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Chemical studies of metal pollutants on spectrophotometer of water in the rivers of Wardha District

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ABSTRACT

*Dham and Wardha (flowing from north to south) are the major rivers of wardha district supplying drinking water and water for irrigation. Though some of metals like Cu, ,Fe,,Mn & Zn are essential as micronutrients for life processes in plants and microorganisms, they are proved detrimental beyond a certain limit. Therefore monitoring these metals is important for safety assessment of the environment and human health In this work, an attempt made to study the chemical properties of metal pollutants such as Copper, Manganese, Iron, Zinc, and Nickel in water in these river and to verify weather water is potable or not and its suitability for irrigation purpose & farming. The physiochemical parameters such as Colour, Odour, Taste, Temperature, pH, Electrical conductivity, Sulphates, Mg-hardness, Acidity, Bicarbonates alkalinity, Chlorides, Ca-hardness, Sodium, Potassium were also analyzed. The detection of metals was done spectro*photometrically (AAS). The studies revealed that, all the above parameters are well within permissible limits as per Indian standard specification. The water is totally harmless for human being & animals. It is also harmless for washing and irrigation.

INTRODUCTION

Our environment is a complex and dynamic system, in which all forms of life are inter-dependent & interconnected. When water contained certain harmful, disease producing matter, may lead to many diseases on being consumed by healthy person. The water-borne diseases are cholera, Typhoid, paratyphoid, dysentery, diarrhea, jaundice, malaria, yellow fever, warm infection, Blue babies etc. A safe and potable drinking water should conform to the following water quality characteristics.

1. Free from pathogenic organism.
2. Low in concentration of compounds that are actually toxic or that have serious long term effect such as lead.
3. Clear.
4. No saline (Salty).
5. Free of components that cause on offensive taste or odour.
6. Non-corrosive, nor should it cause encrustation piping or staining of clothes.

Water pollution (1-3) occurs due to the addition of various organic materials found in domestic and industrial effluents and excessive dissolved organic materials which leads to turbidity, colour, temperature rise, associated radioactivity, depression in level of dissolved oxygen etc.In India (4) water demand is increasing year by year. In the year 1997 – 1998, water demand was 629 Km^3/year which is projected to be 1180 Km^3/year in 2050.

About the study area – Wardha District

Wardha district is located in the central part of the Vidarbha region of Maharashtra was one of the major centers of activities during the pre-independence period. It is well known for Sewagram Ashram of Mahatma Gandhi and Pawnar Ashram of Vinoba Bhave. The Wardha district lies between north latitudes of $20^0 18'$ to $21^0 21'$ and east longitudes of $78^0 4'$ to $79^0 15'$. The district falls in the survey of India degree sheet nos. 55 K/L and P, on the north eastern side of the state Maharashtra.

A considerable amount of work has been carried out by various workers. Pandya et al. (5) carried out the study of effective stabilization of overburden material for agriculture purposes by characterization of the overburden material and its use for farming in control conditions. They reported the increase in organic contain by 2.34 % and water holding capacity by 30 – 40%, increase in pH from 5.6 to 8.2 application of time sludge together with overburden materials. While, nutrients like nitrogen, phosphorus and potassium showed substantial rise as compared to the overburden alone. Kaushik et al (6) reported that anaerobically digested distillery effluents of molasses based distilleries with high BOD and COD cause deterioration of land ground water quality. They study the growth of Spiriulina Plantensis in different dilutions and used for the treatment and safe disposal of anaerobically digested distillery effluents.

S. R. Warhate et al (7) studied the impact of continuous mining on water and soil of Wani region. The study indicated adverse influence of mining activities on the soil quality. Shilpi Bansal et. al. (8) studied hydrochemical monitoring of pollutants in drinking water of Aligarh. The results indicate that drinking water quality of Aligarh is deteriorating and water is becoming polluted due to untreated industrial and sewage water discharge which can be controlled by adopting standard methods for water treatment. Dr. Indradev Yadav (9) studied the drinking water before and after flood east zone of Kosi division and concluded that when the concentration of Nitrate exceed 40 mg/lit. The skin becomes glue due to the decreasing efficiency of hemoglobin to combine with oxygen. It affects the mortality in pigs and calves due to the presence the high concentration in cattle.

