VOL. 10, NO. 14, AUGUST 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

A SOLID WASTE MANAGEMENT IN COIMBATORE CITY

Pa. Ganeshwaran[1] and S. Deepa Shri[2]
[1]Karpagam University, Coimbatore, India
[2]Department of Civil Engineering, Karpagam College of Engineering, Coimbatore, India
E-Mail: pa.ganeshwaran@gmail.com

ABSTRACT

Municipal solid waste management (MSWM) is one of the major environmental problems of Indian cities. Improper management of municipal solid waste (MSW) causes hazards to inhabitants. It is an obligatory duty of municipal authorities in the country to keep cities/towns clean and provide a good quality of life to the citizens. However, the services provided by the municipal authorities are outdated and very inefficient. Domestic, commercial, biomedical and variety of toxic and domestic hazardous wastes are generally disposed of by the citizens on the streets, drains, open spaces, water bodies, etc., causing serious problems of health and environment. Studies have revealed that waste generation rate varies from 0.12 to 0.60 kg per capita per day amounting to 115000MTs of waste per day i.e. 42 million tons annually in India. Analysis of physical composition indicates total compostable matter in the waste is in the range of 40-60 percent while recyclable fraction was observed between 10 and 25 percent. The moisture content in the MSW was observed to vary from 30 to 60 per cent while the C:N ratio was observed to be in the range of 20-40. The TATA Energy Research Institute (TERI) has estimated that the waste generation will exceed 260 million tons by 2047 which speaks volumes of the problems that urban areas are going to face in coming decades in managing their waste.

Keywords: municipal solid waste management, domestic, biomedical, c: n ratio, urban.

INTRODUCTION

Rapid industrialization and population explosion in India has led to the migration of people from villages to cities, which generate thousands of tons of MSW daily. The MSW amount is expected to increase significantly in the near future as the country strives to attain an industrialized nation status by the year 2020 (Sharma and Shah, 2005; CPCB, 2004; Shekdar *et al.*, 1992). Poor collection and inadequate transportation are responsible for the accumulation of MSW at every nook and corner. The management of MSW is going through a critical phase, due to the unavailability of suitable facilities to treat and dispose of the larger amount of MSW generated daily in metropolitan cities. Unscientific disposal causes an adverse impact on all components of the environment and human health (Rathi, 2006; Sharholy *et al*., 2005; Ray *et al*., 2005; Jha *et al*., 2003; Kansal, 2002; Kansal *et al*., 1998; Singh and Singh, 1998; Gupta *et al*., 1998). Generally, MSW is disposed of in low-lying areas without taking any precautions or operational controls. Therefore, MSWM is one of the major environmental problems of Indian megacities. It involves activities associated with generation, storage, collection, transfer and transport, processing and disposal of solid wastes. But, in most cities, the MSWM system comprises only four activities, i.e., waste generation, collection, transportation, and disposal. The management of MSW requires proper infrastructure, maintenance and upgrade for all activities. This becomes increasingly expensive and complex due to the continuous and unplanned growth of urban centers. The difficulties in providing the desired level of public service in the urban centers are often attributed to the poor financial status of the managing municipal corporations (Mor *et al*., 2006; Siddiqui *et al.*, 2006; Raje *et al*., 2001; MoEF, 2000; Ahsan, 1999). In the present study, an attempt has been made to provide a comprehensive view of MSWM for Coimbatore city to evaluate the current status and identify the problems of MSWM. The study also aims at encouraging competent authorities/researchers to work towards the improvement of the present system through suggestions and recommendations.

