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GROUNDWATER POLLUTION STUDIES IN CHIKHALTHANA MIDC AREA, AURANGABAD DISTRICT

SHOBHA APPASAHEB OGADE, MAZAHAR FAROOQUI, ABDUL AHAD AND SYED UMMUL KHAIR ASEMA

Department of Chemistry,
Maulana Azad College of Arts Science and Commerce, Aurangabad (MS), India

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ABSTRACT

The water shortage is amongst the most critical concerns of this century. Groundwater quality is being severely harmed by the industries' rapid expansion and the careless dumping of their industrial waste water nearby. One of the main cities in the Deccan sub-region is Aurangabad, which is situated in the heartland of Maharashtra State, India, which is prone to drought. In order to determine how seasonal variations in groundwater quality affect irrigation and human health, the Chikalthana neighborhood of Aurangabad was chosen. Using the analytical methods. There has been an effort to investigate the state of the water in the current study. Groundwater around Chikhalthana industrial areas underwent physicochemical investigation. In the summer and winter seasons, 5 locations provided the samples of groundwater, that were analyzed for temperature, pH, electrical conductivity, total hardness, total dissolved solids, turbidity, alkalinity, DO, BOD, COD, chloride, ammonia, calcium, magnesium, iron and nitrate. According to the findings of the physicochemical analysis of 16 water quality indicators, the pH, electrical conductivity, total hardness, chloride, ammonia, calcium, magnesium, iron, and nitrates were all within acceptable limits. While the turbidity, dissolved oxygen, and biochemical demand of the groundwater were higher than allowed in both time periods.

KEY WORDS : pH, DO COD, DO, TDS, Water quality.

INTRODUCTION

The best major supply of fresh water for drinking, agriculture, and industrial needs is groundwater. Worldwide, groundwater is being used for agriculture as well as home and industrial water supplies. Due to a lack of freshwater, groundwater has nowadays become a crucial and dependable supply for drinking and agricultural uses in many nations (Adimalla, 2019). In general, anthropogenic inputs and geological formations have an impact on groundwater composition (Yuan *et al.,* 2018; Mukate *et al.*, 2019). In India, factors like population pressures, agricultural chemicals, urbanisation, and industrialization all pose serious concerns to the quality of groundwater that is drawn from aquifer systems (Pawar *et al.,* 2008; Rao *et al.*, 2014; Panaskar *et al.,* 2016; Varade *et al*., 2018; Barakat *et al.,* 2019). Drinking contaminated water has caused numerous health issues in recent decades, including fluoride, arsenic, boron, nitrate, and other toxins (Hossain *et al.,* 2013). In order to reduce health-related issues and to safeguard groundwater quality for a sustainable approach, it is essential to identify and check the quality of the groundwater. The current investigation was conducted to check groundwater pollution pertaining to physico- chemical studies of it in Chikhalthana locality of Aurangabad district. The total geographical area of Chikhalthana is 1374.72 hectares, with 19.8896551 *Latitude* and 75.3790986 *Longitude. The current study evaluates the seasonal change in groundwater quality for irrigation and consumption.*

MATERIALS AND METHODS

Sampling points were chosen as the representative for the overall industrial zone and were situated in the neighboring local industrial zones. Ideally, samples were taken in the morning during the first week of each month from 5 separate bore wells located at different locations. Sampling sites are Ahilyabai chowk (L1), Mali colony (L2), Pushpak garden (L3), Mhada colony (L4) and Ram nagar (L5).

Two liters of sample was collected from each sampling station in a polythene container previously washed with distilled water, transferred to the laboratory, and maintained at 4°C for chemical analyses. 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. The American Public Health Association's recommended standard procedures were used to evaluate water samples collected for pH, electrical conductivity, total dissolved solids, hardness, DO, BOD, COD, ammonia, calcium, magnesium, chloride, phosphate, nitrate, Fe and sulphate (APHA, 1995).

RESULTS AND DISCUSSION

Given the effects of various chemical components of water on human biology, the appropriateness of ground water for drinking purposes is evaluated. Although many ions are crucial for human growth, when they are present in excess, they have a negative impact on the human body. The results of physico–chemical analysis are presented in Tables 1, 2.

