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Analysis and Reuse of Ground Water Near Cooum River

Venkatesan G.[1]
1.Research Scholar, Centre for Research,
Anna University, Chennai, Assistant Professor,
Department of Civil Engineering, Priyadarshini
Engineering College,
Affiliated to Anna University, Chennai, Tamil Nadu, India.

Loganathan K.[2], Madhan K.[3]
2,3. Assistant Professor,
Department of Civil Engineering,
Priyadarshini Engineering College,
Affiliated to Anna University, Chennai,
Tamil Nadu, India.

Karthik S.[4]
4. Assistant Professor,
Department of Electronics and
Communication Engineering,
Priyadarshini Engineering College,
Affiliated to Anna University,
Chennai, Tamil Nadu, India.

Nagarajan B[5]
5. Assistant Professor,
Department of Computer Science and Engineering,
Priyadarshini Engineering College,
Affiliated to Anna University,
Chennai, Tamil Nadu, India.

***Abstract*:- In this paper, Groundwater quality in Chennai city along the Cooum river, on 6/7/2015 was analyzed. Groundwater samples were collected from 10 bore wells of the river. The analysis focused on the determination of ten specific water quality parameters, namely, pH, COLOUR, TDS, BOD, COD, HARDNESS, TURBIDITY, ALKALITY, METHYL ORANGE AND CHLORIDE using INDIAN STANDARDS procedures. The analysis of the collected samples reveals that the standard water quality parameters have nearly complied with the IS:10500 standards, but the water is fit for drinking and domestic purposes after treatment process.**

Keyword: Treatment, Contaminated water, Water parameters.

INTRODUCTION

Water is one of the most essential constituents of the human environments. Man needs it, in the first place for his physiological existence. It is used for many purposes e.g. industrial water supply, irrigation, drinking, propagation of fish and other aquatic systems and generation of fish and hydro-powers. Water is the source of energy and governs the evolution and functions of the universe on the earth. Water, the most vital necessity of life, is in abundance 97.3% of the world's water i.e. 1.45 billion cubic Km. Ocean water is salty and cannot be used for agricultural, domestic and industrial purposes. Only$13x10^6$ cubic Kilometers water is available in the form of stream, lakes, wells and tube wells i.e. 0.6%, 8.5x1015 m3 is groundwater, occurs in the depth of 80-135 m below the ground surface as water levels decreasing day-by-day. The run-off water has large number of substances e.g. silt, organic impurities. The global environment is changing continuously due to unfavorable alteration of surroundings, wholly as a byproduct of man's actions, through direct or indirect effects of changes in energy pattern, radiation levels, chemical and physical constitution of organisms. These changes may affect man directly or through his supplies of water and of agricultural and other biological products, the most common types of pollution and pollutants discharged, encountered in domestic and industrial waste waters, along with their possible effects on the water resources are discussed. Chemicals area major source of water contamination that introduced during water movement
through geological materials, manufactured chemicals may cause problems. Fertilizers and pesticides are major contributors to water pollution. Nitrates from fertilizers, Heavy metals, sulphates, nitrates, chlorides, phosphates, carbonates, ammonia, pesticides, phenols, soaps, detergents are a common chemical pollutant of water. It may cause water borne disease in man due to pathogenic micro-organisms produce by pollutants. To overcome this problem the study is taken across Cooum river and their test results are studied using the INDIAN STANDARDS.

LOCATION OF STUDY - COOUM RIVER

The Cooum River is one of several rivers in the Madras Basin in Southern India. It flows to the Coromandel Coast and into the Bay of Bengal from west to east through the centre of the Chennai Metropolitan Area (CMA). Two main waterways flow through the city from west to east: the Adyar River in the south and the Cooum River through the geographical centre of Chennai. Also, the Buckingham Canal runs north to south along the coast through the city, and intersects both the Adyar and Cooum Rivers on their north and south banks. All the waterways in Chennai are considered to be polluted, but the Cooum River and Buckingham Canal are widely recognized to be the worst. The Cooum has a length of approximately 70 km .This river has been described as a "languid stream" which is almost stagnant and which carries little water except during the monsoon. It has also been noted that the Cooum "receives a sizeable quantity of sewage from its neighbourhood for disposal". All along the river's course

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industries dispose of their waste and households toss their garbage. Although parts of the city are serviced by primary and secondary sewerage treatment, in the most densely populated area surrounding the lower reaches and mouth of the Cooum River, raw sewage is diverted into the waterways and ocean.

