Design of Municipal Solid Waste in Pudukkottai Taluk, India

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Abstract- Solid waste is one of the major environmental problems of Indian cities. The quantity of solid waste produced in cities depends on the type of city, its population, living standards of the residents and degree of commercialization, industrialization and various activities prevailing in the city. Solid waste management is an obligatory function of municipal corporations, municipalities and other local bodies in India. Waste quantities are increasing and municipal authorities are not able to upgrade the facilities required for proper management of such wastes. In many cities and towns, garbage is littered on roads and foot-paths; almost 90% of solid waste is disposed of unscientifically in open dumps and landfills, creating problems to public health and the environment. This design is carried out on municipal solid waste management of Pudukkottai Taluk.

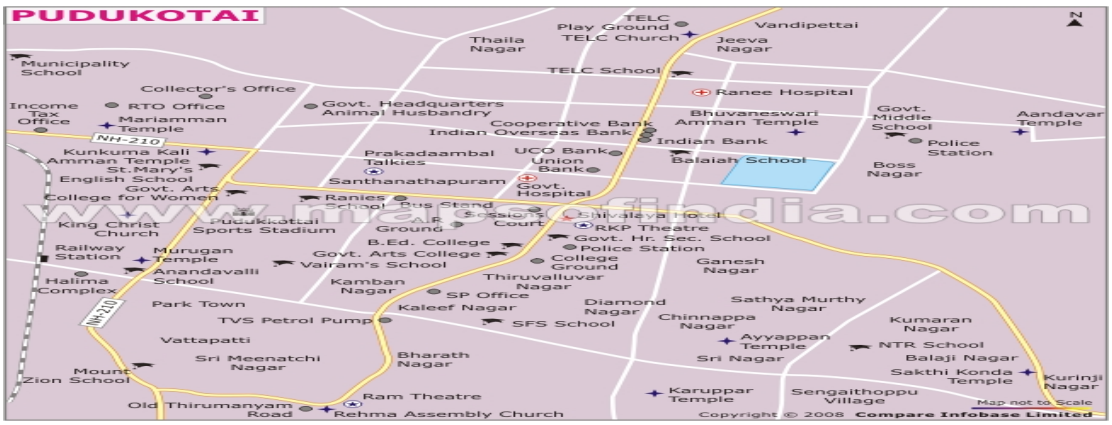
Index Terms- Municipal solid waste, waste generation, transfer station, landfill site.

I. INTRODUCTION

The quality of municipal solid wastes generated in Pudukkottai has been consistently rising over the year. This can be attributed to rapid population growth, mass migration of population from rural to urban areas and increase in economic activities in the city and lifestyle of the people. Ecological impacts such as degradation, water and air pollution are related with improper management of municipal solid waste.

In developing countries, most of municipal solid waste dumped in landfills in large manner. This project is about analyses of municipal solid waste in Pudukkottai taluk. This paper describes analyses the correlation analysis of among various factors of municipal solid waste generation and also estimates the future amount of municipal solid waste generation. Finally, the future land area required for landfill site disposal in Pudukkottai district.

DESIGN CITY:



SOLID WASTE MANAGEMENT SYSTEM:

GENERATION OF WASTE: Municipal solid waste is a waste type that includes predominantly residential sometimes the addition of commercial wastes, construction and demolition debris, sanitation residue, and waste from streets collected by municipality within a area.

POPULATION DETAILS:

Total population : 1,43,748
Total numbers of wards : 42
Total generation of waste : 32 metric tons
Per capita generation of solid waste : 243.500g

GENERATION OF WASTE DETAILS IN WARD WISE:

