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A STUDY OF IONIC STATUS OF WATER IN RELATION TO HUMAN ACTIVITIES PERFORMED IN AND AROUND THE RIVER WAINGANGA DIST. BHANDARA, (MS) INDIA

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Abstract: Present study deals with the study of river water contamination due to human activities and its influence on the ionic status of river water. Sampling of water at downstream stations showed increased values of all parameters due to direct and indirect input of organic matter in water. Mostly washerman's activities, bathing activities, river basin agriculture are found responsible to enhance the ionic concentration in river water. During rainy season the surface runoff soil, clay, etc., transfers enormous amount of solids in river water along with rainwater. The silting of rocks due to flooded water carries the salts of Mg, Fe and Cl, which imparts the more concentration of dissolved solids in river water. Seasonal study indicates that comparatively less water during summer season and concentration of pollutants due to intense activities of localities in and around the river basin, enhance more variations and higher values of Temperature (36.4˚C)conductivity (702 umnos/cm), chlorides (57.2 mg/L), CO2 (24.0 mg/L), Hydrogen ion concentration (7.8). Total alkalinity (60.4 mg/L), Total dissolved solids (658.0 mg/L). All the parameters are estimated by using ELICO make portable water analysis kit except CO_2 and Chlorides are measured by standard methods given by National Environmental Engineering Institute, Central India. The ionic concentrations in Wainganga river water is gradually increases from upstream station to downstream station and found to be well above the potable water standards.

Keywords: Conductivity; Chlorides; Human activity; River water; TDS; pH.

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INTRODUCTION

A water body affects the environment in its vicinity, like charging of ground water tables, conditions of climate etc. Most of the people like washerman, and fisherman, living in the surrounding area depend on this source of water for their survival. Any damages to this water source by any agency will not only make life miserable but that will also disrupt the aquatic ecosystem. It is therefore necessary to study the quality of river water, on the basis of physico-chemical parameters so as to assess its potability. Conductivity is an capacity of water to carry an electrical current and it varies both, with the number and types of ions the solution contains, which intern is related to the concentration of ionized substances in the water. Inorganic substances are dissolved in water and are in the ionized form and hence, contribute to conductance. Conductivity measurement gives rapid and practical estimate of the variations in the dissolved contents of a water supply. Approximate estimation of dissolved ionic contents in water sample can be done by multiplying specific conductance in m mhos/cm by an empirical factor, which may vary from 0.55 to 0.9 depending on the soluble components and on the temperature of water. Measurements of electrical conductivity can be used to estimate the number of ions in the solution. Inorganic salts dissociate easily in water while the majority of organic molecules in water do not give ions and hence cannot contribute to conductivity.

Conductivity measurement can be used to estimate the inorganic concentration in the water such measurements are particularly useful for rapid investigation of charges in water quality. Conductivity is an important parameter to determine the potability of water. Conductance has been found to be suitable for irrigation up stream to 20 µmho/cm.

Change in the concentration of sulphates and chlorides, if any, are reflected in the corresponding change in the conductivity. The pollution by organic or inorganic wastes containing excessive amount of dissolved solids increases the concentration of salts in water, which intern increases conductivity (Thomas, *et al.,* 2001). Increased conductivity of river water indicates contamination of ionic pollutants. There is less water in winter and hence, the solubility of Ca, Mg salts increase. The increased alkalinity leads to increase in the electrical conductivity. High conductivity values are not suitable for agriculture as well as for drinking purpose. Conductivity at reservoir stations shows dissolved organic and inorganic substances in water (Gambhir, 1999).

