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Water Quality Analysis in Buckingham Canal

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Abstract: *The paper presents the study of physico chemical parameters of water in Buckingham canal within the Chennai city limits .The water has been subjected to immense degradation and pollution due to huge amount of domestic and industrial waste entering into it .The restoration of water quality is a major challenge to environmental managers .The study area is divided into 5 regions and water samples are collected .The qualitative and quantitative analysis of water samples are conducted to determine the amount of different pollutants present .The study identifies the critical pollutants affecting the water during its course through the city . The results are compared with the standard limits .Solutions are recommended to reduce the critical parameters and make water purposeful.*

Keywords: *Physico chemical parameters ,degradation and pollution, restoration of water, qualitative and quantitative analysis, critical pollutants.*

I. INTRODUCTION

In total, there is 1400 million billion liters of water, but most of this water is not used for drinking purpose, because 97% is sea water and only 3% is fresh water, out of which 2% is lodged in the polar ice caps and glaciers, only 1% water is available for portable use ; such as irrigation ,drinking, sanitation and all other uses (WHO, 2004).Although three rivers flow through the metropolitan region and drain into the Bay of Bengal, Chennai has historically relied on annual monsoon rains to replenish its water reservoirs since the rivers are polluted with sewage. With the population increasing over the decades, the city has faced water supply shortages, and its ground water levels have been depleted . Buckingham Canal is the most polluted of the three major waterways in the city with nearly 60 per cent of the estimated 55 million litres of untreated sewage being let into it daily, including by Chennai Metropolitan Water Supply and Sewerage Board. About 30 per cent of the untreated sewage gets into the Cooum river and the Adyar river takes the rest. is let out by residents living along the banks and even government agencies .Sources in CMWSSB, known as Chennai Metrowater , said that 340 sewage outfalls into the waterways were identified last year. Of these, nearly 220 outfalls were through storm water drains. About 50 residential and commercial premises directly let out the sewage into the waterways. The project aims to determine the level of pollution and its sources .

The results are to be analysed and recommendations are provided to make the water purposeful.

II. COLLECTION OF SAMPLES

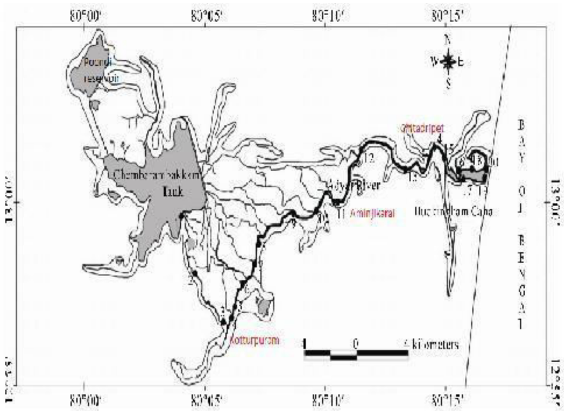
During water quality investigation, the selection of sampling points is more important than actual chemical analysis of water. A successful sampling program entails the selection of sampling points in line with objective of the study. Since various natural and man-made factors are responsible for water pollution. Therefore, there is no general rule that governs the selection of sampling sites. For this purpose, all different locations/sampling sites were outlined and samples were collected. The samples were collected in polystyrene bottle of 2.5 L capacity.

Before sampling, the bottles were washed thoroughly with the detergent, acid tap water, and then distilled water. Chemical parameters were determined by using standard methods immediately after taking them into the laboratory. Usual preservative methods were used to preserve the samples. The samples were analyzed as soon as it was possible the time between sampling and analysis should be kept to a minimum.Storage in glass or polyethylene bottles at a low temperature (e.g. 4°C) in the dark is recommended. Special preservatives may be required for some analyses. Residual chlorine, pH, and turbidity should be tested immediately after sampling as they will change during storage and transport. A total of 5 water samples were collected. The sources and locations of samples are given in table no.1

TABLE NO :1

Sample No	Source	Location
1	River	Poondi
2	River	Chembarambakkam
3	River	Kotturpuram
4	River	Aminjikarai
5	River	Chinthatharipet

FIGURE NO:1
The map shows the sampling points along the Buuckingham canal.



