Solid waste collection and segregation: A case study of JIET (Co-ed) Campus

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***Abstract*— The rapid increase in population and the adopted modern life style is the reason of increase in generation of solid waste, which results into the contamination of air, water and land resources. Improper solid waste management (SWM) cause hazards to inhabitants. It is a big challenge all over the world for human beings. The present study was taken to find out the problems and prospects of solid waste in JIET Campus, Jodhpur, Rajasthan, India. A detailed investigation was made regarding the methods of practices associated with sources, quantity generated, collection, transportation, storage, treatment and disposal of solid waste in JIET Campus. The data concerning to SWM in JIET Campus was obtained through questionnaire, individual field visit, and interacting with people. Photographic evidences were also made about generation, storage, collection, transportation, treatment and disposal of Solid Waste. This study reveals that if few steps are taken the SWM of JIET can become more efficient.**

***Keywords*— Solid Waste Management (SWM); JIET Jodhpur; Segregation; Collection**

I. Introduction

Solid waste management is an integral part of urban and environmental management. The composition of urban MSW in India is 51% organics, 17.5% recyclables (paper, plastic, metal, and glass) and 31 % of inert. The moisture content of urban MSW is 47% and the average calorific value is 7.3 MJ/kg (1745 kcal/kg). The composition of MSW in the North, East, South and Western regions of the country varied between 50-57% of organics, 16-19% of recyclables, 28-31% of inerts and 45-51% of moisture (Table 6). The calorific value of the waste varied between 6.8-9.8 MJ/kg (1,620-2,340 kcal/kg) [1].

Economic and demographic growth of cities, changing lifestyles of people, changing land use patterns and technological advancements led to increase in quantity and complexity of urban Municipal Solid Waste (MSW) generation and management. MSW generally includes degradable (paper, textiles, food waste, straw and yard waste), partially degradable (wood, disposable napkins and sludge) and non-degradable materials (leather, plastics, rubbers, metals, glass, ash from fuel burning like coal, briquettes or woods, dust and electronic waste) [2].

Waste segregation at the source is minimal. Waste minimization is a methodology used to achieve waste reduction, primarily through reduction at source, but also including recycling and re-use of materials [3]. The benefits of waste minimization are both environmental and financial and wide in their coverage [4]. To implement proper waste management, various aspects have to be considered such as: Source reduction, Onsite storage, Collection & transfer, Processing, and Disposal [5]. Solid Waste includes food waste, rubbish, commercial waste, institutional waste, street sweeping waste, industrial waste, construction and demolition waste, and sanitation waste. Solid Waste contains recyclables (paper, plastic, glass, metals, etc.), toxic substances (paints, pesticides, used batteries, medicines), compostable organic matter (fruit and vegetable peels, food waste) and soiled waste (blood stained cotton, sanitary napkins, disposable syringes) [6]. The quantity of Solid Waste generated depends on a number of factors such as food habits, standard of living, degree of commercial activities and seasons. Data on quantity variation and generation are useful in planning for collection and disposal systems. The average per capita generation of MSW in small, medium, and large cities in India is approximately 0.1 kg, 0.3-0.4 kg, and 0.5 kg/day respectively [7]. The estimated annual increase in per capita waste quantity is about 1.33% [8, 9]. More than 90% ofthe MSW collected is directly disposed on land without proper treatment [10].

Table I. Municipal Solid Waste Generation Rate in Different City of Rajasthan (WTERT 2011)

S.No.	City	Tons per day	kg/person/day
1	Jaipur	1,426	0.45
2	Jodhpur	825	0.70
3	Kota	683	0.70
4	Ajmer	428	0.63
5	Bikaner	378	0.52
6	Udaipur	264	0.49
7	Bhilwara	155	0.40
8	Alwar	152	0.41
9	Ganganagar	137	0.45
10	Pali	117	0.45
11	Bharathpur	113	0.40
12	Sikar	103	0.40
13	Hanumangarh	101	0.56
14	Kishangarh	99	0.62
15	Beawar	98	0.56
16	Tonk	92	0.49

A. *JIET Campus*

Jodhpur Institute of Engineering & Technology (JIET) is one of the top ten colleges among RTU (Rajasthan Technical University) different colleges. Jodhpur Institute of Engineering & Technology is established in year 2003. It have Four Boys Hostel, two Girls Hostel, academic section, and residential section for faculty shown in Fig 1, currently with approximate 3,000 peoples residing in this campus. The management of SW is going through a critical phase, due to the unavailability of suitable facilities to treat and dispose of the larger amount of SW generated daily. Anthropogenic activities in campus generate large quantities of wastes posing a problem for their disposal.

