any severe health hazard. The temperature of the water samples of MIA was 30°C, while of Sanganer samples was 25°C.

The conductivity of distilled water ranges between 1 to 3 μmho $cm^{-1}$. Suitable limit for irrigation water is less than 225 μmho $cm^{-1}$. In tubewell water samples of MIA, Alwar, EC value was 868–970 μmho $cm^{-1}$. It is a much higher value than standard values given by USPH and ISI (300 μmho $cm^{-1}$). Therefore the water under investigation is suitable for irrigation only for soil of good permeability and typical leaching should be provided for removal of excess salts and only salt tolerant crops can be grown with this water. Otherwise, higher amount

of salts will deteriorate the soil texture, and will accumulate on the surface of soil and thus reduce the permeability of the soil.

Therefore, it is concluded that tubewell water samples of MIA, Alwar contain high concentration of dissolved ionizable solids and is unsuitable for drinking but suitable for irrigation.

TABLE-1
PHYSICO-CHEMICAL PARAMETERS OF UNDERGROUND WATER IN MATSYA INDUSTRIAL AREA, ALWAR AND SANGANER INDUSTRIAL AREA, JAIPUR[9]

| Parameters | Tubewell water samples of MIA, Alwar | | | | | | | Tubewell water samples of Sanganer, Jaipur | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TW1 | TW2 | TW3 | TW4 | TW5 | TW6 | TW7 | TW1 | TW2 | TW3 | TW4 |
| pH | 7.3 | 7.5 | 8.1 | 7.9 | 8.3 | 8.1 | 6.9 | 8.1 | 8.2 | 7.7 | 7.9 |
| Turbidity (NTU) | – | – | – | – | – | – | – | 10 | 8 | – | – |
| Temperature (°C) | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 25 | 25 | 25 | 25 |
| Colour | – | – | – | – | – | – | – | 5 | 5 | 5 | 5 |
| Total alkalinity (as $CaCO_3$) (mg/L) | 645 | 703 | 670 | 694 | 688 | 712 | 803 | 320 | 500 | 270 | 360 |
| Total hardness (mg/L) | 330 | 380 | 365 | 352 | 390 | 374 | 360 | 150 | 100 | 430 | 350 |
| $Ca^{2+}$ hardness (mg/L) | 210 | 254 | 268 | 218 | 293 | 240 | 250 | 60 | 20 | 90 | 30 |
| $Mg^{2+}$ hardness (mg/L) | 120 | 126 | 97 | 134 | 97 | 134 | 110 | 90 | 80 | 340 | 320 |
| Carbonate hardness (Temp. Hardness) (mg/L) | 106 | 108 | 124 | 131 | 109 | 127 | 98 | 150 | 100 | 270 | 350 |
| Non-carbonate hardness (Per. hardness) (mg/L) | 224 | 272 | 241 | 221 | 281 | 247 | 262 | – | – | 160 | – |
| E. conductivity (μmho/cm) | 970 | 880 | 960 | 957 | 803 | 868 | 903 | – | – | – | – |
| Chloride (mg/L) | – | – | – | – | – | – | – | 70 | 80 | 270 | 240 |
| Sulphate (mg/L) | – | – | – | – | – | – | – | 36 | 38 | 188 | 64 |
| Nitrite (mg/L) | – | – | – | – | – | – | – | 4.1 | 0.59 | 0.01 | 0.01 |
| Nitrates (mg/L) | – | – | – | – | – | – | – | 4 | 16 | 3 | 3 |
| Fluoride (mg/L) | – | – | – | – | – | – | – | 4.8 | 2.3 | 0.2 | 0.3 |
| TDS (mg/L) | 1130 | 1090 | 1124 | 1200 | 1128 | 1037 | 1208 | 616 | 840 | 1050 | 980 |
| Initial D.O. (mg/L) | 6.5 | 6.4 | 7.2 | 6.3 | 6.8 | 7.1 | 6.5 | 5.3 | 3.6 | 5.2 | 6.7 |
| B.O.D. (mg/L) | – | – | – | – | – | – | – | – | 5 | – | – |
| C.O.D. (mg/L) | 13 | 12 | 13 | 12.5 | 13.2 | 14.1 | 12.8 | – | 7 | – | – |
| Phosphate (mg/L) | – | – | – | – | – | – | – | 0.75 | 2 | 0.25 | – |
| T.S.S. (mg/L) | 90 | 120 | 110 | 80 | 88 | 74 | 96 | 40 | 80 | 60 | 60 |