III. QUALITY PARAMETERS AND ANALYSIS METHOD

A. Physical examination

Colour: Dissolved and particulate material in water can cause discoloration. Slight discoloration is measured in Hazen units (HU).Impurities can be deeply colored as well, for instance dissolved organic compounds called tannins can result in dark brown colors, or algae floating in the water (particles) can impart a green color. It is determined using platinum cobalt method. Unit : ppm

Turbidity: It is the measure of resistance to passage of light through water. It is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air.It is determined using Jackson turbidity meter , Nephelometer.
Unit :ppm

Specific conductance: To determine the amount of dissolved salts. It is determined using di -ionic water tester.

Total dissolved solids (TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular (colloidal sol) suspended form.

Total suspended solids (TSS) and volatile solids (VSS)

This parameter was called non-filterable residue (NFR), a term that refers to the identical measurement of the dry-weight of particles trapped by a filter, typically of a specified pore size.

The TSS determination is accomplished by filtration using glass fiber Whatman GF/C within 1µm pore-size and then evaporation at 105°C for 2 hours. The weigh difference between filter and the filter after evaporation corresponds to the suspended solids.

The VSS analysis consists of combusting the filter and TSS in an oven at 550°C for 30 min. This process converts the organic matter into carbon dioxide and water. The loss in weight is interpreted as the organic matter (which has volatilized).

Calculation

Let:

Mo: the initial mass of the clean filter (g)

M1: mass of the filter with suspended solids after evaporation at 105°C for 2 hours (g)

M2: mass of the filter after ignition at 550°C for 30 min (g). Vs: volume of sample that is filtered (m)

Assume that after combustion, the paper has lost approximately 1% of its initial weight

The concentration of the total suspended solids (TSS) and volatile suspended solids (VSS) present in the sample is given by the formula:

$$(TSS = \frac{[(M1-Mo)*10^6]}{Vs}$$

mg/l)

$$VVS = \frac{[(M2-(M1+0.01Mo))*10^6]}{Vs} \quad \text{(mg/l)}$$

Total solids (TS) and total volatile solids (TVS)

The Total solids can be found by evaporating a sample of water and weighing the dry residue left.TSS can be found by filtering water sample through WAHTMAN Filter paper no.44 Unit: ppm**.**

To determine the total solids and total volatile solids, 30 ml of sample is added into a completely dry porcelain bowl (heat resistant), and then dried in an oven at 105°C during 24hours. Cool the bowls and then weigh. Put the bowls at 550°C for 1 hour. Cool and weigh.

Expression of the results

Let:

Mp: the initial mass of the porcelain (g)

Mp1: mass of the bowl with solids after evaporation at 105°C during 24 hours (g).

Mp2: mass of the bowl after ignition at 550°C for 1 hour (g). Vs: volume of sample (ml).

The concentration of the total solids (TSS) and total volatile solids (VSS) present in the sample is calculated using the following formula:

$$TVS = \frac{[(Mp2-Mp1)*10^6]}{Vs}$$

(mg/l)

$$TS = \frac{[(Mp - Mp1) * 10^6]}{Vs}$$
(mg/l)

B. Chemical examination:

pH: It indicates the hydrogen ion concentration in water. If pH < 7 , it indicates water is acidic. Acidity causes tuberculaion and corrosion of pipelines. chromium, cobalt, nickel, copper, zinc, selenium, silver,
If pH> 7, It indicates water is basic. antimony and thallium.
Alkalinity causes incrustation and sediment deposit in pipelines and chlorination. It is measured using potentiometer and calorimetric method.

Hardness: hard water is water that has high mineral content (in contrast with "soft water"). Hard water is formed when water percolates through deposits of limestone and chalk which are largely made up of calcium and magnesium carbonates.

Hardness can be quantified by instrumental analysis. The total water hardness is the sum of the molar concentrations of Ca2+ and Mg2+, in mol/L or mmol/L units.