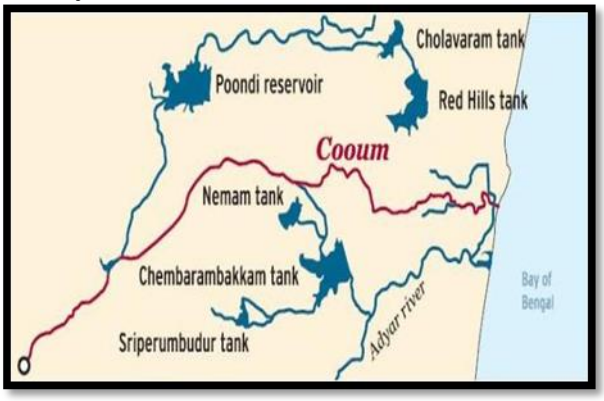
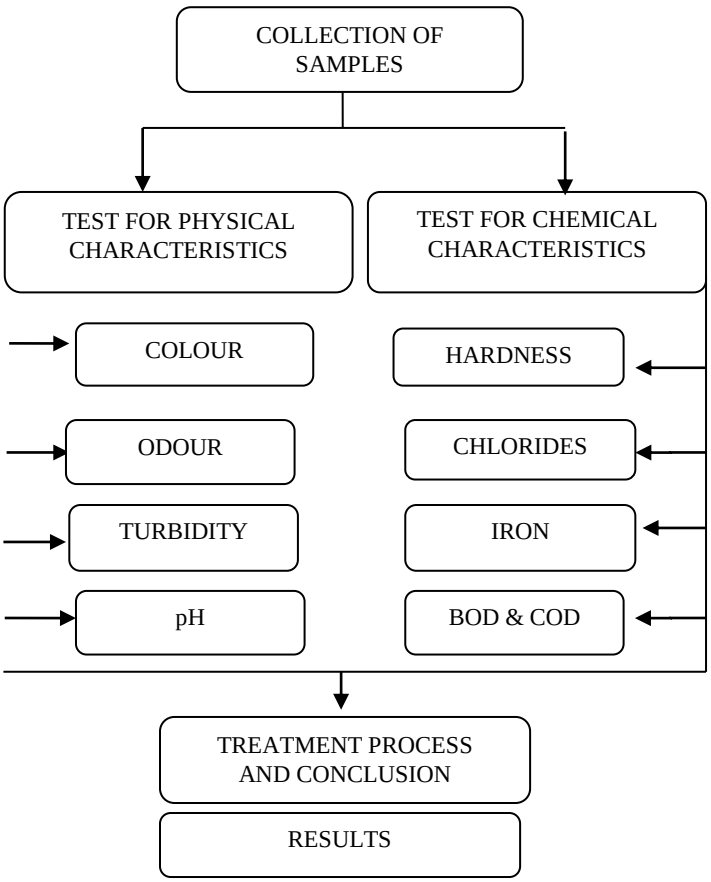


FIG-1 MAP OF COOUM RIVER

SCHEMATIC REPRESENTATION OF METHODOLOGY



COLLECTION PROCEDURE

Water samples must be collected from the bore wells at a depth of 30–40m below the ground level at 10 locations along the Cooum River. The collected samples must be stored in cleaned and well-dried bottles (1L), with necessary precautions. These bottles is to be labeled with respect to the collecting points, date, and time in order to avoid any error between collection and analysis. All the sample collections must be immediately taken to the laboratory for determining the specific water quality parameters.