Total dissolved solids is an important parameter for drinking water and water to be used for other purposes. Beyond a definite limit it imparts a peculiar taste to water and reduces its potability. TDS in water less than 1000 mg/L is classed as non-saline. The permissible limit of TDS suitable for drinking is 500 mg/L (WHO), 2100 mg/L (ISI). The value of TDS for water samples of MIA, Alwar ranges from 1037 to 1207 mg/L and for Sanganer, Jaipur it ranges from 616 to 1050 mg/L, which is greater than that recommended by WHO. Therefore it is concluded that tubewell water is unsuitable for drinking purposes and prompt remedial measures are required. It is also concluded that tubewell water is safe

for irrigation purpose, because the tolerance limit for effluent to be discharged on the land for irrigation is 2100 mg/L for dissolved solids.

Alkalinity is an important parameter of water analysis. It is the quantitative capacity to react with a strong acid to a predesigned pH. Alkalinity of irrigation water is determined by $CO_3^{2-}$ and $HCO_3^-$ concentrations, while total alkalinity involves $HCO_3^-$, $CO_3^{2-}$ and $OH^-$ ions. In tubewell water samples of MIA, Alwar, phenolphthalein alkalinity (which is due to $CO_3^{2-}$) was found nil while methyl orange alkalinity (which is due to $OH^-$ and $HCO_3^-$ ions) was found 645–803 mg/L. Since it was above the permissible limits, therefore this water is not suitable for irrigation. Total alkalinity of Sanganer samples ranges from 270 to 500 mg/L, which is better than that of MIA, Alwar.

Total hardness (TH) was observed very high and ranges from 330 to 390 mg/L for MIA samples and 100 to 430 mg/L for Sanganer samples. The standard limit according to ISI is only 20–40 mg/L, so that the water under observation is unsuitable for irrigation as it will render the soil very alkaline and unfit for domestic purposes. TH, carbonate hardness (temporary hardness) ranges from 98 to 131 mg/L and noncarbonate hardness (permanent hardness) ranges from 221 to 281 mg/L. Since these are very high values, there is an urgent need of proper remedial steps.

Dissolved oxygen is one of the most important parameters in assessing water quality and understanding the physical and biological processes prevailing in the water. A good water should have the solubility of oxygen, 7.6 and 7.0 mg/L at 30 and 35°C respectively[12]. The DO of the water samples of MIA ranges from 6.4 to 7.2 mg/L and of the Sanganer samples from 3.6 to 6.7 mg/L.

The maximum permissible value of chemical oxygen demand (COD) is 10 mg/L for drinking water[13]. This parameter of MIA water samples was 12.0–14.1 mg/L, which indicates that water is rich either with respect to some dissolved organic compounds or oxidizable inorganic substances.

## Conclusion

It is concluded from this study that the underground waters of MIA, Alwar and Sanganer, Jaipur are very much comparable and in both cases urgent treatment is required. The main reasons to the rise in parameter concentrations are:

(i) Excessive withdrawal of groundwater as compared to its recharge is a main reason for deterioration of water quality.

(ii) Discharges of domestic and industrial waste, septic tanks and population growth are the major sources of rise in parameters in tubewell water.

Concentrations of the various parameters are found to be high, which may have an adverse effect on the ecosystem, thus suggesting an urgent need for proper action. The following preventive steps seems the only alternative at present to protect these sources:

(i) To educate the common people and farmers for proper and moderate use of fertilizers.

(ii) Adequate drainage system with proper sewage treatment, before disposal to land.

(iii) To impose a complete ban on drilling of new tubewells or to form a regulatory body for the clearance for drilling of new tubewells.

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