Municipal Solid Waste Management in India with Special Reference to Narasapur Town in West Godavari District, Andhra Pradesh, India

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***Abstract:** In the initial stages of industrial regime, there was a gradual relocation of the rural population to the industrialized urban areas in the developing countries. However, the collection and creation of solid waste was at a practicable rate and hence, the regular ejection of family and trade scrap was not a serious problem for the jurisdiction. Later, rising urbanization led to rapid change in the quantity and character of the waste in line with the changing lifestyle of the people, and also with the changes in the marketing technology, fuel technology and building technology. Research studies conducted in certain developed and developing countries substantiate the magnitude and the subsequent consequences of the modern technologies in aggravating the problem of solid waste management. Landfills are designed separately for the disposal of different types of wastes: for hazardous waste, designated waste (non-hazardous waste that may release constituents in concentration that are in excess of applicable water quality standards established by central and state governments such as combustion ash, asbestos and other similar wastes), and municipal solid waste. In developed and developing countries, substantial increase in recycling and consequently a reduction in landfilling appeared in the last decade of the 20th century. Within the East European countries in 1995, approximately 86% of solid waste was landfilled and 2.4% was incinerated. The data for 1999 shows an improvement in reducing landfilling to 83.7% while the share of incineration of municipal solid waste increased to 6% and the share of incineration increased to nearly 160%. The plan of municipal solid waste landfill is to place residuals in the land according to a well-designed, careful, coordinated plan so as to minimize environmental impacts and maximize benefits, especially to keep the resource and financial cost as low as possible. This studies presented an overview of the principal technology available for diverting biodegradable municipal waste along with the landfill technique. Leachate is created as rainfall lands on an uncapped landfill and percolates through the wastes. 450 gms/capita/day is the per capita waste generation is obtained.*

***Index Terms:** Municipal solid waste management, India scenario, SWM practices*

I. INTRODUCTION

Municipal solid waste production continues to grow both in per capita and overall terms in cities which grow faster and become overcrowded with higher population densities due to the consequent change in the lifestyle of the people. The quantity of waste produced as a result of increase in the world population, increasing urbanization and changing lifestyle have a direct negative impact on human health and quality of urban life. Current approaches of urban solid waste management are, therefore, by and large, unsustainable.

West Godavari is one among the most urbanized District in Andhra Pradesh. The district sub-division headquarter located at Narsapur. The total area of West Godavari District is 7,700 Sq.Km[1].

Narsapur is located in the southern part of West Godavari district, state of Andhra Pradesh, in the south-eastern part of India. Narsapur Town is located at 16.32' North latitude and 81 42' East longitude, in the Southern part of West Godavari District. It has an average elevation of 2 meters (7ft). River Godavari unload into Bay of Bengal nearby Antervedi, at 7km from Narsapur. Fig.1 depicts the location map of the study area.

Narsapur municipality area is about 11.32 sq.kms. It is observed that the growth rate from 1961 to 1971 is rapid i.e., 6,083(20.23% increases) afterwards the growth of rate from 1971 to 1981 is rapid i.e., 9,886(27.43% increases) afterwards the growth of rate from 1981-1991 rapid i.e., 10,329(22.43% increases) and afterwards the growth of rate from 1991-2001 rapid i.e., 2,242 (3.97% increased) but the growth rate slowly in decade 2001-2011. Narsapur Municipality composed of 31 wards and 48 hovels in an area of 11.52 Sq. Kms. As per the Census 2011 the population of the Town as 58,901.

II. MATERIALS AND METHODS

A. Planning and design criteria

The following phases are considered for the Design of Proposed Solid Waste Management in Narasapur.

