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STUDIES ON PHYSICO-CHEMICAL ANALYSIS AND METAL COMTAMINATION OF DAMANGANGA RIVER WATER

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ABSTRACT

Metal contamination of rivers is closely associated with rapid industrialization and urbanization. Partially treated industrial waste water discharged into nearby bodies of water can lead to severe ground water pollution and have long-term toxic effects on humans and the environment. In present study Physicochemical analysis of Damanganga River water collected from Vapi Region was carried out. Out of physicochemical parameters tested like pH, Colour, EC, TDS, TH, TA, calcium, calcium hardness, Magnesium, Magnesium Hardness, Chloride, Nitrate, Sulphate, Fluoride, BOD, COD. Following parameters TDS, Total Hardness, Calcium Hardness, Magnesium Hardness, Fluoride were found to be well above normal range as per IS 10500:2012 standards. Surface water sample were analyzed for 14 metals (Al, Ba, Cu, Fe , Mn , Zn, Cd, Pb, Hg, As, Cr, Mo, Ni, Se) using the Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) .The concentration of Cadmium (0.01 mg/ lit), Arsenic (0.04 mg/lit) ,Aluminum (0.07 mg/lit) is found to exceed significantly as per IS 10500:2012/ IS 13428:2005/IS 14543:2016 and concentrations of other metals is within the acceptable limit. It can be concluded that rapid population growth and industrialization deteriorated the quality of Damanganga River water.

Keywords – Damanganga, Cadmium, Arsenic, Aluminum, Vapi.

INTRODUCTION

River water quality monitoring issues have become a major problem for the nation. Contaminants, including domestic and industrial waste, are getting into the rivers and adversely affecting the health. (Mustapha & Halimoon, 2015) Countries and regions find it difficult to comprehend and address this issue because of a lack of monitoring and enforcement. Metal contamination in the environment is one of the persistent global environmental problems. The continual expansion of the mining, fertilizer, tannery, paper, chemical, battery, and electroplating industries is mainly responsible for this contamination, which has had

detrimental effects on human health all over the world. (Kartik et al., 2016) . Heavy metals, in contrast to organic pollutants, are non biodegradable and also carcinogenic. Heavy metals such as Zinc, Copper, Nickel, Mercury, Cadmium, Lead, Chromium and Arsenic tend to accumulate in organisms, which may lead to a reduction in species diversity. (Gupta et al., 2012) If River adjacent to industrial sites is used for the discharge of inadequately treated liquid effluents and dumping of solid wastes, the river may become contaminated with heavy metals. (Gabarron M et al, 2017) . The heavy metal contamination of surface freshwater bodies, particularly rivers, has become a focus of current research in recent decades.(Mishra S et al, 2020).

Several studies on the distribution of heavy metals in various Indian rivers like Godavari, Yamuna, Hindon and Gomati have been carried out. (Hussain, J. *et al.*, 2017;Shrama .R. et al ,2020; Mishra S et al, 2020; Gaur. K. et al 2005.) The present study aimed to investiagate the water quality status of river Damanganga with respect to its heavy metal concentrations. The Damanganga River originates from Sahyadri Hills near Valveri village in Nashik District of Maharashtra. Damanganga River flows 131.30 kilometers from east to west, passing through the hilly areas of Maharashtra, Gujarat, and the Union Territories (UT) of Dadra & Nagar Haveli (DNH) and Daman & Diu (DD) before draining into the Arabian Sea. There are approximately 5105 larges, medium, and small-scale industries located along the river's stretch. Damanganga River receives Industrial and domestic waste from the many drains located along the river's stretch in Dadra & Nagar Haveli, Vapi (Gujarat), and Daman industrial clusters As a result , the water and sediment of the river Damanganga get contaminated by heavy metals and other pollutants. (Patel & Sahoo, 2021)

Fig 1.Location of river Damanganga

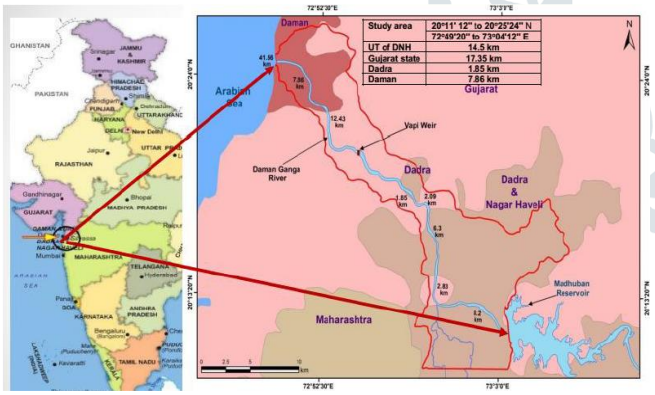

Fig 2 Damanganga river ,Vapi

MATERIALS AND METHODS

Study Area

Vapi GIDC in Gujarat's District Valsad is one of Asia's largest industrial areas. Fine chemicals, pharmaceuticals, dyes, dye intermediates, textiles, pesticides, agrochemicals, various metals, alloys, and many other industries are included in it. The remainder consists primarily of pulp and paper mills, plastics, and food processing units. The Central Pollution Control Board (CPCB) released a list of critically polluted areas in December 2009 using a comprehensive environmental pollution index (CEPI) .Vapi GIDC was the second most polluted industrial area in India, with a CEPI index of 88.29, and Ankleshwar was the first, with a CEPI index of 88.5. . (Nirgude et al., 2013.)

