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Comparative Assessment of Water Quality In Terms Of Total Hardness from Godavari and Darna River, Nashik (M.S.) India

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Abstract

This study has been undertaken for comparative assessment of total hardness from Godavari and Darna River. Amount of Calcium and Magnesium in water is the primary indicator of hardness. The current study encompasses 32 Km of the Godavari River, featuring 26 sampling locations, and approximately 25 Km of the Darna River, which includes 10 sites. Groundwater quality continues to decline due to Geogenic and Anthropogenic activities raising significant concerns. The present investigation found that TH levels ranged from 105 to 252 mg/L, indicating that water is hard and not suitable for human consumption. During our general inspection of sampling sites, we found increased sewage waterways of many small businesses, disposal of residential garbage and Nirmalya is major reason for pollution of Godavari river. On the other side, overuse of chemical fertilizers due to increasing agricultural land near the Darna river is the cause of hardness of water. Comparative study of water quality of these rivers has not been studied till now. The main aim were to understand how different sources contribute in increased hardness of water. We analysed these two rivers to understand and compare effect of Geogenic and Anthropogenic activities on TH water. On the basis of result's we conclude that more research is needed to make more appropriate recommendations.

Index Terms: *Hardness, Darna River, Godavari River, Geogenic, Anthropogenic.*

Introduction

Nashik is the heart of Maharashtra, India. It is well-known for its intricate river system in addition to its rich cultural legacy and religious significance. The Nashik is situated between latitudes 19°.55' and 20°.05' in North and longitudes 73°42' and 73°5' in East. It is situated on the eastern slops of North south Sahyadri ranges at 565 meters (Gaikwad et al., 2000). The Nashik rivers are crucial not just for environmental conservation but also for guaranteeing the sustainable development and well-being of the populations that rely on them. The Godavari and Darna Rivers are the major rivers of Nashik. Measuring about 1465 Km and 80 Km in length respectively. Darna is minor tributary of the Godavari river near Nashik. These rivers are vital to Nashik district as they support agriculture, provide livelihoods and serve as a means of transportation and recreation for local communities. Many river systems around the world, including Nashik, face many challenges due to environmental degradation, urbanization, industrialization and unsustainable agricultural use.

The hardness of water is a on of the Physico-chemical characteristic of water. The amount of total hardness indicates the amount of Magnesium and Calcium ions in the water. Calcium and magnesium are crucial components are useful to human health in many way. This nutrients have negative health effects if not consumed in sufficient amounts. Hardness is not generally regarded as a pollution indicator parameter but it is correlated with it (Stocks 1970) In farming area routine application of agricultural fertilizers is the major source (Altman and Parizek, 1995; Emongor et al., 2005). In urban areas careless disposal of industrial effluents and other wastes may contribute greatly to the poor quality of the water (Chindah et al., 2004; Emongor et al., 2005)

According to its equivalent $CaCO_3$ concentration drinking water hardness has categories in the following ways (APHA 1995).

Soft: ~60 mg/l.
Moderately hard: ~60-120 mg/l.
Hard: ~120 - 180 mg/l.
Very hard: ~180 mg/l.

Hardness was defined as the sum of the calcium and magnesium concentration determinant by EDTA (Ethylene Daiamine Tetra Acetic Acid) titrimetric method and expressed in ppm (part per million)/ mg/l (Ashim Ahmad, 2020). The EDTA titration method is widely accepted techniques for quantifying water hardness.

In EDTA titration method for hardness estimation. In which 50ml of sample water taken and few drop of Erichrome black indicator added. This indicator results in a formation of wine red colour complex. Then add 1 ml of buffer solution to set the pH at 10. Then titrate the solution with EDTA. End point was noted for multiple times. Repeat the process for different water samples. End point is turning of solution wine red to blue expressed as Ca Co_3 equivalent in mg/l (Standard methods, 1998)

Formula:

Hardness (mg/l) as $CaCo_3$ = ml of EDTA used × 1000 / ml of sample (Standard methods, 1998)

Material Methods

Study Area:

Figure 1: Sampling sites of Godavari river

Figure: 2 Sampling sites of Godavari river

Figure 3: Sampling sites of Darna river

Methodology:

The current study was conducted over the months of January, February, and March. The present investigation determined overall hardness. The total hardness was determined immediately after sample collection using the titrimetric method.

