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Status of composting in India with emphasis on Delhi

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Abstract*— The present waste handling techniques in the States of India were examined. Results indicated that around 7% of waste is being composted in India at present. The cities having composting facilities have grown from 22 in the year 2008 to 115 cities at present. Also, out of the total 369 compost plant in India, 177 are in operation and 192 are at planned stage. Delhi is the most densely populated and urbanized city of India. The annual growth rate in population during the last decade (1991-2001) was 3.85%, almost double the national average. Delhi is the largest producer of municipal solid waste in India, producing nearly 8000 metric tons of solid waste every day, which is projected to rise to 17,000-25,000 tonnes/day by the year 2021. Out of the generated waste approximately 6,500 to 7000 MT per day is collected. Approximately 650 MT per day of waste is composted and the remaining is sent to a landfill. There are four Compost plants in Delhi i.e. Okhla, Bawana, Tikri and Bhalswa. Visits to the compost plants showed that the compost plants in Delhi were operating at less than their design capacity. The quality of compost being produced at Okhla compost plant and Bawana compost plant was good and adhered to the specifications stipulated by Central Pollution Control Board (CPCB). The compost being produced at the Bhalswa and Tikri compost plants were not of the desired quality.

Keywords: Composting, Present Status, India, Delhi, Technology, Working Status

I. INTRODUCTION

Municipal solid waste is defined as commercial and residential waste generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. In the rapidly urbanizing India about 377 million people are living in 7935 cities (census, 2011) across the country which constitutes about 31.2 % of the total population. The number of class I cities has gone up from 212 to 468 during 1981-2011 which has lead to a tremendous increase in the amount of solid waste being generated.

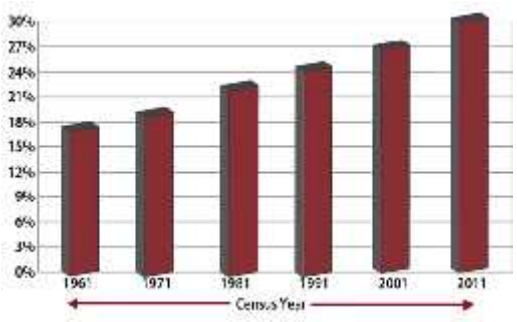


Figure 1: Trend of Urbanization in India

Management of municipal solid waste resulting from rapid urbanization has become a serious concern for government departments, pollution control agencies, regulatory bodies and public. Unscientific disposal causes an adverse impact on all components of the environment and human health. Therefore, MSWM is one of the major environmental problems of Indian mega cities.

As per the data released by Maharashtra State Pollution Control Board in the year 2011, At present the waste generation varies from 200 gm to 600 gm per capita / day. Collection efficiency for the solid waste generated ranges between 50% to 90%. With urban population increasing between 3 – 3.5% per annum, yearly increase in waste generation is around 5% annually. As per information received from State Pollution Control Boards/ Pollution

Control Committees (in between the year 2009-12) 130 KTPD (Kilo Tons per day) municipal solid wastes is generated in the Country during 2011-12 (Maharashtra State Pollution Control Board). Out of which, 90 KTPD (70%) of Municipal Solid Wastes (MSW) is collected and 16 KTPD (12.45%) is processed or treated. To deal with the issue of collecting, handling and management of MSW in India, "Municipal Solid Wastes (Management and Handling) Rules 2000" was drafted. Since the amount of MSW to be handled at present and in the future is a big amount, Solid Waste Management (SWM) is the best possible way to control and reduce waste generation. To implement proper solid waste management, various aspects that should be considered are Source reduction, Onsite storage Collection and transfer, Processing techniques and Disposal. The Solid Waste Characteristics reveal that in India the organic fraction accounts for 48%-80% of the waste (National Solid Waste Association of India, 2003) and has low calorific value of around 800-1200 Kcal/kg (CPCB, "Status of Solid Waste Generation, Collection, Treatment and Disposal in Metro cities, Series: CUPS/ 46/1999-2000,") which makes composting the most suited option for MSW handling in India.

