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QUANTIFICATION OF SOLID WASTE AND MANAGEMENT OF DAVANAGERE CITY

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Abstract: Solid wastes are posing serious problems as the available technologies are not adequate for their safe disposal. The amounts of solid wastes generated each day per capita are increasing as a result of social, economical and technological changes. The great increase in production of wastes is not only posing problems in storage, collection and transport but also in treatment and ultimate disposal of Solid waste management is a serious problem faced by most of the countries of the globe and there is an urgent need to solve this burning issue. Municipal Solid waste management comprises of scientific collection, storage, transportation, treatment and disposal of waste without causing any harm to the humans and environment. In this study the current scenarios of Municipal solid waste management of Davanagere city is studied which has the population of about 4,27,128. Out of 37 Wards of the Davanagere City based on the priority and as per standard of living 3 wards are selected for this study. Door to door survey is done in all the 3 wards to collect the data of quantity of waste generated along with the population. Using a questionnaire, the ward wise data and current solid waste management procedures are collected from Davanagere city Municipal Corporation. The quantity of waste generated for all the wards is calculated by establishing relationship between population and quantity of waste generated. The study reveals that approximately 150 Tons/day of solid waste is generating in Davanagere city. Analysis is made by studying the current practices and some of the best practices like segregation of waste at source, recycling and reusing of waste composting the organic waste are suggested. Further it was observed that since most part of the waste was found to be organic in nature Sanitary land filling is suggested in order to maintain clean and hygiene conditions in the city

Keywords: Municipal Solid waste, Sanitary Landfills, Segregation, Hauling equipments, Quantification

I INTRODUCTION

Solid Waste management is a major environmental and health challenge around the globe today and this is even more serious in developing countries. Waste management is the art of scientific collection, conveyance, storage and disposal of generated waste effectively. Hence the system has to be planned rationally for long term. Nowadays the cities generated huge quantities of solid waste due to improved standard of the living. Hence, it is necessary to have detailed information on quantification and characterization of municipal solid waste for handling of waste during various stages of the management system. Currently, most of the municipal corporations and councils do not weigh and quantify the waste however the quantities are estimated on

the basis of number of trips of truck which haul then waste to the disposal site.

It is estimated that in the year 2006 the total amount of municipal solid waste generated globally reached 2.02 billion tonnes, representing a 7% annual increase since the year 2003 as per global waste management report 2007. Further it is estimated that between the year 2007 and 2011, generation of municipal waste universally will rise by 37.3% equivalent to approximately 8% increase per year.

II SOLID WASTE

Solid wastes are basically all the waste generated from anthropogenic exercises and animal activities, which are usually solid in nature and that are rejected as mass of throwaways from commercial as well as residential activities.

III STUDY AREA

Davanagere district is a city which lies in the western part of South India. The municipal organization of the city is overseen by the Davangere City Municipal Corporation, Davangere gets normal yearly precipitation of 644 mm (25.4 in). As indicated by 2011 evaluation the Davangere city having populace of 4,27,128.

Davanagere has been chosen as one of the hundred Indian urban cities to be created as a smart city under Smart Cities Mission. Initially among first 20 cities selected Davanagere is one among them.

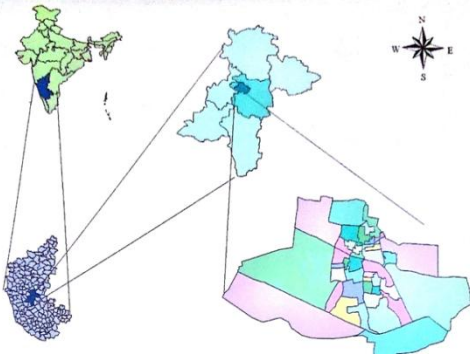


Figure 1 Location map of study area

IV OBJECTIVES OF THE STUDY

- Identifying the source of waste generation.
- Population survey of the selected wards.
- Categorization of the wards is done based on the standard of living.
- Estimating the quantity of waste generated.
- Establishing the analytical and actual waste generation relationship.
- Classifying the waste generated.
- Identifying the comprehensive integrated solid waste management approach
- Suggesting the disposal methodology for the waste generated.

V METHODOLOGY

The following methodology was adopted for this study:

A questionnaire is prepared which is used to collect the data about quantification of solid waste and the ward wise data is collected from the Municipal corporation office. Out of all the 41 wards 3 wards are selected based on the priority according to generation of the solid waste as per standard of living. Subsequently Door to door survey is done in all the 3 wards about the quantity of waste generated along with the population. A relationship is established with population and quantity of waste generated and quantification of solid waste is accomplished. The quantum of waste produced for all the wards of the city is calculated using the same philosophy as

above and arrived at total quantity of waste. In the further step the data is collected regarding the current solid waste management procedures from Davanagere city Municipal Corporation. An attempt is made to suggest best management practices for management of solid waste effectively for all the wards of the Davangere City.

