

A COMPREHENSIVE STUDY ON GENERATION AND DISPOSAL OF SOLIDWASTE AND ITS SMART MANAGEMENT IN WARJE (PUNE)

***Pratik Murke, **Prof. Abhijeet Datye, *Tejas Patil, *Aditya Talekar**

**Students, **Professor Department of Civil Engineering,*

RMD Sinhgad School of Engineering, Pune Bangalore Highway, Taluka Haveli, Warje, Pune, Maharashtra, India

ABSTRACT

This Paper provides survey of generation and collection of waste from the Warje area and the effective technique must be implemented. Maximum or expanded epidemic spreading of diseases due to inappropriate waste handling in urban areas which are having an exponential population growth. In current situations the Waste Collection vehicles collect wastes few times in a week. In this way the problem is oversteaming of wastage on the streets and areas. Thus to avoid this restriction, some schemes are done for smart solid waste management using some technologies called Radio-Frequency identification devices i.e. RFID, Machine to Machine i.e. M2M, Internet Of Things are some methods on the basis of data collected from the Warje area. In that after the survey done and the analysis by mathematical means it is come to know that advanced techniques of SWM is better rather than or conventional techniques.

Keywords: - Analysis of waste management, Current methods, Radio Frequency Identification Device (RFID), Solid waste management, Study area of Warje.

INTRODUCTION:

“Solid waste management is defined as the amount of waste generated from household, public community, etc i.e. organic or inorganic gets collected to the treatment plant and finally disposed the unsustainable matter.”

Solid Waste is mixed mass of wastes, which may generate from household, commercial, industrial or agricultural activities. Solid waste is a broad term, which includes all kinds of waste such as Municipal Solid Waste, Industrial Waste, Hazardous Waste, Bio-Medical Waste and Electronic Waste depending on their source & composition. Source reduction, recycling and composting, waste-to energy conversion facilities, and land filling are the four basic things of Waste Management. The main challenge of Warje area is enlarging quantities of waste and disposal. The rapid growth in urbanization extends rapid growth in waste.

Waste minimization is a methodology used to achieve waste reduction, primarily through reduction at source, and also including recycling and re-use of materials. The benefits of waste minimization are both environmental and financial and wide in their coverage. In order to implement proper waste management, various aspects have to be considered such as: Source reduction, Onsite storage, Collection & transfer, Processing, and Disposal.

Waste management is the process of all activities and actions which is required from generation or inception to final disposal. Waste management is anticipated to reduce adverse effects of waste on

health, environment or aesthetics. Waste management practices are not consistent among countries (developed and developing nations); regions (urban and rural area), and sectors (residential and industrial). Waste management has hierarchy of 3Rs i.e. Reduce, Reuse, Recycle and sometimes Rethink. The generated waste is reused to avoid its piling and finally recycled into usable by products.

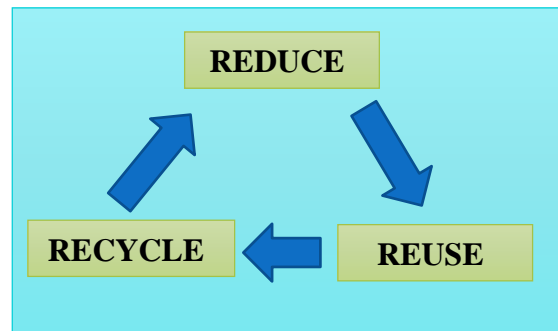


Fig.1 Solid Waste Management Process

PROBLEM STATEMENT

Since the garbage collection system is not well managed, people dispose the garbage wherever possible mostly in the drainages or the river banks. So there must be a smart technique or method which not yet present in this area.

This leads to huge environmental pollution affecting the health of mankind and the other living being. So it is very necessary to implement effective and smart solid waste management system for Warje area in Pune.

OBJECTIVES

The primary objective of this study is to investigate the solid waste management process of Warje area. We concerned on the present situations: sources of solid waste generation, process used to manage solid waste, effectiveness of the processes, effects and impacts on public. Then we suggested modifications which can be done and then we have made some recommendations using the knowledge gained in the college and from Internet.

