Assessment of heavy metals and physico chemical parameters of water samples of the vicinity of the municipality dumping sites of Karimganj district, Assam, India

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ABSTRACT

A total number of six water samples have been collected from Naughty Khal, a canal connects the municipality waste dumping site and Longai river of Karimganj district during month of August, 2011. A uniform distance between the collection sites has been maintained during the collection of the sample. Analysis have been done for the quantitative determination of the concentration of Fe, Mn, Cu, Cr, Cd, As and also for the qualitative determination of physical parameters like pH, EC, TSS, TDS, TS and total hardness of the collected water samples. The concentration of Mn, Cr, Fe, Cd and As obtained were higher than the permissible limit declared by WHO. pH and Electrical conductance of the water samples lies between 6.60-7.41 and 7.43-9.91 ms/cm respectively. TSS, TDS, TS and total hardness were found to be within the permissible limit declared by WHO.

Keywords: Municipality waste dumping site, Naughty Khal, Heavy metals, Physical parameters, WHO.

1. Introduction

Disposal of solid waste in to open dumps is the normal practices by municipalities of our country. During the rainy season leachate formation takes place from the wastes which enters near by water resources and penetrate deep down in to ground water. Leachates are composed of high concentration of organic substances, soluble salts and other constituents including toxic heavy metals etc (De, 1989, Dara, 1995, Kaushik et al. 2004, Obodo, 2001, Lark et al. 2002, Kudesia, 2000, and Waheed et al. 2007). Though some metals like Cu, Fe, Mn, Ni, Zn are essential for life, many other metals like Cd, Cr, Pb have very detrimental effects if present beyond a certain limit [Jain, 1978, Shrivastav, 2001 and Duruibe et al.(2007)]. Kar et al. (2008) has studied the contamination of river Ganga by inorganic contaminants as well as by heavy metals .Analysis of heavy metal concentration in soil and lichens from various localities of Hosur road of Banglore has shown the presence of significant amount of heavy metal(Begam et al. 2009). Joseph (2002) has found that urban centers of the developing world are ill equipped to handle the increasing amount of MSW. Health and environment get jeopardized when urban infrastructure is unable to cope with increasing amounts of solid wastes. It was reported by Dhere et al.(2008) that the urban centers of India produce 120,000 t of solid per day and is almost all the cites , unscientific disposal of solid waste has created environmental pollution. Recently Rajkumar et.al (2010) has analyzed 43 ground water samples and 7 surface water samples from waste dumping sites at Erode city, tamilnadu and
found that the analysed water samples are unsuitable for drinking due to contamination from leachates.
In the present research work, authors have analyzed six water samples of Naughty khal, a canal connecting Municipality waste dumping site and Longai river of Karimganj district, Assam for possible contaminants like heavy metals, As and also physical parameters like pH, Electrical conductance, TS, TDS and TSS during the month of August, 2011.

2. Materials and Method

2.1 Study Area

Karimganj town is the district head quarter of Karimganj district of Assam, a state in the north eastern region of India. The district is situated just on the Bangladesh border with the river Kushiara flowing in between. It is located approximately along 24° 52' N latitude and 92° 49' E longitude and has the area about 6.9 km². According to the 2011 census report the total population of the district is 52,613. One prominent feature of the place is a wide canal meandering across the town. Earlier it used to be a connecting river way between Kushiara and Longai facilitating river communication and also balancing of water-levels between the two rivers. Although now, this canal has been blocked at several places through embankments and land-fills to pave way for road transport and construction works but still today Longai river is directly connected with the canal. The east side area near the embankment connecting Bonomali road and Hospital road of karimganj district was used by municipality for dumping the waste for several rears. During rainy season, leachate from the municipality dumping site directly goes to the canal and ultimately pollutes the water quality of Longai river which is the main water resource used by Public health engineering of Karimganj district for domestic purpose.

2.1 Sampling procedure

Water samples were collected from six different sites of Naughty khal at regular distance from the municipality waste dumping site of Karimganj district during the month of August, 2011. The description of sampling sites are given in the table 1. The samples were collected from a depth of 1ft below the surface and kept in 1liter prewashed polythene containers. Half part of the water samples were analysed for the physicochemical parameters with in 24 hours of collection and the other half part has been kept in refrigerator at ~4°C with 1 ml concentrated HNO₃ per 500 ml in order to preserve the metals and also to avoid precipitation.