VI RESULTS

As per the data collected from the Municipal Corporation 3 wards are selected based on the standard of living namely:

1. **Class 1:** Siddaveerappa Badavane (ward No 31) which has 2066 houses and has population of about 8108 containing most of high standard living people.
2. **Class 2:** S.S Badavane (ward No 30) which has 2936 houses and has population of about 13266 containing medium standard living people.
3. **Class 3:** Kurubara Kere (ward No 8) which has 5134 houses and has population of about 23687 containing low standard living people.

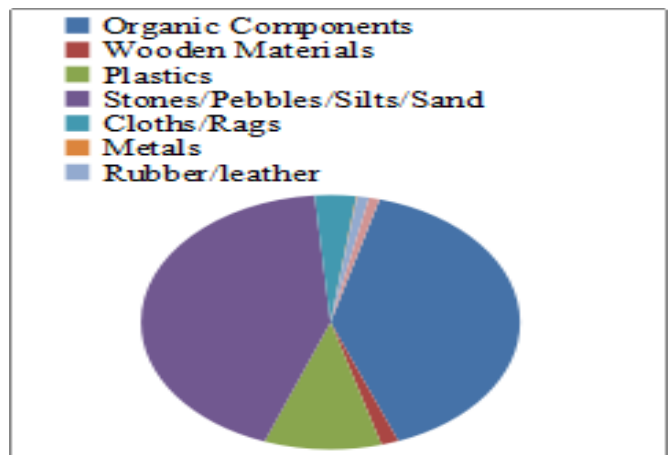


Figure 2 Composition of Municipal solid waste in Davanagere

Total Solid Waste (SW) Generation = Total Population x Per Capita Generation

Table 1 Solid Waste Generation

| Class | Solid waste generation(TPD) |
|---------|-----------------------------|
| Class 1 | 3.243 |
| Class 2 | 4.974 |
| Class 3 | 8.290 |

Theoretical Computation of Total Solid Waste (SW) generated in Davanagere city

Using geometrical increase method

$$P_{2021} = P_{2011} [1 + (r/100)]^n$$

$$P_{2021} = 427128 [1 + (17.17/100)]^1$$

$$= 500485$$

Increase in population = 73357

Percentage Increase in population per decade = 17.17%

So from above calculation the % increase in population every year = $17.17\% / 10 = 1.717$

Therefore, the present population
 = $P_{2011} + (1.717\% \times 73357 \times 3)$
 = $427128 + 3779 = 430907$

Total Quantity of waste generated in Davanagere City
 = Population x Average per capita waste generated per person per day
 = $430907 \times 0.35 \text{ Kgs}$
 = 150817 kgs/day
 = $150.817 \text{ tonnes/day}$

The data collected from Davanagere city Municipal Corporation is 150 TPD, which exactly matches with the analytical calculation as shown above.

This quantum of waste has to be properly segregated and managed effectively in order to maintain clean and hygiene conditions in the city.

System of Collection

The solid waste generated in the city is collected from various origins by different practices. The solid waste management activities in Davanagere comprises of waste generators transferring the waste into the hauled containers of capacity 3- 4.5m³. The waste collectors cleans the road and drains and then deports the waste into tiny accumulations (piles) on the road or into the waste collection bins.

There are 160 steel containers which are kept at various locations in Davanagere city. These containers have a capacity of 3 - 4.5 m³. The accumulation of waste from these waste collection bins is outlined in agreement with regularity of the container becoming full. In extension, there are 5 dumper placer containers used as primary collection containers in commercial areas and bulk waste generator. Currently, in Davanagere City door to door collection system is adopted but not in all wards out of 41 wards 33 wards is having door to door collection service out of which 22 is full door to door collection and 9 are partial. The waste collected in containers at the collection point, through dumper placers accumulation of waste from these points and transferring them to the waste processing facility (WPF) or any other point of disposal of waste.

The total number of employees adopted for waste management practices in Davanagere city is 754. In addition to the above some of the contract laborers are employed in order to properly manage the waste effectively for entire city

Transportation and disposal

The waste which is accumulated from the waste collection points is transferred by waste collecting vehicles to the final disposal site. The collection vehicles have to navigate for approximately 10 km distance through the city to haul the waste up to disposal site. The tractors as well as dumpers hauling the waste are either not enclosed or partially enclosed during the travel and waste tends to drop or scatter

on the roads. Sometimes, the workers are not provided with necessary personal protective equipments (PPEs) so chances of exposure to the waste are more in that case. The storing and dumping of waste is done through mechanical system, thereby lowering the immediate contact of worker with the wastes during handling and transportation processes.

After collection of all the waste daily, it is being disposed off on to the land near a place called Avaragolla by open dumping method located 10 kms away from Davanagere city limits.

Drawbacks observed in the current management practices

Number of laborers and collection bins should be increased and color coded for proper segregation and use. Liquid and solid waste must be segregated at the origin itself which is not currently practiced. Currently, Hauled Container System is adopted in Davanagere which is best suited for a city and saves the time provided if they increase the number of tippers. If the number of self compactors is increased we can density the huge volume of waste which decreases the overall haul time which in turn saves the fuel. Land disposal method is adopted in Davanagere for all types of wastes generated. Instead of adopting the same land disposal method we can adopt different methods like Incineration Composting, Engineered sanitary landfills after proper segregation of waste.

