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Water Quality Assesment of Physiochemical Properties of Shivnath River in Durg District (Chhattisgarh)

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Abstract- A study was undertaken to determine the quality of water of Shivnath river in Rasmara region of Durg district. The samples collected were analyzed for the physical properties like color, temperature, and odor, chemical properties like pH, Total dissolved solids (TDS), sulphates, nitrates etc. All the above stated properties were analyzed according to the guidelines provided by the Central Pollution Control Board, New Delhi, APHE, BIS and WHO for both upstream and downstream sampling points to determine the effect of industrial as well as domestic discharge on the quality of the river water. The results of different tests revels that, addition of discharges into the river water has increased its pollution load. The pH of water has increased downstream. Turbidity of the water is also quite high than the allowable limits. The DO, COD & BOD has also been found in excess than the limit. Amount of calcium is 77.4 mg/l which is more than the allowable limits & faecal coliforms were also found in larger amounts which are not permissible.

Index Terms- Surface water, Investigation, TDS, Nitrate (NO3-), World Health Organization (WHO), BIS, Water Quality (WQ), Shivnath river .

1. INTRODUCTION

Water is an essential natural resource and is vital for all forms of life. 70.9% of the Earth's surface is covered by the water. 96.5% of the planet's water is occupied in oceans, 1.7% in the form of groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland 0.001% in the air as vapor, clouds and precipitation. Only 2.5% of the Earth's water is fresh water, and 98.8% of that water is in ice and groundwater [11]. Two-third of the human body is constituted of water. For the survival of humans, animals, plants & all other forms of life water is absolutely essential. Therefore, it is necessary that the water required for their needs must be free from any form of impurities and should be hygienic [6]. Overexploitation of the precious reserve is caused due to increasing population and urbanization. This has increases a major concern for water engineers and planners in recent years, to formulate effective strategies and model for sustainable water resource management.

India was once bestowed with abundant freshwater reserves like various rivers & ground water reserves. Due to population explosion and economic development a serious problem of natural water resource scarcity is being encountered in India. Biological, toxic, organic, and inorganic pollutants have contaminated 70% of India's surface water resources and are contaminating growing percent age of its groundwater reserves also. In 1951 the average annual freshwater was 5177 cubic meter which is reduced to about 1869 cubic meters in 2001. It is estimated that this will further come down to 1341 cubic meters in 2025 and 1140 cubic meters in 2050 [10]. Main reason behind this is dumping of untreated municipal as well as industrial wastes directly into natural water bodies. Besides this excessive use of pesticides and fertilizers adds on the deterioration of fresh water bodies [3]. Hence, good water conservation techniques and water treatment methods are required to be formulated in an effective manner to maintain the water quality within standards.

Many small and big rivers co-originate in Chhattisgarh state. Mahanadi River is the most important river of the state and is also known as the life line of Chhattisgarh. Shivnath River is the second important river of the state & is the main tributary of Mahanadi River [2]. Total length of flow of Shivnath river in Chhattisgarh State is 290 km. It emerges from Panbaras range situated at the height of 625 meters, at Ambagarh tehsil of Rajnandgaon district. After emerging from panabaras it flows about 40 km to the north direction & then turns its flow towards east direction at Ambagarh Chouky. Rajnandgaon, Durg and Janjgir, Champa district are some of the main areas situated at the bank of Shivnath River. Arpa, Lilagar, Maniyari, Kharoon, Aabar, Surahi, Tandula

etc are the main tributaries of shivnath River [2]. Due to dumping of variety of wastes (industrial as well as domestic) Shivnath is facing a huge problem of pollution. The present study focuses on assessment of impact of the discharges on the physicochemical and microbiological quality of the Shivnath river water in Durg district.

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2. METHODOLOGY

• The analysis of water quality is carried out as per APHA norms to establish the existing water quality.

• The existing water quality is then compared with the water quality standards presented by the Central Pollution Control Board, New Delhi, APHE, WHO & BIS (IS:10500-2012) [7] [2] [5]. The description analysis results of the physiochemical properties of the collected water samples are given in Table 2.

The method used for studying physical, chemical & bacteriological properties are listed in the following table: (All the tests were carried out within 24 hours of sample collection.) [1] [4] [6].

Table 1: Methods Used for Testing the Water Characteristics.

