International Journal of Future Generation Communication and Networking
Vol. 13, No. 4, (2020), pp. 2951–2959

Solid Waste Management and Effect of Landfill Leachate on Ground Water (Case study of Tumakuru city)

Dr. M.A.Nagesh[1]
[1]*Professor, School of Civil Engineering, REVA University, Bengaluru.INDIA*

. Pushpa Latha N [2]
[2] *Research Student, School of Civil Engineering, REVA University, Bengaluru, INDIA*

Sakeshwari[3]
[3]*Asst. Professor, Department of Civil Engineering, Veerappa Nisty Engineering College, Shorapur, India*

Guruprasad TN[4]
[4]*Asst. Professor, Department of Civil Engineering, SSIT, Tumakuru, India*

Abstract
Solid Waste Management is the process of collecting, transporting, processing and disposing of waste material in a scientific manner. The aim of waste management is to clean up the surroundings and see that the waste does not have a detrimental influence on environment. Solid waste management prevents contamination of soil, water & the atmosphere. The paper aims to study the Solid waste management of Tumakuru city and assess the effect of leachate produced by the city municipal dump yard on ground water quality of nearby area. In the study, the influence of leachate of landfill on quality parameters of ground water near city municipal landfill area is reported.

Keywords: *Solid Waste Management, Contamination, Leachate, Ground water quality*

Introduction

Solid waste management involves the disposal of city waste in scientific manner. The waste generated may be handled in a variety of ways. In case of Solid Waste Management, the landfills are typically used for municipal waste disposal. Solid waste must be managed systematically to ensure habitable environment for humans. Solid waste management should be a part of environmental planning of any city. The Figure.1 shows temporary dumping of solid waste at Tumakuru.

Figure 1: Transit dump of Solid Waste in Tumakuru

ISSN: 2233-7857 IJFGCN

Landfill method is commonly used method for solid waste disposal. This is a better option compared to either open-air disposal or open-pit dumping. But leachate formation as in case of landfill method may result in possible soil and ground water pollution, if proper measures are not taken. The municipal solid waste which may contain hazardous substances can increase the health risks due to leachate formation. The liquid that emanates from land fill dumps is termed as leachate. The leachate is liquid extract of soluble or suspended solid of solid waste. Leachate is the liquid that has dissolved environmentally harmful substances.

Effect of landfill Leachate on Ground Water:

Groundwater and surface water pollution is one of the effect of landfill leachate. Leachate, if not properly collected, treated and safely disposed, may percolate through soil reaching ground water causing ground water pollution. The solid waste disposal of Tumakuru city at Ajjagondanahally and the leachate generated from this landfill may have impacts on the groundwater quality. In the paper the present status of solid waste management of Tumakuru city along with the leachate effect on ground water is reported.

Description of Study Area:

The study area, Tucker is situated very near to the electronic city, Bangalore. The average rainfall of the city is around 70 cm. Most part of the city is fed by treated Hemavathy river water diverted to the city for its domestic needs. Tumakuru possesses a good network of underground drainage system. For better governance the city is divided in to 35 wards and is shown in Figure 2

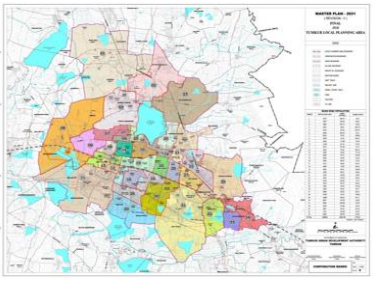

Figure 2: Ward wise map of Tumakuru city

Each ward is represented by a councilor. The Tumakuru Municipality manages the solid waste disposal of the city. With its limited staff and hired staff & equipment, the municipality if managing the solid waste management of the city.

The population data of Tumakuru city as per the records (2001- 2010) along with the wards is as in Table 1.