Chemical oxygen demand (COD) test is commonly used to indirectly measure the amount of organic compounds in water. Most applications of COD determine the amount of organic pollutants found in surface water (e.g. lakes and rivers) or wastewater, making COD a useful measure of water quality. It is measured by the following procedure,excess potassium dichromate must be measured to ensure that the amount of Cr3+ can be determined with accuracy. To do so, the excess potassium dichromate is titrated with ferrous ammonium sulfate (FAS) until all of the excess oxidizing agent has been reduced to Cr3+. Typically, the oxidation-reduction indicator Ferroin is added during this titration step as well. Once all the excess dichromate has been reduced, the Ferroin indicator changes from blue-green to a reddish-brown. The amount of ferrous ammonium sulfate added is equivalent to the amount of excess potassium dichromate added to the original sample. Note: Ferroin Indicator is bright red from commercially prepared sources but when added to a digested sample containing potassium dichromate it exhibits a green hue. During the titration the color of the indicator changes from a green hue to a bright blue hue to a redish-brown upon reaching the endpoint. Ferroin indicator changes from red to pale blue when oxidized. It is expressed in milligrams per liter (mg/L), which indicates the mass of oxygen consumed per liter of solution.

Biochemical oxygen demand (BOD) is the amount of dissolved oxygen needed (i. e., demanded) by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. BOD is determined by either dilution method or manometric method. The BOD value is most commonly expressed in milligrams of oxygen consumed per litre of sample during 5 days of incubation at 20 °C and is often used as a surrogate of the degree of organic pollution of water.

Heavy metals:A toxic heavy metal is any relatively dense metal or metalloid that is noted for its potential toxicity, especially in environmental contexts. The term has particular application to cadmium, mercury, lead and arsenic, all of which appear in the World Health Organisation's list of 10 chemicals of major public concern. Other examples include manganese,

C. Bacterial examination

Coliform bacteria are a commonly used bacterial indicator of sanitary quality of foods and water. They are defined as rod-shaped Gram-negative non-spore forming and motile or non-motile bacteria. While coliforms themselves are not normally causes of serious illness, they are easy to culture, and their presence is used to indicate that other pathogenic organisms of fecal origin may be present. Such pathogens include disease-causing bacteria, viruses, or protozoa and many multicellular parasites. Coliform procedures are performed in aerobic or anaerobic conditions

TABLE NO:2
The table shows the various physical and chemical parameters of the water from the five chosen sampling points

BIS10500:2012	RESULT				
I.PHYSICAL PROPERTIES	1	2	3	4	5
1.Appearance	Clear	Clear	Clear	Turbid	Turbid
2.Colour	Color less	Color less	Black	Black	Black
3.Odour	None	None	Foul Smell	Foul Smell	Foul smell
4.Turbidity	4.6	4.2	72.3	39.5	57.5

5.Total dissolved solids	286	159	22120	1225	1305
6.Electrical conductivity	408	227	31600	1750	1864
II.CHEMICAL PROPERTIES					
7.pH	7.49	7.40	6.94	7.39	7.23
8.Ph. alkalinity	0	0	0	0	0
9.Total alkalinity	140	76	328	368	448
10.Total Hardness	120	65	3700	344	312
11.Calcium	38	22	1240	109	99
12.Magnesium	6	3	144	17	15
13.Sodium	36	21	5240	226	272
14.Potassium	4	2	280	14	18
15.Iron	0.23	0.21	1.07	1.31	1.55
16.Manganese	0	0	0	0	0
17.Free Ammonia	0.50	0.40	24.43	29.25	27.69
18.Nitrite	0.01	0.03	0.02	0.04	0.09
19.Nitrate	4	3	11	12	15
20.Chloride	40	21	10750	310	286
21.Fluoride	0.32	2.4	0.78	0.94	0.86
22.Sulphate	6	4	316	67	63
23.Phosphate	0.05	0.06	1.68	3.15	3.79
24.Tidys Test	1.1	1.0	26.4	31.2	30.4
25.C.O.D	-	-	-	305.6	291.8
26.B.O.D	-	-	-	120	116

TABLE NO.3
Different analytical water quality parameters with their analytical technique and guideline values as per who and Indian standard

Sr. No.	**Parameter**	**Technique used**	**WHO std**	**Indian Std**	**EPA guidelines**
01	Temperature	Thermometer	-	-	-
02	Color	Visual / color kit	-	5 Hazen units	-
03	Odour	Physiological sense	Acceptable	Acceptable	-
04	Electrical conductivity	Conductivity meter / Water analysis kit	-	-	2500 us/cm
05	pH	pH meter	6.5 – 9.5	6.5 – 9.5	6.5 – 9.5
06	Dissolved oxygen	Redox titration	-	-	-
07	Total Hardness	Complexometric titration	200 ppm	300 ppm	< 200 ppm
08	Alkalinity	Acid – Base titration	-	200 ppm	-