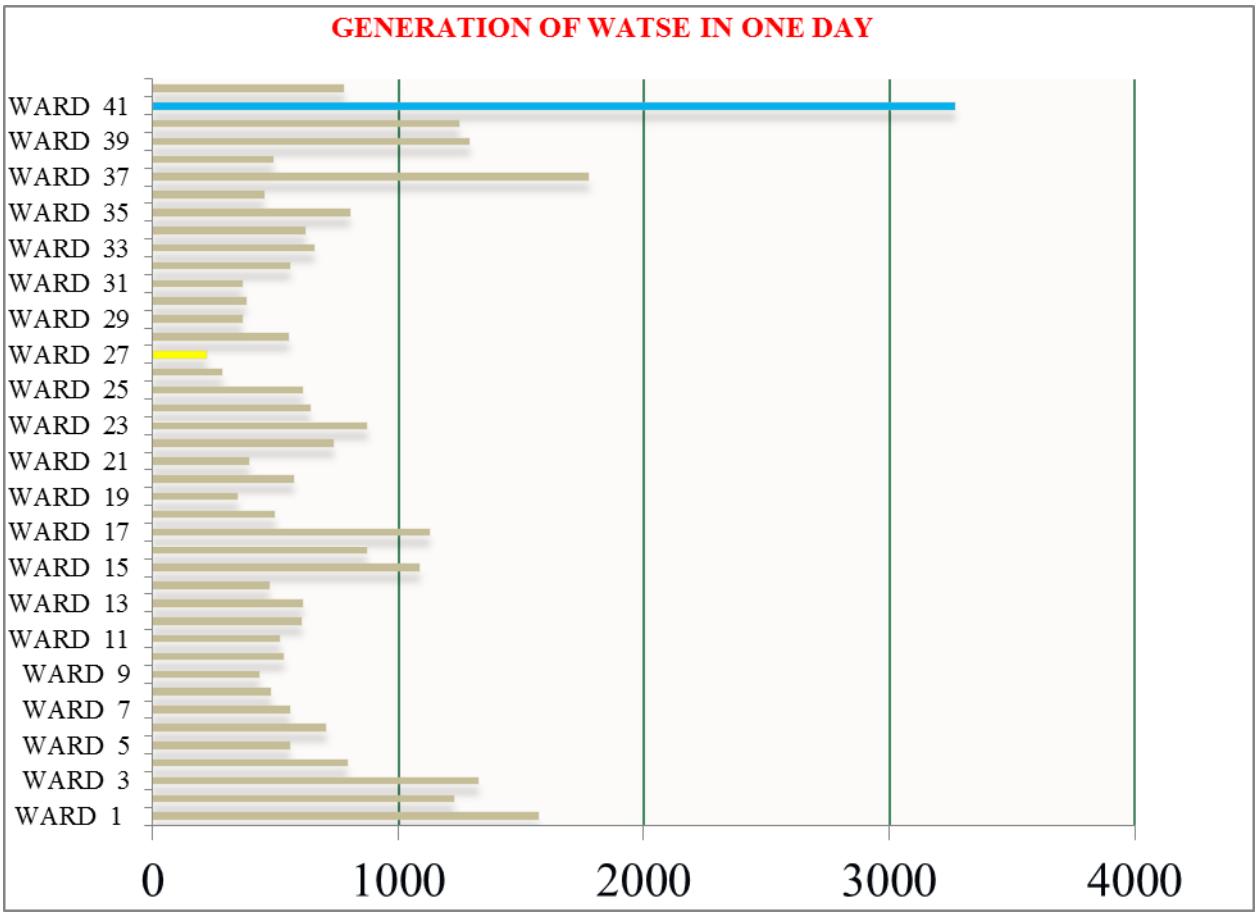
WARD	POPULATION × PER CAPITA GENERATION OF WASTE (kg)
Ward 1	= 6452 × 243.5 = 1571.06
Ward 2	= 5032 × 243.5 = 1225.3
Ward 3	= 5448 × 243.5 = 1326.58
Ward 4	= 3248 × 243.5 = 790.88
Ward 5	= 2292 × 243.5 = 558.10
Ward 6	= 3630 × 243.5 = 707.124
Ward 7	= 2284 × 243.5 = 556.15
Ward 8	= 1980 × 243.5 = 482.13
Ward 9	= 1780 × 243.5 = 433.43
Ward 10	= 2190 × 243.5 = 533.265
Ward 11	= 2130 × 243.5 = 518.655
Ward 12	= 2484 × 243.5 = 604.854
Ward 13	= 2508 × 243.5 = 610.698
Ward 14	= 1950 × 243.5 = 474.825
Ward 15	= 4465 × 243.5 = 1087.227
Ward 16	= 3575 × 243.5 = 870.513

