ASSESSING THE SOLID WASTE MANAGEMENT PROCEDURES OF MANAGEMENT INSTITUTES IN MUMBAI

Prof. Sanchayita Banerjee*

Prof. Jestin Johny**

Abstract

Generation of solid waste has become a very crucial problem these days. Awareness regarding the risk of solid waste polluting all vital elements of living is growing internationally, but in India, people are not enough careful about it's after effects due to various political and social factors and time has come now to be conscious and behave in a more responsible manner. India being such a huge country, initiatives should start from big cities first to develop the awareness and implementation of waste management at a decentralized level for effectiveness of these programmes. Our study focuses on Mumbai as the largest metropolitan city in India with over 20 million populations. It is the capital of Maharashtra state and the financial capital of the country. Every year a big number of people migrate here from different parts of India in search of better job or better education. The city has a big number of educational institutions which generate a huge quantity of waste regularly. Medical and technological institutes generate hazardous wastes also. Schools are also a big contributor of the same. But, there are some wastes which are bio-degradable and care could be taken at this (institution) level. This paper is trying to find out how Management Institutions of this city, as a responsible citizen-maker, are handling their wastes at individual (institute) level, and if there is any possibility to do it in a better manner.

Keywords: Solid waste, waste generation, waste recycling, planning of waste minimization, waste segregation, waste disposal

* **Assistant professor, St. Francis Institute of Management and Research, Mumbai**

** **Assistant professor, St. Francis Institute of Management and Research, Mumbai**

Introduction

Solid Waste Management (SWM) is a contemporary urban issue in India. It is an integral part of modern society. Increasing growth in urban population leads to a dramatic increase in municipal solid waste (excluding industrial, construction, hospital waste) with severe socio economic and environmental impact. Great amount of generated municipal solid waste due to lack of proper storage and high processing cost cause threats to our health, and destroy delicate natural balance. As a result, the waste generated easily penetrates to ecosystem; contaminate soil, and ground water. It is the moral responsibility of every citizen to be conscious towards the management of these wastes at a micro level at the beginning, and gradually take it to the macro level.

Literature Review

Under the Mumbai Municipal Corporation Act of 1988, it is a mandatory duty of the corporation to maintain the area falling under its jurisdiction in clean and hygienic conditions in order to ensure a good and healthy environment. The 3R principle of Reduce, Reuse and Recycle aims at attaining highest quality of cleanliness on a permanent and sustained basis taking under consideration the ecological and economical aspects associated with the functioning of the system as a whole. The Municipal Solid Waste Rules 2000, framed by the Government of India (GoI) makes it mandatory for the stockpile of garbage at the source and its integrated collection at the doorstep.

Existing Situation

Waste generation in Mumbai

Everyday around 7,025 MT solid waste is generated in Mumbai, out of which approximately 5000MT is general municipal waste. Municipal solid waste comprises of waste generated by commercial and residential premises, sand and dust generated from street sweeping and other materials such as plastics, metals, glass, etc. though plastics has a very small share in the generated waste, it creates the most nuisance such as, clogging of drains, etc. Also its combustion poses health hazards due to release of toxic gases, and moreover, it is not bio-degradable. MCGM has banned plastic bags below 20 micron size.

Collection of solid waste

Waste is collected from sweeping the roads, collection through community bins and house to house, office to office collection. The collection from collection bin is carried out in 3 shifts and transferred to the three transfer stations or directly to the disposal points. The areas under corporation where municipal services are not available, the corporation fixes responsibility of the cleanliness on the NGOs formed by local residents. MCGM has adopted 'Slum Adoption Scheme' as waste collection mechanism, and 'The Advance Locality Management' , which is for extensive interaction and involvement of MCGM with local neighborhood groups in the ward and are especially responsible for garbage management. The three transfer stations at Mahalaxmi, Kurla and Versova support intermediate transfer of waste from the surrounding areas upto the dumping grounds. In 2007 MCGM took certain initiatives in sectors of collection and transportation, like purchase of standardized community bins, Management and upgradation along with modernization of existing Transfer Stations and setting up 3 more Transfer Stations, Creation of dry-waste sorting centres managed by NGOs to accept the recyclable and E-waste in each ward, Computerization Project inclusive of vehicle tracking system, Implementation of Radio Frequency Identification (RFID) Tags for real time tracking of bin servicing, etc. But, these initiatives were not implemented properly till now.

