Recommendations for Modernization of Solid Waste Management Practices in Class - I Cities
- Suggestions on Choice of Technology in Indian Context


Preamble

The Supreme Court Committee for Solid Waste Management in Class-1 Cities in India, formed on 16.01.98 in response to a PIL (Public Interest Litigation WP(C) 888/96 – Almitra Patel) for improvement of poor waste management countrywide, recommended in its March 1999 Report the composting of biodegradable waste as the method of choice for hygienic waste processing. Although this was reflected in the resulting Municipal Solid Waste (Management & Handling) Rules 2000, the recommendation was politically diluted by the inclusion of loopholes permitting energy recovery and even incineration. This paper explores the success rate and viability of these different waste-processing options in the Indian context.

With the availability of land for processing and disposal of waste becoming scarce and bio-degradable component useful to agriculture going waste, measures for conservation of land and organic waste resources shall be taken and organics shall be returned to the soil. To meet these objectives, all bio-degradable waste shall be composted, recyclable waste shall be passed on to the recycling industry and only rejects shall be land filled in a scientific manner.

Integrated Plant Nutrient Management or IPNM, where composted urban waste is used along with chemical inputs, has been shown to drought proof crops through improved soil vitality, root growth and soil moisture retention.

Beware of Expensive & Unproven Technology – Local bodies are cautioned not to adopt expensive technologies of power generation, fuel pelletisation, incineration etc. until they are proven under Indian conditions. It is therefore, suggested that local bodies should not experiment with any such expensive technology until after adequate experimentation and one or two successful pilot projects, to the scale corresponding to the technologies, they have been proven and Govt. of India Ministry of Non-Conventional Energy Sources, Ministry of Environment, Ministry of Urban Development or any other agency identified by Govt. of India have advised them to adopt such technology or have certified that the technology is proven and can be adopted in Indian conditions.

State Govt to Notify Waste Zones – One of the most serious problems facing even successful compost plants and potential new ones is the lack of state Government will to formally Notify Buffer Zones of ‘No New Development’ in their land-use plans, although mandated under the MSW Rules. Such a Notification has political implications since it will affect land use and property values within at least a square kilometer of potentially urbanisable land close to cities and towns. (The Committee Report suggested 0.5 km from the plant perimeter to avoid public objections in the future after costly immovable investments have been made in paved compost yards and lined landfills etc). This is very important for protecting proposed and even existing sites from demands for shift. In this connection the objection to existing landfill site was overruled by the following Judgement – (CWP No. 8504 of 2003, High Court of Punjab & Haryana – Date of Judgement: 17th March 2009)
**Choice of Technologies**

**Mechanized Waste Sorting at Site – Failure**

An ambitious attempt at mechanized pre-sorting of waste in 1975 failed dismally as it blindly imported Western technology for 12 “Ferti-plants”, copying sorting-conveyors, magnets and crushers designed for developed country wastes containing mostly clean dry packaging and not more than 16-24% organics.

This is quite unlike Indian waste which is soggy and compact containing over 70% organics, after two undesirable activities - recyclables are removed from garbage in advance and inerts are added during co-collection.

Hence pre-sorting before composting is virtually impossible except for removal of very bulky items (coconut-leaves etc) and the pre-crushing resulted in fine sharp glass splinters in the compost that made it unacceptable to farmers and their ploughing animals.

**Conversion of MSW into Organic Compost - Recommended**

Composting is a slow natural process in which mixed bacteria, fungi, insects and worms consume plant and animal wastes and convert them slowly to a soil-like substance very beneficial to plant growth. Compost provides energy, minerals, nutrients and micro-nutrients, useful microbes and water-retaining humus to soil. This improves the quality and pest-resistance of produce, makes crops drought-resistant and decreases irrigation water requirements. Compost can find a good market if properly promoted and made conveniently available to the farming community.

Composting can be done by aerobic and anaerobic processes.

**Aerobic Composting**

The aerobic wind-row process can now be completed in 45-60 days, on any scale, even with mixed non-toxic wastes, by repeated turning and aeration. Indigenous biocultures, fine-tuned over a decade, and now produced by many others, convert even mixed garbage (wet, dry, inerts) to a free-flowing humus rich heap smelling like new rain, with 40% volume reduction in 45-60 days after weekly turning of aerobic windrows.

This sanitized waste, with the heat of the windrowed heaps destroying both pathogens and weed-seeds, can be sieved to saleable compost (soil conditioner) and fortified with farmer-friendly microbes for excellent crop results. A 5% suspension in water of fresh cow-dung can also generate heat and control odour in the windrows.

However, all efforts shall be made to segregate the organic matter at source and bring the same to the composting site. Learning from the past experience, it is important to keep the level of mechanization and the production cost to the minimum and to produce a good quality of compost free from heavy metals, sharps, glass etc. so that it can find a ready market.

