Waste Management 29 (2009) 1163–1166

Contents lists available at ScienceDirect

Waste Management

journal homepage: www.elsevier.com/locate/wasman

Municipal solid waste management in India: From waste disposal to recovery of resources?

Tapan Narayana *

Hidayatullah National Law University, HNLU Bhawan, Civil Lines, Raipur 492001, Chhattisgarh, India

ARTICLE INFO

Article history:
Accepted 2 June 2008
Available online 1 October 2008

ABSTRACT

Unlike that of western countries, the solid waste of Asian cities is often comprised of 70–80% organic matter, dirt and dust. Composting is considered to be the best option to deal with the waste generated. Composting helps reduce the waste transported to and disposed of in landfills. During the course of the research, the author learned that several developing countries established large-scale composting plants that eventually failed for various reasons. The main flaw that led to the unsuccessful establishment of the plants was the lack of application of simple scientific methods to select the material to be composted.

Landfills have also been widely unsuccessful in countries like India because the landfill sites have a very limited time frame of usage. The population of the developing countries is another factor that detrimentally impacts the function of landfill sites. As the population keeps increasing, the garbage quantity also increases, which, in turn, exhausts the landfill sites. Landfills are also becoming increasingly expensive because of the rising costs of construction and operation.

Incineration, which can greatly reduce the amount of incoming municipal solid waste, is the second most common method for disposal in developed countries. However, incinerator ash may contain hazardous materials including heavy metals and organic compounds such as dioxins, etc. Recycling plays a large role in solid waste management, especially in cities in developing countries.

None of the three methods mentioned here are free from problems. The aim of this study is thus to compare the three methods, keeping in mind the costs that would be incurred by the respective governments, and identify the most economical and best option possible to combat the waste disposal problem.

1. Introduction

Rapid population growth, urbanization and industrial growth have led to severe waste management problems in the cities of developing countries like India. The large quantity of waste generated necessitates a system of collection, transportation and disposal. It requires knowledge of what the wastes are comprised of, and how they need to be collected and disposed. Recycling of waste, energy generation and employment opportunities from waste management also have immense potential. However, it has been widely observed that the Municipal Corporations in India do not have adequate resources or the technical expertise necessary to deal with the problem. Successful waste management requires the participation of citizens, local governments, and private entrepreneurs.

The increase in the population and rapid income growth in India has changed the lifestyle of urban residents, thus changing the composition of the garbage generated. The presence of paper, plastic and metal is on the rise, resulting in more disposal difficulty. The municipalities have not been able to collect and dispose of the enormous quantity of waste being generated. Scavengers and rag pickers have helped the corporations with the collection of the garbage generated, since they collect it from households to garbage dumps and carry out the important function of waste segregation.

Waste management and disposal is a pressing issue facing India today, since about 90% of waste is currently disposed of by open dumping. Some commonly used methods by which the waste could be managed are: incineration, landfilling and composting. However, these methods are inefficient and harm the environment. This paper argues that the solution to waste management is not merely technical, but also organizational. There is a great need to move away from the disposal-centric approach and toward the recovery-centric approach of waste management. This paradigm shift requires some level of public participation by regulating and monitoring waste generation and disposal.

2. Incineration

Incineration refers to the combustion of waste materials that result in ash residue and air emissions. Waste incinerators do not eliminate waste – in fact they generate it. Since physical matter cannot be destroyed, an incinerator actually transforms the origi-

* Tel.: +91 98279 09171; fax: +91 0771 4080118.
E-mail address: tapan.narayana@gmail.com

0956-053X/$ - see front matter © 2008 Elsevier Ltd. All rights reserved.
doi:10.1016/j.wasman.2008.06.038

nal waste materials into several new forms, including: air emissions, ash and liquid discharge (Department of Environment, 1995). These new forms are far more difficult to deal with than the original raw waste materials.

2.1. Is it a good option?

Global resistance to incineration is on the rise, with countries around the world banning incineration technologies, particularly the USA, Europe, and Japan. The incinerator companies in these countries are facing declining popularity and sales and are looking for new markets. The incineration facilities built in Manila, Lagos, Istanbul, and Mexico have not been used. When they were used, as in Indonesia, the cost was prohibitive (Martin Medina, 2005). The waste composition is largely organic in developing countries with a high moisture content, making incineration a poor option.

2.2. Health impact

The air emissions from waste incinerators have been identified as a cause of cancer. The incineration of solid waste leads to air emissions that contain heavy metals, dioxins, and other volatile organic compounds. Many of these substances, dioxins in particular, can be carried long distances from their emission sources, persist for decades in the environment without breaking down into less harmful compounds, and accumulate in soil, water, and food sources (N.R.C., 2000). Ash is a product of incineration. The toxins in the ash will eventually leach into soil and water from landfill ash deposits.

