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# Evaluation of Physico-Chemical Studies on Groundwater in and around Aurangabad's Waluj MIDC Area

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**ABSTRACT**

Aurangabad District is primarily in the Godavari Basin, with a small portion in the Tapi River Basin to the north. Aurangabad is the divisional head of Maharashtra's Marathwada area, which is located on 74 to 76 degrees East longitude and 19 to 20 degrees North latitude. It is part of India's huge Deccan plateau. Aurangabad covers a total area of 10107 square kilometres, accounting for 3.28 percent of the state's total area. Chikhalthana MIDC, Shendra MIDC, and Waluj MIDC are three of Aurangabad's major industrial regions. The present study is under taken to explore the temperature, PH, DO, COD, TDS, TSS, Alkalinity, total hardness, nitrate, vhloride, and Sulphate, among other physico-chemical parameters, from Waluj MIDC area. The findings demonstrate that the majority of the physical and chemical parameters are well within the acceptable range. DO levels were found to be higher than the permitted limit at all sampling stations. When the results were compared to the World Health Organization's drinking quality criteria, It had been discovered that a few examples of water quality metrics were higher than the acceptable maximum value while others were not. Furthermore, current research might aid new places in better comprehending the hazards to the underground water supplies.

***Key words:*** *Physico-chemicals Parameters, Ground water; Waluj MIDC, Aurangabad City, Maharashtra*

## Introduction

For human existence and economic growth, groundwater is a worldwide essential and valuable renewable resource. Groundwater is an integral ingredient of home, industrial, and drinking water supplies. Contaminated groundwater can be unfit for a variety of uses and cleaning it up is complex, time-consuming, and costly. It could be hazardous to both human and environmental health (Chatterjee *et al.*, 2009). Water contamination is caused by manufacturing-related waste water and processing of chemicals businesses. Chemical substances that are easily recognisable in industrial waste water are common. It has been discovered that effluent discharge, solid wastes, and other hazardous wastes account for one-third of total water pollution. Surface water is the primary source of waste disposal for industry. Almost all rivers have been discovered to be contaminated in some way by some industry along most of their lengths. Despite the fact that all industries operate under the stringent strategy of the Central Pollution Control Board (CPCB), the environmental circumstances remains dire. Depending on the emission potential of each industry, different standards and guidelines are established. The majority of significant industries have industrial wastewater treatment facilities. Small-scale enterprises, on the other hand, cannot afford large investments in pollution control technology since their profit margins are thin. As a result, there is enough documentation in India to support the mismanagement of industrial wastes (Rajaram and Das, 2008). Thus it is critical to monitor the quality of drinking water on a regular basis, as well as to identify the many sources of groundwater pollution. The study's goal is to determine the influence of industrialization and rapidly expanding development activities in the study region on ground water quality, as well as to identify the many sources and types of contaminants that cause changes in ground water quality. The current analysis explored a range of physical and chemical parameters like temperature, pH, DO, COD, TDS, TSS, alkalinity, hardness, nitrate, chloride and sulphate etc.

## Materials and Method

Eleven sampling sites (bore wells) are placed throughout Waluj MIDC's main areas to monitor ground water quality. The chosen locations are around 1000 to 1500 metres apart. The samples were analyzed from the winter of 2021 through the summer of 2022. The entire glassware set, burettes, and pipettes were thoroughly cleaned with tap water before being washed by means of distilled water that has been de-ionized. For the analysis, A.R. grade chemicals and reagents were used. Water samples were taken in 1000 ml screw-capped and labeled polyethylene bottles, closely packed, transferred to the laboratory, and maintained at 4 °C for chemical analyses. Temperature and pH were measured on the sampling sites using a thermometer and a pocket digital pH-meter, respectively. Other characteristics like electrical conductivity, total dissolved solids, total hardness, total alkalinity, calcium, chloride, magnesium, sodium, sulphates, phosphate, dissolved oxygen, and biochemical oxygen demand were calculated in the lab using standard water chemical analysis procedures (APHA, 1998). Table 1 shows where the samples were taken.

## Results and Discussion

The physical and chemical parameters of samples of ground water obtained from the area around Waluj industrial neighborhood were analyzed, and the seasonal experimental facts is provided in Table 2a, 2b, 3a and 3b.

