IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 4, Issue 10, October 2017

Integrated Solid Waste Management: Review for Better Solution

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Abstract: Solid waste considered as discarded material, but it need to be considered as a source. Solid waste management includes collection, transportation, disposal, but integrated waste management includes collection, transportation, recycling, composting, disposal. Management of solid waste reduces effects on the environment and human health and gives improved quality of life. Integrated solid waste management can generate coordination of waste from one manner to become resources for another. At present solid waste disposal at open dump and landfilling are more considered in developing countries. While developed countries they have more focused on recycling of waste, generate energy from waste, by those revenues and employment is generated. For developing countries challenge is posed to mitigate the problems of arising waste management. This paper reflects the potential for integrated waste management in developed countries and gives the guideline for developing countries.

Keywords: Composting, developed country, developing country**,** Integrated Solid Waste Management, incineration, recycling, Waste management

I. INTRODUCTION

Solid waste is the unwanted for some people and useful to many people and it is generated from residential, industrial and commercial activities in a specific area. It may be categorized according to its origin (domestic, industrial, commercial, institutional); according to its contents (organic material, glass, metal, plastic, paper etc.)

Management of solid waste reduces adverse impacts on the environment and human health and supports economic development and improved quality of life. The sanitation goal will fail if the solid waste management aspect not gains proper attention. The municipality can effectively manage waste by these processes monitoring, collection, transport, processing, recycling and disposal. Using the methods of waste reduction, reuse and recycling, it is beneficial to the environment. Therefore, it is advisable that those methods should be adopted for a waste management plan.

Definition of integrated solid waste management: Integrated Solid Waste Management is a comprehensive waste of reuse, recycling, composting, and disposal program. Integrated solid waste management is an approach to manage the municipal waste to generate coordination of waste from one manner to become resources for another. (Integrated solid waste and resource management, Vancouver, 2010) Aim of this is reducing the amount of waste being disposed to landfill. In first aspect source reduction is preferred; we can utilize this by reuse of material. In second aspect recycling is there; we can utilize this by segregation of useful material like plastic, metal, glass, etc. In third aspect we can achieve recovery by composting of organic waste. In a fourth aspect after doing above treatments which material we can't recover or reuse that we can use for waste-to-energy plants. In last aspect left out waste material should be disposed to landfill. Based on above aspects we have to choose appropriate technology to manage municipal solid waste. (Municipal solid waste management manual, Govt. Of India, 2016)

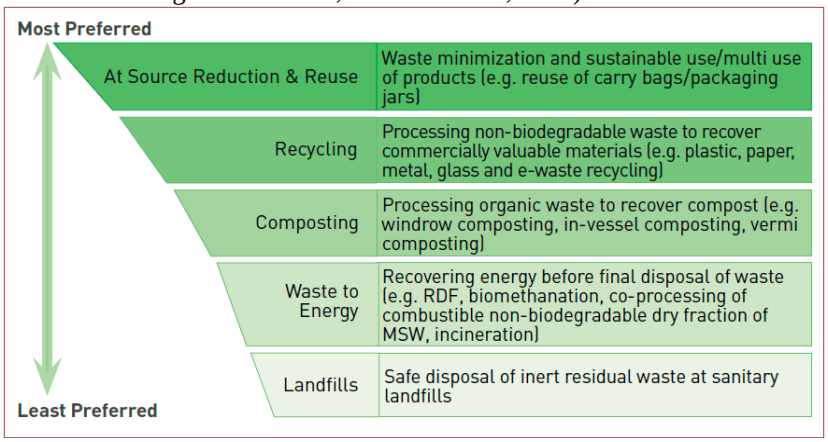

Fig. 1. Integrated waste management system Hierarchy [Source]

