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# Physico-chemical Assessment of Groundwater and Surface Water of Mining Area Adjoining Bikaner District

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**ABSTRACT**
*Mining activities take it scroll on several aspects to environment like land (Geomorphology) soil, cover, forest cover, surface water and ground water air etc. Long year of mining which involves extractions of materials affects the land cape by defacing of land formation of anthropogenic and diversion of natural drainage system mines excavation may cause temporary water accumulation during rain.The present investigation has been undertaken to assess the quality of the surface and ground water in mining areas adjoining the Bikaner district. For this purpose, 10 water samples from various sampling sites were collected and physico-chemical parameters of the collected samples were analyzed.Physico-chemical parameters of surface water and ground water were observed through the study and found that the concentration of various water pollutants in collected samples has reached alarming proportions which may cause health hazard, exacerbating various disorders among the people.*
**Keyword:** Impact of mining activity, water pollution, BIS Standard, Water Parameter

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## INTRODUCTION

Mining refers to the process of extracting metals and minerals from the earth. Mining Industry works to extract the metals and minerals that our society needs for agriculture, housing, music, telecommunication, the environmental industry, construction, space exploration and medicines (1).Long year of mining which involves extractions of materials affects the landscape by defacing of land formation of anthropogenic and diversion of natural drainage system mines excavation may cause temporary water accumulation during rain (2). The problems associated with mining activities are land degradation, disposal of over burden(OB), deforestation, washing rejects, subsidence, water pollution due to wash off, discharge of mine water, acid mine drainage, coal washing operation, air pollution due to release of gases and dust, noise pollution, mine fires, damage to forest flora and fauna, occupational health hazards etc. Mining can deplete surface and groundwater supplies (3). The seeping or leaching of mines drainage water from waste or rock piles tailings into ground water aquifers is a potential source of water pollution from mines (3). Groundwater withdrawals may damage or destroy streamside habitat many miles from the actual mine site. Major impacts of mining on water are quality Acid Mine Drainage, Heavy Metal Contamination & Leaching, Processing Chemicals Pollution, Erosion and Sedimentation (4). In India, gypsum mining is mainly carried out in the state of Rajasthan, which contributes about 99% of the total production; the remaining 1% is contributed by Jammu & Kashmir and Gujarat. In Bikaner district various types of minerals available under minor category such as Gypsum, Ball clay, Fullers earth, Limestone, Bajri-Gravel, sandstone etc. About 240 leases of these minerals are operating in the district (5).Most of the mineral produced is being supplied to the cement industries situated in various parts of the country. Objective of the study is based on surface water & Ground water by determine the water qualities of mining area and identify the ground water prospect in rock terrains, assign feature for the ground and surface water potential zoning such as vary good, good moderate and poor.

## MATERIAL AND METHODS

**Study Area:** Bikaner is a city in the northwest of the state of Rajasthan in northern India. It is located 330 Kilometers (205mi) northwest of the state capital, Jaipur.The climate in Bikaner is characterized by significant variations in temperature. In the summer season it is very hot when the temperatures lie in

the range of 28-45 °C (82.4-119.3°F). In the winter, it is fairly cold with temperatures lying in the range of 5-23.2 °C (941.0-73.8°F). Annual rainfall is in the range of 260-440 mm (10-17 in). Bikaner shares international boundaries with Pakistan. The district is divided in eight sub divisions i.e., Bikaner, Pugal, Nokha, Kolayat, Dungargarh, Chhatargarh, Loonkaransar and Khajuwala for administrative and development. The rural development of Bikaner district is being looked after by seven panchayat samities, i.e., Bikaner, Nokha, Dungargarh, Loonkaransar, Kolayat, Khajuwala and Panchoo. There are 1498 villages and 290 Gram panchayats in the district.