EXPERIMENTAL

A work plan has been conceived for the present investigation to study the ionic status and water quality of "WAINGANGA RIVER". In view of the various domestic activities four sampling stations have been selected in Pauni town in Bhandara district for the present investigation. Station 'S-1' is located at the site of Dam at village Gosikhurd, nine kilometers away from the sampling station S-2 of Pauni town. Besides all these sources of pollution, the decaying cow dung manure also pollutes the river water during summer. The dry regions of the river basin has been taken on lease, for farming the crops of Watermelon and Muskmelon, by some farmers during the months from February to May, The cow dung, which is used as fertilizers for these crop fields enters in the water current at stations S-2 and S-3. The fishing activities are carried at stations S-1, S-2 and S-3, the fisherman prepares artificial hiding places with the help of dry wooden branches of trees. Samples from different sampling stations were collected for physical and chemical analysis. The sample analysis were performed in the fields and in laboratory with the methods given by NEERI. The parameters, Conductivity, Temperature, pH, were estimated with the help of ELIKO make Water Analysis Kit with necessary precautions. The weekly collection of samples of water from different spots and depths of river was done by Mayer's sampler. The samples were preserved by refrigeration at 4^{o}C, in ice box for short interval of travel, which is most general accepted method (NEERI, 1986).

RESULTS AND DISCUSSION

Conductivity of river water increases during the summer and decrease during winter season. High concentration of municipal wastes and domestic activities and less flow of river during summer is responsible for increase of ionic contents in water and conductivity. However, more flow of river in the rainy season and winter dilute the pollutants to some extent and lowers the ionic contents of water (Thomas *et al.,* 2001). It is evident from the observations that, conductivity attains peak values in the months of summer, at stations S-2, S-3, and S-4. This may be due to higher chlorides and total dissolved solid contents in river water during summer. The data collected shows that, lower values of conductivity at station S-1 in comparison with the other stations, since, there is no significant source of pollution. The reduced rate of decomposition activities at the lower temperature of water in the winter also affects the ionic concentration. Mass bathing and other activities on the bank of river, helps to raise the values at station S-3, and S-4 to some extent. However, during rainy season, the surface runoff from the catchment areas maintains the ionic content in river water and values of conductivity recorded are slightly more as compare to the values recorded in the winter season (Table 1). The organic matters from catchment areas from town influences the microbial activities and increase the ionic status of river to some extent. The study period spread over two years shows that, the values of river water has a regular and gradual increase in conductivity from upstream station S-1 to downstream station S-4, in all seasons, (Table 4.4 and 4.5) (Shukla *et al*., 1989). The Wainganga river water has higher conductivity in summer. The values are higher than permissible level. The permissible level for potability is 300

µmho/cm. Present investigation indicates that, the pH of water increases in the winter, (Table 2).This may be due to discharge of municipal sewage and domestic wastes in river water. However increase of carbonates and bicarbonates concentration in the river water, is responsible for maximum values of pH in winter. More turbid water at station S-4, due to more loads of pollutants affects the photosynthetic activities of phytoplanktons and their assimilation of CO_2 and bicarbonates from water (Mohanta and Patra, 2000). Total alkalinity in Wainganga river water varies with seasons. Maximum values of alkalinity recorded in the winter and minimum during the rainy season, (Table 2). The value of alkalinity increases with increasing load of pollutants in the river water (Sinha *et al.,* 1989). Maximum value during winter may be due to richness of salts in river water. The presence of CO2 concentration and increased levels of carbonates and bicarbonates in winter increase the levels of alkalinity in river water. The sewage and domestic wastes are the source of organic matter at downstream stations S-2, S-3, S-4. Decomposition of organic matter by microbes leads in to formation of CO2 in river water, which intern increase the concentration of carbonates and bicarbonates salts (Raju *et al.,* 1994). The values of alkalinity during summer may be due to more concentration of pollutants in less flow of river water. Intense photosynthetic activities of phytoplanktons in summer increases the rate of assimilation of CO_2 and bicarbonates from water, hence the values are deflected in summer season (Prasanthan and Nayar, 2000) has reported the low level of alkalinity due to assimilation of bicarbonates by aquatic plants. In present investigation, minimum values were obtained in the rainy season than winter and summer. This may be attributed to dilution of pollutants in the increased flow of river water (Adebisi, 1981). The intense domestic activities of locality, at station S-3 and S-4, adds soaps and detergents in the river water, which may be the cause of increased values of total alkalinity at these stations. In addition to sewage, domestic wastes, the discharge of temple wastes and cremated ashes contaminates the river on large scale (Aggrawal *et al*., 2000).