- Generation
- Storage
- First collection
- Peripheral collection and Transportation
- Processing/ Treatment
- Final Disposal

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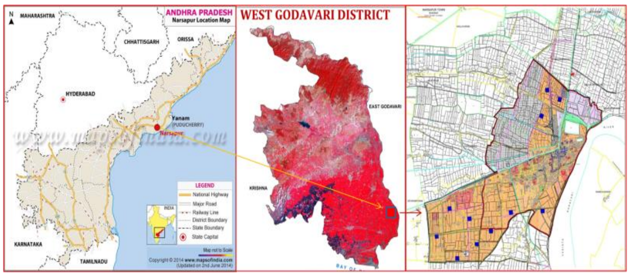

Fig.1 Location map of the study area

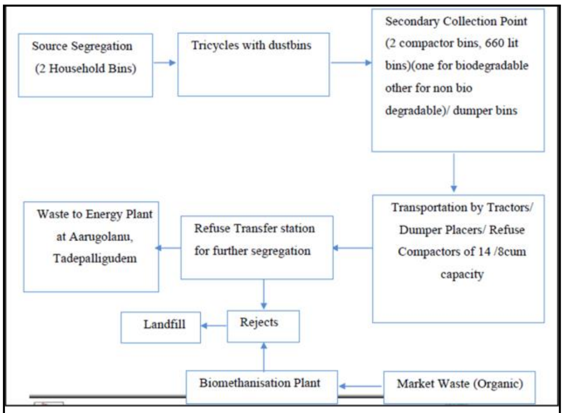

Fig. 2 Schematic diagram for SWM

Fig. 2 shows the schematic diagram for solid waste management Various studies, as mentioned below, are been made to assess the upturn in the per capita waste generation per annum depend on which the raise in per capita waste generation for Narasapur. The physical characteristics and Garbage generation will shown in Tables 1, 2 and 3.

Table 1 Norms for Garbage Generation

Garbage Generated From	Average Waste
Population range upto 1 lakh	0.21 Kg per person per day
Population range 1 to 5 lakh	0.21 Kg per person per day
Population range 5 to 10 lakh	0.25 Kg per person per day
Population range 10 to 20 lakh	0.27Kg per person per day

Table 2 Physical Characteristics of Municipal Solid Wastes in Indian Cities

Population range (in millions)	Number of cities surveyed	Waste composition (in percent)					
		Paper	Rubber leather and synthetics	Glass	Metals	Total compostable matter	Inert
0.1 to 0.5	12	2.91	0.78	0.56	0.33	44.57	43.59
0.5 to 1.0	15	2.95	0.73	0.35	0.32	40.04	43.59
1.0 to 2.0	9	4.71	0.71	0.46	0.49	38.95	44.73
2.0 to 5.0	3	3.18	0.48	0.48	0.59	56.67	49.07
>5.0	4	6.43	0.28	0.94	0.8	30.84	53.9

B. Storage and collection

With a dream to keep the high quality of public health, the villages and towns in the Andhra Pradesh, the expected outcomes shall be: Total separation at source as per Municipal solid waste Rules door-to-door gathering. It is for that reason the storage and primary collection system will be designed adequately. Waste is continuously produced because of human activities. As this waste cannot be continuously removed, it has to be stored and transported quickly at specific frequencies. The removal of waste from individual houses often termed as 'collection of waste' can be carried out by using various methods such as house to house and community bin system [2].

Source segregation and storage is not the primary responsibility of the NM. However, if achieved, there will be a significant improvement in the waste quality and subsequently enhancement in the waste dispensation.

Recycling conserves natural resources and reduces the carbon footprint. Community Participation indicates various actions that could be taken by Narasapur Municipality to increase the public participation for the management of Municipal Solid Waste (MSW). The following sections deal with issues that need to be considered for source segregation and various options available to Narasapur Municipality to implement the system.

Scrap separation at origin can be attained by storing dry and wet fraction of MSW in two various bins/ bags and dispose them individually. Table 4 showing the segregation categories.

Table 3 Physical Characteristics of Municipal Solid Wastes in Indian Cities

Population range (in millions)	Number of cities surveyed	Moisture (%) of wastes	Organic matter (%) of wastes	Nitrogen vs total Nitrogen	Phosphorous as P2O3 (%) of wastes	Potassium as K^2O(%) of wastes	C/N Ratio	Calorific value in kcal/kg
0.1 to 0.5	12	25.81	37.09	0.71	0.63	0.83	30.94	43.59
0.5 to 1.0	15	19.52	25.14	0.66	0.56	0.69	21.13	43.59
1.0 to 2.0	9	26.98	26.89	0.64	0.82	0.72	23.68	44.73
2.0 to 5.0	3	21.03	25.6	0.56	0.69	0.78	22.45	49.07
>5.0	4	38.72	39.07	0.56	0.52	0.52	30.11	53.9