09	Acidity	Acid – Base titration	-	-	-
10	Ammonia	UV Visible Spectrophotometer	0.3 ppm	0.5 ppm	0.5 ppm
11	Bi carbonate	Titration	-	-	-
12	Biochemical Oxygen Demand (B.O.D.)	Incubation followed by titration	6	30	5
13	Carbonate	Titration	-	-	-
14	Chemical Oxygen Demand (C.O.D.)	C.O.D. digester	10	-	40

TABLE NO.4
Different analytical water quality parameters used for testing of quality of water and their source of occurrence and potential health effects with USEPA guidelines.

Sr. No.	Parameter	Source of occurrence	Potential health effect
01	Turbidity	Soil runoff	Higher level of turbidity are associated with disease causing bacteria's.
02	Color	Due to presence of dissolved salts	-
03	Odor	Due to biological degradation.	Bad odor unpleasant
04	Electrical conductivity	Due to different dissolved solids.	Conductivity due to ionizable ions. High conductivity increases corrosive nature of water.
05	pH	pH is changed due to different dissolved gases and solids.	Affects mucous membrane; bitter taste; corrosion
06	Dissolved oxygen	Presence due to dissolved oxygen.	D. O. corrode water lines, boilers and heat exchangers, at low level marine animals cannot survive.
07	Total Hardness	Presence of calcium (Ca2+) and magnesium (Mg2+) ions in a water supply**.** It is expressed. Hardness minerals exist to some degree in every water supply.	Poor lathering with soap; deterioration of the quality of clothes; scale forming
08	Total Alkalinity	Due to dissolved gases (CO2)	Embrittlement of boiler steel. Boiled rice turns yellowish
09	TDS	Presence all dissolved salts	Undesirable taste; gastro-intestinal irritation; corrosion or incrustation
10	Calcium	Precipitate soaps, anionic	Interference in dyeing, textile,
11	Magnesium	surfactants, anionic emulsifiers,	paper industry etc.
12	Ammonia	Due to dissolved gases and degradation of organics	Corrosion of Cu and Zn alloys by formation of complex ions.
13	Barium	Discharge of drilling wastes; discharge	Increase in blood pressure

		from metal refineries; erosion of natural deposits	
14	Biochemical Oxygen Demand (B.O.D.)	Organic material contamination in water	High BOD decreases level of dissolved oxygen.
15	Carbonate	Due to dissolution of CO2	Product imbalance Unsatisfactory production Short product life
16	Chloride	Water additive used to control microbes, disinfect.	Eye/nose irritation; stomach discomfort. Increase corrosive character of water.
17	Nitrate	Runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits	Effect on Infants below the age of six months Symptoms include shortness of breath and blue-baby syndrome.
18	Phosphate	-	stimulate microbial growth, Rancidity Mold growth
19	Sodium	Natural component of water	-
20	Sulphate	Due to dissolved Ca/Mg/Fe sulphates	Taste affected; gastro-intestinal irritation. Calcium sulphate scale.

IV. RECOMMENDATIONS

Urban runoff via roads & urban public space.Most urban roads are maintained by local highway authorities. Includes metals and chemicals associated with road transport and faecal matter from animal fouling. It is also a significant source of sediment deposited in water bodies.

- Work with stakeholders, particularly local highway authorities, to develop science, guidance and promote measures and best practice which we know have a positive impact in reducing road runoff such as Sustainable drainage systems (SuDS).
- Work with Highways Agency to identify polluting outfalls on the Highway network.

Misconnections of foul drainage (e.g. from house extensions) into storm drainage systems. Contributes untreated sewage to water bodies. Work with the Environment Agency, local authorities and water companies to identify and repair misconnections cost effectively.

- Awareness of the problem should be created to prevent future misconnections.

Septic tanks & non–mains sewage systems– foul sewage from properties not connected to the main sewerage network. There are hundreds of thousands of non mains sewage discharges are to water bodies or groundwater.

