ISSN 2348 – 8034
Impact Factor- 4.022

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

IMPACT ON ENVIRONMENT BY LANDFILL AND A CASE STUDY ON VISHAKHAPATNAM LANDFILL

D. V. SK Chaitanaya[*1] & P. Neeharika[2]
[*1&2]Dept. of Civil Engineering, Acharya Nagarjuna University Guntur , India

ABSTRACT

Solid waste like any other wastes are the result of human activities and are not free flowing. Based on their sources and characteristics, the solid wastes can broadly be classified into Municipal (Urban) solid wastes, Industrial wastes and Hospital wastes. In developed countries, per capita waste generation increased nearly threefold over the last two decades, reaching a level five to six times higher than that in developing countries. With increase in population and living standards, waste generation in developing countries is also increasing rapidly, and may double in volume in the current decade. In the year 1947, cities and towns in India generated an estimated 6 million tonnes of solid waste; which rose in the year 1997 to about 48 million tonnes (SOER, 2009). As per Annual Report on Environment (MoEF, 2009-10) CPCB estimated around 57 million tonnes per annum of MSW presently generated in the country. CPCB with the assistance of NEERI, has conducted a survey of solid waste management in 59 cities (35 metro cities and 24 state capitals).a case study of vizag municipal waste landfill is done and an engineered land fill design is preposed

Keywords: magnetic water, mortar, compressive strength, mineral admixtures and curing period

I. INTRODUCTION

Throughout history, mankind has used opens dumps to solve solid waste problems. In the past, when waste streams were simple and land constraint was not a challenge, open dumping was used as an inexpensive and often appropriate solution. It served the purpose of keeping waste separated from the populace, hence limiting exposure to disease vectors, as well as odour and other direct effects.

The Health and Sanitation Department of the Greater Visakhapatnam Municipal Corporation of Visakhapatnam consists of the following sections.

- Sanitation – Solid waste Management & Bio-Medical Waste Management
- Medical Care
- Urban Malaria Scheme
- Veterinary Public Health
- VACS – AIDS Control
- Implementation of Prevention of Food Adulteration Act
- Trade Licensing

Fig:1. Widely spread un-covered waste

II. SANITATION& SOLID WASTE MANAGEMENT IN VISAKHAPATNAM

- The area of the city: 533 Sq Kms.
- Population: 12 Lakhs (2001 census)
- Current Estimated Population: 20 Lakhs (2011 census)
- Estimated HouseHolds: 4 Lakhs
- Wards :72 Wards
- Waste Generation:1000 to 1050 MTS/day

1. Domestic Waste Generation :600Tons Per day (Approx)
2. Commercial,Drainsiltandothers:450-500TonsPer day
3. Daily Waste Collection: 880 MTS to 960 MTS Per Day
4. Source Segregation and Door to Door Waste Collection Door to door Waste collection – 70% Future strategy is to cover
5. 100%
6. Dust bin free model wards: .User Charges – Current Status

Transportation and Storage of Waste
Tricycles collect the waste from the households and tip the waste in metal dumper bins.
Dumper placer vehicles lift the metal dumper bins, transport the waste to the transfer station.

At the transfer station the 14 ton capacity Taurus Tipper Vehicles collects the waste from dumper vehicles and transports the waste to the dumping yard. leaning operations.

- Trucks and 30 compactor bins put in to operation.
- The transfer station at Town Kotha Road has been modern
- Kapuluppada Dumping Yard land fill site has been closed.

GVMC desires to implement Project of Solid Waste Management in Visakhapatnam which includes setting –up of Municipal Solid Waste Management Processing and Disposal Facility at Kapuluppada village in Greater Visakhapatnam City

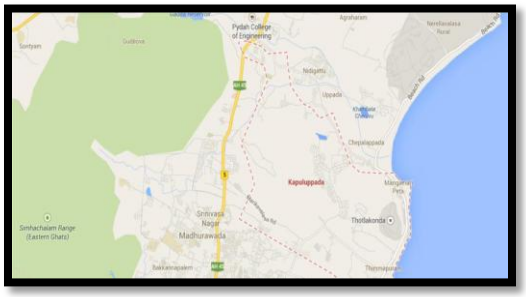

Fig:2 location of Kapuluppada dump site

3. PROPOSED LANDFILL DESIGN FOR KAPULUPPADA DUMPING YARD

3.1LANDFILL PLANNING AND DESIGN

3.1.1 Design Life

Landfill design life will comprise of an 'active' period and an 'closure and post closure' period. The 'active' period may typically range from 10 to25 years depending on the availability of land area. The 'closure and post-closure' period for which a landfill will be monitored and maintained will be 25 years after the 'active period' is completed.