Table 4 MSW Source Segregation – categories

Bio-degradable(wet waste)	Recyclable & Non-bio-degradable (dry waste)
Food & Green waste **:** Cooked/uncooked food, vegetable, fruit, meat, borne, fish waste, leaves, grass	Paper, Plastics, glass, metal, ceramic, rubber, leather, rags, used cloths, wood, stone, sand, ash, thermocol, straw & packing materials

However, it is not easy to implement source segregation practices immediately. A prolonged campaign by NM will be required with adequate budgetary provisions under Information Education and Communication Programs which will be, taken up with the help of Non Governmental Organizations, Ministry of Environment and Forests Recommends a 3 Bin system of storage of waste, however, such a system of segregation in the initial stages of waste management is difficult for the community to practice. It is hence proposed to establish a system based on '2 Bin structure of Solid Waste Storage at origin. For Food/Green waste and Recyclables/Non-biodegradable waste, every household was motivated to keep separate Bins/containers [3]. The

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household bin for food & green waste could be of 60 liters capacity mad e of plastic / reinforced plastic or metal.

C. Sanitary land filling site

In absence, practice of any processing mechanisms and organized recovery existing disposal system of most municipal towns is miserable. Which causes to the unutilization of garbage unnecessary occupation of dumpsites leading to health hazards and inconvenience to citizens. The final functional element in the solid waste management system is distruction. Nowadays the disposal of wastes by uncontrolled dumping is the ultimate fate of all solid wastes. Ideally the Non-biodegradable waste collected from transfer stations, throw-outs from the processing plant and the inactive materials and wastage from the compost plant shall be collected distinctly and afterwards disposed in a Scientific Sanitary landfill.

D. Cell Method

One of the landfill method is cell method, the collected waste is deposited in a pre-constructed bonded area. This method encourages the progressive filling and restoration, it is a preferred method for industries.

Operating a cellular method of filling permits wastes to be deposited in a organized manner since the entire cell serve to both conceal the tipping and rap much of the litter, which may be generated.
Sanitary landfill helps in reclamation of land for valuable use and prevents burning of garbage also. While using sanitary Landfill approach MSW Rules will also be considered. The landfill is based on concepts of isolation of the landfill from surface water and containment of wastes within the landfill. Liner systems with leachate collection would be provided for isolation of the wastes from surface runoff and containment of the waste to protect against the movement of leachate directly into the ground. This facility is provided with proper design and specifications, a cover liner would be provided whenever the planned waste levels are reached The landfill will be developed with a perspective of 20-25 year's.

III. RESULTS AND DISCUSSION

A. Solid waste management system

Each household in the town is initially (first year) provided by two 10 lit capacity household bins to encourage the source segregation. Sanitary worker collects the household waste and empties in the proposed 60 lits bins allotted for biodegradable and non-biodegradable waste separately in tricycle. Around 50 households are covered by a sanitary worker for door to collection. Each tricycle is provided with 6 bins to transport to the secondary collection point.

At every secondary collection point two dumper bins/compactor bins of each 660 lit capacity, one for biodegradable and the other is for non-biodegradable, waste are proposed. The waste from primary collection is emptied in these bins. Existing tractors/dumper placer vehicles/ compactors are proposed to lift the secondary collection bins to transport to the proposed transfer station. Separate compactors are proposed for transportation of both wet waste and dry waste. The waste generates from vegetable markets, fruit markets which have high moisture content and high organic content will be processed under Biomethanisation.

In view of transporting segregated waste to Waste To Energy (WTE) plant at Narsapur and to reduce the fuel cost a transfer station is proposed. Magnetic separators and proposed in transfer station to retain metals and to separate the silt, street sweepings or dust from the waste. These inerts are proposed to be land filled in sanitary landfill designed for 15 years. 14 m3 compactors are proposed to transport the waste to WTE plant. The brief of the process as

- Infrastructure required for House Hold Collection of Waste and transportation – Bins and tricycles
- Infrastructure required for collection of waste from commercial establishments, markets and other institutions – Bins.
- Vehicles for secondary transportation – Existing Tractors and dumper placers are utilised, newly Compactors are proposed.
- Transfer Station
- Transporting the waste to Waste to Energy Plant at Tadepalligudem, west Godavari district, Andhra pradesh
- Bio Methanantion plant for highly biodegradable organic matter from Markets

B. Population projection

The population projection methods namely, arithmetic progression, geometric progression and incremental increase method have been tried to project the population. Owing to the decrease in % growth of population Geometric method found not suitable. Incremental Increase Method is adopted to forecast the population for 25 years for the town. Tables 5 and 6 shows projected population by different methods.

