Seasonal Variation of Heavy Metal in Tapti River

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Abstract Water quality is an index of health and is one of the areas of major concern to environmentalists. Since Industrialization, urbanization and modern agriculture practices have direct impact on the water resources. Hence study of the river water quality is most essential aspect for sustainable development and river conservation. This paper deals with determination of eight heavy metals namely Fe, Cu, Zn, Pb, As, Hg, Ni, Cd in the river water of different sites of Tapti River. The study was done in pre-monsoon and post-monsoon. Seasons in the period of 2010-11. The samples were analyzed by ICP-AES and data is useful to assess the level of heavy metals in river water.

Key word : River water, Heavy metal, ICP-AES

INTRODUCTION
Rivers play an important role in the life of the people because these are mostly used as a source of water for drinking, bathing, irrigation, recreation and other miscellaneous purposes [1]. Trace amounts of metals are common in water and these are normally not harmful to human health. In fact some metals are essential to sustain life. Cu, Fe, Zn… are needed at low levels as catalysts for enzyme activities but excess limits can have severe consequences on health [2,3]. River water contains high levels of these toxic metals such as Cu, As, Cd, Ni, Pb, Hg, may be hazardous to human health. This gives rise to disorders in aquatic organism. Up-take of heavy metal through food chain in aquatic organism may cause various psychological disorders. Availability of heavy metals in the aquatic ecosystem and its impact in flora and fauna has been reported by many investigators [4]. Among the pollutants present in water, heavy metals are more toxic to the living organism. Having entered into environment they play a significant role in aquatic ecosystem thereby posing a biological threat to the public health. Thus, to maintain the environmental quality and avoid health hazards [5]. It is necessary to remove the heavy metals from the water bodies for the detection and assessment of the concentration of these toxic heavy metals becomes very important.

MATERIALS AND METHODS

Study area: Tapti is one of the three major rivers in central India which flow from east to west with a length of 724 km and of area of 30,000 Sq km, the main reason of contamination of the river Tapti by the heavy metals is due to drainage discharge from all villages and cities on both the banks of the river and its tributaries. Similarly heavy metals contamination also takes place due to small brick industry, small scale industries and farming runoff water containing fertilizer and pesticides. Also Prakasha is considered a holy place called Dakshin-Kashi hence many cremations (burning of dead bodies) takes place in all villages nearby and the ash and bones remaining are immersed in the River Tapti leading to pollution of the river water.

Sample Collection:-

For the assessment of heavy metals in Tapti river water five sample were collected in pre-monsoon at different stations during Dec-Jan 2010-11 and five
samples were collected in post monsoon period of May-June 2011 at the same stations. All the water samples were collected and preserved and digested following standard methods and procedures [6,7]. A brief description of sampling sites is represented in Table No. 1 and 2. Eight heavy metal namely Copper, Lead, Nickel, Cadmium, Iron, Zinc, Mercury, Arsenic were analyzed by Inductively Coupled Plasma-Atomic Emission Spectroscopy and most promising emission technique which has been used for heavy metal analysis/detection.

RESULT AND DISCUSSION

Table - 1

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Metals Contamination mg/L</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Cu</td>
</tr>
<tr>
<td>A-1</td>
<td>0.01</td>
</tr>
<tr>
<td>A-2</td>
<td>ND</td>
</tr>
<tr>
<td>A-3</td>
<td>0.024</td>
</tr>
<tr>
<td>A-4</td>
<td>ND</td>
</tr>
<tr>
<td>A-5</td>
<td>ND</td>
</tr>
</tbody>
</table>

• ND – mean not detected (less than 0.01 mg/L)

Table - 2

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Metals Contamination mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cu</td>
</tr>
<tr>
<td>E-1</td>
<td>0.185</td>
</tr>
<tr>
<td>E-2</td>
<td>ND</td>
</tr>
<tr>
<td>E-3</td>
<td>ND</td>
</tr>
<tr>
<td>E-4</td>
<td>ND</td>
</tr>
<tr>
<td>E-5</td>
<td>ND</td>
</tr>
</tbody>
</table>

• ND – not detected (less than 0.01 mg/L)

The major source of heavy metal pollution in river water was its tributaries which are following in city, village it carries lot of untreated sewage, industrial waste, metallic solid west disposal religious festival waste material, human social activity, coal combustion, over use of fertilizer and pesticide invariably discharge into water result in pollution, the heavy metals are biologically non degradable and though the food chain there may pass on to human and can causes signification health concern [8].

