Solid Waste Management and Impact of Landfill Leachate on Groundwater in Hassan City, Karnataka

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***Abstract*- Environmental problems include air pollution, water pollution, and solid waste disposal. It is unfair to classify solid waste as being deleterious to a single part of environmental rather solid waste problems transcend traditional environmental boundaries and contributed to air and water pollution as well as land pollution. Solid waste management has been an issue since urbanization commenced and we started using plastic. According to study conducted in Hassan city the total amount of waste generated from one man can be taken as 375 gm, total amount of waste generated from an entire city estimated as 58 tons in which 28.5 ton in the form of organic waste and 25 tons as inorganic and 4.5 ton as recyclables, all these wastes without any segregation directly disposed to landfill site selected near channapatna. An amount of 64% of food and vegetable waste coming for a landfill site giving birth to leachate having nitrate content of 256 mg/l which is going to affecting ground water quality for the wells coming within 500 m. The results have shown that the water in the wells coming within 500m radius contaminated by having higher fluoride, pH, and nitrate content crossing the permissible limits described by Bureau of Indian standards no. 70500, Hence there is need of protecting the ground water source by treating the leachate to the level of discharge limits and also by adopting scientific method of solid waste management.**

Keywords: Ground water, Landfill, Leachate , Solid waste

I. INTRODUCTION

Any solid material in the material floe pattern that is rejected by the society is called solid waste. Solid waste arises from human and animal activities that are normally discarded as useless and unwanted. In other words, solid waste may be defined as the organic and inorganic waste material produced by various units of the society and which have lost their value to the first user. As a result of rapid increase in production and consumption, the urban society rejects and generates solid material regularly which leads to considerable increase in volume of waste generated from several sources such as domestic wastes, commercial waste, institutional wastes and industrial wastes are of most diverse categories. Typical urban society comprises of garbage, rubbish, construction and demolition wastes, leaf, litter, hazardous wastes etc.

Municipal solid waste is the waste that is generated in people's everyday life and work in homes, yards, business, and premises and areas, including domestic waste of different kind, food waste, gardening, paper, cardboard, rags, wooden, metal, glass, porcelain, leather, plastics and rubber articles and similar harmless waste. The basic data on quantity and quality of solid waste will help in deciding the effective solid waste management system.

II. STUDY AREA

Hassan is the Headquarters of the district. It is located at NH 48, 196 Km west of Bangalore and 163 Km east of Mangalore. Hassan is the base for the surrounding places of tourist in names Belur, Halebid and Shravanabelgola. Originally agricultural based, now changed to a tertian's base with a predominance of commercial and administrative services. Rains season between June to September and rainfall in the district 900mm in average temperature is minimum 14.3^0 c and maximum 33^0c. Population of the city 1,55,006 as per services 2011 and area covered 26.5 Km square.

The values constituting the demographic detail are:

- ✓ Area 26.5 sq-km
- ✓ Number of properties 27240
- ✓ Number of wards 35
- ✓ Length of roads 211 km
- ✓ Total water supply 18.9 MLD
- ✓ Per capita water supply 135 lpcd
- ✓ Summer temperature $19\text{-}33^o$ c
- ✓ Winter temperature $14\text{-}26^o$ c

Figure 1: Landfill site at Hassan city

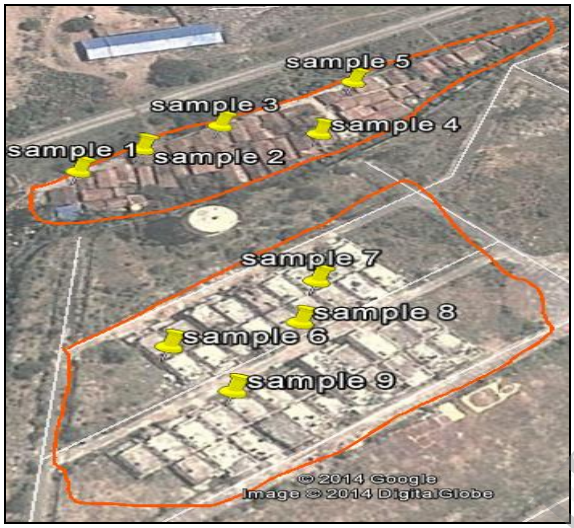

Figure 2: Sampling location in the study area

III METHODOLOGY

The landfill site located at channapatna only about 4 km from city premises and very near to state highway (BM road), having an total coverage area of 23 acres situated along Hassan- Gorur road having an elevation of 432 m as shown in figure 1.

