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Determination of Water Quality Index (WQI) and Suitability of Holy Wardha River Water (Kaundyanapur) from Amravati District, Maharashtra, India.

KEYWORDS: Water Quality Index, Water quality status, Wardha River (kaundyannapur).

G. N. Budhlani

Adarsha Mahavidyalaya, Dhamangaon Rly

ABSTRACT *Ironically, Wardha river passing by Kaundyannapur of Amravati district of Maharashtra is viewed as a figure of purification by Hindus in this area and this river is under constant threat of pollution by discharges of ashes of dead bodies, floral wastes generated on account of pilgrimage during fair, animal crazing, agricultural wastes, washing of cloths and vehicles. The present study was carried out to calculate the Water quality index (WQI) of Holy Wardha River (Kaundyanapur) to ascertain the water quality status of water for drinking and other purposes. Water quality index was determined on the basis of parameters pH, Total hardness (TH), Total solids (TS), Total alkalinity, Nitrate, Dissolved oxygen, Biological Oxygen demand (BOD), Chemical Oxygen demand (COD) studied for one year during Oct.2010 to Sept. 2011. The results shows that WQI values of Wardha River (kaundyannapur) of Amravati district are above 100 indicating that the source, i.e, Wardha River is unsuitable for drinking purposes. The study also revealed that this pollution is due to the disposal of ashes in river, floral wastes, domestic sewage, agricultural runoff, fecal contamination, cattle grazing, washing of cloths.*

INTRODUCTION:-

Rivers play an important role in the development of nation and sustenance of life which are being polluted due to speedy urbanization, industrialization and other developmental activities (Alam and Pathak,2010).Supply of potable water is important to the development of any country. The quality of water is described according to their physicochemical and microbiological analysis. For effective maintenance of water quality through appropriate control measures, continuous monitoring of large number of quality parameters is essential (Mishra *et. al.*,2008).

Water Quality Index (WQI) is an indicator which reflects composite influence of a number of water quality parameters that are significant for a specific beneficial use. This management tool helps to assess the overall water quality of water (Ajit Pratap Singh,1999). Parameter selection has a great importance for calculation of water quality index, since various parameters depend on intended use of water (Guru Prasad,2003).WQI based on some important parameters can provide a simple indicator of water quality. It gives a general idea of possible problems within a particular region (Murali *et al.*,2011).

Water Quality Index (WQI) is one of the most effective tool to communicate information on the quality of waters to the concerned citizens and policy makers (WHO,1995).The following four steps, parameter selection, transformation of the parameters of the different units and dimensions to a common scale, assignments of weightages to all the parameters and aggregation of sub-indices to produce a final index score are the most often associated with the development of any WQI depending on the sophistication being aimed at, additional steps may also be taken. Water Quality Index (WQI) is a unit less, single dimensional number between 0 and 100 (Manja and Kaul,1992).

The Wardha River passing by Kaundyannapur of Amravati district is viewed as a figure of purification by Hindus in this area and people persist in dumping the ashes of cremated bodies into it and take a holy dip during such activities in the river.This river has been considered as case study because it is a holy river of Vidarbha region in India. Kaundyannapur (Tiwsa Taluka) is a small town of Amravati district from Maharashtra which is famous historical place for Rukminidevi Mandir built along the bank of Wardha River and this river is under constant threat of pollution by discharges of ashes of dead bodies, floral wastes generated on account of pilgrimage during fair and agricultural runoff, cattle grazing, fecal contamination, washing of cloths and vehicles.

The objective of this study is to establish the water quality status of the river for all seasons of a year. The results reported here will provide base-line data for framing suitable remedial action plan.

MATERIALS AND METHODS:

Water Samples were collected in plastic bottles for physicochemical analysis from 8 sampling stations of Wardha River (Kaundyanapur) during Oct.2010 to Sept.2011.

Samples were collected during morning hours between 8 to 10 a.m. Every time. pH was monitored at the sampling stations while total hardness, total alkalinity, total solids, nitrates, Dissolved oxygen, BOD and COD were analyzed in the laboratory in accordance with standard methods (Trivedy and Goel,1986; Kodarkar *et al.*,1988 and APHA,1995).

