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Solid Waste Management Performance towards the Zero Waste Index in Suburban Area

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Abstract -In today's world, most nations do no longer have powerful waste control practices. The waste engenders in immense abundance with aids of the humans. Zero-waste management exercise probably makes the environment. Zero waste management control theory encompasses the recycling and recovery of waste. The ultimate objective of zero waste management isn't any waste is ahead to landfill. The waste has to be handled and reused in a selected area. This paper aims to deliver zero waste implementation in the Urapakkam town. The main objective of the project is to make the Urapakkam town sustainable surroundings with 100% recycling and restoration of waste. The study analyzed and discern out the technologies feasible and favored pertinent to provincial circumstances. The maximum pertinent technology revolutionizes the vicinity into the zero-waste city. From the overall waste of 8.3MT in 2019 at Urapakkam town the usage of the waste to energy concept, within the thermal conversion of non-biodegradable waste, the energy recovery potential is 110.58 KW and from Biodegradable waste 42.55KW of energy can be recovered. Therefore all fraction of waste is converted into energy.

Key Words:Zero waste management, Energy recovery, Biodegradable waste, Non-biodegradable waste, Sustainable environment, recycling

1. INTRODUCTION

1.1. Background to the study

Over the decade's world's populace more in rural areas. But now the rural populace migrating closer to their habitation in suburban as compared to urban locations because of non-violent due to the fact the locations are outskirts from city. The present moment utilization induced community generates a prodigious quantity of garbage. Already stated the extent of waste brings a massive burden on the municipality authority to regulate waste in a major viable demeanor. Waste control exercises do no longer possess excellent consideration inside the city planning manner compared to other sectors. Accordingly, inconsistency can be ascertained in waste management in modern-day metropolis planning. This affects the usual living of humans as a whole lot of the waste generated. The zero-waste management approach provides explication towards waste management issues. The Zero-waste machine is outlined through an oblique large movement, that the equivalent perceptible is frequently recycled. In a period the zero-waste structure, none of the waste stays pristine. The precise intention of zero waste management approach is the rebate of landfills along with none of the waste incineration left out energy recovery.

The aim of the paper is to deliver about zero waste management practices within the Urapakkam town. The transfiguration of conventional practice into zero waste practice which makes the surroundings in a more sustainable way by the reusing and recycling of waste. It improves the standard of living by bringing income through the recycling of waste by zero waste management approach. ZW holds a particular technique only can't capable to discern waste problems on the reasoning of public aid, maintenance framework, managerial guiding principles, and ecological analysis technology in a viable aspect. Though, it restraint the function of waste energy (WTE), that devour waste to produce electricity and waste removal in a standard zero waste environment within the conventional waste approach and non-residual waste management

1.2. Study Area Profile

The suburban region Urapakkam which comes under the Panchayat union of kattankalathur and placed within the Chengalpattu district the state Tamilnadu also part of Chengalpattu taluka. The census report of 2011 states the total vicinity of urapakkam is 5.5 Km^2. along the National Highway 32 (GST Road) parts of towns are positioned approximately 33 km (21miles). The census report of 2011 states the total vicinity of urapakkam is 5.5 Km^2.Along the National Highway 32 (GST Road) parts of towns are positioned approximately 33 km (21miles). And it also situated on the busy NH45 which connects to the southwest of the kingdom capital Chennai. Urapakkam has placed among the Entrance Gate of South Chennai city Limit and Kanchipuram region Guduvancheri Chengalpattu taluk. The major southbound bus terminal is proposed in Urapakkam (VGP ground) which connects the flyover to urapakkam railway station which serves for the most important provider between the urapakkam railway and the bus terminus. The neighboring airport is meenambakkam and the adjacent

seaport is the Chennai port. The coordinates of urapakkam are located at 12°52'4" N 80° 4'20''E.