Table 1: Description of sampling sites

| Sample | Site description |
|--------|------------------|
| S₁ | Nearest to the dumping site |
| S₂ | Near the Bonomali embankment |
| S₃ | Near the Betail embankment |
| S₄ | Near the water supply plant of PHE where Naughty khal and Longai river joined |
| S₅ | Opposite to Longai police out post in Longai river |
| S₆ | Opposite to Satsangha Asram In Naughty khal |

2.2 Physico Chemical Parameters
2.2.1 pH and conductivity

pH was determined by Elico pH meter and conductivity was determined by Weiber conductivity bridge.

2.2.2 TS

250 ml of each water sample is taken in a pre weighed beaker. The beakers are then covered with watch glass and placed inside an oven at ~60°C till dryness. The beaker with the substance was weighed again. The increase in the beaker weight represent the total solid in water sample.

\[ \text{TS (mg/l)} = (A - B) \times 10^6 / V \]

Where,  
A= Final weight of the beaker and residue in g.  
B= Initial weight of the beaker in g.  
V= Volume of the sample.

2.2.3 TSS

100 ml of each water sample was filtered through a pre weighed sintered glass crucible and dried in the oven at ~60°C. The sintered crucible with the substance was weighed again. The increase in the crucible weight represent the total suspended solid in water sample.

\[ \text{TSS (mg/l)} = (A - B) \times 10^6 / V \]

Where,  
A= Final weight of the crucible and residue in g.  
B= Initial weight of the crucible in g.  
V= Volume of the sample.

2.2.4 TDS

The filtrate remaining after the determination of TSS was taken in pre weighed beakers. The beakers are then covered with watch glass and placed inside an oven at ~60°C till dryness. The increase in the beaker weight represent the total solid in water sample.

\[ \text{TS (mg/l)} = (A - B) \times 10^6 / V \]

Where,  
A= Final weight of the beaker and residue in g.  
B= Initial weight of the beaker in g.  
V= Volume of the sample.

2.2.5 Total Hardness

Ca-hardness (Ca-H) and Mg hardness (Mg-H) were determined with the help of usual EDTA complexometric method found in the literature.

2.3 Metal analysis
100 ml of each acid digested water sample was taken in beaker and the beaker was then kept in a oven at 70°C to reduce the volume up to 50 ml. Mn, Fe, Cd, As, Cu and Cr were analyzed by Atomic Absorption Spectrometer (AAS) by using three standards calibration curve. AAS required an acid digestion step prior to analysis by treating the samples with concentrated HNO₃. Digestion of samples is performed essentially as described in standard method in American Public Health Association (APHA, 1989). All trace metal determinations by AAS used a Perkin-Elmer Model 200 instrument, for which settings were determined from the recommendations in the instruction manual (IO).

3. Result and Discussion

The values of physico-chemical parameters are given in Table 2 and the metal contents are given in Table 3. Detailed discussions are as follows:

3.1 pH and Conductivity
Except S1 all the five samples have pH lie between 6.9-6.5, i.e. those are slightly acidic in nature. S1 has the pH value 7.41, i.e. slightly alkaline in nature. Again the Conductivity of the S1 is found to be highest (9.91ms/cm) where as S2 has lowest conductivity value (7.43 ms/cm). Other four samples have the conductivity in the range 9.5-8.0 ms/cm.

Table 2: Values of Physico Chemical parameters

| Sample | pH   | EC(ms/cm) | TSS(mg/l) | TDS | TS(mg/l) | Total Hardness(mg/l) |
|--------|------|-----------|-----------|-----|----------|----------------------|
| S₁     | 7.41 | 9.91      | 20        | 188 | 208      | 70                   |
| S₂     | 6.73 | 7.43      | 70        | 46  | 116      | 37                   |
| S₃     | 6.66 | 9.47      | 150       | 105 | 256      | 50                   |
| S₄     | 6.73 | 9.47      | 10        | 280 | 292      | 53.3                 |
| S₅     | 6.60 | 8.06      | 10        | 114 | 124      | 30                   |
| S₆     | 6.71 | 9.42      | 30        | 120 | 150      | 65                   |

EC: Electrical conductance, TSS: Total suspended solid, TDS: Total Dissolved solid, TS: Total solid

Table 3: Metal contents for the water samples

| Sample | Mn(mg/l) | Cu(mg/l) | Cr(mg/l) | Cd(mg/l) | Fe(mg/l) | As(mg/l) |
|--------|----------|----------|----------|----------|----------|----------|
| S₁     | 0.446    | 0.069    | 0.729    | 0.008    | 3.503    | 0.01042  |
| S₂     | 0.461    | 0.102    | 0.347    | 0.073    | 0.867    | 0.01269  |
| S₃     | 0.492    | 0.203    | 0.921    | 0.003    | 3.17     | 0.04012  |
| S₄     | 0.502    | 0.197    | 0.462    | BDL      | 2.172    | 0.02006  |
| S₅     | 0.469    | 0.142    | 0.469    | 0.029    | 1.1683   | 0.01007  |
| S₆     | 0.456    | 0.161    | 0.512    | 0.032    | 1.683    | 0.01225  |