Incremental Increase method is best suited for Narsapur town which matches the previous year population data compared to other population projection method. Following table shows projected population by Incremental Increase method for next 25 years.

Table 5 Population Projection of Narasapur

Year	Arithmetical Increase Method (Pn)	Geometrical Increase Method(Pn)	Incremental Increase Method (Pn)
2011	58901	58901	58901
2014	60608	59916	59984
2016	61746	60603	60545
2017	62315	60949	60778
2021	64590	62353	61388
2022	65159	62709	61461
2027	68004	64520	61344
2028	68573	64889	61224
2031	70279	66007	60673
2032	70848	66384	60426
2037	73693	68301	58708
2038	74262	68691	58268
2040	75400	69478	57292
2042	76537	70274	56189
2046	78813	71893	53597

Table 6 Projected Population – Narasapur

Year	Projected population	Year	Projected population
2015	61177	2029	69142
2016	61746	2030	69711
2017	62315	2031	70279
2018	62884	2032	70848
2019	63453	2033	71417
2020	64022	2034	71986
2021	64590	2035	72555
2022	65159	2036	73124
2023	65728	2037	73693
2024	66297	2038	74262
2025	66866	2039	74831
2026	67435	2040	75400
2027	68004	2041	75968
2028	68573	2042	76537

C. Estimation of Per capita Waste generation and Present Waste Quantity

Per capita waste quantification for Naraspur was carried out by following methods:
Quantity of waste as reported by respective Urban Local Body (ULB)- Quantity of waste as reported by ULB has been recorded and further verified with the actual number of trips being carried at dump site on day to day basis. Quantification Survey by taking representative samples- Representative samples collection from each ULBs for seven days as per the methodology given by the Central government MSW manual. The waste reported by ULB and calculated by survey is compared with the norms given by the Central Public Health and Environmental Engineering Organisation (CPHEEO) manual. As per ground per capita waste creation is secured as 450 gms/capita/day. Rate of magnification of per capita creation of solid waste is acquired as 2% for annual. Projected waste generation from the ULB is shown below. Table 7 showing the Solid waste created in Narsapur.

D. Physico-chemical characteristics of solid waste

Characterization of municipal solid scrap is carried using out by taking representative samples from dump sites of respective towns. Sample waste collected has been sorted using Quarter & coning Sampling Procedure. Physical characteristics of waste is derived at the site by in-situ manual sorting of the waste. Table 8 shows the constituents and their average weights in percentage of waste.

Table 8 Physical characteristics of Narasapur Municipality

S.No.	Physical characteristics	Patna bazaar	Peech palem road	Ballavari veedi	Average
1	Organic waste	47.9	48.9	47.9	48.23
2	Garden waste	8.6	8.4	8.3	8.43
3	Coconut shells	2.9	2.8	2.6	2.77
4	Ply wood, wood chips, broken furniture	5.9	5.6	6.2	5.90
5	Plastics	3.2	3.6	3.5	3.43
6	Paper	6.6	6.1	5.9	6.2
7	Textiles	3.3	3.2	3.2	3.23
8	Metals	0.8	0.7	0.9	0.80
9	Glass & ceramics	1.5	1.2	0.8	1.17
10	Rubber , Leather & Synthetics	0.8	0.9	1.2	0.97
11	Dust, stone, debris & boulders	18.5	18.6	19.5	18.87

Intensively varied so gathered the total quantity of waste and then lowered by method of quartering till a sample of such size is procured which can be lifted in the laboratory. Table 10 showing the chemical attributes of the waste.

