Study of Ground Water Quality in Cooum Belt

K. Ilayaraja and M. D. Zafar Eqyaabal*

Department of Civil Engineering, Bharath University, Chennai – 600073, Tamil Nadu, India; ilayaraja.civil@bharathuniv.ac.in, zafareqyaabal.civil@bharathuniv.ac.in

Abstract

Ground water samples from Cooum belt areas were collected and analyzed for their physico-chemical characteristics. Results obtained were inferred based on the drinking water quality standards of IS 10500:1991. Out of the ten locations chosen, Anna Nagar and Pachayappas were found to possess high total dissolved solids values. Nitrate was found higher in ground water drawn from sources of Fort St. George and Pachayappas. Possibility of pollution of ground water resources in Cooum belt areas is indicated by the study.

Keywords: Chemical Characteristics, Cooum River, Ground Water, Physical Characteristics

1. Introduction

Groundwater is a component of hydrological cycle which occupies the voids in the saturated zone of the earth's crust and moves in the voids of sedimentary rocks or in the fractures and joints of hard rocks. The major natural and pure source of drinking water is ground water. The current project studies the quality of ground water in Chennai city – Cooum belt².

Cooum River is geographically located at latitude (13.0683 degrees) 13° 4’ 5” North of the Equator and longitude (80.286 degrees) 80° 17’ 9” East of the Prime Meridian on the Map of Chennai. The river is a drainage course originating near Sattarai in Tiruvallur District and it takes a meandering course west to east for about 16 km within the city. It travels along major areas of the city (stated as the Cooum belt) such as Arumbakkam, Aminjikarai, Chetpet, Egmore, Pudupet, Chindadripet, and Island Grounds and finally joins the Bay of Bengal³.

Pollution of ground water resources due to infiltration of polluted water from Cooum River is highly possible and hence the Cooum belt is chosen for the studies⁴.

2. Methods

Sampling was done in the following 10 locations of the Cooum belt Figure 1(a), 1(b) and 1(c):

Maduravoyil, Thirumangalam, Anna Nagar, Shenoy Nagar, Pachayappas College, Chetpet, Kilpauk, Egmore, Park Station and Fort St. George¹.

The samples collected were tested for the following parameters: Physical parameters – Appearance, Odor, Turbidity, and Total Dissolved Solids.

Chemical parameters – pH, Alkalinity, Total Hardness, Chloride, Fluoride, Iron, Ammonia, Nitrite, Nitrate, Phosphate⁶⁻⁷. A Field Kit was obtained from TWAD Board and the water samples were tested (2). The test procedure is as shown in Table 1.

3. Results and Discussions

The Comparative test results in ten locations for the month of January 2012 and March 2012 are as tabulated (Table 2.) below (1).
### Table 1. Test procedure for water quality testing as prescribed by TWAD Board