The Coimbatore city generates 530 tonnes of waste per day of which 50% was compostable and 15.52% was recyclable. It further estimated that the calorific value of the garbage is 2381 Kcal/kg. Tamil Nadu is one among the most urbanized states in India with 43.86% of state population living in urban areas. The rate of urbanization in Tamil Nadu doubled from about 22% in 1961 to the present level in 2001. Its population as per 2001 census is 930882 and its present population is around 1009677 (December 2006). Density of population as per 2001 is 8815 persons per Sq.m. The waste generation estimated by the municipal corporation is 601 MT/day, out of which 91% waste is collected each day. Looking to the industrial and commercial activities in the city of Coimbatore and its future potential it is desirable to assume 5% increase in the quantity of waste generation each year. The physical composition of waste has 77% as biodegradable, 6% as non-biodegradable and inert wastes as 16%. The World Bank and TERI have through different studies estimated an annual increase of 4.1 to 5.0% annually in urban areas on account of population growth and change in life style. This is a major infrastructure development initiative undertaken by Government of India from last fiscal year to

improve essential infrastructure in 35 one million plus cities, state capitals and certain important cities of India (63 cities). It is envisaged to invest Rs. 100000 crores over a period of 7 years. The JnNURM consists of two sub missions: (1) urban infrastructure and governance and (2) basic service to the urban poor. The objective present paper is to urban infrastructure and governance, which directly covers solid waste management as one of the important components

STATUS OF COMPLIANCE OF MSW RULES, 2003

The compliance of rules of MSW rules in Coimbatore City Corporation is shown in Figure-1

1. *Prohibit littering of waste on the streets and storage of waste* at source in two bins; one for biodegradable waste and another for recyclable material. With the efforts made so far, 55.19% households and 20.83% shops and establishments have started storing the waste at source.
2. The compliance in regard to segregation of recyclable waste is reported to be only 9.09%.
3. Organize *Primary collection.* System of primary collection of waste from the doorstep has been introduced in 43.96% households and establishments.
4. Organize *Street sweeping*. The corporation has a road length of 686.5 km, in which high density around 95 km and medium density is 150 km and balance goes for low density. The 72%, 15%, 5%, 5% and 3% are frequency of cleaning in streets for daily, alternate days, twice in a week, once in a month and occasionally.
5. *Secondary storages.* Still 84% of city storages are on site open storage and balance goes for with storage containers
6. Organize *Transportation.* The system of using large 2 MT container has been introduced without proper synchronization with the primary collection system.
7. *Waste Processing.* The City Corporation does not have any facility for processing of municipal solid waste except a 50 MT vermi compost plant recently commissioned by a private sector to the extent of 20 MT/day at its "Vellalore" site. The entire waste of the city is disposed of at the landfill site untreated. The present compliance of MSW Rules in regard to treatment of municipal solid waste is only 3%.
8. *Waste disposal*

   City Corporation is fortunate to have a large parcel of 643 acres of land.