E. Phase wise Landfill Design for the Proposed Site

Landfills are a key component of any well-designed Municipal solid waste management system. They are the last repositories of Municipal solid waste after all other Municipal solid waste management choices have been exercised. The landfill site is designed for the year 2032 for Narasapur.
The overall approach to the growth of the sanitary landfill for Narsapur town is formulated to content the regulatory requirements of Municipal solid waste management rules, CPHEEO guidelines and with the aims of environmental conservation and cost effectiveness. Considering the above, conservation of the quality of the groundwater in the site and adjoining locations is of paramount importance in the formulation of the design approach for the landfill facility.
Since the waste to be landfilled is mostly inert, the generation of leachate and Gas will be within the permissible limits.
However adequate care has been given in designing the landfill to accommodate any future migration of toxic components to the environment.

Table 7 Solid waste generated in Narasapur

Year	Projected Population	Domestic Waste Generation (Grams PerCapita /Day)	Total Domestic Waste(TPD)	Commercial Waste Generation (Grams PerCapita/Day)	Commercial Establishment (TPD)	Street Sweeping Silt Waste Generation (Grams PerCapita/ Day)	Street Sweeping (TPD)	Institutional Waste Generation (Grams PerCapita/ Day)	Institutional (TPD)	Total Waste Generated (TPD)
2015	61177	270.0	17	162	9.9	108.0	6.6	0.0	0.0	33.04
2016	61746	275.4	17	165.2	10.2	110.2	6.8	0.0	0.0	34
2017	62315	280.9	18	168.5	10.5	112.4	7.0	0.0	0.0	35
2018	62884	286.5	18	171.9	10.8	114.6	7.2	0.0	0.0	36
2019	63453	292.3	19	175.4	11.1	116.9	7.4	0.0	0.0	37
2020	64022	298.1	19	178.9	11.5	119.2	7.6	0.0	0.0	38
2021	64590	304.1	20	182.4	11.8	121.6	7.9	0.0	0.0	39
2022	65159	310.1	20	186.1	12.1	124.1	8.1	0.0	0.0	40
2023	65728	316.3	21	189.8	12.5	126.5	8.3	0.0	0.0	42
2024	66297	322.7	21	193.6	12.8	129.1	8.6	0.0	0.0	43
2025	66866	329.1	22	197.5	13.2	131.7	8.8	0.0	0.0	44
2026	67435	335.7	23	201.4	13.6	134.3	9.1	0.0	0.0	45
2027	68004	342.4	23	205.5	14.0	137.0	9.3	0.0	0.0	47
2028	68573	349.3	24	209.6	14.4	139.7	9.6	0.0	0.0	48
2029	69142	356.3	25	213.8	14.8	142.5	9.9	0.0	0.0	49
2030	69711	363.4	25	218.0	15.2	145.4	10.1	0.0	0.0	51
2031	70279	370.7	26	222.4	15.6	148.3	10.4	0.0	0.0	52
2032	70848	378.1	27	226.8	16.1	151.2	10.7	0.0	0.0	54
2033	71417	385.6	28	231.4	16.5	154.3	11.0	0.0	0.0	55
2034	71986	393.3	28	236.0	17.0	157.3	11.3	0.0	0.0	57
2035	72555	401.2	29	240.7	17.5	160.5	11.6	0.0	0.0	58
2036	73124	409.2	30	245.5	18.0	163.7	12.0	0.0	0.0	60
2037	73693	417.4	31	250.4	18.5	167.0	12.3	0.0	0.0	62
2038	74262	425.8	32	255.5	19.0	170.3	12.6	0.0	0.0	63
2039	74831	434.3	32	260.6	19.5	173.7	13.0	0.0	0.0	65
2040	75400	443.0	33	265.8	20.0	177.2	13.4	0.0	0.0	67
2041	75968	451.8	34	271.1	20.6	180.0	13.7	0.0	0.0	69
2042	76537	460.9	35	276.5	21.2	184.3	14.1	0.0	0.0	71

The above constituents are classified as follows in the Table 9.

Table 9 Physical characteristics of Solid waste

S.No.	Type of waste	Physical Characteristics	Average	Composition
1	Bio-degradable waste	Organic waste	48.2%	48.2%
		Total	48.2%	
2	Dry waste/combustibles	Garden waste	8.4%	32.9%
		Coconut shells	2.8%	
		Ply wood, wood chips, broken furniture	5.9%	
		Plastics	3.4%	
		Paper	6.2%	
		Textiles	3.2%	
		Total	30.0%	
3	Recyclables	Metals	0.8%	
		Glass & ceramics	1.2%	
		Rubber & synthetics	1.0%	
		Total	2.9%	
4	Inert and dust	Dust, stone, debris & boulders	18.9%	18.9%
		Total	18.9%	
		Grand total	100.0%	100.0%

Design Life

The landfill design comprises of an active period and a closure and post closure period. For this site the active period is designed as 15 years. The closure and post-closure period for which the landfill will be monitored and maintained is 15 years after the active period is completed.

