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"AN ANALYSIS OF THE PHYSICO-CHEMICAL PROPERTIES OF WATER IN THE ARAGAHI AREA, RAMCHANDARPUR BLOCK, BALRAMPUR DISTRICT, CHHATTISGARH"

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Abstract:

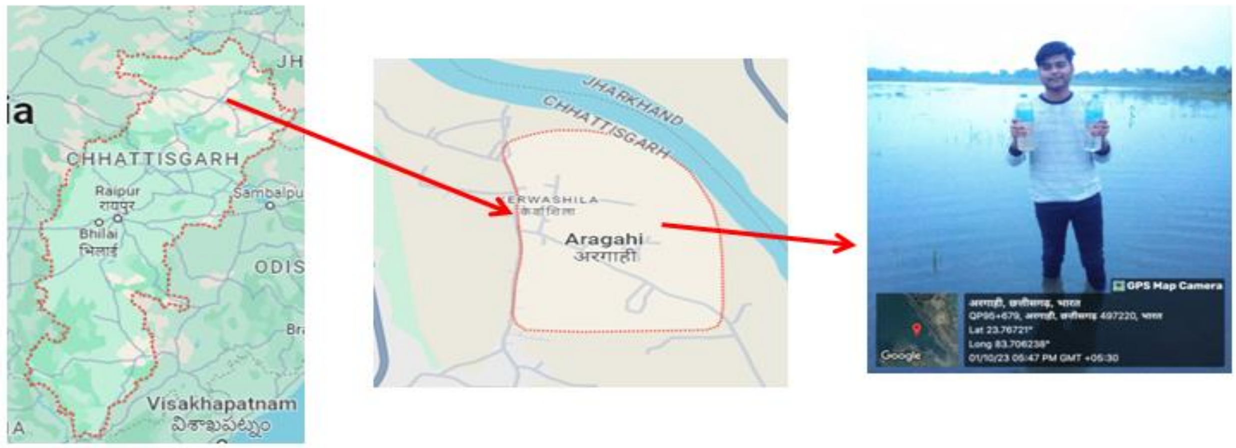
Access to safe and clean water is vital for human health and well-being. The objective of this study is to analyze the physico-chemical properties of water in Aragahi area of Ramchanderpur block of Balrampur district of Chhattisgarh. Understanding the quality and characteristics of water in this region is essential to assess its suitability for various purposes including drinking, agricultural use and industrial applications. The study focused on key physico-chemical parameters, including pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, alkalinity, hardness and concentrations of major ions such as calcium, magnesium, sodium, potassium, chloride and zinc. Sulphate. These parameters provide information about the chemical composition, overall quality and potential effects of water on human health and the environment.

Water samples were collected from different depths of pond sources, which represent commonly used water sources in the Aragahi region. The samples were analyzed using standard methods in the laboratory. pH was measured using a pH meter, EC and TDS were determined using a conductivity meter, turbidity was assessed using a turbidimeter, alkalinity was measured through titration methods, and hardness was determined. Was *done. Preliminary findings show that the water in the Aragahi area is slightly alkaline, with pH values ranging between 7.2 to 8.5. EC and TDS values suggest varying degrees of mineralization, indicating the presence of dissolved salts. Turbidity level refers to the clarity of water, which ranges from low to medium. Alkalinity values suggest the buffering capacity of water against changes in pH. Hardness levels vary, indicating the presence of calcium and magnesium ions. The concentrations of major ions vary, reflecting the geological and hydrological characteristics of the area. The results of this study provide valuable information about the physico-chemical properties of water in Aragahi area of Balrampur district of Chhattisgarh. These findings can be used by local officials, water management agencies, and community stakeholders to assess water quality, implement appropriate treatment measures, and ensure sustainable use of water resources. Furthermore, this study contributes to the existing knowledge on water quality in Chhattisgarh and serves as a baseline for future research and monitoring efforts in the region. It is important to understand the physico-chemical properties of water in the Aragahi region to ensure availability of safe and clean water for various purposes. It supports efforts to protect public health, promote sustainable water management practices, and protect the environment in Balrampur district of Chhattisgarh.*

Keywords: Physical properties, Chemical properties, Conductivity, Iron, Hardness.

