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# Study of physico-chemical parameters and presence of heavy metals in underground water of rural areas of pune

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Research Article

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**ABSTRACT**

In this research, an endeavour has been made to study physicochemical parameters as an attempt to provide the water industry with an updated understanding of factors that influence the potability of water. Corrosion especially in terms of Iron is one of the most critical problems faced by drinking water facilities. Many Parameters affect pipe corrosion, including water quality and composition, flow conditions, biological activity, and corrosion inhibitors. In this study, potability of water was studied along with 30 different parameters. In particular, this article focuses on underground water and its potability studies. Various physicochemical parameters as well as heavy metal contents of water samples were studied. The results showed that underground water samples of residential area were not only containing traces of heavy metals but also were showing remarkable hardness.

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## INTRODUCTION

It is well known fact that neat clean drinking water is absolutely essential for healthy living. Many areas of ground water and surface water are now contaminated with heavy metals, persistent organic pollutants and anti-nutrients that can adverse effect on health. Contamination of water can cause water borne diseases [1]. Physico-chemical analysis is of prime importance to access the quality of water for its cost usage like drinking, bathing, fishing, industrial processing etc, and to get idea about pollution load of domestic sewage and industrial wastes on receiving water bodies [2]. Quantitative analytical procedures can be done by gravimetric, volumetric, colorimetric estimations and hyphenated techniques such as GCMS (Gas Chromatography-Mass Spectroscopy)[3].

## MATERIAL AND METHODS

### Sampling for Chemical analysis

The water samples are collected from residential areas of rural pune, at depth of 0.5 meter in case of open water bodies and in case of piped water supply system from the tap in the thoroughly cleaned jar or natural gas container of minimum 5 liter of capacity provided with double cap device. The samples were collected upto top without living any space so as to prevent the premature release of dissolved gases during the transit period [4].

### Physico-chemical analysis

Physico chemical analysis of water includes study of following parameters,

1. Mineral analysis - comprising physical, parameters and significant cations and anions.
2. Demand analysis - including biological oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO), and total organic carbon (TOC).
3. Nutrient analysis - consisting analysis of different forms of nitrogen and phosphorus.
4. Trace determinants including metal analysis, organic analysis and pesticide analysis [5].
5. In this study 30 different parameters were selected. These include primary parameters such as Colour, pH, Turbidity, Total Alkalinity, Total Hardness, Chlorides, Total Dissolved Solids, Iron, Sulphates, Magnesium, Calcium, Conductivity. These also include, Metal analysis such as Aluminium, Flouride, Boron, Molybdenum, Nickel, Selenium, Sulphide, Phenolic Compounds, Anionic Detergents, Zinc, Nitrate, Chromium, Cadmium, Copper, Lead, Mercury, Arsenic, Manganese [6].
6. All the Parameters were studied by referring standard operating procedures as per worldwide guidelines of water testing.

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## RESULTS AND DISCUSSION

### Physico-chemical analysis

The results of Physico-chemical Analysis and Heavy Metal Analysis are reported in Table 1 and 2. The Indian standard and the WHO standard for physical appearance, odour and taste are agreeable. In the present study also the water samples showed results as colourless, odourless and agreeable to these three parameters and hence water can be considered for human consumption [7].

| Sr.No | Parameters | Units | Results | Limits (IS:10500-2012) | Method of Test |
|---|---|---|---|---|---|
| 1 | Colour | Hazen | BDL | 5.0-15 | EPA 6010c |
| 2 | pH | ..... | 8.29 | 6.5 - 8.5 | IS 3025(Part 11) |
| 3 | Turbidity | NTU | Nil | 1 (Max) | IS 3025(Part 10) |
| 4 | Total Alkalinity(as $CaCO_3$) | mg/Litre | **430.0** | 200 ( Max) | IS 3025(Part 23) |
| 5 | Total Hardness(as $CaCO_3$) | mg/Litre | **450.0** | 200 ( Max) | IS 3025(Part 21) |
| 6 | Chlorides(as Cl) | mg/Litre | 103.79 | 250 ( Max) | IS 3025(Part 32) |
| 7 | Total Dissolved Solids (TDS) | mg/Litre | 780.0 | 500 ( Max) | IS 3025(Part 16) |
| 8 | Iron (as Fe) | mg/Litre | 0.3 | 0.3 ( Max) | IS 3025(Part 53) |
| 9 | Sulphates (as $SO_4$) | mg/Litre | 67.50 | 200 ( Max) | IS 3025(Part 24) |
| 10 | Magnesium (as Mg) | mg/Litre | **34.440** | 30 (Max) | IS 3025(Part 46) |
| 11 | Calcium (as Ca) | mg/Litre | **124.24** | 75 (Max) | IS 3025(Part 40) |
| 12 | Conductivity at 25 °C | µmhos/cm | 1392.8 | — | — |