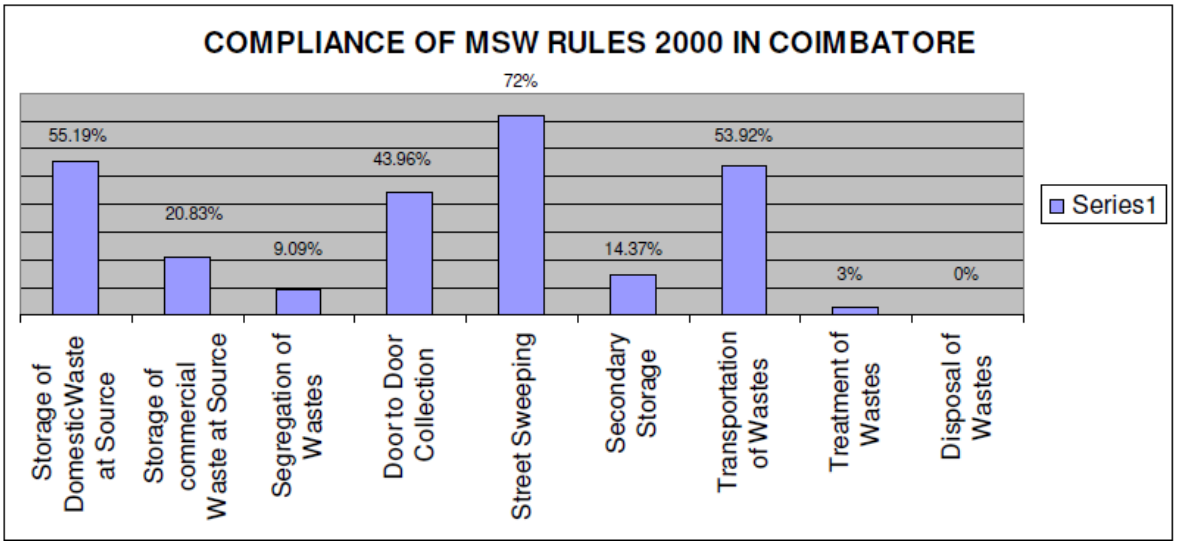

Figure-1. Compliance of MSW rules.

MSW CHARACTERISTICS AND COMPOSITION

The composition and the quantity of MSW generated form the basis on which the management system needs to be planned, designed and operated. In India, MSW differs greatly with regard to the composition and hazardous nature, when compared to MSW in the western countries (Gupta *et al*., 1998; Shannigrahi *et al*., 1997; Jalan and Srivastava, 1995). The composition of MSW at generation sources and collection points was determined on a wet weight basis and it consists mainly of a large organic fraction (40-60%), ash and fine earth (30-40%), paper (3-6%) and plastic, glass and metals (each less than 1%). The C/N ratio ranges between 20 and 30, and the lower calorific value ranges between 800 and 1000 kcal/kg. The ingredients of MSW in India are presented in Figure-2. It has been noticed that the physical and chemical characteristics of MSW change with population density from year to year of population growth and habit of people changes (Garg and Prasad, 2003; CPCB, 2000; Bhide and Shekdar, 1998). The differences in the MSW

characteristics indicate the effect of urbanization and development. In urban areas, the major fraction of MSW is compostable materials (40-60%) and inerts (30-50%). The relative percentage of organic waste in MSW is generally increasing with the decreasing socio-economic status; so rural households generate more organic waste than urban households. For example, in south India the extensive use of banana leaves and stems in various functions results in a large organic content in the MSW. Also, it has been noticed that the percentage of recyclables. (paper, glass, plastic and metals) is very low, because of rag pickers who segregate and collect the materials at generation sources, collection points and disposal sites.

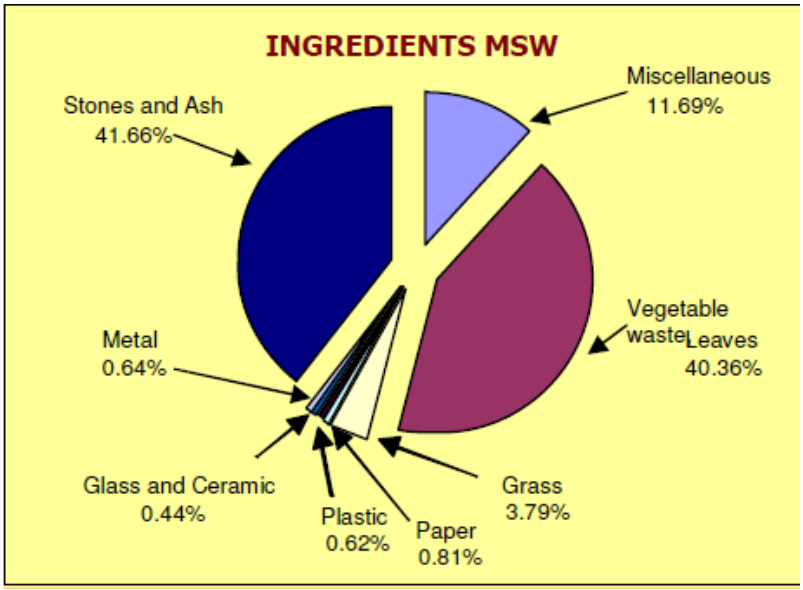

Figure-2. Ingredients of MSW.