Transfer station is not adopted in city. Since the city has spread across a large geographical area with many Industrial pockets like Karur Industrial area and rural Davanagere has many Poultry farms it is necessary to have a transfer station in order to segregate and manage waste effectively. If proper segregation methods are adopted at different stages of management practices a huge volume of waste can be composted and energy in the form of biogas using composting and Incineration can be done some quantity of waste to generate energy.

Abandoned wells are being used as solid waste dumping sites in slums and low lying areas which should be avoided and wells can be replenished by rain water discharge. If not the same wells can be made into anaerobic digestors to generate biogas. In dumping site the waste was simply covered by natural soil cover, so the soil does not protect the waste effectively. Hence the site forms a breeding ground for mosquitoes and insects and other species.

Suggesting best Management Practices

Open dumping method is not scientifically effective method of waste disposal because they cause many environmental problems. Open dumping in low lying areas on the outskirts of the Davanagere city is prevalent and practiced. However, due to these methods ill effects, authorities are now exploring new and innovative methods of waste disposal. The best alternative method of municipal

waste disposal as per the composition of waste is sanitary land filling.

Sanitary Landfill

Sanitary land filling is a scientific and effective method of disposal of municipal solid waste economically in which wastes is spread in layers and the waste mass is compacted by bull dozers to reduce the volume. Further a bed of impermeable soil of minimum thickness 15 cm (~6 inches) is dispersed on the cover of the compacted waste known as cell. This cell is further compacted before the next layer of waste is supplemented. When the designed height of the waste-soil mound is reached, then it is covered with another layer of soil of thickness 60 cm, which is then vegetated. The underground water table under the disposal site must be minimum depth of 2 m and the selected site should not be subjected to flooding. Soils differ considerably in their composition and capability to accommodate and renovate the decomposition products of solid waste, so careful consideration is to be made while selecting the site for sanitary land filling.

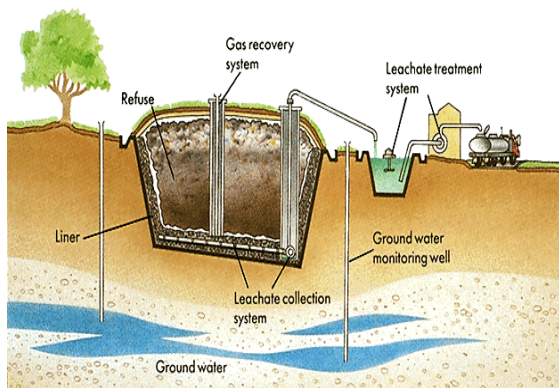


Figure 3 Pictorial representation of basic Sanitary Landfill

Reference: oocities.org/green_juris/landfill

Sanitary land filling of the municipal solid waste is the economical and satisfactory method of disposal among other alternative disposal methods, but only if appropriate land is available within the economic hauling distance. Generally, accumulation and transferring involves 75% of the total cost of solid waste management (SWM) programme. Nevertheless, recycling as well as reduction of the waste can be done together with the landfill to additionally decrease the various costs involved in the SWM. This helps to decrease the amount of waste reaching landfills, thereby increasing the lifespan of the landfill.

Due to the presence of heterogeneous substances in the landfills it creates irregular settlement of the mound, and usually in such cases a closed landfill cannot be utilized as a building site. It might be restored later for recreational

purposes. In many cases the restored site may be used for golf courses or theme parks.

As envisaged, considering the amount and the nature of municipal waste and its composition, sanitary landfill is suggested for Davanagere city with proper leachate collection system. Sanitary land filling site will have a design period of 25 years. The project is proposed to provide the feasible solution to address the Davanagere city’s present and future solid waste management problems. However other techniques can also be explored in near future considering the nature of solid waste and its composition.

VII CONCLUSIONS

It can be concluded that from the above results and discussions that sanitary landfills are best suited method for Davanagere city, since most of the waste generated in organic in nature. Only few wards out of all 41 wards has door to door collection .It is required to have the door to door collection system for all the wards to manage waste effectively. It is found that the collection bins are kept in mutilated conditions and improper locations, to locate the exact site of placement of collection bins GPS tracking systems can be used and its site and numbers along with its capacity can be determined. If the waste is segregated properly into organic, dry and wet waste the processed waste can be effectively converted into energy sources by generation biogas or it can be converted into compost by composting techniques. It can be noted that hauling distance to disposal site is 10kms presently but in future it may increase in coming years to cater the demand of future it is necessary to provide a transfer station and process station somewhere in the city to manage, process and dispose waste efficiently. Finally it can be concluded that the city needs enhancement in its management practices and also Municipal Corporation needs to create awareness programmes among public about waste generation and management to make a cleaner, better and hygiene atmosphere in Davanagere city.

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