Segregation

As per the Ecological Solid Waste Management Act of 2000, waste should be segregated under three categories: Recyclable (paper, plastics, steel, bottles or glasses, etc.), Compostable (kitchen waste, landscape waste etc.), and Residual (sharp objects, carbon papers, tetra packs etc.). The degree of source separation creates an impact in the total amount of the waste to be recycled and its secondary material's quality. Often in developing countries MSW is not segregated or sorted before it is taken for disposal. Sometimes the waste pickers remove the recyclables before disposing at disposal sites. It should be ensured that waste which can be processed for recovery of material and energy does not become co-mixed with undesirable elements. However source separation and and separate collection increases the cost of waste collection process. Different studies say that the collection percentage of MSW varies by national income and by region. The degree and sophistication of waste picking influences overall collection. Data show that low

income countries have low collection rates, around 41%, while high income countries have higher collection rates, around 98%.

The Municipal Corporation of Greater Mumbai (MCGM) encourages the composting of wet waste at different institutional premise under the ALM (Advance Locality Management) Scheme. The MCGM has already declared the segregation and storage of garbage at source mandatory. The various methods adopted for the disposal of solid waste in Mumbai are composting, bio-methanation of wet garbage, vermin-composting, and recycling of dry waste. As a solution to the support of municipal authorities to manage solid waste, the Rules called for involvement of actors like community-based organizations, private contractors and nongovernment organizations (NGOs) in the solid waste management. There are many such NGOs in Mumbai, like **Clean Mumbai Foundation, Green earth foundation for Global Environment, Help organization for people, Environment and society (HOPES), Youth for unity and Voluntary action (YUVA**), etc. who are working on Solid Waste Management. The ALM Scheme was initiated by MCGM with the objective of mobilizing citizens in a participative approach in setting up a system for dealing with the problem of solid waste management by taking care of the eco-system. The cornerstone of the initiative was decided as 'waste minimization' and 'segregation of waste at source'. The present Government is taking enough initiative to develop a clean India. The plan of developing 100 smart cities in India is also giving a special focus to solid waste management as a way towards zero waste for success of smart cities in India.

Role of MCGM in solid waste management in Mumbai

. Mumbai has a garbage production of 6500 tons per day. It also produces nearly 2500tons of construction and demolition waste per day. MCGM operates a huge fleet of 983 Municipal and private vehicles for collection of waste making 1396 number of trips per day. The total manpower employed by MCGM thirty thousand four hundred and thirteen.

Initiatives taken by MCGM in sectors of transportation and collection

- Purchased of Standardized Community bins
- Mechanized sweepings of highway and beach

- Management and up gradation along with modernization of existing transfer stations and setting up 3 more transfer stations.
- Deployment of NGO Labors for collection of garbage around collection points
- Implementation of Greater Mumbai Cleanliness and Sanitation Bye-laws, 2006
- Creation of dry waste sorting centers managed by NGO's to accept the recyclable E-waste in each ward.
- Computerized Project inclusive of vehicle tracking system, implementation of Radio frequency identification(RFID) tags for real time tracking of bin servicing
- Implementation of construction and demolition waste disposal project as per the Debris management policy.
-

Waste generation in Management Institutions: - The study found that on an average, around 30 to 50 kg waste is generated in a day in a management college. There are many sources of waste generation in these institutions. Some of them are—

Landscape waste—Waste generated in garden, eg. Leaves, branches, etc.