STORAGE AND COLLECTION OF MSW

Storage of MSW at the source is substantially lacking in most of the urban areas. The bins are common for both decomposable and non-decomposable waste (no segregation of waste is performed), and the waste is disposed at a communal disposal center. Storage bins can be classified as movable bins and fixed bins. The movable bins are flexible in transportation but lacking in durability, while the fixed bins are more durable but their positions cannot be changed once they have been constructed (Nema, 2004; Malviya *et al.*, 2002). The collection of MSW is the responsibility of corporations/municipalities. The predominant system of collection in most of the cities is through communal bins placed at various points along the roads, and sometimes this leads to the creation of unauthorized open collection points. Efforts to organize house-to-house collection are just starting in many megacities such as Delhi, Mumbai, Bangalore, Madras and Hyderabad with the help of NGOs. It has been observed that many municipalities have employed private contractors for secondary transportation from the communal bins or collection points to the disposal sites. Others have employed NGOs and citizen's committees to supervise segregation and collection from the generation source to collection points located at intermediate points between sources and dumpsites. In addition, the welfare associations on specified monthly payment arrange collection in some urban areas. A sweeper who sweeps the roads manually is allotted a specific area (around 250 m^2). The sweepers put the road wastes into a wheelbarrow, and then transfer the waste to dustbins or collection points (Colon and Fawcett, 2006; Nema, 2004; Malviya *et al*., 2002; Kansal *et al*., 1998; Bhide and Shekdar, 1998).

The collection efficiency is the quantity of MSW collected and transported from streets to disposal sites divided by the total quantity of MSW generated during the same period. Many studies on urban environment have revealed that MSW collection efficiency is a function of two major factors: manpower availability and transport capacity. The average collection efficiency for MSW is 64.6%, and average it is about 70% (Rathi, 2006; Siddiqui *et al*., 2006; Nema, 2004; Gupta *et al*., 1998; Maudgal, 1995; Khan, 1994).

Generally, overcrowded low-income settlements do not have MSW collection and disposal services. The reason is that these settlements are often illegal and the inhabitants are unwilling or unable to pay for the services. They throw away the waste near or around their houses at different times, which make the collection and transportation of waste very difficult in these areas. The Central Pollution Control Board (CPCB) has collected data for the 299 Class-I cities to determine the mode of

collection of MSW. It is found that manual collection comprises 50%, while collection using trucks comprises only 49% (CPCB, 2000).

TRANSFER AND TRANSPORT OF MSW

Transfer stations are not used, and the same vehicle, which collects refuse from individual dustbins, takes it to the processing or disposal site (Colon and Fawcett, 2006; Khan, 1994). The MSW collected from the dustbins and collection points is transported to the processing or disposal sites using a variety of vehicles. In smaller (rural) towns, bullock carts, tractor-trailers, tricycles etc., are mainly used for the transportation of MSW. Light motor vehicles and lorries are generally used in big towns or cities for transport of MSW. The trucks used for transportation of MSW are generally of an open body type and are usually kept uncovered; thus during transportation, the waste tends to spill onto the road resulting in unhygienic conditions. In some cities, modern hydraulic vehicles are gradually being introduced (Bhide and Shekdar, 1998; Reddy and Galab, 1998). Collection and transportation activities constitute approximately 80-95% of the total budget of MSWM; hence, it forms a key component in determining the economics of the entire MSWM system. Municipal agencies use their own vehicles for MSW transportation although in some cities they are hired from private contractors (Ghose *et al*., 2006; Siddiqui *et al*., 2006; Nema, 2004; Bhide and Shekdar, 1998).