Phasing: The land filling activity will be under taken in a phased manner in 3 phases for 15 years. Each phase comprises 5 years from the base year 2017 until the year 2032 (i.e.) for 2017-2022, 2023-2027, 2028-2032.

F.Phase wise Landfill Design for the Proposed Site

The depth of landfill has been considered keeping the ground water table at the site in to consideration. The height of the landfill is fixed at 5 m above Ground Level (GL) and 2.5 m below ground level considering the volume of scrap to be dumped over a period of 15 years.

Design Criteria for Landfill

(i) Active of Life of each Phase: 5 Years
(ii) Topography : Flat Terrain
(iii) Water Table : 10 m below ground surface
(iv) Average Precipitation : 1115mm/ Year
(v) Base Year : 2017
(vi)Side slope : 1:4 side slope for the above ground portion of the landfill.
(vii) Side slope : 1:2 side slope for the below groun

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Table 10 Chemical characteristics of waste

S.No.	Characteristics	Units	Patna bazaar	Peechpalem road	Ballavari veedi
1	Density of waste	kg/cum	390	380	370
2	Moisture content	%	50.4	48.6	47.9
3	pH(5% solutions)	--	8.1	80.6	8.08
4	EC(5% solutions)	Um/cm	1280	1290	1310
5	Total waste soluble	%	4.9	5.2	5.4
6	TOC	%	18.1	18.8	18.4
7	C/N ratio(Dry)	--	26.62	26.11	26.29
8	Calorific Value	k.cal/kg	920	960	980
9	Total Phosphorus	%	0.56	0.58	0.6
10	Total Potassium	%	0.52	0.53	0.54
11	Nitrogen as N	%	0.68	0.72	0.7
12	Arsenic	mg/kg	20	20	30
13	Cadmium	mg/kg	3	4	4
14	Chromium	mg/kg	30	30	40
15	Nickel	mg/kg	40	50	50
16	Lead	mg/kg	120	130	130
17	Zinc	mg/kg	110	120	130
18	Copper	mg/kg	100	120	120

Table 11 shows the design criteria for landfill.

G. Leachate Drainage, Collection and Removal System (LCRS)

A leachate collection system comprises of a drainage layer, a perforated pipe collector system, sump collection area and a removal system.

A leachate drainage layer, 15 cm thick of granular soil material of permeability value 1x 10^{-2}cm/sec with a slope of 2% is considered.

Leachate is removed from the landfill by (a) pumping in vertical wells or chimneys, (b) pumping in side slope risers, or (c) by gravity drains through the base of a landfill in above ground and sloped landfills [4].

Perforated drainage pipes can provide good long-term performance. These pipes have been shown to transmit fluids rapidly and to maintain good service lives.

H. Leachate generation

The following factors causing the sanitary landfill of leachate volume:

- The area of rainfall
- Groundwater /surface runoff
- MSW moisture
- Degree of compaction
- Evaporation
- Capacity of the soil and the MSW to retain moisture

The rainfall is the head origin of the leachate of volume.

Not only by rainfall in the area but also by runoff of the landfill is accountable for Leachate,

Either by increasing the amount of filtration or by direct precipitation the scrap deposited there through craks in the land of which increases the quantity.

The volume of Leachate processed is often determined by using coefficients that correspond the formerly intimated parts since it is hard to obtain climatologic details.

The below method allow to make a simple, quick assessment of the flow of Leachate or percolate liquid by using the calculation

$$Q = P \times A \times K$$

Q = Mean leachate flow generated (m3/month)

P = Maximum monthly precipitation (m/month)

A = Surface area of the landfill (m2)

K= Coefficient that depends on the degree of waste compaction

- For weakly dense landfills with specific weight of 0.4 to 0.7 t/m3, the estimated production of Leachate is between 25 and 50% (K=0.25 to 0.50) of the mean annual precipitation for the landfill area.