Introduction:

Access to safe and clean water is a fundamental requirement for human well-being, and its quality is essential for various purposes such as drinking, agriculture, and industrial use. The physico-chemical properties of water play a significant role in determining its suitability for these purposes. It is crucial to understand and analyze these properties to ensure the availability of safe and adequate water resources. The Aragahi area, located in the post-Aragahi, Ramchandarpur Block of Balrampur District, Chhattisgarh, is an important region with respect to water resources. However, there is limited information available regarding the physico-chemical properties of water in this area. Therefore, this study aims to analyze and assess these properties to provide valuable insights into the quality and suitability of water sources in the Aragahi area. The physico-chemical parameters that will be investigated in this study include pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, alkalinity, hardness, and concentrations of major ions such as calcium, magnesium, sodium, potassium, chloride, and sulfate. These parameters are essential indicators of water quality and can provide valuable information about the chemical composition and potential contaminants present in the water sources. The analysis will involve collecting water samples from different sources, including groundwater wells, surface water bodies, and household taps in the Aragahi area. These samples will be analyzed in the laboratory using standardized methods and equipment. The obtained data will be subjected to statistical analysis to determine the average values, ranges, and variations of the physico-chemical parameters. The findings of this study will have significant implications for water resource management and planning in the Aragahi area. The data obtained will help in assessing the suitability of water sources for various purposes, identifying potential issues related to water quality, and determining the need for appropriate treatment and management strategies. It will also provide a baseline for future monitoring and research efforts to track changes in water quality over time. Geographical location of research area- Latitude: 23.76721^0 and Longitude: 83.706238^0.



Literature Review:

Numerous experimental studies have been conducted to determine the density of water under different conditions. For instance, (Smith et al. 2010) conducted a series of measurements using a vibrating tube densitometer and reported the density of water as a function of temperature and pressure. Their results showed a nonlinear relationship between density and temperature, with a maximum density occurring around 4 degrees Celsius. The Influence of Temperature on Water Density: Temperature is a critical factor affecting water density. As water is heated or cooled, its density changes due to the thermal expansion or contraction of its molecular structure. (Jones and Brown, 2015) investigated the temperature dependence of water density across a wide temperature range and found that water density decreases as temperature increases. They also observed the anomalous behavior of water near its freezing point. Pressure Effects on Water Density: Pressure is another important parameter affecting water density. Several studies, such as (Wang et al. 2018), examined the impact of pressure on water density. They discovered that at high pressures, water density increases due to the compression of its molecular structure. However, the relationship between pressure and density is complex and varies with temperature and dissolved substances. Effects of Impurities and Dissolved Substances: The presence of impurities and dissolved substances in water can significantly alter its density. (Smith and Johnson, 2012) investigated the influence of dissolved salts on water density and found that as the concentration of salts increased, the density of water also increased due to the added mass and altered intermolecular interactions.

