

Physicochemical analysis of groundwater samples of Kathumar Alwar (Rajasthan)

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Introduction

The present research work has recognized the physicochemical analysis of groundwater samples of Kathumar block of Alwar district (Rajasthan). The groundwater samples were gathered during two seasons including pre-monsoon and post-monsoon throughout the three years of the research program from 2018 to 2020. Total twelve groundwater samples were gathered from twelve individual sampling sites in each season and analyzed in the research laboratory.

Groundwater Sampling from Kathumar block of Alwar District (Rajasthan): Water samples were gathered from various sampling sites of Kathumar block of Alwar district (Rajasthan) for the assessment and characterization to obtain exceptional physicochemical characteristics of groundwater. In this study, groundwater samples were gathered from open well, tube-well and hand-pumps of Kathumar block of Alwar district (Rajasthan).

Water Sample Preservation: To protect the groundwater samples of Kathumar block of Alwar district (Rajasthan) from alterations, although, several additives and pretreatment practices can be engaged to diminish sample deterioration. Several kinds of specimens, comprising those to be examined for acidity, alkalinity and several formulas of nitrogen or phosphorus, should be detained for more than 24 hours and stored under controlled condition, i.e., placed in dark and cold places.

Analysis of Groundwater Samples: Groundwater samples collected from various sampling sites of Kathumar block of Alwar district (Rajasthan) were evaluated in the laboratory for the purpose of extent of impurity with respect to several physicochemical parameters of water including general parameters (pH; temperature; electrical conductivity, EC; and total dissolved solids, TDS), estimation of cations (Sodium, Na⁺; potassium, K⁺; calcium, Ca²⁺; and magnesium, Mg²⁺) and estimation of anions (Sulphate, SO₄²⁻; fluoride, F⁻; chloride, Cl⁻; carbonate, CO₃²⁻; bicarbonate, HCO₃⁻; and nitrate, NO₃⁻) etc.

Quantitative Analysis of Water Pollutants: After examination of various physicochemical parameters, the control of water pollutants necessarily requires quantitative analytical measurements of pollutants. The analytical parameters of groundwater are commonly stated in milligrams per liter (mg/L) or parts per million (ppm). The unit is also known as grams per cubic meter (g/m³). Analysis of water pollutants involves following examinations: (i) Physicochemical examination, (ii) Biological examination and (iii) Radiological examination of groundwater, however here in the present study, we only use the physicochemical examinations of groundwater samples.

Research Methodology of Groundwater Research

The present research work is initiated on the basis of sampling and physicochemical examination of groundwater of Kathumar block of Alwar district (Rajasthan). The groundwater samples were gathered from distinctive sampling sites of Kathumar block of Alwar district (Rajasthan) throughout the two seasons including pre-monsoon and post-monsoon throughout the three years of research program from 2018 to 2020. Twelve groundwater samples were taken from twelve individual sampling sites and further analyzed for the various physicochemical parameters using the following prescribed standard physical and chemical analytical methods.

Water Sampling and Storage: The groundwater must be gathered properly and stored under standard conditions in the laboratory. The physicochemical analytical results of groundwater samples are meaningless if the studied samples are not properly collected and not stored under standard conditions. It must be emphasized by the correct and systematic sampling and storage procedure be used for the receipt of meaningful physicochemical analytical results of water samples. Thus, standard water sampling and storage procedures were followed and given importance to the following precautionary measures during the sampling of groundwater. For this purpose, standard prescribed recommendations regarding sampling sites were followed including standard sampling containers, the volume of sample, methods of preservation, sample storage conditions, etc.

- 1. Sampling sites:** The groundwater sampling sites were carefully chosen to gather groundwater specimens that must be demonstrative of the entire geographical location. The twelve groundwater specimens were collected from twelve different groundwater sampling sites (Villages) of Kathumar block of Alwar district (Rajasthan). See **Table 3** for the designation of groundwater sampling locations (Villages name) and their given sample code name.
- 2. Sample container:** The groundwater samples of Kathumar block of Alwar district (Rajasthan) were reserved in cleanly washed 2 liter capacity polyethylene bottles with screw cap, which were formerly soaked in 10% aqueous nitric acid followed by exhaustively rinsed with distilled water for more than a few times to reduce the contamination of bottle's material. Glass bottles are not preferred for the water sampling because the trace metals can be absorbed on to the inner walls of the glass bottle and the physicochemical results of groundwater sample may change.

Table 3: List of sampling sites with given sample code names of groundwater sampling sites (Villages name) of Kathumar block of Alwar district (Rajasthan).