The Hassan city corporation disposes nearly 58 tons garbage every day and due increase in population every year nearly 6 percentage of garbage is piled on. The animals (cows, dogs) and birds coming to meet their food giving a serious threat to vehicular movement. Due to lack of segregation process the leachate originating from an organic waste affecting ground water quality of surrounding wells and also due to open burning practicing in landfill site the polluting air causing ill effects to surrounding public. Nearly 700 people residing on the surrounding of present landfill site and within 200 m radius there are 8 bore wells and 2 hand pumps are located as shown in figure 2.
The data (table1&2) about physical and chemical characteristics of the waste entering into a landfill site and water table data around the landfill site were collected.

Table1: Physical characteristics of waste
(source: city municipal council, Hassan)

Item	Mass (%)	Moisture Content (%)	Density (Kg/Cum)
Food, vegetable waste	64	68	132.1
Plastic	8	17	52.3
Paper	7	2	65.7
Wood	3	16	242.5
Rubber	1	2	124.6
Leather	2	13	137.6
Textile	3	17	55.6
Glass	3	1	198.5
Dirt, bricks etc..	9	9	456.2

Table 2: Chemical characteristics of waste
(source: city municipal council, Hassan)

Item	Residential	Commercial	Institutional
Carbon content	19.6	17.2	12.3
Nitrogen content	0.65	0.72	0.68
Potassium content	0.75	0.68	0.52
Calorific value	756	1152	821
pH	7.4	6.9	6.2

3.1 Ground water analysis

The ground water sample from five (S1,S2,S3,S4,S5) different wells within 200m and four samples (S6,S7,S8,S9) within 800m around the site are collected. The most suitable bottles are made from polyethylene and glass are used to collect the samples with details of source, date of sampling, time of sampling and address. The samples are tested in laboratory within 24 hours from the time of

collection. The analysis is carried out as per world health organization (WHO) standards to determine the physical, chemical, bacteriological parameters of water samples. The qualitative analyses were carried out at the chemical analysis laboratory. The samples were analyzed for pH, Total Dissolved Solids(TDS), Total Hardness, Nitrate were carried out in the water laboratory using standards methods for the examination of water and to determine the fluoride content of sample spectrophotometer was used.

IV RESULTS AND DISCUSSION

Table 3: Analysis of water samples for the month of March (2014)

Parameter	**S1**	**S2**	**S3**	**S4**	**S5**	**IS limits**
Turbidity	7	9	7	5	6	5-10
pH	**9**	**8.2**	**6.2**	**7.5**	**7**	**6.5**
Alkalinity(mg/l)	258	418	125	313	269	600
Calcium(mg/l)	163	169	182	124	152	200
Magnesium(mg/l)	108	98	69	82	61	125
Chloride(mg/l)	754	524	338	732	718	1000
Sulphate(mg/l)	326	325	192	282	352	400
Fluoride(mg/l)	**1.7**	**1.3**	**2.1**	**0.7**	**1.9**	**1.5**
Nitrate(mg/l)	**48**	**62**	**78**	**39**	**56**	**45**
Total hardness(mg/l)	438	528	514	414	541	600
Iron(mg/l)	0.8	0.52	0.25	0.7	0.3	1

Compare to all other parameters the pH of sample S1,S2,S4,S5 crossing the IS desirable limits 6.5 and fluoride content of sample S1,S3,S5crossing a permissible limits of1.5mg/l and nitrate content sample S1,S2,S3,S5 crossing a limits of 45mg/l for drinking water. When problems are identified only with pH, fluoride and nitrate content the repeated tests are carried out for different time intervals.

Table 4: Analysis of sample for the month of April (2014)

Parameter	**S1**	**S2**	**S3**	**S4**	**S5**	**IS limits**
pH	7	6.8	5.1	4.9	6.9	6.5
Fluoride(mg/l)	2.1	1.2	2	1.4	2.3	1.5
Nitrate(mg/l)	58	49	64	35	62	45

Table 5: Analysis of sample for the month of May (2014)

Parameter	**S1**	**S2**	**S3**	**S4**	**S5**	**IS limits**
pH	7.2	7.6	4.9	6.8	7.9	6.5
Fluoride(mg/l)	2	1.35	2.2	1.9	1.6	1.4
Nitrate(mg/l)	74	41	57	32	68	47

From the results tabulated in above table 4 and table 5, it is clear that the wells coming within 200m from landfill site having a higher concentration of pH, Fluoride and Nitrate content crossing the IS permissible limits. Hence there is need of precautionary measures to protect the well water source.

4.1 Leachate Analysis

The leachate collected from landfill site in the month of March and April (2014) is also tested to determine the various parameters like pH, total nitrogen, cadmium, lead, chromium, zinc, COD, BOD, fluoride, benzene.