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II. INTEGRATED SOLID WASTE MANAGEMENT IN DEVELOPED COUNTRIES

Integrated solid waste management is effectively used in developed countries for reduction of load to landfill sites. This also helps in the control of carbon emission. Integrated solid waste management is difficult to implement for urban local bodies and municipalities around the world. In exiting solid waste management is done as collection, transformation and disposal. Generally disposal is done at landfill sites or open dumping is done in many countries this gives rise to methane emissions. Many countries in Europe have made policies in that they have planned to ban all recyclables to landfill by 2025, by implementing these policies they have achieved a reduction in quantity of waste to landfill from 70% in 2004 to 34% in 2013. Compare to Netherland and Germany this amount is very high, in these countries only 2% of total solid waste generated goes to landfill. In UK positive change in was found in waste generation and disposal due to changes in the solid waste management arena. The change is found in waste generation and recycling rate for the year of 2001 to 2010, waste generate rate was 36.1 million tonnes in 2004 which is reduced to 32.4 million tonnes in 2010, they have reduced solid waste landfills from 80% in 2001 to 49% in 2010, and their recycling rate was increased from 12% in 2001 to 39% in 2010, and they have set a target to recycle waste to 50% by 2020. (Municipal Waste Management in the United Kingdom, 2013) In UK 21% generated waste is managed by incineration plant, which lower than Netherland and Germany, their value is 49% and 35% respectively. In UK 80% electricity of total electricity generated in the UK is generated from 25 waste incineration plants. (H.K. Jeswani, A. Azapagic, 2016) US manage their waste by disposed to landfill 77% and 18% recycled in 2004. (Brian Bahor, Michael Van Brunt, Jeff Stovall, Katherine Blue, 2009) In the US they were facing huge solid waste problem in 1960 they are generating 90 million metric tonnes/year wastes; this value is increased by 60% by 2007 about 250 million metric tonnes/year. In 2012 the rate of waste generation was same, but they increased the recycling and composting rate about 87 million tonnes of total waste, in that 65 million tonnes waste through recycling, and 21 million tonnes waste composted or landfilled after it was discarded from composting and recycling. (US EPA, 2014) Canada manage their waste by many procedures and they deposit less amount of waste to landfill, it includes the incineration process of waste, which manage 5% of total waste, they divert their waste about 51% by recycling and composting and remaining waste goes to landfill. (Human activity and the environment, Canada, 2012) In Italy they have 5 waste-to-energy plants and generate 819 kWh/T electricity and 173,100 tonnes waste per year. (International solid waste association, 2006) In year 2010 France has 2 waste-to-energy plants and they generate 609 kWh/T electricity and 57000 tonnes waste per year. (Don McCallum, 2011)

III. INTEGRATED SOLID WASTE MANAGEMENT IN DEVELOPING COUNTRIES

Developing countries like India, Srilanka, Malaysia etc. solid waste related issues are in quantum level due to high population and low income of the population and Technology have not found in the level of developed countries. Thus, these countries they need more and better waste infrastructure. The rise of population growth and urbanization waste volume is also increasing; if waste expansion service will not expand it will harm the environment. In Asia they generate waste about 0.29tonnes/capita/year and their collection rate is 67%. UNEP describes methods for waste treatment and disposal in developing Asian countries like open dumping about 50%, landfill 10-30%, incineration 2-5% and composting less than 15%. (Yeny Dhokhikah, Yulinah Trihadiningrum, 2012) In Bangladesh Dhaka City Corporation are collecting waste by door to door collection method and their waste generation rate is 3500 tonnes per day and they have estimated 30,000 tonnes per day by 2020. Thus till 2020 Dhaka city will be in need of about 167.11 acres/year to 96.97 acres/year with composting facility of organic waste and without composting they need 206.31 acres/year. In Dhaka composting was more successful in small-scale plants rather than large-scale plants. (Faisal Ibney Hai, M. Ashraf Ali, 2005). Malaysia generates 5475,000 tonnes of solid waste in 2001, (Uyen Nguyen Ngoc, Hans Schnitzer, 2009) and manages their by final disposal is about 70% and 25-30% was dumped or thrown into the river. In Indonesia they generate 19,100 tonnes/year in 2005 and they manage solid waste to landfill 69%, buried 6.9%, composted 7.15%, burnt 4.8%, disposed to river 2.9% and others 6.55%. In the Philippines they generate about 36,172.50 tonnes/year and they have implemented Clean development Mechanism with a waste -to-energy plants in Payatas, this energy plant generates about 60-70 kW electricity, which was supplied to 20 residents. (Yeny Dhokhikah, Yulinah Trihadiningrum, 2012) In Singapore they generate approximately 1400 tonnes/ day and they manage their waste by 10% composting, 2% open dumping, 2% landfill, 70% incineration, 7% others. Vietnam generates about 49,134,000 tonnes/year and they manage their waste by 70% open dumping, 8% landfill, 10% composting, 2% incineration, 10% others. In 2001 Thailand generates waste about 38,640 tonnes/day and they manage their waste by 5% landfill, 5% incineration, 10% composting, 65% open dumping, 15% others. (Uyen Nguyen Ngoc, Hans Schnitzer, 2009)

India had a population of 1.2 billion in 2011 and from those 377 million people lives in urban areas, and they generate waste about 143,449 metric tonnes per day. (Manual of solid waste management, India, 2016) In India, solid waste management is one of the main functions of municipal bodies. Though it is not fulfilling services which people of India

