DRINKING WATER QUALITY INDEX AROUND KAKRAPAR ATOMIC POWER STATION, GUJARAT

[1]Toral P Chaudhari, [2]Dr.Reshma L Patel, [3]Himanshu Chaudhari,
[1]Student-Environmental Engineering, [2]Associate Professor, [3]Lecturer
[1]Civil Engineering Department,
[1]Birla Vishvakarma Mahavidyalaya, Vallabh Vidyanagar, Gujarat, India

Abstract: This study has been undertaken to evaluate water quality index that involves analysis of water parameters of ten villages bore well water around Kakrapar surrounding villages using water quality index method and is calculated through weighted arithmetic method. Ten physico-chemical parameters are considered from different sampling locations by the methods recommended by WHO drinking water guidelines. The ten parameters for calculation of water quality index are pH, alkalinity, turbidity, total dissolved solids, hardness, calcium, magnesium, chloride, sulphate, fluoride. The analysis is followed as per APHA, AERB, Standard methods for the examination of water and waste water and Gujarat Pollution Control Board manual and reference for the permissible limits are considered as per BIS 10500:2012 drinking water specification. Considering monthly sample collected in January, February and March 2019.

IndexTerms **– Kakrapar, Physico –chemical parameters, Water Quality Index, Weighted arithmetic method, WHO**

I. INTRODUCTION

Water is critical to the survival of all living organisms. Some organisms can thrive on salt water, but the great majority of higher plants and most mammals need fresh water to live. The safety and accessibility of drinking water are major concerns throughout the world. Fresh water makes up a very small fraction of all water on the planet, while nearly 70 % of the world is covered by water; only 3 % of it is fresh.

The population has exploded and every year competition for a clean, copious supply of water for drinking, cooking, bathing and sustaining life intensifies. Although surface water is an important source of drinkable water, surface water depends on several variable precipitation patterns, which makes it unreliable. Protecting and managing the underground and surface water is an essential task in ensuring availability of drinkable water. Therefore, it is important to monitor drinking water quality and interpret the temporal and spatial variation in water quality. The origin of Tapi river is Mount Vindhya of Saputara range in Maharashta.

The water requirement of Kakrapar Atomic Power Station for the process of cooling and raw water system is met from moticher lake. The moticher lake acts as an balancing reservoir between Kakrapar weir (left bank canal) and ratania regulator. The plant utilizes water from moticher lake and after utilization, it discharges from blow down into the moticher lake. Also low level liquid waste is diluted and then discharged into the same as per standard waste management practice. Water from moticher lake is partly mixed with Tapi river through the koliwada regulator.

II. WEIGHTED ARITHMETIC WATER QUALITY INDEX METHOD

The weighted arithmetic mean method for water quality index is used to analyse the quality of water and to determine the potability of water. This method is widely used method for finding the water quality index (WQI). This method incorporates data from multiple water quality parameters into a mathematical equation that rates the health of water body with number.

The water quality index is calculated using the following formula:

$WQI = \sum^{n}_{i=1} qiwi / \sum^{n}_{i=1} wi$

Si is the standard value of ith parameter

The unit weight (wi) for each water quality parameter is calculated by using the following formula:

$wi=K/S$

K= proportionality constant

The quality rating scale (qi) for every parameter is determined using following expression:

$qi = 100(Vi-V0/Si-V0)$,

Where,

Vi is estimated concentration of ith parameter in the analysed water

V0 is the ideal value of this parameter in pure water

V0=0 (aside from pH= 7 and DO= 14.6 mg/l)

The above given formula gives a WQI value, we get to check the potability of water. Water quality ratings and grading concludes whether water is suitable for drinking or not.

III. MATERIAL AND METHOD

3.1 STUDY AREA

This study was carried out in Kakrapar region, Gujarat, India as shown in figure. Kakrapar is situated on the southern bank of Moticher Lake which is about 85 km from Surat city in the southern region of Gujarat state. Latitude and longitude(21.2996 °N and 73.3664 °E).