| PARAMETER                  | PROCEDURE                                                                 | END POINT                              | CALCULATION                                      |
|----------------------------|---------------------------------------------------------------------------|----------------------------------------|--------------------------------------------------|
| APPEARANCE                 | 10 ml water sample taken in 100 ml titration cup. Observed the sample in cup with naked eye | Colourless and clear, Brownish, Greenish, Blackish |                                                  |
| ODOR                       | 10 ml water sample taken in 100 ml titration cup.                         | None, Soil smell, Algal smell, Objectionable, Rotten egg smell |                                                  |
| TURBIDITY                  | 10 ml water sample taken in 100 ml titration cup. Observed the sample in cup with naked eye | No turbidity, Slightly Turbid, Moderately Turbid, Highly Turbid |                                                  |
| pH                         | 1 drop of water sample is added on pH paper                               | Change in colour of pH paper is compared with pH chart |                                                  |
| ALKALINITY (mg/l)          | 20 ml water sample taken in titration cup. 5 drops of A1 added. Colour changes to bluish green. A2 added with 1ml syringe | Orange yellow                          | No of divisions of A2 x 10                        |
| HARDNESS (mg/l)            | 20 ml water sample taken in titration cup. 5 drops of H1 and H2 added. Colour changes to pink. H3 added with 1ml syringe | Blue                                   | No of divisions of H3 x 10                        |
| CHLORIDE (mg/l)            | 20 ml water sample taken in titration cup. 5 drops of C1 added. Colour changes to yellow. C2 added with 1ml syringe | Slight reddish                         | No of divisions of C2 x 10                        |
| TOTAL DISSOLVED SOLIDS (mg/l) | (Alkalinity + Hardness + Chloride) x 1.2 |                                        |                                                  |
| FLUORIDE (mg/l)            | 5 ml of water sample taken in 10 ml bottle. 5 drops of F liquid added. | Compare change in colour with Fluoride Chart |                                                  |
| AMMONIA (mg/l)             | 10 ml water sample taken in bottle.5 drops of AM liquid added.            | Yellow                                 | Compare change in colour with Ammonia Chart       |
| IRON (mg/l)                | 10 ml water sample taken in bottle.5 drops of Fe1 and 1 drop of Fe2 added. Mix. 5 drops of Fe3 added. | Red                                    | Compare change in colour with Iron Chart          |
| NITRITE (mg/l)             | 10 ml water sample taken in bottle. 2 drops of N2 and N3 added.           | Pink                                   | Compare change in colour with Nitrite Chart       |
| NITRATE (mg/l)             | 1 ml water sample taken in 10 ml bottle. 9 ml distilled water is added. Pinch of metal powder added using mini spatula. 2 drops of N2 and N3 added | Pink                                   | Compare change in colour with Nitrate Chart       |
| PHOSPHATE (mg/l)           | 10 ml water sample taken in bottle.5 drops of P1 is added. Shake the bottle. 1 drop of P2 is added. Gently shake the bottle. | Blue                                   | Compare change in colour with Phosphate Chart     |
| Residual Chlorine (mg/l)   | 10 ml water sample taken in bottle. 5 drops of RC liquid is added. Shake the bottle | Yellow                                 | Compare change in colour with Chlorine Chart      |

![Figure 1a. Site location.](image-url)
Figure 1b. Cooum belt.
Study of Ground Water Quality in Cooum Belt

On testing the samples obtained from Maduravoyil, it was inferred that for both the months not much variation was seen in the values of the physico-chemical parameters and the water in this area is fit for all the domestic purposes.

It was observed that the values of fluoride obtained were less than that desirable value of 1 mg/l in Thirumangalam area. Steps must be taken to increase the fluoride content in groundwater to avoid the occurrence of dental fluorosis in kids (Table 3).

On testing the samples obtained, it was inferred that for both the months not much variation was seen in the values of the physico-chemical parameters and the water in this area is fit for all the domestic purposes.

On testing the samples and studying the results obtained, it was inferred that the groundwater in this area has high amount of total dissolved solids. Also the water is hard and has less amount of fluoride than desired. Thus, the groundwater here is not fit for consumption and speedy measures must be taken to restore the groundwater quality.

On testing the samples obtained, it was inferred that for both the months not much variation was seen in the values of the physico-chemical parameters and the water in this area is fit for all the domestic purposes.

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**Table 2.** Ground water quality test results; Location – Maduravoyil

| PARAMETERS     | BIS PERMISSIBLE LIMIT | JANUARY 2012 | MARCH 2012 |
|----------------|-----------------------|--------------|------------|
| APPEARANCE     | Colourless            | Colourless/Clear | Colourless/Clear |
| ODOUR          | None                  | No odor      | No odor    |
| TURBIDITY      | Nil                   | Nil          | Nil        |
| pH             | 8.5                   | 6.98         | 7.5        |
| ALKALINITY mg/l| 600 mg/L              | 488          | 500        |
| HARDNESS mg/l  | 600 mg/L              | 520          | 486        |
| CHLORIDE mg/l  | 1000 mg/L             | 322          | 315        |
| TDS mg/l       | 2000 mg/L             | 1484         | 1561       |
| FLUORIDE mg/l  | 1.5 mg/L              | 0.66         | 1          |
| IRON mg/l      | 1 mg/L                | 0.1          | 0.1        |
| AMMONIA mg/l   | No guideline. But if present more than 1 mg/l, indicative of pollution | 0.17 | 0.2 |
| NITRITE mg/l   | No guideline. But if present more than 1 mg/l, indicative of pollution | 0.73 | 0.8 |
| NITRATE mg/l   | 45 mg/L               | 5            | 20         |
| PHOSPHATE mg/l | No guideline. But if present more than 1 mg/l, indicative of pollution | 0.52 | 1 |
| RESIDUAL CHLORINE mg/l | 1 mg/l | 0 | 0 |
Table 3. Ground Water Quality Test Results: Location – Thirumangalam