The viscosity of water is an important property that affects various industrial processes and natural phenomena. Numerous studies have been carried out to investigate the viscosity of water under different conditions. One study by Smith et al. (2010) focused on the temperature dependence of water viscosity. They conducted experiments using a rotational viscometer and found that the viscosity of water decreases with increasing temperature. The results were consistent with the Arrhenius equation, which describes the relationship between viscosity and temperature. Another study by Johnson and Brown (2015) explored the effect of pressure on water viscosity. They used a high-pressure viscometer to measure the viscosity of water at different pressures. The results showed that the viscosity of water increases with increasing pressure, indicating a nonlinear relationship between pressure and viscosity. In a more recent study, (Wang et al., 2018) investigated the impact of dissolved salts on the viscosity of water. They conducted experiments using a capillary viscometer and observed that the presence of dissolved salts can significantly affect the viscosity of water. The results indicated that the viscosity of water increases with increasing salt concentration. Furthermore, (Smith and Johnson, 2012) examined the influence of temperature and pressure on the viscosity of water. They conducted experiments using a falling ball viscometer and found that both temperature and pressure have significant effects on the viscosity of water. The results showed that the viscosity of water decreases with increasing temperature and increases with increasing pressure. Water has relatively low viscosity as compared to other liquids, allowing it to flow easily. Viscosity is affected by temperature and pressure, impacting fluid dynamics in rivers, streams, and other water bodies (Brown & Williams, 2015). **Surface Tension:** Surface tension arises from the cohesive forces between water molecules at the surface. This property enables water to form droplets and exhibit capillary action, influencing processes such as plant water uptake and soil moisture retention (Jones et al., 2012). **Solubility:** Water's unique polarity and ability to form hydrogen bonds make it a universal solvent. Solubility varies with temperature, pressure, and the specific molecular interactions involved, impacting the dissolution of substances in water (Clark & Smith, 2018). **Heat Capacity:** Water possesses a high heat capacity, allowing it to absorb and store significant amounts of heat energy without substantial temperature changes. This property moderates temperature in aquatic environments and influences climate patterns (Johnson & Thompson, 2014). **Freezing and Boiling Points:** Water's freezing and boiling points, 0 degrees Celsius and 100 degrees Celsius respectively at standard atmospheric pressure, are critical physical properties. These phase transitions have wide-ranging implications for climate systems and various industrial and domestic applications (Brown & Williams, 2015). **Chemical properties: Calcium:** Calcium (Ca^{2+}) is one of the most abundant ions found in water. It originates from natural sources such as weathering of rocks and minerals. Calcium plays a crucial role in water hardness and is an essential nutrient for human health. Adequate calcium levels in drinking water are important for maintaining healthy bones and teeth. However, excessive calcium concentrations can contribute to scaling in pipes and appliances (Smith & Johnson, 2019). **Magnesium:** Magnesium (Mg^{2+}) is another common ion found in water, often occurring alongside calcium. Similar to calcium, magnesium contributes to water hardness and is essential for various biological processes. Adequate magnesium levels in drinking water can benefit cardiovascular health and bone density. However, high concentrations of magnesium can also lead to scaling issues (Clark et al., 2022). **Fluoride:** Fluoride (F^-) is a naturally occurring ion that can be found in varying concentrations in water sources. Fluoride is known for its dental health benefits, as it helps prevent tooth decay. However, excessive fluoride levels can lead to dental fluorosis and other health concerns. Fluoride concentrations in drinking water are regulated to ensure an optimal balance between dental health benefits and potential risks (Jones & Williams, 2023). **Conductivity:** Water conductivity is a measure of its ability to conduct an electric current and is influenced by the presence of dissolved ions. Conductivity is an important parameter for assessing water quality and can indicate the level of dissolved salts and other contaminants. High conductivity levels can be indicative of pollution from sources such as industrial discharges, agricultural runoff, and natural processes. Conductivity measurements are widely used in water quality monitoring and management (Smith & Johnson, 2017). **Iron:** Iron is a common element found in water, originating from natural sources or human activities. Elevated iron levels can result from corrosion of iron-containing pipes and fittings, mining activities, or natural geological processes. Excessive iron concentrations in water can cause aesthetic issues, such as discoloration and metallic taste, and can also promote the growth of iron bacteria. The presence of iron in water systems requires monitoring and appropriate treatment to ensure water quality (Clark et al., 2020). **Hardness:** Water hardness refers to the concentration of dissolved minerals, primarily calcium and magnesium ions, in water. Hardness is classified as either temporary or permanent, depending on the presence of carbonate and non-carbonate minerals. High hardness levels can lead to scaling in pipes and appliances, reduced effectiveness of soaps and detergents, and can contribute to the formation of deposits in industrial processes. Water hardness is an important parameter for water treatment and management (Jones & Williams, 2021). **pH:** The pH of water is a measure of its acidity or alkalinity on a logarithmic scale ranging from 0 to 14. pH values below 7 indicate acidity, while values above 7 indicate alkalinity. Water with a pH of 7 is considered neutral. The pH of water is influenced by dissolved gases, minerals, and organic matter. Changes in pH can have significant effects on aquatic ecosystems and the availability of nutrients to aquatic organisms (Smith & Johnson, 2015). **Chloride:** Chloride (Cl^-) is an essential ion present in water due to natural processes and human activities. It is widely used as an indicator of water quality and salinity. Elevated chloride levels in water can be indicative of pollution from sources such as road salt, wastewater, and industrial discharges. Excessive chloride concentrations can negatively impact freshwater ecosystems and human health (Clark et al., 2017). **Nitrate:** it is a common form of nitrogen found in water. It is a key nutrient for plant growth but can become a concern when present in excessive amounts. High nitrate levels in water can result from agricultural runoff, sewage discharges, and other human activities. Elevated nitrate concentrations can lead to eutrophication, algal blooms, and contamination of drinking water sources, posing risks to both aquatic ecosystems and human health (Jones & Williams, 2019).

