Toxics *Link*
Factsheet
Number 15 / March 2002

Waste-to-Energy

Indian garbage: should energy be the driving concern?

Urban Indians produce an estimated 100,000 tonne of wastes per day.[1] It is a growing urban problem, and the industry is eyeing it as a potential money-spinner. Even though every stakeholder does have a role in mitigating the problem, it must be realised that waste is wasted natural resources and it is unsustainable to generate more and more waste. Hence instead of treating it merely as an economic good, any intervention must be examined in the context of waste minimisation, making waste less toxic and reducing its environmental impact. Also in an Indian context, it is a fact that the livelihood of millions of people depends on waste recycling.

The problem of waste concerns not only its quantity but also its nature. There are two main components of Indian urban waste; the biodegradable component consisting mainly of food items, kitchen waste, etc; and the non-biodegradable component consisting of plastics, metals, etc. Intervention in the waste stream, that is, manufacturing, usage, disposal and post disposal, needs careful planning in a holistic way.

Composition of Indian garbage

The composition of Indian municipal solid waste (MSW) is quite different from that of US and Europe; its distinctive features are the following:

1. Low calorific value,
2. High moisture content,
3. High proportion of organic matter,
4. Earth, sand and grit.

The multibillion-dollar worldwide waste industry sells the promise that waste as a mixed commodity is fine and there is no need for segregation or segmental approaches. Components like paper, plastics, metal and food become 'waste' only after they are mixed, but remain recyclable materials if they are not.

Treating energy as the sole focus for waste treatment is not only unsustainable from the point of energy economics, but also distorts waste management, since it does not automatically lead to waste minimisation and sustainable waste behaviour. The issue becomes more complex if high-heat thermal technologies, such as incineration, pyrolysis or gasification are used for waste treatment. These processes have an adverse environmental impact, necessitating a high cost to even attempt any acceptable levels of regulation.

How does a facility, which generates energy from waste, survive? Fundamentally it has two revenue streams. First, a tipping fee paid by the waste collector to use the facility, and second the sale of energy

AT A GLANCE

- **High-heat Waste-to-energy (WTE) involves non-segregation of plastic, which is violative of Municipal Solid Wastes (Management Handling) Rules 2000**
- **WTE plants emit high levels of suspended particulate matter and ash at the end of the process, which can be hazardous to nearby communities**
- **Claimed volume reduction of waste in the WTE processes is a fallacy. It ignores the potentially toxic ash and toxic air emissions**

Table 1: Composition of Indian MSW

Composition	Percentage
Biodegradable	52
Metal scrap, rubber, textiles, leather, etc	11
Stones and rubble	8
Fine earth and sand	23
Plastics	1
Paper and paper products	5

Source: Srishti, 1998

produced. The sum total of these revenues is used to cover the cost of running the facility and also making it profitable and hence sustainable. If either of these revenue streams is missing, the utility can never be sustainable. In India, the concept of a tipping fee has not even been introduced. By replacing tipping fee with subsidies, the linkages with the original waste generator are broken, and the justification for the waste-to-energy (WTE) scheme is lost.

Of course, the capital cost of the facility itself depends on the type of technology used, and thermal technology costs have risen exponentially in the past few years in developing countries to meet the rising environmental standards. A 2000 tonne per day facility can cost upwards of US$500 million with more than 50 per cent of the cost in pollution control equipment. It is now evident that there is dumping of obsolete, less environmentally rigourous thermal technologies into India and other developing countries, promoted by misplaced governmental programs and subsidies.

Also the ongoing cost of generating electricity from a waste-to-energy plant is at least twice that of a thermal power plant. Thus, there needs to be a perpetual subsidy provided to the facility to cover the price difference and to enable the sale of energy to an Electricity Board. Unfortunately, though the project is garbed as a waste management one, it does not even address the basic causes of the waste problem. It cannot be justified either for energy generation or for waste abatement.

In India, the only subsidies available for waste projects are when energy is generated. However, if compost is made as a product then there are almost no subsidies or support available.