The committee recommends centralized Aerobic composting
**Vermi Composting**

In this process, earthworms are used for converting the organic wastes into compost (vermi-castings). Vermi-composting is a process in which earthworms consume decayed plant and animal wastes with the help of bacteria in their gut, to excrete fine-grained soil-like vermi-castings rich in minerals and microbes very beneficial to plants and free of disease germs. Many other soil organisms assist in the breakdown and conversion of biodegradable wastes.

This process necessitates use of segregated organic waste and carefully weeding out of toxic material etc. This process also requires management of earthworms. This process has been successfully used in a limited scale up to 80 MT per day in Bangalore, Pune, Mumbai etc. but there is no large-scale centralized plant experiences in India. This technology therefore, has a good potential in the cities where decentralized disposal is possible.

**Anaerobic composting**

This has been practiced since Vedic times and even today in villages and very small towns, wherever homes have enough space around where a family’s domestic food wastes can be co-disposed in a pit with cattle-shed straw and manure for almost a year, until needed for pre-monsoon soil application. Here individual care is taken to avoid adding plastics and inerts to the compost pits.

However, as volumes of urban mixed wastes increase, this option is unviable and very smelly, as successful composting bio-cultures have not yet been developed for anaerobic use. Decentralised composting at home or neighbourhood or campus level, attempted sporadically in various cities, is successful with strong individual commitment or NGO funding, but has not really taken off as it should. It is useful for cooked food wastes in de-centralised operations.

Anaerobic composting processes are very slow. They take about 180 days to produce compost in airless pits or trenches in the ground, and generate methane, an environmentally harmful green-house gas. Anaerobic composting can be accelerated in bio-gas digesters, where the harvested methane becomes a useful fuel and the slurry produced is useful organic manure. As temperatures inside bio-gas digesters are not high, pathogens are not killed.

**Bio-Methanation - Gobar Gas Plant**

India has a very widespread, long-standing and successful experience with production of “gobar-gas” or biofuel from cowdung, from individual farm units set up with massive promotional Government subsidies. These comprise mostly below-ground floating steel gas-collectors in brick-lined pits. Homes with four or more cattle can meet their cooking, water-heating and even lighting requirements with this, through direct on-site use. The resulting slurry is directly used in the farmers’ fields. The rate of growth of these is declining as India’s draught cattle are increasingly replaced by tractors.
**Bio-Methanation – Power generation**

**Lucknow Bio-Methanation Plant & Power Generation – Failure**

However it was natural to try and apply this Gobar Gas concept to pure organic municipal waste.

In 1993, a project for bio-methanation of 300 TPD of Lucknow’s garbage was approved, using Austrian technology. This costly misadventure was justified as having a two-for-one benefit, “handling waste plus generating power”. It commenced in 1998 and was commissioned in 2002-3 for intended production of 5 MW (megawatts) of exportable power, to be produced in turbines running on biogas.

After 14 months of trials, produced only 0.4 to 0.5 MW net exportable power, which amounted to a capital cost of Rs 16 crore per MW, compared to conventional thermal or hydel power investment at just Rs 5 Crore per MW produced. The Lucknow plant received Rs 15 Crore as Government subsidy for a “demonstration project” on Waste-To-Energy.

The Lucknow plant has been plagued by non-availability of “acceptable waste” despite the city’s total waste generation of 1650 TPD. This is again because of inordinately high inerts in Indian waste, far higher than in comparable Asian countries. Hence “rejected” truckloads of untreated waste lay in growing hillocks around the entire plant. This unviable plant ceased operations in 2005.

**RDF - Fuel Pellets**

There have been two small experimental projects to dry and pelletise municipal waste. Both failed for the simple reason that the calorific value of mixed Indian waste is barely 800 to 1000 Kcal/kg of waste. Sun-drying is impossible in the monsoon rains, covered storage of sufficient area is prohibitively costly and artificial drying is energy-negative. Issues of PVC waste generating dioxins from burning of Refuse Derived Fuel (RDF) have not been addressed.

**Waste to Electricity - Incineration**

This is a thermal process for burning the waste at a very high temperature. Incineration requires high calorific value waste, which can burn without any external fuels. Indian waste contains only 3 to 7% of combustibles, paper and plastic by the time the waste reaches the disposal site. This is principally because most of the burnable material is retrieved by rag pickers from the waste lying on the streets, dust bins and dump yards. This calorific value of Indian waste at the dump yards is found to range from 800 to 1000 Kcal/kg., which is very low. The system of incineration is therefore not suitable under Indian conditions for this and the following additional reasons:

- High ash and dust contents of Indian waste.
- The system is not environmentally friendly.
- High capital cost, especially for adequate control of emissions.
- High Operation and Maintenance cost.
- The system requires high technical skill to man it.
- The incineration of general municipal waste is therefore not recommended as a method of Municipal Solid Waste disposal.
**W2E Plants – MSW + Biomass**

Despite this, two large Waste-To-Energy plants have come up, at Hyderabad and Vijayawada, which are touted by the Ministry of Non-Conventional Energy (MNES) as successes worth emulating. Set up on free municipal land to supposedly solve their city’s waste problems, these plants too are actually running their operations on high-calorie paddy-husk and/or wood wastes, while showing fictitious intake of waste trucks as the heaps of untreated rotting or burning waste surrounding the plants seem to indicate. More such projects are being actively promoted by unscrupulous entrepreneurs, in order to avail of potential subsidies, concessional-interest loans (diverted for other projects) and higher-than-average power purchase agreements.