According to the 2011 census, overall 12,456 households are inhabiting the city. The total populace of urapakkam city is 29,122 as consistent with the 2011 census, from the total populace 14,647 are males and females are 14,475 and the average intercourse ratio is 988.children population of age 0-6 years is 3284(11%) of the total populace. The literacy rate of the population is 91.5%.compared to Kanchipuram district of 84.5% urapakkam is high. And in 2019, the overall population is recorded as 41,665 and the projected population through arithmetic method also stated the same.

2. Solid Waste Quantification and Characterization

In the urapakkam Panchayat, the average daily generation of waste is estimated at around 8.3 MT. At the capita of waste generation per day is 200 gm/capita/day. The details of the summary of municipal solid waste generation are provided within the table.

Table -1: Municipal solid waste generation

S.no	Source of waste generation	Total qty (MT/Day)
1.	Residential waste	6.9
2.	Hotels	0.1296
3.	Markets	0.0202
4.	Shopping Centre	0.0125
5.	Fruits & vegetable shops	0.0675
6.	Commercial shops	0.040
7.	Marriage hall/party hall	0.100
8.	Schools	0.009
9.	Industries/factories	0.00112
10.	Hospitals/clinics	0.0019
11.	Street Sweeping	0.140
12.	Drain & slit	0.180
	Total	7.60 MT/Day
Source: Urapakkam Panchayat Records		

10% for unaccounted waste = 7600+760

= 8360 Kg/day

= 8.3 MT/Day

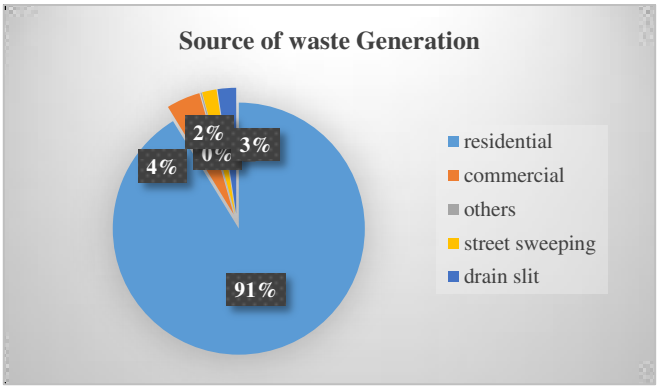

Fig. 1 Source of Waste Generation

2.1. Solid Waste Characterization

For the solid waste quantification and characterization, the samples were accumulated from the residents and few commercial establishments of Urapakkam. Being ease for the sample collection the complete Urapakkam area cannot be cover. So the major places in Urapakkam taken consideration for the sample collection.

Based on the sources and types of waste the physical composition and chemical characterization of waste are done.

2.1.1 Physical Characterization

The physical characterization of waste data and information is necessary so as to select the equipment and facilities for the design of the disposal mechanism.

Table.2 Characterization of Municipal Solid Waste

S.No	Type Of Waste	Quantity Of Waste (MT)			
		2011	2019	2011	2019
1.	Biodegradable waste	65%	64%	2.8	3.7
2.	Recyclables	22%	24%	0.58	1.9
3.	Non-Biodegradable	13%	12%	1.2	2.7
	Total	100%	100%	5.8	8.3
Source:Urapkakam Panchayat Record and sample collection estimation					

