Impact of solid waste leachate on surface water quality: A case study in Jhansi district, U.P., India.

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ABSTRACT

This study, converse about the impacts of a potential leachate leakage from a Kallan Sahai Khanti solid waste landfill, situated in Jhansi, Uttar Pradesh, India, on the near by water body (Laxmi Tal). The landfill is widened over an area of about 4 acres. Solid waste (SW) was deposited in a non-engineered manner that has resulted in steep and unstable slopes, leachate accumulation within the SW mass, and leachate runoff into historical Pond Laxmi Tal. The current study looks into the physicochemical characterization of landfill leachate and nearby water body (Laxmi Tal) from September-2018 to August- 2019. The outcome of the study shows that High concentration of organic pollutants and heavy metals are found on landfill sites, as well as the concentration of these metals in ponds is high. Based on physicochemical analysis the class of water was found to be inappropriate for drinking purpose. Important steps should be taken by the authority to prevent the further abomination from leachate.

Keywords: *Solid waste, Leachate, Laxmi Tal, Jhansi*

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1. INTRODUCTION

Speedy industrialization and increase in population in India has led to the large scale relocation of people from villages to cities which result in the generation of 1000 of tons S.W daily. The S.W mass is called upon to enhance significantly in the upcoming as the country aims to attain an Industrialized country position by the year 2020[1][2][3].Poor Collection and inadequate transportation are the major reasons for the accumulation of M.S.W at every nook and corner of cities[4]. The management of M.S.W is passing through a grave phase, due to the lack of adequate facilities to treat and dispose of the bulk amount of M.S.W generated daily in metropolitan cities [5].

In general terms, municipal solid waste landfills produce high levels of environmental pollution due to landfill gas combustion, leakage of leachate and foul smells[6]. Among all these, leakage of leachate affects the nearby environment most, especially the surface and ground water bodies because the leachate comprises the amount of heavy metal, organic compounds and toxic contents. Recently, many

cases have been recorded around the world related to pollution of the aquatic ecosystem which was caused by municipal solid waste landfills [7].

The World Health Organization (WHO) evaluates that more than 20% of the world population (around 1.3 billion people) don't have suitable drinking water and that more than 40% of all populations lack proper sanitation [8]. Low grade water quality continues to be a significant issue in many areas of the world. It can often limit the use of these vital resources and in more extreme cases can have negative effects on human and other life [9]. Water can be polluted by substances that dissolve in it or by solid particles and insoluble liquid droplets that become suspended in it [10]. Even paper is often a high-tech material. It's not just a bunch of fibers that are laid down and put together. It's coated, bonded and got a high amount of technology built-in it [11].

2. MATERIALS AND METHODS

Study area

Jhansi is well known district of Bundelkhand region of Uttar Pradesh with a geographical area of 502.75 thousand hectare. The district is situated in the South West corner of the region at 24º11' - 25º57' N latitude and 78º10' - 79º23' E longitudes. Population of Jhansi is near about 4, 79,612.The western area of the district is covered with hillocks. Jhansi is located in the plateau of central Indian area dominated by rocky reliefs and minerals underneath the soil. The city has a natural slope in the north as it lies on the south western border of the vast *Tarai* plains of Uttar Pradesh. The land is suitable for citrus species fruits. Crops include wheat, pulses, peas, oilseeds. The region relies heavily on Monsoon rains for irrigation purposes. Under an ambitious canal project (Rajghat canal), the government is constructing a network of canals for irrigation in Jhansi and Lalitpur and some area of Madhya Pradesh.

Monitoring Sites

Laxhmi Taal It is situated a few meters from the gate of historical Jhansi city in the east. The area of the lake is 0.162 km2. It is polluted due to leachate from Kallan Sahai Khanti solid waste dumping site, Narayan Bagh road.

Sampling

To carry out the observation the spatio-temporal variations of leachates and surface water, one undiluted representative leachate sample (L, leachate collected directly from the landfill) and another samples of water from the nearby pond (P) were collected during September 2018 to August 2019.

Analytical design

Physical and chemical properties of surface water have been done according to standard methods (APHA,2005)[12] and heavy metal was analyzed using Atomic Absorption Spectrophotometer (Perkin Elmer 200).

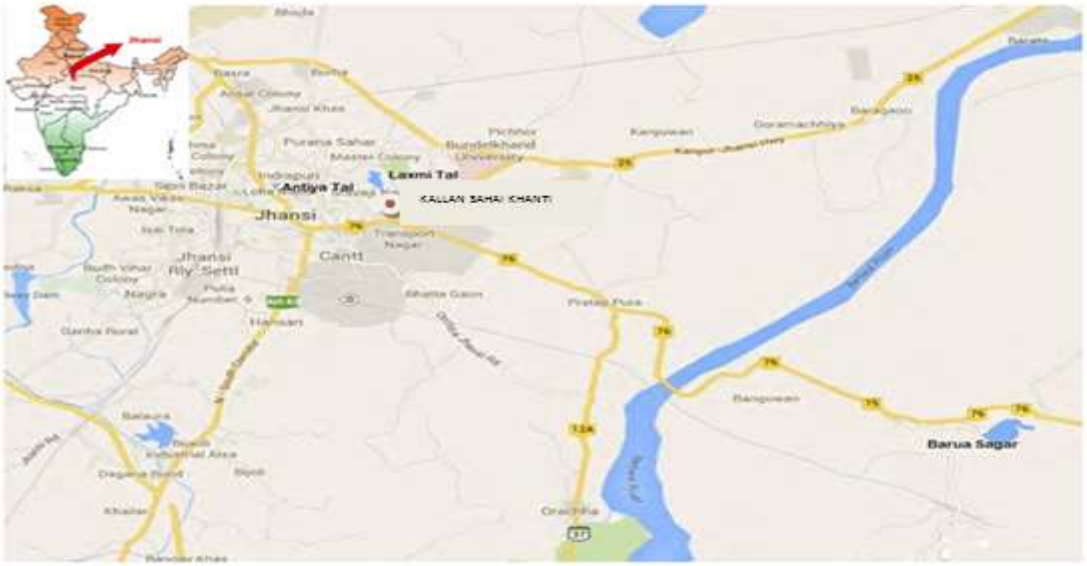

Fig-1 : Location of the selected water body and dumping site for study.