Mathew Koshy et. al. (10) studied water quality parameters of reverse in Alappuzha district. The result of present dissertation work indicates that there are variations in the physicochemical parameters in the river water system. D. V. Tayade (11) reported the assessment of some metal in ground water and canal water of Nagapur village of Yavatmal district, Maharashtra. The result found to contain Calcium; Magnesium and Iodide elements were below maximum permissible limit whereas fluoride was above the maximum permissible limit. Bilgrami & Dattamunshi (12) studied the pH values in river Ganga and its major tributaries mainly Gandak, Barni, Kosi and attributed pH changes due to planktonic and fish activities.

Talling and Rhoska (13) opined that photosynthetic activities of algae were largely responsible for increase value of pH in fresh waters. H. G. Malatkar et. al. (14) studied the water harvesting in drought prone area. He suggested that it is better to develop water harvesting techniques. The water can be conserved in occurrence stage through different methods of water harvesting.

Mahadevan & Krishnaswamy (15) found a maximum conductivity of 1067 µ mhos cm^{-1} in river Vaigai. Paramsivam & Sreenivasan (16) observed a conductivity vaue of 285 µ mhos cm^{-1} for the river Cauvery. Datta et. al. (17) found the values of conductivity between 349 to 390 µ mhos cm^{-1} in Ganga at Hooghly sector. He also opined that channel input increases calcium and magnesium in river system. Bilgrami et. al. (18) reported the conductivity values between 510 to 1180 mhos cm^{-1} from Ganga at Patna-Farraka region. Singh & Singh (19) recorded the values of conductivity ranging from 96 to 415 mhos cm^{-1} for the river Subarnarekha. He found that the high value of hardness indicates the pollution of the river due to domestic wastes in industrial effluents.

Unni (20) observed declined in pH at polluted stations of river Wainganga receiving acidic industrial effluents. Chnadraprakash, et. al. (21) noticed upto 8.8 mg/lit. of dissolved oxygen in Yamuna River. Dakshini & Soni (22) reported to maximum of 5.2 mg/lit. of dissolved oxygen in Yamuna at Delhi. Jabenesan, et. al. (23) reported that D.O. values of surface water fluctuated. Francis, et. al. (24) observed that conductivity values fluctuated between 250 mhos cm^{-1} to 420 mhos cm^{-1} in the monsoon fed fresh water ponds, Coimbatore. Bhuvaneswaran, et. al. (25) reported 545.3 mg/lit. of alkalinity for Adayar River and CPCB (26) reported 424 mg/lit. of River Cauvery. As per the Bureau of Indian Standards, the desirable level of total alkalinity for drinking water is below 200 mg/lit. and the permissible limit in the absence of alternate source is 600 mg/lit.

D. K. Semwal, et. al. 2007 (27) studied physicochemical examination of drinking water sample in and near Srinagar city (Uttarakhan) and it was concluded that the drinking water samples of various places in and near Srinagar city was found to well within permissible limit as per WHO Standard. Ajit Verghese George, et. al. 2007 (28) studied water quality parameters of river Pallikkal in Kollam district, it was found from the pH values of the different

stations in the river Pallikkal that the water is slightly acidic in nature. Madhyastha, et. al. (29) reported the impact of anthropogenic activities on the river water quality along pilgrimage centers at Dakshina Kannada. Mathew Koshi & Vasudevan Nair (30) suggested that the high MPN values found in river Pumba may be attributed due to the anthropogenic activities of pilgrims and local people.

Yogamoorthi (31) found the caliform bacterial count in Pondichery costal water is very low at 500 m. away from the costal area and the presence of Caliform bacteria was detected at the coast of the sea. D. Kar, et. al. 2007 (32) studied assessment of heavy metal pollution in the surface water. The river water samples exhibited an alkaline pH in the range of 7.21 to 8.32. Except for Fe and Mn, the concentrations of other metals in the Ganga water were lower than the observed metal concentrations of the river Bhadra, Karnataka and Purna. The mean concentrations of the metal were observed in the order Fe > Mn > Ni > Cr > Pb > Zn > Cu > Cd.

