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Research Paper

Waste Management: A collective, comparative report on various techniques employed across the globe

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Abstract— **In view of fast paced economic growth accompanied with rapid urbanization, management of waste has emerged as one of the major environmental challenges of present times. Both the developing and developed countries are going through the problem of waste management. It is observed that the current laws are unable to ensure environmentally sound and sustainable ways of dealing with waste generation and disposal practices, in spite of various efforts in enforcing it. The practice of the uncontrolled dumping of waste on the outskirts of towns/cities have created a serious environmental and public health issues. In abroad, Advanced Thermal Treatment (ATT), incineration with energy recovery, which has the lowest Global Warming Potential (GWP), and landfill are used widely compared to other methods. In India waste dumping or open burning continue to be the principal method of waste disposal which is not environment friendly. The great need for the appropriate waste management techniques with respect to the changing pattern of the waste generation is needed, which can help the urban local bodies, responsible for waste management, in preparing more efficient plans. The more alarming situation that is faced now is the unavailability of dumping grounds for wastes. As a way to fix few of these things, primary waste collection should be carried out, by collecting wastes from various sources of waste generation on a daily basis, through active public participation. Measures should be taken to adapt new techniques for collection, treatment, disposal of waste meanwhile planning an Integrated Waste Management System. Recovery, reuse, volume reduction, environmental awareness campaigns, household separations should be enforced for effective control on waste generation and disposal. This study highlights the present waste management techniques employed in different countries and their applications, along with the pros and cons of each one of them, which will shed light upon various effective technologies that can be implemented or improved to handle the wastes produced, in a better way, so that we can think of a healthier life on the planet.**

Keywords: Management, waste, control

INTRODUCTION

The main purpose of solid waste management (SWM) strategies are to address the human health, environmental issues, land-use, resource, and economic concerns associated with the improper disposal of waste [1]. Increasing rapid urbanization, population levels, booming economy and the rise in community living standards have greatly accelerated the municipal solid waste generation rate in developing countries. In recent years, a large number of research studies have been undertaken to

determine influential factors affecting waste management systems in developing countries [2]. During the earlier days, solid wastes were conveniently and unobtrusively disposed off in large open land spaces, as the density of the population was low. One of the consequences of global urbanization is an increased amount of solid waste. Fast paced economic growth accompanied with rapid urbanization, although a global phenomenon, their ramifications are more pronounced in developing countries. These are believed to likely account for 90% of the growth in urban population and is estimated to double between 1975 and 2015. Such rapid, unplanned and haphazard urbanization brings challenges in the form of expansion of slums and additional pressure on the already overburdened urban infrastructure. One of the direct outcomes of growth in urban population is the corresponding increase in the generation of Municipal Solid Waste (MSW) [3].

HISTORY

Humans have been producing solid waste since they first formed non-nomadic societies around 10,000 BC. Public health concerns, aesthetics, scarcity of resources, and security concerns acted as central drivers for waste management systems. As waste accumulated in these growing communities, people simply lived amongst the filth. Organized SWM processes were implemented in the ancient city of Mahenjo-Daro in the Indus Valley by 2000 BC. The industrial revolution brought rapid expansion to American and European cities. A new era in sanitation began to take shape between 1790 and 1850 in London, where the high ash content of household waste caused by heating and cooking using coal, created a flourishing market for waste collection and promoted its use as a raw material to meet the excess demand for bricks. Public health legislation continued to drive waste management forward in the coming century. The first municipal priority was to collect and remove waste from the immediate vicinity of residential areas.

CURRENT METHODS

Surveys that are carried out have indicated that, in India, for increase of every INR 1000 in the income, the solid waste generation increases by one kilogram per month. The growth of GDP for every decade, since 1960, suggests that Indian GDP growing rapidly during last few decades [4].

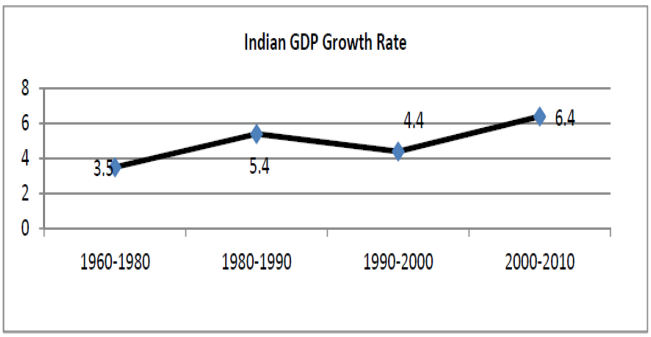

Figure1: Indian GDP growth rate

Composting:
Composting is difficult process as the waste arrives in a mixed form and contains a lot of non-organic material. When mixed waste is composted, the end product is of poor quality. The presence of plastic objects in the waste stream is problematic, since these materials do not get recycled or have a secondary market. In the absence of segregation, even the best waste management system or plant will be rendered useless.

Incineration:
Incineration is a poor option as the waste mainly consists of high organic material (50%) and high inert content (40%) with low calorific value content (800–1100 kcal/kg) and high moisture content (40%) in MSW.

Gasification:
It is the solid waste incineration under oxygen deficient conditions, to produce fuel gas. In India, there are very few gasifiers in operation, but they are mostly for burning of biomass such as agro-residues, sawmill dust, and forest wastes. Gasification can also be used for MSW treatment after drying, removing the inert and shredding for size reduction.