- Ward 17 = 4625 × 243.5 = 1126.19

WARD	POPULATION × PER CAPITA GENERATION OF WASTE (kg)
Ward 18	= 2045 × 243.5 = 497.95
Ward 19	= 1425 × 243.5 = 346.98
Ward 20	= 2355 × 243.5 = 573.44
Ward 21	= 1610 × 243.5 = 392.035
Ward 22	= 3020 × 243.5 = 735.37
Ward 23	= 3590 × 243.5 = 874.17
Ward 24	= 3285 × 243.5 = 639.92
Ward 25	= 2500 × 243.5 = 608.75
Ward 26	= 1160 × 243.5 = 282.46
Ward 27	= 0895 × 243.5 = 217.93
Ward 28	= 2280 × 243.5 = 555.18
Ward 29	= 1490 × 243.5 = 362.82
Ward 30	= 1555 × 243.5 = 378.64
Ward 31	= 1490 × 243.5 = 362.82
Ward 32	= 2295 × 243.5 = 558.83
Ward 33	= 2700 × 243.5 = 657.45
Ward 34	= 2550 × 243.5 = 620.93
Ward 35	= 3295 × 243.5 = 802.33
Ward 36	= 1855 × 243.5 = 451.69
Ward 37	= 7295 × 243.5 = 1776.33
Ward 38	= 2015 × 243.5 = 490.65
Ward 39	= 5304 × 243.5 = 1291.52
Ward 40	= 5120 × 243.5 = 1246.72
Ward 41	= 13420×243.5 = 3267.77
Ward 42	= 3196 × 243.5 = 778.33

GENERATION OF WASTE:

- Total generation of waste per day : 32248 kg or 32 tons.
- Total generation of waste per week:225736 kg or 226 tons.
- Total generation of waste per year :11770520 kg or 11770.5 tons.
- Among 42 wards maximum generation of waste in ward 41
- And minimum generation of waste in ward 27.



PROCESSING AND STORAGE :

- Second functional element of an integrated solid waste management system
- Describes the separation of components and/or treatment of solid wastes
- Used for materials that have already escaped source reduction and are on the way to being discarded into the environment at or near the source of generation
- On-site storage means storage of solid waste (both separated and/or mixed) at or near the source of generation before primary collection.

STORAGE CAPACITY:

- Storage capacity of per house per day :

= (per capita generation of waste × number of people in per house) / 1000
= (243.5 × 5)/1000
Storage capacity of per house per day = 1.2 kg .

STORAGE CONTAINERS INFORMATION:

- 1.2 kg is based on both degradable and non degradable
- Per Container capacity : 5 kg
- Number of containers : 3
- Type of containers used : plastic

ON SITE STORAGE CONTAINERS:

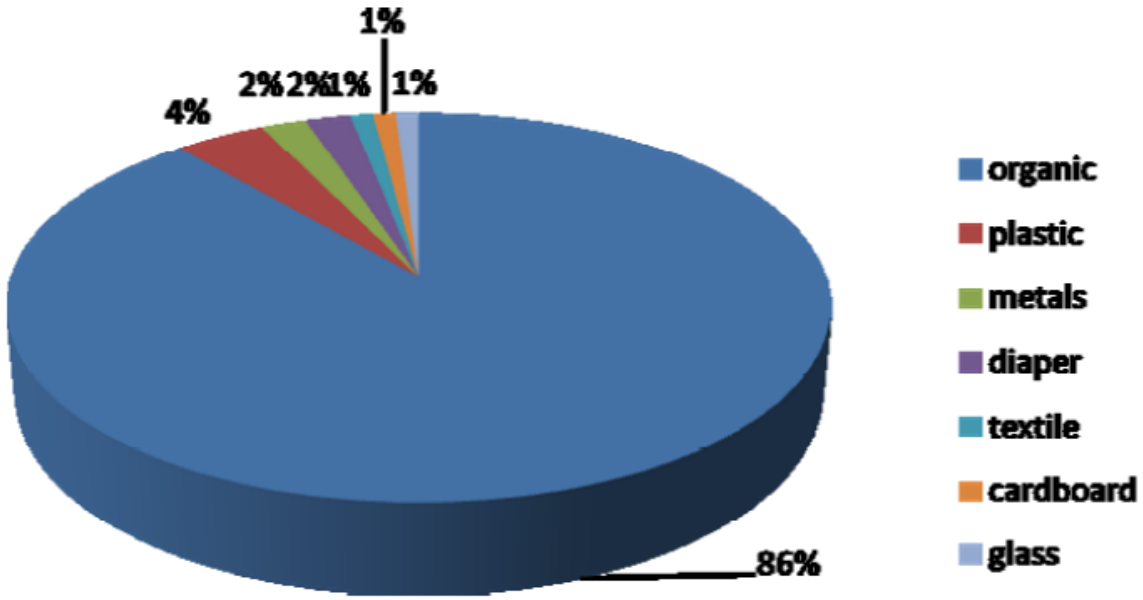
BIO DEGRADABLE CONTAINERS:

Biodegradable containers is a type of container which consists of waste broken down, in a matter of weeks or few months, into a base compounds by micro living thing as organic material

NON BIO DEGRADABLE CONTAINERS:

Non Biodegradable containers is a type of container which waste cannot be broken down into a base compounds by micro organisms, air, moisture or soil in as reasonable amount of time.

PERCENTAGE OF DIFFERENT WASTES:

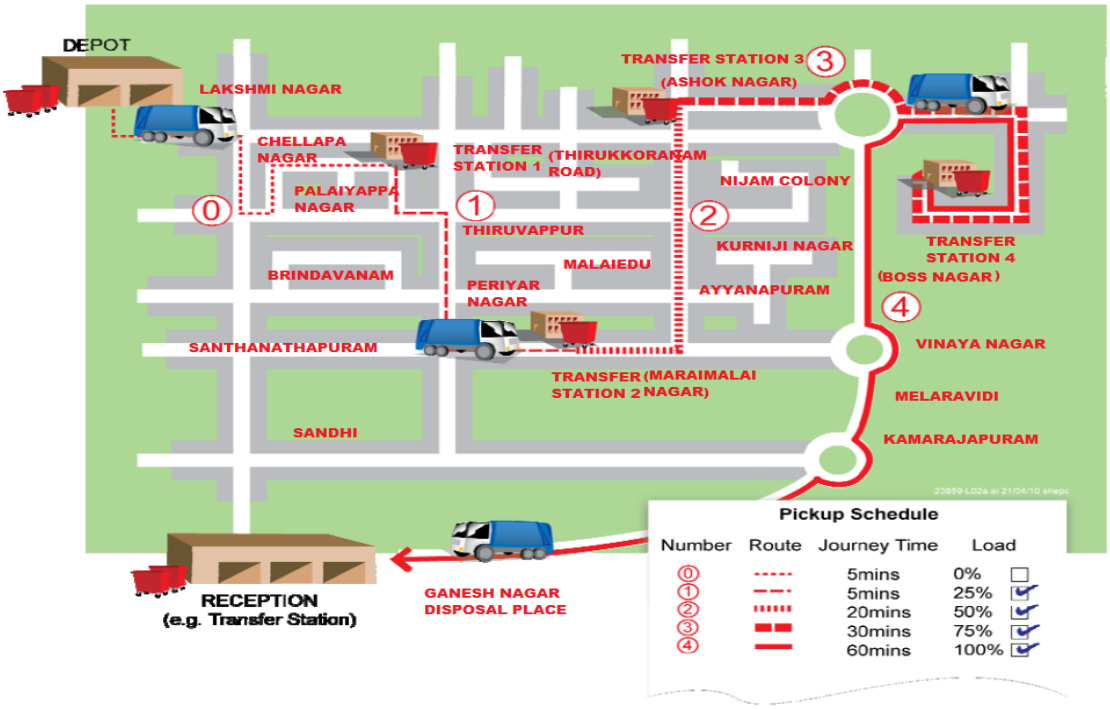


COLLECTION:

- Collecting of waste from door to door every day.
- Collecting the waste into bio degradable and non bio degradable.
- Segregation of waste starts in collection of waste.
- Collection of waste by the collection crew members.
- Per day collection of waste is 32 tons.

COLLECTION ROUTE :

- Collection route which we selected would be more economical and easy to transport.
- Collection route we selected covers all wards in pudukkottai .
- Overall it reduces 60% of the transport cost and 80% it does not covers important places in this 42 wards .
- Collection route should short and minimize the duration.



COLLECTION FREQUENCY:

- Collection of waste day to day by door to door.
- Collection of done in early mornings.
-

COLLECTION CREW:

- Collection crew is designed based on population.
- Our proposal design for collection crew is for 500 population per member

- So maximum population maximum members are used to collect the solid waste
- We designed collection members for each ward

COLLECTION CREW DETAILS :

WARDS		NO OF CREW MEMBERS
Ward 1	=	13
Ward 2	=	10
Ward 3	=	10
Ward 4	=	6
Ward 5	=	5
Ward 6	=	7
Ward 7	=	5
Ward 8	=	4
Ward 9	=	4
Ward 10	=	4
Ward 11	=	5
Ward 12	=	4
Ward 13	=	5
Ward 14	=	4
Ward 15	=	9
Ward 16	=	7
Ward 17	=	9
Ward 18	=	4
Ward 19	=	3
Ward 20	=	5
Ward 21	=	3
Ward 22	=	6
Ward 23	=	7
Ward 24	=	7

WARDS		NO OF CREW MEMBERS
Ward 25	=	5
Ward 26	=	2
Ward 27	=	2
Ward 28	=	5
Ward 29	=	3
Ward 30	=	3
Ward 31	=	3
Ward 32	=	5
Ward 33	=	5
Ward 34	=	4
Ward 35	=	7
Ward 36	=	4
Ward 37	=	7
Ward 38	=	4
Ward 39	=	11
Ward 40	=	10
Ward 41	=	26
Ward 42	=	6

COLLECTION VEHICLES :

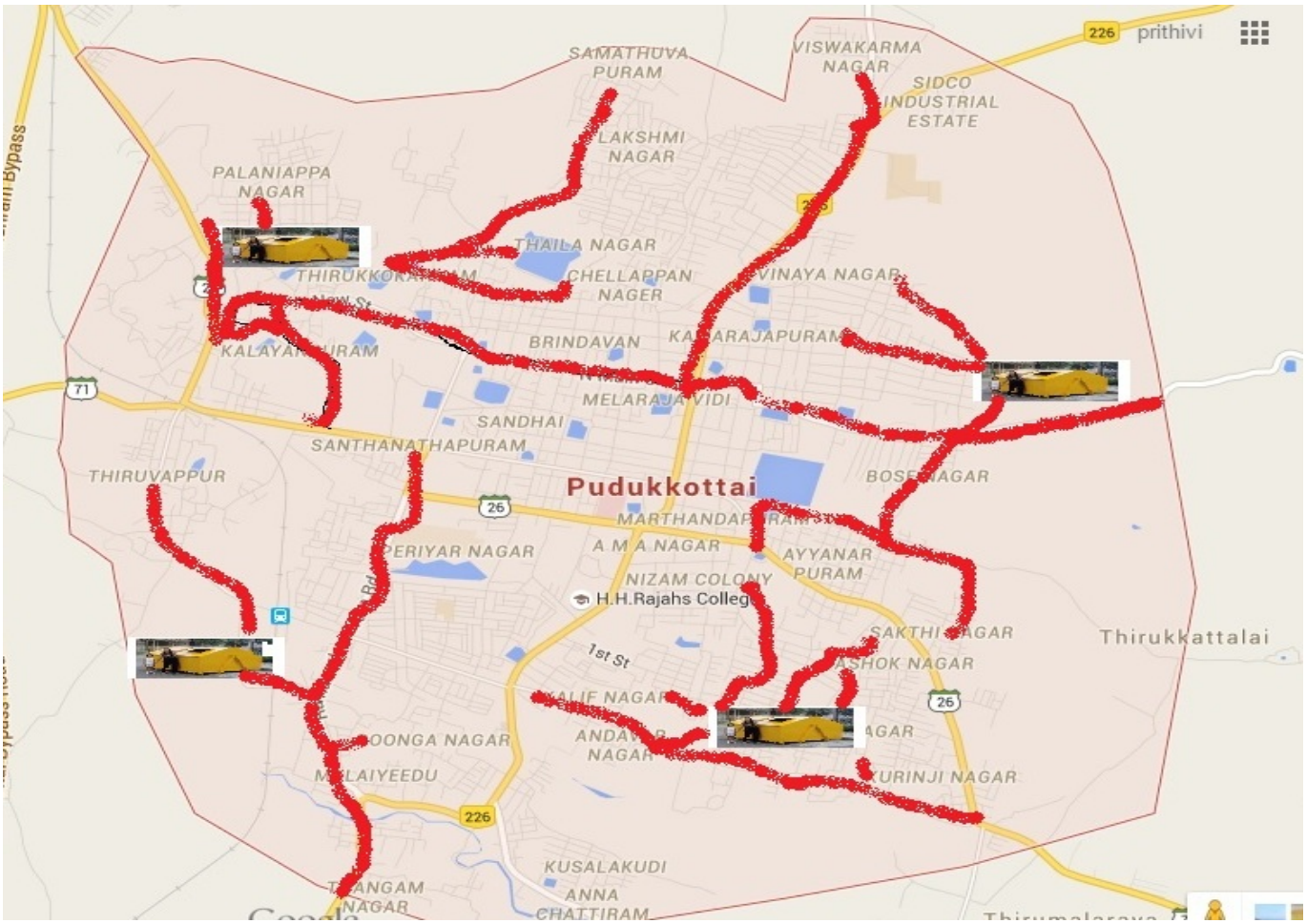
- Collection vehicles are used by collection members.
- Collection vehicles we propose is compactor truck.
- Capacity of compactor tracks is 15 cubic meter .

TRANSPORTATION:

- As we designed in collection route we are transfer the waste in collection vehicle.
- As per collection route we are transferring the solid waste
- In transportation our proposal about transfer station.
- We decide to make four transfer station in pudukkottai municipality.

TRANSFER STATION:

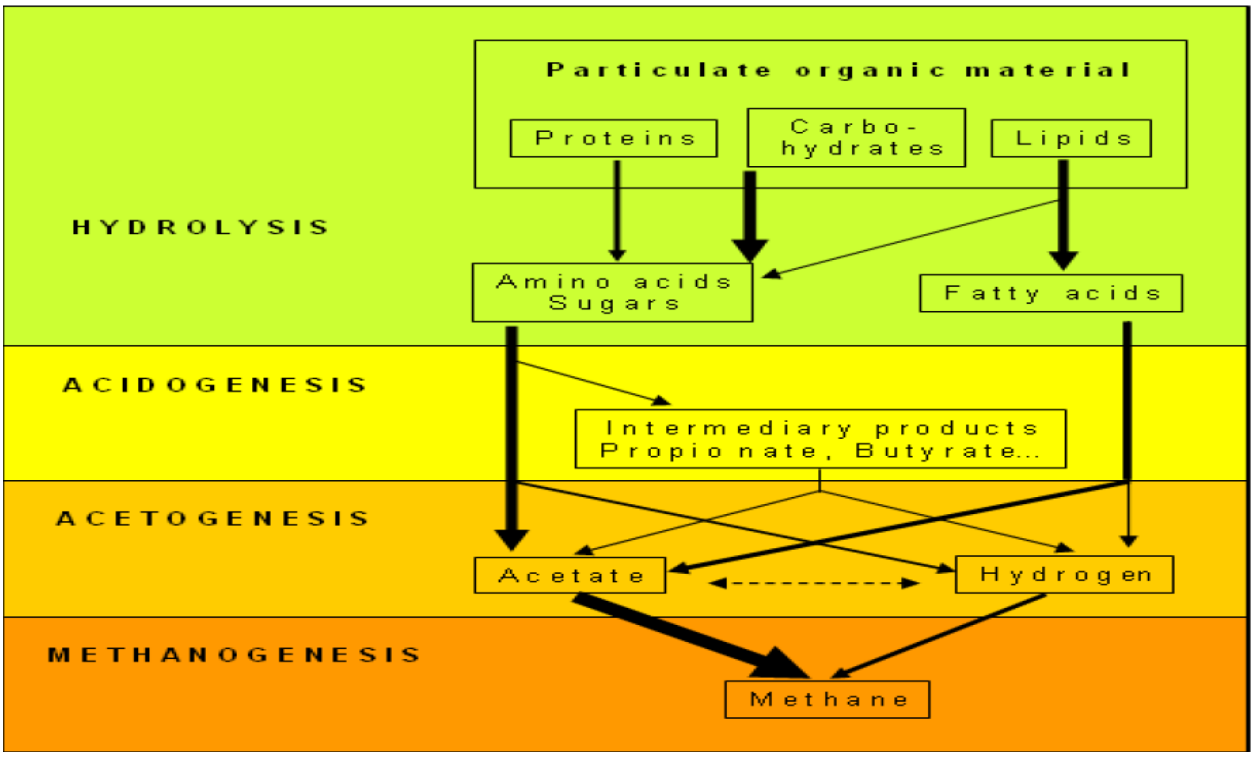
- We selected the four transfer station.
- Overall area is divided into four by its mid point of the city.
- Transfer station selected on the basis of point which do not disturb the peoples.
- All transfer stations are connected to the road lines which we can easily dispose the waste .