II. Composting in India

Composting is a biological process of decomposition carried out under controlled conditions of ventilation, temperature, moisture and organisms. The microbes present in the waste themselves convert waste into humus-like material called compost by acting on the organic portion of the solid waste . Organic waste materials include livestock waste, food waste, garden waste, waste paper and mixed municipal solid waste. These materials contain ample amounts of major nutrients including N, P and K. Many large-scale compost plants with capacities ranging from 150 to 300 tons/day were setup in the cities of Bangalore, Baroda, Mumbai, Calcutta, Delhi, Jaipur and Kanpur during 1975-1980.India has an estimated potential of producing about 4.3 MT of compost each year from MSW. Composting is a successful technology that is low cost and requires low infrastructure set-up but produces a marketable byproduct i.e. compost. In addition to making a positive contribution to agriculture, the sale of organic wastes reduces the amount of waste to be collected and disposed of by municipal authorities. The various Composting methods existing today are Passive Windrow, Turned Windrow, and Aerated Static Pile, In–Vessel Composting (British Columbia, Ministry of Agriculture, Food and Fisheries). Aerobic composting is the most widely employed SWM technology in India. Figure 2 describes the mass balance flow chart of a mechanised composting fascility.

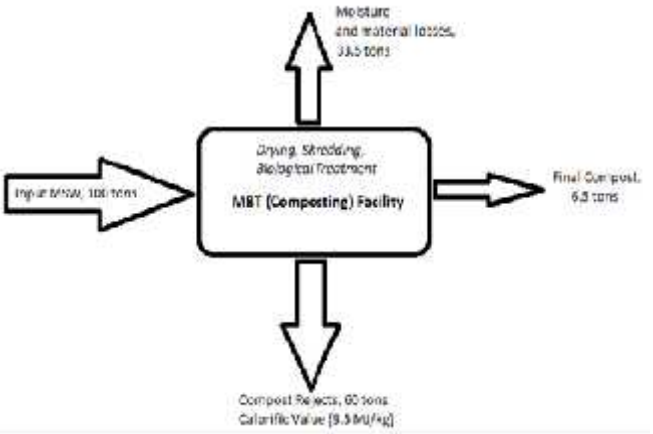
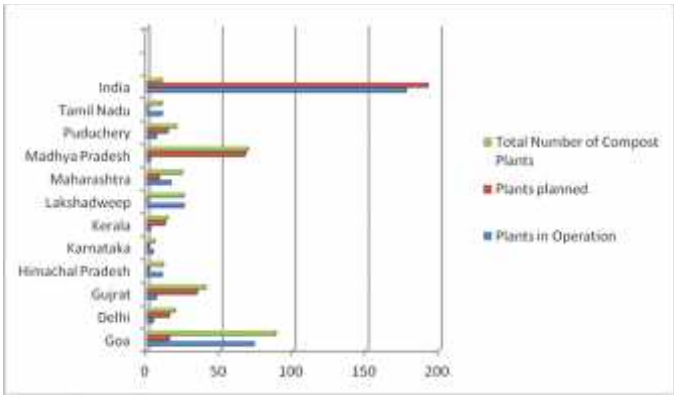


Figure 2: Mass Balance of a Composting facility

Among 74 cities examined by the Central Pollution Control Board for their present waste handling techniques, only 22 cities had composting facilities in 2008, whereas by 2010, the number of cities employing composting grew to 40. Around 7% of waste is being composted in India at present. The status of compost plants which are in operation and planned stage is that out of total 369 compost plant, 177 are in operation and 192 are at planned stage. States like Maharashtra (16), Goa(73), Lakshadweep (25) and Tamil Nadu (10) have the maximum number of plants in operation whereas Gujarat (34), Pondicherry(14), Goa(15), Delhi(15) and Kerala(12) have the maximum number of plants in a planned stage. Figure 3 below gives a summary of status of composting facilities in India.