- Scrap
- Paper waste-- A huge percentage of waste in educational institutes is paper. It includes library waste, admin waste, exam waste, etc.
- Electronic waste-- E-waste includes all kinds of electronic wastes including ACs, refrigerators, computer hardware etc.
- Furniture and fixture—Tables, chairs, benches, cupboards, etc., generated from office, classrooms, hostel rooms, etc.
- Metal waste—fans, bathroom fittings, old cupboards, tools and accessories, etc.
- Food waste—waste generated in canteens

The BMC Solid Waste Management Rules 2006, focuses on the Prohibition of Littering and Regulation of Segregation, Storage, Delivery and Collection of Solid Waste. The BMC has issued a work order for setting up a treatment facility on Built-own-operate-transfer (BOOT). A waste to energy and compost plant for 3600 TPD has also been proposed, although no date of commissioning has been indicated (SWM Cell, AIILSG2003)

Benefits from Waste Management

Many institutions are making special effort to minimise waste generation which further reduce waste treatment and disposal cost, like, for example, going almost paper-free. This also improves resource efficiency.

Initiatives could be taken for proper recycling of waste like composting, making of bio-gas, making of manure etc., at a minimum cost, which may further give an opportunity to use these outputs for direct consumption. It can also be treated as a business opportunity with a good potential.

Problems with solid waste— there are different types of problems with these solid wastes. Some of them are -

- Storage of waste
- No proper segregation before disposal
- Burning of waste leading to emission of harmful gases and highly toxic liquid leachate.
- Big quantity of plastic waste
- No proper treatment of waste before disposal—any untreated waste will definitely lead to a health or environmental hazard at some point of time.
- Limited involvement of private sector and communities
- Green house gas (methane) generation
- Transportation cost of waste

Solution: the best way to solve these problems is through **3Rs: Reduce, Reuse, And Recycle**. Some of the general and widely used solutions are—Composting, Incineration, Gasification Technology, Land filling (unscientific dumping pollutes underground water system in adjoining areas), Vermiculture, Proper treatment before disposal, Plasma technology (widely used technology in foreign countries), Resource generation (IJEST12-04-04-196), etc.

Waste treatment methods

In today's Innovative world there are different waste treatment techniques that transform the waste which is more manageable and can be affordable by reducing the volume of pollution thus

making the waste to easily dispose of. Treatment methods are done on the basis of Quantity and type of waste material.

Thermal treatment –

This process involves the use of heat to treat waste. Below are some of the commonly utilized thermal treatment processes:

Incineration

Incineration is the most common thermal treatment process. After the Incineration process the wastes are converted to carbon-dioxide, water- vapor and ash. This method also have an advantage of reducing the volume of waste, reducing the transportation cost (instead of carrying the waste in open air truck) and lastly reducing the production of Greenhouse gas methane.

Pyrolysis and Gasification

Pyrolysis and Gasification is a process of decomposing the organic waste into high temperatures and low oxygen supply. These techniques use heat to covert Biomass into other forms. Pyrolysis is a method which allows no oxygen and Gasification uses a low oxygen environment.

Open Burning

Open burning is the cheap method of burning unwanted materials directly exposing it to the open air without passing it through the chimney. Open burning is been practiced by different urban centers as it reduces the volume of refuse and extends the life of the dumpsite. Open burning has negative effects on human health and environment. The uncontrolled burning of garbage's by different urban centers releases many pollutants into the atmosphere. The process of open burning releases acidic gases such as the halo- hydrides.

Sanitary Landfills

Sanitary landfills are designed to reduce the risks of waste disposal that effects the public health and environment. It can be further said that sanitary landfills are areas where the ground water level is low due to which there is no water contamination. The layout of landfills are lined up with layers of clay to keep the liquid waste known as leachate, from escaping into the soil.

