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Physico-chemical analysis of water of Well of RIICO at leather complexJaipur, Rajasthan

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Abstract-*Water, the elixir of life, is a priceless commodity and should be available to each and every person on this planet. Jaipur district is the fastest developing city of Rajasthan. Though Jaipur is famous for its historical places and art ,city is facing current trends of urbanization, over-exploitation of resources and exorbitantly increasing population. Therefore, study of physico-chemical parameters of water is considered as an important aspect of pollution studies in the environment.This study is aimed to explore the physico- chemical parameters of water quality standards of Well of RIICO at leather complex, Jaipur.*

Keywords: *Water quality of Well of RIICO at leather complex**, Jaipur.**, Physico-chemicalparameters, statistical analysis SAR, CAI, %Na, KR and LSI*

Abbreviation-
SAR: Sodium AbsorptionRatio
CAI: Chloro Alkaline Indices
% Na: Sodium Percentage
APHA: American Public Health Association
WHO: World Health Organization
NWMP: National Water Monitoring Programme
ICMR: Indian Council of Medical Research

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I. Introduction

India has diversified forms of lands in which Jaipur city is situated in Rajasthan statewhich is located in North West region as a dry state. The water quality is affected by geological formations, anthropogenic activities, current trends of urbanization, over-exploitation of resources and exorbitantly increasing population. In other words, quality of water is deteriorated by excessive use of fertilizers and industrial discharge
. The selected sites for the present study was Well of RIICO at leather complex**,** ***Jaipur***

II. Material And Method

In this study, the water quality standards of different physico-chemical parameters such as pH, Temperature, Conductivity, Turbidity, Fecal coliform, Total dissolved solids, BOD, COD, TA, TH, Calcium, Potassium, Sodium, Magnesium, Nitrate, Sulphate, Phosphate, Chloride , Fluoride, and Boron dissolved and their statistical interpretation for domestic and agriculture purpose were evaluated for water of Well of RIICO at leather complex**,** Jaipur.

Four sample readings were considered for water of Well of RIICO at leather complex**,** Jaipur. collected from Rajasthan Pollution Control Board, Jaipur's Web-Site. Water sample readings were analyzed throughout the year for various physico-chemical parameters using standard methods recommended by American Public Health Association [1]. There are various methodsto determine different physical and chemical parameters.

National Water Monitoring Programme (NWMP) of Rajasthan State Pollution Control Board, Jaipur produces environmental report of different physico- chemical parameters for different stations of Rajasthan State. All Sample readings for different physico-chemical parameters were taken at Regional Laboratory, Kota. In this study, Four sample readings were considered for two consecutive years 2020 and 2021 i.e. two sample readings for each year with even months for water of Well of RIICO at leather complex**,** Jaipur.. In some cases, there was increase or decrease shown in readings which was due to change in weather.

Table-1
Physico-chemical analysis of water of of Well of RIICO at leather complexJaipur, Rajasthan

PARAMETERS	2020		2021	
	JUNE	OCTOBER	APRIL	OCTOBER
	S-1	S-2	S-3	S-4
BOD	N/A	N/A	N/A	N/A
B	0.21	0.36	0.27	0.4
COD	23.20	20.00	27.47	57.53
Ca^{2+}	128	110.4	116.8	206.4
Cl^-	540	404	484	1380
DO	N/A	N/A	N/A	N/A
F^-	0.82	0.54	0.9	1.02
Mg^{2+}	72.224	75.152	62.464	91.744
NO_3^-	1.66	6.18	4.12	6.08
E.C.	2300	1620	2500	4460
pH	7.88	8.1	7.85	7.81
Na^+	410	210	335	855
K^+	8.7	5.1	7.6	6.1
SO_4^{2-}	167.5	61	134	245
PO_4^{3-}	0.1	0.2	0.2	0.36
Temperature	33	30	30	26
Turbidity	N/A	N/A	N/A	N/A
TDS	1858	1156	1884	3230
T.A.	168	136	192	76
T.H.	616	584	548	892
F.C.	7	<3	14	<3

pH – An important parameter which represents acidic and alkaline nature of water. It is vital for varied biochemical reactions [23][16]. Permissible limit for pH in water is 6.5 – 8.5 [1]. Less pH causes tuberculation and corrosion while higher pH causes Incrustation and sediment deposit [14].