STUDY AREA

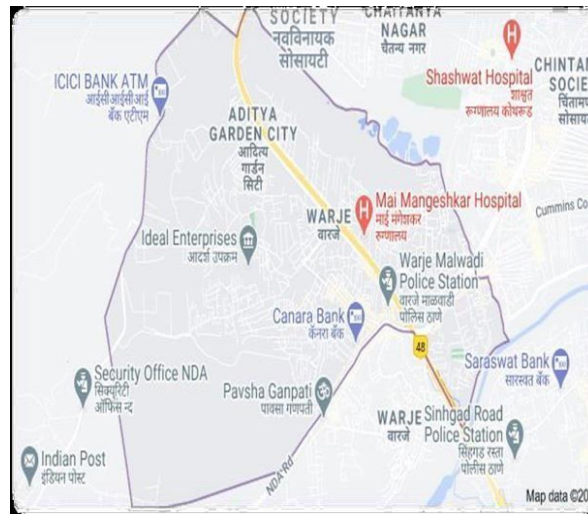


Fig.2 Warje Map(18°29'58"N 73°47'48"E)

Warje is the place situated in Pune with government body of Pune Municipal Corporation of Maharashtra state. Warje is on the bank of the Mutha river, making the village a catchment area for the western hills due to good soil and sufficient water for farming. The population of this area is 75128 according to year 2020. The male and female populations are 38971 and 36157 respectively. The mass or size of this area is 7.86 sq.km. Majority of this area is residential and commercial. Improper handling of waste and spreading of diseases and unhygienic conditions besides spoiling the aesthetics is the main problem.

CURRENT METHODS OF WASTE HANDLING

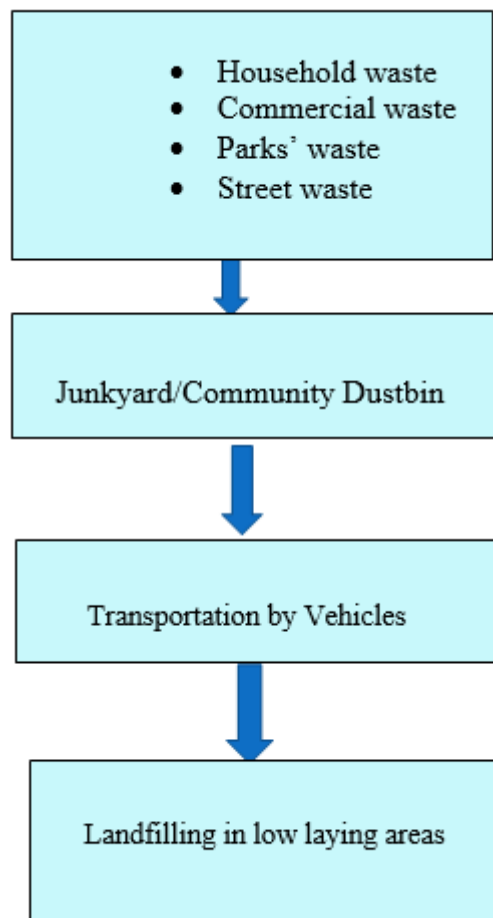


Fig. 3 Workers picking up plastic bags

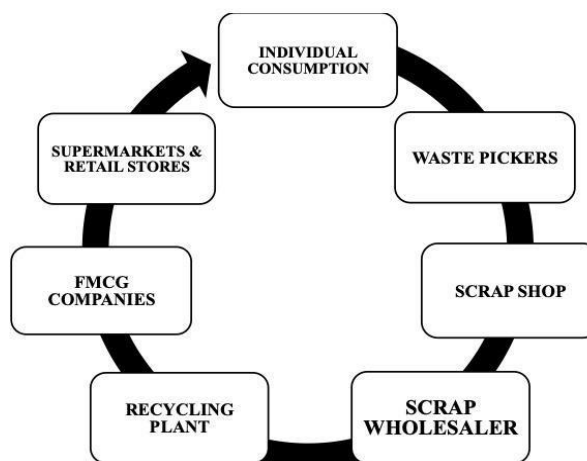


Fig 4. Waste Recycling Process



Fig. 5 Waste collection from streets

OBSERVATIONS

Some present problems are to be observed by which this issue is occurring in that

1. Increasing of the amount of waste brought daily to dumpyard.
2. Unorganized work premises.
3. Workers are not encouraged Properly.
4. Lack of advance or smart technology.
5. Public Attitudes.

SOLUTIONS

There are some easy solutions by which it can be problem can be reduced in some amount that are

1. Provide enough space and facilities.
2. Encouragement of the workers.
3. Implement the smart and effective technology.
4. Encouragement of the public to reuse polythene or use degradable materials instead of polythene.



Fig.6 Image showing waste is thrown in the river.



Fig.7 Image showing public throwing waste on street.

Above showing images clearly mentions that the public is not aware about the waste management in the areas where they live. So there is serious need of some effective and economical technologies.

COMPOSITION AND CHARACTERISTICS MUNICIPAL SOLID WASTE

There are some major categories of waste which is found in this area:

1. Biodegradable Waste: Food and kitchen waste, greenwaste (vegetables, flowers, leaves, fruits) and paper.
2. Recyclable Material: Paper, glass, bottles, Cans, metals, certain plastics, etc.
3. Inert Waste Matter: Construction and Demolition waste, Debris, Dirt.
4. Domestic Hazardous Waste (also called “household hazardous waste”) and toxic waste: Electrical waste items such as light bulbs, tubes, etc. and pesticides containers, batteries, shoe polish.

