ISSN: 2278 – 7798
International Journal of Science, Engineering and Technology Research (IJSETR)
Volume 5, Issue 8, August 2016

# Assessment of Water Quality Index of Saank River, Morena, Madhya Pradesh

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***Abstract*— The aim of the study is to find out the water quality of the Saank River flowing through Morena district near Banmor Industrial area. Tigra dam is Build on upstream of the Saank River near Gwalior district. River water after passing through Kaitha, Agrabhatpura, Dugnawali, Jakhauda, Banmore, Sapchauli, Nurabad, Barendra Village, it finally joins the Pilua dam constructed downstream about 30 Km away from the site in Morena district. These villages are using river water for their day to day work. Sampling and field work was conducted during the period from Dec 2015 to June 2016.Twelve water samples were collected from four sites during each season i.e. winter, summer and monsoon and 13 physico-chemical and MPN was analyzed. There are several ways to assess the quality of water as deemed fit for drinking, irrigation, and industrial use. Water quality index expressing the water quality in term of index number and provide a baseline data, is determined and accordingly water quality is assessed.**

***KEYWORDS:* Saank River, Anthropogenic Activities, Drinking Water, Water Quality Index**

## I. INTRODUCTION

India is a land of many rivers. The most important natural resource of water is river for all living organisms because every living thing needs water. All human being depend on inland water especially fresh water for domestic and industrial use Rivers have always been the most important fresh water resources and most developmental activities still dependents upon availability of water. Rivers are the main mode to carry or disposal municipal waste water, industrial waste water, solid waste and runoff water from agricultural field, road that is the major reason of river water pollution [6]. River water get polluted at some points due to anthropogenic activities, confluence of sewage, domestic waste, and disposal of solid waste .Water quality index (WQI) is a tool that provides meaningful summaries of water quality data. Development in watersheds replaced forests and open land with urban land such as new residential and commercial development. These land use, resulted into increase in the amount of impervious surface resulting in increased storm runoff flow that negatively affect stream ecosystems and water quality. It is necessary to monitor the water quality of river water, which is being used by the people on downstream of the confluence of the water in river. The WHO estimates that more than 20% of the world population has no access to safe drinking water and that more than 40% of all population lack adequate sanitation [7]. All most 75% of the water in India has become polluted due to discharge of domestic sewage, municipals waste drains, urban agricultural waste, large scale of industrial effluents in the river and make the river water contaminated [8].About 80% diseases in human being are caused by water according to WHO organization [9].The Saank river is subjected to multiple uses for community water supply, irrigation, disposal of sewage. Water quality index provides a single number that express overall water quality based on several water quality parameters [10].

Fig. 1 Location map of the study area

## II. MATERIAL AND METHODS

### A. Collection of water

The present study deals with determination of physical and chemical parameter of water to know the present status of water quality at sampling site. The field work was conducted during the period Dec 2015 to June 2016. The samples were collected in polythene container of 2 liter capacity each bottle was washed with 2% Nitric acid and then rinsed three times with distilled water. Three bottles were filled with water samples at every sites in morning hours between 7Am to 10Am. After collection of samples these bottles were labeled and possible efforts were made to transport them to the laboratory as earlier as possible. DO, BOD, COD and MPN determination started within 6 Hour in the MITS laboratory. Remaining parameter was determined within 48 hours (except BOD).

**Table 1. Locations of sampling points**

| Stations | Descriptions |
|---|---|
| S1 | 500 m U/S from Highway Bridge of Nurabad |
| S2 | Below the Highway Bridge Nurabad |
| S3 | 400 m D/S from Highway bridge Nurabad |
| S4 | Below the Railway Bridge Nurabad |


## III. WATER ANALYSIS METHODS

Physical and chemical analysis of the samples was done according to Standard Methods as per APHA [1]. The values obtained were compared with standards prescribed by BIS [2] WHO [3] and ICMR [4].The following table reveals the parameters, with their units which are evaluated, in water samples. The water quality index is calculated by using the standard of drinking water quality prescribed by the World Health Organization, Bureau of Indian Standards and Indian Council for Medical Research. The weighted Arithmetic Index Method has been used for the calculation of water quality index of the River water.

Methods used for physical and chemical analysis of water are shown in below mentioned in (Table 2).