PROPOSAL FOR IMPROVING MSWM

1. Prohibit littering; ensure source segregation of recyclables and storage of waste at source
2. Segregation of recyclable / non-biodegradable waste
3. Primary collection of waste
4. Sweeping of streets and public spaces
5. Abolish open waste storage sites and have covered secondary waste storage depots
6. Transportation of waste
7. Processing of waste
8. Ecofriendly treatment of MSW through production of compound based organic manure
9. Disposal of waste

CONCLUSIONS

The informal policy of encouraging the public to separate MSW and market it directly to the informal network appears to be a better option. The involvement of people and private sector through NGOs could improve the efficiency of MSWM. Public awareness should be created among masses to inculcate the health hazards of the wastes. Littering of MSW should be prohibited in cities, towns and urban areas notified by the state government. Moreover, house-to-house collection of MSW should be organized through methods like collection on regular pre-informed timing and scheduling.

The collection bins must be appropriately designed with features like metallic containers with lids, and to have a large enough capacity to accommodate 20% more than the expected waste generation in the area, with a design for mechanical loading and un-loading, placement at appropriate locations, etc. Municipal authorities should maintain the storage facilities in such a manner that they do not create unhygienic and unsanitary conditions. Proper maintenance of the MSW transportation vehicles must be conducted, and the Dumper Placer should replace the old transportation vehicles in a phased manner. Currently, at the level of waste generation and collection, there is no source segregation of compostable waste from the other non-biodegradable and recyclable waste. Proper segregation would lead to better options and opportunities for scientific disposal of waste. Recyclables could be straightway transported to recycling units that in turn would pay a certain amount to the corporations, thereby adding to their income. This would help in formalizing the existing informal set up of recycling units. It could lead to several advantages such as enabling technology upgradation, better quality products, saving of valuable raw material resources of country, reducing the need for landfill space, a less energy-intensive way to produce some products and employing labor in recycling industries. Organizing the informal sector and promoting micro-enterprises are an effective way of extending affordable services. Promotion and development of recycling is a means of upgrading living and working conditions of rag pickers and other marginalized groups.

Most of the MSW in India is dumped on land in an uncontrolled manner. Such inadequate disposal practices lead to problems that will impair human and animal health and result in economic, environmental and biological losses. Comparing the biological, chemical and thermal treatment options in the Indian scenario, perhaps the biological processing options get the priority. Composting and vermicomposting are successful and quite popular now in India instead of incineration. But, it is slow process and requires a large space. An open dump or an uncontrolled waste disposal area should be rehabilitated. It is advisable to move from open dumping to sanitary landfilling in a phased manner. Landfilling should be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. The current regulations (MSWM rules, 2000) are very stringent. Norms have been developed to ensure a proper MSWM system. Unfortunately, clearly there is a large gap between policy and implementation. The producer responsibility is to avoid having products on the market that cannot be handled effectively and environmentally correctly when they become waste products. A new survey should be carried out on the generation and characterization of MSW in India. Since the MSW is heterogeneous in nature, a large number of samples have to be collected and analyzed to obtain statistically reliable results. Finally, the study

concluded that the lack of resources such as financing, infrastructure, suitable planning and data, and leadership, are the main barriers in MSWM. The increase of service demands combined with the lack of resources for municipalities are putting a huge strain on the existing MSWM systems.

REFERENCES

Agarwal, A., Singhmar, A., Kulshrestha, M., Mittal, A.K., 2005. Municipal solid waste recycling and associated markets in Delhi, India. Journal of Resources, Conservation and Recycling. 44 (1): 73-90.

Ahsan, N. 1999. Solid waste management plan for Indian megacities. Indian Journal Of Environmental Protection. 19 (2): 90-95.

Ambulkar, A.R., Shekdar, A.V. 2004. Prospects of biomethanation technology in Indian context: a pragmatic approach. Journal of Resources, Conservation and Recycling. 40(2): 111-128.

Bezboruah, A.N., Bhargava, D.S. 2003. Vermicomposting of municipal solid waste from a campus. Indian Journal of Environmental Protection. 23 (10): 1120–1136.

