Physico-Chemical Analysisfor Different Lakes/River of Udaipur City- A Case Study

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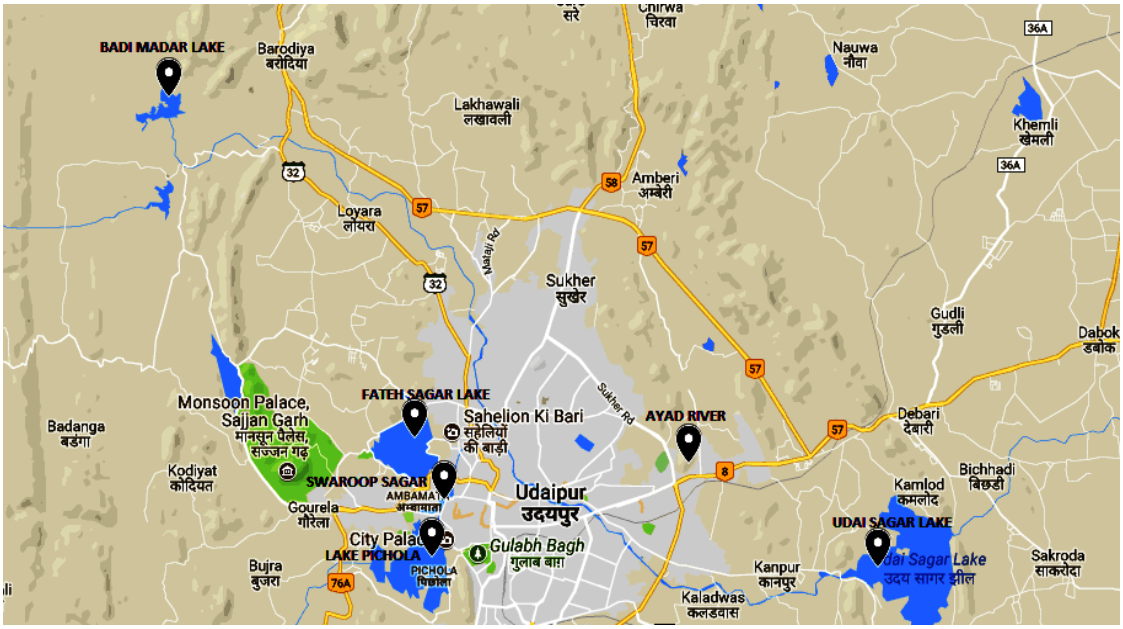
Abstract: This research paper discusses the water quality parameters for different lakes of Udaipur city. Parameters were analysed during the month of March and April, 2017. For this purpose, five different primary lakes and Ayad river of Udaipur were selected and their physical and chemical water quality parameters were determined. These parameters were determined by normal laboratory methods. For physical water quality analysis, parameters analysed were temperature, colour, odour, turbidity, total solids, total dissolved solids and total suspended solids. And for chemical water quality parameters, pH, alkalinity, hardness, dissolved oxygen, biochemical oxygen demand (BOD) and chemical oxygen demand (COD) were analysed. There were little variations in water quality of lakes. These were dependent upon the location and mixing of water into lakes from different sources. Water qualities of these lakes and river are not up to standards. They need to be treated before their use.

Key Words: Water quality parameters, Lakes of Udaipur, Physical water quality, Chemical water quality.

I. INTRODUCTION

Udaipur, formerly the capital of the Mewar Kingdom, is a city in the western Indian state of Rajasthan. It is situated around a series of artificial lakes and is known for its lavish royal residences. Udaipur is also known as the "City of Lakes," the "Venice of the East," or the "Kashmir of Rajasthan". It consist number of lakes in which few important lakes are Fatehsagar, Lake Pichola, Udaisagar and Badi Lake etc. Apart from imparting only beauty to this city, these lakes also form surface source of water. Hence water quality analysis of these lakes becomes important. As water quality of these lakes will determine type of water treatment plant to be set up in this city. Considering these entire things in mind, physical and chemical parameters were analysed. Maximum number of parameters were tried to be evaluated. These parameters becomes in total to 13. Quality of water was varying in different lakes and river because of mixing of different types of waste. At few places, mixing was high and hence contaminations were also observed to be high and vice versa. All these parameter and their method of determination have been discussed in detail in subsequent sections.