PARAMETER STUDY

1. *Colour*
2. *Odour*
3. *Turbidity*
4. *pH*
5. *Total Hardness(EDTA Method)*
6. *Chlorine(Gravity method)*
7. *Total Dissolved Solids(TDS)*
8. *Iron*
9. *BOD & COD*

COLLECTION PROCEDURE

In each area 5 samples were taken as following,

- Water samples were collected from the bore wells at a depth of 30-40m below the ground level at 10 locations along the Cooum River, 5 in Aminjikarai and 5 samples in Chetpet. The collected samples were stored in cleaned and well-dried bottles (1L), with necessary precautions.
- These bottles were labeled with respect to the collecting points as A1, A2, etc., and C1, C2, etc., and second time as A6, A7, etc., and C6, C7, etc., to avoid any error between collection and analysis.
- All the sample collections were immediately taken to the laboratory for determining the specific water quality parameters.

FIG-2 COLLECTION OF SAMPLES

TABLE-1 SAMPLE LOCATION

S.NO.	SITE LOCATION	SAMPLE	DATE OF COLLECTION
1.	Aminjikarai	A1	02-02-2015
2.		A2	
3.		A3	
4.		A4	
5.		A5	
6.	Chetpet	C1	03-02-2015
7.		C2	
8.		C3	
9.		C4	
10.		C5	

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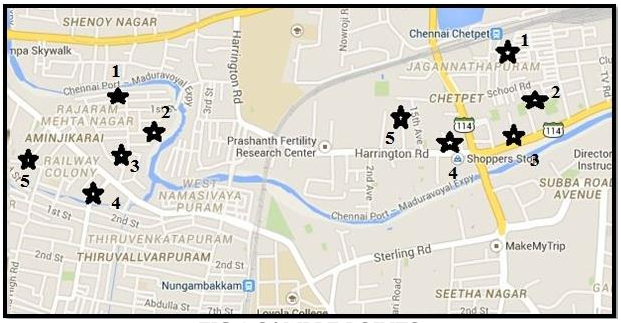

FIG-2 SAMPLE POINTS

SAMPLE REPORTS

The samples were tested according to IS 3025: 1986 Methods of Sampling and Test (Physical and Chemical) For Water and Wastewater. Theaverage reports are as follows.

TABLE-2AVERAGE GROUNDWATER VALUES AT CHETPET

PARAMETER	**C1**	**C2**	**C3**	**C4**	**C5**
Turbidity, NTU, max	0.15	0.15	0.45	0.2	0.15
Ph	7.4	7.25	7.15	7.6	7.45
Total hardness as (CaCO3)	153.5	509.75	391.5	472.8	143.25
Chlorides as Cl	148.75	310.6	316.45	238.8	74.55
Total alkalinity	173.55	330.95	448.85	448.85	117
Sulphate as SO4	18.9	24.5	16.05	24	11.05
Methly Orange Alkalinity	172.5	327.5	446.15	445.6	111.9
Iron as Fe	0.065	0.075	0.16	0.085	0.045
Total inorganic solids	980	1530.5	1431.5	1482.5	541.5
BOD	0.085	0.185	0.175	0.25	0.09

TABLE-3 AVERAGE GROUNDWATER VALUES AT AMINJIKARAI

PARAMETER	**A1**	**A2**	**A3**	**A4**	**A5**
Turbidity, NTU, max	0.15	0.2	0.2	0.1	0.15
Ph	7.3	7.15	7.05	7.8	7.05
Total hardness as (CaCO3)	572.705	705	312	200.5	314.5
Chlorides as Cl	296.5	260.4	120.5	178.8	141.65
Total alkalinity	390.8	451	266.15	449.35	306.25
Sulphate as SO4	26.45	19.35	17.5	21.4	15.75
Methly Orange Alkalinity	379.85	441.4	264.1	458	306.5
Iron as Fe	0.06	0.07	0.075	0.03	0.05
Total inorganic solids	1424	1610.5	943	1461.5	1261.5
BOD	0.32	0.20	0.17	0.25	0.17