Temperature- A vital parameter which not only influence chemistry of water but also governs biologicalactivity and growth of living organisms. It

Turbidity-Turbidity represents cloudiness of the liquid which is formed by the accumulatingindividualparticles which are not visible by the naked eyes like smoke in air. Permissible limit for turbidity is 5-10NTU

Total Dissolved Solids (TDS)- TDS measures the total amounts of charged ions including minerals, salts or metals dissolved in a given volume of water. It is expressed in mg/lit. TDS originates from natural sources, sewage, also influences the different kinds of organisms that can live in water bodies

Electrical conductance-The measure of water's capacity to pass electric flow [27]. Electrical conductance is represented in ionized form of dissolved salts and other inorganic chemicals present in the water. This concentration of ionized form contributes to conductance. Permissible limit is 200-1000 µmho/cm.

Total Alkalinity- The measure of the buffering capacity of water or the capacity of bases to neutralize acids.It basically regulates pH of a water body and also maintains the metal content. It refers to the ability of water to resist change in pH. The general level of fresh water for alkalinity level is 20-200 mg/lit.

Total Hardness-An important parameter which is a measure of polyvalent cations in water. Polyvalent cations

mainly include concentration of calcium and magnesium including other cations like aluminium, barium, manganese and iron etc also contribute to it. 300 mg/lit is permissible limit of total hardness of water by ICMR. The higher content of the hardness is due to the industrial and chemical affluent with excessive use of lime [18].

Biochemical Oxygen Demand (BOD)-BOD measures the oxygen utilized for the biochemical degradation of organic material(carbonaceous demand) and oxidation of inorganic material such as sulphides and ferrous ions during a specified incubation period. Permissible limit for BOD is 3-5 ppm which represents moderately clean level.

Chemical Oxygen Demand(COD) -The measure of the capacity of water to consume oxygen during the process of decomposition of organic matter and oxidation of inorganic compounds like Ammonia, nitrite. It also means mass of oxygen consumed in Volume of the solution.It is expressed in mg/lit. Ideally COD should be zero.

Fecal Coliform-A group of total coliforms that are found in the gut and faeces of animals. Fecal coliform bacteria may occur in ambient water as a significance of overflow of domestic sewage. At the same time it may cause some waterborne diseases such as typhoid fever, viral and bacterial gastroenteritis. The acceptable level of coliform should be non-detectable in 100 ml

Calcium- Most abundant natural element present in all natural water sources. The main source is erosion of rocks such as limestone and minerals like calcite. Permissible limit for Calcium is 75-200 mg/lit.Excess amount of calcium concentration causes the less absorption of essential minerals in the human body

Magnesium- Its higher concentration renders undesirable tastes in water. The main source of magnesium in water is by erosion of rocks and minerals like dolomite or magnetite. Permissible limit of Magnesium is 30-150 mg/lit.

Sodium- Permissible limit for sodium in drinking water must be in range of 30 to 60 mg/lit. Hypertension, Kidney and Heart related diseases are caused by higher concentration of sodium.

Potassium– The lower concentration of potassium is beneficial for humans as well as plants. Hypertension, diabetes, adrenal insufficiency, kidney and heart related diseases are caused by higher concentration of potassium.

Chloride- Chlorides are present in almost all natural water resources. As we all know, the concentration of parameter by affecting its usability and aesthetic property with taste and make it unfit for drinking purpose. Main source of Chloride concentration are formation of rocks and soil with sewage wastes.

Sulphate –Sulphate is present in almost all drinking natural water sources [27]. The sources for sulphate concentration are rocks and geological formation. The excess amount of sulphate content causes laxative effect.Permissible limit for sulphate is 200-400 mg/lit.

Nitrate–Maximum permissible limit of nitrate is 50 mg/lit.[4]. The higher concentration of nitrate causes blue-baby disease or methamoglobinemia.

Phosphate- Permissible range for phosphate is 0.005 to 0.05 mg/lit. Main source of phosphate are sewage and industrial waste disposal in fresh water. Basically it promotes growth of micro-organism. [8]

Fluoride- The controlled addition of fluoride in water supplies to maintain public health is known as water fluoridation. So fluoridated water is used to prevent cavities by maintaining concentration of fluoride in water. Required level is 1.0-1.5mg/lit. Excess concentration causes fluorosis and deformation injoints

Boron Dissolved- Permissible concentration of boron in surface water is 1-5 mg/lit for a day. It is an essential nutrient present in plants.