Fig. 1.1: Map showing locations of study area



II. MATERIAL AND METHOD

Water sample were collected from six different lakes and river of Udaipur. Lakes chosen for analysis were Badi Lake, Fateh Sagar, Swaroop Sagar, Lake Pichola, Udaisagar and Ayad River. The samples were collected in BOD bottles and plastic jerry canes and brought to the laboratory with all necessary precautions. Samples were labelled properly. Few parameters like temperature, pH and dissolved oxygen were measured on site. Grab sampling method was applied during the sampling. Water samples were further analysed by standard methods. The samples were analysed for following physicochemical parameters: Water Temperature (ºC), colour (TCU), odour (TON), pH, hardness (mg/l), turbidity (NTU), total solids (mg/l), total dissolved solids (mg/l), total suspended solids (mg/l), dissolved oxygen (mg/l), biochemical oxygen demand (mg/l), chemical oxygen demand (mg/l) and alkalinity (mg/l). Temperature of water sample was measured at the site using temperature rod attached with DO meter at the site instantly. Measurement of colour was done by comparison of the sample with standard colour solutions using a spectrophotometer. A straight line calibration curve was initially developed by plotting absorbance versus platinum-cobalt colour standard. Odour of water sample was determined by dilution method with great care and within 24 hour of sampling. Turbidity of samples were determined using turbidity meter in the laboratory. Standard solutions of 200 NTU and 400 NTU were used for calibration of turbidity meter. Total solids, total dissolved solids and total suspended solids were determined using Gravimetric Method. Oven was used for their determination at a standard temperature of 103 to 105^0C.pH of the water samples recorded at the site using pH meter. Buffer solutions of pH 4 and pH 9 were used for calibration of pH meter. Alkalinities of samples were determined using titration method of analysis using 0.02 N H_2SO_4 and phenolphthalein indicator solution. Hardness was determined by titration method using 0.02 N EDTA solutions, ammonia buffer solutions and Eriochrome Black T indicator. Dissolved oxygen was analysed using DO meter at the site instantly. It can also be measured in the laboratory using Winkler's method.BOD and COD were determined in laboratory by regular methods.

III. EQUATIONS

All the formulae and equations used for the calculation of parameters mentioned above are discussed in this section.

3.1 Gravimetric method of analysis for solids

$$\text{Total solids} = \frac{(A-B)}{V} \times 1000 \times 1000 \text{ (mg/l)}$$

Where,

A= weight of petridish + weight of total solids left in petridish after evaporation (g)
B= weight of empty petridish (g)
1000= conversion factor for conversion of millilitre into litre, as volume of sample taken for analysis was 20 ml.
Above formula as it is can be applied for determination of total dissolved solids. Only difference will be there, that water sample will be passed from a filter paper. Total suspended solids were determined by subtracting total dissolved solids from total solids.

Total Suspended Solids= Total Solids – Total Dissolved Solids

3.2 Equation for determination of alkalinity

P) Phenolphthalein Alkalinity as (CaCO3) (mg/l) =

$$\frac{\text{Volume of H2SO4 for Phenolphthalein end point} \times \text{N} \times 1000}{\text{Volume of sample taken for titration}}$$

(T) Total Alkalinity as ($CaCO_3$) (mg/l) =

$$\frac{\text{Volume of H2SO4 for Phenolpthalein} + \text{Volume of H2SO4 for Methyl Orange} \times \text{N} \times 1000}{\text{Volume sample taken for titration}}$$

3.3 Equation for determination of hardness

$$\text{Total Hardness as } CaCO_3 \text{ (mg/L)} = \frac{\text{Volume of EDTA titrant} \times \text{N} \times 1000 \text{ X } 50}{\text{Volume of unboiled sample taken for titration}}$$

$$\text{Permanent hardness as } CaCO_3 \text{ (mg/l)} = \frac{\text{Volume of EDTA titrant} \times \text{N} \times 1000 \times 50}{\text{Volume of boiled sample taken for titration}}$$