Table-3 INDIAN STANDARD SPECIFICATIONS FOR DRINKING WATER IS: 10500

S.NO	PARAMETER	REQUIREMENT DESIRABLE LIMIT	REMARKS
1.	Colour	5	May be extended up to 50 if toxic substances are suspected
2.	Turbidity	10	May be relaxed up to 25 in the absence of alternate
3.	pH	6.5 to 8.5	May be relaxed up to 9.2 in the absence
4.	Total hardenss	300	May be extended up to 600
5.	Calcium as Ca	75	May be extended up to 200
6.	Magnesium as Mg	30	May be extended up to 100
7.	Copper as Cu	0.05	May be extended up to 1.5
8.	Iron	0.3	May be extended up to 1
9.	Manganese	0.1	May be extended up to 0.5
10.	Chlorides	250	May be extended up to 1000
11.	Sulphates	150	May be extended up to 400
12.	Nitrates	45	No relaxation
13.	Fluorides	0.6 to 1.2	If the limit is below 0.6 water should be rejected, max limit is extended to 1.5
14.	Phenols	0.001	May be relaxed up to 0.002
15.	Mercury	0.001	No relaxation
16.	Cadmium	0.01	No relaxation
17.	Selenium	0.01	No relaxation
18.	Arsenic	0.05	No relaxation
19.	Cyanide	0.05	No relaxation
20.	Lead	0.1	No relaxation
21.	Zinc	5.0	May be extended up to 10.0
22.	Chromium	0.05	No relaxation
23.	Mineral oil	0.01	May be relaxed up to 0.03
24.	Residual free chlorine	0.2	Applicable only when water is chlorinated
25.	Pesticides	Absent	-

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RESULTS TURBIDITY

The acceptable limit of turbidity in water is 1NTU (Nephlometric Turbidity Unit). If the turbidity is higher, it affects the aesthetics of the drinking water as nobody likes dirty water. The samples collected showed a range of turbidity from 0.1NTU to 0.5NTU. In the graph below, the A line represents the values taken at Aminjikarai and the C line represents the samples taken at Chetpet. The turbidity values of the samples collected are within the limits and hence, it doesn't affect its quality as a drinking water.

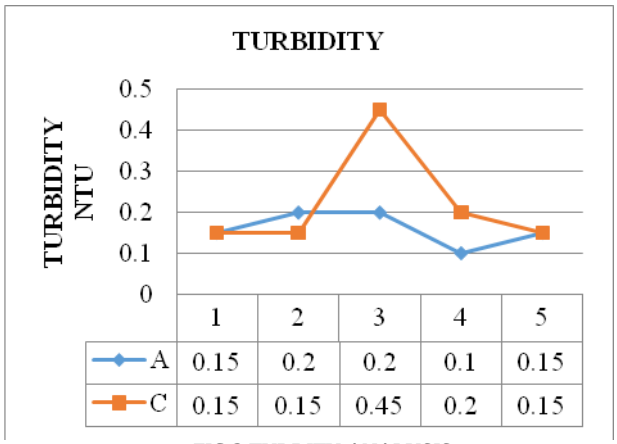

FIG 3 TURBITY ANALYSIS

pH

The pH in drinking water must be in the range of 6.5 to 8.5. pH of 7 is nuetral, neither acidic or basic. Water that can be consumed is about pH 7. Strong acids in water make pH lower. Concentrated acids have a pH of about 1. Concentrated bases have a pH of about 14. The greater the value in either direction will cause the reaction with the cells in your mouth, throat, esophagus, and stomach. The samples collected exhibited a pH of range 7 to 7.8. In the graph below, the A line represents the values taken at Aminjikarai and the C line represents the samples taken at Chetpet. As the results are within the allowable range, it doesn't affect the quality of water.