3.2 TSS, TDS, TS and Total Hardness

The variation of TSS, TDS, Ts and hardness of six different water samples have been shown in the Figure 1

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Figure 1: Variation of TSS, TDS, TS and hardness

It was found that the values of TDS, TS and total hardness of all the six samples were within the permissible limit for drinking water as suggested by WHO (WHO, 1971). But the TSS value of S1, S2, S3 and S6 were well above the permissible limit suggested by WHO. S3 has the highest TSS value (150mg/l) indicating the health risk for the dwellers of the surrounding area of the Betail embankment (site description is given in Table 1).

3.3 Heavy metals

The variation of the concentration of heavy metals in six different water samples are shown in the Figure 2-5.

Figure 2: Variation of Concentration of Cr, Cu and Mn

Out of the heavy metal analysed for the water samples collected, the concentration of Mn, Cr, Cd, As and Fe were estimated to be in large excess as compared with the permissible limit declared by WHO. Authors have compared the result with the permissible limit for drinking water because Naughty Khal is directly linked with the Longai river, which is main source of water uses by PHE for domestic purpose of Karimganj town. More over S3, S4 and S5 have been collected from the sites where the Naughty Khal and Longai river meets. The water of
Naughty Khal and Longai river are used by most of the villagers of the surrounding areas for drinking as well as other domestic purposes without proper treatment because of their ignorance about the presence of heavy metals in water and also its adverse health effect. The concentration of Mn is highest in S4(0.502mg/l) and lowest in S1(0.446mg/l). Both the values are above the maximum allowable limit for drinking water.

![Graph of Concentration of Cd](image)

**Figure 3:** Variation of Concentration of Cd

The concentration of Cr for the tested water samples ranges from 0.729-0.347mg/l and the permissible limit for drinking water is 0.05mg/l. In S3 the concentration of Cr is highest. According to the guide lines of WHO the maximum concentration of Cd in drinking water should be 0.005mg/l. But except S4 and S5 all other samples exceeds this value.

![Graph of Concentration of Fe](image)

**Figure 4:** Variation of Concentration of Fe

Fe was found to be present well above the allowable limit (0.3mg/l) in all the six water samples. And its value ranges from 3.503-0.867 mg/l. As contaminated water effects public health both directly and indirectly. After the analysis of all the six water sample it was found that the concentration of As in S3 was four times and S4 was almost double than the permissible limit for drinking water suggested by WHO(0.01mg/l) (WHO. 1983).
Since the collection site of S3 and S4 are very near to the PHE water supply plant of Karimganj town and also the villagers of surrounding areas of the collection sites use such water not only for drinking purpose but also in irrigation, so it is a real threat for the villagers and in near future it will cause detrimental health effect.

4. Conclusion

The present work has yielded a comprehensive database on the water quality of Naughty khal and Longai river of Karimganj Town. By analyzing the results, the following conclusions can be drawn.

1. pH of some water samples are slightly acidic and a very few are alkaline in nature.

2. Because of the increase of dissolved ion in the water samples from the leachate of the municipal waste dumping site during rainy season, the value of electrical conductance, TDS of S1 and S4 are very high compared with that of the others, which again reflects the direct relation between EC and TDS.

3. TS and total hardness of the water samples analyzed were with in the permissible limit suggested by WHO.

4. TSS of S3 is well above the permissible limit, indicates the water pollution of Naughty Khal and Longai river by the leachate from the municipality waste dumping site to Naughty Khal and ultimately to Logai river.

5. For almost all the six samples the concentration of Mn, Cr and Cd have exceeded the allowable limit for drinking water. The analytical result for Fe and As showed the dreadful water pollution of Naughty Khal and Longai river during rainy season. Especially in S3, the junction point of Logai river and Naughti Khal, the Fe and As conc. is alarming because in S3 the concentration of As is almost four times and concentration of Fe is almost ten times than the permissible limit for drinking water. The astonishing out come of the present work is the presence of high concentration of Fe and as in the surface water. Authors’ target was to estimate the water pollutants of Naughty Khal in rainy season with special attention on S3, S4 and S5 because villagers of the surrounding areas often use such water both for drinking and irrigation purposes without proper treatment.
Taking the points 1-5 in to consideration once again it has been established that dumping of municipality solid waste in an open space or in an adjoining area of water body is completely unscientific and unhygienic, which is a common scenario in all over India. So, to control all kind of pollutions Government should take adequate steps for proper dumping of waste materials.

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