3.1.2 Waste Volume and Landfill Capacity

. The actual capacity of the landfill will depend upon the volume occupied by the liner system and the cover material (daily, intermediate and final cover) as well as the compacted density of the waste. Vizag engineered

landfill facility is expected to receive 960 tons of waste per day in 2017. This quantity will be increased with an annual growth rate of 7%.

- As per the Local Authorities date the waste generated in Vizag is 960 Tons per day with density of 0.95 tons per Cubic Meter.
- 600 Tons of Waste is expected to be dumped in the Landfill
- With previous data of last 5 Years the annual increase in waste quantity is estimated as 7%
- A provision of 15% of the volume is be considered for the daily and intermediate cover.

3.13Assumptions made to compute required capacity of the landfill

1.operation period :5 years
2. compacted density of waste :0.9t/m^3
3. no of days per day: 365
4.Increment in the waste delivery:7%
5.Amount of cover material for daily and intermediate covering-15%

Table 1: Total Waste Quantity

Years	Total Waste per day (TPD)	Total Days per year for receiving of waste	Total Waste Qty (MT)
1st	600.00	365	219,000.00
2nd	642.00	365	234,330.00
3rd	686.94	365	250,733.10
4th	735.03	365	268,284.42
5th	786.48	365	287,064.33
	Total quantity of waste in 5 years (MT)		1,259,411.84

Table2: Calculation for Capacity Requirements

Sr. No	Design Considerations for Capacity Calculations - Considering Settlement & Digestion of waste	Quantity
1	Total quantity of Waste	1,259,411.84 MT
2	Compacted Density of waste (Average)	0.95 MT/m^3
3	Volume of Waste	1,325,696.68 m^3
4	Volume of Daily Cover and Intermediate	198,854.50 m^3

Hence the capacity requirement of Landfill is = 1,524,551.18 m^3.

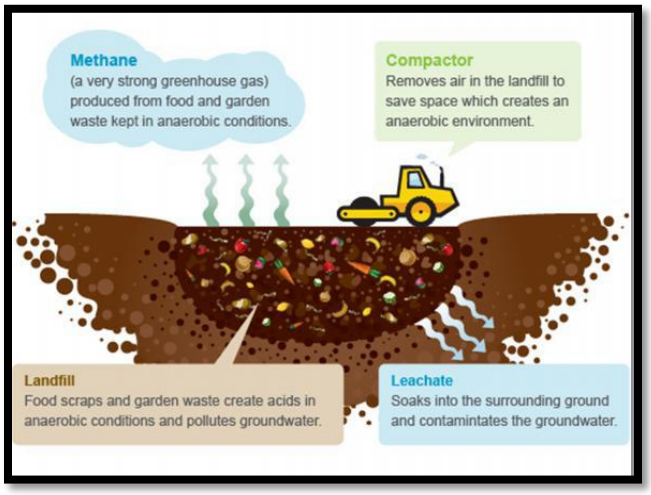

fig3.: impact on environment

3.14Arguments not considered while calculating the volume requirements

Settlement:

A landfill is subject to long-term settlement, as waste decomposes and consolidates; this settlement has significant impacts on the final surface profile, the landfill cap and potential after uses for the site.

Settlements for well-compacted waste vary significantly and can range from 15 to 30 per cent. Most of the settlement occurs within the first few years of the waste received, the result of waste compressing under its own weight and the weight of the daily & intermediate cover

Further to this, slope of final cover system (also called closure cap) shall be minimum 5% and maximum 25% after settlement as per USEPA requirements unless otherwise is demonstrated by the contractor via design calculations that steeper slope are safe and provide low maintenance works.

Slope:

There is no standard method for classifying landfills by their capacity. However the following nomenclature is often observed in literature:

Small size landfill : less than 5 hectare area

Medium size landfill :5to 20 hectare area

Large size landfill : greater than 20 hectare area.

Landfill heights are reported to vary from less than 5 m to well above 30 m.