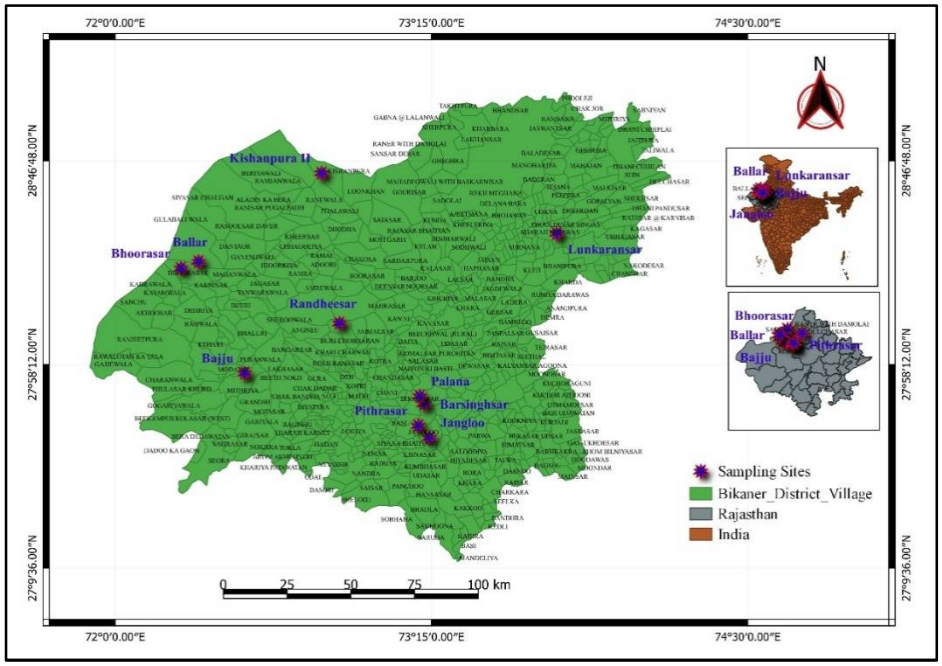


**Figure 1: Sampling sites and Study Area (Bikaner District)**

**Sampling Method:** Total 10sample of surface water and ground water were collected from tube-wells, open wells and Hand pumps of different locations were analyzed for estimation of physical and chemical properties like pH, Total Hardness, Ca+2, TDS, Chloride, EC, Nitrate and Fluoride, the water samples were collected using modified Hal's sampler (6).

**Table 1: Sampling Site and Type of Collected Water**

| S.N. | Sampling Site | Latitude | Longitude | Mineral type | Tehsil | Collection of Water |
|---|---|---|---|---|---|---|
| S1 | Bajju | 27°56'06.76"N | 72°30'41.74"E | Gypsum | Kolayat | Surface water |
| S2 | Bhoorasar | 28°21'07.56"N | 72°15'36.16"E | Gypsum | Kolayat | Ground water |
| S3 | Randheesar | 28°08'02.46"N | 72°53'11.00"E | Gypsum | Kolayat | Ground water |
| S4 | Kishanpura II | 28°43'50.94"N | 72°48'57.80"E | Gypsum | Pugal | Surface water |
| S5 | Ballar | 28°22'43.83"N | 72°19'45.61"E | Gypsum | Khajuwala | Surface water |
| S6 | Jangloo | 27°40'42.90"N | 73°14'31.25"E | Ball Clay | Nokha | Surface water |
| S7 | Pithrasar | 27°43'34.16"N | 73°11'53.61"E | Ball Clay | Nokha | Surface water |
| S8 | Lunkaransar | 28°29'25.88"N | 73°44'43.08"E | Selenite | Lunkaransar | Surface water |
| S9 | Barsinghsar | 27°48'45.68"N | 73°13'14.75"E | Lignite | Bikaner | Surface water |
| S10 | Palana | 27°50'35.76"N | 73°12'15.48"E | Lignite | Bikaner | Ground water |

**Analysis Method:** Physico-chemical parameters like temperature, pH, electrical conductivity, dissolved oxygen, total dissolved solids, nitrate nitrogen, phosphate were analyzed with the help of thermometers and Elico Water Quality Analyzer PE 138. Transparency was measured by Secchi disc. For analysis of other chemical parameters, the samples were collected in glass bottles and transported to laboratory and were analyzed as per procedure given by APH, 2012 (7). The results are comparable with WHO and BIS water standards (8,9).