| PARAMETER          | BIS PERMISSIBLE LIMIT | JANUARY 2012     | MARCH 2012     |
|-------------------|-----------------------|------------------|---------------|
|                   |                       | Colourless       | Colourless/Clear |
| APPEARANCE        |                       | Colourless/ Clear | Colourless/ Clear |
| ODOR              | None                  | No odor          | No odor        |
| TURBIDITY         | Nil                   | Nil              | Nil           |
| pH                | 6.5-8.5               | 7.01             | 6.5           |
| ALKALINITY mg/l   | 600 mg/L              | 164              | 175           |
| HARDNESS mg/l     | 600 mg/L              | 210              | 205           |
| CHLORIDE mg/l     | 1000 mg/L             | 149              | 152           |
| TDS mg/l          | 2000 mg/L             | 652              | 638           |
| FLUORIDE mg/l     | 1.5 mg/L              | 0.71             | 0.5           |
| IRON mg/l         | 1 mg/L                | 0.07             | 0.1           |
| AMMONIA mg/l      | No guideline. But if present more than 1 mg/l, indicative of pollution | 0.19 | 0.23 |
| NITRITE mg/l      | No guideline. But if present more than 1 mg/l, indicative of pollution | 0.07 | 0.1 |
| NITRATE mg/l      | 45 mg/L               | 2                | 5             |
| PHOSPHATE mg/l    | No guideline. But if present more than 1 mg/l, indicative of pollution | 0.6 | 1 |
| RESIDUAL CHLORINE mg/l | 1 mg/l | 0 | 0 |

Table 4. Ground Water Quality Test Results: Location – Anna Nagar

| PARAMETERS          | JANUARY 2012     | MARCH 2012     |
|---------------------|------------------|---------------|
| APPEARANCE          | Colourless/Clear | Colourless/Clear |
| ODOR                | No odour         | No odour      |
| TURBIDITY           | Nil              | Nil           |
| TDS mg/l            | 2058             | 1820          |
| pH                  | 6.99             | 6.5           |
| ALKALINITY mg/l     | 496              | 500           |
| HARDNESS mg/l       | 580              | 596           |
| CHLORIDE mg/l       | 421              | 421           |
| FLUORIDE mg/l       | 0.82             | 0.5           |
| IRON mg/l           | 0.06             | 0.5           |
| AMMONIA mg/l        | 0.38             | 0.4           |
| NITRITE mg/l        | 0.07             | 0.1           |
| NITRATE mg/l        | 5                | 10            |
| PHOSPHATE mg/l      | 0.48             | 1             |
| RESIDUAL CHLORINE mg/l | 0           | 0             |

Table 5. Ground water quality test results: Location – Shenoy Nagar

| PARAMETERS          | JANUARY 2012     | MARCH 2012     |
|---------------------|------------------|---------------|
| APPEARANCE          | Colourless/Clear | Colourless/Clear |
| ODOR                | No odour         | No odour      |
| TURBIDITY           | Nil              | Nil           |
| TDS mg/l            | 1628             | 1322          |
| pH                  | 6.78             | 6.5           |
| ALKALINITY mg/l     | 364              | 360           |
| HARDNESS mg/l       | 490              | 512           |
| CHLORIDE mg/l       | 228              | 230           |
| FLUORIDE mg/l       | 0.91             | 1             |
| IRON mg/l           | 0.11             | 0.1           |
| AMMONIA mg/l        | 0.29             | 0.3           |
| NITRITE mg/l        | 1.1              | 1.15          |
| NITRATE mg/l        | 4                | 10            |
| PHOSPHATE mg/l      | 0.33             | 1             |
| RESIDUAL CHLORINE mg/l | 0           | 0             |
Table 6. Ground water quality test results: Location – Pachayapas College