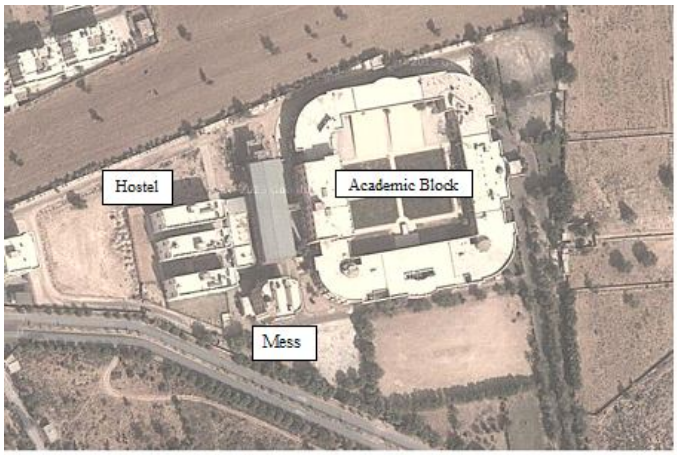


Figure 1

B. *Object of study*

Following are the objectives of study on solid waste management in the JIET Campus.

- To characterized the waste generated from different sources of JIET Campus.
- To identify the existing solid waste management practices in campus.
- To identify whether the current SWM is sufficient or not.
- To suggested some remedial practices for better management of solid waste management in JIET Campus.

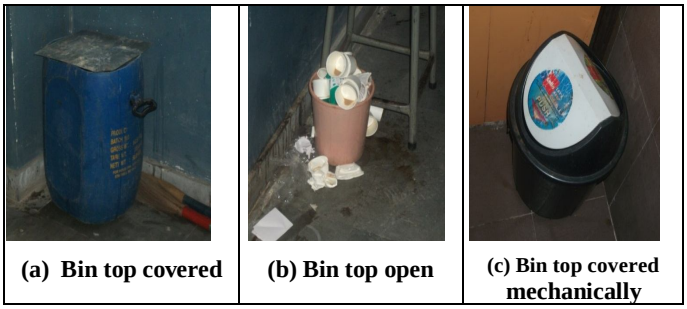
C. *Layout of survey stratergy*

1. Identify the survey area (by maps available on internet).
2. Collect information about
   - *(a).* Different sections of campus (from institute administration).
   - *(b).* Their location and size (by visiting).
3. Divided the campus into four zone according to study
   - *(a).* Academic and Departmental area,
   - *(b).* Residential area.
   - *(c).* Hostels.
   - *(d)* Mess and Canteen.
4. Collect information about the solid waste management activities in campus through
   - *(a).* Questionnaire with staff for SWM,
   - *(b).* Questionnaire with residing peoples.
5. Sample collection and examine the waste.
6. Analysis of observation.
7. Result and discussion.

II. Sample collection and analysis

The solid waste from the four site was collected from bins provided by existing system of waste management. For the purpose of sample collection, large poly bags (fig.2) were placed in the bins shown in Fig.3 (a, b and c) selected for sample collection. There after the samples were collected in these bags and were taken out and examined by weighing (fig.4) the bag. Then the waste was sorted in to different categories and weighted for measurement of composition of particular type of waste.

Figure 2: Polybag for solid waste collection



(a) Bin top covered | **(b) Bin top open** | **(c) Bin top covered mechanically**

Figure 3: Bins for sample collection

Figure 4: Weighting of polybag filled with solid waste

III. observations

Mr. Jay Singh Shekhawat senior supervisor is responsible for the management of solid waste generated in the JIET Campus. His administration has been divided Campus in to four zones Academic section, residential area, mess and canteen, Boys hostel No. 1 to 4. In the campus there are different areas that generates the waste of different type such as Food waste, Plastics, Paper, Tin, Rubber, Metal, Glass, Dust, Textile and Garden Trimming shown in Table II.

A. Collection system

The solid waste is collected from different sources by various methods. The solid Waste management activity in JIET consists of throwing the waste into the different types of bins provided by the JIET waste management system at different locations fig.5, 6 and 7. The sweepers sweep the road and transfer the waste into the bins. There are 60 big dust bins of different types, 140 small (5 liter) plastic cylindrical shape dust bins, and 1 big trolley (capacity 8 quintal) (fig.7) are placed in JIET. Three types of dust bins are used. These are Large Plastic Cylindrical Bins of volume 0.339 m3 (50 liter), big trapezoidal dust bin (50 liter) and small Cylindrical dust bin (5 liter).