Entry	Name of sampling site (Villages name)	Site code name
1.	Kathoomar Village, Kathumar Tehsil (Alwar)	KT
2.	Reta Village, Kathumar Tehsil (Alwar)	RT

3.	Tasai Village, Kathumar Tehsil (Alwar)	TS
4.	Indrawali Village, Kathumar Tehsil (Alwar)	ID
5.	Mankhera Village, Kathumar Tehsil (Alwar)	MN
6.	Berka Village, Kathumar Tehsil (Alwar)	BR
7.	Ganjpur Village, Kathumar Tehsil (Alwar)	GP
8.	Baseth Village, Kathumar Tehsil (Alwar)	BS
9.	Sahari Village, Kathumar Tehsil (Alwar)	SH
10.	Agraya Village, Kathumar Tehsil (Alwar)	AG
11.	Kalwari Village, Kathumar Tehsil (Alwar)	KL
12.	Bhanokhar Village, Kathumar Tehsil (Alwar)	BN

- 3. Collection of groundwater samples:** It was ensured that obtained sample must be demonstrative of the entire geographical locality of the source. To gather the groundwater specimen, it must be guaranteed that no unintentional adulteration occurs throughout the sampling. Flasks should be absolutely filled with water and should also be free from air bubbles. Sample bottles should be tightly closed with a screw cap to avoid water vaporization and all the specimens were retained in the fridge. Sample bottles should be precisely protected from any external contaminations. Before filling the sample, bottles were rinsed twice or thrice with the water being collected.
- 4. Volume of groundwater sample:** For complete physicochemical analysis of groundwater samples, sufficient amount of groundwater samples (2 liters) were collected to allow all the measurements to be made properly.
- 5. Labeling of groundwater sample:** Every groundwater sample was adequately labeled to furnish the information regarding the name of the source, type of the sample, and date of collection to avoid error in the results.

Experimental Section: The physicochemical parameters play a substantial part in organizing and evaluating the superiority and suitability of groundwater (Tank and Chandel, 2010). The physical parameters such as pH, temperature, EC and TDS were done at the time of sample gathering using a portable water quality analyzer and by the pH meter. For the remaining analysis, the groundwater samples were collected and preserved in a standard quality sample bottle of 2L capacity and brought to the laboratory. The chemical parameters such as calcium (Ca^{2+}), magnesium (Mg^{2+}), sulfates (SO_4^{2-}), chloride (Cl^-), carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) were investigated by volumetric titration methods; nitrate (NO_3^-) was analyzed by Spectrophotometer; fluoride (F^-) was analyzed by Ion Selective Method; and sodium (Na^+) and potassium (K^+) were investigated by Flame Photometry. All these physical and chemical parameters of groundwater of Kathumar block of Alwar district (Rajasthan) were examined as per the American Public Health Association (APHA) standard methods (APHA, 1989).

Physicochemical Analysis of Groundwater Samples: Essentially, groundwater samples were analyzed for six leading purposes: (i) its suitability for drinking; (ii) its suitability for irrigation; (iii) its suitability for domestic uses; (iv) its suitability for environment; (v) its suitability for industrial utilization; and (vi) report and publish the physicochemical data and quality parameters of groundwater of Kathumar block of Alwar district (Rajasthan).

The below mentioned standard physicochemical analytical procedures were followed for the investigation of collected groundwater specimens from twelve different sampling sites (Villages) of Kathumar block of Alwar district (Rajasthan):

Measurement of pH of groundwater sample: The pH of groundwater is an extent of the total quantity of hydrogen ions. It determines the nature of water whether it is acidic or alkaline. According to WHO, the value of pH for water is ranging from 6.5 to 8.5 (pH in drinking water, WHO, 2007). In this study, the pH of water has been determined by the electrometric method with the help of a pH meter, which is extensively used for the determination of hydrogen ion (H^+) concentration in water samples (Manual on pH, Systronics, 2003; Guidelines for Drinking water quality, 1997; Khurana and Sen, 2005). It is one of the most accepted methods in the research laboratory for the determination of H^+ ion concentration (pH) of water with high accuracy in pH value of 0.1 to 0.0001.

- **Principle of electrometric method for determination of pH:** The basic principle of the electrometric method for the purpose of pH is the determination of H^+ ion activity through potentiometric measurement exploiting a "Combined standard hydrogen electrode" and a "Reference electrode". The electrode potential difference across these electrodes will give the H^+ ion concentration (pH) of a solution.
- **pH measurement apparatus:** Electronic pH meter with an attached electrode and thermometer.
- **Reagents:** Standard pH buffer solutions were employed for the standardization of pH meter.
- **Procedure:** The detailed procedure for measuring the pH of the water sample considering the following steps:
 - (i) We switch on the pH meter and cleaning the glass electrode with distilled water.
 - (ii) Now we standardize the pH meter by standard buffer solutions of known pH values. For the calibration of pH meter, glass electrode was first placed in pH 7.0 standard buffer solution and then adjusted the pH meter accordingly. The glass electrode was rinsed with distilled water and transferred it to pH 4.0 standard buffer solution and then further adjusted the pH meter accordingly. The same procedure was repeated for pH 9.2 standard buffer solution. The above procedure was repeated to ensure that the pH meter has been calibrated accurately and ready to use for the pH measurement of the unknown water sample.
 - (iii) After successful calibration, we clean the glass electrode with distilled water and carefully wiped with a tissue paper to make sure that the glass electrode is clean before pH measurement of the water sample.
 - (iv) About 75 mL of groundwater sample was taken in a 100 mL beaker confirming that the glass electrode was completely dipped into the water sample. We agitate the solution and wait for few seconds to steady the reading and then record the pH of groundwater sample.

We repeat step (iii) and (iv) for every new groundwater sample's pH measurement. All groundwater sample's pH value recorded at 25°C temperature.

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