Water quality criteria for irrigation

The suitability of water for agricultural use is determined by its quality for irrigation purpose. The quality of water for irrigation purpose is determined by the concentration and composition of dissolved constituents in water. Quality of water is an important aspect in any appraisal of salinity or alkalinity conditions

in an irrigated area. Good soil and water management practices result in good quality of water which can promote maximum yield of crop.

Total dissolved Solids and the sodium content in relation to the amounts of calcium and magnesium or SAR [2] determines the suitability of water for irrigation. The suitability of groundwater for irrigation use was evaluated in the form of salinity by different statistical calculations such as (Sodium absorption ratio (SAR), soluble sodium percentage (SSP) and Chloro alkaline indices (CAI).

Statistical Representation of Water Parameters

Sodium Absorption Ratio (SAR):

SAR is a vital parameter given by Richard in 1954. The basic concept behind the sodiumabsorption is to find out the soil alkalinity of water used for irrigation purposes.

$$\text{SAR (Sodium Absorption Ratio)} = \frac{Na}{\sqrt{\frac{Ca+Mg}{2}}}$$

Note: Ca^{2+}, Mg^{2+} and Na^{+} are expressed in mg/l.

Chloro alkaline indices(CAI):

Chloro alkaline indice is used to calculate the base exchange proposed by Schoeller. Chloroalkaline indices are used to calculate ion exchange between the water and its surrounded area.

It is measured by following equation CAI = $[Cl^{-} - (Na^{+}+K^{+})/Cl^{-}$Note: all ionic concentrations are measured in mg/l.

- CAI >0: No Base Exchange reaction i.e. there is any existence of anion cation exchange type of reactions.
- CAI <0 : Exchange between sodium and potassium in water with calcium andmagnesium in the rocks by a type of Base Exchange Reactions.

Percentage Sodium (%Na):

A method used for rating the irrigation waters which is utilized on the basis of percentage andelectrical conductivity given by Wilcox.

It is calculated by the formula:- $\%Na = \frac{(Na+K)}{Na+K+Mg+Ca} \times 100$

Note: All ionic concentration are expressed in mg/l.

Kelly's ratio (KR):

Kelly ratio represents the assessment ratio for calculating the suitability of water for agriculture purpose. The suitability and unsuitability of water for agricultural purpose on basis of KR is due to alkali hazards.
Kelly's ratio was calculated by using the following expression

$$\text{Kelly Ratio (KR)} = \frac{Na}{(Ca+Mg)}$$

KR ≤1 : Suitable for Irrigation and represent good qualityKR>1 : Unsuitable for irrigation purpose
Note: All ionic concentrations are expressed in mg/l.

3.3.5 Calculation of Indices: Langelier Saturation Index (LSI)

LSI is an equilibrium index which represents thermodynamic driving force for calciumcarbonate scale formation and growth given by Langelier. It is explained with the use of pH.

- LSI <0 : No potential scale and water will dissolve $CaCO_3$.
- LSI >0 : Scale can form and $CaCO_3$ precipitation may occur.
- LSI = 0 : Border line scale potential.

To calculate LSI, value of total alkalinity (as $CaCO_3$), Calcium hardness as $CaCO_3$), totaldissolved solids (TDS) and value of pH and temperature of water (°C) required.

Note: All ionic concentration are expressed in mg/l.

LSI = pH – pHs

pHs is defined as the pH at saturation in calcite or calcium carbonate.

It is calculated by following formulapHs = (9.3 + P + Q) – (R + S)
where P = ($\log_{10}$ [TDS] –1)/10

Q = –13.12 × $\log_{10}$ (°C + 273) + 34.55

R = $\log_{10}$ [CaHardness as $CaCO_3$] –0.4

S = $\log_{10}$ [Total alkalinity as $CaCO_3$]

We can calculate LSI by help of these equations.

LSI is helpful in predicting the scaling or corrosive tendencies of the water.

- If water dissolves calcium carbonate, water is corrosive and has a negative value.
- If the water deposits calcium carbonate; it has a scaling tendency and a positive value.