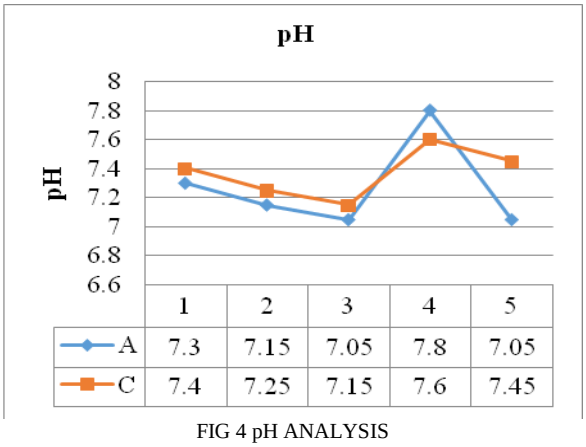

FIG 4 pH ANALYSIS

TOTAL HARDNESS

The acceptable limit is 250mg/l as per Indian Standards Specification of Drinking Water. Both calcium and magnesium are essential minerals and beneficial to human health in several respects. When calcium is absorbed in excess of need, the excess is excreted by the kidney in healthy people who do not have renal impairment. Increased intake of magnesium salts may cause a temporary adaptable change in bowel habits (diarrhoea), but seldom causes hypermagnesaemia in persons with normal kidney function In the graph below, the A line represents the values taken at Aminjikarai and the C line represents the samples taken at Chetpet.

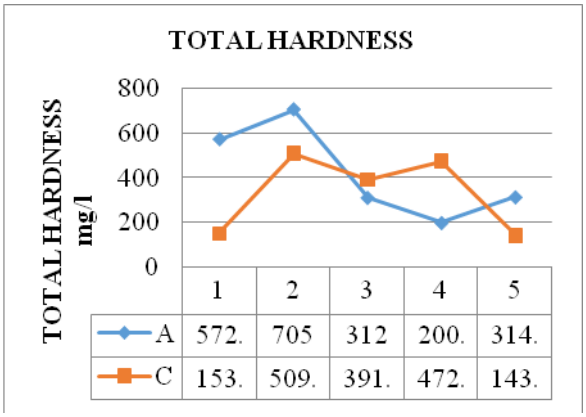

FIG 5 TOTAL HARDNESS ANALYSIS

CHLORIDES

Chlorine has been linked to various types of cancer, kidney and liver damage, immune system dysfunction, disorders of the nervous system, hardening of the arteries, and birth defects. The acceptable limit of chlorine in drinking water is 2000mg/l. The sample exhibit a chloride content of the range 74.1 mg/l to 313.9mg/l. Though the samples contain chlorides within the range, the amount of chloride required is less in these water samples. So the water must be chlorinated before using it for domestic purposes. In the graph below, the A line represents the values taken at Aminjikarai and the C line represents the samples taken at Chetpet.

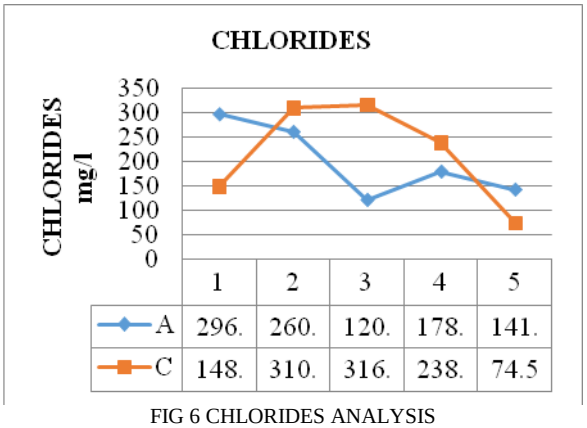

FIG 6 CHLORIDES ANALYSIS

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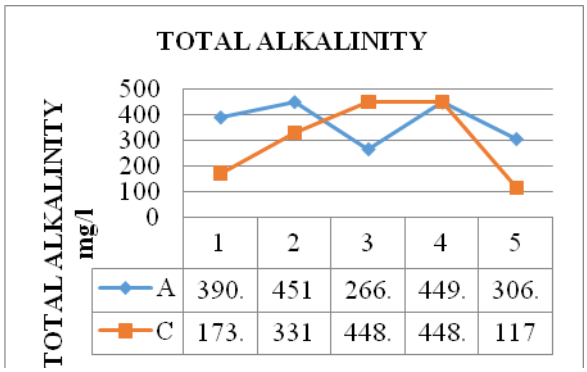
TOTAL ALKALINITY