- With the Environment Agency, develop a strategy to reduce the environmental impact of poorly installed and maintained septic tanks. It is likely that different measures will be required depending on proximity to groundwater supplies.

Railways–runoff from railway land including chemicals used for weed control

- Work with Network Rail and the operating companies
to establish what would be the most effective way of reducing pollution

Airports –runoff from runways including chemicals used in de-Icing

- Work with airport authorities to identify and remediate their impact

Campaigns should be conducted that aims to highlight the link between river health and water use, so that people understand and value water and take action to improve their local rivers and the environment around them.

Initially, industries are to be directed their efforts to treat their effluents so as to meet the discharge norms such as MINAS (minimum allowable standards), usually defined in terms of temperature, pH, BOD, COD, suspended loads, and toxic constituents such as mercury, chromium, cadmium, etc. Large-and medium-scale industries possess their own infrastructure and resources, and they must adopt their own effluent treatment schemes so as to render their discharge streams environmentally safe.

Laws and legislation relating to pollution should be strictly followed by all. People should be made aware that adherence to water laws are in their own interest.

Government should take steps to construct proper sanitary landfill sites.

The household water should be treated properly so that they become environmentally safe. Adequate care should be taken to ensure that effective sewage treatment process is in place and that contaminated water does not get mixed with the environment. in order to prevent water pollution, human and animal excreta should be prevented from mixing with its sources. Construction of pit toilet and proper sewage treatments can offer some solution to this problem.

Ponds, lakes and wells meant for human use should be routinely cleaned and treated, so that it remains fit for human use. It is an essential step that should not be avoided. A system of regular testing of pond and lake water can be introduced to ensure the safety of the water.

Non biodegradeable substances should not be poured into drain.When it is necessary to use something that's toxic to the water supply, such as paint or ammonia, care should be taken to dispose of it properly. Local government's website can be checked or sanitation department is to be called to find out how toxic waste should be disposed of in the particular community.

V. LITERATURE REVIEW

Hua-peng Qin,Qiong Su ,Soon-Thiam Khu and Nv Tang : Water Quality Changes during Rapid Urbanization in the Shenzhen River Catchment: An Integrated View of Socio-Economic and Infrastructure Development 2014

Dr.Jayantibhai and A. Chaudhari ,Department of Chemistry Shri R.K.Parikh Arts and Science College : Physico-Chemical Analysis of Drinking Water and Irrigation Water of Several Villages of Petlad Taluka, District-Anand and Improving Quality of Water

Dhirendra Mohan Joshi and Alok Kumar, and Namita Agrawal Studies on the physic chemical parameters to assess the water quality of River Ganga for drinking purpose in Haridwar district.

Patil. P.N, Sawant. D.V, Deshmukh. R.N Department of Engineering Chemistry, Bharati Vidyapeeth's College of Engineering: Physico-chemical parameters for testing of water – A review

S. A. Manjare, S. A. Vhanalakar and D. V. Muley : Analysis of water quality using Physico-chemical parameters Tamdalge Tank in Kolhapur District.

Devangee shukla , Kinjal Bhadresha , Dr. N. K. Jain , Dr. H. A. Modi : Physicochemical Analysis of Water from Various Sources and Their Comparative Studies.

M. Prasad, B. Muralidhara Reddy, M. Ramakrishna Reddy and V. Sunitha : Studies on physicochemical parameters to assess the water quality in Obulavaripalli Mandal of YSR (Kadapa) District, Andhra Pradesh, India.

Deepshikha Sharma and Arun Kansal : Water quality analysis of River Yamuna using water quality index in the national capital territory, India (2000–2009)

Anwar Khalid,Amir Haider Malik, Amir Waseem, Shazmeen Zahra and Ghulam Murtaza : Qualitative and quantitative analysis of drinking water samples of different localities in Abbottabad district, Pakistan.

Neerja Kalra, Rajesh Kumar1, S.S. Yadav and R. T. Singh:Physico-chemical analysis of ground water taken from five blocks (Udwantnagar, Tarari, Charpokhar, Piro, Sahar) of southern Bhojpur (Bihar)

O. A. Ojo, S. B. Bakare and A. O. Babatunde : Microbial and chemical analysis of potable water in public-water supply within Lagos University ,Ojo.