Solid Waste Management—A Look at Some Technologies of Department of Atomic Energy

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Solid waste management is an important component under Swachh Bharat Mission (SBM) that is being implemented by the Ministry of Urban Development at an estimated cost of ₹620,090 million, out of which ₹368,280 million is to be spent on solid waste management alone. Under SBM, Central Government's assistance for municipal solid waste management projects is ₹240 per capita for present population for each city/town (i.e., for a city with 0.1 million population, maximum central grant/Viability Gap Funding (VGF) admissible is ₹24 million). Also, states have to provide at least ₹80 per capita as their contribution towards the projects. In addition to above, the cost of Detailed Project Report (DPR) preparation is also admissible for each city/town at rate of ₹12 per capita for present population.

One of the critical factors in waste management is selection of technology for processing of waste. Unless we process waste properly, the issue of having mountains of waste in unsanitary landfills would remain unanswered. In India, many technologies have been tried by local bodies—refuse derived fuel (RDF), converting waste into compost, etc. Each technology has issues, as waste in India is not segregated. In fact, if there is a civic movement to segregate at least kitchen waste, small decentralized waste processing plants could be set up in each municipal zone. It could be made mandatory for modern housing complexes and colonies. Each step taken would contribute to minimization of waste.

Some technologies that have been developed by the Department of Atomic Energy and pertinent for solid waste management could be explored and adopted by the local bodies under this mission.

Department of Atomic Energy (DAE) Technologies Relevant for Municipal Solid Waste Management

The DAE has, in its different research institutes, developed some technologies that could be possible technological options for waste processing. These technologies are low cost, indigenous and can be customized as per agro-climate zones. Two prominent ones are being discussed here:

Nirsurgruna[1]

This technology, developed in the Bhabha Atomic Research Centre (BARC), is based on the concept of paying back nature's loan. It works as a sustainable and viable option for solid biodegradable waste. This technology processes kitchen waste—both cooked and uncooked—to get biogas and manure.

This indigenous technology is developed by Nuclear Agriculture and Bio-technology Department of BARC which is headed by Dr Sharad P. Kale. This technology is mainly for decentralized process for bio-degradable waste. It combines both aerobic and anaerobic degradation of biodegradable waste materials.

The aerobic phase is aided by the addition of hot water to support the growth of efficient thermophilic and thermoduric degraders belonging to the Genus Bacillus. The anaerobic phase results in formation of biogas and organic manure, which can help in obtaining the self-sustainability of the project. The organic manure is rich in nitrogen, carbon, potassium and phosphorous and is devoid of any heavy metals. The weed seeds are either macerated in the mixer or killed by the hot water added in the predigester; hence it is weed-free. As per Central Public Health & Environmental Engineering Organisation (CPHEEO) estimates, the country has the potential to produce about 4 million metric tonnes of compost every year. However, only about 0.1 million metric tonnes of compost is produced every year (against installed capacity of 1 million metric tonnes).

This technology can be adopted by housing complexes, colonies, universities, schools and all small towns having population below 20,000. This Technology can be easily adopted as it helps in achieving zero garbage and zero effluent. It not only generates energy but also produce manure which is rich in carbonic content.

Few prominent plants operating on Nisargruna Technologies are located in Baroda (Carcass Plant); Anushaktinagar, Mumbai; Ankaleshwar, Gujarat; TCS, Thane; Symbiosis, Pune; Kalameshwar Municipal Council; Anjangaon, Amravati; Katol, Nagpur; Hiranandani Estate, Thane; Tata Institute of Social Sciences, Deonar; Kurudampalayam, Coimbatore and Tihar Jail, New Delhi.

However, more such plants need to be brought up. The first step would be for adoption of this technology by all housing boards, government construction agencies, whether in Railways, Airport Authority, Defence, Central Public Works Department, development bodies, so that more and more of waste is treated in a decentralized and cost-effective manner. Once it has a wider dissemination, either upgradation or upscaling can be done. State Governments can think of making small decentralized waste management plants necessary in the planning laws, wherever approval for the construction of more than 100 houses/flats is given by them. It is also to be remembered that it is mostly the affluent section of society living in such complexes that generates the maximum waste.

Plasma Pyrolysis Technology

Plasma, the fourth state of matter, is an electrically conducting fluid consisting of charged and neutral particles. These charged particles have high kinetic energies. The particle's kinetic energy takes the form of heat and can be used for decomposing chemicals. Pyrolysis is a process of thermal disintegration of organic mass in an oxygen-starved environment. High temperature can be produced using thermal plasma ($> 5000^0$ C in the plasma core) that is capable of dissociating molecular bonds; therefore, it efficiently takes care of biomedical waste including plastics present in it. Plasma pyrolysis has recently been gaining popularity in the world and has been accepted as a technology alternative to incineration in *China, Japan* and *USA*.