Tapti river water samples were analyzed in post monsoon and premonsoon season for Copper, Zinc, Iron, Nickel, Lead, Cadmium, Arsenic, and Mercury. The presence of essential micronutrient’s viz copper, zinc, iron. With concentration within the range of 0.17-0.185, 0.103-0.366, 6.792-7.474 mg/L with an overall mean of 0.101, 0.234, 7.133 mg/L respectively besides the presence of the five toxic heavy metals viz lead, cadmium Nickel, Arsenic, and mercury in the range of 0.0207-0.0705 0.0-9.122, 0.0-0.018 mg/L with an overall mean of 0.0456, 9.122, 0.018, mg/L. The overall
mean concentration of the metals were observed in the order of Cd>Fe>Cu>Zn>Ni>Pb.

The Annual maximum Iron concentration was found 12.678mg/L and 17.122mg/L in post and premonsoon season at A₁ and E₁ station respectively. It may be assigned to the soil water interaction especially within the middle and lower part of river stretch during post monsoon season. [9] Lowest concentration (2.11 mg/L) was observed in premonsoon at E₁ station, Maximum Iron was recorded in Brahami river in summer and winter season [10] and lowest Iron was recorded in the range of 0.01 mg/L. Cauryiver around KRS dam Karnataka, India [10]. Toxicity of copper to aquatic life is dependent on the alkalinity of water, as copper is generally more toxic to aquatic fauna at lower alkalinitities [11] over doses of copper may also lead to neurological complication. The maximum copper was found 0.024 mg/L and 0.185 mg/L at station A₁ and E₁ in post and premonsoon season it may be attributed to domestic sewage and from extensive farmed area [12] low level could be due to the adsorption of copper on to the particulate matter and consequent settlement to the bottom [11] Minimum copper 0.01 mg/L was recorded at station A₁ in postmonsoon season. Copper in Godavari River as in range of 1.755 to 3.640 mg/L the highest concentration of copper in water was recorded in May 2005. While minimum was in Oct. 2005 recorded [14].

Higher concentration of Zinc in sampling station was 0.281 and 0.699 mg/L in post and premonsoon season at stations, A₁, E₁ respectively it is attributed to the presence of unused remain of Zinc sulphate in fertilizer and pesticides in agriculture [12]. Zing value in Ganga River as highest 0.031 mg/Lin summer while lowest value 0.019 mg/Lin rainy season [13].

The maximum value of Nickel was 0.018 mg/L in premonsoon season at E₁ station recorded. 9.0 mg/L concentration of Nickel was recorded in Summer.[9] The previous studies has been ensure that the atmospheric precipitation is very much responsible for metal contamination in surface water [12, 16, 17].

Exceptionally the maximum concentration of cadmium was 30.157 mg/L was recorded in premonsoon season at station E₁ which is much higher than other station so it can be call for farther investigation. The major source of cadmium is the coal combustion metal industry, and west incineration [15] lowest concentration 0.284 mg/L was recorded in premonsoon season. Concentration of cadmium in Damodar River was 0.073 Mg/Lin premonsoon and 0.02 mg/Lin postman soon season [19]. High level of cadmium may be due to discharge form industrial waste or by leaching from sewage laden landfill [20]. Also large use of P.V.C. plastics and Nickel cadmium batteries, insecticides, motor oil and disposal of sludge in dump cities [21].