Table 6: Characteristics of landfill leachate

Parameters	March	April	Discharge standards
Total nitrogen(mg/l)	**241.0**	**256.0**	**70**
pH	**9.6**	**11.5**	**8.9**
Lead(mg/l)	0.41	0.28	0.5
COD(mg/l)	**8462.0**	**9142.0**	**200**
Benzene(microgram/cum)	13.46	18.12	20
Fluoride(mg/l)	**4.6**	**3.1**	**1.5**
BOD(mg/l)	**4500.0**	**4231.0**	**20**
Cadmium(mg/l)	0.03	0.03	0.1
Chromium(mg/l)	0.11	0.18	0.5
Zinc(mg/l)	1.20	1.13	2

On observing the test results of leachate sample, the leachate originating in a present landfill site having an higher Nitrogen content of 256 mg/l, pH content of 11.5, and also higher BOD and COD content of 4500 mg/l and 9142 mg/l respectively. From this observation one can conclude leachate from present landfill site having possibility of contaminating the ground water and one more evidence we can observe from following table 7.

When study was conducted to determine the quality of water from wells coming within 800m from landfill site the value constituting characteristics of water sample are:

Table 7: Analysis of water sample for wells within 800m

Parameter	**S6**	**S7**	**S8**	**S9**	**IS limits**
Turbidity	5	4	7	5	10
pH	5.2	4.1	6	5.8	6.5-8.5
Alkalinity(mg/l)	321	298	172	348	600
Calcium(mg/l)	170	142	158	141	200
Magnesium(mg/l)	97	87	61	78	125
Chloride(mg/l)	652	508	302	635	1000
Sulphate(mg/l)	297	351	284	278	400
Fluoride(mg/l)	**1.8**	**0.6**	**2.1**	**0.7**	**1.5**
Nitrate(mg/l)	21	34	18	29	45
Total hardness(mg/l)	425	523	467	365	600
Iron(mg/l)	0.4	0.57	0.32	0.7	1

The results have shown that wells coming within 800m having a higher concentration fluoride only and concentration of Nitrate and pH are within IS permissible limits. These higher concentration of fluoride may be due characteristics of natural formation but higher concentration of Nitrate values observed from wells coming within 200m is definitely occurring from leachate because of unscientific solid waste management practice.

V CONCLUSIONS

From the results of the study, following conclusions can be drawn

- The present landfill site located very close to city becoming a source of problems like: traffic congestion, ground water contamination, public health problems etc.
- From the study it can be recommended that, new sanitary landfill with clay or plastic liners to prevent leachate from getting to water table, adaptation of clean technology for recycling greenhouse gases originating from landfill is a necessary criteria.
- The leachate form existing landfill site having an higher concentration of Nitrogen 256 mg/l, and also higher BOD and COD content of 4500 mg/l and 9142 mg/l respectively. hence having possibility of contaminating ground water quality because of lower water table observed around landfill site (10.2 m)
- There is need of constructing leachate treatment plant of anaerobic baffled reactor followed by aerobic process type at landfill site to protect ground water quality and also chances for using treated leachate for practicing the composting at the site premises itself.
- By practicing windrow composting at a site, the 28.5 tons organic waste coming into a site can subjected to process their by reducing a waste to an great extent of about 50%.

REFERENCES

1. Al-Muzaini, S., and Muslmani, k (1994), "*study of environmental pollution from landfill sites receiving wastes during the Iraqi occupation."* Rep No. KISR 4451, Kuwait institute of scientific research, Kuwait.
2. Al sabahi E., Abdul Rahim S., Wan Zuhairi W.Y., Al Nozaily F., Alshaebi F.(2009): "*The characteristics of leachate and ground water pollution at municipal solid waste landfill of Ibb city, yeme",*American journal of Environmental Sciences, vol. 5, pp. 256-266.
3. Bureau of Indian Standards (BIS): *Indian standard specification for drinking water* IS 10500.1991:pp.2-4
4. Christopher oluwakunmi and Akinbile (2012), " *Environmental impacts of landfill on groundwater quality and agricultural soil in Nigeria",* Soil & water Res.,7, vol.1,pp.18-26
5. Dinesh K, Babu A.J, "*Analysis of landfill leachate contamination potential of a Municipal Landfill using Landfill leachate pollution Index",* Workshop on sustainable Landfill Management, Vol 3, 2003; Chennai, India, pp 147-153.
6. Fatta D, Papadopoulos A, Loizidou M(1999), "*A study on the landfill leachate and its impacts on the ground water quality of the greater area",* Environ Geochem vol.2,pp.175-190
7. Foo K. Y and Hameed B.H, "*An overview of landfill leachate treatment via activated carbon adsorption process",*journal of Hazardous Materials, Vol 171,2009,pp 54-60.
8. Renou S, Givaudan J.G, Poulain S, Dirassouyan F, Moulin P, "*Landfill leachate treatment: Review and opportunity:*, Journal of Hazardous Materials, Vol. 150,2008,pp 468-493.
9. Simi Goel, 2010, "*Anaerobic Baffled Reactor for treatment of textile dye effluent*", Journal of scientific and Industrial Research, Vol 69, Pg No.305-307