If the alkalinity is too low, the ability of water to resist pH changes decreases. Water with low alkalinity can also be corrosive and can irritate the eyes. Water with high alkalinity has a soda-like taste, can dry out skin and can cause scaling on fixtures and throughout water distribution systems. There do not appear to be serious adverse health effects from drinking water with alkalinity above or below the suggested levels. However, many public water utilities try to maintain an acceptable alkalinity level in order to prevent low pH (acidic) water from damaging pipelines and other distribution equipment. The allowable limit is 300 mg/l. In the graph below, the A line represents the values taken at Aminjikarai and the C line represents the samples taken at Chetpet.

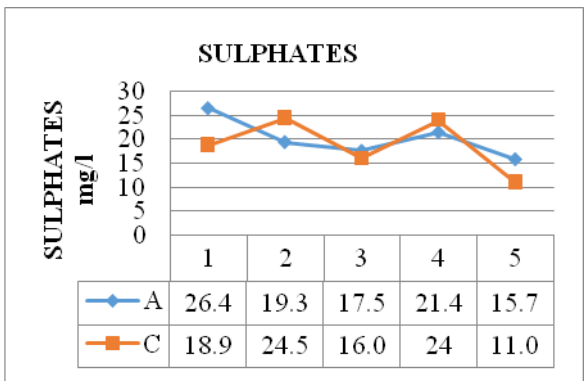


	1	2	3	4	5
A	390.	451	266.	449.	306.
C	173.	331	448.	448.	117

FIG 7 TOTAL ALKALINITY ANALYSIS

SULPHATES

There are no symptoms associated with sulphate deficiency. However, most people get the majority of their dietary sulphates through food and not from the water. High sulphate levels (1000 mg/L) have been shown to have a laxative effect on humans and can cause mild gastrointestinal irritation. Therefore, excessively high sulphate levels are usually investigated by water treatment authorities. The allowable limit is 400mg/l. In the graph below, the A line represents the values taken at Aminjikarai and the C line represents the samples taken at Chetpet. Since it is very low sulphate content the samples are not affected.

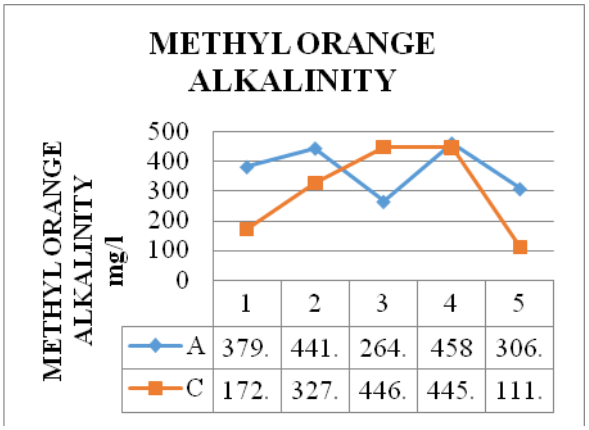


	1	2	3	4	5
A	26.4	19.3	17.5	21.4	15.7
C	18.9	24.5	16.0	24	11.0

FIG 8 SULPHATE ANALYSIS

METHYL ORANGE ALKALINITY

The allowable methyl orange alkalinity is 250 mg/l. The samples have a range of 109 to 443mg/l. The test were conducted according to IS 3025: 1986 Methods of Sampling and Test (Physical and Chemical) For Water and Wastewater, Part 23 Alkalinity. As the values exceed the allowable limit, the water is affected. In the graph below, the A line represents the values taken at Aminjikarai and the C line represents the samples taken at Chetpet.