**Table 2**

| S. No. | Parameters | Method adopted |
|---|---|---|
| 1 | pH value | pH Probe |
| 2 | Electrical Conductivity | Conductivity meter |
| 3 | Total dissolved solids | Gravimetric method |
| 4 | Alkalinity | Neutralizing by standard HCL |
| 5 | Total Hardness | Titrimetric method |
| 6 | Sulphate | Turbidimetric method |
| 7 | Nitrate | Colorimetric PDA method |
| 8 | Chloride | Argentometric Titrimetric |
| 9 | Turbidity | Digital Turbidity meter |
| 10 | Phosphate | Stannous Chloride Method |
| 11 | Dissolved Oxygen | Titrimetric Method |
| 12 | BOD | Titrimetric Method |
| 13 | COD | Closed Reflux (Titrimetric) |
| 14 | Coliform test(MPN) | Multiple tube |

*A.* ***Water Quality Index Calculation:*** Essentially, a WQI is a compilation of a number of parameters that can be used to determine the overall quality of a river. The parameters involved in the WQI are pH, Electrical conductivity, Total dissolved solids, Alkalinity, Total Hardness, Sulphate, Nitrate, Chloride, Turbidity, Phosphate, Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demand.

$WQI = \sum QiWi / \sum Wi$

The quality rating scale (Qi) for each parameter is calculated by using this expression:

$Qi = 100 \{(Va-Vi)/ (Vs-Vi)\}$

Where Va = actual value of the water quality parameter obtained from laboratory analysis.

Vi = ideal value of the water quality parameter can be obtained from the standard tables. $V_{ideal}$ for pH = 7 and for DO $V_{ideal}$ = 14.6 mg/l.

Vs = recommended standard value of $i^{th}$ parameter

The unit weight for each water quality parameter is calculated by a value inversely proportional to recommended standard (Vs) for the corresponding parameter using the following expression.

$Wi = K / Vs$

Wi is Unit weight of factor

K is proportionality constant.

Values of K were calculated as;

$$K = \frac{1}{\sum (1/Vs)}$$

The rating of water quality according to above calculated WQI is as follows [11, 12]

| WQI Level | Water quality status |
|---|---|
| 0-25 | Excellent water quality |
| 26-50 | Good water quality |
| 51-75 | Poor water quality |
| 76-100 | Very Poor water quality |
| Above 100 | Unsuitable for drinking purpose |

## IV Result

**Table3. Physico-chemical analysis of water Samples of Saank River (Dec 2015)**

| S. No. | Parameter | S1* | S2* | S3* | S4* |
|---|---|---|---|---|---|
| 1 | pH | 8.10 | 8.20 | 8.15 | 8.12 |
| 2 | Electrical conductivity | 544 | 580 | 676 | 504 |
| 3 | Total Dissolved Solid | 216 | 212 | 312 | 198 |
| 4 | Alkalinity | 60 | 76 | 70 | 58 |
| 5 | Total Hardness | 120 | 120 | 138 | 112 |
| 6 | Sulphate | 4 | 5.6 | 12 | 7.5 |
| 7 | Nitrate | 7.80 | 6.10 | 9.85 | 8.35 |
| 8 | Chloride | 50 | 58 | 52 | 62 |
| 9 | Turbidity | 2 | 3 | 8 | 4 |
| 10 | Phosphate | 0.14 | 0.62 | 0.8 | 0.38 |
| 11 | Dissolved Oxygen | 3.6 | 3.8 | 2.0 | 3.2 |
| 12 | Biochemical oxygen demand | 12.20 | 13.0 | 14.0 | 12.6 |
| 13 | Chemical oxygen demand | 100.80 | 98.20 | 151.20 | 102.50 |
| 14 | MPN | 290 | 1100 | 1100 | 1100 |

All Unit are in mg/l. Except pH, EC (µS/cm) and Turbidity (NTU)

**Table 4. Physico-chemical analysis of water Samples of Saank River (May 2016)**

| S. No. | Parameter | S1* | S2* | S3* | S4* |
|---|---|---|---|---|---|
| 1 | pH | 7.98 | 8.10 | 7.93 | 7.95 |
| 2 | Electrical conductivity | 538 | 574 | 688 | 619 |
| 3 | Total Dissolved Solid | 258 | 272 | 362 | 276 |
| 4 | Alkalinity | 65 | 78 | 72 | 68 |
| 5 | Total Hardness | 112 | 124 | 148 | 142 |
| 6 | Sulphate | 3.8 | 4.6 | 14.2 | 10.80 |
| 7 | Nitrate | 8.25 | 6.80 | 11.15 | 9.10 |
| 8 | Chloride | 58 | 64 | 82 | 76 |
| 9 | Turbidity | 4 | 5 | 8 | 3 |
| 10 | Phosphate | 0.22 | 0.56 | 0.78 | 0.40 |
| 11 | Dissolved Oxygen | 3.8 | 4.2 | 2.6 | 3.0 |
| 12 | Biochemical oxygen demand | 12.60 | 13.40 | 16.20 | 14.80 |
| 13 | Chemical oxygen demand | 108.20 | 104.60 | 168.50 | 142.60 |
| 14 | MPN | 1100 | $2400^{+}$ | $2400^{+}$ | $2400^{+}$ |

All Unit are in mg/l. Except pH, EC (µS/cm) and Turbidity (NTU)

**Table 5. Physico-chemical analysis of water Samples of Saank River (June 2016)**

| S.No. | Parameter | S1* | S2* | S3* | S4* |
|---|---|---|---|---|---|
| 1 | pH | 7.95 | 8.14 | 8.06 | 8.10 |

| | | | | | |
|---|---|---|---|---|---|
| 2 | Electrical conductivity | 549 | 569 | 761 | 607 |
| 3 | Total Dissolved Solid | 238 | 246 | 339 | 267 |
| 4 | Alkalinity | 78 | 84 | 88 | 82 |
| 5 | Total Hardness | 118 | 120 | 134 | 126 |
| 6 | Sulphate | 4.20 | 4.30 | 13.40 | 8.30 |
| 7 | Nitrate | 12.25 | 9.30 | 15.46 | 12.95 |
| 8 | Chloride | 60 | 68 | 74 | 68 |
| 9 | Turbidity | 3 | 4 | 7 | 4 |
| 10 | Phosphate | 0.19 | 0.68 | 0.94 | 0.55 |
| 11 | Dissolved Oxygen | 3.20 | 4.20 | 2.80 | 4.0 |
| 12 | Biochemical oxygen demand | 14.00 | 14.60 | 18.80 | 17.10 |
| 13 | Chemical oxygen demand | 117.6 | 100.80 | 184.80 | 151.2 |
| 14 | MPN | 460 | 1100 | $2400^{+}$ | 1100 |

All Unit are in mg/l. Except pH, EC (µS/cm) and Turbidity (NTU)

**Table 6. Calculation for water Quality Index of station S1.**

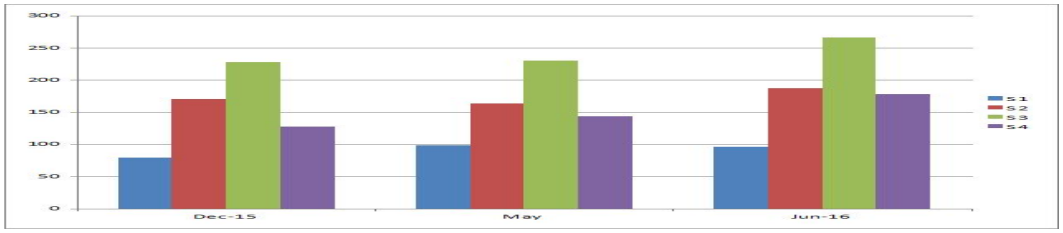
| S.No. | Parameter | Observed | Standard | Unit Wt. (Wi) | Quality Rating | WiQi |
|---|---|---|---|---|---|---|
| 1 | pH | 8.10 | 6.5-8.5* | 0.035 | 73.33 | 2.566 |
| 2 | EC | 544 | 300*** | 0.001 | 181.33 | 0.181 |
| 3 | TDS | 216 | 500* | 0.0006 | 43.20 | 0.0259 |
| 4 | Alkalinity | 60 | 120* | 0.0025 | 50 | 0.125 |
| 5 | T.Hardness | 120 | 300* | 0.001 | 40.00 | 0.040 |
| 6 | $SO_4$ | 4 | 200* | 0.0015 | 2 | 0.003 |
| 7 | $NO_3$ | 7.80 | 45* | 0.0067 | 17.33 | 0.1161 |
| 8 | Chloride | 50 | 250* | 0.0012 | 20 | 0.024 |
| 9 | Turbidity | 2 | 5* | 0.06 | 40 | 2.4 |
| 10 | $PO_4$ | 0.14 | 0.4* | 0.75 | 35.00 | 26.25 |
| 11 | DO | 3.6 | 5* | 0.06 | 114.58 | 6.87 |
| 12 | BOD | 12.20 | 6** | 0.05 | 203.33 | 10.166 |
| 13 | COD | 100.80 | 10** | 0.03 | 1008 | 30.24 |
| | | | | ∑Wi=0.9995 | | ∑WiQi=79.007 |
| WQI =∑WiQi/∑Wi = 79.007/0.9995=79.05 | | | | | | |