Table 1: Ward wise population data

WARD No.	POPULATION
1	8,810
2	9,063
3	9,024
4	8,171
5	8,912
6	7,775
7	6,507
8	6,313
9	5,329
10	11,126

ISSN: 2233-7857 IJFGCN

11	8,647
12	11,141
13	7,446
14	7,281
15	9,115
16	7,291
17	6,624
18	11,804
19	7245
20	8,185
21	7,148
22	6,267
23	6,496
24	12,034
25	8,232
26	9,472
27	9,276
28	8342
29	11,228
30	12,142
31	12,635
32	9,495
33	7,835
34	7,446
35	8,285

Data of solid waste in Tumakuru city:
The Tumakuru city has Total wards of 35 and the salient details of solid waste management details of the city is as follows:

- Total waste produced per day : 130 tonnes
- Waste produced per person per day:450 gms.
- Separation of the dry and wet waste at the point of source collection.
- Wet waste is segregated at Ajjagondanahally. Around 80 tonnes subjected to vermi composting and windrow composting. The remaining 50 tonnes waste is land filled at Ajjagondanahally.
- Dry waste collection points are at upparalli bridge, Shettyhalli, siragate & PTP plant
- Transfer points at Upparahalli underpass, dobhighat, maralurdinne, siragate, dibbur, PTP plant, Kyathsandra.

Population forecast of Tumakuru city:
Population data collected and forecasted for next three decades is as in Table 2 is calculated based on geometric progression method. The population data for calculations is as follows:

- Population data (2001-2011) – 3,02,142
- Population data (2011-2021) – 3,95,647

Table 2: Population forecast of Tumakuru city

Decade	Forecasted Population	Estimated Waste Tonnes/day
First (2021-2030)	4,52,747	203

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Second(2031-2040)	5,18,069	233
Third (2041-2050)	5,92,826	266

Transportation Required for Solid Waste Management:
Tumakuru city for its Waste Management is having the following types of vehicle with an average of two trips in a day for each vehicle.

- Autos for 35 wards : 95 (2 to 3 per ward)
- Other vehicles : Tractor – 25, Tipper -3, JCB- 3

The requirement of transportation for next three decades is shown in Table 3.

Table 3: Transportation forecast of Tumakuru city

Decade	Autos for ward wise collection	In terms of Tippers with 2 trips/day
First (2021- 2030)	108	12
Second (2031-2040)	124	15
Third (2041- 2050)	142	17

Results of Leachate & quality of Ground water:
In present study, leachate from the Ajjagondanahally municipal dump is collected along with the ten ground water samples within 0.5 to 3 km of distance the landfill dump.
The leachate and the ground water samples collected were tested for its constituents like pH, Total Dissolved Salts(TDS), Total Hardness, Calcium (Ca), Magnesium (Mg), Chloride (Cl), Total Alkalinity (CaCO3), Sulphates, Iron & Fluoride. The leachate was also checked for COD, BOD, Zinc(Zn) &Lead (Pb). The Table (4) give the values of various parameters analyzed for leachate of land fill dump.

Table 4: Constituents of Leachate

Constituents	**Values**
pH	11.2
Total Dissolved Salts	3200
Total Hardness	2100
Calcium (Ca)	440
Magnesium (Mg)	243
Chloride (Cl)	980
Total Alkalinity (CaCO3)	920
Sulphates	454
Iron	7.65
Fluoride	1.98

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COD	189
BOD	58
Zinc (Zn)	BDL
Lead (Pb)	NDL

Comparison of Parameters with landfill Leachate and nearby bored well Ground Water (GW) samples:
The Figure 3 to Figure 12 has the comparative details of various constituents of Leachate along with ten ground water samples.

The pH comparison of Leachate and samples of water from bore well is as in Figure 3.

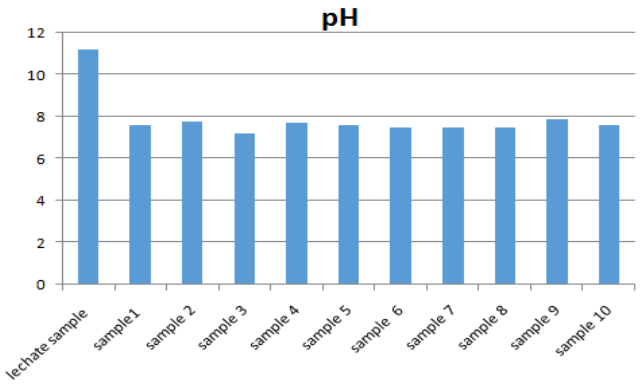

Figure 3: pH comparison of Leachate & GW samples

The comparison of TDS of Leachate and samples of bore well water is as in Figure 4.