Bioreactor Landfills

Technological advancement have led to the introduction of Bioreactor landfill, it uses the enhanced microbiological process to accelerate the decomposition of waste. The main controlling factor in Bioreactor landfills is the constant addition of liquid to maintain optimum moisture for microbial digestion. These enhanced microbial process have the advantage of reducing the volume of waste and can create more space for additional waste.

Anaerobic Digestion

Anaerobic Digestion uses biological processes to decompose organic waste, it makes use of bacteria and an oxygen free environment to decompose the waste. The process is used for industrial or domestic purposes to manage waste and/or to produce fuels. Anaerobic digestion is also used as a method of producing bio-gas which can be used to generate electricity.

Anaerobic digestion is the latest and most innovative technology developed by the waste management experts. The process is simple it just makes use of microorganism in an environment starved by oxygen. The process is quick and it can also be used as fertilizer while the biogas produced can be used to fulfill energy requirements

E-Parisaraa

The emergence of IT Industry has led to many hazardous waste which can lead major environmental problems endangering human health. Today's gadgets are provides comfort, security, easy and faster exchange of resources and information, but it also leads to unrestrained consumption and an alarming waste generation.

E-Parisaraa Pvt.Ltd, India's first Government authorized electronic waste recycler started operations from September 2005 in Bangalore, engaged in handling and reusing of waste electrical and electronic equipment in an eco-friendly way .

Solid Waste Management: Towards Zero Waste in GIFT City (giftgujarat.in)

- Automated Waste Collection System (AWS) through chute system
- Minimum Human Intervention and Minimize space requirement
- Waste sucked through pipes at a speed of 90 km/hr
- Waste Treatment through Plasma Technology

- The garbage transport underground pipe network runs parallel with the other infrastructure services

A comprehensive approach to manage waste in today's world is the use of 3R principle.

Reduce:

Waste could be reduced by only buying whatever is required, so that waste is not created. Many organizations are now trying to go paper free and prefers to use emails for official correspondence.

Reuse:

The second most important strategy of 3Rs is **Reuse.** Many organizations and institutions are giving away their computers and other scraps to others for reuse. Reuse could be encouraged through organizing different competitions like paper bag making, best out of waste, waste basket segregation, eco painting, quiz competition on environment, etc.

Recycle:

The third R in the hierarchy is for **recycle**, which in terms of waste is the reprocessing of disposed materials into new and useful products. Paper, food waste, landscape waste etc. could be recycled and used as a new product. Vermicomposting is a good example of recycling.

There are policy gaps and most of the institutions are not adequately oriented toward resource efficiency.

What we see are—

- Limited efforts on reducing waste at source
- Lack of segregation, poor collection, illegal dumping, open dumping and burning
- Limited involvement of private sector and communities
- Poor waste management further compounding water issues, etc.

Need for the Study

The solid waste policy in India specifies the duties and responsibilities for hygienic waste management for cities and citizens of India. The study focuses towards finding out the level of

alertness amongst the management colleges towards handling and disposing of solid wastes and whether they can do it in a further better manner. The study also intends to find what are the best practices followed by some of the institutes and whether it is feasible for other institutes to follow.

Objectives

- To identify possible solid wastes in educational institutions
- To study the options available to manage these solid wastes and the problems in implementing those options
- To find the best practices followed by some institutes to reduce, reuse, and recycle the institutional solid wastes

Research Methodology

The type of research is Exploratory and Descriptive in nature. The method used are a structured questionnaire survey and interview. There are in total around 120 odd management colleges in Mumbai, and a sample of 12 institutes (10% of the population) are taken. The sampling technique used is non-probability quota sampling where quotas referred to western suburbs, central suburbs and Mumbai city.

Sources of Data—Secondary data collected was from various journals, MCGM website, research papers, news reports, e-waste websites, etc. Primary data collected from the 12 chosen institutes through interviewing and interview schedule.

Tools and techniques used for data analysis is simple graphs and charts, Chi Square Test and Paired Two Sample t-test.