Total Hardness determination by EDTA Titration method

1. **Preparation of EDTA Solution**: A burette was filled with an EDTA solution, which acts as a chelating agent, binding to divalent metal ions like Ca^{2+} and Mg^{2+}
2. **Water Sample Preparation**: 50 ml of river water sample were transferred into a conical flask for titration.
3. **Buffer Addition**: To maintain a constant pH at 10 throughout the titration process, 1 ml of buffer solution were added to water sample. The buffer ensures accurate and reproducible results by stabilizing the pH.
4. **Indicator Addition**: 1-2 drops of EBT indicator were added to the water sample. In the presence of divalent ions EBT forms wine red complex.
5. **Titration Process**: The water sample were titrated against EDTA solution, which reacts with the Ca^{2+} and Mg^{2+} ions to form stable EDTA metal ion complexes. The titration was conducted by slowly adding the EDTA solution while gently swirling the flask.
6. **Observation of colour change**: Titration results in a change of wine red colour of solution to blue.
7. **Endpoint Determination**: When the colour of the solution changed permanently from wine-red to blue this will be the endpoint of titration. This indicates that all Ca^{2+} and Mg^{2+} ions in the water sample had reacted with the EDTA solution.
8. **Volume Measurement**: The reading of each titration was noted on the appearance of end point.
9. **Repetition of Titration**: The titration was repeated until two concordant readings (i.e., readings within 0.1 mL of each other) were obtained to ensure the reliability of the results.
10. **Calculation of Total Hardness**: Noted readings was then used to calculate the Total Hardness of water sample, which is typically expressed as mg/L of Ca CO_3.

This procedure provides an accurate readings for determination of Total Hardness of Water samples.

Result and Dicussion

Results suggests that TH levels ranged from 105 to 252 mg/L, indicating that water is hard and not suitable for human consumption. We got highest TH value at site 4 of Godavari river which is a Kushavart tirth, Trambak, Nashik. Lowest TH value 105 at site 15 of Godavari which is Indra Kund, Nashik City. Results indicate that water is particularly hard at some areas where we saw many sewage canals of several small businesses, disposal of domestic waste and Nirmalya, and bathing at Kushvarte tirth. Yogita S. Patil et al. assessed the chemical characteristics of the Drana river in 2020, comparing their findings to ours, which revealed an increase in TH levels in 2024. In recent years, rapid population growth and urbanization in the vicinity of the Darna River catchment area, driven by the availability of water for agriculture, have led to an increased use of chemical fertilizers. As a result, we found that out of all the samples tested, 16 samples (±61.53%) from the Godavari River and 3 samples (±30%) from the Darna River were classified as very hard and unsuitable for drinking. Additionally, 9 samples (±34.61%) from the Godavari River and 6 samples (±60%) from the Darna River were categorized as hard. Only 1 sample (±3.84%) from the Godavari River and 1 sample (±10%) from the Darna River were moderately hard and considered suitable for consumption.

Figure 4: Graph Showing TH of water from Godavari river

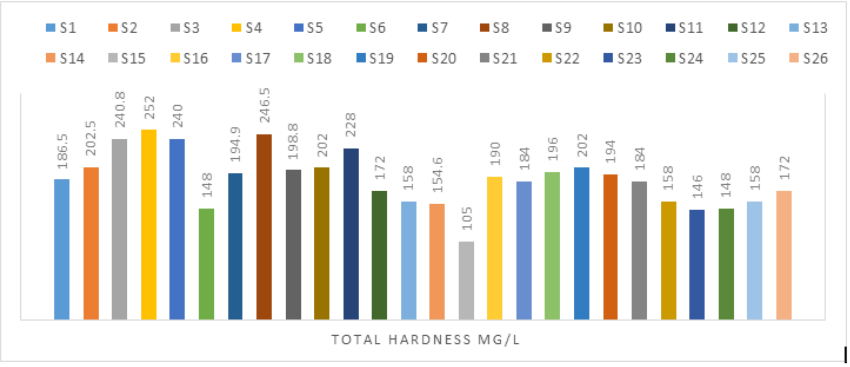
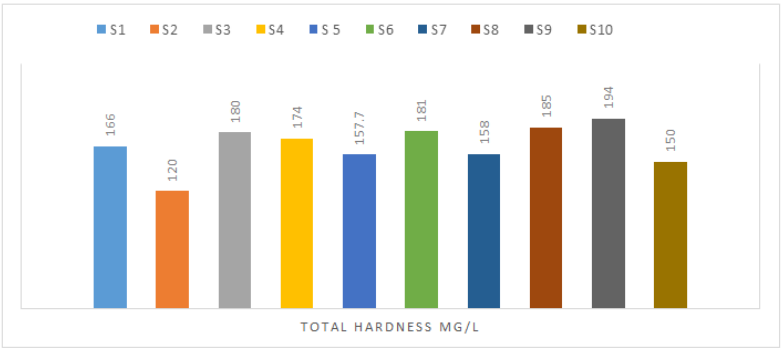


Figure 5: Graph Showing TH of water from Darna river



Conclusion

As we have observed, there are many causes of pollution in the river. If these conditions persist over a long period of time, they will become increasingly harmful to aquatic life. Therefore, proper mechanisms for the collection and disposal of domestic and industrial sewage, along with effective sewage treatment plants, should be implemented and maintained.

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Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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