Figure 3: Composting Facilities in India



Compost Quality depends more on the raw materials used and production management than on the type of technology applied. Use of high-quality raw materials generally produces a high-quality compost. The more inhomogeneous and polluted the raw material is the more effort is required for sorting, process management, staff training and monitoring to achieve an acceptable product. However, investment in management and quality control should pay dividends. Compost from mixed waste composting plants is found to be highly contaminated with heavy metals. A study conducted by the Indian Institute of Soil Science (IISS), Bhopal found that compost produced from MSW in India is low grade, with high heavy metal concentrations and low nutrient value (IISS). Table 1 shows the Indian standards for average concentration of heavy metals in MSW Compost.

pH	*5.5- 8.5*
Cu	*300*
Cr	*50*
Ni	*50*
Pb	*100*
Cd	*5*

Table 1: Indian standards for average concentration (mg/kg) of heavy metals in MSW Compost

Mixed waste composting is therefore not an option for sustainable waste management. Lack of actual performance data of MSW composting facilities was a major concern during initial research. During the current project, an important finding is that the compost yield from mixed waste composting facilities (MBTs) is only 6-7%. Rest of the MSW, up to 60% of the input waste (accounting for moisture loss and material loss during decomposition) is discarded as composting rejects and sent to a landfill site.

III. COMPOSTING IN DELHI

Out of the collected municipal solid waste, only 10-15 per cent is used for composting and the remaining is disposed at various landfills. Municipal Corporation of Delhi generates around 8,000 MT of municipal solid waste per day. Out of the generated waste, 6,500 to 6,700 MT per day get collected. Around 650 MT of waste per day is composted in existing three composting plants and the remaining goes for land filling. The estimated amount of waste that remains uncollected is 500 to 1,000 MT per day. New Delhi Municipal Corporation generates around 300-350 MT of municipal solid waste per day and the whole amount gets collected. NDMC has its compost plant of 200 MT of garbage handling capacity per day in Okhla. The Cantonment Board generates around 60 MT of municipal solid waste per day and whole amount is getting collected also. In Delhi there are four Compost plants existing today i.e. Okhla, Bawana, Tikri and Bhalswa.

A. IL&FS Okhla Composting plant

The compost Plant in Okhla is spread over an area of 2 hectares. It was started in July 2007 and was handed over to IL&FS for a lease period of 25 years. It is a 200 TPD plant but presently is processing around 150 TPD of waste to generate around 22 TPD of compost. It generates around 506TPM of compost out of which it sells around 200 tons @Rs.117 per 50 kg bag. It gets its waste from south zone, North zone & central zone. The rejects from the plants are Combustibles (498 Tons Per Month) which are sent to Waste to Enegy plant in Okhla & Inert (212TPM) disposed at Okhla Sanitary Landfill. 2000 liters per day of leachate is produced for which a Leachte Treatment Plant of capacity 25 m^3/ day is developed. Green belt is maintained over an area of 2000 m^2 in which trees, fruit and flower bearing plants are grown.

B. Narela-Bawana Compost Plant

The plant is spread over an area of 40 hectares and has two working cells. It was started in September 2011 and was given on lease for 20 years to Ramky. The input to the plant is around 1200TPD of garbage against the designed value of 1500TPD & produce around 100 tons/day of compost (12-15% yield). The compost generated here is sold under various brand names such as Ramky Shakti, Coromandal, and Shakti Organic etc. The compost is sold @ 150per bag of 50 kg. It receives its garbage from Civil Lines & Rohini which is Mixed Municipal Solid Waste. The rejects from the plant include inerts (250 TPD) which

are sent to landfill. Plantation is done on an area of around 17 Acres and around 8000 plants are grown.

C. *Bhalswa Compost Plant*

The plant is spread over an area of area of 4.9 hectares. It is operated and maintained by M/s Nature Waste Management Pvt. Ltd (M/s Excel Industries Pvt. Ltd.). It is operating at about 300-350 MT/day as against the installed capacity of 500 MT/day. Compost is approximately 24% of the total garbage received. It gets its waste from West zone (100%), Rohini zone (10%), Najafgarh zone (3%), Narela (100%), Karolbagh, etc.

D. *Tikri Compost Plant*

The plant was established in the year 2001 in an area of about 2.6 hectares. The area is provided on lease by A.P.M.C on rent. The plant has a capacity to process around 125TPD of waste which was later upgraded to 200 TPD. The technology used in this project activity is open windrow aerobic composting which is a simple well established global technology.