3.4 Equation for determination of BOD

$$\text{BOD of the sample} = \frac{[(\text{Do} - \text{D5}) - (\text{Co} - \text{C5})] \times \text{Volume of diluted sample}}{\text{Volume of sample taken}}$$

Where,

Do = Initial dissolved oxygen of diluted sample
D_5= Dissolved oxygen at the end of 5 days for diluted sample
Co= Initial dissolved oxygen of blank
C_5= Dissolved oxygen at the end of 5 days for blank

3.5 Equation for determination of COD

$$\text{COD of sample} = \frac{(\text{A} - \text{B}) \text{X N X } 8\text{X}1000}{\text{Volume of sample take } n}$$

Where,

A= Volume of ferrous ammonium sulphate for blank
B= Volume of ferrous ammonium sulphate for sample
N= Normality of ferrous ammonium sulphate
1000= is a factor to convert result into litre from millilitre

IV. OBSERVATIONS AND ANALYSIS

Table 4.1: Water Quality Parameters for Lakes/Rivers of Udaipur

Water Quality Parameter	Parameter	Badi lake	Fateh Sagar	Swaroop Sagar	Pichola	Udai Sagar	Ayad
Physical Water Quality Parameters	Temperature (^{0}C)	28.40	30.60	29.80	29.60	30.50	31.50
	Colour (TCU)	Colourless	Colourless	Yellowish Tinge	Colourless	Greenish	Reddish brown
	Odour (TON)	Absent	Absent	Faint	Absent	Unpleasant	Pungent
	Turbidity (NTU)	10.50	13	14	12	15	20
	Total solids (mg/l)	900	500	650	561	753	1376
	Total Dissolved Solids (mg/l)	650	327	416	374	564	941
	Total Suspended Solids (mg/l)	250	173	234	187	189	435
Chemical Water Quality Parameters	pH	10.01	9.78	10.31	9.15	10.32	8.9
	Alkalinity (mg/l)	147	115	125	122	170	325
	Hardness (mg/l)	246.91	201	223.47	256.29	419.75	630
	Dissolved Oxygen (mg/l)	5.60	6.50	6.80	5.40	5.10	4.30
	Biochemical Oxygen Demand (mg/l)	37	14	27	24	45	72
	Chemical Oxygen Demand (mg/l)	78	37	61	52	114	183