**W2E – Delhi (Timarpur) Failure**

The most spectacular failure of Waste to Energy in India to date is a Danish-supplied incinerator installed at Timarpur in Delhi in about 1980, which cost Rs 41 Crore then but ran for only six days (sic) because of high inerts and ash in the waste supplied. India lost at the Hague because the “suitable waste” to be provided by the city was not defined in the agreement. Current interest and caretaking costs have totaled a staggering Rs 221 Crore or more to date. Even worse, this valuable waste-disposal site has been lost for decades to the city as the plant is neither being sold for scrap nor can find any takers (even free) to take it over for operation.

**Sanitary Landfilling**

This is a term often mistakenly used by Municipalities to refer to open dumping, presently the commonest method of waste disposal, which causes problems of subsoil-water contamination. True Sanitary Landfills for untreated mixed wastes require impervious soil strata or liners at the bottom plus bottom piping for collecting and pumping out leachate for treatment and re-circulation, along with piping arrangements to collect, extract and use part of the methane gas generated in such anaerobic conditions. The waste is also to be covered daily by soil or inert material in scientifically managed cells. These precautions are expensive but necessary.

With available land for waste disposal becoming more and scarcer every year, efforts must be made to strictly minimize the wastes going to landfills, by segregating non-biodegradable waste for recycling and by composting of bio-degradable wastes. Landfilling should be used only as the last step in the waste-processing chain, not for untreated mixed wastes. Only rejects should be land filled, in a scientific manner, once compost plants are set up.
The way forward

What then can cities do to resolve the immediate SWM crisis?

Firstly, municipalities must change their own habits and immediately practice the discipline of collecting inerts (road dust, drain silt, debris) in a separate trip from garbage, instead of waiting for thousands of citizens to change to dry-wet waste delivery practices.

Waste stabilization can and must be done immediately, using composting bio-cultures (ideally wherever the garbage trucks are loaded) and unloading the waste in planned windrows instead of random heaps. This can improve even existing sites, whether currently suitable or not, until alternatives are arranged.

Because of increasing NIMBY resistance to new sites, maximum use must be made of traditional existing ones. Even those dumpsites whose “life is over” can be restored by reclamation & scientific waste mining.

Villagers who are expected to accommodate waste-processing sites within their territory must be mandatorily compensated, on a polluter-pays basis, by the city whose waste they are asked to accept. This will become increasingly necessary as villages learn to exercise their rights under the Constitution 73rd Amendment granting them autonomy in local decisions.

State and Central governments can give a great boost to cleaner cities and more productive use of agricultural land, water and seeds, by promoting IPNM, Integrated Plant Nutrient Management using city compost in combination with chemical fertilizers. Along with this, credible quality assurance for composts in general needs to be put in place to safeguard farmers and win their confidence. The single worst factor operating against sensible use of organic city wastes for crop productivity is the massive subsidy regime for chemical fertilizers. India’s neighbours Bangla Desh, Pakistan and Sri Lanka have all managed to roll these back entirely, hence composting can flourish there. Hopefully WTO and economic imperatives will help roll back India’s fertilizer subsidy that benefits mainly urea manufacturers, but so far this is a politically sensitive move seen as “anti-farmer” by parties both in and out of power.

Recent PIL-prodded Govt initiatives to promote IPNM will hopefully improve and widen its acceptability. The use of compost to enrich the soil, along with chemical fertiliser in a balanced ratio, is therefore very necessary. This view has been repeatedly expressed by government bodies as well as the fertiliser association for over a decade.

Finally, it is simply a question of political will, of priority spending on obligatory civic duties, and effective decision-making. In one word – good governance.

Signs of Hope

Despite all that has been said above, there is countrywide a generally raised official as well as civil society consciousness about the importance of waste management which was not there a decade ago. Even better, there are two small south Indian towns, Suryapet in Andhra Pradesh (population 103,000) and Namakkal in Tamil Nadu (pop. 53,000), which are both dustbin-free “zero-garbage” towns. Their highly motivated city managers and elected members, working in unison with dedication and focus to win public participation, have achieved this without any Central or State encouragement or subsidy. If they can do it, so can others. There lies the hope for India’s future.