Temperature: One of the key elements that controls environmental natural processes and regulates an organism's physiological processes is temperature. The current analysis revealed that the range of temperature values grew starting in summer.

pH: Water quality is determined by its pH value. PH levels typically alter as a result of contamination from carbonate and bicarbonate in industrial waste. The modest rise in pH in samples taken before the monsoon season can be related to the reduction in CO_2 supply

Electrical Conductivity: The ability of a substance to conduct electric current is measured by something called electrical conductivity (EC). Since most salts in water exist in their ionic forms and can conduct electricity, conductivity is a suitable way to evaluate the quality of groundwater. When compared to pre-monsoon season samples, the EC of ground water samples in the post-monsoon season is higher, which may be due to the dissolving of minerals. The conductivity values at four sampling sits are higher than the desirable limit.

Total Dissolved Solids: The concentration of all dissolved minerals in water is known as the total dissolved solid, which indicates the general saltiness

Table 1. Physico-chemical groundwater parameters in the summer season

Parameters	L1	L2	L3	L4	L5	Standard Limits IS 10500 : 2012
Temperature	22.13	23	22.4	22.2	22.5	-
pH	6.88	7.1	7.31	6.71	6.88	6.5-8.5
Electrical Conductivity	521.66	252.86	346.56	519.34	372.2	300-1500
Total Hardness	149.67	295	173.43	190.23	183.33	300-600
TDS	353.26	260.55	230.58	340.45	345.2	500-2000
Turbidity	5.3	5.4	5.8	5.9	5.1	1-5
Alkalinity	58.26	82.26	119.19	136.606	139.43	200-600
DO	4.2	4.12	5.53	6.13	6.20	4-7
BOD	7.89	15.5	10.11	9.80	5.1	05
COD	109	115	124	120	114	250
Chloride	40.38	15.85	29.29	42.89	36.6	250-1000
Ammonia	0.040	0.032	0.059	0.029	0.033	<0.05
Calcium	42.56	38.27	39.15	50.12	51.23	75-200
Magnesium	20.36	19.75	20.33	29.33	28.93	30-100
Iron	0.56	0.36	0.25	0.21	0.26	0.3
Nitrate	10.2	8.5	12.11	11.3	8.96	45-100

All variables except for PH, EC (S/cm), and Turbidity are reported in mg/L. (NTU) of water. Humans are not harmed by total dissolved solids levels, but larger concentrations may result in heart and renal problems. Natural sources, sewage, urban runoff, and industrial pollutants are the main sources of TDS in ground water. All sampling sites' total dissolved solids levels fall within the permitted limit range.

Total Hardness: Total Hardness is regarded as a significant component of drinking water. The concentrations of calcium and magnesium ions are what are used to characterize hardness.The Total Hardness readings during the summer and winter seasons, respectively, range from 149.67 to 295 mg/l and 146.66 to 289 mg/l. Sometimes due to the dumping of sewage and untreated industrial effluents, the degree of hardness is higher.

Turbidity: The presence of several sorts of harmful organisms is what causes the turbidity. It serves as a sign of pollution. Every sample had values that above the standard limits. Water must be properly treated.

Alkalinity: The weathering of rocks is the principal cause of the alkalinity in water bodies. The values in this study are considerably within the acceptable range.

Chloride: The level of chloride in the research environment was noted. Chloride can be found in natural water as a result of salt dissolving, industrial effluent discharge, sewage discharge, irrigation drainage, and contamination from refuse leachate, among other causes. According to WHO and ISI guidelines, the permitted level of chloride in drinking water is 250 mg/l. The readings are well below the standard limit for all samples.

DO: Aquatic life depends on dissolved oxygen to survive. All sample values in both the season , for dissolved oxygen were over the allowable limit.

BOD: The BOD test is frequently used to gauge how polluting household and industrial waste is. Table 1 and 2, displays the BOD values acquired in the current experiment for summer and winter season. The current study's BOD readings are larger than 3 mg/l, which indicates that the water quality is poor and that effective management is required.

COD: Total organic matter, both biodegradable and non-biodegradable, is measured by COD in a sample. Aquatic life suffers from O2 depletion due to high COD values. Untreated home and industrial waste water discharge into freshwater bodies results in groundwater percolation, which raises COD levels. The average value of COD in both the season is found to be 123 mg/l at all the locations, which is in under the limit.

Ammonia: The majority of the total soluble inorganic nitrogen was made up of ammonia. All samples, with the exception of location 3 (L3), had ammonia concentrations that are within the acceptable range.

