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Water Quality Index and Assessment of Physico – Chemical Parameters Water samples, Calicut city, Kerala state, India

Anjali V Gopi[1], Dr.. Harikumar P S[2], Akhil Nath G[3]

[1]*M Tech Environmental Engineering Student, Dept. of Civil Engineering, KMCT CEW, Kerala, India*
[2] *Senior Scientist, Dept. of Water Quality Division, CWRDM, Kerala, India*
[3]*Assistant Professor, Dept. of Civil Engineering, KMCT CEW, Kerala, India*

Abstract - *Water Quality Index is the dimensionless value that represents the quality of water. CCME (Canadian council of ministers of the Environment) water quality index method was applied to study the quality of water bodies in the Calicut city in Kerala state, India. Nineteen sampling stations were selected across the city for taking water sample and conduct physico – chemical experiments. Sampling and analysis were carried out as per the standard procedure given in Standard Methods for the Water and Waste water (APHA 2012). The following parameters were analyzed: p^H, Turbidity, Hardness, Sodium, Potassium, Iron, sulphate, Nitrate, Phosphate, Total coliform, Fecal coliform. Calicut city got the overall water quality index value of 44.16. Status of water quality is under poor condition*.

Key Words: Water Quality, Physico- chemical parameters, CCME, Water Quality Index, Calicut city

1. INTRODUCTION

Water is an important element among the five rings such as Earth, Water, Fire, Wind and Void. Water quality is the condition of the water body or water resource in relation to its designated uses. It can be defined in qualitative and/or quantitative terms. Parameters in defining water quality can be grouped into three broad categories: physical, chemical, and biological. . The main problem in water quality monitoring is the complexity associated with analyzing the large number of measured variables

Water Quality Index (WQI) is a dimensionless number that combines multiple water-quality factors into a single number. Factors to be included in WQI model could vary depending upon the designated water uses and local preferences. Some of these factors include, total coliform bacteria, temperature, and nutrients (nitrogen and phosphorus), etc.

2. MATERIALS AND METHODS

2.1 Study Area

Kozhikode, formerly called as Calicut is the traditional capital of Northern Kerala under the Samuthiri ruler. It was the most prominent region of Malabar which was one of the safest trading centers for Arabs and later on Portuguese, and finally British, which flourished on trade and commerce for nearly three centuries since the 12th century. Kozhikode Corporation is the headquarters of Kozhikode district, covering an area of 2358Sq.km on an undulating terrain with ground level varying from 2.5m to 1348m from the mean sea level and bounded by Kannur district on the north, Wayanad and Malappuram district on the east, Malappuram district on the south and Lakshadweep sea on the west.

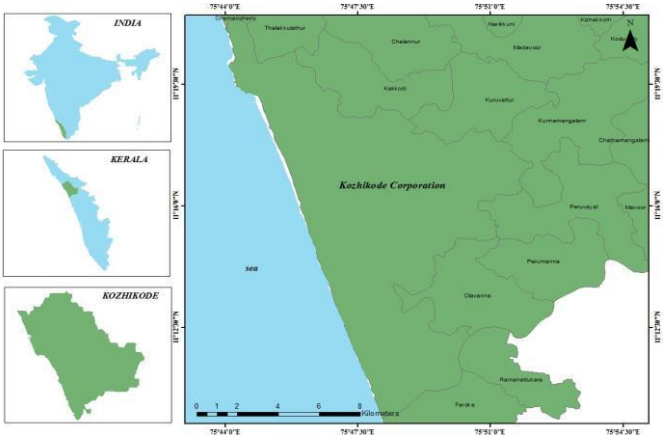

Fig – 1 Map of Calicut city

2.2 CCME Water Quality index

A committee of water quality experts from across Canada developed the Canadian Council of Ministers of the Environment (CCME) Water Quality Index (CWQI) in the late 1990's (CCME, 2001). The index was a guideline – driven tool that allows the user to distil large amounts of water quality data from a monitoring site into a single number and index value. Canadian Council of Ministers of the

Environment Water Quality Index (CCME WQI) provides a convenient method of summarizing complex water quality data that can be easily understood by the public, water distributers, managers and policy makers.

The CCME WQI incorporates the three elements:

Scope (F_1) : The number of water quality parameters not meeting water quality objectives

Frequency (F_2) : The number of times the objectives are not meet

Amplitude (F_3) : The extent to which the objectives are not meet

Scope, F_1 represents the percentage of variables that do not meet the objectives at least once during the time period under consideration (failed variables), relative to the total number of variables measure.

$$F_1 = \frac{\text{Number of Failed variables}}{\text{Total number of Variables}} \text{ X } 100$$

Frequency, F_2 represents the percentage of individual tests that do not meet objectives (failed test)

$$F_2 = \frac{\text{Number of failed Tests}}{\text{Total number of tests}} \text{ x } 100$$

The number of times the individual concentrations is greater than the objective (or less than when the objective is minimum) the objective was termed excursion and is expressed as follows.