RECYCLING AND RECOVERY OF ENERGIES:

- **we have organic waste is maximum as collection details**
- **We can generate the bio gas from the organic waste by anaerobic digestion**
- **Anaerobic digestion consists of three biological process**
  1. **Hydrolysis**
  2. **Acidification**
  3. **Methanogenesis**

PRODUCTION OF BIO GAS DESIGN:



DESIGN OF BIOGAS PLANT:

NUMBER OF POPULATION = 1,43,748

SIZE OF DIGESTER :

$$VD = SD \times RT$$

where

VD = volume of digester in m^3;

SD= substrate input in m^3/day or L/day;

RT= retention time in Days;

DETAILS OF FEEDSTOCK:

- Assume Retention time is 40 days.
- Substrate input (SD) = biomass (B) + water (W) [m^3/d]
- The mixing ratio for food waste and water (B: W) is 1:2
- Average daily feedstock 25600 kilogram complimented with 51200 liters of water per day

CALCULATIONS:

VOLUME OF DIGESTER

$$VD = SD \times RT$$
$$= (25600+51200) \times 40$$
$$= 3072000 \text{ lit/day}$$
$$VD = 3072 \text{ m}^3$$

Assume specific gas production as 0.040 cubic meter per kg

Gas production = Substrate feeding × specific gas production

$$= 25600 \times 0.040$$
$$= 1024 \text{ [m}^3 \text{ biogas/day]}$$

Gas storage volume = 60% of maximum daily gas production

$$= 0.6 \times 1024$$

Total volume = 3072 + 614.4

$$= 3686.4 \text{ m}^3$$

Dead volume = 20% of total volume

$$= 3686.4 \times 0.2$$

= 737.28 m^3

Total plant volume

= Digester volume +Gas storage volume +Dead volume

= 3072 + 614.4 + 737.28

= 4423.68 m^3

= 614.4 m^3

Radius of dome (R) = [Total volume ÷ (2/3 π)] 1/3

= [4423.68 ÷ (2/3 π)] 1/3

= 12.8m

The size adopted as per standard code GGC 2047 & modified GGC 2047

PRODUCTION OF METHANE FOR ONE DAY:

- 2kg of organic waste produces the 500 g of methane gas.

  = 25600 × 250

  = 6400 kg of methane for day.
- So we can induce the bio gas reactor for production

bio gas.

- For week we can produce = 6400× 7 = 44800 kg
- For year we can produce = 6400 × 365 = 2336 tons
- Other than organic waste plastics have maximum percentage
- So plastics can be used for road construction
- Glasses and other material can be used as a useful bi- products

FINAL DISPOSAL:

- Our proposal of final disposal is landfill
- Area we selected is uncultivable area and area is used as grave yard
- People does not use that place ant it almost government property
- Already municipal waste is disposing there, so totally land was contaminated
- So we proposed to dispose the solid waste on near to Ganesh Nagar police station and back side of pudhukulam pond , the place which was outside the municipality area and there was low residential area

COMPARING OF PRESENT BY OUR PROPOSAL:

- Municipality use for disposal 3 acres or 12140.57 square meters
- By producing organic waste into bio gas we can reduce a land area as 1 acres or 4046.856 square meters
- By reducing its size we can protect the soil from the contamination of solid waste and protect the environment from the pollution

LANDFILL DETAILS:

- Quantity of waste filled in land is 20% from the total generation of waste per day

= (20/100) × 32000

= 6400 kg

= 6.4 tons

- Quantity of waste filled in land from the total generation of waste per week

= 6400 × 7

=44800 kg

=44.8 tons

- Quantity of waste filled in land from the total generation of waste per year

= 6400 kg × 365

=2336000 kg

=2336 tons

- Area we going to use is 1 acre
- Depth we going to use is 3m
- Landfill area is identified by GPS

PLACE OF LANDFILL:

II. CONCLUSION

When we follow our design we can reduce the solid waste and recover the energy as bio-gas . Even non-biodegradable plastics waste can used in pavement in stead of bitumen. Glasses and papers can also recycle and used as a bi-products. By doing this process we can make environment as pollutant free .

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