Characteristics	**Method of Testing**
pH	pH Meter
Turbidity	Turbidity Meter
Temperature (°C)	Temperature sensitive probe
Calcium	Titrimetric Method
Magnesium	Hy. Calcution [TH-(CaH)] * 0.243
Nitrates	PDA Method
Sulphates	Spectrophotometer
Total Alkalinity	Titrimetric Method
Total Hardness	Titrimetric Method
TDS	TDS Meter
DO	Winkler's iodometric method
BOD	Dilution Method
COD	Acidic Oxidation + Potassium dichromate
Faecal Coliforms	Membrane Filter Method

3. SELECTION OF SAMPLING POINTS:

The sampling points were selected so as the water samples represent the entire river study area.

Upstream Point: The Pulgaon Channel (since it is one of the major sources of industrial and domestic area discharges) joining into the river (Ganjpara, Durg),
Downstream Point: Near the NH-6, bypass shivnath Railway bridge at Rasmara village (Rasmara Durg).

3.1. *Collection Of Water Sample:*

Samples were collected through Grab sampling process. Plastic collection bottles of 1000ml capacity were used for collection of samples. The bottles were rinsed with sampling point water and emptied downstream of the sampling station after this they were filled and sealed. The collected samples were kept under normal room temperature during the testing procedure [9].

4. RESULTS & DISCUSSIONS:

The tests results suggest that, due to addition of discharges into the river water its pollution load has been increased. Detailed description is listed below & results of the analysis are also given in graphical representations.

4.1. *Temperature, Turbidity & pH:*

The temperature of the water for upstream & downstream was 24°C and 25.2°C respectively. pH of the downstream was 9 which is greater than the BIS limits [12] [4]. Turbidity values were also high for both upstream & downstream.

Sr. No.	Characteristics	Unit of Measurement	**BIS**	**WHO**	**ICMR**	Upstream	Downstream
Physical -							
1	pH	pH Scale	6.5-8.5	6.5 -8.5	7-8.5	7.6	9
2	Turbidity	N.T.U.	1	5	4-5	5.5	6.7
3	Temperature (°C)	°C	-	-	-	24	25.2
4	Color	300Hazen units.	5	5	5	colorless	colorless
5	Taste & Odour	-	-	-	-	Unobjectionable	Unobjectionable
Chemical -							
6	Calcium	mg/l	75	75	75	48.2	77.8
7	Magnesium	mg/l	30	50	50	9.27	10.82
8	Nitrates	mg/l	45	45	45	16.2	43.2
9	Sulphates	mg/l	200	200	200	9	19.9
10	Total Alkalinity	mg/l	200	75	-	160	200
11	Total Hardness	mg/l	200	500	500	140	197
12	TDS	mg/l	500			197	211
13	DO	mg/l	4-6 ppm	4-6 ppm	4-6 ppm	5.87	4.55
14	BOD	mg/l	3	2	3	7	13
15	COD	mg/l	-	-	-	12	18
Bacteriological -							
16	Faecal Coliforms	CFU/ 100 ml	Nil	Nil	Nil	68	84

Table 1: Analysis Results of Collected Samples.

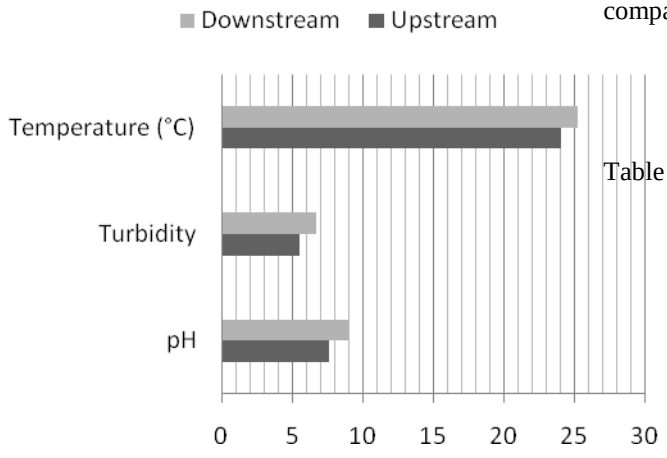

Figure 1: Upstream & Downstream Sample comparison for pH, Turbidity & Temperature values.

4.2. *Hardness, Sulphates & Nitrates:*

Tests results show that the Calcium hardness has increased beyond the allowable limit i.e. more than 75 mg/l [12] [4]. Nitrates were also reaching near the upper limit of specification. But magnesium hardness and sulphates were within the allowable limits.