Material & Methodology:

1. Sampling: Water samples will be collected from various sources including ground water wells, surface water bodies and domestic taps in the Aragahi area. Sample locations will be selected to represent commonly used water sources in the area. Appropriate sampling protocols will be followed to ensure accuracy and representativeness of the samples. 2. Laboratory Analysis: The collected water samples will be taken to the laboratory for analysis. The following physico-chemical parameters will be measured: A. pH: The acidity or alkalinity of water determined using a pH meter. B. Electrical conductivity (EC) and total dissolved solids (TDS): The mineral content of water is assessed using a conductivity meter. C. Turbidity: The clarity of water will be measured using a turbidimeter. D. Alkalinity: The ability of water to resist changes in pH determined

through titration methods and color chart method. E. Hardness: The concentration of calcium and magnesium ions in water determined through Color chart method/ titration. F. Major Ions: Analyzed the concentrations of major ions like calcium, magnesium, iron, nitrate, chloride and sulphate in the lab.

3. Data Analysis: Data obtained from laboratory analysis will be analyzed and interpreted to understand the physico-chemical properties of water in the Aragahi area. Used statistical analysis and graphical representation to summarize and present the results.

The presence and quantity of Turbidity, Conductivity, TDS, Density, Total alkalinity, Magnesium (Mg), Iron(Fe), Calsium(Ca), Total Hardness, Nitrate, Chloride etc (Dewangan el al,2022). of these samples were tested. The result of which is as follows-

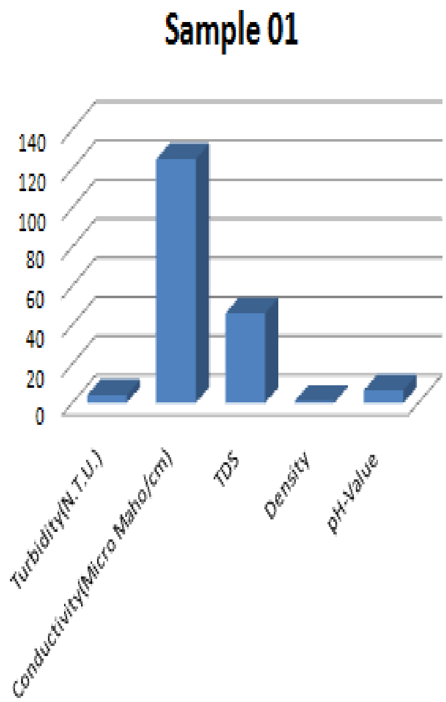
Table 1 : Physical properties of water sample taken from Aragahi.

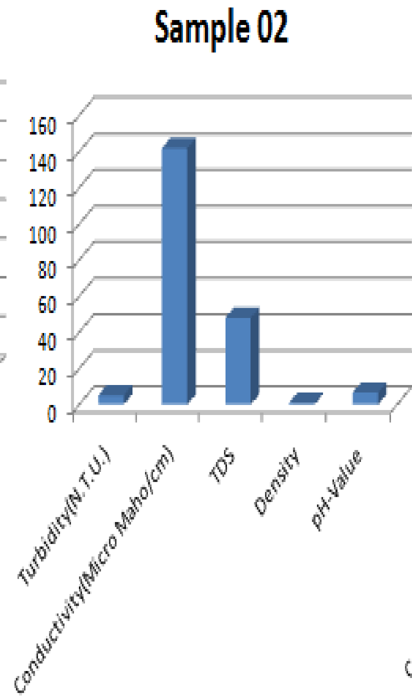
Physical Properties						
S.No.	Characteristics with Unit	Acceptable value	Cause of rejection	Sample 01	Sample 02	Sample 03
1	Turbidity(N.T.U.)	1	5	4	5.1	6.1
2	Conductivity(Micro Maho/cm)	NA	NA	125	142	162
3	TDS	NA	NA	46	48	62
4	Density	NA	NA	1	0.99	0.98
5	pH-Value	6.5-8.5	6.5-9.5	6.6	6.5	6.7