Bhide, A.D., Shekdar, A.V. 1998. Solid waste management in Indian urban centers. International Solid Waste Association Times (ISWA). (1): 26-28.

Central Pollution Control Board (CPCB). 2004. Management of Municipal Solid Waste. Ministry of Environment and Forests, New Delhi, India.

CPCB. 2000. Status of Solid Waste Generation, Collection, Treatment and Disposal in Metrocities, Series: CUPS/46/1999-2000.

CPCB. 2000. Status of Municipal Solid waste Generation, Collection, Treatment and Disposal in Class I Cities, Series: ADSORBS/31/1999-2000.

Chakrabarty, P., Srivastava, V.K., Chakrabarti, S.N., 1995. Solid waste disposal and the environment - a review. Indian Journal Of Environmental Protection. 15(1): 39-43.

Colon, M., Fawcett, B. 2006. Community-based household waste management: lessons learnt from EXNOR's zero waste management scheme in two south Indian cities. Journal of Habitat International. 30(4): 916-931.

Das, D., Srinivasu, M., Bandyopadhyay, M. 1998. Solid state acidification of vegetable waste. Indian Journal of Environmental Health. 40(4): 333-342.

Datta, M. 1997. Waste Disposal in Engineered Landfills. Narosa publishing house, New Delhi, India.

Dayal, G. 1994. Solid wastes: sources, implications and management. Indian Journal of Environmental Protection. 14 (9): 669-677.

Garg, S., Prasad, B. 2003. Plastic waste generation and recycling in Chandigarh. Indian Journal of Environmental Protection. 23 (2): 121-125.

Ghose, M.K., Dikshit, A.K., Sharma, S.K.. 2006. A GIS based transportation model for solid waste disposal - A case study on asansol municipality. Journal of Waste Management. 26(11): 1287-1293.

Ghosh, C. 2004. Integrated vermin - pcsciculture - an alternative option for recycling of municipal solid waste in rural India. Journal of Bioresource Technology. 93(1): 71-75.

Gupta, S., Krishna, M., Prasad, R.K., Gupta, S., Kansal, A. 1998. Solid waste management in India: options and opportunities. Resource, Conservation and Recycling. 24: 137-154.

Gupta, P.K., Jha, A.K., Koul, S., Sharma, P., Pradhan, V., Gupta, V., Sharma, C., Singh, N. 2007. Methane and Nitrous Oxide Emission from Bovine Manure Management Practices in India. Journal of Environmental Pollution. 146(1): 219-224.

Mohanasundaram, K. M., N. Godwin Raja Ebenezer, and C. Krishnaraj. 2012. "Forward Kinematics Analysis of SCORBOT ER V Plus using LabVIEW." European Journal of Scientific Research. 72(4): 549-557

Jalan, R.K., Srivastava, V.K.. 1995. Incineration, land pollution control alternative - design considerations and its relevance for India. Indian Journal of Environmental Protection. 15(12): 909-913.

Shri, S. Deepa, R Thenmozhi. 2013. "Prediction of Impact Energy Absorption Using Modified Regression Theory" Life Science Journal. 10(2): 743-749.

Jha, M.K., Sondhi, O.A.K., Pansare, M. 2003. Solid waste management - a case study. Indian Journal of Environmental Protection. 23(10): 1153-1160.

Joardar, S.D. 2000. Urban residential solid waste management in India. Public Works Management and Policy. 4(4): 319-330.

Joseph, K.. 2006. Stakeholder participation for sustainable waste management. Journal of Habitat International. 30 (4): 863-871.

Kansal, A. 2002. Solid waste management strategies for India. Indian Journal of Environmental Protection. 22(4): 444-448.

Krishnaraj, C., K. M. Mohanasundram, and S. Navaneethasanthakumar. 2012. "Implementation Study Analysis Of Ftfmea Model In Indian Foundry Industry." Journal of Applied Sciences Research. 8(2).