*BIS [2] **WHO [3] **ICMR (1975)[4]

**Table 7 (As the above table all other sampling station WQI were calculated)**

| Station / Month | S1 | S2 | S3 | S4 |
|---|---|---|---|---|
| Dec 2015 | 79.007 | 170.54 | 227.92 | 127.6 |
| May 2016 | 98.63 | 163.25 | 230.37 | 143.86 |
| June 2016 | 96.176 | 187.56 | 266.52 | 178.087 |

**Graphically representation of the Water Quality Index**




Discussion

The results obtained from analysis of water sampled of river Saank are shown in Table 3, 4 and 5. The values of various physico-chemical parameters for calculation of water quality index are presented in Table 7. The water quality Index obtained for the river in different month of study period i.e. Dec 15 May and June 16 ( S1= 79.007 , 98.63 ,96.176 ,S2= 170.54, 163.25 ,187.56 S3= 227.92 , 230.37 , 266.52 ,S4= 127.6 , 143.86 ,178.087 ) respectively which indicate the very poor quality of river water and unsuitable for humans uses.

The pH is an important parameter which determines the suitability of the water for various purposes. In the present investigation the pH value of Surface water ranged from 7.93 to 8.20 indicating that the nature of water is slightly basic. Electrical Conductivity was Maximum at station (S3) and ranged from 504 µS/cm to 761µS/cm. In the present Study it has been found that the Total Hardness ranges from 112mg/l to 148 mg/l equivalent to $caco_3$. Sulphate ion is one of the major anions occurring in natural waters. During the study period the Sulphate $SO_4$ ions concentration ranged from 3.80mg/l to 14.20mg/l.The value of Nitrate was observed is in range of 6.10mg/l to 15.46 mg/l. All the values of Nitrate were within permissible range as prescribed by BIS and WHO drinking water standards. Maximum turbidity value was recorded at 8 NTU while the least was observed at 2 NTU.The concentration of phosphate at the station S3 is 0.78 to 0.94mg/l.This exceeds the permissible limit of 0.4mg/l and hence, the risk of eutrophication is not excluded in this part of the River favored by the domestic wastewater. The DO of River water ranges from 2.0mg/l to 4.20mg/l, D.O value is quite low and it does not favour to support fresh water ecosystem.BOD is an important parameter of surface water quality and which indicates the level of organic contamination in surface water. The biochemical oxygen demand (BOD) was higher in station S3 because at this station water flows through the densest urbanized and industrialized area. Most of the industries are situated near the vicinity of this station. BOD ranges 12.20mg/l to 18.80mg/l. In the present study the COD concentration in Surface Water was in range 98.2mg/l to 184.8 mg/l.

**Conclusion**

During the study, it is observed that the water quality of River Saank was very poor at all selected sites. The Study show that the water of the Saank River is deteriorated very badly due to the addition of domestic sewage, anthropogenic activities, rapid industrialization, dumping of solid waste. The same water is used for washing, Bathing and sometime it is used for the drinking purposes also. The main aim of this study is to assess the water quality of Saank River. We concluded that the water is not fit for drinking purpose without treatment (filtration, disinfection etc). It is recommended that stringent pollution control activity shall be under taken immediately to improve the WQI.The users of water on downstream are at high risk of health hazard. A detail survey of the pollution activity needs to be undertaken to find out the source of pollution and accordingly mitigation efforts shall be made.

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