Fig. 4.1: Graph showing variation of physical parameters for all lakes and river

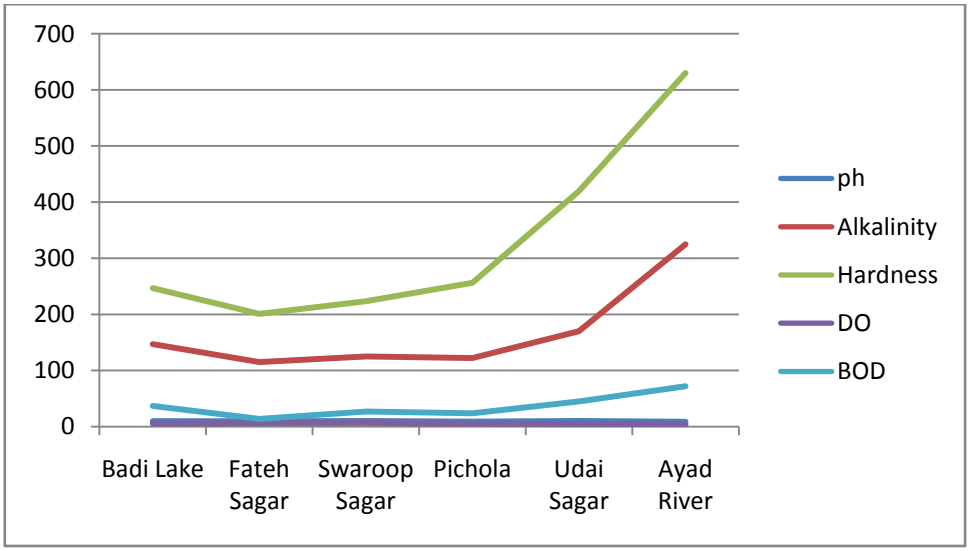
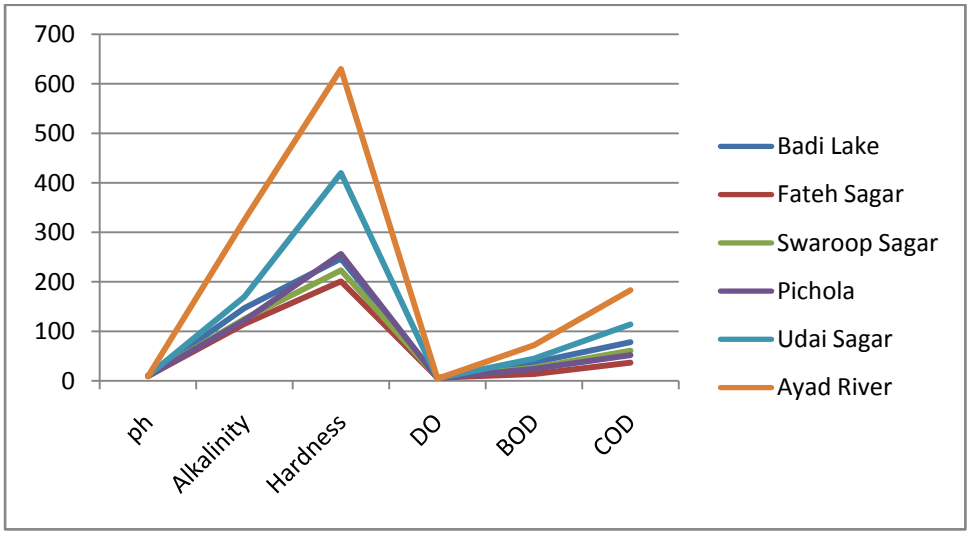


Fig. 4.2: Graph showing variation of Chemical Parameters for all lakes and river



V. CONCLUSION

Results from the above analysis shows that lakes and rivers have varying physical and chemical water quality parameters. Temperature was found almost to be same as the sampling was done in the same season of spring. Colour was observed to be colourless except the locations Swaroop Sagar, Udai Sagar and Ayad River. Reason behind their not being colourless is that mixing of municipal waste into these lakes and subsequently presence of algae also specially in Udai Sagar. Odour were generally not present in lakes but it was observed sufficiently in Ayad River as mixing of municipal waste is very high in this case. Turbidity was high in all lakes and river beyond the permissible limit of standards. And it was highest in Ayad River as it is most polluted among all these stations. In terms of total solids, total dissolved solids and suspended solids, water from Fateh Sagar and Lake Pichola were found to be somewhat better than others. Swaroop Sagar had moderate value and remaining others had high value of solids.pH of all samples were found to alkaline in nature. It was highly alkaline in Udai Sagar as water from various places was mixing there and algae concentration was also high. Water in all lakes was measured to be hard and a few locations like Udai Sagar and Ayad River, hardness was found to be very hard. Reason behind their high value of hardness is due to mixing of various types of waste coming from different commercial and municipal areas.Dissolved oxygen concentrations were almost normal at all sampling stations. Ayad River had DO value very close to permissible limit of 4 mg/l. BOD and COD values were high at every locations but it was observed to be highly deviating from the standard value of 350 ppm (of BOD) for Ayad River because of its very bad water quality. Overall analysis shows that water quality of Udai Sagar and Ayad River is found to be of very low quality. Simple reason is that waste water emerging from commercial areas and various municipalities are directly being discharged into river which is contributing most contamination in Ayad River. Udai Sagar has poor water quality due to discharge of pollutants from surrounding phosphorite mines, chemical factories, distillery, sewage and domestic waste from various settlements and hotels. All these pollutants are reaching this lake through the River Ayad. Various restoration works need to be implemented for improving water quality of these lakes and river like restrictions on disposal of waste products and sewerage in the lakes and restrictions on mining activities in the catchment areas etc.

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