The concept of indices to represent gradation in water quality was proposed by Horton (1965). Water Quality Index (WQI) indicates the quality of water in terms of index number which represents overall quality of water for any intended use. It is defined as a rating reflecting the composite influence of different water quality parameters on the overall quality of water quality.The indices are among the effective ways to communicate the information on water quality trends to the general public or to the policy makers and water quality management.

WQI Calculation:

For calculation of WQI, selection of parameters has great importance. Since selection of too many parameters might widen the water quality index and importance of various parameters depends on the intended use of water, eight

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physicochemical parameters, namely, pH, total solids, total alkalinity, total hardness, nitrate, Dissolved oxygen (DO), BOD and COD were used to calculate WQI. The calculation of WQI was made using weighted arithmetic index method (Brown *et al.,1972*, Bhadja *et al.,2013*) in the following steps:

$$qn = 100[(Vn - Vio) / (Sn - Vio)]$$

Where

qn = quality rating for the nth water quality parameter.
Vn = estimated value of the nth parameter at a given sampling station.
Sn = standard permissible value of nth parameter
Vio = ideal value of nth parameter in pure water.
Ideal value in most cases Vio = 0 except in certain parameters like pH and dissolved oxygen. The calculation of quality rating for pH and DO (Vio ≠ 0) is 7.0 and 14.6 mg/l respectively. Unit weight was calculated by a value inversely proportional to the recommended standard values Sn of the corresponding parameters.

$$Wn = K/Sn$$

Where

Wn = Unit weight for nth parameter
Sn = Standard value for nth parameters
K = Proportionality constant.

The overall water quality index was calculated by aggregating the quality rating with the unit weight linearly.

$$W.Q.I. = \Sigma qnWn/\Sigma Wn$$

The suitability of River waters was analyzed on the basis of water quality status (Chatterji and Raziuddin, 2002).

Table 1:-Drinking Water Standards recommending Agency and Unit Weights (All values are expressed in mg/l except pH)

S.No.	Parameter	Standards	Recommended agency	Unit weight
01	pH	6.5-8.5	ICMR/BIS	0.2190
02	Total hardness (TH)	300	ICMR/BIS	0.0062
03	Total Alkalinity	120	ICMR	0.0155
04	Nitrate(NO_3	45	ICMR/BIS	0.0412
05	Dissolved oxygen (DO)	5.00	ICMR/BIS	0.3723
06	BOD	5.00	ICMR	0.3723
07	Total solids TS	500	WHO	0.0037

Table 2: Water Quality Index (WQI) and status of water quality
(Chatterji and Raziuddin 2002).

Water quality Index 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
>100	Unsuitable for drinking

Table 3:-Seasonal variations of Physicochemical parameters of Wardha River water (Kaundyanapur)

Sr.No	Parameters	Winter Season	Summer Season	Monsoon Season
01	pH	8.5	8.775	8.487
02	Total hardness (TH)	219	219	215.375
03	Total Alkalinity	358.5	357.5	356.25
04	Nitrate(NO_3	6.37	6.55	6.033
05	Dissolved oxygen (DO)	6.9	6.9	7.05
06	BOD	2.91	3.0	2.975
07	Total solids TS	412.	415.5	413
08	COD	8.95	9.05	9.187
	Water Quality Index	259.30	103.66	117.06

Table 4: Water Quality Index of Wardha river (Kaundyanapur) during different seasons during Oct.2010 to Sept. 2011.

Water Quality Index (WQI)	Winter	Summer	Monsoon
Wardha River((Kaundyanapur)	259.30	103.66	117.06

Results and discussion:

The observations on physicochemical parameters of water samples from Wardha river passing by Kaundyannapur of Amravati district studied for one year during Oct.2010-Sept.2011 and Water Quality Index (WQI) of water reservoir are presented in Table 1-4.