DATA COLLECTION AND ANALYSIS

1. Collection

In which the certain following wastes are collected from House to House, street bins, commercial and industrial area etc.

2. Segregation

The waste which collected from is brought to the Kothrud solid waste collection depot and where the waste is separated as wet waste and dry waste from the vehicle itself.

- Average mix waste = **85114.2 kg**
- Average wet waste = **28087.7 kg**

From that 7 tonnes is sent to Biogas plant Bavadhan and remaining waste is brought to Kothrud depot for composting. Therefore the average dry waste = **57026.57 kg**

3. Transportation

The waste which is collected in the bulk refuse carrier is then covered and carried to the disposal site for proper disposal.

4. Landfill

Earthen waste and garden waste is sent to landfilling at Fursungi and Hadapsar industrial estate.

DATA COLLECTION OF VEHICLES AND CONTAINERS

1.	Ghantatrucks	14
2.	Containers	115
3.	Compactbuckets	46
4.	Hotel gadi	04
5.	B.R.C.	05

DATA ANALYSIS OF SOLID WASTE

One day Sample data dry segregated waste: composition of waste for 100 kg

SR.NO.	PARAMETERS	WT (KG)
1.	PLASTIC	15.6
2.	PAPER	10.7
3.	TEXTILE	19.5
4.	LEATHER	9.7
5.	GARDEN WASTE	26.8
6.	GLASS	8.7
7.	METAL	1.95
8.	EARTHEN MATERIAL	6.8
	TOTAL	99.75

RESULTS:

1. Average mix waste = **85114.2 kg**
2. Average wet waste = **28087.7 kg**
3. Average dry waste = **57026.57 kg**

DRY WASTE COMPOSITION:

SR NO.	PARAMETERS	AVERAGE %WASTE	TOTAL WT.(KG)
1	PLASTIC	19.75	11262.74
2	PAPER	9.83	5605.71
3	TEXTILE	8.72	4972.71
4	LEATHER	7.95	4533.61
5	GARDEN WASTE	23.5	13429.75
6	GLASS	12.01	6848.89
7	METAL	8.84	5041.14
8	EARTHEN MATERIAL	9.36	5337.68

Each segregated parameter is disposed using suggested methods of disposal as given below:

Plastic

Plastic from segregated unit can be sold at 14 Rs/kg for recycling unit.

Total plastic collected = 11262.74 kg. Rate per kg = Rs 14.

Total cost after selling plastic = $14 \times 11262.74 = 157678.36$ Rs.

Segregated plastic is directly sent for recycling to the corresponding industry that uses plastic as a raw material.

On other hand the raw plastic material is melted and coarse aggregate is mixed in the raw plastic mixture and the mixture of both is given the desired shape and used as the paving block.

If excess plastic is retained at depot then it is sent to disposal site for landfilling.

Paper

Paper can be sold at 17 Rs/kg (varying according to region) For recycling unit.

Total weight of paper = 5605.71 kg. Rate per kg = 17 Rs

Total cost after selling paper = $17 \times 5605.71 = 95297.07$ Rs.

Paper can be sent to paper industry to use as raw material to produce fresh paper from it.

Textile

Almost 100% of household textile and clothing can be recycled, regardless of quality of condition recycling clothing and textile benefits charities reduces solid waste and provide Texans.

Specific benefits include-

- a. reduces solid waste in landfill.
- b. converts waste product into value added products.

Leather

Leather can be recycled by selling it to leather recycling industry.

Rate per kg = 4 Rs

Total weight = 4533.61 kg

Total cost gained after selling = $4 \times 4533.61 = 18134.44$ Rs

After recycling leather waste, leather boards are manufactured.

The size of leather board is 3*4 feet (approximate weight = 3.5 kg)

It can also be reused but the size of leather waste should be more it should not be in small pieces.

Garden waste

Total garden waste generated is 13429.75kg which can be used for compost or can be directly used for dumping.

Garden waste is sent to backside of Vanaidevi Devitekdi for dumping.

Glass

Total quantity of glass = 6848.89kg

Recycling involves sorting glass by its colour. It is used for decorative purpose also.

Manufacturing of new glass containers.

Crushed glass sent to landfilling, reduces volume. Coloured pieces of glass can be used on wall compound

Metal

Total metal generated = 5041.14kg Rate per kg = 21 Rs

Total cost after selling metal waste = $5041.14 \times 21 = 105863.94$ Rs.

Earthen waste

Total earthen waste = 8337.67kg

Earthen waste is sent to backside of Vanaidevi Devitekdi for dumping.