**Table 1**: Important Physicochemical Parameters of Water Analysis

| Sr.No | Parameters | Units | Results | Limits (IS:10500-2012) | Method of Test |
|---|---|---|---|---|---|
| 13 | Aluminium | mg/Litre | 0.02 | Max 0.030 | EPA 6010c |
| 14 | Flouride | mg/Litre | **0.64** | Max 0.1 | EPA 6010c |
| 15 | Boron(As B) | mg/Litre | 0.22 | Max 0.5 | APHA 3120B,EPA 6010c |
| 16 | Molybdenum | mg/Litre | BDL | Max 0.07 | EPA 6010c |
| 17 | Nickel | mg/Litre | BDL | Max 0.02 | EPA 6010c |

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|---|---|---|---|---|---|
| 18 | Selenium | mg/Litre | BDL | Max 0.01 | EPA 6010c |
| 19 | Sulphide | mg/Litre | BDL | Max 0.05 | EPA 6010c |
| 20 | Phenolic Compound(C6H5OH) | mg/Litre | BDL | Max 0.001 | SFA |
| 21 | Anionic Detergents as MBAS | mg/Litre | 0.500 | Max 0.2 | SFA |
| 22 | Zinc (as Zn) | mg/Litre | BDL | Max 5 | EPA 6010c |
| 23 | Nitrate | mg/Litre | 12.320 | Max 45 | IS 3025(Part 34) |
| 24 | Chromium | mg/Litre | 0.01 | rvlax 0.005 | EPA 6010c |
| 25 | Cadmium | mg/Litre | BDL | Max 0.003 | EPA6010c |
| 26 | Copper(Cu) | mg/Litre | BDL | Max 0.05 | EPA 6010c |
| 27 | Lead (Pb) | mg/l | 0.023 | Max 0.01 | EPA 6010c |
| 28 | Mercury | mg/Litre | BDL | Max 0.001 | EPA 6010c |
| 29 | Arsenic | mg/Litre | 0.016 | Max 0.01 | EPA 6010c |
| 30 | Manganese | mg/Litre | BDL | Max 0.1 | EPA 6010c |

**Table 2:** Element (Heavy Metal) Parameters of Water Analysis

### Turbidity

Turbidity values are well within limits. The pH values ranges to 8.29 which complies with the limits. The TDS value recommended by BIS & WHO are 500 but TDS values found higher for samples making these samples are unfit for human consumption and thereby it leads to necessity of RO filter system at every house.

### Conductivity

The specific conductance ranged from 1392.8 µmhos/cm. It shows that water has very low electrical conductivity implying the presence of reduced ion species.

### Concentration of chloride ions

Concentration of Chloride ions was between 103.79 mg/lit. The limits are 250 mg/lit, in all the samples the amount of chloride ions is within the limiting values indicating lesser degree of water pollution. This confirms the compatibility of chloride ions within the prescribed limit.

### Nitates and Nitriets

Nitrates and Nitriets observed in samples are below prescribed range. The nitrates and nitrites were 12.320 mg/lit which are well within the limit of 45 mg/lit.

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### Total hardness

The excessive limit of total hardness is 200 mg/L. But in the analysis of given samples the total hardness values exceeds the limit as 450mg/L, hence water from these bore-wells are unfit for drinking purpose. The hardness may be due to addition of calcium and magnesium by soap washings and water can be used for general washing purposes [8].

### Alkalinity

The values of alkalinity are found to be higher than the prescribed range and therefore water is unsafe for drinking but can be used after proper treatment

### Iron

Iron as Fe found ranging from 0.3 mg/L which is around the boundary of the prescribed limit & hence, it can be considered that there is less amount of corrosion to the pipes.

### Fluoride

The value of fluoride content shows a value between 0.6 mg/lit which is too high compared to the limit.

### Calcium

The value prescribed for Ca is 75, water sample showed 124.24 which is higher than acceptable limits.

### Magnesium

The value of magnesium is 34.44 mg/L which is slightly higher compared to standard of 30 mg/L [9].

### Heavy metals analysis

**Arsenic** – Arsenic observed in the samples was slightly above to prescribed range.

**Lead** – The value of lead in the sample was found higher than prescribed limit.

**Cadmium** – Values of cadmium in the sample was Below Detection Limit.

**Mercury** – Mercury was found totally absent in the water sample [10].

## CONCLUSION

The values of all 30 parameters measured for collected water samples are far low in many cases but 8 parameters were having higher readings than the acceptable limit, which indicates the nature of ground water in this region is non-potable and but of course, can be used for drinking purposes only after proper disinfection and certainly this indicates the necessity of RO Filters for every house in the region.

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