3. RESULTS AND DISCUSSION

The important factors which influence the leachate quality such as municipal solid waste composition, elapsed time, temperature, moisture and available oxygen. Generally, leachate quality with similar waste types may be different in different landfills located in varied climatic regions. Furthermore, operational practices in landfills also influence the leachate quality. The results of physicochemical characteristics of the leachates and water bodies from Kallan Sahai Khanti landfill and Laxmi Tal respectively are presented in Table-1.

pH

pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. Most of the water is slightly alkaline due to the presence of carbonates and bicarbonate. The pH value of leachate and pond sample was found 7.4±0.13 and 7.92 ± 0.020 respectively.

Electrical Conductivity (EC)

Electrical conductivity (EC) is a measure of the total salt content of water based on the flow of electrical current through the sample. The higher the salt content, greater will be the flow of electrical current. It is low to moderately mineralize as conductivity of a water sample at 250C (WHO, 2011). Result shows the average concentration of electrical conductivity was recorded 3410±41.59 and 931 ± 0.523 µs/cm in leachate and pond sample respectively during the study.

Total Dissolved Solids (TDS)

TDS is the term used to describe the inorganic salt and small amounts of organic matter present in solution in water. The principal constituents are generally calcium, magnesium, sodium and potassium cations and carbonate, hydrogen- carbonate, chloride, sulphate and nitrate anions. Average

concentration of TDS was recorded 1627±23.45 mg/L in leachate sample and425 ± 0.657 mg/l in pond sample.

Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

In the present study, of leachate and pond BOD was recorded 82.0±2.78 mg/l and 19.57 ± 0.035 mg/l respectively and COD was found 940±8.96 mg/l in leachate sample and 185 ± 0.656 mg/l in pond sample.

Table:1- Physicochemical characteristics of the leachate and Pond water

Characteristics	Leachate	Pond (Laxmi Tal)	Standard
pH	7.4±0.13	7.92 ± 0.020	6.5-8.5
Ec	3410±41.59	931 ± 0.523	----
TDS	1627±23.45	425 ± 0.657	500
COD	940±8.96	185 ± 0.656	250
BOD	82.0±2.78	19.57 ± 0.035	---
DO	0.24±0.01	2.12 ± 0.02	4-6
Nitrate	22.36±1.42	1.96± 0.12	45
Iron	8.16±0.01	1.497 ± 0.011	1
Cd	0.036±0.001	0.015 ± 0.0003	0.01
Pb	1.3±0.02	0.0526 ± 0.024	0.05
Zn	3.0± 0.012	0.920 ± 0.006	5
Ni	1.339±0.019	0.0429 ± 0.017	0.02
Cr	0.0212± 0.004	0.01 ± 0.007	0.05

Values are Mean ± SE (n = 3); Units: - Concentration in mg/l, except pH; Temperature (ºC); EC (µS/cm);

Dissolved Oxygen (DO)

The diffusion of oxygen from air is mainly dependent on temperature, salinity, total dissolved salt and water movements etc. (Kumar et al., 2010). In the present study, the Dissolved Oxygen was found 0.24±0.01 mg/l in leachate sample and 2.12 ± 0.02 mg/l in pond sample.

Nitrate

In the study area surface water contains nitrate due to leaching of nitrate by dumping sites. The nitrate content was found in the leachate sample 22.36±1.42 mg/l and in pond water 1.96± 0.12 mg/l .

Zinc (Zn) and Iron (Fe)

Some of metals is known essential for life in drinking water may contain excess metal which causes chronic or acute poisoning. metal such as Zn and Fe was analyzed and found 3.0± 0.012and 0.920 ± 0.006 mg/L 8.16±0.01and 1.497 ± 0.011 mg/l in leachate and pond sample respectively.

Lead (Pb) and Cadmium (Cd)

In the study, Pb was recorded in Leachate sample 1.3±0.02mg/l and in pond sample 0.0526 ± 0.024 mg /l and cadmium was found in leachate sample 0.036±0.001 mg/l and 0.015 ± 0.0003mg/l in pond sample.

Nickel (Ni) and Chromium (Cr)

During the investigation Nickel was recorded in Leachate and pond sample 1.339±0.019mg/l and 0.0429 ± 0.017 mg/l respectively and chromium was found 0.0212± 0.004mg/l and 0.01 ± 0.007mg/l in leachate and pond sample respectively.

4. CONCLUSION

The concentration of metals and other physico-chemical parameters remarked in this study has revealed that the majority of the water utilized from the various natural sources examined is polluted. This observation is mainly to be attributed to the indiscriminate dumping of wastes into the environment. This is a great threat to human population, especially those within the area. Consequently, it is therefore recommended that effective disposal mechanism of solid waste in Jhansi, district of Uttar Pradesh in particular, be introduced that would enhance sustainable development. In addition, a program of operational monitoring of water quality needs to be re-emphasized.

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