## RESULT AND DISCUSSION

Total 10 water samples of surface and groundwater, collected from various sampling sites adjoining mining area of Bikaner district, and were analyzed for assessing the physicochemical parameters. The present study has been carried out between November 2021 to February 2022. Details of different physico-chemical parameter and their results are shown in tables (3). The results of the present study are fairly supported by the earlier findings. [10-14].

**pH:** pH is categorized as one of the most required parameters of water quality. Acidity or alkalinity of the water is measured by pH level i.e., if the pH is below 7.0. it refers as acidic Meanwhile, it is alkaline if the pH is higher than 7.0. Acidic water can lead to corrosion of metal pipes and plumping system. Meanwhile, alkaline water shows disinfection in water. The pH values of all water samples have been ranged between 6.5 and 8.7, where the lowest was found at site S1 and highest values were from site S10, respectively (Table 3).

**TDS:** The inorganic matters and small amounts of organic matter present as solution in water can be refer as TDS. The standard or allowable value of the TDS set by NDWQS is 1000mg/L [17]. The values found from collected water samples are all within the maximum limit of 1000mg/L. TDS concentration of collected samples has been ranged between from 2.4 mg/L to 5.8 mg/L where the highest TDS values was found at site 10 (5.8mg/L) followed by site S7 (5.6 mg/L) whereas the lowest values of was recorded at site S1 (2.4 mg/L), respectively (Table 3).

**Turbidity:** Cloudiness of water caused by a variety of particles is known as turbidity and it is another physical parameter of drinking water analysis. It is also related to the content of diseases causing organisms in water, which may come from soil runoff. Turbidity for all 10 water samples has been observed in the range of 0.7 NTU to 6.4 NTU. The lowest turbidity value was found at site S2 whereas highest was recorded at site S10 (6.4 NTU) followed by S9 (5.6 NTU) and S5 (5.6 NTU) which crossed the maximum permissible limit for the turbidity (5NTU) set by WHO and NDWQS.

**Electrical conductivity:** The presence of dissolved solids such as calcium, chloride, and magnesium in water samples carries the electric current through water and ability of any medium to carry an electric current in water is refers as Electrical conductivity. The measured conductivity values of all the collected water samples found to be within the maximum allowable level of conductivity is 1000 $\mu$S/cm set by NDWQS. The results showed that the measured conductivity of all water samples ranged from 1.3 $\mu$S/cm to 4.9 $\mu$S/cm, and the average conductivity value is 3.50 $\mu$S/cm (Table 3). The maximum electrical conductivity value was recorded at site S9 (4.9 $\mu$S/cm) while minimum was recorded at site S1 (1.3 $\mu$S/cm).

**Total alkalinity:** According to WHO (2016), the desired limit of alkalinity is 200 mg/L and the permissible limit in the absence of alternate source is 600 mg/L. It has been observed from the results of all analyzed water samples that the alkalinity varies between 34 mg/L (S10) to 80 mg/L (S1). Alkalinity is not harmful to the human beings, still the water with less than 200 mg/l are desirable for domestic use.

**Chloride:** The desirable and permissible limits of chloride specified as follow 200 mg/L and 600 mg/L. In the present investigation the concentration of chloride has been found in the range of 15.50–35.50 mg/L.Maximum value of chloride was found at S1 (35.50 mg/L) sampling site whereas minimum value of chloride was found at S6 (15.50 mg/L). the results of the study indicate that the water samples contained chloride concentration with in permissible limit.

**Dissolved Oxygen:** Gaseous oxygen gets into water by diffusion from the surrounding air by aeration and also from aquatic photosynthesis. The permissible limit of dissolved oxygen in drinking water is 4- 6 mg/L. In all measured water samples the dissolved oxygen level has been recorded in the range of 2.1–8.7 mg/L. Maximum D.O. level was recorded at S9 (8.7 mg/L) followed by S7 (6 mg/L) while minimum level was found at S1 (2.1 mg/L). The results of the study indicate that dissolved oxygen level in all water samples has been observed with in permissible limit except S9 sampling site.