2.3. Economic viability

Incinerators require a large capital investment with little economic return. The plants need a constant supply of waste for maintaining optimal combustion, which results in the creation of long-term contracts with local authorities that guarantee a certain ton of waste per year to the incinerator (Connett and Connett, 1994). This effectively destroys incentives for local decision-makers to minimize waste. Incinerators need material with high calorific value, such as paper, cardboard, and plastics, etc. to maintain combustion levels (Davis, 1994). In fact, the only materials in mixed waste that exceed the average calorific value of standard power-generating fuels (such as natural gas, coal, diesel, etc.) are waste oils, solvents, and plastics, which produce air emission problems when burned (Murray, 1999). In India and various other developing countries, the waste consists mainly of organic matter; for instance in Kerala, organic content varied between 30% and 75% of the total waste (see Table 1) and contains less paper, plastic, and cardboard, which makes it economically less viable to operate in developing countries. Furthermore, landfills are still required for the disposal of the ash, which adds to the operational cost of an incinerator. The increased concentration of toxins in fly ash makes it a hazardous substance, which requires deposition into a costly hazardous materials landfill.

2.4. Medical wastes

Incineration of medical and quarantine waste is not a safe solution. Only about 15% of medical waste is potentially infectious (Toxics Action Group, 2001). Although incineration certainly kills pathogens, it changes a potential biological threat into a formidable set of chemical problems by destroying not only the pathogens, but also the materials on which the pathogens sit, such as plastic, glass, paper, and metal, etc. (Franklin Associates, 2000). This is especially important, since many medical supplies are rich in PVC (polyvinylchloride), which is one of the worst materials in terms of producing dioxins when combusted. Coordinating initiatives with suppliers of medical equipment could help minimize the waste generated. Additionally, effective sorting of medical waste at its source could divert most of it for reuse and recycling. Alternative treatments for the remaining infectious waste include: autoclaving (high pressure steam treatment), microwaving moistened waste, and sterilizing waste with disinfectants (chemical sterilization).

2.5. Practice in India

In India, incineration is not a common practice, since the garbage tends to be low in calorific value and volumes are generally low for a central facility. The technology for incineration is not available domestically and import options are highly capital intensive. An incinerator plant was established in Delhi during the 1980s and was expected to generate power for the local grid. However, the operational experience was not satisfactory.

In summary, municipal solid waste in developing countries is not suitable for incineration and, thus, this solution is not economically viable. Countries like India do not find this method to be very favorable, especially considering the waste content and the high costs of setting up and running the plants (see Table 2).

3. Landfilling

A landfill is an area of land onto or into which waste is deposited. The aim is to avoid any contact between the waste and the surrounding environment, particularly the groundwater. Landfills can be classified into three categories, which are:

Table 1
Physical characteristics of solid waste in some Kerala towns

Type of solid waste	Thiruvananthapuram city TPD (% of total)	Kottayam town TPD (% of total)	Palakkad town (% of total)
Organic waste	151.6 (50.5)	39.5 (75.1)	(14.9)
Paper	31.6 (10.5)	4.6 (8.7)	(25.64)
Glass	7.2 (2.4)	0.9 (1.7)	(1.73)
Textile	7.7 (2.6)	0.8 (1.5)	(0.67)
Plastic	22.8 (7.60)	2.6 (4.9)	(6.35)
Metal	6.5 (2.2)	2.2 (4.2)	(1.12)
Ash	11.4 (3.8)	–	(20.77)
Sand	32.6 (10.8)	–	–
Miscellaneous	25.2 (8.4)	2.0 (3.8)	–
Other	–	–	(26.10)
Total	300 (1000)	52.6 (100)	(100)
Population	700,000	67,000	130,000

Source, Nair and Sridhar (2005).

Table 2
Sources of solid waste – some examples from Kerala

Source of solid waste	Thiruvananthapuram city TPD (% of total)	Kottayam town TPD (% of total)
Households	181 (60.3)	14.4 (27.4)
Shops	13 (4.3)	–
Hotels/restaurants	30 (10)	–
Hospitals	2 (0.7)	–
Tea shops	1 (0.3)	–
Workshops	1 (0.3)	–
Markets	40 (13.3)	7.6 (14.4)
Street sweepings	290.6	–
Construction work	10 (3.3)	–
Marriage halls	20 (6.7)	–
Establishments and institutions	–	30.6 (58.2)
Total	300 (100)	52.6 (100)

Source, Nair and Sridhar (2005).