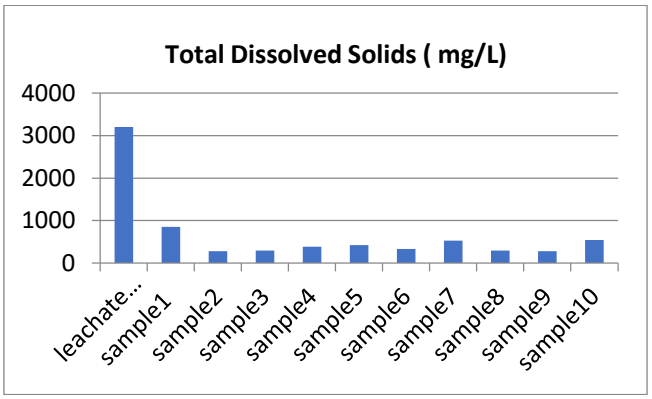

Figure 4: TDS comparison of Leachate & GW samples

The comparison of Total Hardness of Leachate and Ground water samples is as in Figure 5.

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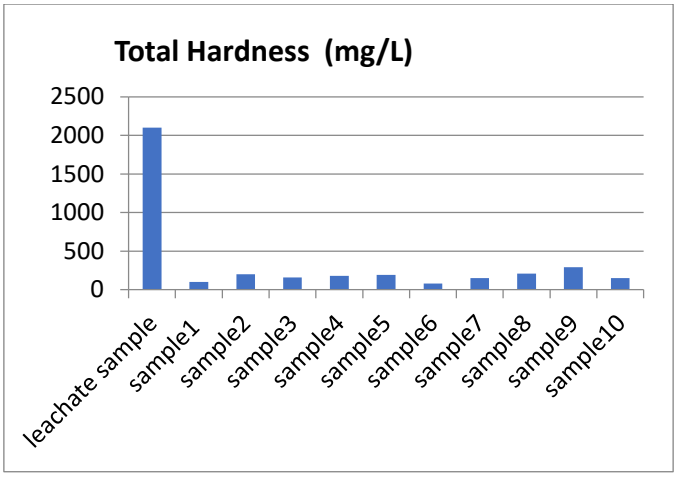

Figure 5: Total Hardness of Leachate & GW samples

The comparison of Calcium of Leachate and samples of bore well water is as in Figure 6.

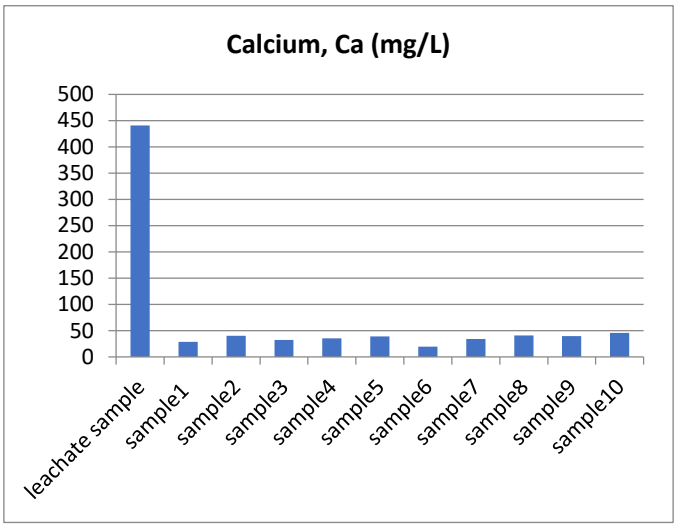

Figure 6: Calcium comparison of Leachate & GW samples

The comparison of Magnesium of Leachate and Ground water sample is as in Figure 7

