CHEMICAL ANALYSIS OF BHADRA DAM WATER

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Abstract: -
Bhadra is one of the important water bodies in Karnataka, India. It is used by a large section of people of Karnataka for their daily use and agriculture. However, with the release of chemical effluents from the industries, the chemical composition of the water body is now changed, which makes it harmful for consumption. This paper aims to analyze the chemical characteristics of Bhadra Dam water to find out how the chemical composition of Dam water changes in different locations of the Dam, and how safe it is for human consumption.

Keywords: - *Bhadra, Chemical Effluents*

INTRODUCTION

Bhadra river is a tributary of river Tungabhadra. Bhadra rises near Samse in the Aroli hill range of Kudremukh latitude 13º15″, 70º N, and longitude 75º09″,42º20″ E Karnataka state, India. Bhadra river initially flows in the east direction, in course changes to the north and joins Tunga at Koodli latitude 75º40″, 32º61″ E and Longitude 13º59″,43º75″ N in Shimoga district.

The study has been conducted the downstream of Bhadra rivers which flow 48 km from the origin and meets with Tunga river. Bhadra catchment covers three districts: Shivamogga, Chikmagalur, and Davangere. The Tungabhadra command area comprises seven districts and 27 taluks. Tungabhadra river flows up to 298 km, through Karnataka and some parts of Andhra Pradesh, and joins river Krishna.

The paper presents a case study on the water quality analysis carried out at Bhadra Rivers backwater and different six places of river flows and finally in Koodli Shivamogga, Karnataka, India. Fifteen Physico-chemical parameters were considered in this analysis and were carried for mid-monsoon. The water quality index indicated that most of the sampling locations come under a good category indicating the suitability of water for human use. Due to industrialization and agricultural disposition, some samplings have become listed.

The parameters considered were

1. pH
2. Nitrate
3. Temperature
4. Total hardness
5. Chloride
6. Fluoride
7. Total alkalinity
8. Iron
9. Nitrite
10. ammonia
11. Phosphate
12. Dissolved Oxygen
13. Carbon-dioxide
14. Biological Oxygen Demand
15. Chemical Oxygen Demand

Materials and Methods

The analysis was carried out using Field Test Kits (FTK). FTK is

1. A simplified version of standard lab analysis.
2. Easy to operate.
3. Do not require any energy source.
4. Compared to standard methods the results may vary from 20-30 units.

Procedure

1. pH - Hydrogen ion concentration

Take a pH paper strip. Take the water sample in a beaker. Dip the pH strip into the water sample. There will be instant color development on the pH paper. Match the color with the standard color chart of pH. The corresponding pH value is noted down.

2. Turbidity

Fill the glass beaker with water samples up to 80 ml. Keep the turbidity chart horizontally on a plane surface with enough daylight. Place the glass beaker with the water sample on the standard Sacchi disc icon of the chart, look down through the water sample at the standard icon under the beaker. Compare the appearance of the standard icon under the beaker to the turbidity chart icon.

3. Total hardness

Using the 25ml measuring cylinder, take a 10 ml water sample in a conical flask. Add 10 drops of buffer solution to this sample. Add a composite total hardness tablet which consists of an indicator and inhibitor. Dissolve it by vigorous shaking. The water sample will have a wine red color and the solution shows floating or settled fragments of insoluble material. With the help of a 5 or 10 ml pipette titrate the sample with standard EDTA solution till the wine red color changes to blue.

Total hardness(as calcium carbonate) mg/l = (A) of EDTA x 100

4. Chloride

Using the 25 ml measuring cylinder take 10 ml of water sample in a conical flask. Add 5 drops of potassium chromate solution. This will produce a yellow color. Titrate this against standard silver nitrate solution with the help of a 10 ml pipette with constant stirring, till a slightly reddish-brown color is observed and stays. This is the endpoint. Note the volume of the silver nitrate solution required (A).

Chloride = A X 50(mg/l).

5. Fluoride

Keep the standard fluoride color chart in the chart holder. Take one test tube, rinse it well with sample water and fill it up to the mark (4ml). Add drop-by-drop fluoride reagent solutions till it reaches the upper mark (5ml) and mixes well. Instant color will be developed. Put this test tube on the chart holder, the color in the test tube matches one of the standard color charts of fluoride.