IV. PROCESS ADOPTED FOR COMPOSTING IN DELHI

A. *Process for composting at IL&FS Okhla and Narela Bawana Compost Plant*

The process followed for preparation of compost in the Okhla and Narela Bawana plant are the same. The Municipal Solid waste is taken and dried. Once dried it is sent to the shredder. The waste of size more than 70 mm is rejected and is used as Refused Derived Fuel. The remains are sent to a sieve of pore size 35 mm wherein the components of size more than 35 mm are rejected and the rest are kept in Windrows for 8 weeks and is turned once a week. The waste from these Windrows is taken to the 16mm sieve. The particles with size more than 16 mm are rejected and the remainder left for curing for 2-3 weeks. After the curing is done the waste is sent to a 4mm sieve. The particles with size less than 4mm are sent for final finishing and the Compost is formed. The quality of compost being produced at Okhla compost plant and Bawana compost plant is good and adheres to the specifications decided by Ministry of Urban Development (MoUD) and Central Pollution Control Board (CPCB).

B. *Process for composting at Bhalswa and Tikri Compost Plant*

The process followed for compost formation is almost the same as in Bhalswa and Tikri compost plants. The waste is taken to the yard and is made into Windrows. Inoculum is sprayed over the Windrows. These Windrows are turned on every 10th day using a front-end loader. After 2 rounds of turning a part of waste is transferred for Vermi-Composting. The remaining waste is sieved and is left for maturation. The compost received after maturation is packed and sold in bags and the rejects are diverted to landfill. The qualities of compost being produced at Bhalswa do not adhere to the specifications decided by Ministry of Urban Development (MoUD) and Central Pollution Control Board (CPCB).

C. *Process for Leachate Treatment Plant in Coposting Facilities of Delhi*

Leachate treatment facility is available only in Okhla and Bawana compost plants and are similar. The leachate produced is treated in the leachate treatment plant wherein it is first sent to the screening chamber where the larger materials are removed. From there it goes to oil and grease trap to remove fatty acids and oil. The leachate is then taken to an equalization tank. From the equalization tank is goes to the PVA (Poly Venyl Alcohol) gel reactor where the biological treatment of waste takes place. The leachate from here is then taken to tube settlers to remove suspended impurities. The settled sludge is finally taken to drying beds and clean water is reused.

V. CONCLUSION

“Composting does not make you rich’’, as stated by a composting plant operator, appropriately sums up the current situation of organic waste treatment in Indian cities. However, it is expected that with the support of the municipal authorities, composting facilities probably can recover costs and even yield a profit. The compost plants in Delhi are running less than the design capacity (Site Inspection). Figure 4 and Table 2 gives the summary of Delhi Compost Plants.