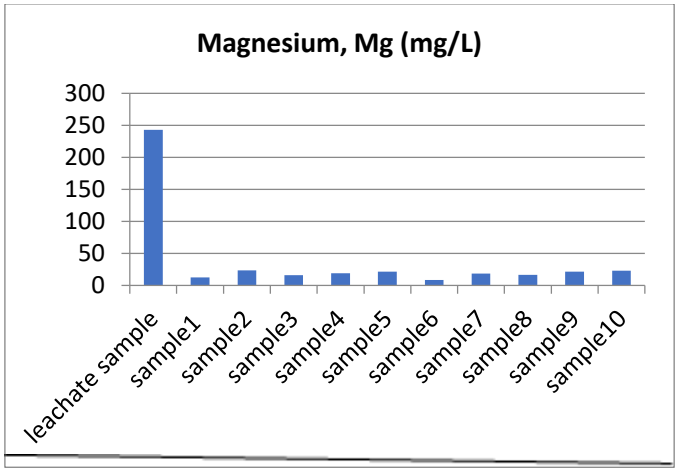

Figure 7: Magnesium comparison of Leachate & GW

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The comparison of Chloride content of Leachate and Ground water samples is as in Figure 8.

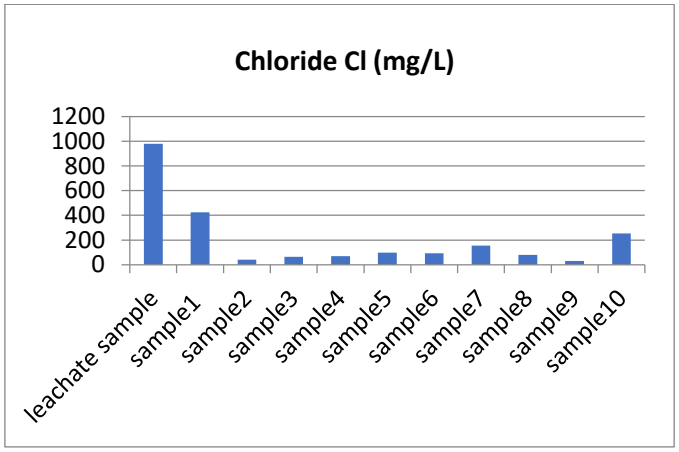

Figure 8: Chloride comparison of Leachate & GW samples

The comparison of Total Alkalinity of Leachate and Ground water sample is as in Figure 9.

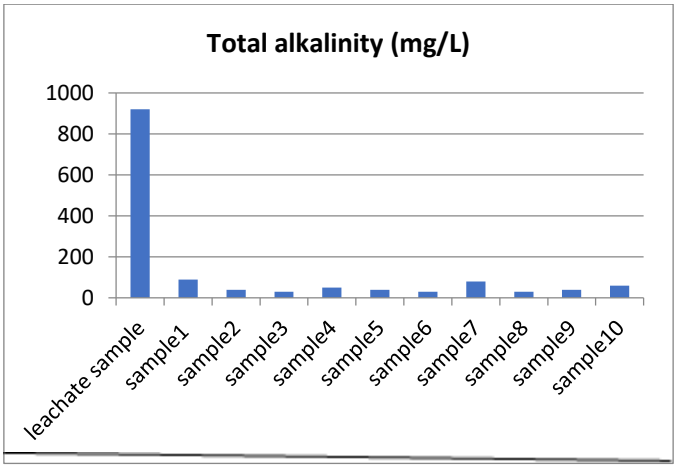

Figure 9: Total Alkalinity comparison of Leachate & GW

The comparison of Sulphates of Leachate and Ground water sample is as in Figure 10.

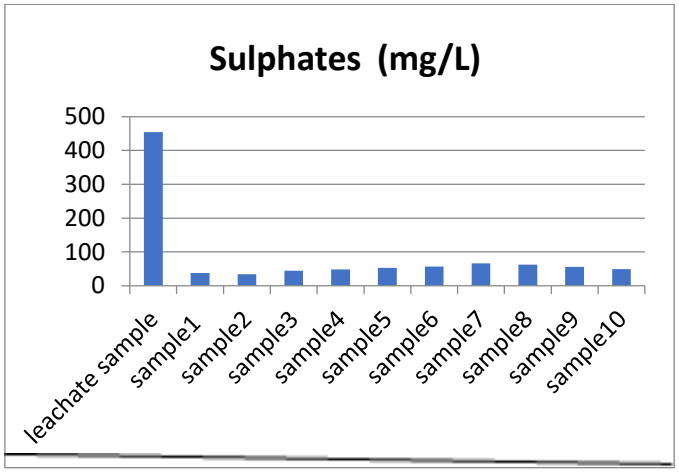

Figure 10: Sulphates comparison of Leachate & GW samples

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The comparison of Iron content of Leachate and Ground water sample is as in Figure 11.