It is a non-burn waste disposal technology that is also capable of disposing different types of organic waste as well as biomedical waste, plastic waste, solid waste, agro-waste, etc. It has been approved by the Central Pollution Control Board (CPCB) as the emissions comply to its limits for waste category 1, 2, 5 and 6. In this technology, the hazardous and toxic compounds are broken down into elemental constituents at high temperatures and they do not cause any dioxins and furans. It is an eco-friendly alternative to

incineration. This technology is indigenously developed in India in the Institute for Plasma Research, under the Department of Atomic Energy in Gandhinagar, Gujarat. The plastic waste that is a bane of modern civilization can be treated with this technology. Plastic waste is non-biodegradable and leads to clogging of drains, contamination of ground water as well as stopping of rejuvenation of groundwater source. A 15 kg/hr capacity plant costs only ₹4 million while a 50 kg/hr capacity (1 ton/day max.) plant costs only ₹9 million. The floor space required for them is only 10 × 0.8 metre and 12 × 10 metre, respectively.

This technology has been developed, as stated above, in the institute for Plasma Pyrolysis Research under the Department of Atomic Energy and has been approved by the CPCB. However, it has not been disseminated or adopted by the local bodies, as the coordination between technological institutes, academic institutes and local bodies is missing. This technology, can also be used for safe disposal of floral waste in temples, mosque and other religious places so that the same are not disposed into the water bodies. The country has present potential to generate about 500 MW of power and the same can be increased to 1075 MW by 2031 and 2780 MW by 2050. However, the present power generation from municipal waste is 20 MW only.

It is time that plastic waste and other waste should not be seen as a business model or a financially viable project. The spinoff achieved in terms of better quality of life and environment cannot be assessed in monetary terms.

Keeping in view the governance structure of local bodies where revenue scheme to the smaller local bodies is less and their capacity is meagre, each State Government or Central Government can set aside some funds for treatment/processing of waste. The capital cost and operation maintenance cost are so low that each State government or Central Government can take initiative to develop some model plants. These plants can be developed by Central Public Works Department (CPWD), Military Engineering Services (MES), other government bodies and housing board for dissemination and then these can be rolled out. Treatment of plastic waste along with with treatment of organic waste in a systematic manner can lead to cleaning of cities, and real *Swachh* (clean) India.

The CPCB and State Pollution Control Board need to be more sensitive on technologies available. Presently, there is a disconnection between the local bodies and Central Pollution and State Pollution Control Board with respect to solid waste management. Treatment of solid waste takes low precedence in the entire gamut of Environment and Forests Department. There is a need to bring it in the forefront of both environment as well as Urban Development Departments. These indigenous technologies, developed in India, can lead to massive reduction in plastic waste and can be adopted by small- and medium-class towns. Hand holding can be done by research institutes and pollution control boards. There is a need to invigorate the communication between the local bodies and technologies development institute, which at present is missing.

In New Delhi alone, 8,300 metric tonne of waste is generated every day. North Delhi Municipal Corporation generates 3,100 metric tonne of garbage every day and only 500 metric tonne of waste is sent for energy treatment plant to Okhla while 1,700 metric tonne is sent to Narela–Bawana plant for composting. The South Delhi Municipal Corporation generates 2,700 metric tonne of garbage per day, of all which is processed and sent to the landfill site at Bhalswa and Okhla that is filled up to the brim and is approximately 50 m high from the ground level. The East Delhi Municipal Corporation is generating 2,200 metric tonne of garbage that is being disposed at Ghazipur sanitary landfill site which has exhausted. The New Delhi Municipal Corporation generates 300 metric tonne of waste every day. It also uses compost garbage using compost pits in gardens and conversion of organic waste into pellets using foodies' machines at many places like Palika Services Officers Institute (PSOI)-Nehru Park, Malcha Marg, etc.

These technology which are developed in India based on indigenous knowledge can be replicated in a decentralised manner. Land is available with different organisation like Defence, Airport Authority, Railways, Municipal bodies and various other institutes and government organisation. A collective effort needs to taken in systematic way to address the issue of plastic waste which is hazardous.

Note

1. **Dr. Sharad P. Kale,** Nuclear Agriculture and Biotechnology Division, Bhabha Atomic Research Centre (BARC), Mumbai: Nisargruna plant for urban and rural waste management, energy conservation, better environment and restoration of soil fertility. Bio Energy News, Vol.8, No.1, 22–26 (2004).