Kaushik A. et. al. (33) studied heavy metal pollution of river Yamuna in the industrially developing state of Hariyan. He found that Fe, Ni & Co concentrations exceeded the maximum permissible limits prescribes for drinking all along the river. Rawat M. et. al. 2003 (34) studied inventory compilation and distribution of heavy metals in waste water from small scale industrial areas of Delhi, India and he detected heavy metals such as Fe, Mn, Cu, Zn, Ni, Cr, Cd, Co & Pb using a GBC 902 atomic absorption spectrometer. The result indicated that SSI could be one of the point sources of metal pollution in the river system.

Sponza D. and Karaoglue N. (35) reported environmental geochemistry and pollution studies of Aliga metal industry district. Dr. Jyoti Sharma et. al. 2006 (36) studied the total hardness variation of various samples at Bharatpur city of Rajsthan.

B.A. Abd El-Hady 2007 (37) compared the effect of polluted and River Nile irrigation water on contents of heavy metals of some soils and plants. S. L. Patil and M. Hussain 1997 (38) studied salinity a case study at Tapi basin. Abd El-Tawab (39) showed that the liquid wastes produced by industrial complex at Helwan increased Fe, Zn and Mn content in the Nile water by three times than their normal contents. ,

Objectives of the present work

From the literature survey, it is clear that vast studies have been done in India on physicochemical as well as biological properties of water. The wardha is historical place in India. It is one of the famous place in maharashtra due to Gandhiji's Sevagram Ashram. Dham and Wardha are the major rivers of wardha district supplying drinking water and water for irrigation. In this work, an attempt made to study the chemical properties of metal pollutants in water in these rivers.

The origin of Dham river is from Bhrahmanwada hills located in Arvi Taluka. These hills are 300-450 m high. Dham, river is the main source of supplying water to the Wardha city. Water from Dham river is collected at Pawnar from where the water is distributed to all over the Wardha city with the help of municipal water distribution system. The origin of Wardha River is from Multai lake, District- Baitul (M.P.). Both the rivers i.e. Dham River and Wardha River are flowing from North to South. This shows that the Wardha district is having the slope from North to South.

We examined the water of Wardha and Dham river due to following reasons-

1)To determine metal pollutants like Cu, Zn, Mn, Fe, Na, Li etc. spectrophotometrically.
2)To discuss the harmful effects of these metal pollutants on human beings and plants.
3)To verify whether water is potable or not.
4)To determine the suitability of water for irrigation purpose and farming.
5)To estimate the degree of pollution of water from the river.
6)To study physico-chemical parameters of water from Dham and Wardha river.
7)To suggest the peoples, the water treatment methods for purification.
8)To find the various sources of metal pollutants.
9)To discuss the effect of industrial wastes, sewage and domestic pollutants this contaminates the river water.
10) To study the effect of various pesticides, fertilizers and toxic materials on water pollution.

MATERIALS AND METHODS

The Samples were collected from the various stations as cited in Table-1 and Table-3 for Dham river and Table-2 and Table-4 for Wardha river during the period of February and March 2008. Water samples were collected 2 meters away from the bank, 0.3 meter below surface was taken as the standard depth for sampling to avoid surface micro layer. The samples were collected in plastic bottles. All the chemicals used in the study were of analytical grades. Double distilled water was used throughout the study. All glass wares and sample containers were thoroughly

cleaned and finally rinsed with double distilled water.

Standard methods for the examination of water and waste water (17th edition) published by American Public Health Association (APHA, 1989) and Bureau of Indian Standards (BIS) methods of sampling and test (physical and chemical) for water and waste water (IS-3025) were adopted as reference manual for analytical procedures. The following physico-chemical parameters - Colour, Odour, Taste, Temperature, pH, Electrical conductivity, Sulphates, Mg-hardness, Acidity of water, Bicarbonates alkalinity, Chlorides, Ca-hardness, Sodium, Potassium were analyzed.