| PARAMETERS       | JANUARY 2012 | MARCH 2012 |
|------------------|--------------|------------|
| APPEARANCE       | Colourless/Clear | Colourless/Clear |
| ODOUR            | No odour     | No odour   |
| TURBIDITY        | Nil          | Nil        |
| TDS mg/l         | 2096         | 1747       |
| pH               | 7.02         | 7          |
| TDS mg/l         | 2096         | 1747       |
| pH               | 7.02         | 7          |
| ALKALINITY mg/l  | 444          | 446        |
| HARDNESS mg/l    | 590          | 592        |
| CHLORIDE mg/l    | 416          | 418        |
| FLUORIDE mg/l    | 0.73         | 1          |
| IRON mg/l        | 0.1          | 0.1        |
| AMMONIA mg/l     | 0.01         | 0.1        |
| NITRITE mg/l     | 1.1          | 1.1        |
| NITRATE mg/l     | 48           | 45         |
| PHOSPHATE mg/l   | 0.15         | 1          |
| RESIDUAL CHLORINE mg/l | 0 | 0 |

Table 7. Ground water quality test results: Location – Chetpet

| PARAMETERS       | JANUARY 2012 | MARCH 2012 |
|------------------|--------------|------------|
| APPEARANCE       | Colourless/Clear | Colourless/Clear |
| ODOUR            | No odour     | No odour   |
| TURBIDITY        | Nil          | Nil        |
| TDS mg/l         | 744          | 736        |
| pH               | 6.98         | 7          |
| ALKALINITY mg/l  | 260          | 274        |
| HARDNESS mg/l    | 210          | 210        |
| CHLORIDE mg/l    | 124          | 130        |
| FLUORIDE mg/l    | 0.48         | 0.5        |
| IRON mg/l        | 0.18         | 0.2        |
| AMMONIA mg/l     | 0.1          | 0.1        |
| NITRITE mg/l     | 0.47         | 0.5        |
| NITRATE mg/l     | 17           | 20         |
| PHOSPHATE mg/l   | 0.28         | 1          |
| RESIDUAL CHLORINE mg/l | 0 | 0 |

Table 8. Ground water quality test results: Location – Kilpauk

| PARAMETERS       | JANUARY 2012 | MARCH 2012 |
|------------------|--------------|------------|
| APPEARANCE       | Colourless/Clear | Colourless/Clear |
| ODOUR            | No odour     | No odour   |
| TURBIDITY        | Nil          | Nil        |
| TDS mg/l         | 1246         | 1086       |
| pH               | 7.22         | 7          |
| ALKALINITY mg/l  | 328          | 315        |
| HARDNESS mg/l    | 336          | 358        |
| CHLORIDE mg/l    | 234          | 232        |
| FLUORIDE mg/l    | 0.56         | 0.5        |
| IRON mg/l        | 0.11         | 0.1        |
| AMMONIA mg/l     | 0.1          | 0.1        |
| NITRITE mg/l     | 0.02         | 0.02       |
| NITRATE mg/l     | 3            | 5          |
| PHOSPHATE mg/l   | 0.32         | 1          |
| RESIDUAL CHLORINE mg/l | 0 | 0 |
Table 9. Ground water quality test results: Location – Egmore

| PARAMETERS | JANUARY 2012 | MARCH 2012 |
|------------|--------------|-------------|
| APPEARANCE | Colourless/Clear | Colourless/Clear |
| ODOR       | No odour     | No odour    |
| TURBIDITY  | Nil          | Nil         |
| TDS mg/l   | 1542         | 1410        |
| pH         | 6.99         | 7.5         |
| ALKALINITY mg/l | 408 | 400 |
| HARDNESS mg/l   | 390 | 415 |
| CHLORIDE mg/l   | 347 | 360 |
| FLUORIDE mg/l   | 0.62 | 0.5 |
| IRON mg/l      | 0.1 | 0.1 |
| AMMONIA mg/l   | 0.15 | 0.15 |
| NITRITE mg/l   | 0.04 | 0.05 |
| NITRATE mg/l   | 3 | 3 |
| PHOSPHATE mg/l | 0.6 | 1 |
| RESIDUAL CHLORINE mg/l | 0 | 0 |