Table .2
Well of RIICO at leather complex, manpurimacheri, Jaipur, Rajasthan(STATION CODE-2963)

Parameters	S-1	S-2
	11-06-2020	26-10-2020
SAR	14.84	22.21
CAI	0.154	0.187
%Na	56.3	66.7
KR	1.22	1.92
LSI	-0.05	0.358

Table-3
Classification of Water samples Readings of water of Well of RIICO atleather complex Jaipur,Rajasthan on the basis of Statistical Analysis(Station Code-2963)

Parameters	Categories	Range	No. Of Samples	
			2020	2021
Sodium Absorption Ratio(SAR)	Excellent	0-10		
	Good	10-18	1	
	Fair	18-26		
	Poor	>26	1`	All
ChloroAlkanineIndices(CAI)	Base Exchange Reaction	Negative Value	NIL	NIL
	Cation Exchange Reaction	Positive Value	All	All
Sodium Percentage(%Na)	Excellent	0-20		
	Good	20-40		
	Permissible	40-60	1	
	Doubtful	60-80	1	2
	Unsuitable	>80		

Kelly Ratio(KR)	Suitable MarginalSuitable Unsuitable	<1 1-2 >2	1 1	1 1
Langelier Saturation Index LSI	: No potential scale and water will dissolve $CaCO_3$.	LSI <0	All	All
	Border line scale potential.	LSI = 0		
	Scale can form and $CaCO_3$ precipitationmay occur.	LSI >0		

III. Conclusion

Value of some parameters for all samples are below higher permissible range these include Boron, Calcium, Fluoride, Magnesium, Nitrate, Sulphate, TDS, TA, TH and pH.
Value of some parameters for all samples are below higher permissible range these are BOD, COD, EC, Chloride, Sodium, Potassium, Phosphate, Temperature, Turbidity
High value of these can cause following effect.High value of BOD –
The greater the BOD, the more rapidly oxygen is depleted in the stream. This means less oxygenis available to higher forms of aquatic life: **aquatic organisms become stressed, suffocate, anddie**.

High value of COD -

Higher COD levels mean a greater amount of oxidizable organic material in the sample, which will reduce dissolved oxygen (DO) levels. A reduction in DO can lead to anaerobic conditions,which is deleterious to higher aquatic life forms.
High value of EC-

A key issue with high conductivity in boiler water is that operational issues such as scaling can occur, which is a buildup of solid material in the boiler. When this occurs**,** the boiler becomes less efficient andincreases the fuel consumption of the unit.

High value of Chloride-
High levels of chloride can corrode and weaken metallic piping and fixtures, give a "salty" taste to the drinking water, damage household appliances, boilers, and, if the water is being used for irrigation, it may inhibit the growth of vegetation.

High value of Sodium-
High levels of sodium in the water can cause soil aggregates to disperse and form crusts on the soil surface that impede the infiltration of water. Poor infiltration will increase run-off from furrow and sprinkler systems.

- High value of Phosphate-

Too much phosphorus can cause increased growth of algae and large aquatic plants, which can result in decreased levels of dissolved oxygen– a process called eutrophication

- High value of Potassium-

Potassium is weakly hazardous in water, but it does spread pretty rapidly, because of its relativelyhigh mobility and low transformation potential. Potassium toxicity is usually caused by other components in a compound, for example cyanide in potassium cyanide

Temperature-

Warm water holds less dissolved oxygen than cool water, and may not contain enough dissolved oxygen for the survival of different species of aquatic life. Some compounds are also more toxic to aquatic life at higher temperatures.

Turbidity-

Turbidity can increase the cost of water treatment for drinking and food processing. It can harm fish and other aquatic life by reducing food supplies, degrading spawning beds, and affecting gillfunction.

- Value of chloride is high for Well as compare to maximum allowable concentration. A high content of chloride in irrigation can be harmful to crops and soils. First, it will reduce the PH rate of soils or make the soil acidity, hence the crops will lose their ability to grow on a certain acidic soil. The most common toxicity is from chloride in the irrigation water.
- Value of total dissolved solid is high for Well as compare to maximum allowable concentration.TDS levels above about 2,000 mg/L are very likely to cause plant growth problems**.**

- - Value of total hardness is high for Well as compare to maximum allowable concentration. When water hardness that is too high, precipitation of calcium and magnesium salts might occur in the irrigation system, damage it or reduce its efficiency.

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