The detection of Copper, Manganese, Iron, Zinc, Nickel, metal was done spectrophotometrically.

The Services for detection of Cu, Zn, Ni, Fe, Mn by Atomic absorption spectroscopy was provided by District Soil analysis laboratory, Wardha by adopting standard methods.

Table- 1

S.N	Dham river stations	Temp.	pH	Electrical Conductivity (mS/cm)	Ca hardness ppm	Mg hardness ppm	Acidity of water ppm	Bicarbonates alkalinity ppm	Chlorides ppm	Sulphates ppm
1	Pawnar Near Ashram	20^0 C	7.48	0.55	68.7	37.5	Nil	36.5	142	34.56
2	Pawnar at upstream	19^0 C	7.38	0.45	65	30	Nil	34.6	142	34.56
3	3 km away from the Pawnar near M.I.D. Collection	22^0 C	7.49	0.56	95.6	18.7	Nil	36.6	170.4	28.7
4	Garpith	22^0 C	7.2	0.45	44.3	18.0	Nil	Nil	75.5	23.6
5	Garpith at upstream	18^0 C	6.50	0.47	54	39.5	Nil	45.6	75	24.9
6	Garpith at downstream	19.5^0C	7.20	0.38	103	49.5	Nil	Nil	38.7	33.7
7	Sukli at 1 km away from the direction of upstream	24^0 C	7.50	0.66	34	70	Nil	46	96	43.20
8.	Dham River water at Sukli	25^0 C	7.78	0.59	76	65.3	Nil	Nil	67	34.4
9.	Sukli at down stream	28^0 C	7.34	0.69	67.2	39.5	Nil	37.6	135	29.40
10.	Dham river from Kharangana Gode	27^0 C	8.00	0.68	88	33.5	Nil	56.2	99	27.00

Table-2

S.N	Wardha river stations	Temp.	pH	Electrical conductivity (mS/cm)	Ca-hardness ppm	Mg-hardness ppm	Acidity of water ppm	Bicarbonates alkalinity ppm	Chlorides ppm	Sulphates ppm
1.	At Deyulwada	35^0 C	7.2	0.56	90.0	23.5	Nil	49.2	83.0	68.00
2.	Deyulwada at upstream	30^0 C	7.5	0.66	99.0	19.0	Nil	46.0	76.2	66.5
3.	Deyulwada at down stream	29^0 C	7.5	0.57	90.0	31.5	Nil	32.2	63.7	62.3
4.	At Mount of Cotton Industrial, waste carrying Nala	27^0 C	8.0	0.74	67.5	22.3	Nil	89.2	67.0	69.0
5.	At upstream Near Railway Bridge	27^0 C	8.2	0.58	44.0	25.5	Nil	78.3	56.4	78.8
6.	At Down Stream 5 Km away (mouth of Nala)	28^0 C	7.48	0.65	85.0	28.3	Nil	99.0	89.7	88.3
7.	At Kapsi	28^0 C	7.5	0.67	101.0	33.0	Nil	98.0	44.7	74.9
8.	Kapsi at up stream	32^0 C	7.9	0.72	98.3	28.9	Nil	39.0	77.0	98.8
9.	Kapsi at down stream	31.5^0 C	8.0	0.56	56.0	35.9	Nil	25.0	43.5	98.7

Table- 3

S. N	Dham river station	Copper (ppm)	Manganese (ppm)	Iron (ppm)	Zinc (ppm)	Nickel (ppm)	Sodium (ppm)	Potassium (ppm)
1	Pawnar Near Ashram	0.014	0.035	0.05	0.049	0.01	87.4	6.24
2	Pawnar at upstream	0.013	0.03	0.06	0.05	0.03	74.2	5.20
3	3 km away from the Pawnar near M.I.D. collection 0.01	0.017	0.04	0.09	0.05	0.04	84.87	3.9
4	Garpith	0.01	0.03	0.03	0.04	0.02	77.3	4.22
5	Garpith at upstream	0.027	0.07	0.06	0.045	0.04	77.4	3.34
6	Garpith at downstream	0.02	0.072	0.043	0.044	0.01	95.4	9.30
7	Sukli at 1 km away from the direction of upstream	0 .022	0.041	0.035	0.05	0.03	47.4	7.23
8.	Dham River water at Sukli	0.02	0.03	0.04	0.025	0.02	67.3	9.34
9.	Sukli at down stream	0.03	0.04	0.05	0.04	0.05	83.2	4.19
10.	Dham river from Kharangana Gode	0.017	0.05	0.06	0.04	0.03	74.3	11.2