Burning waste – creating toxics

In recent years, thermal technologies claiming to reduce the quantity of waste and generating substantial quantities of decentralised energy are being promoted into India. The Ministry of Non-conventional Energy Sources (MNES) recently took fresh initiatives to promote such technologies, amongst others, based on the combustion of unsegregated urban and industrial wastes. Not only that, the MNES has issued an executive order asking all the state governments and union territories to follow suit unmindful of the organic composition of Indian waste.[2]

Such technologies have larger environmental footprints than others, especially when they convert waste into other forms of toxicity. Included in these are conversion technology options such as pelletisation, gasification, pyrolysis, incineration, all of which are high-temperature technologies, that are not only extremely expensive to operate safely but also inappropriate to the organic nature of Indian urban waste. Therefore, energy generated using these technologies are neither economically nor environmentally sustainable.

TESTING

No testing facilities for dioxins and furans emitted from waste-to-energy facilities are available in India. These tests cost $1,000 to $50,000 for complete profiling

1. Manual of Municipal Solid Waste Management, the expert committee, Ministry of Urban Affairs and Employment, January 2000

2. Ministry of Non-conventional Energy Sources

Decomposition reactions take place, and a mixture of hydrogen and CO are the predominant gas products, along with water, methane, and CO_2. There are many countries that list gasification and incineration as one technology from the environmental viewpoint.

Meanwhile there have been a host of failed or questionable projects for waste-to-energy from high heat processes.

The Delhi Case

The Danish incinerator installed at Timarpur, New Delhi for a cost of Rs 44 crore, which ran for only a week, is one such failure. Way back in the 1980s, an incinerator came up in Timarpur but was shut down because the waste was unfit for burning. Since then it has been lying idle, incurring maintenance costs. When WTE has failed to prove itself as an effective technology, why should we in India go for it, is a question that no Ministry official is willing to answer.

The Chennai Case

In an attempt to deal with the growing volume of garbage, the Corporation of Chennai, in collaboration with the Tamil Nadu Industrial Corporation (TIDCO), has initiated a scheme to start a WTE plant in Perungudi. The plant cost is nearly Rs 200 crore with only 12-15 MW of electricity likely to being generated. The question is whether a city like Chennai can afford to dabble with such an expensive and experimental technology. Of the Rs 200 crore, the Ministry of Non-conventional Energy Sources and the Indian Renewable Energy Development Agency (IREDA) will subsidise Rs 30 crore. No environmental study has been conducted on this project. There has been virtually no public consultation in relation to plant. Needless to say, the project lacks transparency and no information about the technology or its impacts has been forthcoming from the project proponents or the Corporation. The technology chosen is unproven and untried at this scale.

Hyderabad Pelletisation Experience

This WTE plant, started in 1999, is based on refuse-derived fuel technology. However, it also promotes the scattered burning of plastic wastes. The plant is a pilot project run by a company called Selco. It is located next to the Ganghamguda municipal land dump (20 acres), which receives 1,300 tonnes of garbage every day from Hyderabad city. The installed capacity of the plant is 1,000 tonnes/day and it can manufacture 200-250 tonnes/day of fuel pellets. The company claims that the calorific value of the fuel pellets is 400 kcal/kg (can be increased to 6000 kcal/kg) and has ash content less than 10 per cent. Currently, the plant is processing only 100-150 tonnes of garbage a day since there is no demand from the industries. Since the pellets are made up of mixed waste, they contain plastics and several heavy metals. The company or the municipality is doing hardly any marketing.

Some Expert Opinions

Dr D.N. Rao, environmental economist, Jawaharlal Nehru University, New Delhi: We wonder why the Ministry of Environment and Forests is not objecting to the project. This is a prima facie violation of Environment Protection Act, 1986. The problem of Suspended Particulate Matter (SPM) must be addressed. Burning cheap energy to generate costly energy is not a sensible policy because there is a perennial cost involved. At the national policy level it has been decided that no electricity will be subsidised apart from agriculture and even in agriculture it is going to be raised in a phased manner. How can the Finance Ministry agree to it? The objective of volume reduction is not achieved because, in the long run, ash disposal will be another problem we will be faced with. The argument that gasification is not incineration is nothing but jugglery of words. We demand a public hearing and environment impact assessment of the project.[7]

P.U. Asnani, Chairman, Core Group, Appropriate Technologies for Solid Waste, Ahmedabad: There is a need to stress on the need for composting and appropriate technological inputs to manage solid waste.[8]