Refuse Derived Fuel (RFD) Plants:
They produce an improved solid fuel or pellets from MSW. The RDF plant reduces the pressure on landfills. Combustion of the RDF from MSW is technically sound and is capable of generating power. RDF can be fired along with the conventional fuels like coal without any ill effects for generating heat. Operation of the thermal treatment systems involves higher cost and also a relatively higher degree of expertise.

Landfilling:
A landfill is an area of land, onto which the waste is deposited. The aim is to avoid any contact between the waste and the surrounding environment, particularly the groundwater. Open, uncontrolled and poorly managed dumping is commonly practiced, giving rise to serious environmental degradation of MSW in cities and towns. These methods are not in accordance with the practices of sanitary land filling. The dumping is often done in low lying areas, which are prone to flooding, thereby increasing the possibility of surface water contamination during the rainy season. Such dumping activity in many coastal towns has led to heavy metals rapidly leaching into the coastal waters. The daily cover techniques are poor, which makes leakage easier. This is mainly because of a lack of knowledge and skill on the part of the local authorities.

Figure2: Landfill

Bioreactor Landfill:

A further development in technology is the bioreactor landfill. Bioreactor landfills are designed, constructed and operated to optimize moisture content and increase the rate of anaerobic biodegradation. The principal function that distinguishes them from conventional landfills is leachate recirculation. The goal is to increase the rate of bio-degradation to achieve maximum gas generation rate and output, so as to optimize recovery for energy production. This approach mainly aims to minimize the landfill stabilization time and reduce the period of monitoring and liability retention. The bioreactor option is a direct result of engineering and building a new generation of environmentally sound landfills; it provides environmental security while permitting and encouraging rapid stabilization of the readily and moderately decomposable organic waste components.

Waste management and recycling system components in reference cities [4]

From the data obtained from table we can observe that the collection of waste is more in developed countries comparatively to developing ones in terms of percentage. Land filling and incineration are principal methods followed for waste disposal.

City, Country	Drivers for development				
	Public health	Environmental protection		Resource value	
	Coverage of waste collection and sweeping (%)	Controlled disposal/ incineration of total disposed/ incinerated (%)	State-of-the-art landfilling/ incineration of total disposed/ incinerated (%)	Materials recovered by formal sector (%)	Materials recovered by informal sector (%)
Adelaide, Australia	100	100	100	54	0
Rotterdam, Netherlands	100	100	100	30	0
San Francisco, USA	100	100	100	72	0
Tompkins County, USA	100	100	100	61	0
Varna, Bulgaria	100	100	100	2	26
Belo Horizonte, Brazil	95	100	100	0.1	6.9
Canete, Peru	73	81	0	1	11
Curepipe, Mauritius	100	100	100	NA	NA
Kunming, China	100	100	100	38	NA
Sousse, Tunisia	99	100	100	0	6
Quezon City, Philippines	99	100	0*	8	31
Managua, Nicaragua	82	100	0	3	15
Bengaluru, India	70	78	78	10	15
Delhi, India	90	100	0	7	27
Ghorahi, Nepal	46	100	100	2	9
Dhaka, Bangladesh	55	90	60	0	18
Nairobi, Kenya	65	65	0	NA	NA
Moshi, Tanzania	61	78	0*	0	18
Lusaka, Zambia	45	100	100	4	2
Bamako, Mali	57	0	0	0	85
Average	**82**	**90**	**62**	**16**	**15**
Median	**93**	**100**	**100**	**4**	**11**

Figure3: Waste management in different cities

IV FUTURE CHALLENGES:

A successful long term planning depends on the characteristics of the solid waste and estimation of future quantities. Decisions related to treatment choices and disposal options for solid waste management will get affected by the composition of solid waste in the future. A long time Forecast will be more meaningful if it gives the most optimistic, most pessimistic values and also the most likely values [5].

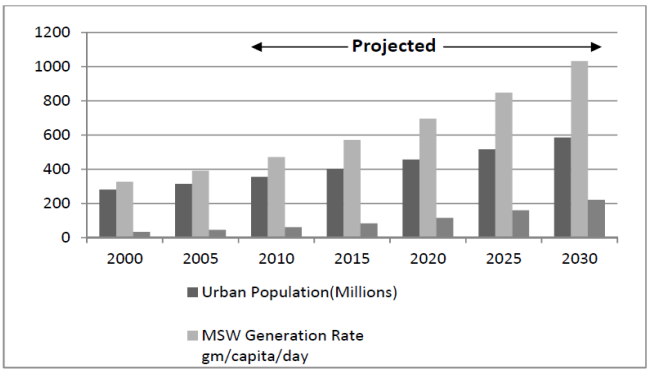

Figure4: Projected Municipal Waste Generations for

Urban population

V CONCLUSION:

An attempt has been made in this article to study the changing trends of quantity and characteristics of MSW to find its impact on the performance and capacity planning of recovery/recycle, compost, incineration and landfill facilities across the globe. The changing pattern of waste composition emphasizes the importance of segregation for successful operation of waste management facilities. Municipal authorities should maintain the storage facilities in such a manner that they do not create unhygienic and unsanitary conditions.

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