1. Landfill Layout:

The master plan for the engineered sanitary landfill at Vizag has been developed. The requirements for the general layout and site arrangements are as follows:

1. Landfill cell designed and constructed to full compliance of USEPA(United States Environmental Protection Agency) including engineering barrier system consisting of HDPE/GCL (High Density Polyethylene/ Geosynthetic Clay Liner) composite lining system and leachate collection HDPE Geonet and protective geotextiles and soil lining system to protect the geosynthetic lining system from operation equipment
2. Two leachate evaporation ponds designed to current USEPA standards with primary and secondary composite lining systems and leachate detection monitoring system. The side of each pond shall be sufficient for leachate management and storage. The evaporation ponds shall have minimum capacity of 500m^3.
3. Leachate transfer system
4. A high performance leachate collection and removal system
5. HDPE manholes for leachate collection and transfer to the evaporation pond
6. Surface water runoff collection, collection and storage system.
7. Embankments to be constructed around the landfill cell excavation. The contractor shall propose the width, and height of embankment

8. Internal circular Roads, 6m with 50mm shoulders on both sides and drainage system along both sides for equipment and trucks movement
9. Unacceptable waste storage area,
10. Soil stock pile area
11. A three meter (3m) high security chain fence along the perimeter of the site and around the evaporation pond and workshop.
12. A 10-m buffer zone along the perimeter fence for landscaping features
13. Sliding entrance gate sufficient for the incoming trucks.
14. Entrance asphalt road connected to the haul road.
15. Two electronic weighbridges and gate house
16. Administration building
17. Labourers facility
18. Garage/workshop equipment with overhead crane
19. Fuel station and oil/water separator system
20. Parking areas
21. Landscaping features-internal and on the perimeter
22. Gas collection and venting system
23. Groundwater monitoring system
24. Fire fighting plan and fire fighting system as per the civil defence requirements

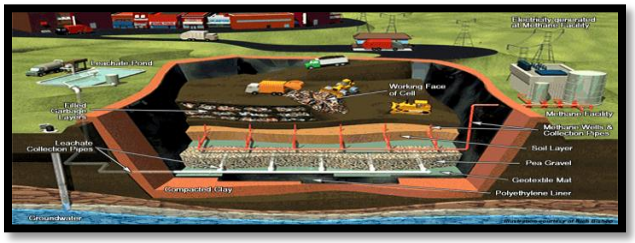

Fig:4.Basic elements of engineered Landfill

4.1 Site Planning and Layout of Engineered Landfill at Vizag

The site planning for the Vizag landfill project was undertaken to allow future expansion of the landfill in north direction and has taken into account various management facilities being planned by be'ah around the project site. The salient features of the project site plan are as follows:

- The size of the landfill is 300m * 325m measured from top of the bund to the bottom bund to accommodate 1.52millions m^3 of the waste volume.
- Overall design and conceptual layout of the landfill, evaporation pond and other ancillary facilities required at the site have been done taking into consideration the general topography of the site and accessibly to the site. Moreover, the locations of buildings and civil works have been planned away from the active working areas.
- Low lying areas of the site have been used for constructing the landfill to reduce the cost excavation. The geotechnical investigation report has been considered for deciding the depth of landfill.
- Natural ground has a gradient from south to north and east to west. By considering this the leachate evaporation ponds are located on west side of landfill and administrative area is located on south east side of landfill within an area of 150mm x 100mm on south side.
- The site layout is developed to accommodate the existing infrastructure facilities like road and connection to existing highway for easy access to the landfill site.
- The leachate collection within landfill will be done through a network of leachate collection pipes and the final disposal to the evaporation ponds by pumping.
- The base sealing will have roof and valley formation so that landfill can be expanded in the modular fashion. More so, it will be easier to separate leachate and rain water
- The north side of the landfill has been designed to facilitate future northern lateral expansion.
- An unacceptable waste storage area is located south of leachate evaporation pond
- A temporary crossing located on southeast side of the landfill would be provided (when required) for movement of crawler mounted vehicles to reach equipment workshop from site and vice versa

- The administrative facilities like car parking, temporary site office, equipment parking and workshop, fuel storage, labour facility and administration building have been located and grouped at one place so that the coordination and interaction is easier.

2. Conclusions:

1. The waste dumping practices in the Visakhapatnam City was studied.
2. In present work, the waste generation for vishakapatnam city up to 2019 was forecasted as 1,259,411.84 MT.
3. Based on this forecast, the capacity requirement of landfill was calculated as 1,524,551.18 m^3
4. The dimensions of landfill were determined as 300m * 325m measured from top of the bund to the bottom bund to accommodate 1.52millions m^3 of the waste volume.
5. Waste filling sequence was also provided.
1. So, finally this design helps in reducing Potential impacts on environment and improves public health and safety.