RESULTS

Total waste- 85114.2 kg Wet waste- 28087.7 kg

7 tonnes- Bavdhan Biogas

20 tonnes- compost plant Kothrud (capacity 25tonnes)

Dry waste- 57026.57 kg

Sent for landfilling (earthen material, garden waste, some quantity of glass waste)

= 20767.43 kg

Effective dry waste recycled = **36259.14 kg**. Approximate **63.58 %** dry waste can be reused of total landfill daily.

SMART METHODS OF WASTE MANAGEMENT

There are some internet based methods or technologies which are effective which are on the basis of smart sensors and communication technologies like connecting machines, softwares, devices among them without human intervention.

Some are as follows:

A. Ultrasonic Sensors:

Each waste bin is attached with a ultrasonic sensor which detects the waste level of the bin. The ultrasonic sensor measures the level of the waste by sending a sound wave at a specific frequency and listens the reflected sound wave that is bounced back.

B. Moisture Sensor:

The basic segregation of waste into dry waste and wet waste can be achieved by integrating moisture sensor. The moisture sensor detects the moisture content of the waste that is disposed into the bin and segregates and the waste is stored separately depending on the moisture content of waste. By segregating the waste using moisture sensor the further processing of waste can be more efficiently.

C. Integration of GPS, GPRS :

The coordinated arrangement of GPRS and GPS makes the waste bin identification and customer information accumulation framework efficient. The GPS and GPRS framework is generally implemented in the computerized/ electronic guide, the vehicle monitoring and administration system, the security navigation. Integrating of GIS and GPS innovation can show and track vehicle position in subject advanced maps.

D. RFID (Radio Frequency Identify Devices):

The RFID playing the main role in latest technologies in solid waste management. In this system has using in different areas in waste management like smart bins. If the RFID tag was attached on the bottles then the smart bins are automatically open. At the same time when bottle is RFID tagged it will be identified in mixing of solid waste explains about the when the plastic water bottle has RFID tag while in the same time bins having the sensor when the user puts the bottle near to the bins when the plastic bin will be opened. In that same time when the glass particles and paper particles are nearer to the bins when the bins are opened by using RFID tags and sensors.

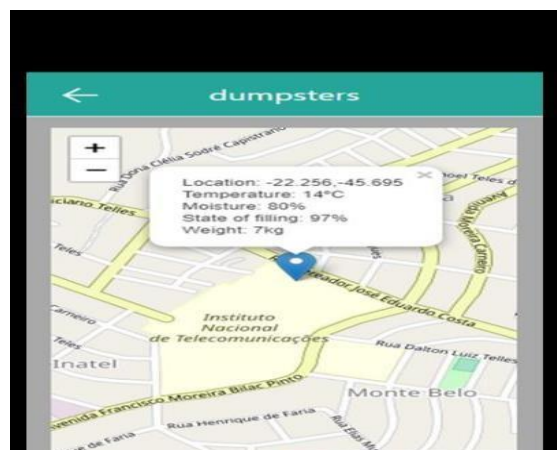


Fig.8 Image from the In. IoT middleware platform showing the location of smart bins.

From the above smart methods **RFID method** with the help of GPS this technique is very cost effective. As the working of RFID is given in fig

Advantages of RFID

- RFID readers can read multiple RFID tags simultaneously, offering increases in efficiency.
- It reduces human effort.
- It is cost effective.
- All RFID tags which are in range can be tracked very instantly

Disadvantages:

- RFID tags are usually larger than barcode labels.
- RFID technology is harder to understand.
- Many Tags can respond at a time.

Cost of RFID system:

- The cost of RFID tag is 80-100 Rs. Perbin/per house.
- The Reader of RFID which is installed on trucks are upto Rs.100000

As it is cost effective system it should be applicable in Warje area so that monitoring onwaste will be easy.

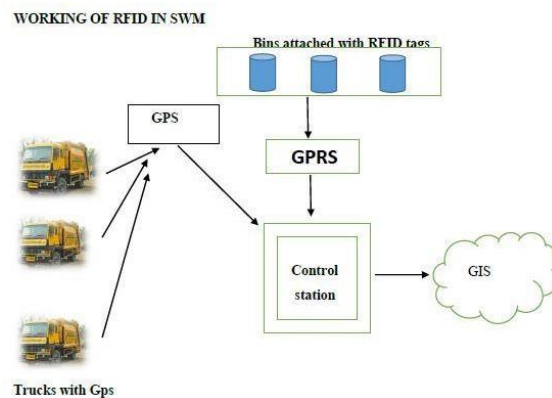


Fig.6 Working of RFID in WasteManagement

CONCLUSION:

Taking into account the creation of a real prototype of the smart container and the implementation of a new waste management mobile application and corresponding Web version, and based on the case study experiments, it was concluded that the proposed system can efficiently improve the way people deal with their garbage and optimize economic and material resources.

The revenue generated from the recycling of waste should be used in the installation & maintenance of the RFID Smart system.

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