**Sodium and potassium:** In the present assessment the concentration of sodium has been ranged between 1 mg/l to 75 mg/l whereas the concentration of potassium has been ranged between 1 mg/l to 11 mg/l. the results of the study indicate that level of sodium was higher in few water samples (S5 and S6) as compare to potassium.

**Total hardness:** Total hardness is defined as the total of temporary and permanent hardness. It is causes in water mostly by the presence of calcium and magnesium salts. According to WHO (2016), the permissible limit of total hardness is 300 to 600 mg/L. The minimum and maximum concentration of total harness in all assessed water samples has been found in the range of 207 to 334 mg/L. During the study it has been observed that total hardness level in all water samples has been observed with in permissible limit. High concentration of total hardness in water may cause kidney stone and heart disease in human.

**Biological oxygen demand:** BO.D. is termed as a measure level of oxygen is used by microorganism in aerobic oxidation or for the breakdown of organic matter in aquatic ecosystems. The amount of oxygen required to oxidize substance to carbon dioxide and water may be calculated by stoichiometry if the chemical composition of the substance is known. The permissible limit of biological oxygen demand in drinking water is 30 mg/L. Biological oxygen demand has been ranged from 2.4 to 4.7 mg/L in all measured water samples. It was interestingly noticed that all the values are within the permissible limit prescribed by WHO and BIS.

**Chemical Oxygen Demand (COD):** The COD test is used to determine the oxygen equivalent of the organic matter that can be oxidized by strong chemical oxidizing agent (potassium dichromate) in an acid medium. Both BOD and COD serve as a milestone for the environmental health of a surface water supply. COD level in the measured water samples has been observed between 35 to 96 mg/L. It was interestingly observed that all the values are within the permissible limit (255 mg/L) prescribed by WHO.

**Table 3: Site wise average concentration**

| Parameter | Site wise average concentration | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **S1** | **S2** | **S3** | **S4** | **S5** | **S6** | **S7** | **S8** | **S9** | **S10** |
| Color (Hz) | 10 | 10 | 8 | 7 | 9 | 5 | 8 | 10 | 9 | 8 |
| Temp. (°C) | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| TDS(mg/l) | 2.4 | 2.5 | 3.9 | 3.9 | 4.9 | 3.9 | 5.6 | 4.8 | 5.8 | 3.2 |
| Turbidity(mg/l) | 4.8 | .7 | .8 | 2.7 | 2.1 | 5.6 | 4.8 | 3.9 | 5.6 | 6.4 |
| Electric conductivity | 1.3 | 2.8 | 3.8 | 3.4 | 4.8 | 3.7 | 4.9 | 3.5 | 4.9 | 2.8 |
| pH | 6.5 | 6.9 | 7.4 | 7.5 | 6.8 | 8.5 | 7.3 | 7.5 | 7.9 | 8.7 |
| Chloride(mg/l) | 35.5 | 17.5 | 18.5 | 20.6 | 21.6 | 15.5 | 19.7 | 17.8 | 18.3 | 30.5 |
| Total alkalinity(mg/l) | 80 | 48 | 35 | 42 | 38 | 39 | 52 | 45 | 60 | 34 |
| D.O.(mg/l) | 2.1 | 4.3 | 5.2 | 4.2 | 5.5 | 5.5 | 6 | 5.8 | 8.7 | 4.3 |
| Sodium(mg/l) | 1 | 1 | 1 | 1 | 60 | 1 | 69 | 1 | 75 | 1 |
| Potassium(mg/l) | 11 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2 |
| Total hardness (mg/l) | 330 | 234 | 280 | 334 | 290 | 220 | 207 | 330 | 315 | 275 |
| B.O.D. (mg/l) | 3.9 | 2.8 | 3.9 | 2.3 | 2.5 | 4.7 | 4.7 | 3.8 | 3.8 | 2.6 |
| C.O.D. (mg/l) | 96 | 84 | 45 | 45 | 40 | 70 | 75 | 35 | 75 | 55 |