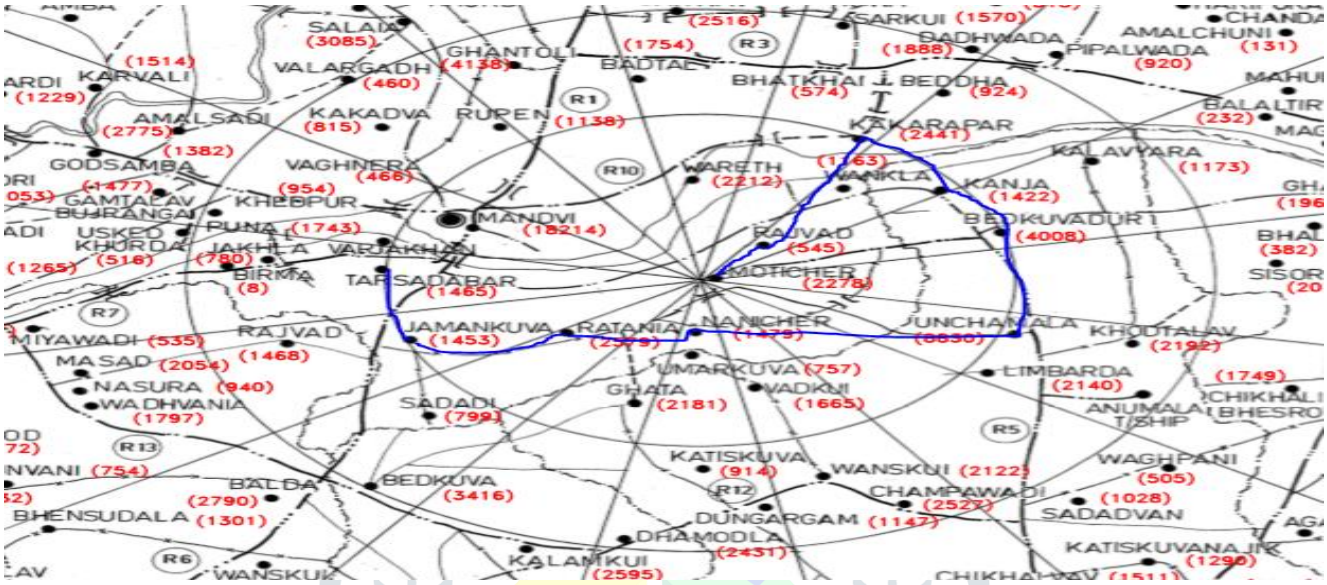

Fig. 1 (2011) CENSUS Marked blue lines indicates villages near by Power Station

3.2 SAMPLE COLLECTION

The drinking water samples were collected from ten different locations. Twelve physico- chemical parameters were measured on monthly basis.

Table 1Parameters and method of analysis

Sr. no.	Parameters	Method
1.	Alkalinity	Titration with H_2SO_4
2.	Hardness	Titration with EDTA
3.	pH	Recorded by pH meter
4.	Total dissolved solid (TDS)	Gravimetric method (dried at stated temperature)
5.	Sulphate	Turbidimetric method
6.	Turbidity	Recorded by turbidity meter
7.	Chloride	Titration (Mohr method)
8.	Fluoride	Colorimetric (after distillation) ; Specific Ion Electrode
9.	Calcium	Titration (Calcium Hardness)
10.	Magnesium	Titration with EDTA

For a drinking water quality analysis, first priority should be given to those elements which are important and affects the health and potability. Second priority is given to the substances which are present in drinking water in about appropriate concentrations (Guidelines for Drinking-Water Quality, 2006). Some of the important parameter which affects the drinking water quality and are prescribed by BIS -10500:2012 code for drinking water are given below in TABLE which are to be analysed for this research.

IV. RESULT AND DISCUSSION

Table 2Calculation of WQI of month January

Sr. No.	Parameters	Mean value(Vi)	Si	Ideal value(Vio)	Unit weight (wi)	Quality rating(qi)	qiwi
1	Alkalinity	98	200	0	0.00227	49	0.150
2	pH	7.5	8.5	7	0.0534		0.333
3	Turbidity	0.42	1	0	0.454	42	19.068
4	TDS	352	500	0	0.000908	70.4	0.063
5	Chloride	30	250	0	0.001816	12	0.021
6	Sulphate	14	200	0	0.00227	7	0.015
7	Fluoride	0.6	1	0	0.454	60	27.24
8	Hardness	96	200	0	0.00227	48	0.108
9	Calcium	44	75	0	0.00605	58.66	0.355
10	Magnesium	11	30	0	0.0151	36.66	0.554
					0.992		47.91

Table 3Calculation of WQI of month February

Sr. No.	Parameters	Mean value(Vi)	Si	Ideal value(Vio)	Unit weight (wi)	Quality rating(qi)	qiwi
1	Alkalinity	102	200	0	0.00227	51	0.150955
2	pH	7.3	8.5	7	0.0534		0.2
3	Turbidity	0.46	1	0	0.454	46	20.884
4	TDS	359	500	0	0.000908	71.8	0.065194
5	Chloride	35	250	0	0.001816	14	0.025424
6	Sulphate	13	200	0	0.0022	6.5	0.014755
7	Fluoride	0.4	1	0	0.454	40	18.16
8	Hardness	98	200	0	0.00227	49	0.11123
9	Calcium	42	75	0	0.00605	56	0.338987
10	Magnesium	12	30	0	0.01513	40	0.605333
					0.99213		40.55588

Table 4Calculation of WQI of month March

Sr. No.	Parameters	Mean value(Vi)	Si	Ideal value(Vio)	Unit weight (wi)	Quality rating(qi)	Qiwi
1	Alkalinity	101	200	0	0.00227	50.5	0.1509
2	pH	7.5	8.5	7	0.0534		0.333
3	Turbidity	0.4	1	0	0.454	40	18.16
4	TDS	350	500	0	0.000908	70	0.0635
5	Chloride	32	250	0	0.00181	12.8	0.0232
6	Sulphate	15	200	0	0.00227	7.5	0.0170
7	Fluoride	0.5	1	0	0.454	50	22.7
8	Hardness	98	200	0	0.00227	49	0.1112
9	Calcium	42	75	0	0.00605	56	0.338
10	Magnesium	12	30	0	0.0151	40	0.605
					0.9921		42.503

Table 5The WQI of drinking water around Kakrapar Atomic Power Station

Sr.no	Month	WQI	Water quality rating
1	January	47.91287	Good
2	February	40.55588	Good
3	March	42.50367	Good

Table 6Rating of water quality for various WQI

WQI status	Water quality rating	Grade
0-25	Excellent	A
26-50	Good	B
51-75	Poor	C
76-100	Very poor	D
Above 100	Unsuitable for drinking	E

CONCLUSION

The analysis states that the water quality index of all the experimental sites around the power plant of nearby villages of Kakrapar have good water quality. So water is suitable for potable purposes.

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