Ravi Agarwal, Solid Waste Expert, Srishti, New Delhi: We are being used as guinea pigs. Gasification and similar technologies like pyrolysis, plasma arc, are classified by the European Union as incineration processes and have similar health concerns. The syngas produced during the processes will be contaminated with dioxins,

7. Dr D.N. Rao, Environmental Economist, Jawaharlal Nehru University, New Delhi, personal communication

8. P.U. Asnani, Chairman, Core Group, Appropriate Technologies for Solid Waste, personal communication

9. Ravi Agarwal, Solid Waste Expert, Srishti, New Delhi, personal communication

10. Dr Sanat Mohanty, Chemical Engineering and Material Science, University of Minnesota, e-mail communication

11. Report 'Solid Waste Management in India', presented by the Committee constituted by the Supreme Court of India, Central Pollution Control Board

12. 'Making the Most of a Mess', a handbook on municipal solid waste, A publication by Srishti and Toxics Link, January 2002

tissues of humans, fishes, chickens, lambs, goats, predatory birds and Ganges River dolphins, collected from various locations in India. Dioxins were found in most of the samples analysed, with the liver of the spotted owlet containing the highest concentration of 3,300 pg/g fat wt while in human fat tissues they existed in concentrations ranging from 170 to 1,300 pg/g fat wt. Among fish, meat and wildlife samples analysed, concentrations of dioxins were found in the order of country chickens < goat/lamb fat < fishes < river dolphins < predatory birds.

As compared to even the conservative WHO limits of 1-4 pico grams per kg of body weight, the study translated to alarmingly high contamination levels This is the first report of its kind detecting dioxins in human tissues, fishes, meat and wildlife collected from India.[5]

Are they viable?

Burn techniques such as gasification, pyrolysis and incineration are technically inappropriate for Indian garbage which has a calorific value of about 800 cal/kg. Burning the waste would require at least 1,500 cal/kg, else auxiliary fuel is needed. This raises the probability of undesirable materials being used as fuel supplement, such as plastics and other waste oils. The use of backup fuel not only demolishes the rationale for the project, that is garbage disposal, but also makes the process more uneconomical and unprofitable than it already is.

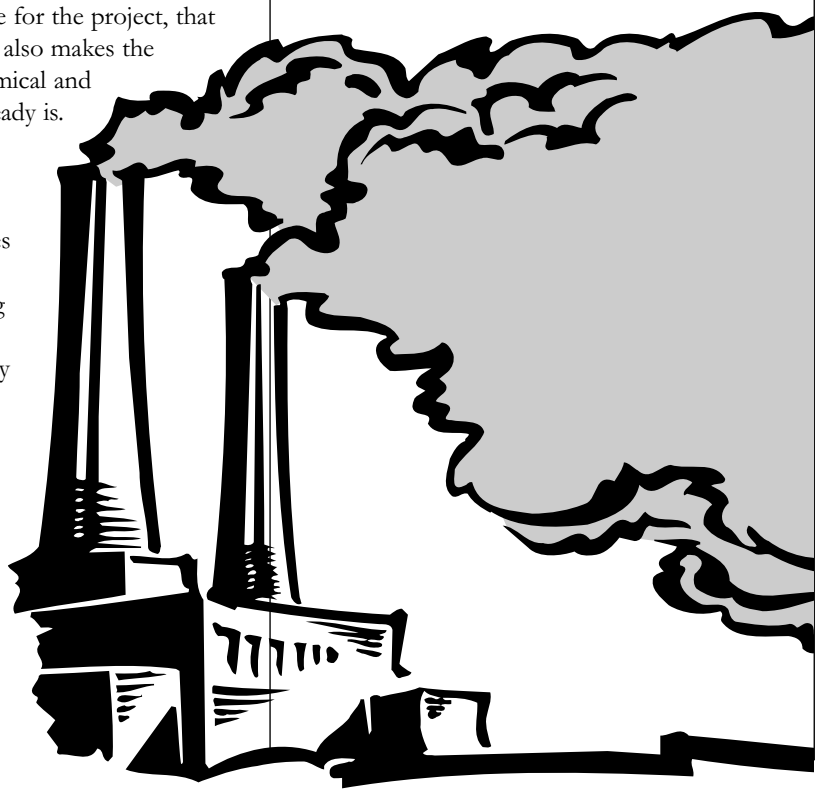
Perpetual subsidies

The various subsidies given to these WTE projects without levying any cost on the waste generator bypasses a key reason for waste reduction. Disposal costs, if borne by the waste generators, serve as a disincentive to create more. On the other hand, these WTE schemes imply that waste generation is good, since it means more energy.