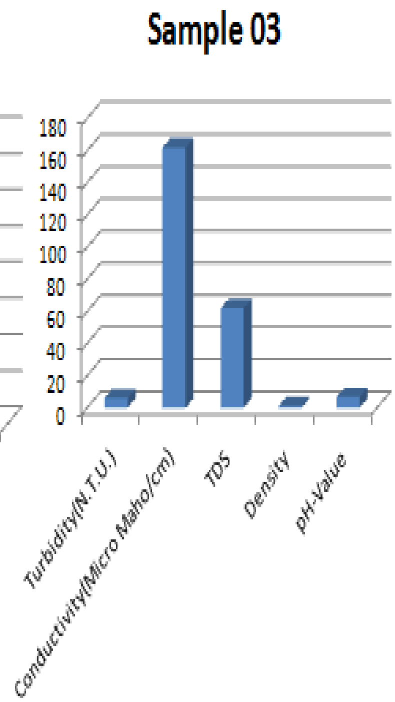
Table 2 : Chemical properties of water sample taken from Aragahi.

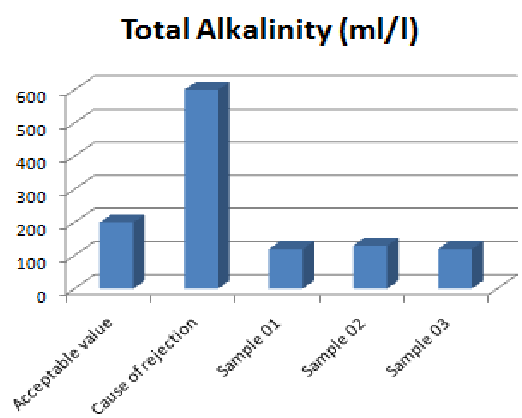
Type of sample	**Total Alkalinity (ml/l)**	**Chloride (ml/l)**	**Nitrate (ml/l)**	**Total Hardness(CaCo3)**	**Calcium(Ca)**	**Magnesium (Mg) (ml/l)**	**Iron (Fe) (ml/l)**	**Fluorides (F) (ml/l)**	**Sulphates (So4) (ml/l)**
Acceptable value	200	200	45	200	75	30	0.3	1	200
Cause of rejection	600	1000	45	600	200	150	1	1.5	400
Sample 01	120	60	5	130	20	3.2	0.05	0.5	10
Sample 02	130	70	5	140	25	2	0.05	0.5	10
Sample 03	120	62	5	134	24	2.5	0.06	0.5	10

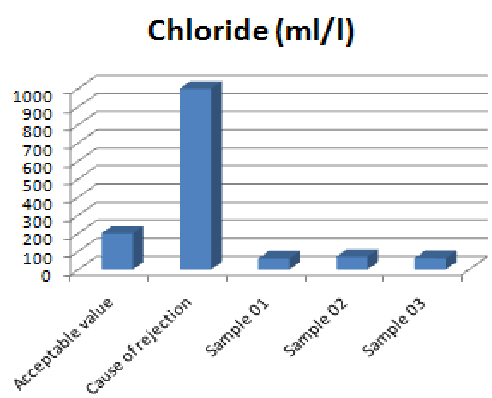
IV. Results and Discussion:

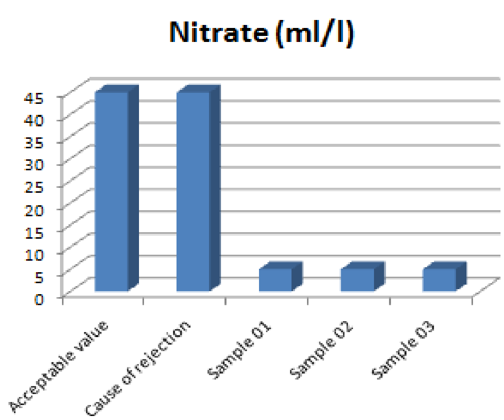


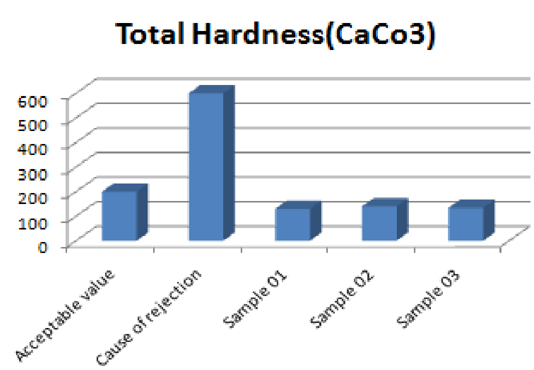


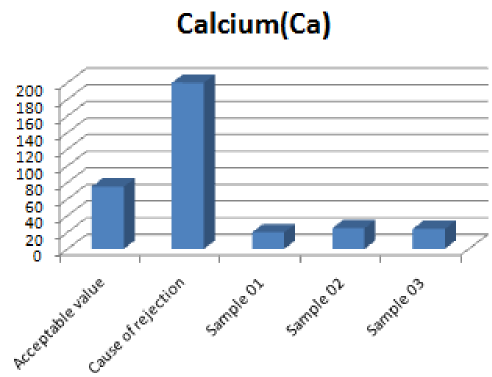


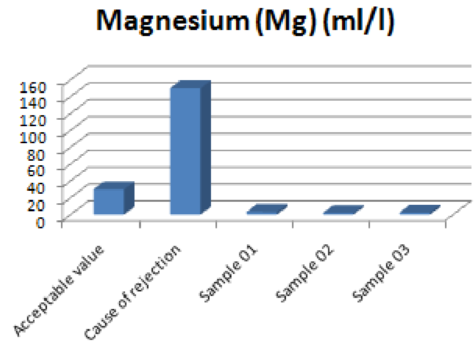


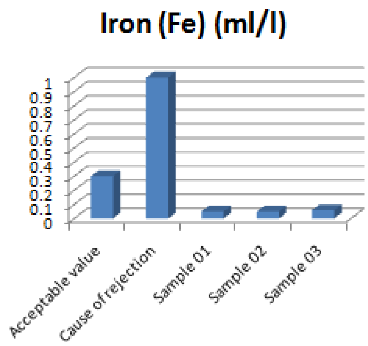


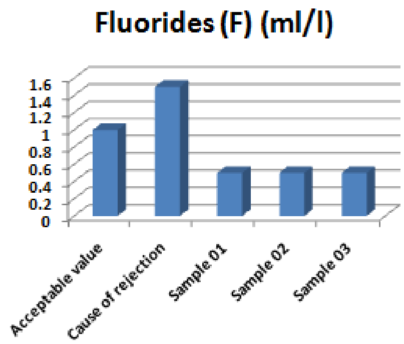


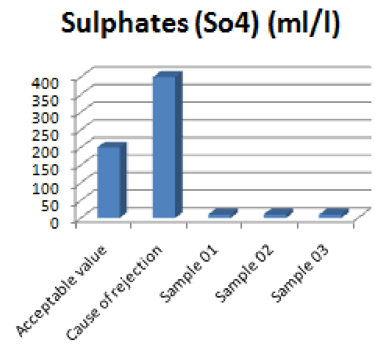












Based on the obtained data table, here is a discussion of the characteristics and values:

1. Turbidity (N.T.U.): The acceptable value for turbidity is 1 N.T.U. Sample 01 has a turbidity value of 4 N.T.U., which is within the acceptable range. However, both Sample 02 and Sample 03 have turbidity values of 5.1 N.T.U. and 6.1 N.T.U., respectively, exceeding the acceptable limit. Higher turbidity values indicate the presence of suspended particles or impurities in the water samples.

2. Conductivity (Micro Moho/cm): The acceptable value for conductivity is not provided (NA). However, Sample 02 and Sample 03 have conductivity values of 142 Micro Moho/cm and 162 Micro Moho/cm, respectively. These values suggest the presence of dissolved ions or minerals in the water samples.