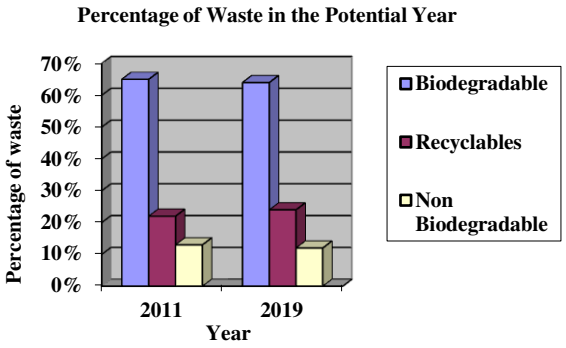

Fig. 2. Percentage of waste generated in the potential Year

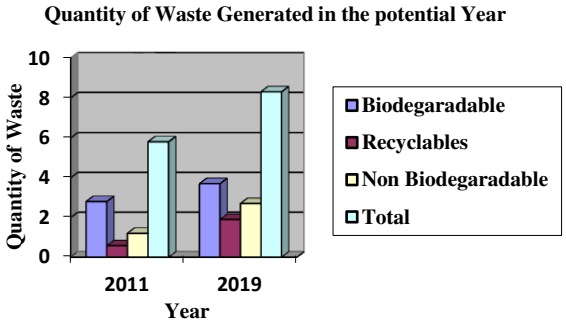

Fig.3 Quantity of Waste Generated in the Potential Year

2.1.2 Chemical Characteristics

Chemical characteristics considered for municipal waste are mainly, moisture content, nitrogen, phosphorus, potassium, C/N ratio, etc. The sample of 500 g of municipal solid waste is taken from the urapakkam Panchayat. The sample was analyzed based on the experimental procedure stated in CPHEEO for chemical characterization. The table shows the results of chemical characterization

A. pH

The pH content of solid waste is determined by way of employing digital pH meter alongside the glass electrode. According to IS 10158-1982 stated with the aid of CPHEEO. The procedure was carried to be able to find the pH content of municipal solid waste. The sample of 10g is taken in a flask, and 500ml of distilled water is added to the sample about 3 to 5min water is stirred well. The mixture is allowed to settle for 5mins and using pH meter along the glass electrode pH is measured. Then measured and corrected for temperature. The pH of the solid waste sample found to be 8.6

B. Volatile and Non-Volatile Substances

Volatile substances are stated as a fraction in the waste sample that breakdown at the sample is heated as much as 600°C According to IS10158-1982 stated through CPHEEO. The procedure was followed in order to find the volatile substances of solid waste samples. The finely ground sample of 5g is taken in a porcelain dish and heated in a muffle furnace to the temperature of 600°C for 2hrs. Finally, the dish is allowed to cool for some time in a desiccator and again weighed. To calculate the volatile substances of a solid waste percentage of the original mass as followed. The volatile and non-volatile substances of the solid waste found to be 50.76 and 49.24 %

Volatile substance,

Percent by mass (VS) = initial mass-Final mass/initial mass x 100

Nonvolatile substance,

Percent by mass = 100- VS

C. Moisture Content

Municipal solid waste of Moisture content is demonstrated as a weight of moisture per unit weight of wet material. The moisture content ranged from 20%-45% which represents the characteristics of waste in an arid and wet climate. If there is an increase in moisture the cost of collection and transportation get increases. The formula used for calculating the moisture content is

Moisture content (%) =wet weight –dry weight/wet weight x 100

According to the IS: 9235-1979 the test procedure was carried out and the moisture content of the sample found to be 41.34%

D. Calorific Value

The calorific value of waste is described as the amount of heat generated from the combustion of the unit weight of waste and it is expressed as the KJ/kg. The calorific value of waste is determined using a bomb calorimeter form the combustion of the dry samples when the heat is generated at a constant temperature of 25.c According to IS 1350 (part 2) 1970 the test procedure is carried out. From the experimental analysis, the calorific value of municipal solid waste is found to be 3410 kJ/Kg.

E. Potassium

By the treatment with sulphuric acid, the sample of waste contains the organic matter and it is decomposed. Ashing is done to convert to their respective sulphates and residues are treated further with the acid mixture containing HF to make it as silica free. Then the sample is subjected to photometric flame analysis. According to IS IS10158-1982 stated by CPHEEO. The procedure is followed and the potassium content in the sample was determined. In order to determine the potassium reagents like acid mixture, nitric acid (5%) and hydrofluoric acid (40%) were used.