6. Phosphate

Keep the standard phosphate color chart in the chart holder, take a 5ml tube and rinse it well with the sample water and fill the tube up to the mark of 5 ml, add one drop of phosphate reagent 'A' into the test-tube and mix immediately. Add 2 drops of phosphate reagent 'B' mix well. Now add one drop of phosphate reagent 'C' mix well, allowing 5 minutes for maximum color development. Put this test tube in the slot on the chart holder. Match the developed color with one of the colors in the standard color chart of phosphate.

7. Total alkalinity

Using the 25 ml measuring cylinder take 10 ml of water sample in a conical flask. Add 2-3 drops of Phenolphthalein indicator, if the pink color develops titrate with 0.02N sulfuric acid, with the help of 10ml pipette till it disappears. Note the volume of sulfuric acid required (A). Add 2-3 drops of Methyl Orange indicators to the same flask and continue titration till the golden yellow color changes to pink, note the volume of sulfuric acid(B).

Alkalinity mg/$CaCO_3$ = (A + B) * 100

8. Residual Chlorine

Collect the water sample to be tested in the beaker. Take one test tube, raise it with the sample water and fill sample water up to the mark (5ml). Add 4 drops of Orthotoludine (OT) reagent solutions into the test tube containing the water sample, instant yellow color will be developed to match this color with the standard color chart of residual chlorine.

9. Ammonia

Keep the standard ammonia color chart in the chart hola der, take off 5ml tube and rinse it with sample water and fill the tube with the mark 5 ml. Add 4 drops of ammonia reagent 'A' into the test tube mix well. Immediately add ammonia reagents 'B', immediately put the cap on the cube and mix well. Allow 5 minutes for maximum colour development put this test tube in the slot on the chart holder, match this development with one of the colors on the standard colour chart.

10. Nitrite

Keep the chart on the chart holder takes one test tube and rinse it and fill it with water up to mark(5ml), add one nitrite reagent tablet 'A' with the help of forceps into a tube and mix well, add 3 drops of nitrite reagent 'B' solution into the tube and mix well, wait for 10 minutes for maximum color development allow molecule particles to settle down separating the color water. This color water in the test tube will nearly match with one of the colors in the standard color chart of nitrite.

11. Iron

Keep the standard iron color chart in the chart holder. Take one tube and rinse it with sample water and fill it mark 5 ml, add 2 drops of iron reagent of 'A' into the tube and mix well wait for 5 minutes then add 5 drops f iron reagents 'B' mix, allow for 10 minutes for maximum color development put this on chart holder. This color on the test tube nearly matches with one of the colors in the standard color chart of iron.

12. Free Carbon dioxide

Take 50ml of water sample in a conical flask, add 2-3 drops of Phenolphthalein indicator. If the color turns pink then this indicates that free carbon dioxides are absent. Then this is titrated against standard sodium thiosulphate, taken in the burette, until the appearance of the pale pink color.

13. Dissolved Oxygen

Take a glass stoppered BOD bottle of known volume to fill the sample avoiding any bubbling that should be trapped in the bottle. Now add 2 ml manganous sulfate and alkaline potassium iodide solution using puppeteers. A precipitate will appear, close the stopper and shake well. Allow the precipitate to settle down and add 2 ml of concentrated sulfuric acid, pipette out of a known volume of it into conical flask adding few drops of starch indicator and titrate against sodium thiosulfate solution until the initial blue color turns to colorless. The amount of dissolved oxygen is calculated by using the formula,

DO mg/l = (Normality of titrating * 8 * 1000) / (V_2 [(V_1 - V)/V_1])

14. Biological Oxygen Demand (BOD)

Take a BOD bottle of a known volume to add the appropriate amount of the sample to this bottle, to determine the initial one set, add 2ml of alkaline potassium iodide and manganese sulfate which gives a precipitate, allow the precipitate to settle and add 5 ml of a concentrated Sulfuric acid shake well until precipitate dissolves. The other set of BOD or BOD bottles are incubated for 5 days at 20 degrees C to find the final DO. take the known volume of samples and add a starch indicator, titrate against Sodium thiosulfate solution until the color changes from blue to colorless.

BOD mg/l = (Initial DO - Final DO) / Volume of Sampled * Volume of Bottled

15. Chemical Oxygen Demand (COD)

The amount of organic matter in water is estimated by its oxidability by a chemical oxidant such as potassium permanganate or potassium dichromate by the permanganate method. The organic matter is oxidized with known volume $KMnO_4$ and then excess oxygen is allowed to react with a potassium iodide to liberate iodine in the amount equal to the excess of the oxygen which is estimated from titration with sodium thiosulfate solution using starch as an indicator.