The cost of a typical 5 MW WTE project is about Rs 40 crore, with each MW of electricity consuming 150 tonnes of urban waste. This amounts to an investment of Rs 8 crore per MW, or four times the cost of conventional thermal power. The subsidy exceeds 50 per cent of the total project cost, an unjustifiable public investment of Rs 20 crore for 800 tonnes of urban waste disposal. A cost which should be borne specifically by the waste generator. On the other hand, a similar composting plant will cost less than Rs 5 crore.

Gasification is incineration

There have been claims by the industry as well as gullible bureaucrats that gasification is not incineration. In fact everyone seems to be agreed that incineration is bad, but gasification is good. There is a minor semantic difference between the two, when it comes to toxic emissions. According to the latest studies, incineration and gasification are the same, since both have smokestacks that emit pollution in the air when municipal solid waste is burnt.[6] Although the amount of emission of toxic pollutants like dioxins may vary but the toxins are the same. Gasification is a high-temperature process that is optimised to produce a fuel gas with a minimum of liquids and solids. Gasification consists of heating the feed material in a vessel with or without the addition of oxygen.



GASIFICATION

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5. Polychlorinated Dibenzo-p-Dioxins, Dibenzofurans, and Polychlorinated Biphenyls in Human Tissues, Meat, Fish and Wildlife Samples from India; Kurunthachalam Senthilkumar et al, Institute of Environmental Science and Technology, Yokohama National University, 79-7 Tokiwadai, Hodogaya-ku, Yokohama 240-8501, Japan; National Food Safety and Toxicology Center, Michigan State University, East Lansing, Michigan 48824, USA; Kovai Medical Center and Hospitals, PO Box 3209, Avinashi Road, Coimbatore 641 014, Tamil Nadu, India; and K.G. Hospital and Post-graduate Medical Institute, Arts College Road, Coimbatore 641 018, Tamil Nadu, India

6. US Environmental Protection Agency, Compilation of Air Pollutants Emission Factors, Volume 1, Fifth Edition

Table 2: Toxic metals identified in garbage incinerator emissions and ash residues[3]

Antimony	Copper	Nickel
Arsenic	Lead	Selenium
Beryllium	Manganese	Tin
Cadmium	Mercury	Vanadium
Chromium	Molybdenum	Zinc

Thermal waste-to-energy processes are the easiest and dirtiest option. But in terms of the consequences, environment and health pay a heavy price. These methods produce chemical toxins, which have grave health effects on humans. If trapped, they become a part of the fly ash, which becomes very toxic to dispose of.

Why are 'burn technologies' dangerous?

In theory, a properly designed thermal process such as an incinerator should convert simple hydrocarbons into nothing other than carbon dioxide and water. However, in practice, the garbage contains chemicals that escape pollution control devices through airborne emissions, or concentrate in the ash residue, which is typically disposed of in landfills or stockpiled above the ground.

Some of these pollutants are:

- Particulate matter, heavy metals, acid gases, oxides of nitrogen and products of incomplete combustion, including chlorinated organic compounds and, as with all combustion devices, large quantities of carbon dioxide (CO_2). CO_2 is considered to be one of the major contributors to global climatic changes.
- Acid gases: These are formed during combustion when certain elements in garbage come in contact with oxygen or hydrogen. Sulphur dioxide and hydrogen chloride are two of the gases released into the atmosphere, contributing to the acidification of rain or fog and consequently metal corrosion, and the erosion of limestone and marble buildings.

RECYCLING

India has millions of people making a livelihood from recycling. It is imperative that their working conditions be improved and technology upgradation take place. Burning mixed waste will kill the sector instead of making it more sustainable

3. California Air Resources Board (1984); Air Control at Resource Recovery Facilities

4. Dioxins paper presented at Dioxin 2001, International Symposium on Halogenated Environmental Organic Pollutants and POPs, Kyoung ju, Korea, September 9-14, 2001

- Dioxins and furans: Dioxins are the most lethal carcinogens known to humans. These are formed as unintended by-products when chlorinated substances are burned at a temperature between 200-800 °C. Dioxins and related chlorinated compounds are extremely potent toxic substances that produce a variety of adverse effects in humans and animals even at extremely low doses. These compounds are persistent in the environment and accumulate in magnified concentrations as they move up the food chain, concentrating in fat and breast milk. Findings from the new EPA report states that the risk of getting cancer from dioxin is 10 times higher than reported in 1994.