F. Phosphorous

There are 2 methods for determining the phosphates content in the solid waste sample. According to IS10158-1982 stated by CPHEEO, the test procedure is followed in order to determine the Phosphorous content. The test procedures

implicate the production of phosphomolybic acid as the salt of the quinoline. The titration of quinolinephosphomolybdate is done with the sodium hydroxide. From the experimental investigation, the phosphorous content of the solid waste is found to be 0.04 and it is expressed in percentage.

Phosphorous as p, percent by mass = 0.059 [V1- V2-(V3-V4/5)]/M

G. Carbon

The carbon is determined by the empirical method on the basis of the principle of the ratio of carbon to volatile substances content remains constant, to some extent for a specific type of waste. According to the IS: 10158-1982 as stated by the CPHEEO in order to determine the carbon content the procedure was followed. In order to determine the volatile substance and carbon content is calculated using the following formula.

Carbon, Δ x VS

H. Nitrogen

The total nitrogen is determined by the way of the approach of Kjeldahl in the form of total nitrogen of urban waste. According to the IS: 10158-1982 as stated by the CPHEEO so one can determine the nitrogen content. The test procedure includes the reagent like sucrose, chromium metal, concentrated hydrochloric acid, potassium sulphate, mercuric acid, sulphuric acid, zinc metal, boric acid, and alkaline thiosulphate. To calculate the nitrogen content as a percentage of the original mass the following formula was used. From the experimental investigation, the result found to be 0.20%

Nitrogen percent, = (A-B) X N X 14 X 100 X 2 /E

S. No	Parameters	Units	Results
1	Moisture	%	41.34
2	pH	-	8.6
3	Calorific Value	Kcal/kg	3410
4	Volatile Solids	%	50.76
5	Non-Volatile solids	%	49.24
6	Ash Content	%	6.58
7	Total Organic Carbon	%	29.4
8	Nitrogen as N	%	0.20
9	Phosphorus as P	%	0.04
10	C/N ratio		147:1
Source: Experimental Investigation			

Table. 3 Chemical characterization of Municipal Solid waste

3. Energy Recovery of Municipal Solid Waste Generation

3.1 Biodegradable Waste

The biodegradable waste is waste which can be recycled and reuse again. These wastes are decomposed by different organisms like bacteria and fungi. Biodegradable waste is also known as organic waste which includes meal waste, leaves, useless flowers, eggshells. This waste converted into dung by using burning them in compost pits is called composting. In the urapakkam town, 2019 the amount of biodegradable waste which constitutes 3.7 MT (64%) and in 2011 census records it states 2.8 MT (65 %). These biodegradable waste can be converted into useful products like compost which can be used for the agricultural field and from the kitchen waste biogas can be generated using anaerobic digestion method.

Table. 4 Recovery of Biodegradable Waste

Amnt of waste generated	% of waste generated	Methods	Amount of Energy recovery potential generated	Amntof Net Power generation potential
3.7 MT	64%	Anaerobic Digestion (Bio gas)	3407.7 KWh	42.55 Kw
		composting	2.5 MT	

3.2. Non-Biodegradable Waste

The non-biodegradable waste is waste that can't be degraded by the natural process into an effective form. The non-biodegradable waste includes plastic, paper, glass, metals, rubber. If this waste is burned can causes more pollution to the environment. This waste can be recycled in the shape of beneficial products. The non-biodegradable waste is converted into energy (electricity) through the thermal conversion of gasification or pyrolysis technique. In the Urapakkam Panchayat, the non-biodegradable waste constitutes of 2.7 MT of waste.