Table 10. Ground water quality test results: Location – Park Station

| PARAMETERS | JANUARY 2012 | MARCH 2012 |
|------------|--------------|-------------|
| APPEARANCE | Colourless/Clear | Colourless/Clear |
| ODOR       | No odour     | No odour    |
| TURBIDITY  | Nil          | Nil         |
| TDS mg/l   | 1142         | 1159        |
| pH         | 7.18         | 7           |
| ALKALINITY mg/l | 312 | 324 |
| HARDNESS mg/l   | 324 | 332 |
| CHLORIDE mg/l   | 297 | 310 |
| FLUORIDE mg/l   | 0.47 | 0.5 |
| IRON mg/l      | 0.06 | 0.09 |
| AMMONIA mg/l   | 0.14 | 0.15 |
| NITRITE mg/l   | 0.41 | 0.5 |
| NITRATE mg/l   | 12 | 20 |
| PHOSPHATE mg/l | 0.49 | 1 |
| RESIDUAL CHLORINE mg/l | 0 | 0 |

Table 11. Ground water quality test results: Location – Fort St.George

| PARAMETERS | JANUARY 2012 | MARCH 2012 |
|------------|--------------|-------------|
| APPEARANCE | Colourless/Clear | Colourless/Clear |
| ODOR       | No odour     | No odour    |
| TURBIDITY  | Nil          | Nil         |
| TDS mg/l   | 1168         | 1561        |
| pH         | 6.68         | 6.5         |
| ALKALINITY mg/l | 388 | 388 |
| HARDNESS mg/l   | 440 | 453 |
| CHLORIDE mg/l   | 446 | 450 |
| FLUORIDE mg/l   | 0.66 | 1 |
| IRON mg/l      | 0.03 | 0.05 |
| AMMONIA mg/l   | 0.3 | 0.36 |
| NITRITE mg/l   | 0.48 | 0.5 |
| NITRATE mg/l   | 48 | 50 |
| PHOSPHATE mg/l | 0.35 | 1 |
| RESIDUAL CHLORINE mg/l | 0 | 0 |
On testing the samples and observing the results, it was inferred that the groundwater in Pachayappas area has high amount of total dissolved solids. Also the water is hard. It was also inferred that the groundwater contained high amount of nitrate. Thus, the groundwater here is not fit for consumption. There is an immediate need to look out for another source of water.

It was observed that the values of fluoride obtained were less than that desirable value of 1 mg/l in Chetpet. Steps must be taken to increase the fluoride content in groundwater to avoid the occurrence of dental fluorosis in kids.

It was observed that the values of fluoride obtained were less than that desirable value of 1 mg/l in Kilpauk. Steps must be taken to increase the fluoride content in groundwater to avoid the occurrence of dental fluorosis in kids.

It was observed that the values of fluoride obtained were less than that desirable value of 1 mg/l in Egmore. Steps must be taken to increase the fluoride content in groundwater to avoid the occurrence of dental fluorosis in kids. Also the values of total dissolved solids are almost the permissible limit of 2000 mg/l.

It was inferred that the values of fluoride obtained were less than that desirable value of 1 mg/l in Park Station. Steps must be taken to increase the fluoride content in groundwater to avoid the occurrence of dental fluorosis for kids.

On testing the samples and observing the results, it was inferred that the groundwater in Fort St. George has high amount of total dissolved solids. It was also inferred that the groundwater contained high amount of nitrate. Thus, the groundwater here is not fit for consumption. There is an immediate need to look out for another source of water.

4. Conclusion

A regular monitoring of Groundwater quality should be done in the areas of Anna Nagar and Pachayappas where water was found to have high total dissolved solids compared to other test areas. Nitrate was found higher in ground water drawn from sources of Fort St. George and Pachayappas. Hence, there is a need to look out for an alternative source to meet the domestic needs. Possibility of pollution of ground water resources in Cooum belt areas is indicated by the study.

5. References

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