**Table 1.** Sampling Station's Location

| Sample No. | Location | Source |
|---|---|---|
| Sample 1 | Cidco waluj MIDC | Bore Well |
| Sample 2 | Pravin Ambilwade | Bore Well |
| Sample 3 | R-H -45 Colony | Bore Well |
| Sample 4 | Balasaheb Tahkare Chowk | Bore Well |
| Sample 5 | Jai Bhavani Nagar | Bore Well |
| Sample 6 | Chtrapati Nagar Wadgaon Road | Bore Well |
| Sample 7 | Mohta Devi Mandir Waluj | Bore Well |

One of the most essential ecological characteristics is temperature. It regulates organism activity, as well as the saturation of gases and salts in water. The rate of microbial activity increases as the temperature rises. As the water temperature increases, the amount of DO decreases. The temperature of samples taken in this study ranges from 20 °C to 20.9 °C, with an average of 20.4 °C in winter season and from 31.0 °C to 31.6 °C, with an average of 31.3 °C in summer season. One of the reliable indicators is pH, which is a gauge of the acidity or alkalinity of water. pH is a basic characteristic that is incredibly essential since it controls the majority of chemical reactions in the aquatic environment. Marine life would be killed by anything that was either extremely acidic or extremely alkaline. pH variations are sensitive to aquatic organisms, therefore biological therapy necessitates pH control or monitoring. As a result, pH is crucial in determining the condition of water samples. ISI (1991) and WHO (1994) recommend a pH range of 6.5 to 8.5 for drinking water. The pH values of the waste water effluents obtained in winter season from this study ranged from 6.5 to 7.6, with an average of 6.98, and for summer season it is ranged between 6.5 to 7.55, with an average of 7.1, which is within acceptable limits. The amount of total dissolved solids (TDS) in water is a measure of salinity. Carbonates, bicarbonates, chlorides, sulphates, phosphates, and nitrates of calcium, magnesium, sodium, potassium, iron, and manganese, among others, are commonly found dissolved in natural waters. A high concentration of dissolved solid components impacts water density, freshwater osmo regulation in organisms, gas solubility (such as oxygen), and the utility of water for drinking, irrigation, and industry. TDS levels in water samples in winter, range from 1,430 to 2611 mg/l in this study, with an average of 2057 mg/l and varied from 1470 to 2426 mg/l in summer season with an average of 1977.5 mg/l. Waters can be classed as desirable for drinking (up to 500 mg/l), permissible for drinking (up to 1,000 mg/l), beneficial for irrigation (up to 2,000 mg/l), and not useful for drinking and irrigation (beyond 3,000 mg/l) based on TDS content (ICMR, 1975; Wilcox, 1955). The water samples cannot be considered safe for irrigation purposes based on the aforesaid classification. Hardness is a characteristic that stops soap from lathering. Ca and Mg chloride, sulphate, and nitrates cause momentary hardness, while chloride, sulphate, and nitrates cause long - lasting hardness. Hard water has a range of negative consequences on industrial processes, including fabric quality, dyes, organic matter, and so on. Total hardness of waste water samples ranges from 411 mg/l to 1320 mg/l in this study, with an average value of 810 mg/l in winter season and from 428 mg/l to 1335 mg/l, with an average value of 826.4 mg/l in summer season. This means that the overall hardness content is higher than 300 mg/l, the ISI's highest allowed limit. Chloride is found in variable quantities in all natural waterways. Excess chloride in drinking water isn't especially dangerous, and the requirements for this anion are mostly focused on its quality and potential for high corrosiveness (Bhujangaiah and Nayak, 2005). Excess chloride (> 250 mg/l) gives water a salty flavor, and persons who aren't used to high chlorides may experience laxative effects. The amount of chloride in the water samples ranged from 172 to 246.1 mg/l, with an average of 214 mg/L in winter season and ranged from 165 to 232 mg/l, with an average of 201.4 mg/l in summer season. The results show that the chloride level is slightly above the WHO's tolerable guideline of 200 mg/l and below ISI's standard of 250 mg/l. Oxygen is a vital component of the respiration of all aquatic species that use aerobic metabolism. The amount of DO in the water shows the quality of the water and its relevance to the distribution and abundance of various algal species. The DO readings reflect how polluted the water bodies are. The standard for drinking water is a DO value of 5.0 mg/l (Bhanja *et al.*, 2000). The amount of dissolved oxygen (DO) in bore well water measured in the current study ranged from 7.32 to 7.52 mg/l with an average of 7.40 mg/l in winter season and between from 7.2 to 7.56 mg/l with an average of 7.4 mg/l in summer season. The biochemical oxygen demand (BOD) is a chemical process for estimating the amount of dissolved oxygen required by aerobic biological organisms in a water body to decompose organic material contained in a particular water sample at a specific temperature and time period. Although it is extensively employed as an indicator of the organic quality of water, it is not a purely quantitative measure (Suthar *et al.*, 2012). The acceptable maximum of BOD in water, according to WHO (1993), is 5 mg/l. The acceptable limits were found in all seven sta-