Data Analysis and Interpretation

Charts below show the analysis and interpretation of data collected through a structured questionnaire from 12 management colleges in Mumbai, area covering western and central suburban Mumbai and Mumbai city.

The data is collected in terms of number of students in the institute, whether the institute handles its waste on its own or it is a part of a group of institution where the waste is managed at a central point, types of solid waste generated, segregation of waste at source, processing of waste,

number of canteens, quantity of waste generated, frequency of the disposal of waste and if they have any other plan for waste management. Data was also collected in a five point Likert scale from strongly agree to strongly disagree about the responsibility of the institution regarding the segregation of waste before disposal and the requirement of a proper planned waste management system which is a duty of these institutions.

Sample profile of the selected institutions—

Table – 1.1

Location	No. of Institutes
Mumbai City	7
Western Suburb	3
Central Suburb	2

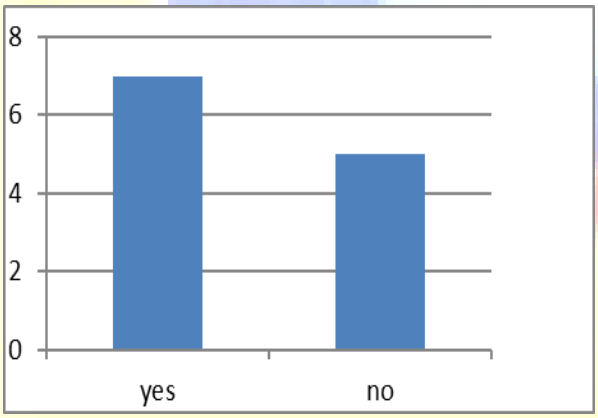


Chart 1

Segregation of waste at source

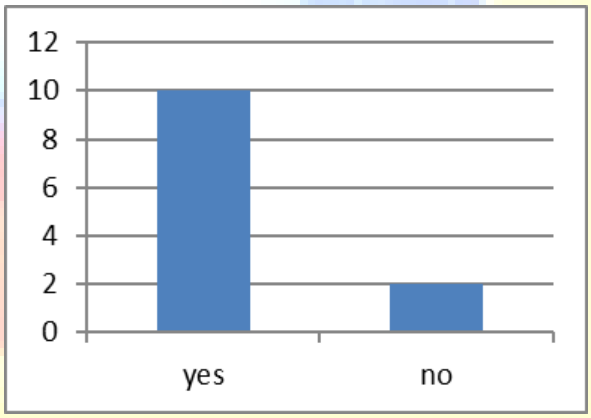


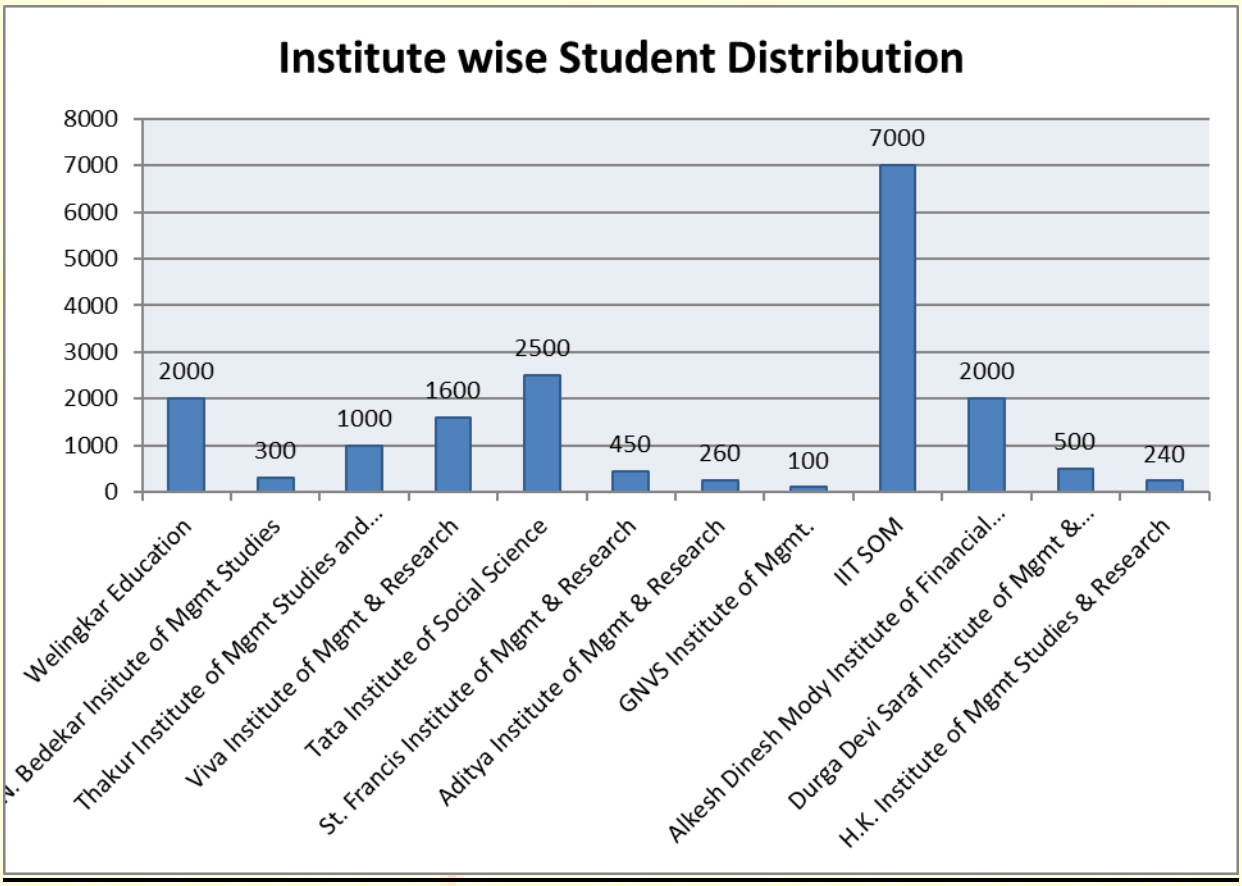
Chart 2

Group of institutes whose waste is handled Together

The above charts show the responses of different institutes towards their waste management process. Chart 1 shows that majority of the institutes segregate the waste at source itself but 50% of them do not process them before disposing. Moreover it is been noticed that where there is a

group of institutes whose wastes are handled together, majority of them process it at source. Many institutes confessed that processing of very small quantity of waste is quite expensive and hence not feasible. Also it is seen that wherever there are group of institutes, most of them prefer to manage the waste as a centralized activity. As per data collected, 9 out of 12 are a part of group institutions, and 7 out of those 9 goes for centralized waste management system.

Table 1.2



The above chart shows the number of students each of these management institutes has, where IIT SOM is showing an abnormal data, as the figure provided by them included total strength of IIT and other proper data was provided.

Statistical Testing of Hypothesis

Item wise simple frequency in the form of bar graph and chart, and chi-square test, and t-test is applied to reach at a proper conclusion.

Study 1

Null Hyp. H0: There is no significant relationship between the quantity of waste generated and the processing of waste.

Alt Hyp. H1: There is a significant relationship between the quantity of waste generated and the processing of waste.

Variable H is the quantity of waste generated on a daily basis in those institutes

Variable G is whether they process the waste before disposal or not.

Observed Values Proper explanation of variables and observations required in both the below mentioned tables.