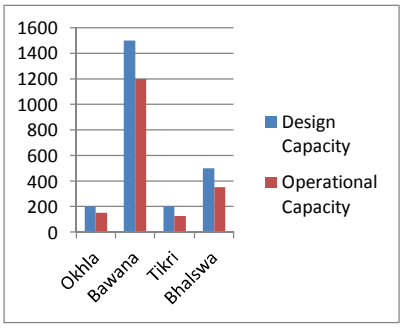


Figure 4: Composting Plants in Delhi

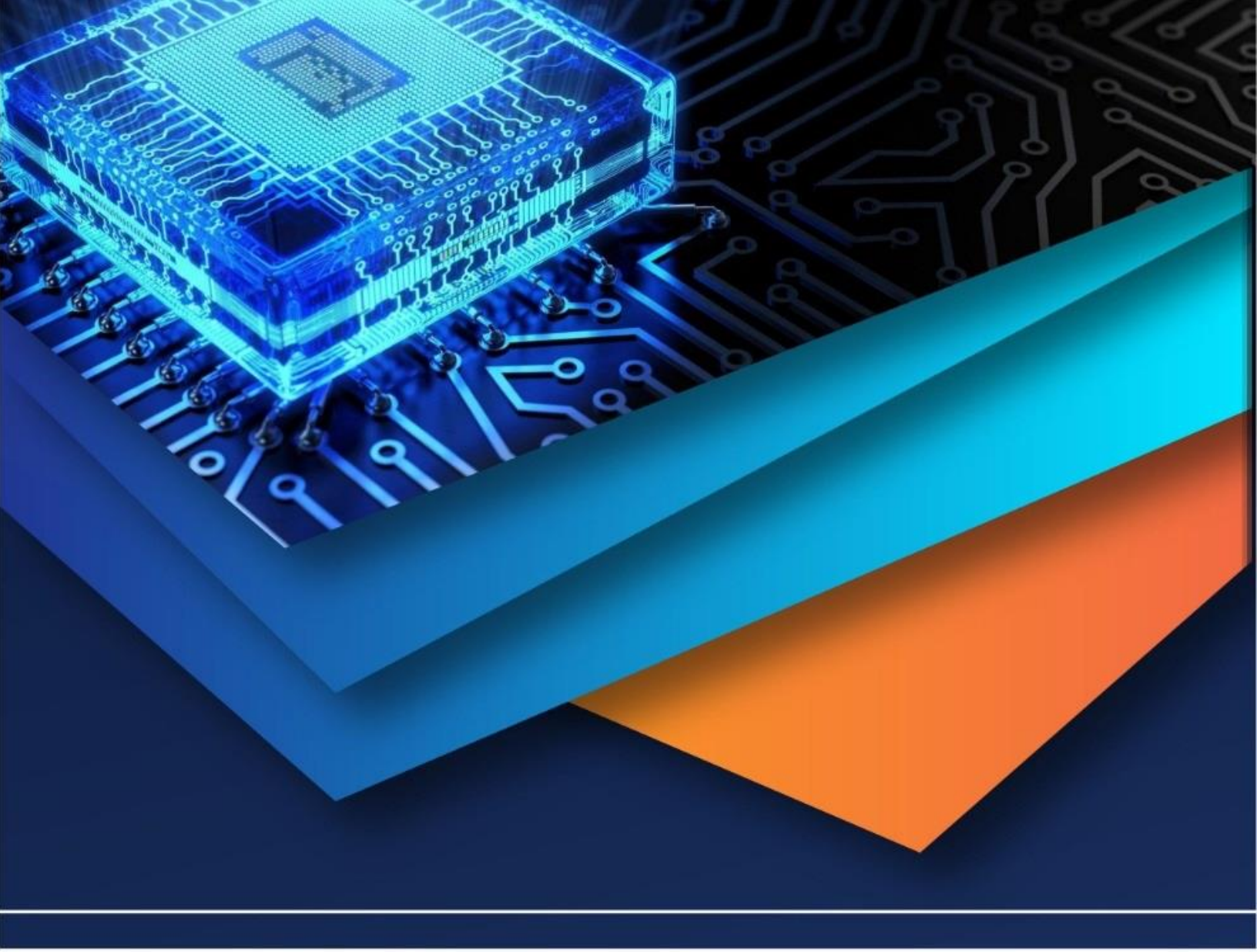
Facility	Area (Ha)	Starting Year	Technology
Okhla (MCD)	3.2	1981	Aerobic, windrow Compostin g
Okhla (NDMC)	3.4	1985	
Bhalswa (Private sector)	4.9	1999	
Tikri Khurd (APMC & Private Sector)	2.6	2001	
Narela Bawana	40	2011	

Table 2: Summary Table of Delhi Composting Facilities

Average moisture in compost samples varied from 44.67to 49.42 percent, which is in range (40 to 50) as per UNEP report on Composting. Bulk density of the compost samples (0.48to 0.67g/cc,) were well within the standard range (0.4 to 0.7 g/cc) as suggested by U.S Composting Council (2002).The C: N ratio of the compost being produced at Okhla compost plant and Bawana compost plant is in the range of 20:1 to 25:1 and adheres to the specifications decided by Ministry of Urban Development (MOuD) and Central Pollution Control Board (CPCB). The compost being produced at the Bhalswa and Tikri compost plant is not of desirable quality with content of Nitrogen less than desired. The poor compost quality and lack of technology at these sites have led to the expansion plans being put on hold. In the near future, it is expected that with improved technology and proper management, these composting facilities can recover costs and also yield a profit.

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