Maximum lead concentration was found 0.035 mg/Land 0.091 mg/L in post and premonsoon season at station A₁, E₁. High level of lead during premonsoon season due to concentration effect among other factor [13]. The maximum lead 27.00 mg/L was recorded in premonsoon season [21]. In present study few sampling station in both season exceeds the WHO guide line due to direct precipitation and subsequent monsoon run-off that supersedes the salinity and pH of the aquatic phase [9] lead in the present study originates from battery manufacturing units, automobile related subject lowest lead was recorded in post monsoon season at station A₁. Lowest lead 0.019 mg/L was recorded in Gomati River [20] Arsenic and mercury was not detected in both seasons. Low level of mercury in river water might have been caused by the higher ingestion rate of organism, re-suspension of sediments and absorption onto the particulates. In present study seasonal variation in metal concentration due to phytoplankton activates, dilution effect, evaporation rate, flow rate of river, also different type of activities caused by human. Low concentration of Zinc and Copper in postmonsoon season due to phytoplankton could consume more copper and Zinc. Evidently high density of phytoplankton population during monsoon consumed more copper and zinc leading to their low concentration in monsoon and winter season reported [23, 24].

In present study it was concluded that most of the dissolved metals showed slightly higher concentration during premonsoon season than that of postmonsoon season. This kind of pattern indicate the accumulation of metal concentration during low flow condition of river it may be attributed to high evaporation rate of surface water followed by elevated temp [20], few metals such as copper, Zinc, Iron, Lead were lower during post monsoon season it may be due to effect of rain. [26]. The previous studies has been ensure that the atmospheric precipitation very much responsible for metal contamination in surface water [12, 16, 17]. During study period it was observed that concentration of metal increased along with decreased in pH it is reported by many. The concentration of cadmium and mercury in water depend on acidity of surrounding medium. [20, 27].
many revel reported that high water temperature, oxygen concentration, basis pH, and hardness of river water increases the heavy metals toxicity[28].

The highest concentration of most of the heavy metals copper, zinc, iron, Nickel, Lead at stations A1, E1 may be due discharge of heavy metals loaded industrial waste water, sewage water, agriculture run off, high evaporation rate, less dilution, high pH low flow rate[29]. The concentration of heavy metal in Tapti river water were within prescribe limit of standards of world health organization (WHO) except cadmium in premonsoon and lead in both season. Water sample is suitable for flora and fund and it can be used for drinking purposes only after proper treatment.

The analysis of heavy metal in Tapti river water which may be useful for human health and economy. An examination of water quality is basically a determination of the organic, inorganic and mineral contained in the water.

CONCLUSION:

Metal concentration of river basins depends not only on industrial and house hold waste inputs but also on the geochemical composition of the area. The Analysis data of heavy metal concentration in Tapti river water collected in pre-monsoon and Post monsoon Period. The samples are collected in same places in both seasons. In both the seasons concentration of copper varied from 0.0068 to 0.037 mg/L and iron, 6.79 to 5.979 mg/L. Nickel is not detected in all sample of post monsoon period but in pre monsoon period concentration slowly increase up to 0.036 mg/L. Lead varied from 0.0166 to 0.0282 mg/L, there is no much variation among both seasons, Cadmium is also not detected in pre-monsoon period but in post-monsoon period, concentration suddenly increases by 7.30 mg/L. Arsenic and Mercury are not detected in both seasons in all samples. The average concentration is as Cd > Fe > Cu > Zn > Ni > Pb > As, Hg. It is also observed that in dry season concentration of heavy metal in water increases due to high water temperature, oxygen concentration, basic pH and hardness of river water. In Tapti river water samples in both seasons it is also observed that some heavy metals are not detected. Main reason is that there are no chemical industries related to the heavy toxic metals near the river. Also these metals are not used in fertilizers, pesticides, insecticides related to agriculture in the Tapti River under study, Hence these metal are not detected. The higher concentration of metals observed in Post-monsoon reason could be attributed to the heavy rainfall and subsequent river run- off, bringing much industrial and land derived material, along with domestic and agricultural wastes, which include the residues of heavy metals containing pesticides.

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