The collection of waste from these dust bins is planned in accordance with frequency of container becoming full by the by sweepers to the larger cemented bins constructed at different places which his finally collected by the collection tractor came on every second day. The present location of dust bins and the waste collection point have been classified into daily collection (A type), weekly twice collection (B type) and weekly once collection (C type). In the JIET campus one senior supervisor, 4 supervisors and 30 sweepers are currently working for the solid waste management and cleaning.

Table II. Major Sources of Solid Waste Generation in JIET Campus.

S.No	Source	Type of waste
1	Mess	food, tin, plastic, paper and dust
2	Residential	Food, tin, plastic, paper, rubber, metal, glass, dust, textile, leather, garden trimming
3	Academics	Plastic, paper, dust, Cardboard, Garden Trimming
4	Hostel	Glass, plastic, paper, tin, leather, dust, Cardboard
5	Road side	Glass, plastic, paper, wood.

IV. RESULT AND DISCUSSION

Waste generation rates works out to be 0.40 Kg per capita per day. Approximately 15.6kg/day waste is generated from the residential area, 67.5kg. From mess activities, 37.4kg from hostel and 67 kg from academic region which contribute to the total 187.5kg solid waste per day shown in Table III. There is additional 15 kg waste also estimated as road side deposited solid waste that is not collected by any collection system.

A. Characteristics of solid waste

The quantity and characteristics of solid waste vary from place to place. Factors that influence the quantity and Compositions are the different activity areas for waste materials. The typical composition of solid waste of JIET is given in Table IV - VII & Figure 8 - 11.

B. Transportation

Transportation of collected solid waste to larger bins by sweepers is carried out properly by a tractor at each second day. Lifting of garbage is done manually. The waste collected from the roads and bins is directly transported to the final dumping site. The refuse vehicles have to travel outside the campus at a particular dumping site. The tractors carrying waste are not covered during the journey and waste tends to spill on the roads.The loading and unloading of waste done through mechanical system reduces direct contact of worker with the wastes.

Figure 5

Figure 6

Figure 7

TABLE III: The Various Waste Generating Places in Campus

S.No.	Source area	Amount of waste (per day)
1	Mess	67.5 Kg
2	Residential	15.6 kg
3	Academics	67 kg
4	Hostel	37.4 kg
5	Road side	20 kg
Total		207.5

TABLE IV: Composition of Solid Waste Generated in JIET Academic Area per Day

S. No.	Type of waste	Calculated Amount	Percentage
1	Food waste	2 kg	2.985
2	Plastic	8 kg	11.94
3	Paper	22 kg	32.83
4	Glass	2 kg	2.985
5	Cardboard	10 kg	14.925
6	Dust	7 kg	10.44
7	Garden Trimming	8 kg	11.94
8	Tin	2 kg	2.985
9	Wood	3 kg	4.48
10	Metal	3 kg	4.48
	Total	67 kg	100

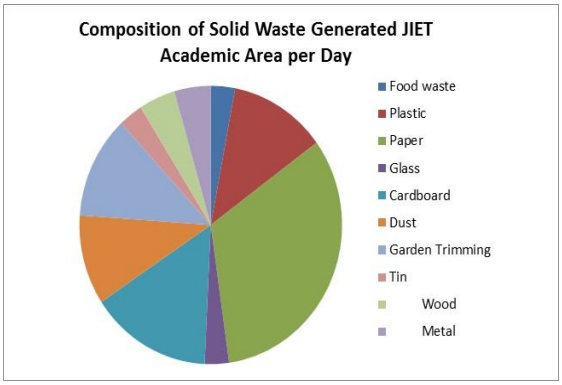


Figure 8

TABLE V: Composition of Solid Waste Generated in Residential Area of JIET Campus per Day

S.No.	Type of waste	Calculated Amount	Percentage
1.	Food waste	4 kg	25.65
2.	Plastic	1 kg	6.40
3.	Paper	3 kg	19.24
4.	Glass	1.5 kg	9.61
5.	Cardboard	2 kg	12.8
6.	Dust	2 kg	12.8
7.	Garden Trimming	0	0
8.	Tin	1 kg	6.40
9.	Wood	0.8 kg	5.15
10.	Metal	0.3 kg	1.93
	Total	15.6kg	100