Table 1.3

	G1	G2	Sum
H1	0	2	2
H2	1	0	1
H3	3	0	3
H4	0	1	1
H5	2	3	5
Sum	6	6	12

Expected Values

	G1	G2	Sum
H1	1	1	2
H2	0.5	0.5	1
H3	1.5	1.5	3
H4	0.5	0.5	1
H5	2.5	2.5	5
SUM	6	6	12

The Chi Test value is 0.125689, and the Chi Table value @ dof 4 and @5 % los =0.711

As the calculated Chi square value is less than the table value at 5 % significance level, we accept the Null Hypothesis. Hence there is no significant relationship between the quantity of

waste generated and the processing of waste. From the observation also it was found that there are places where enough quantity of waste is generated but no proper waste management policy is followed.

Sample is too small, use Fisher's exact test instead of Chi-square test. The same applies to Study 2 and 3.

Study 2

Null Hyp. H0: There is no significant relationship between the number of students in college and the quantity of waste generated.

Alt. Hyp. H1: There is a significant relationship between the number of students in college and the quantity of waste generated.

Variable H is the quantity of waste generated on a daily basis in those institutes

Variable C is the number of students in the management institution.

Observed Values

Table 1.4

	C1	C2	C4	C5	sum
H1	1	0	0	1	2
H2	1	1	0	0	2
H3	2	0	1	0	3
H5	2	0	1	2	6
sum	6	1	2	3	12

Expected Values

	C1	C2	C4	C5	sum
H1	1	0.17	0.33	0.5	2
H2	1	0.17	0.33	0.5	2
H3	1.5	0.25	0.5	0.75	3
H5	3	0.5	1	1.5	6
sum	6	1	2	3	12

Note: there was no response for H4 (40kg-50kg) and C3 (1001-1500 students intake) and so the responses are not considered.

The Chi Test Value is 0.468595, and the Chi Table value @ dof 9 and @5 % los =16.9190

As the calculated Chi square value is less than the table value at 5 % significance level, we accept the Null Hypothesis. Hence there is no significant relationship between the number of students in college and the quantity of waste generated. It must be noted that through the observation of these cases it was found-- due to majority of the institutes are a part of a group of institutions, their waste handling is centralized and so the quantity of waste generated is not only by them, but also by other sister institutions, which is making a difference in the calculated output.

Study 3

Null Hyp H0: There is no significant difference in the responses relating to the importance of the segregation of waste before disposal by the institute and the planning for proper waste management in near future by the institute.

Alt. Hyp. H1: There is a significant difference in the responses relating to the importance of the segregation of waste before disposal by the institute and the planning for proper waste management in near future by the institute.

Table 1.5

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	4.333333333	0.833333333
Variance	0.424242424	0.878787879
Observations	12	12
Pearson Correlation	0.694808334	
Hypothesized Mean Difference	0	
df	11	
t Stat	17.98332561	

P(T<=t) one-tail	8.33077E-10
t Critical one-tail	1.795884814
P(T<=t) two-tail	1.66615E-09
t Critical two-tail	2.200985159

Where variable 1-- the importance of the segregation of waste before disposal to the institute

Variable 2-- the planning for proper waste management in near future by the institute

The P value is 1.66615 which is less than the alpha value 0.05 and hence we accept the alternative hypothesis. Hence, there is a significant difference in the responses relating to the importance of the segregation of waste before disposal by the institute and the planning for proper waste management in near future by the institute. This result is attributed to the sampling error.

Findings

- Most of the institutes do not have a proper waste management policy and no proper amount is allocated specifically for waste management.
- Majority of the institutes do not process the waste before disposal due to lack of knowledge of the people handling the waste.
- The basic awareness of the requirement of waste management is there but the importance is not felt much, because of which most of the institutes prefer to give away their waste to BMC and not go with a proper and planned waste management process.
- There are different NGOs working on the proper solid waste management system, and are coming up with different solutions, like Stree Mukti Sangathan , which as a support function works with BMC and collects only paper wastes, which is further taking care of women empowerment through employment.
- There is no proper e-waste management system at most of the places and mostly they either donate or sell as a scrap. There is an agency who takes the e-waste and gives a certificate after proper disposal.
- Most of the colleges invite quotation and then select their scrap vendor. There are many institutes who are trying to reduce their waste generation, like trying to be paper-free.