When the test value does not exceed the objective

$$\text{Excursion} = \frac{\text{Failed test value}}{\text{Objective}} - 1$$

For the cases on which test value does not fall below the objective

$$\text{Excursion} = \frac{\text{Objective}}{\text{Failed test value}} - 1$$

The collective amount by which individual tests were out of compliance was calculated by summing the excursions of individual tests from their objectives and dividing by the total number of tests. That variable always referred to as the normalized sum of excursions or NSE is calculated as

$$\text{NSE} = \sum_{i=1}^{n} \frac{\text{Excursions}}{\text{Tatal number of the the test}}$$

F_3 is calculated by an asymptotic function that scales the normalized sum of the excursions from the objectives to yield a range between 0 and 100.

$$F3 = \frac{\text{NSE}}{\text{NSE X } 0.01 + 0.01}$$

The water quality index (CCME WQI) is calculated by the following equation.

CCME water quality index: CCME WQI = 100 ($\sqrt{\ ^2 + \ ^2 + \ ^2}$)/ .

Rank	Score	Interpretation
Excellent	96-100	Water Quality Meets all criteria for use as a source of drinking water
Good	81 -95	Water Quality rarely violates criteria for use as a source of drinking water
Fair	66 – 80	Water Quality sometimes violates criteria, possibly by a wide margin, for use as a source of drinking water
Marginal	46 – 65	Water Quality often violates criteria for use as a source of drinking water by a considerable margin
Poor	0 – 45	Water Quality almost always endangered, condition deviate from normal level

Table -1: Water Quality Index scoring system

3. RESULTS AND DISCUSSION

3.1 Water Quality monitoring

Water quality monitoring was the programmed process of sampling, measurement and subsequent recording or signalling, of various water characteristics, often with the aim of assessing conformity to specified objectives. It was important to note the emphasis given to collection of data for the purpose in the definitions of water quality monitoring. That purpose was most commonly related to water quality management, which aims to control the physical, chemical and biological characteristics of water. Specific management activities were determined by natural water quantity and quality, the use of water on natural and socio – economic system and prospects for the future. Water quality was a term used to define the physical, chemical or biological characteristics by which a particular variety of water may be evaluated in order to establish its acceptability for various beneficial uses.

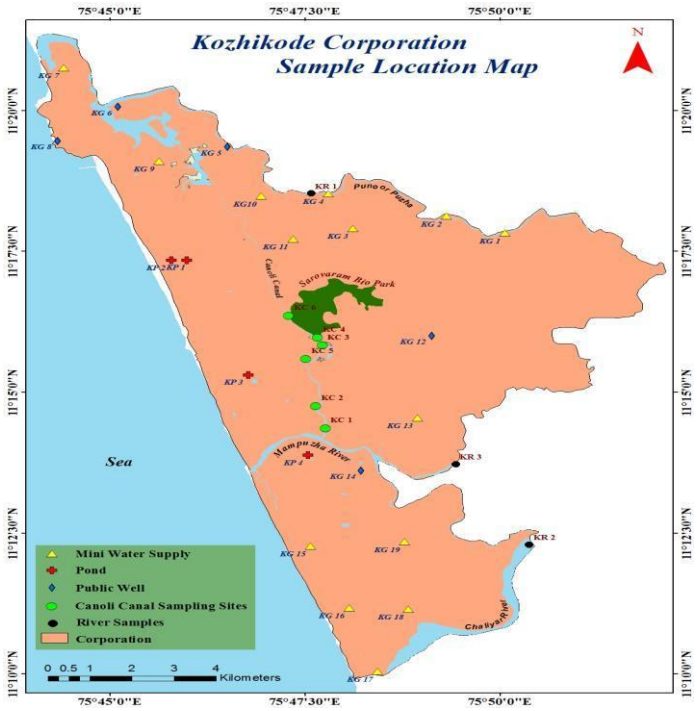

Fig – 2: Map showing Sampling Stations

Water samples were collected from nineteen stations across the Calicut city. The physico – chemical parameters are determined by laboratory tests. Water samples were analysed for determining the parameters such as pH, conductivity, Turbidity, Total Alkalinity, Total dissolved solids, Total Hardness, Calcium, Magnesium, Sodium, Potassium, Iron, Nitrate, Sulphate, Chloride, Total Coliform, Fecal Coliform and E- Coli. Sampling and analysis were carried out as per the standard procedure given in Standard Methods for the Water and Waste water (APHA, 2012). Water quality index were calculated for these parameters using the CCME Water Quality index method developed by Canadian Council of ministers of Environment. Water samples were collected by two times in the interval of one month.