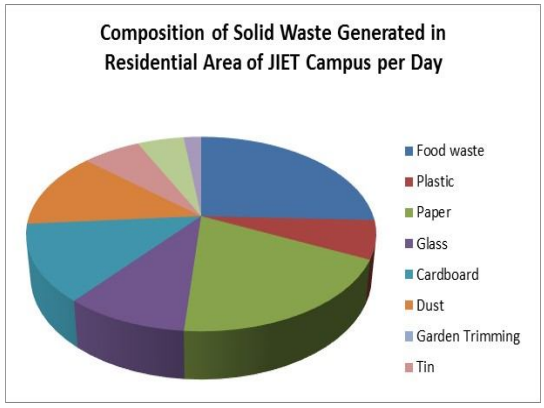


Figure 9

TABLE VI: Composition of Solid Waste Generated in hostel of JIET Campus per Day

S.No.	Type of waste	Calculated Amount	Percentage
1	Food waste	6 kg	16.04
2	Plastic	4 kg	10.69
3	Paper	12 kg	32.08
4	Glass	2 kg	5.35
5	Cardboard	4 kg	10.69
6	Dust	5 kg	13.37
7	Leather	0.2 kg	0.53
8	Tin	1 kg	2.68
9	Wood	0.2 kg	0.534
10	Metal	1 kg	2.68
11	Garden trimming	2 kg	5.35
	Total	37.4 kg	100

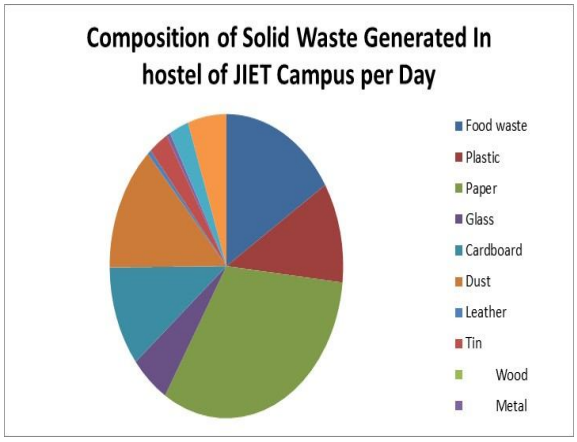


Figure 10

TABLE VII: Composition of Solid Waste Generated in Mess and Canteen of JIET campus per Day.

S.No.	Type of waste	Calculated Amount	Percentage
1	Food waste	35kg (solid) 15 kg (semi solid)	74.07
2	Plastic	3 kg	4.45
3	Paper	5 kg	7.40
4	Glass	1kg	1.48
5	Cardboard	3 kg	4.45
6	Dust	2.5 kg	3.7
7	Leather	0	0
8	Tin	2 kg	2.96
9	Wood	0	0
10	Metal	1 kg	1.48
11	Garden trimming	0	0
	Total	67.5 kg	100

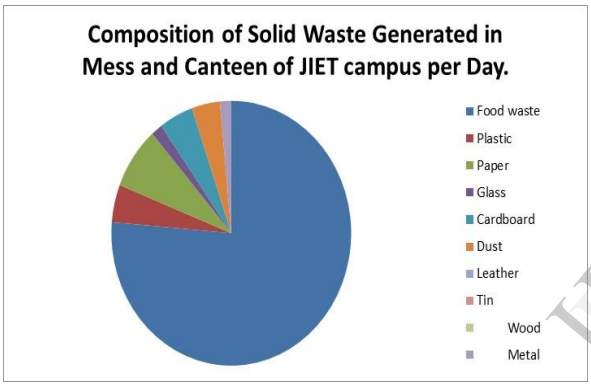


Figure 11

V. CONCLUSION

The solid waste management in JIET appears to be inadequate and needs up gradation. Segregation of recyclable material would also leads to reduction in quantity of solid waste for final disposal. Rather than considering the solid waste simply as material to be thrown away, it should be recognized as resource materials for the production of energy, compost and fuel depending upon the techno-economic viability, local condition and sustainability of the project on long term basis. A better management for recyclable and biodegradable waste utilization provides the facility to reduce the waste disposal up to 50-70 % of the total waste dispose at present. Proper management requires a suitable management plan with construction and installation of essential facilities [11].

VI. SUGGGESTIONS

1. As from the above study done it is clear that there is huge amount of paper waste and food waste. To reduce paper waste source reduction practices should be implied. Disposable cups and glasses should be replaced by ceramic cups. Biodegradable waste should be used for Vermicomposting.
2. Three types of bins should be provided for biodegradable waste, recyclable waste and deposition waste.
3. Segregation of different types of waste at source.

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