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deserves. Solid Waste Management is important, on-going and large public service system, which needs to be efficiently provided to the community for good aesthetics and public health standards. (Dipam Saikia, Manash Jyoti Nath, 2015) It is predicted that the population of India would be about 1,823 million by 2051 and about 300 million tonnes per annum of solid waste will be generated that will require about 1,450 km2 of land to dispose it in a systematic manner, if ULBs in India continue to rely on landfills for MSW. (Rajkumar Joshi and Sirajuddin Ahmed, 2016) Big cities collect about 70 - 90% of Municipal Solid Waste generated, whereas smaller towns collect less than 50% of waste generated. More than 91% of the solid waste collected formally is directly disposed to open landfill. About 10% of the collected solid waste are openly burnt or is caught in landfill fires. It's not that India is not doing for the waste management, they have planned to apply many technologies but somehow they have failed. MBT plants were built in 1975-1976, WTE facility built in 1985, and two RDF plants were built in 2003 near Hyderabad and Vijayawada. Anaerobic digestion at large scale not worked in India because the absences of source separation. Biomethanation plant built in Lukhnow at large scale to generate 6 MW of electricity, but it was failed for the same. Anaerobic digestion somehow successful at smaller scale for vegetable and meat markets, restaurant and household level. In Thiruvananthapuram, Kerala 20,000 household biogas plants were installed and divert 2.55% of organic waste from landfill. Aerobic composting is widely employed waste management technology in India, by this technology up to 6% of waste collected and composted. There are more than 80 MBT plants in India most of them located in the states of Maharashtra (19), Himachal Pradesh (11), Chhattisgarh (9), and Orissa (7). India has 5 RDF plants located in Hyderabad, Vijayawada, Jaipur, Chandigarh and Rajkot. There are only 2 WTE plants were built in India, both in Delhi and they generate 16 MW of electricity of 1350 tonnes/day of solid waste.

None of the above plants are in working conditions because it is designed for more waste than it acquired; allocation of funds and maintenance was ignored, local conditions were not considered for importing the technology. (Sustainable Solid waste management in India, 2012)

IV. PROBLEMS OF SOLID WASTE IN INDIA

In India, Municipal Solid waste management is governed by Municipal Solid Waste Rules. The majority of ULBs does not have proper action plans for execution of that management rules. In India major problem is collection, no city can claim 100% collection of waste only 70% collection is observed and remaining 30% is lost in the environment. (CPCB Report, 2013) Main problem in India is facing is segregation of waste, there is no appropriate method or system for segregation at household level or at community level. After the collection of waste transportation occur major vehicles is used for transportation are bullock cart, hand rickshaws, compactors, trucks, dumpers, tractors. These vehicles need maintenance, if any problem or fault will occur that solved in the workshop only minor repairs are done, if vehicle will break down, it will affect the collection, transportation, disposal efficiency reduced. (Joseph, 2002) Biggest problem in India is 90% of waste is dumped into open land and that is harmful to public health and the environment. Because of open dumping it will create leachate that will penetrate into the ground and pollute the ground water. (R. Chatterjee, 2009)

V. CONCLUSION

The management of municipal solid waste in India is facing various problems not only because of environmental and aesthetic concerns, but also because of the major amount of quantities generated every day. India needs to educate people to follow the guidelines which are actually circulated. Developed countries have the well maintained and better infrastructure for integrated waste management while developing countries they need to pay the proper attention and need to take this waste management problem at serious note. Developed countries have the various technologies like a waste to energy plant, Composting of organic waste, Incineration, recycle of waste, landfill while developing countries need to focus to develop these technologies with greater amount and Covert waste management from integrated waste management. They need to involve the community in solid waste management to sustain the project and need to start collecting tax on Waste management. The waste should be treated as a resource and from total waste separation of non-recyclable material can provide employment to rag-pickers. Developing country likes India they face rapid urbanization and industrialization, it creates more waste generation, because of less public participation, the amount of waste generated is high for ULB to manage. This can be reduced by source segregation, installing decentralized composting plant and involvement of PPP mode.

ACKNOWLEDGMENT

I would like to express the deepest appreciation **Arti Pamnani** who gives continues support, her patience, motivation and immense knowledge which enabled me to complete this paper. I am also **thankful Indrajit N Patel**, who is principal of the B.V.M Engineering College and Jagruti Shah, who is a faculty of the Infrastructure Engineering department, they have provided guidance and support with a positive attitude.

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