**Table 2a.** Variation in ground water quality parameters in winter 2021 in the Waluj industrial area

| Sample No. | Temp | pH | EC | Cl | TH | TDS | TA | DO | BOD |
|---|---|---|---|---|---|---|---|---|---|
| Sample 1 | 20.13 | 6.5 | 540 | 196.2 | 429 | 1430 | 278 | 7.4 | 4.20 |
| Sample 2 | 20.15 | 6.7 | 520 | 246.1 | 988 | 2325 | 290 | 7.32 | 3.7 |
| Sample 3 | 20 | 7.40 | 526 | 219.4 | 889 | 2395 | 278 | 7.39 | 4.85 |
| Sample 4 | 20.9 | 7.6 | 555 | 180.2 | 1320 | 1700 | 290 | 7.46 | 5.39 |
| Sample 5 | 20.12 | 6.4 | 575 | 172 | 411 | 1831 | 300 | 7.33 | 4.81 |
| Sample 6 | 21.6 | 6.8 | 530 | 245 | 861 | 2109 | 298 | 7.40 | 4.19 |
| Sample 7 | 20 | 7.5 | 538 | 239.5 | 777 | 2611 | 235 | 7.52 | 5.36 |

**Table 2b.** Variation in ground water quality parameters in winter 2021 in the Waluj industrial area

| Sample No. | COD | $SO_4$ | $PO_4$ | Ca | Mg | Na | Fe | $NO_3$ |
|---|---|---|---|---|---|---|---|---|
| Sample 1 | 28.20 | 26.72 | 0.161 | 333 | 59 | 255 | 0.56 | 2.40 |
| Sample 2 | 28.50 | 34.75 | 0.151 | 101 | 105 | 141 | 0.36 | 5.15 |
| Sample 3 | 26.50 | 32.81 | 0.139 | 225 | 181 | 178 | 0.20 | 2.11 |
| Sample 4 | 20.30 | 78.86 | 1.128 | 324 | 82 | 125 | 0.21 | 2.1 |
| Sample 5 | 22.31 | 25.53 | 0.129 | 101 | 32 | 36 | 0.19 | 3.00 |
| Sample 6 | 22.30 | 33.11 | 0.139 | 232 | 72 | 78 | 0.16 | 3.13 |
| Sample 7 | 25.25 | 29.51 | 0.149 | 152 | 79 | 35 | 0.40 | 3.41 |

tions, respectively. Chemical Oxygen Demand (COD) is a pollution indicator in aquatic systems. Due to microbial decomposition, high COD may induce oxygen deprivation to a level that is harmful to aquatic life (11). During winter season, COD levels range from 20.30 to 28.50 mg/l, with an average of 24.76 mg/l in the current investigation. In summer, COD levels range from 15.60 to 23.55 mg/l with an average of 47.7 mg/l in summer season. The alkalinity number in water indicates the amount of naturally salts in the water. The alkalinity levels in this study ranged from 235 to 300 mg/l in winter and in summer it is between 206 to 311 mg/l. According to WHO (1993), the alkalinity levels are below the safe range of 600 mg/l. Water's conductivity refers to its ability to transport an electrical current. This capacity is mostly dependent on the existence of anion and cations in water, as well as mobility, ion valence, and temperature. Crop germination was hampered by high electrical conductivity, which could result in lower yields (Suthar *et al.*, 2012). The WHO's acceptable limit for EC in water is 600 μmhos/cm. When compared to the permitted limit, the electrical conductivity of all stations is in the limits. Phosphate can be found in ground water due to sewage, detergents, agricultural fertilizers, and industrial waste water. Phosphate concentrations in the study area ranged from 0.129 mg/l to 1.128 mg/l in winter and ranged from 0.133 mg/l to 0.335 mg/l in summer. In modest amounts, sulphate can be found in ground water. Sulphate can enter ground water as a result of industrial or anthropogenic additives such as sulphate fertilizers. Sulphates from the samples water in the study area ranged from 25.53 to 78.86 in winter and in summer it is found 27.1 mg/l to 77.55 mg/l. Sulphate levels in the total sample for all stations are within WHO (1994) acceptable limits (250 mg/l). Organic pollution is indicated by the high nitrogen level. It is caused by nitrogen fertilizers, the rotting of dead plants and animals, animal urine and faces, and other factors. They are all converted to nitrate by natural processes, therefore nitrogen is present in bore well water in the form of nitrate in the area studied, which ranged from 2.1 to 3.41 mg/l in winter and from 3.42 to 4.25 mg/l in summer season. Because calcium is prevalent in most rocks, it is commonly found in groundwater. According to the findings, samples in both seasons had a higher concentration of calcium. It's a sign that the water isn't safe to drink. The excessive calcium levels could be attributed to industrial discharges of numerous chemically dangerous chemicals that have percolated into the ground water. The average calcium found in water samples are 209.7 mg/l and 218.2 mg/l in winter and summer seasons respectively. As per WHO (1994) the limit for calcium is 75 mg/l. Hardness is caused by the presence of significant ions such as Ca, Mg, and $HCO_3$ in wa-