During summer the value of TDS gradually increases from February to May with decrease of water level in river. Municipal sewage discharge from the sewage channels is the major source of contamination of river water at station S-2, S-3 and S-4. Sewage rich in bicarbonates and carbonates frequently enters in the river at station S-2 and S-4. The values of TDS in Wainganga river may be due to sodium, potassium and chlorides in the river sediments, (Table 3). However, the activity of cloth washing and bathing adds the carbonates and bicarbonates of Na, Ca, K and Cl at station S-3 and S-4 in river water. During rainy season the surface runoff soil, clay, etc., transfers enormous amount of solids in river water along with rainwater. The silting of rocks due to flooded water carries the salts of Mg, Fe and Cl, which imparts the more concentration of dissolved solids in river water. During summer concentration of chlorides is maximum at all the stations, (Table 3). This may be due to concentration of sewage and human activities performed on the bank of river. The reduction of dilution of pollutants due to less flow of river in the months of summer is also a additional factor for the increase of chloride level in river water (Gyannath *et al.,* 2000). Mostly the cattle washing activities at station S-3 during rainy season and winter may affect the chloride level at this station in addition to other sources of pollutants (Koshy and Nayar, 2000). The results of present investigation carried out during present study, it can be concluded that, the concentration of chlorides in Wainganga river increases from upstream station to downstream with increasing load of pollutants (Agrawal and Kannan, 1996). The permissible level of chlorides in potable water is 250 mg/L. In Wainganga river water it is well within the permissible limits. At upstream station S-1, the less concentration of CO2 has been recorded. It may be due to active photosynthetic activities by aquatic flora within the period of intense sunlight, in summer. This intern accelerates the assimilation of CO2 by phytoplanktons. Increasing load of pollutants at stations S-2, S-3 and S-4 resulted in to increase of concentration of sewage and wastes with turbidity. The turbid water affects the rate of photosynthic activities of aquatic flora and

ultimately reduces the assimilation of CO_2 (Shivanikar, 1998). The maximum value at downstream station S-4 may be attributed to discharge of cremated ashes religious and domestic wastes. Turbid water and increased decomposition activities by microbes increase the levels of CO_2 (Table 4).

Table 1. Ranges of conductivity at different stations during the months of Summer, Winter and rainy season

Season	Station	Temp(°C)	Mean Variation	Conductivity umhos/cm	Mean variation
SUMMER (Feb., Mar. Apr. May.)	S-1	28.6-35.1	6.4	360-458	12.1
	S-2	29.0-35.4	6.4	563-608	44.4
	S-3	29.6-35.6	5.9	601-626	24.8
	S-4	29.6-36.4	6.7	628-702	74.2
WINTER (Oct.,Nov., Dec., Jan.)	S-1	26.1-28.1	2.0	312-335	23.1
	S-2	26.7-28.6	1.9	416-450	33.4
	S-3	26.7-27.9	1.2	449-528	78.3
	S-4	26.1-28.5	2.4	497-562	65.6
RAINY SEASON (Jun. Jul, Aug.Sep.)	S-1	28.7-31.1	2.4	346-368	22.1
	S-2	28.9-32.4	3.4	418-558	139.5
	S-3	29.6-32.5	2.8	457-598	140.5
	S-4	30.2-33.0	2.8	496-603	107.2

Table 2. Ranges of pH and alkalinity at different stations during the months of Summer, Winter and rainy season

Season	Station	H^+ conc.	Variation	Alkalinity (mg/L)	Mean variation
SUMMER (Feb., Mar. Apr. May.)	S-1	7.4-7.5	0.1	35.5-43.9	8.4
	S-2	7.4-7.5	0.1	41.3-45.9	4.6
	S-3	7.5-7.7	0.1	44.6-47.4	2.8
	S-4	7.6-7.8	0.1	45.5-57.2	11
WINTER (Oct.,Nov., Dec., Jan.)	S-1	7.4-7.6	0.1	42.4-47.9	5.5
	S-2	7.5-7.8	0.3	47.3-52.1	4.7
	S-3	7.6-7.9	0.3	49.2-58.2	9.0
	S-4	7.8-8.1	0.2	56.4-64.2	7.7
RAINY SEASON (Jun. Jul, Aug.Sep.)	S-1	7.2-7.4	0.2	34.9-40.0	5.0
	S-2	7.3-7.6	0.3	37.8-49.2	11
	S-3	7.3-7.7	0.3	40.6-53.3	12
	S-4	7.5-7.7	0.2	48.1-60.4	12