The pH of water body is very important in determination of water quality since it affects other chemical reactions such as solubility and metal toxicity (Agbarie 2009). It should be recognized that, like dissolved oxygen, pH also varies in reservoir naturally throughout the day due tothe photosynthesis and respiration cycles in the presence of algae in water bodies. The pH is measure of the intensity of acidity or alkalinity andthe concentration of hydrogen ion concentration. pH has no direct adverse effects on health; however, higher values of pH hasten the scale formation in water heating apparatus and also reduce germicidal potential of chloride. High pH induces theformation of tri halo methane which is toxic. pH is one of the most important factors that serves as an index for the pollution (Bhadja *et al.,2013*). From the available data, it appears that the average pH values were 8.5, 8.7 and 8.4 during winter, summer and Monsoon respectively. It indicates that pH was alkaline throughout all the seasons and beyond acceptable limit as recommended by BIS (IS,10500;1998). The average values of total hardness of river water were 219 mg/L during winter, 219 mg/L during summer and 215.3 mg/L during monsoon indicating that total hardness was beyond the acceptable limit throughout all the seasons. Hard water causes incrustation in distribution systems and excessive soap consumption (Coleman 1976). The average values of Total solids (TS) of river water samples were 412. mg/L

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,415.5 mg L and 413 mg/L during winter, summer and monsoon respectively. Total solids are measure of suspended and dissolved solids in a body of water. It appears that river water samples tested were not exceeding the desirable limit prescribed by BIS (Subin and Aneesha 2011). According to Nayak *et al*. (1982) and Ghosh and George (1989) the higher alkalinity indicates pollution. The value of alkalinity in water provides an idea of natural salts present in water. The cause of alkalinity is the minerals which dissolve in water from soil. The various ionic species that contribute to alkalinity include bicarbonate, hydroxide, phosphate, borate and organic acids The average values of total alkalinity were 358.5 mg/L, 357.5 mg/L and 354-359 mg/ L during winter, summer and monsoon respectively. Total alkalinity was beyond the acceptable limit throughout all the seasons. The average values of Nitrate were 6.37 mg/ L, 6.55 mg/L and 6.033 mg/L during winter, summer and monsoon respectively. It indicates that it was within the acceptable limit throughout all the seasons as per the BIS standards. The main source of the formation of nitrate is the decomposition and biodegradation of organic matters. High nitrates would indicate pollution load. Intrusion of sewage into the natural waters increases levels of nitrate (Manson 1991). High level of DO is normally a sign of healthy river and average values of DO were 6.9 mg/L, 6.9 mg/L and 7.05 during winter, summer and monsoon respectively. Decrease in DO values can favor anaerobic decomposition of organic wastes (Salle, 1974). The average BOD values were 2.91 mg/L, 3.0 mg/L and 2.97 mg/L during winter, summer, and monsoon respectively. The BOD test is measure of organic load in a body of water. As per BIS, the maximum permissible limit is 5 mg/L and it is within the permissible limit throughout all the seasons as per BIS standards. COD estimates the carbonaceous fraction of organic matter (Arthi *et al*. 2011). COD values convey the amount of dissolved oxidizable organic matter including the non-biodegradable matters present in it. The average COD values were 8.95 mg/L, 9.05 mg/L and 9.18 mg/L during winter, summer and monsoon respectively.

Application of WQI is a useful method in assessing water quality at individual sampling station in order to determine its water quality for various beneficial uses. In present study, application of WQI gives us comparative evaluation of water quality at different sampling stations during different seasons. The water quality index obtained for the reservoir water system in different seasons of study period i.e., winter season, summer season and monsoon season are 259.30, 103.66 and 117.06, respectively which indicate the very poor quality of water(Chatterji and Raziuddin 2002).

CONCLUSION:

From present observations, it may be concluded that WQI values of Wardha River passing by kaundyannapur of Amravati district of Maharashtra are above 100 indicating that the source, i.e, Wardha River is unsuitable for drinking purposes.

This pollution is due to the disposal of ashes in river, floral wastes, domestic sewage, agricultural runoff, fecal contamination, cattle grazing, washing of cloths. Therefore, people in these areas have high potential risk of contracting water borne diseases if they use this river water for drinking purposes. Therefore, it is recommended that river water should not be used for domestic purposes without treatment.

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