Kansal, A., Prasad, R.K., Gupta, S. 1998. Delhi municipal solid waste and environment - an appraisal. Indian Journal of Environmental Protection. 18(2): 123-128.

Khan, R.R. 1994. Environmental management of municipal solid wastes. Indian Journal of Environmental Protection. 14(1): 26-30.

Shri, S. Deepa, R. Thenmozhi, and M. Anitha. 2012. "Experimental Validation of a Theoretical Model for Flexural Capacity of Hybrid Ferrocement Slab." European Journal of Scientific Research. 73(4): 512-526.

Lal, A.K.. 1996. Environmental status of Delhi. Indian Journal of Environmental Protection. 16(1): 1-11.

Malviya, R., Chaudhary, R., Buddhi, D. 2002. Study on solid waste assessment and management - Indore city. Indian Journal of Environmental Protection. 22(8): 841-846.

Maudgal, S., 1995. Waste management in India. Journal of Indian Association for Environmental Management. 22 (3): 203-208.

Krishnaraj, C., and K. M. Mohanasundram. 2012. "Design and Implementation Study of Knowledge Based Foundry Total Failure Mode Effects Analysis Technique." European Journal of Scientific Research. 71(2): 298-311.

Ministry of Environment and Forests (MoEF). 2000. The Gazette of India. Municipal Solid Waste (Management and Handling) Rules, New Delhi, India.

Mor, S., Ravindra, K., Visscher, A.D., Dahiya, R.P., Chandra, A. 2006. Municipal solid waste characterization and its assessment for potential methane generation: a case study. Journal of Science of the Total Environment 371 (1): 1-10.

Nema, A.K.. 2004. Collection and transport of municipal solid waste. In: Training Program on Solid Waste Management. Springer, Delhi, India.

Pappu, A., Saxena, M., Asokar, S.R. 2007. Solid Waste Generation in India and Their Recycling Potential in Building Materials. Journal of Building and Environment. 42(6): 2311-2324.

Krishnaraj. C., K.M. Mohanasundram, S.R. Devadasan,and N.M. Sivaram. 2012. “Total failure mode and effect analysis: a powerful technique for overcoming failures.” International Journal of Productivity and Quality Management. 10(2): 131-147.

Peavey, H.S., Donald, R.R., Gorge, G. 1985. Environmental Engineering. McGraw-Hill Book Co, Singapore.

Raje, D.V., Wakhare, P.D., Despande, A.W., Bhide, A.D. 2001. An approach to assess level of satisfaction of the residents in relation to SWM system. Journal of Waste Management and Research. 19: 12-19.

Rao, K.J., Shantaram, M.V. 1993. Physical characteristics of urban solid wastes of Hyderabad. Indian Journal of Environmental Protection. 13(10): 425-721.

Rathi, S., 2006. Alternative approaches for better municipal solid waste management in Mumbai, India. Journal of Waste Management. 26(10): 1192-1200.

Ray, M.R., Roychoudhury, S., Mukherjee, G., Roy, S., Lahiri, T., 2005. Respiratory and general health impairments of workers employed in a municipal solid waste disposal at open landfill site in Delhi. International Journal of Hygiene and Environmental Health. 108(4): 255-262.

Reddy, S., Galab, S. 1998. An Integrated Economic and Environmental Assessment of Solid Waste Management in India - the Case of Hyderabad, India.

Sannigrahi, A.K., Chakrabortty, S. 2002. Beneficial management of organic waste by vermicomposting. Indian Journal of Environmental Protection. 22(4): 405-408.

Shannigrahi, A.S., Chatterjee, N., Olaniya, M.S. 1997. Physico-chemical characteristics of municipal solid wastes in mega city. Indian Journal of Environmental Protection. 17(7): 527-529.

Shri, S. Deepa, and R. Thenmozhi. 2012. "An Experimental Investigation on the Flexural Behavior of SCC Ferrocement Slabs Incorporating Fibers." International Journal of Engineering Science and Technology. 4(5).