In India no testing facilities for the dioxins and furans emitted from the waste-to-energy facilities are available anywhere. These tests cost $1,000 to $50,000 for complete profiling of dioxins and furans. In fact very few developed countries have dioxin measuring facilities. Municipal and medical waste incineration has been listed as the primary source of dioxin production worldwide.

Do we need to be saddled with these pollutants when there are alternatives that are cheaper, cleaner and healthier?

Dioxin levels already alarmingly high in India

Dioxins are no longer only a 'Western' problem. Two recent studies have revealed their presence in India in very high levels.

In the first study, dioxins were detected in human breast milk samples collected from Perungudi, Chennai in India on August 2000, which have dumping sites of municipal wastes in the suburbs of urban area. Breast milk samples were stored at -20°C until analysis. Dioxin levels were even higher when compared with those in the general public of developed countries, such as the Japanese, Americans, and Canadians. This indicates that significant pollution sources of dioxin-related compounds are present in dumping sites in India, probably due to secondary formation caused by burning of municipal wastes.[4]

According to the second recent study, concentrations of dioxins were measured in

toxic heavy metals like mercury, lead and other toxic substances.[9]

Dr Sanat Mohanty, doctorate in Chemical Engineering and Material Sciences, University of Minnesota: It's technological astigmatism. What this strategy achieves is that we delay solving the problem. When degradation occurs 20 years from today, our children and future generations will be exposed to these chemicals and have to deal with them. Waste-to-energy is certainly not a solution.[10]

Supreme Court-constituted Burman Committee Report: Local bodies are cautioned not to adopt expensive technologies of power generation, fuel pelletisation, incineration, etc until they are proven under Indian conditions.[11]

What needs to be done? [12]

Promote cleaner technologies appropriate to our waste

Instead of subsidising energy and fertilisers, it would be sustainable to subsidise composting. Wherever government can be a buyer, it ought to encourage it by undertaking to do so.

Waste minimisation efforts

The technological options exact a high cost in terms of their recycling and composting potential, besides displacing the large informal sector in these areas without providing them safer alternatives. India has millions of people making a livelihood out of recycling. It is imperative that their working conditions be improved and sustainable technology upgradation take place. This needs support from the government as well as the industry as part of an extended product responsibility, to happen. Burning mixed wastes will kill the sector instead of making it more sustainable.

ALTERNATIVES

The ideal resource management strategy for municipal solid waste is to avoid its generation in the first place. This implies changing production and consumption patterns

Adopt alternative cleaner methods of disposal

The search for systems sensitive to ecology and health to manage waste in developing countries is particularly challenging. The need for low-cost solutions presents significant difficulties, but it is not an impossible task. The ideal resource management strategy for MSW is to avoid its generation in the first place. This implies changing production and consumption patterns to eliminate the use of disposable, non-reusable, non-returnable products and packaging. The alternatives include:

i. Waste reduction
ii. Waste segregation
iii. Reuse and extended use
iv. Recycling
v. Biomethanation technology
vi. Composting
vii. Vermicomposting

If you have any suggestions or require more information, please visit our website at www.toxicslink.org or contact:

GOPAL KRISHNA
Toxics Link – Delhi
H2 Jungpura Extension
Ground Floor
New Delhi 110 014
Tel: +91-(0)11-4328006/0711
E-mail: tldelhi@vsnl.com

Toxics Link – Mumbai
4th floor CVOD Jain School
84 Samuel Street
Dongri 400 009
Tel: +91-(0)22-3752050/3759657/
3716690
E-mail: tlmumbai@vsnl.com

Toxics Link – Chennai
7, Fourth Street
Venkateswara Nagar
Adyar, Chennai 600 020
Tel: +91-(0)44-4460387/4914358
E-mail: tlchennai@vsnl.net

Designed and produced by Splash! Communications, *e-mail* makeasplash@vsnl.net