Sampling Code	Sampling Station
KG_1	Moozhikkal medical college mini water supply
KG_2	Poolakkadvu mini water supply
KG_3	Thadambattuthazham mini water supply
KG_4	Vengery mini water supply
KG_5	Mokavoor public well
KG_6	Eranjikkal public well
KG_7	Elathur mini water supply
KG_8	Puthiyappa public well
KG_9	Puthur kizhuvalathuthazham mini water supply
KG_{10}	Parambathu mini water supply
KG_{11}	Karuvassery mini water supply Kurulithazham
KG_{12}	Nellikkode public well
KG_{13}	Kuttiyilthazham mini water Supply
KG_{14}	Naduvattam public well
KG_{15}	Manthottam mini water supply
KG_{16}	Marad malsya grama drinking water supply
KG_{17}	Beypore port mini water supply
KG_{18}	Kizhakkumpadam mini water Supply
KG_{19}	Kolathara minin water supply

Table 2: Brief description of Sample stations

The pH measurement reflects a change in the quality of the source. High acidic or high alkaline water produce sour or alkaline taste. In this study, the average values for pH ranged from 7.43 to 7.65. They are within the objective range of 6.5-8.5 for drinking water. Turbidity of the water samples were within the range as below 1 NTU except some stations and the station KG_{12} have high turbidity as 3.1 NTU. In the case of electrical conductivity, all stations show high electrical conductivity. The total hardness, Total alkalinity and Chlorides are within the range. E- Coli were present in some stations

Sampling Code	Sampling point	Water Quality Index	Specification
KG_1	Moozhikkal medical college mini water supply	43.88	Poor
KG_2	Poolakkadavu mini water supply	42.59	Poor
KG_3	Thadambattuthazham mini water supply	42.58	Poor
KG_4	Vengery mini water supply	42.76	Poor
KG_5	Mokavoor public well	42.69	Poor
KG_6	Eranjikkal public well	42.62	Poor
KG_7	Elathur mini water supply	44.31	Poor
KG_8	Puthiyappa public well	42.51	Poor
KG_9	Puthur kizhuvalathuthazham mini water supply	42.71	Poor
KG_{10}	Parambathu mini water supply	61.51	Marginal
KG_{11}	Karuvassery mini water supply kurulithazham	42.61	Poor
KG_{12}	Nellikkode public well	42.77	Poor
KG_{13}	Kuttiyilthazham mini water supply	45.19	Marginal
KG_{14}	Naduvattam public well	42.53	Poor
KG_{15}	Manthottam mini water supply	42.44	Poor
KG_{16}	Marad malsya grama drinking water supply	42.48	Poor
KG_{17}	Beypore port mini water supply	42.58	Poor
KG_{18}	Kizhakkumpadam mini water supply	43.13	Poor
KG_{19}	Kolathara minin water supply	47.18	Marginal

Table 3: Water Quality Index

The following graph showing the variations of water quality index of different sampling stations

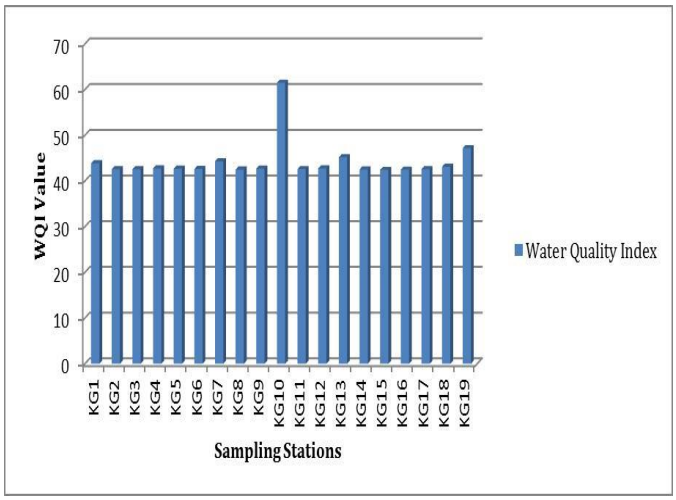

Chart 1 : Variations of Water Quality Index

4. CONCLUSION

A study was conducted on Calicut city to determine the water quality index. Nineteen sampling stations were selected for collecting the samples. Physico- chemical and biological parameters are measured. Sampling and analysis were carried out as per the standard procedure given in Standard Methods for the Water and Waste water (APHA, 2012). Sampling station Parambathu mini water supply had got high water quality index of value of 61.51. And the overall water quality index of Calicut city got the value of 44.16. The status of the water quality is poor.

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