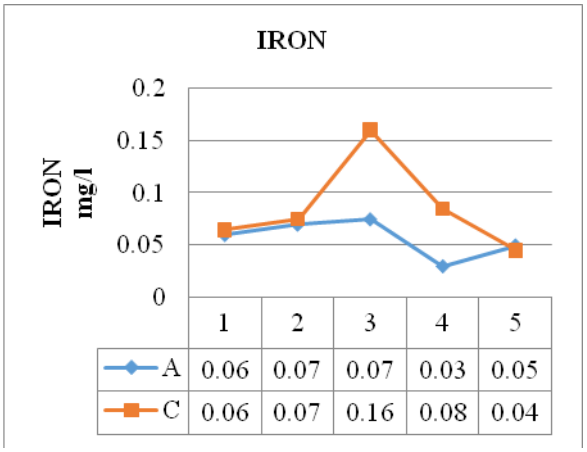


	1	2	3	4	5
A	379.	441.	264.	458	306.
C	172.	327.	446.	445.	111.

FIG 9 METHYL ORANGE ALKALINITY ANALYSIS

IRON

Iron is an essential element for humans with food providing the majority of the iron requirements. There should be no direct health effects with iron in drinking water, but iron can be linked to excessive bacterial activity[12]. The end result of this action is water that is not pleasant to drink (smell and taste), cooking with this water can also lead to a very unpleasant experience, as will using it to do laundry or wash with. The samples contained iron of the range 0.03 to 0.15mg/l. The allowable limit is 0.3mg/l. In the graph below, the A line represents the values taken at Aminjikarai and the C line represents the samples taken at Chetpet. The water is not affected by iron content.



	1	2	3	4	5
A	0.06	0.07	0.07	0.03	0.05
C	0.06	0.07	0.16	0.08	0.04

FIG 10 IRON ANALYSIS

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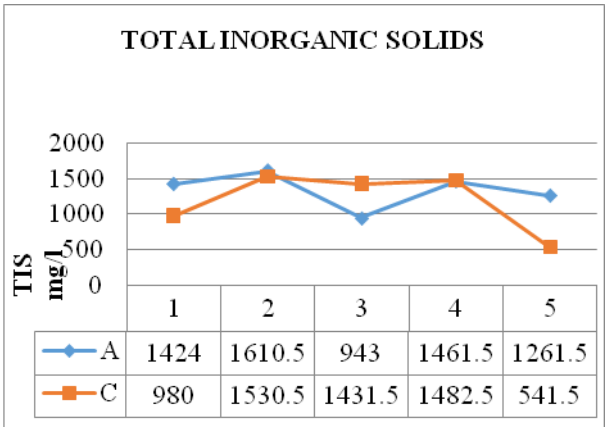
TOTAL INORGANIC SOLIDS

The allowable limit of total inorganic solids is 3000mg/l. The samples exhibited a range of 520 to 1790mg/l of total inorganic solids.[15] The test was conducted according to IS 3025 (Part 18): 1984 Methods of Sampling and Test (Physical and Chemical) For Water and Wastewater Part 18 Volatile and Fixed Residue (Total, Filterable And Non-Filterable)[16]. In the graph below, the A line represents the values taken at Aminjikarai and the C line represents the samples taken at Chetpet. As the values are within the limits, it doesn't affect the quality of the water.