REFERENCES

1. *Alamgir, 2A. Ahsan, "municipal solid waste and recovery potential: Bangladesh perspective", Iran. J. Environ. Health. Sci. Eng., 2007, Vol. 4, No. 2, pp. 67-76.*
2. *Amar M. Dhere, Chandrasekhar B. Pawar, Pratapsingh B. Pardeshi and Dhanraj A. Patil, "Municipal solid waste disposal in Pune city – An analysis of air and groundwater pollution." Current science, Vol. 95, no. 6, 25 September 2008. pp.773-777.*
3. *Bundela P.S. , Gautam S.P. , Pandey A.K. , Awasthi M.K. , Sarsaiya S. "Municipal solid waste management in Indian cities – A review." International journal of environmental sciences, Vol 1, No 4, 2010, pp. 591-606.*
4. *Gaurav K. Singh, Kunal Gupta, and Shashank Chaudhary, "Solid Waste Management: Its Sources, Collection, Transportation and Recycling", International Journal of Environmental Science and Development, Vol. 5, No. 4, August 2014 .pp.347-351.*
5. *Gregory N. RICHARDSON and aigen ZHAO. "Geosynthetic fundamentals in landfill design" proc. Of int. Symp. On GeoEnvironmental eng., ISGE2009 September 8-10, 2009, Hangzhou, China:275-295*
6. *Hilary I. Inyang. "Geoenvironmental Engineering Principles And Applications." Marcel Dekker, Inc.2000.*
7. *Hoe I. Ling, Dov Leshchinsky, Yoshiyuki Mohri/ and Toshinori Kawabata,Members, ASCE., "Estimation of Municipal Solid Waste Landfill Settlement." Journal of geotechnical and Geoenvironmental engineering January 1998. Pp. 124:21-28.*
8. *J.P.Giroud, J.G.Zornberg, & A.Zhao. "Hydraulic design of Geosynthetic and granular liquid collection layers" Geosynthetics International(2000):vol7. Pp.285-380.*
9. *Krishna R. Reddy. "A review: moisture distribution in bioreactor landfills" Indian Geotech J 42.3 (July – September 2012) :125–149.*
10. *Karena ostrem. "Greening waste: anaerobic digestion for Treating the organic fraction of municipal Solid wastes." May 2004, pp. 1-59.*
11. *Ljupka Arsova. "Anaerobic digestion of food waste: Current status, problems and an alternative product." May 2010, pp. 1-77.*
12. *Moradeyo Olabisi Odunlami," Investigation of Groundwater Quality near a Municipal Landfill Site (IGQMLS)." International Journal of Chemical Engineering and Applications, Vol. 3, No. 6, December 2012. pp.366-369.*
13. *Mufeed Sharholy, Kafeel Ahmad, Gauhar Mahmood, R.C. Trivedi, "Municipal solid waste management in Indian cities – A review." M.Sharholy et al.Waste Management 28 (2008).pp. 459–467.*
14. *Manoj Datta ."Geotechnology for environmental control at waste disposal sites" Indian Geotech J 42.1 (January–March 2012).pp.1–36.*
15. *Pin-jing he. "Full-scale practice of ecologically based landfill of municipal solid waste: to accecelerate the biological conversion inside landfill and cover layers." Proc. of Int. Symp. On Geoenvironmental Eng., ISGE2009 September 8-10, 2009, Hangzhou, China pp.217-258.*
16. *Pankaj r.modak, prakash b. Nangare. "Quantitative And Qualitative Assessment Of Municipal Solid Waste For Nagpur City." JERS. Vol.II Issue II. April-June, 2011, pp. 55-61.*

17. *Rishi Rana rajiv Ganguly, Ashok Kumar Gupta. "An Assessment of the solid waste management system in Chandigarh city, India." Vol. 20 [2015], Bund. 6. Pp. 1547-1572.*
18. *Rajani Srivastava, Vijay Krishna and Ishan Sonkar. "Characterization and management of municipal solid waste: a case study of Varanasi city, India." ISSN: 2347-3217., Vol.2, No.8, August-2014, pp.10-16.*
19. *Rowe, R. Kerry. "Systems engineering: the design and operation of municipal solid waste landfills to minimize contamination of groundwater." Geosynthetic International 18.6 (2011): pp. 391-404.*