- For strongly dense landfills with specific weight ≥ 0.7 t/m3 the assessed making of the Leachate is between 15 and 25% (K=0.15 to 0.25) of the mean yearly precipitation for the landfill area.

Since leachate generation occurs mainly during rainy periods and for diverse days subsequently and stop during dry periods, it is a good idea to adopt monthly precipitation instead of yearly.

The Table 12 values have been adopted for estimating leachate generation.

Table 11 Design criteria for landfill

S.No.	Description	Unit	2017-2022	2023-27	2028-32	Total
1	Total volume of waste leading to land fill site in starting year per day	Cum/Day	4.30	5.00	6.00	15.30
2	Proposed life of landfill	Years	5	5	5	
3	Total volume of waste leading to land fill site after 5 years per day	Cum/Day	5.00	6.00	7.00	
4	Total volume of waste in 5 years (Vw)	Cum	8487	10038	11863	
5	Dialy cover considered	% of Total Volume (Vw)	10%	10%	10%	
6	Total volume of daily cover in 5 years (on the basis of 15 cm soil cover on top and sides for lift height of 1.5 to 2 m) (Vc=0.1 xVw)	Cum	849	1004	1186	3039
7	Liner and closer cover considered	% of Total Volume (Vw)	25.00%	25.00%	25.00%	
8	Total volume required for components of liner system and of cover system (VL=0.25xVW)	Cum	2122	2510	2966	7598
	(on the assumption of 1.5m thick liner system (including leachate collection layer) and 1.0m thick cover system (including gas collection layer)					
	Vc=k Vw(cum) (k=0.25 for 10m high landfill, 0.125 for 20 m high landfill and 0.08 for 30 m high landfill. This is valid for landfills where width of landfill is significantly larger than the height)					
9	Volume available within 10 years due to settlement/biodegradation of waste @ 10% of Total Volume (Vs=0.1 x Vw)	Cum	849	1004	1186	
10	Total landfill capacity (Vn=Vw+Vc+VI-Vs)	Cum	10609	12548	14829	37986
11	Proposed height of landfill (H)	Mtr	5	5	5	
12	Area required for landfill (AI=Vn/H)	Sq.m	2122	2510	2966	7598
13	Area required for infrastructure (at 15% of total area) (Ai)	Sq.m	319	377	445	1141
14	Total area required (At=AI+Ai)	Sq.m	2441	2887	3411	8739
15	Size of Landfill					
	Length	Mtr	66.0	71.0	78.0	215
	Width	Mtr	33.0	35.5	39.0	107.5

Table 12 Estimation of leachate

Leachate generation from sanitary landfill	Qty	Units
Rainfall (p)	0.15	m
No of rainy days in that particular month	4.0	Nos
K=0.2 (landfill)	0.2	
A=(landfill area)	1351.4	Sqm
Q=P*A*k	40.3	Cum/month
No of rainy days in that particular month	10.0	Nos
Q(m3/day)	4.0	Cum/day

IV. CONCLUSION

Municipal solid waste management is great important for a clean and beneficial environment. This conclusion follows from the fact that. In India most of the existing municipal solid waste management practices are not satisfactory and do not follow the grasping rules and municipal solid waste management.

This is an matter for future research to explore because of execution of efficient and scientific municipal solid waste management operations, door to door gathering , public awareness and participation had better satisfactory municipal solid waste practices in Narasapur town. We could not finalize a unique solution to be apply all over India because different regions in India have various geological, meterological parameters, environmental variations, socio-economic and cultural conditions. In the selection of the appropriate techniques of waste disposal practices in the above waste disposal options would help at the decision making and planning stage itself. On the basis of climatic

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conditions,socio-economic-cultural pattern and geographical conditions should be focused for upcoming studies.

The reason attributed to the preference of landfilling is due to the fact that landfills are cheaper to construct and operate than incineration. The major concern highlighted regarding landfill is the capacity of the site. But a positive trend noticed is the decrease of the total waste generated for the last decade of 20th century which increases the life time of existing landfill sites. Another problem associated with landfilling is the production of methane, a biogas, a major greenhouse gas which can be tackled only by avoiding the landfilling of biodegradable organic matter and by collecting and utilizing gas at the landfill.

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