## CONCLUSION

The analysis of groundwater quality of various locations adjoining the mining areas of Bikaner district was carried out. The Physicochemical and biological parameters i.e., temperature, turbidity, electrical conductivity, pH, alkalinity, chloride, sodium, potassium, total hardness, dissolved oxygen, biological oxygen demand and chemical oxygen demand were determined. The results of present study revealed that the quality of Surface water and ground water of water samples is not according to norms of Rajasthan government and WHO standards. The pH results indicate that ground water of Bikaner district is highly brackish to saline in nature. The total hardness of ground water of this area falls in the hard category. The aim of present investigation was to assess the impacts of mining activities on surface water and ground water quality and to find out problems. The study suggests that regular evaluation of water quality is needed in area of west Rajasthan which will help policy makers and administration to develop the innovative strategies to reduce excessive limit of pollutants and the water can made suitable for drinking purposes.

## REFERENCES

1. Sumi, L. and Thomsen, S. (2001) Mining in Remote Areas, Issues and Impacts. MinindWatch Canada/ Mines Alerte,http://www.miningwatch.ca.
2. Yadav J, Pathak RK, Khan E (2013) Analysis of water quality using Physicochemical Parameters, Satak Reservoir in Khargone District, MP, India. Int Res J Environment Sci 2: 9-11.
3. Dasgupta, A. (2012) Impact of mining on rural environmental and economy. A case study, Kota district, Rajasthan. International Journal of Remote sensing and Geoscience (IJRSG).v.2, pp.21-26.
4. Ahmad, A.F., Sharma, H.K., Ahmad, R.M. and Rao, R. J. (2014). Impact of Mining Activities on Various Environmental Attributes with Specific Reference to Health Impacts in Shatabdipuram, Gwalior, India. International Research Journal of Environment Science, ISSN 2319–1414,Vol. 3(6), 81-87,
5. Venkatesharaju K, Ravikumar P, Somashekar RK, Prakash KL. Physico-chemical and bacteriological investigation on the river cauvery of bollegal stretch in Karnataka. Journal of Science Engineering and Technology, 2010, 6: 50.

6. Singh, Alok & Kumar, Alok. (2018). Petrographic and Geochemical Study of GurhaLignites, Bikaner Basin, Rajasthan, India: Implications for Thermal Maturity, Hydrocarbon Generation Potential and Paleodepositional Environment. Journal of the Geological Society of India. 92. 27-35. 10.1007/s12594-018-0949-z.
7. APHA 2012. Standard Methods for the analysis of water and waste water, 18th edition, American Public Health Association Washington D.C.
8. W.H.O. (2013). Guidelines for the drinking water quality, Vol. II, Geneva, 327 & Vol. III, Geneva, 127.
9. Bureau of Indian Standards (BIS), Central Water Commission,(2012). Guidelines for the drinking water quality.
10. Jhariya, D.C., Khan, Rubia, and Thakur, G.S. (2016) Impact of Mining Activity on Water Resource: An Overview study. Recent practices and Innovations in Mining Industry.
11. Ochieng, George M., Seanego, Ephrahim S. and NkwontaOnyeka I. (2010) Impacts of mining on water resources in South Africa, A review. Scientific Research and Essays Vol. 5(22), pp. 3351-3357.
12. Sinha, A.K. and Musturia, Y. (2004), high fluoride groundwater in Chaksu Tehsil, Jaipur, Rajasthan, India Journal of Environmental Science, 8(2); 103-107.
13. Singh, G., Pal, A., Niranjan, R.K. and Kumar,M (2010) Assessment of environmental impacts by mining activities: A case study from Jhansi open cast mining site - Uttar Pradesh, India. Journal of Experimental Sciences Vol. 1, Issue 1, Pages 09-13.
14. Warhate, S.R., Yenkie, M.K.N., Chaudhari, M. D. AND Ponkale, W. K. (2006) Impacts of Mining Activities on Water and Soil. JOURNAL OF ENVIRON, SCIENCE & ENGG. VOL 48, P81-90.
15. CPCB, Pollution control acts, rules and notifications issued there under. Pollution control series: PCL/2/1992 (VolumeI) New Delhi: Central Pollution Control Board, (2003).
16. The Environment (Protection) Act, 1986, Ministry of Environment & Forests.



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