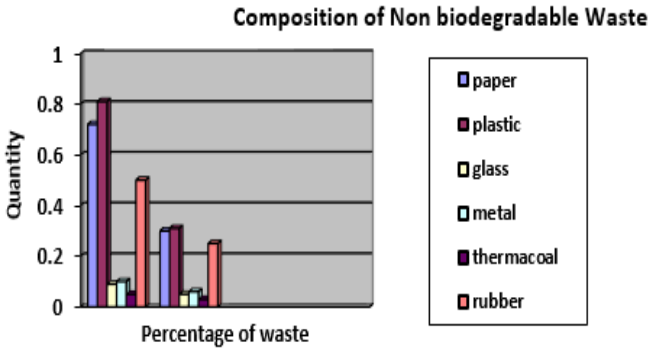

Fig. 4 Composition Fraction of Non-Biodegradable Waste

Table.5 Composition of Mixed Non-Biodegradable Fraction

S.No	Fractions	Quantity	Percentage
1.	Paper	0.72	30%
2.	Recyclable plastic	0.81	31%
3.	Glass	0.09	5%
4.	Metal	0.10	6%
5.	Thermocoal	0.05	3%
6.	Rubber	0.50	25%
	Total	**2.27**	**100**
Source:Urapakkam Panchayat Record			

Table.6 Recovery of Non-biodegradable waste

Amnt of waste generated	% of waste generated	Process of waste converted	Amnt of Energy recovery Potential	Amntof net power generation potential
2.7 MT	12%	Gasification / pyrolysis	10680.12 Kwh	110.58 KW

3.3. Recyclable Material

From the non-biodegradable waste, some quantity of waste may be recycled. The non-biodegradable waste constitutes 2.7 MT from the overall waste 12% of waste is a non-biodegradable waste. From that waste can be separated and recycled into useful products. Among 1.9MT is recyclable waste from that 1.2 MT of waste is recycled.

Table. 7 Summary of Recyclable material from non-biodegradable waste

S.no	Waste fraction	NB waste	Recycling Rate	Qty of waste Recovered (MT)
1.	Paper	0.72	60%	0.432
2.	Recyclable plastic	0.81	60%	0.48
3.	Glass	0.09	70%	0.063
4.	Metal	0.10	70%	0.07
5.	Thermocoal	0.05	60%	0.03
6.	Rubber	0.50	30%	0.15
	Total			**1.22**

4. Result & Discussion

The sustainable zero waste concept relies upon on the 100% recovery of waste generating from the community. The experimental investigation and theoretical calculation of energy recovery state that waste is converted into energy and compost by suitable techniques.

Table. 8 Summary of total resource recovery from Non-biodegradable and biodegradable fractions

S.no	Fractions of waste	Amnt of waste generated (MT)	Amnt of Potential Energy Recovered
1.	Biodegradable waste	3.7	42.55 KW
2.	Non-biodegradable waste	2.7	110.58 KW
3.	Recyclable waste	1.9	-
	Total waste Generated and Treated	8.3	-
	Total energy recovered		**153.13 KW**

The end result of biodegradable waste is converted into biogas and compost. The net energy recovery potential from biodegradable waste is 42.55KW and the non-biodegradable waste is converted into thermal energy by the process of gasification and pyrolysis. The amount of electricity generated from non-biodegradable waste is 110.58 KW. The non-

biodegradable cannot be decomposed. The handiest option is to the recycling of waste. From 1.9MT of recyclable material, the 1.2 MT of waste is recycled. Therefore overall generated waste is converted into energy not one of the waste is continue to be left. The net-zero waste is done by means of using a suitable technique

5. CONCLUSION

To make a sustainable environment the zero waste strategy is the quality concept. In reality, transforming the metropolis into the zero-waste city is difficult to implement. Because more communication participation, municipal authority support, and financial resources are necessary to execute. The end-user wishes to endure abide respective of the fact of a certain waste is an adored resource as occurrence the value of food waste, plastic, paper, metal will generate profit when it is recycled.so that the waste is not sent to the landfill. This take a look at indent to apprehend the intricacy of urban waste management. Still more considerable research is needed in order to find the evasion of recycling in the community. The result has shown that waste generated in the community is recycled with 100% and from that the waste electricity can be generated and profit can be achieved through the recycling techniques. Also, people of the town will be beneficial in employment opportunities and monetary activities from the recovery of all resources of Waste.

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