**Table 3a.** Variation in ground water quality parameters in summer 2022 in the Waluj industrial area

| Sample No. | Temp | pH | Ec | Cl | TH | TDS | TA | DO | BOD |
|---|---|---|---|---|---|---|---|---|---|
| Sample 1 | 31.1 | 6.5 | 570 | 192 | 439 | 1470 | 277 | 7.2 | 4.20 |
| Sample 2 | 31.2 | 6.72 | 555 | 232 | 1000 | 2423 | 311 | 7.33 | 3.79 |
| Sample 3 | 31.0 | 7.5 | 560 | 210 | 929 | 2426 | 279 | 7.4 | 4.92 |
| Sample 4 | 31.6 | 7.6 | 555 | 180 | 1335 | 1809 | 289 | 7.56 | 5.45 |
| Sample 5 | 31.5 | 7.55 | 580 | 165 | 428 | 1855 | 322 | 7.5 | 5.11 |
| Sample 6 | 31.2 | 6.8 | 542 | 230 | 872 | 2130 | 206 | 7.5 | 4.28 |
| Sample 7 | 31.6 | 7.6 | 540 | 201 | 782 | 1730 | 250 | 7.6 | 5.6 |

**Table 3b.** Variation in ground water quality parameters in summer 2022 in the Waluj industrial area

| Sample No. | COD | $SO_4$ | $PO_4$ | Ca | Mg | Na | Fe | $NO_3$ |
|---|---|---|---|---|---|---|---|---|
| Sample 1 | 23.50 | 27.1 | 0.168 | 321 | 57 | 265 | 0.68 | 3.5 |
| Sample 2 | 22.80 | 25.87 | 0.155 | 100 | 105 | 138 | 0.41 | 4.25 |
| Sample 3 | 21.50 | 35.32 | 0.141 | 220 | 177 | 181 | 0.32 | 3.42 |
| Sample 4 | 15.60 | 77.55 | 0.133 | 372 | 79 | 128 | 0.25 | 3.82 |
| Sample 5 | 18.90 | 26.68 | 0.335 | 115 | 32 | 42 | 0.21 | 3.91 |
| Sample 6 | 211.50 | 34.29 | 0.148 | 240 | 68 | 91 | 0.20 | 3.50 |
| Sample 7 | 20.35 | 27.61 | 0.155 | 160 | 81 | 45 | 0.22 | 3.42 |

ter, making it unfit for drinking. The permitted limits of Mg according to Indian norms are 30 mg/l, yet all of the ground water samples in this investigation revealed exceeding these levels. In water, sodium content is critical. Patients with hypertension, congenital heart disease, or kidney difficulties should avoid excessive sodium in their water (Rao *et al*., 2012). It is hazardous to human health, especially in newborns, as it causes Methaemoglobinemia. The allowed maximum for sodium is 200 mg/l, according to WHO (1994). Except sample 1, all the water samples are in permissible limits as per the Indian standards. Iron is the fourth most prevalent element in the earth's crust in terms of mass. It is mostly found in ferrous or ferric states in water. Iron ores (magnetite, taconite, and hematite) are found in rocks, soil, and minerals, accounting for around 5% of the earth's crust (Lide, 2020). During the winter and summer seasons, the mean iron concentration was 0.29 mg/l and 0.3 mg/l, respectively, which is in the limits of B.I.S. (2012) acceptable (0.3 mg/l) and permitted limit (0.3 mg/l).

## Conclusion

The purpose of this study was to examine specific physico-chemical parameters in ground water samples collected in and around Aurangabad's Waluj industrial area. The study areas' ground water was collected and evaluated for several physico-chemical characteristics. In a summary, all of the metrics examined were found to be within the allowed range for drinking water, with the exception of calcium ions. At point and non-point sources of contamination, ground water resources must be decontaminated, cleansed, and treated efficiently on a long-term basis. It is possible to deduce that industrial waste will have a significant impact on ground water quality in the near future. The quality of drinking water should be adequately maintained and made available to the human population in order for them to live a healthy and longer life.

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