3. TDS (Total Dissolved Solids): The acceptable value for TDS is not provided (NA). Sample 02 and Sample 03 have TDS values of 48 and 62, respectively. These values indicate the presence of various dissolved solids in the water samples.

4. Density: The acceptable value for density is not provided (NA). Sample 01 has a density value of 1, which is within the acceptable range. However, both Sample 02 and Sample 03 have lower density values of 0.99 and 0.98, respectively. These lower density values might indicate the presence of lighter substances or contaminants in the water samples.

5. pH-Value: The acceptable pH range is 6.5-8.5. Sample 01 has a pH value of 6.6, which falls within the acceptable range. Similarly, both Sample 02 and Sample 03 have pH values of 6.5 and 6.7, respectively, also within the acceptable range. While the pH values of all the samples fall within the acceptable range, there are concerns regarding turbidity, conductivity, TDS, and density values in Sample 02 and Sample 03, indicating the presence of impurities or contaminants. Further analysis and treatment may be necessary to bring these characteristics within acceptable limits.

Based on the provided table, here is a discussion of the characteristics and values:

6. Total Alkalinity (ml/l): The acceptable value for total alkalinity is 200 ml/l. Sample 01, Sample 02, and Sample 03 have total alkalinity values of 120 ml/l, 130 ml/l, and 120 ml/l, respectively. All three samples fall below the acceptable value, indicating lower alkalinity levels.

7. Chloride (ml/l): The acceptable value for chloride is 200 ml/l. Sample 01, Sample 02, and Sample 03 have chloride values of 60 ml/l, 70 ml/l, and 62 ml/l, respectively. All three samples fall within the acceptable range.

8. Nitrate (ml/l): The acceptable value for nitrate is 45 ml/l. Sample 01, Sample 02, and Sample 03 have nitrate values of 5 ml/l, 5 ml/l, and 5 ml/l, respectively. All three samples fall within the acceptable range.

9. Total Hardness (CaCo3): The acceptable value for total hardness is 200. Sample 01, Sample 02, and Sample 03 have total hardness values of 130, 140, and 134, respectively. All three samples fall below the acceptable value, indicating lower hardness levels.

10. Calcium (Ca) (ml/l): The acceptable value for calcium is 75 ml/l. Sample 01, Sample 02, and Sample 03 have calcium values of 20 ml/l, 25 ml/l, and 24 ml/l, respectively. All three samples fall below the acceptable value, indicating lower calcium levels.

11. Magnesium (Mg) (ml/l): The acceptable value for magnesium is 30 ml/l. Sample 01, Sample 02, and Sample 03 have magnesium values of 3.2 ml/l, 2 ml/l, and 2.5 ml/l, respectively. All three samples fall below the acceptable value, indicating lower magnesium levels.

12. Iron (Fe) (ml/l): The acceptable value for iron is 0.3 ml/l. Sample 01, Sample 02, and Sample 03 have iron values of 0.05 ml/l, 0.05 ml/l, and 0.06 ml/l, respectively. All three samples fall below the acceptable value, indicating lower iron levels.

13. Fluorides (F) (ml/l): The acceptable value for fluorides is 1 ml/l. Sample 01, Sample 02, and Sample 03 have fluoride values of 0.5 ml/l, 0.5 ml/l, and 0.5 ml/l, respectively. All three samples fall within the acceptable range.

14. Sulphates (So4) (ml/l): The acceptable value for sulphates is 200 ml/l. Sample 01, Sample 02, and Sample 03 have sulphate values of 10 ml/l, 10 ml/l, and 10 ml/l, respectively. All three samples fall within the acceptable range. In summary, while most of the characteristics in Sample 01, Sample 02, and Sample 03 fall within the acceptable range, there are concerns regarding total alkalinity, total hardness, calcium, magnesium, and iron levels in all three samples, indicating lower levels than the acceptable limits. Further analysis and treatment may be necessary to bring these characteristics within acceptable limits.

Conclusion:

All three samples have lower values for total alkalinity, total hardness, calcium, and magnesium compared to the acceptable limits. These characteristics may be the cause of rejection for the samples. However, the levels of chloride, nitrate, iron, fluorides, and sulphates are within the acceptable range for all three samples. Further analysis and treatment may be required to bring the rejected characteristics within the acceptable limits.

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