Table 3. Ranges of TDS and chlorides at different stations during the months of Summer, Winter and Rainy season

Season	Station	TDS (mg/L)	Variation	Chloride (mg/L)	Variation
SUMMER (Feb., Mar. Apr. May.)	S-1	186-340	154	29.8-32.8	3.4
	S-2	209-336	127	33.2-36.7	3.5
	S-3	312-639	327	35.3-37.8	2.5
	S-4	393-658	264	44.2-47.1	2.9
WINTER (Oct.,Nov.	S-1	178-306	128	24.5-27.0	2.4
	S-2	192-348	156	27.5-34.3	6.7
,Dec., Jan.)	S-3	219-353	133	30.2-35.0	4.7
	S-4	231-402	171	31.3-39.3	8.01
RAINY SEASON (Jun. Jul, Aug.Sep.)	S-1	302-498	196	21.9-26.2	4.33
	S-2	314-627	312	26.3-30.8	4.49
	S-3	423-644	220	26.3-32.3	5.98
	S-4	440-670	230	31.0-37.9	6.85

Table 4. Ranges CO_2 at different stations during the months of Summer, Winter and Rainy season

Season	Station	CO_2 (mg/L)	Mean variation
SUMMER (Feb., Mar. Apr. May.)	S-1	7.8-10	2.00
	S-2	11-18	6.78
	S-3	13-18	5.00
	S-4	21-24	2.40
WINTER (Oct.,Nov., Dec., Jan.)	S-1	5.9-10	3.99
	S-2	8.9-12	3.60
	S-3	11-16	5.66
	S-4	14-23	9.40
RAINY SEASON (Jun. Jul, Aug.Sep.)	S-1	3-5.4	2.50
	S-2	5-7.6	2.80
	S-3	10-13	2.58
	S-4	16-22	6.22

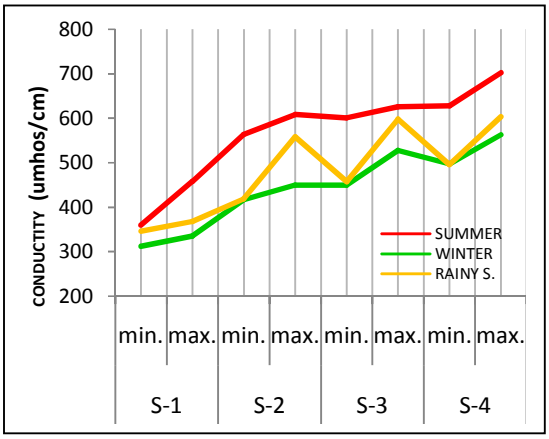

Figure 1. Variation of conductivity in Waingangariver

CONCLUSION

The present study showed conductivity of river water increases during the month of summer and decrease during winter season. High concentration of municipal wastes and domestic activities and less flow of river during summer is responsible for maximum conductivity. The dilution of pollutants to some extent is affected due to increased flow of river during winter months and lowers the ionic contents of water. The reduced rate of decomposition activities in the lower temperature of water also affects the ionic concentration in river water. Mass bathing and other activities on the bank of

river also help to raise the values at station S-3, and S-4. During rainy season, the surface runoff from the catchment areas maintains the ionic content in river water. Conductivity in river water increases from upstream station to downstream station S-4, in all seasons. Due to higher chlorides and total dissolved solid contents during summer, the higher values of conductivity are obtained. The Wainganga river water has higher conductivity in summer; the values are more than permissible level. The permissible level for potability is 300 umho/cm.

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