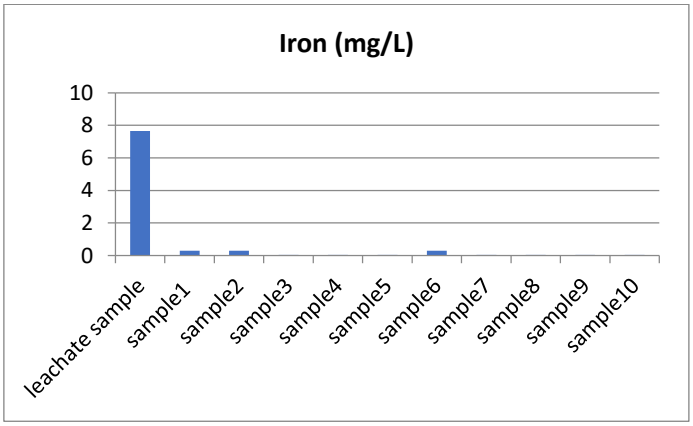

Figure 11: Iron comparison of Leachate & GW samples

The comparison of Fluoride of Leachate and Ground water sample is as in Figure 12.

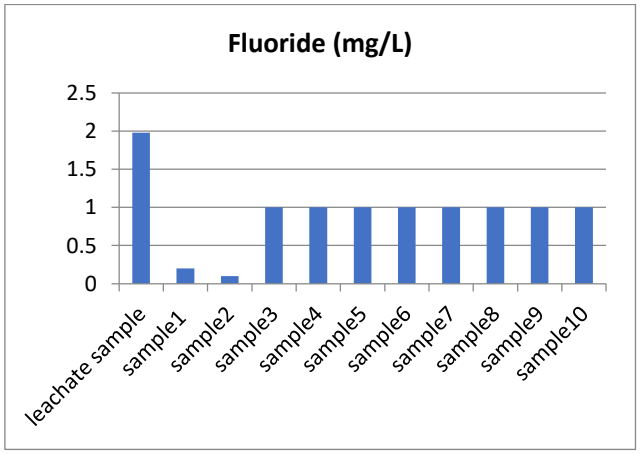

Figure 12: Fluoride comparison of Leachate & GW samples

Conclusions:

Solid Waste is one of the threats in front of world. The change in habitats of people and rapid development are responsible for large quantity generation of waste. This waste is creating problems to public health, drainage, and aesthetics of the cities. There is intense need for efficient waste management systems in the city as well as villages. In the study, the projected population for three decades is given in Table 2 and Transportation requirement given in Table 3. The decadal growth of Tumakuru city is around 0.75 Lakhs and the city administration should gear up to this increase of population for efficient solid waste management.

Leachate emanating from a landfill dump causes significant undesirable effect on surface water and ground water. Leachate results from precipitation entering the landfill and also due inherent moisture that exists in the waste. At present nearly 60% of solid waste generated in Tumakuru city is subjected to Vermi compost and is being utilized for farmers for nutrient management of their lands. The remaining 40% is being disposed in Ajjagondanahally landfill.

From the results and analysis of Leachate at Ajjagondanahally landfill with nearby ten bored well ground water samples, it is observed that the Iron content of all ground water samples is more than the prescribed limits 0.3 PPM of drinking water standards. Also in most of the ground water samples the Total Dissolved Solids (TDS) is observed to be greater than 500 PPM.

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It is also, observed that the Leachate of this landfill is not having appreciable effect on nearby bored well ground water quality since this landfill is operational from few years. Also sufficient care is taken to prevent the leachate reaching ground water aquifers. Further, by chemical treatment of leachate, the future effects of ground water pollution can be prevented.

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