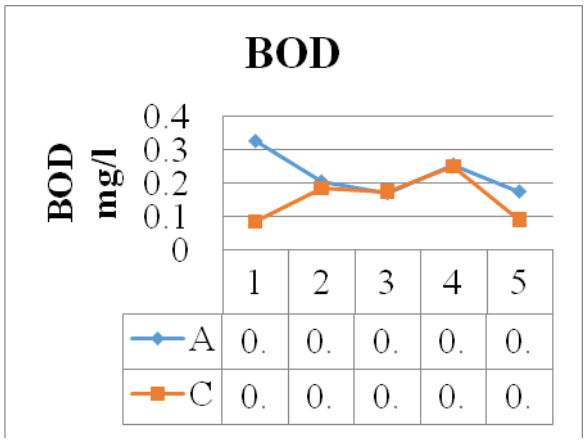


	1	2	3	4	5
A	1424	1610.5	943	1461.5	1261.5
C	980	1530.5	1431.5	1482.5	541.5

FIG 11 TOTAL INORGANIC SOLIDS ANALYSIS

BIOCHEMICAL OXYGEN DEMAND

A high BOD in water means that the water has a great amount of microorganisms, mainly aerobic bacteria. This fact is very common in areas contaminated with wastewater or effluents of water treatment plants. The acceptable limit in drinking water is less than 5mg/l. The values obtained are in the range of 0.08 to 0.32mg/l. In the graph below, the A line represents the values taken at Aminjikarai and the C line represents the samples taken at Chetpet. As the values are within the limit, this doesn't affect the quality of water.

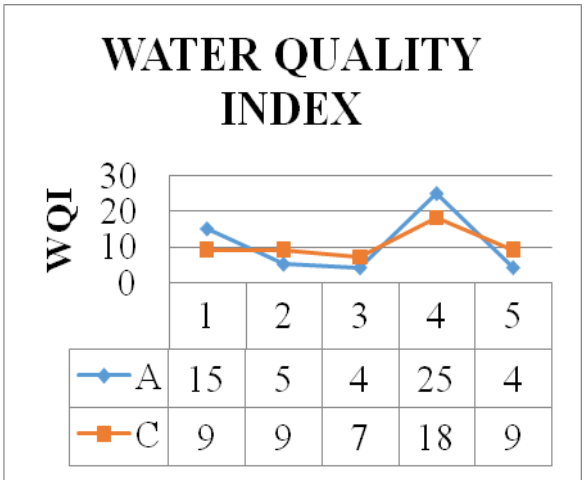


	1	2	3	4	5
A	0.	0.	0.	0.	0.
C	0.	0.	0.	0.	0.

FIG 12 B.O.D ANALYSIS

COMPARISON OF WATER QUALITY INDEX

The BIS and ICMR Standards were used for calculating the unit weight.In the graph below, the A line represents the values taken at Aminjikarai and the C line represents the samples taken at Chetpet. The water quality index was calculated and the quality of water is excellent.



	1	2	3	4	5
A	15	5	4	25	4
C	9	9	7	18	9

FIG 13 WATER QUALITY INDEX

WATER TREATMENT PROCESS

After testing, the values are nearly in acceptable limit as per IS: 10500 So,the water is used for gardening and other non domestical purposes. The following treatment method are to be used to improve the bore water quanlity for drinking purpose.

1. Softning of water (adding lime)
2. Screening
3. CO_2 Aerators
4. Activated Carbon
5. Chlorination

CONCLUSION

The samples were collected and tested in 10 different locations in two areas on july 2015. The colour and odour of the water in the selected areas are acceptable. The turbidity of the entire site samples are within the acceptable limit. The pH of the water is within the range of 6.5-8.5.As the hardness is above the acceptable limit, there is a risk of milk alkali syndrome and hypercalcaemia, change in bowel habits (diarrhoea) and may cause hypermagnesaemia in persons with normal kidney function. And it may cause corrosion in pipes. The chloride content is acceptable but too it is recommended to chlorinate the water before using it for domestic purposes. The total alkalinity varies below and above the acceptable limit. There do not appear to be serious adverse health effects from drinking water with alkalinity above or below the acceptable level. The sulphate content in the water of areas studied is less than 10% of the acceptable limits. So, it has no effects on

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human health and can be used for domestic purposes. The iron and the total inorganic solids in the water is under the acceptable limits. The biological oxygen demand is also under the acceptable limits. The water quality index also lies within 25 and hence the quality of water is excellent. It is therefore concluded that the contamination of Cooum River does not affect the ground water quality of Aminjikarai and Chetpet.
(Note: project is under research on treatment process)

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