COD mg/L = (8 * M * (A-B) * 1000) / S

Results of the Analysis

Tests	Dam Water	Sunnadahalli	New Bridge	Dasar Kallahalli	VISL (effluent)	Koodli (final point)
Turbidity(in NTU)	0-10	10-20	10-20	20-25	20-30	10-20
pH	6.8	7	6.5	7.6	7.5	7
Temperature in Celcius	24	24	25	25	27	24
Total Hardness (in mg/l)	75	150	200	190	210	200
Chloride (in mg/l)	35	50	60	85	95	75
Total Alkalinity (in mg/l)	50	200	400	320	260	240
Residual Cl(in ppm)	0.0	0.0	0.2	0.2	0.0	0.3
Fluoride (in ppm)	0.5	0.5	0.5	0.5	0.5	0.5
Nitrate (in ppm)	0	10	10	10	10	10
Iron (in ppm)	0	0.3	0.5	0.3	4	0.2
Ammonia (in ppm)	0.5	0	0.5	0.5	0	1
Nitrite (in ppm)	0	0	0	0	0.5	0
Phosphate (in ppm)	0	0	0	2	1	0.1
Dissolved Oxygen (in mg/l)	8.26	5.06	5.03	4.63	1.0	5.0
Free CO2	17.8	39.6	57.2	59.3	79.2	68.3
BOD (in mg/l)	2.05	5.07	7.45	6.43	1.00	5.25
COD (mg/l)	75	104	176	192	428	210

The physio-chemical analysis of Bhadra River describes how the Physico-Chemical parameters are changing from the initial point of the Bhadra river along with the downstream and the endpoint.

1. The physicochemical parameters revealed that the water in the reservoir is very less populated when compared to other sampling spots, which were chosen for this analysis from downstream.
2. The temperature remains constant between 24 degrees to 25 degrees celsius in all selected sampling plots, with a small variation of 1 degree. A slight variation of pH was observed in the selected sampling spots, but the values remain in the natural range of 6.5 to 7.5
3. The turbidity was not observed in the BRP but in the 5 spots of water, moderate turbidity could be seen. The turbidity from dam water to downstream was due to the addition of agricultural wastewater, sewage, factory effluents, and run of water earth surface to the rover.
4. The highest dissolved oxygen content of 8.26 mg/l was estimated in the reservoir, then it gradually decreased along with the downstream sampling spots. In Koodli the endpoints of the sample have the DO contents of 5.00 mg. l. The decrease in DO is due to the addition of sewage and other pollutants to the rivers.
5. The free carbon dioxide content was less in the first 2 sampling spots but in the remaining four sampling spots, it was high. Out of these 4 samples, VISL sampling contains a high amount of free carbon -dioxide of 79.2 mg/l.
6. Both BOD and COD showed an increase in values from the reservoir to the downstream spots till the endpoint. The BOD increases from 2.05 mg/l to 7.45 mg/l due to the absence of bio components like decomposers. COD also increases from 75 mg/l to 210 mg/L along with the downstream spots.
7. The water becomes soft to very hard from the reservoir to the endpoint. The hardness of the water in the reservoir is 75 mg/L and 200 mg/L in the endpoint at Koodli. This is due to the addition of factory effluent.
8. The chloride content increases from 35 mg/L to 95 mg/L and then decreases to 75 mg/L.Alkalinity increases from 50mg/L to 400 mg/L and decreases to 240 mg/L. This change is due to the addition of sewage.
9. Fluoride, Ammonia Nitrate, and Nitrite remain constant. Residual Chloride is not observed in the first two selected sampling spots. A small amount of residual chlorine was observed in the other 4 sampling spots. This is due to the addition of chlorinated effluents.
10. There is no presence of iron contents in the first 2 sampling spots but the VISL effluents show the presence of 4 ppm of iron concentration. In addition to this effluent to the river, the river water shows an iron content of 0.3 ppm in the last three sampling spots.

Conclusion

All the physicochemical parameters show that only the reservoir water is below the pollution level. As we move downstream, the pollution level increases. This pollution is due to the addition of pollutants like agricultural wastes, factory effluents, sewage, biological and human activities, and runoff water from the earth's surface.
From this analysis fluoride, ammonia, nitrate, and nitrite remain constant. Residual chlorine was not observed in the first 2 sampling spots. A small amount of residual chlorine was found in the remaining spots. There is no presence of iron content in the first 2 sampling spots but the VISL effluents showed the presence of iron.

From all these observations, it can be concluded that only the dam water is fit for human consumption.

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