Table-4

S. No.	Wardha river station	Copper (ppm)	Manganese (ppm)	Iron (ppm)	Zinc (ppm)	Nickel (ppm)	Sodium (ppm)	Potassium (ppm)
1	At Deyulwada	0.01	0.03	0.05	0.02	0.03	72.3	15.3
2	Deyulwada at upstream	0.013	0.05	0.04	0.05	0.015	67.4	18.3
3	Deyulwada at down stream	0.035	0.07	0.06	0.052	0.02	66.3	18.7
4	At Mount of Cotton Industrial, waste carrying Nala	0.02	0.05	0.091	0.06	0.04	83.9	28.3
5	At upstream Near Railway Bridge	0.029	0.074	0.06	0.04	0.07	89.5	22.6
6	At Down Stream 5 Km away (mouth of Nala)	0.02	0.06	0.07	0.07	0.03	86.4	25.3
7	At Kapsi	0.01	0.02	0.03	1.03	0.02	84.3	22.9
8	Kapsi at up stream	0.032	0.055	0.06	0.07	0.03	57.9	17.3
9	Kapsi at down stream	0.033	0.08	0.07	0.05	0.03	89.00	27.4

RESULTS AND DISCUSSION

In this work we have analysed the waters of two main rivers of Wardha district. These two rivers are Dham river and Wardha river.

As complete analysis of single water gives only the information regarding the nature of water. Multiple sampling and analyzing are needed to project a better picture regarding the quality of water. Keeping this view in mind we have selected various places for sampling.

In Wardha river, the calcium content ranges from 44ppm to 101ppm and Magnesium content varied between 19.0 to 35.9ppm. In the present study, the water from wardha river is not found polluted w.r.t. alkalinity. Its highest value is 99.0ppm and lowest value is 25.0ppm. Chloride value of Wardha river system ranges from 43.5ppm to 89.7ppm. Sulphate conc. was found to vary from 62.3ppm to 98.8ppm

From the metal analysis of water in Wardha district, it has been found that the copper conc. varies from 0.01ppm to 0.035ppm, manganese conc. varies from 0.02ppm to 0.08ppm. In the present investigation, Iron conc. varies from 0.03ppm to 0.091ppm. Minimum Zinc content value is 0.02ppm and maximum value is 1.03ppm. The Nickel conc. ranges from 0.015ppm to 0.07ppm.Simillarly, the maximum sodium and potassium concentrations observed are 89.5ppm and 28.3ppm respt. and their minimum concentrations are 57.9ppm and 15.3ppm respt.

In the investigation of Dham river, it is observed that the Calcium and Magnesium content has minimum value of 34.0ppm & 18.0ppm respt. and 103ppm & 70ppm respt. The Chloride conc. is in the range of 38.7ppm to 170.4ppm. Sulphate is also within the permissible limit and its conc. varies from 24.9ppm to 43.2ppm. .

From the metal analysis of water in Dham river, the copper conc. is found in the range of 0.01ppm to 0.03ppm Mn conc. varies from 0.03ppm to 0.072ppm. Highest value of Iron conc. is 0.09ppm and its lowest conc. value is 0.03ppm. Similarly, Zinc conc. varies from 0.025ppm to 0.05ppm and Nickel conc. varies from 0.01ppm to 0.05ppm. The maximum sodium concentration value found is 95.4ppm and minimum conc. value is 47.4ppm. Similarly, the range of potassium concentration is from 3.34ppm to 11.2ppm.

Thus, it can be seen that as per the Indian Standards Specifications all the parameters and metal concentration values are within the permissible limit. The water from Wardha and Dham rivers is totally harmless for human being and animals. It is also harmless for washing and irrigation.

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