The most significant industrial effluents discharged into the river and its estuary is from the Common Effluent Treatment Plant (CETP) of the GIDC, Vapi.

Sampling

Surface water samples were collected in Acid soaked polythene container of 2 liters capacity from Damanganga River 300 meters downstream of CETP Vapi outlet.(Lat 20.342829^0 ,Long 72.905428^0)

Sample Analysis

The water samples were analyzed for determining following physico-chemical parameters pH, Colour, EC, TDS, TH, TA, calcium, calcium hardness, Magnesium , Magnesium Hardness, Chloride, Nitrate, Sulphate , Fluoride , BOD, COD as per standard procedure given in APHA 23rd Ed. and IS 3025.Trace metal analysis was carried out for 14 metals (Al, Ba, Cu, Fe , Mn , Zn, Cd, Pb, Hg, As, Cr, Mo, Ni, Se) using the Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) following standard methods given in IS 3025 (Part 2)

RESULTS AND DISCUSSION

The physico-chemical parameters of water samples are given in Table-1. Out of physicochemical parameters tested following parameters TDS, Total Hardness, Calcium Hardness, Magnesium Hardness, Fluoride were found to be well above normal range as per IS 10500:2012 standards. The specific heavy metal elements and their origins may potentially reveal details about the history environmental pollution. The heavy metals concentrations were estimated and primarily compared with their respective permissible limit for drinkable water as per IS 10500:2012 standards to identify the major contaminant in the Damanganga River. Environmental heavy metal contamination is a serious concern . Maternal exposure to heavy metals due to environmental pollution is a potential risk factor for new born birth defects. (Lin, Z. et al. 2018) Even at very low concentrations, heavy metals are mutagenic, teratogenic, neurotoxic, and carcinogenic. Mercury can combine with other elements to form organic and inorganic compounds. Various chemical forms of mercury exist in nature, and they all have an impact on human and animal health. (Farahani et al., 2020) The concentrations of heavy metals studied are shown in a table 2. The concentrations of Cadmium was found to be 0.01 mg/ lit which is , found to be higher than its normally accepted value (0.003mg/l) as per IS 10500:2012/ IS 13428:2005/IS 14543:2016. Cadmium may be found in relatively small amounts as inorganic complexes in the aquatic environment, such as carbonates, hydroxides, chlorides, or sulphates. (Hiatt and Huff 1975) Even in heavily contaminated rivers Cadmium levels in the aqueous phase can be extremely low, and occasionally even below the detection limit. It is one of the trace and toxic metal which have strong affinity for sulphur and bind to the sulphydryl groups of enzyme to inhibit their activity.(Hussain et al. 2014) Industrial wastes , plating operations, textile mills, cadmium-stabilized polymers, nickel-cadmium battery manufacturing facilities, or effluents from sewage treatment plant have all contaminates surface waters. (Rani et al. 2014) BIS has recommended 0.01 mg/L as acceptable concentration of arsenic in drinking water. The data revels that the concentration of Arsenic (0.04 mg/lit) is four times higher, than its acceptable value . According to BIS the acceptable limit of Aluminum is 0.03 mg/l .The occurrence of Al in river water is 0.07 mg/lit which also exceed than its acceptable value . The

concentrations of other heavy metals chromium (0.01mg/l), iron(0.04mg/l), zinc(0.02mg/l) , Manganese (0.05mg/l) , Boron(0.21mg/l), Molybdenum(0.03mg/l) is within the acceptable and permissible limits as per IS 10500:2012

Table 1 Physico chemical parameters of Damanganga River water

Parameter	Observed values
pH	7.3
Colour	283.4 CU
Odour	Not Agreeable
Test	Not Agreeable
TDS	605.2 mg/l
Temperature,	25.5^0c
Total hardness	242.0 mg/l
Total Alkalinity	155.3 mg/l
Calcium	68.9 mg/l
Calcium hardness	172.0 mg/l
Magnesium	17.01 mg/l
Magnesium hardness	70 mg/l
Oil and Grease	Not dectected
Chloride	182.8 mg/l
Free chlorine	Not Detected
Nitrate	4.73 mg/l
Sulfate	146.8 mg/l
Fluoride	1.06 mg/l
BOD	60 mg/l
COD	147.6 mg/l

Table 2. Heavy metal content in Damanganga River water

Heavy Metal	Conc.(mg /l)	Acceptable Values (mg/l) As per IS 10500:2012
Aluminum	0.07	0.03
Barium	0.02	0.7
Boron	0.21	0.5
copper	Not Detected	0.05
iron	0.04	0.3
Manganese	0.05	0.1
zinc	0.02	5.0
cadmium	0.01	0.003
lead	Not Detected	0.01
Mercury	Not Detected	0.001
arsenic	0.04	0.01
chromium	0.01	0.05
Molybdenum	0.03	0.07
nickel	Not Detected	0.02
Selenium	Not Detected	0.01

CONCLUSION

The present study was carried out to check the status of trace and toxic heavy metals in Damanganga River water from vapi region .The analyzed data indicates the excess amount of Calcium, Magnesium and Fluoride along with increased TDS and Total Hardness. The study also shows that the concentrations of toxic heavy metals (Arsenic, Cadmium) are well above their accepted values. Increased industrialization around the Damanganga river and population growth in Vapi region is leading to increased level of River Pollution. Discharge of Partially treated industrial effluents and dumping of solid waste may have resulted in increased levels of toxic Heavy metals in Damanganga River Water which makes it unfit for human consumption as well as for irrigation .

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