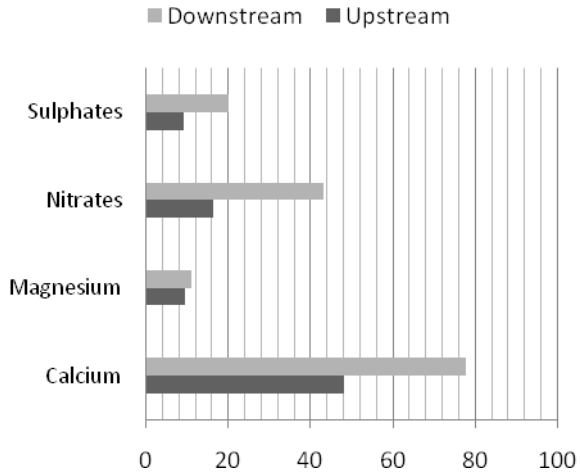

Figure 2: Upstream & Downstream Sample comparison for Hardness, Sulphates & Nitrates values (all in mg/l).

4.3. *Total Alkalinity, Total Hardness & TDS:*

The TDS values were found to be within the allowable limits. Although Total alkalinity & total hardness values were found to be within the limits (i.e. ≤ 200 mg/l for both) but they are found to be reaching near the upper limits [12] [4].

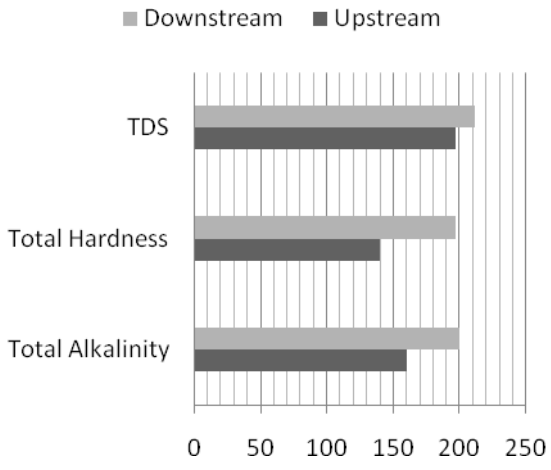

Figure 3: Upstream & Downstream Sample comparison for Total Alkalinity, Total Hardness & TDS (all in mg/l).

4.4. *BOD, COD, DO:*

A significant increase in both BOD (7 and 13 mg/l for upstream & downstream respectively) and COD (12 and 18 mg/l for upstream & downstream respectively) values has been found more than the allowable limits. [12] [4] DO was found to be within the limit but it was decreased from 5.87mg/l (upstream) to 4.55 mg/l (downstream).

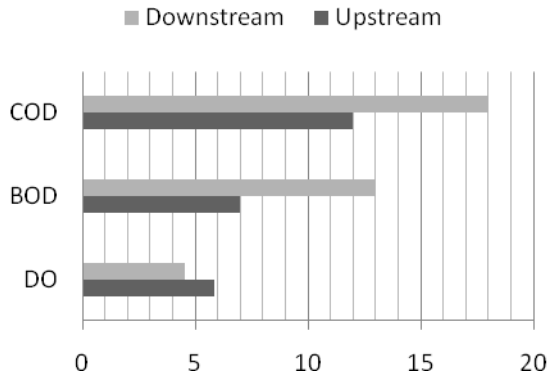

Figure 4: Upstream & Downstream Sample comparison for DO, COD & BOD values (all in mg/l).

4.5. *Faecal Coliforms:*

Faecal Coliforms were also increased in downstream sample (i.e. from 68 CFU /100ml to 84 CFU /100ml) which is not permissible.

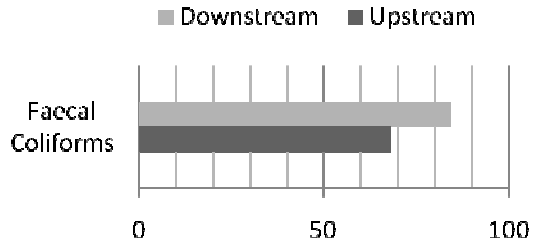

Figure 5: Upstream & Downstream Sample comparison for Faecal Coliforms values (in CFU/ 100 mg).

5. CONCLUSION

In above study it was found that maximum parameters were not under allowable BIS limits. pH , Turbidity, Calcium, Total Alkalinity, DO, BOD, COD and faecal coliforms exceeded the BIS limits. The amount of

faecal coliforms was very high which makes the water unsuitable for use. This all shows that the quality of the river water is below the prescribed standards and it is unsuitable for drinking or household purposes without any disinfection process.

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