Calcium: Water naturally contains calcium. Rocks like marble, calcite dolomite, gypsum, fluorite, and

Table 2. Physico-chemical groundwater parameters in the winter season

Parameters	L1	L2	L3	L4	L5	Standard Limits IS 10500 : 2012
Temperature	20.13	21.2	20.4	20.1	20.2	-
pH	6.7	6.07	7.1	6.5	6.4	6.5-8.5
Electrical Conductivity	530.66	260.86	366.66	616.33	478.2	300-1500
Total Hardness	146.66	289	163.33	188.33	173.33	300-600
TDS	333.26	160.55	220.58	330.45	333.2	500-2000
Turbidity	5.1	5.4	5.5	5.6	5.5	1-5
Alkalinity	56.16	84.61	129.39	138.60	145.53	200-600
DO	4.5	4.23	6.53	5.23	5.32	4-7
BOD	7.85	11.5	10.2	8.95	6.2.1	3-5
COD	122	134	123	119	117	250
Chloride	42.47	25.95	30.19	52.32	51.23	250-1000
Ammonia	0.043	0.023	0.075	0.019	0.041	<0.05
Calcium	45.30	47.38	42.08	54.75	58.65	75-200
Magnesium	16.34	8.50	15.63	20.73	15.14	30-100
Iron	0.32	0.33	0.22	0.15	0.22	0.3
Nitrate	10.5	9.5	11.12	10.5	9.96	45-100

All variables except for pH, EC (S/cm), and Turbidity are reported in mg/L. (NTU).

apatite can all dissolve it. Because calcium can be found in water as calcium ions, it can be used to determine the hardness of the water. Calcium is known to strengthen bones and may reduce blood pressure. The average calcium levels are 44.26 and 40.63 mg/l in summer and winter seasons respectively. Due to the dissolution of $CaCO_3$ and $CaMg (CO_3)^2$ precipitates during recharge, calcium levels were greater during the post-monsoon season.

Magnesium: Magnesium is present in many minerals. It is removed from the rocks and then ended up in the water. Magnesium is filler or fire retardant that chemical firms add to plastics and other products. Additionally, it pollutes the environment as a result of the use of fertiliser and cow feed. During the summer and winter seasons, the Mg value fluctuates from 20.36 to 28.93 mg/l and 8.5 to 20.73 mg/l, respectively. A high Mg value during the summer season suggests that industrial effluents have contaminated the groundwater. Diarrhea can be brought on by excessive amounts of the geologically abundant and very soluble mineral magnesium.

Iron: In terms of mass, iron is the fourth most common element in the crust of the earth. It mostly exists in ferrous or ferric state in water. About 5% of the earth's crust is composed of iron in its natural state as the ores magnetite, taconite, and hematite (Lide, 2020). The average iron level throughout the summer and winter seasons was 0.328 mg/l and 0.248 mg/l, respectively, exceeding the B.I.S. recommended and allowed limits of 0.3 mg/l. The weathering of iron-containing minerals and rocks in the soil and the leaching of naturally occurring iron deposits into aquifers may both contribute to the measured iron content exceeding acceptable limits. Drinking water with a high iron level can cause haemosiderosis and a variety of other neurode generative illnesses.

Nitrate: Due to percolation into the ground, fertilizers, sewage, and manure storage are the main sources of nitrate in groundwater. According to Bruning-Fann and Kaneene (1993), it can result in methemoglobinemia, sometimes known as the blue baby disease, and adult-onset hypertension (Mkadmi *et al.,* 2018). In most cases, nitrate does not pose a health risk unless it is converted to nitrite.

CONCLUSION

The results of the physicochemical examination of 16 water quality parameters revealed that the pH, electrical conductivity, alkalinity total hardness, total dissolved solids, COD, chloride, ammonia, calcium, magnesium, iron, and nitrate were within permissible limit. Whereas The groundwater showed turbidity, dissolved oxygen and bio chemical demand exceeds the permissible limits in both periods. As a result, this water is unfit for drinking and household use.

Therefore, it is necessary to regularly monitor groundwater quality in order to periodically review pollution activity and take the necessary management actions in order to reduce the intensity of pollution activity. The corrective actions recommended in light of this investigation include

- Strict adherence to environmental regulations.
- Industrial waste treatment before safe disposal,
- The growth of vegetation in and around industrial sites,
- Setting up an effective drainage system, and
- Availability of safe water

Additionally, industrial and urban garbage disposal facilities ought to be located outside of residential neighbourhoods. The public must be made acutely aware of the sources, causes, severity, and prevention of groundwater pollution, and also the effects of pollution on human health, which would be crucial for the region's sustainable growth.

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