- Due to space constraint, most of the institute cannot set up a bio-gas plant, even if they have enough quantity of canteen waste generated. Also, the initial investment of setting up a plant for bio-gas or composting is quite expensive.
- The quantity generated of waste is not of so much amount in case of most of the institutes, where they can go for composting or bio-gas. In such cases, if proper waste collection is done from different institutes and then processing is done, it will be more cost effective, and also justifies for recycling.
- The level of technical knowledge related to waste processing was very limited in most of the cases which was a barrier to get proper information. Moreover, at many places many people were involved to do the job and it was not in an organized manner.
- There are some institutes who outsource the waste management activity so that it is done in a proper manner, but still they find that the people handling the wastes are not enough knowledgeable and are not trained technically to work in a proper manner.
- There are institutes who donate papers to the Swami Narayan Temple at Dadar.
- Institutes like TISS, IIT SOM, and Welingkar etc. are more conscious and are following a system to manage the waste and has bio-gas plant, composting, vermiculture, etc. TISS is trying to develop a market for their manure and outsourcing different agencies to help them to work in that front, which could be considered as one of the best practices.
- Most of the colleges were a part of a group of institutions and so for certain things the waste management was centralized and for other things it was decentralized.

Conclusion

We conclude from our study that there is awareness about the hygiene factor but there is no willingness to do proper waste management. The main deterrent in implementing solid waste management in educational Institutes is due to lack of technical Knowledge and trained manpower to process the waste generated in the Institute. Managing solid waste is an integral part of the Institute and will benefit in the long run. There are different NGO's working towards awareness toward waste management but as long as the individual is not keen on doing it every effort will go in vain. The process of waste management depends upon the number of students and the area of the Institute. There are many innovative methods of waste management but the people are not aware of it, and so India is the fifth largest polluter of e-waste in the world.

Institutes should develop a proper waste management policy and should adhere to it which will lead towards further development of the institute in the long run. Management of different institutes should take the initiative in bringing in change in the organizational culture. However, there many initiative taken by MCGM towards waste management in Mumbai the financial hub of the country. We can hereby say that Solid waste management process and awareness regarding its effects to the environment is at very infant stage lot more needs to be done by the citizens as well as the State Government.

References

(Books and Journals)

- Darshini Mahadevia, Bela Pharate, Amit Mistry, New practices of waste management, Case of Mumbai -S.P. working paper series – working paper no.35, December 2005
- Priya Salvi, Kisan Mehta and Dilip Sankarreddy-- Integrated Solid Waste Management Programme—A Sustained and Perennial Solution——Save Bombay Committee, 2005 India(http://www.savebombaycommittee.org/database/reports/ISWMP.pdf)
- Sachin S. Pendse (Solid Waste Management in India—A Study of Mumbai) Online International Interdisciplinary Research Journal (bi-monthly) ISSN 2249-9598, Vol.2, Issue IV, July—August 2012
- Jain Ajit Kumar; Solid Waste Management in Mumbai, All India Institute of Local Self Govt., Published in the Bombay Chamber Bulletin (2004)

(Websites)

- Summary of the Brihan Mumbai Municipal Corporation Solid Waste (Prohibition of littering and Regulation of Segregation, Storage, Delivery and Collection) Rules 2006—19-02-06. (http://www.karmayog.com/cleanliness/mswrules2006summary.htm)
- United Nations Environment Programme *International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management*
- Solid Waste Management Department, Municipal Corporation of Greater Mumbai at http://www.mcgm.gov.in/departments/swmanage.html
- E-waste in India—Research unit (LARRDIS) Rajyasabha Secretariat New Delhi, June 2011 http://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf