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Corrosivity Analysis of Groundwater of Ganeshwar Village in Neemkathana Block of Sikar District (Rajasthan) India

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Abstract

Corrosion is an important water quality tribulation as it tends to increase some metals in drinking water pipes and fittings, which can also affect the public health. The following items are made from metals like steel, lead and copper or other metals such as: water flowing pipes, storage tanks, solders and pipe fittings etc., and if the water have corrosiveness nature then the metals will be dissolved sometimes in water and these metals creates both problems as aesthetic and health-related in certain cases. The Langelier index (LI), aggressive index (AI), Ryznar index (RI), Puckorius index (PI), and Larson-Skold index (LS) are the most common corrosion and scaling indices. The AI is a good scaling index as compared to others and can be used in all parameters. In this study aggressive index (AI) is used. The corrosivity of groundwater of Ganeshwar village of Neemkathana block is taken to evaluate its suitability for human health. For this purpose, groundwater samples were collected during the period of January 2022 to December 2022 from the bore-well of the sampling sites. The physico-chemical parameters like pH, total hardness and total alkalinity were selected and tested as per the norms of BIS (IS 10500: 2012) standard and compared simultaneously. The AI indices reveals that the potable water of borewell of Ganeshwar village did not have corrosivity and does not corrosively damage the storage tank and supply water pipes lines and fittings.

Keywords

Corrosivity, Groundwater, physio-chemical parameters, WHO, BIS, Human Health

Abbreviations

pH	***pH of water***	*pHeq*	***pH at equilibrium***
pHs	*pH at saturation state ofCaCO3*	***Cl–***	*chloride(mg/L)*
TDS	*total dissolved solids (mg/L)*	***SO42–***	*sulphate (mg/L)*
T	*temperature(°C)*	***Balk***	*bicarbonate alkalinity of CaCO3 (mg/L)*
Ca2+	*calcium hardness of CaCO3 (mg/L)*	***Calk***	*carbonate alkalinity of CaCO3 (mg/L)*
Alk	*alkalinityof CaCO3 (mg/L)*		

1. Introduction

The climate on the Indian sub-continent varies from region to region, and the country's geological formations range in age from the ancient Achaeans to more modern alluviums. Lal et al. [15] studied the water born disease and its prevention by using the five-stage reverse osmosis system at Kota India. The water quality assessment and the solution by which humans can save their life from various dieses were presented. During the study the supplied water was the upstream water of Chambal River. It is observed that the underground water is ore safer than the groundwater or river/pond water. Kakodia et al. [9] have been analyzed the water and presented the physiochemical properties of Ghatol block (Banswara), India.The similar study for water quality were assessed by Machhar et al. [11, 12], Verma et al. [23], Kakodia et al. [7, 8], Verma et al. [22].

Atasoy and Yesilnacar [1] studied the effect of sulphate concentration on corrosivity of underground water in the Harran plain of Turkey. The small lead percentage may affect the humans and the exposure of lead effect on children was carried out by Bellinger [2]. Siddha and Sahu [16] evaluated the corrosivity of ground water of central Gujarat. The depth of soil and sub-surface geological formations for which ground water remains in touch with affects the chemical composition of groundwater. Groundwater's importance is growing every day and has reached its highest point in recent decades. Naturally caustic water is not harmful to ingest in and of it, but it can have negative effects on health when it interacts with plumbing fixtures and pipelines in homes. Both drinking water sources, surface water and groundwater, have the potential to be corrosive, which refers to how aggressively water corrodes pipes and fixtures. According to the USGS (2019), corrosive water can cause lead and copper in pipes to flow into drinking water and eventually result in plumbing leaks. According to CDC (2013), the electrochemical electron exchange that causes corrosion of metal pipes is brought on by the varied galvanic characteristics of different metals, ionic impacts from solutions, aquatic buffering, or the pH of the solution. Corrosivity is influenced by higher chloride concentrations, an acidic pH, high concentrations of dissolved and suspended particles, and decreased alkalinity.

Kalyani et al. [10] reported that most of the corrosion-related issues in the industry may be due to groundwater and stated that major water quality parameter causing are pH, alkalinity, total dissolved solids (TDS), dissolved oxygen (DO), total hardness (TH), electrical conductivity (EC), temperature (T). No safe levels of lead exposure for children have been identified. Even at low exposure levels, children can show neuro developmental deficits. Sidhha & Sahu [16] evaluated corrosivity and scaling properties of groundwater of Central Gujarat for industrial usage and reported that the CR and RSI values of groundwater in 98.58% and 51%, respectively, of the total area was unsuitable for industrial purposes. According to LS, very corrosive groundwater was found in 82.76% of the total area, and the LSI and PSI values of the groundwater were 97.87% and 56.2%, respectively. In Harran Plain, Turkey, Atasoy & Yesilnacar [1] evaluated the impact of high sulphate content on groundwater corrosivity and found that seasonal variations in corrosive features were a result of precipitation, excessive irrigation, and changes in groundwater level. According to El Din [6], desalinated water has a reputation for being extremely aggressive. The census 2011 presented the population of 2011-22 and other parameters required to survive the human being like water availability and water pollution, air pollution and the socio-cultural points. Verma et al. [18-23] studied the corrosivity of ground water in Heeranagar village and Mandoli village in Neemkathana block of Sikar District India. Lal et al studied the al-

kaline water and human health and observed the benefits of alkaline water to control various diseases.

2. Material and Methods

2.1. Site Selection

Open cast mining on a large scale is severely harming the local ecosystem. Fine dust particles seeping upto aquifer system and affecting the quality of groundwater and portability of water continuously diminishing. Villagers will receive crucial information from the current study. Geographical location of Ganeshwar village in terms of Latitude and Altitude is 27.2475° N and 74.7850° E respectively, with area of 1435-hectare, and has 1873 inhabitants as shown in figure 1. The distance of the village from Jaipur is 83 km and from Sikar is 66.4 km. The total population of the village is 6994. The surface water is scarce, and the people rely on groundwater.

Figure 1: Ganeshwar Village Neemka Thana

2.2. Methodology

Table 1 shows the methodology adopted for the evaluation of corrosivity of the ground water of Ganeshwar village [11]. The formulas are indicated the values which are required to put into and can get the index value. The corrosivity is depends on the index value for selected methodology. Table 2 presented the List of Parameters and Methods of Determination.

Table 1. Methodology adopted for the calculation of the corrosiveness and scaling potential of the groundwater

Index	Calculation method
Langelier index (LI)	LI=pH–pHs; pHs=(9.3+A+B)–(C+D) A=(Log10 (TDS)–1)/10 B=–13.12×Log10 (T +273)+34.55 C=Log10 (Ca^{2+})–0.4 D=Log10 (Alk)
Aggressive index (AI)	AI=pH+Log10 (Alk×Ca^{2+})
Ryznar index (RI)	RI=2pHs–pH
Puckorius index (PI)	PI=2pHs–pHeq pHeq=1.465×Log10 (Alk)+4.54
Larson–Skold index (L–S index)	LS=(Cl^{-} +SO_4^{2-})/(Balk+Calk)

Table 2. List of Parameters and Methods of Determination

Parameters	Methods of determination
pH	pH Meter
TH (mg/L)	EDTA Method
Ca (mg/L)	Titration Method
Mg (mg/L)	Titration Method

3. Results and Discussions

For the evaluation period of January 2022 to December 2022, groundwater samples from Ganeshwar village were collected and analysed for specific physico-chemical parameters. The outcomes are displayed in table 3. Table 4 presented the Aggressive Index (AI) of Ganeshwar village in Neemkathana block, therefore the monthly variation of AI is shown in figure 2. The value of AI is varying between 12.08 to 13.09 and which is less than the standard marked value of corrosivity and observed the underground water of Ganeshwar village is non-corrosive.

Table 3. Water testing data of Ganeshwar village in Neemkathana block

Groundwater testing of Ganeshwar Village in Neemkathana			
Month	pH	Total Alkalinity, mg/L Ca-CO3	Total Hardness, mg/L
Aug-20	7.4	250	470
Sep-20	7.2	380	350
Oct-20	7.7	270	340
Nov-20	7.3	250	420
Dec-20	7.8	330	400
Jan-21	8	400	310
Feb-21	7.9	300	200
Mar-21	7.6	240	400
Apr-21	7.2	470	260
May-21	7.2	240	360
Jun-21	7.1	270	360
Jul-21	7.6	360	270

Table 4. Aggressive Index of Ganeshwar village in Neemkathana block

Months	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21
AI Value	12.47	12.32	12.66	12.32	12.92	13.09	12.67	12.58	12.28	12.13	12.08	12.58

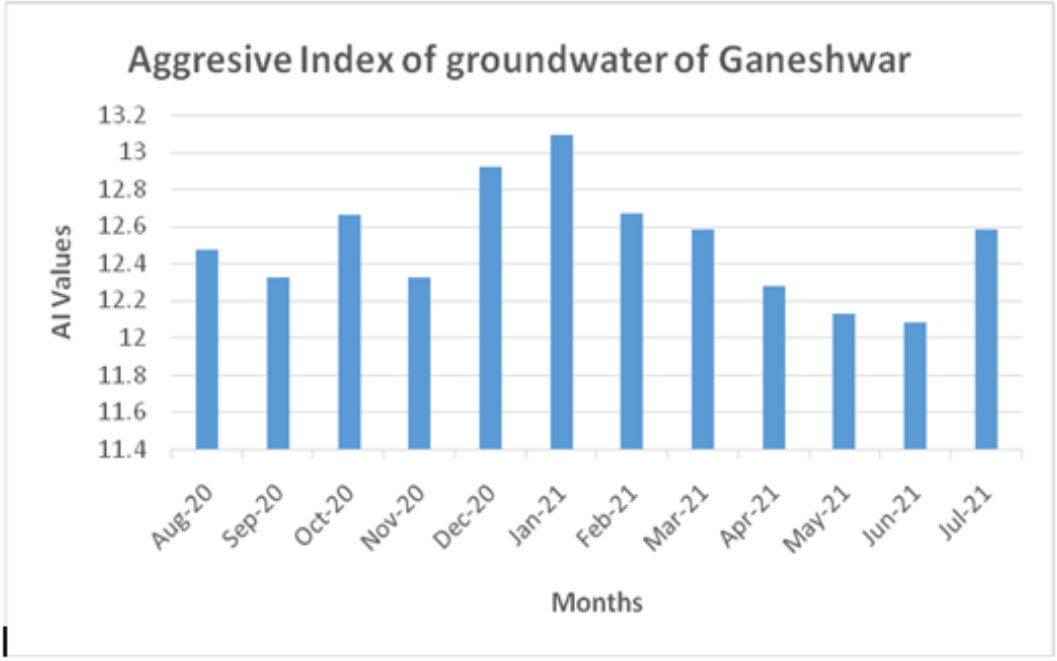

Figure 2. Aggressive Index of groundwater of Ganeshwar village

4. Conclusion

A significant portion of the Neemkathana block is covered by open-cast mining, and some portions are mineral-rich. Both anthropogenic and geological reasons are causing groundwater quality to decline. Groundwater at Ganeshwar village was found to have total alkalinity and total hardness that were above BIS (IS 10500: 2012) permissible limits. In this study, an aggressive index is used in the methodology for calculating the groundwater's propensity for corrosion and scaling. The moderately aggressive or aggressive nature of groundwater will be if the value is near or less than 12. Here in this study for the assessment period values of AI are near 12, showing that the samples of groundwater are non-aggressive, but its value near 12 shows that deterioration of the quality of water can show a further decrease in the values and in that condition, it may be aggressive and corrosive. The communities will be able to monitor the quality of the chosen source of drinking water thanks to the current study for groundwater parameters.

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