International Journal of Chemical Studies

P-ISSN 2349–8528
E-ISSN 2321–4902
IJCS 2015; 2(5): 51-53

Received: 06-02-2015
Accepted: 07-03-2015

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Review on waste to energy potential in India

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Abstract
India is one of the most rapidly developing countries in the world. The environmental benefits of waste to energy, as an alternative to disposing of waste in landfills, are clear and compelling. Waste to energy generates clean, reliable energy from a renewable fuel source, thus reducing dependence on fossil fuels, the combustion of which is a major contributor to greenhouse gases emissions. Currently India depends mainly upon fossil fuels and thus has to pay a huge bill at the end of every contractual period. India holds a huge potential for such non-conventional sources of energy.

Keywords: Municipal Solid Waste (MSW), Waste to Energy, Renewable Energy, Indian.

1. Introduction
Every year, about 55 million tones of MSW and 38 billion liters of sewage are generated in the urban areas of India. In addition, large quantities of solid and liquid wastes are generated by industries. Waste generation in India is expected to increase rapidly in the future. As more people migrate to urban areas and as incomes increase, consumption levels are likely to rise, as are rates of waste generation. The high volatility in fuel prices in the recent and past the resulting turbulence in energy markets has compelled many countries to look for alternate sources of energy, for both economic and environmental reasons [4]. With growing public awareness about sanitation, and with increasing pressure on the government and urban local bodies to manage waste more efficiently, the Indian waste to energy sector is poised to grow at a rapid pace in the years to come. The dual pressing needs of waste management and reliable renewable energy source are creating attractive opportunities for investors and project developers in the waste to energy sector [3].
Some of the reasons why the MSW to energy route makes a lot of sense in India are due to the fact that there are huge volume reductions (80-90%) that can be achieved, the consumption of the waste can happen on a daily basis, all the processes are pathogen free, various technologies can be used for different types or MSW, these waste to energy technologies are capable to treat non-putreciable organic matters such as wood, rubber, plastic, etc, and finally there is a ready market for energy which makes waste to energy from MSW commercially viable [8].

2. Waste to Energy Potential
According to the Ministry of New and Renewable Energy (MNRE), there exists a potential of about 1700 Mega Watt from urban waste (1500 Mega Watt from MSW and 225 Mega Watt from sewage) and about 1300 Mega Watt from industrial waste. The ministry is also actively promoting the generation of energy from waste, by providing subsidies and incentives for the projects [9]. State wise potential of energy recovery from urban and industrial waste in India is given in table 1.

3. Waste to Energy Possibilities in India
Energy recovery techniques include thermal treatments as incineration, gasification and other techniques as e.g. anaerobic digestion. Thermal treatments require the burning of waste with recovery of energy. Anaerobic digestion has been used for the treatment of agricultural and sewage sludge. About 65.34% of the electricity consumed in India is generated by thermal, 21.53% by hydroelectric power plants, 2.70% by nuclear power plants and 10.42% by renewable energy sources [6]. More than 50% of India's commercial energy demand is met through the country's vast coal reserves. Electricity can be produced by burning MSW as a fuel. MSW power plants, also called waste to energy plants, are designed to dispose of MSW

and to produce electricity as a by-product of the incinerator operation. Burning MSW can generate energy, while reducing the volume of waste by up to 90 percent [6].

Table 1: Potential of Energy Recovery from Urban and Industrial Wastes in India

States	From Liquid Wastes (Mega Watts)	From Solid Wastes (Mega Watts)	Total (Mega Watts)
Andhra Pradesh	16.0	107.0	123.0
Assam	2.0	6.0	8.0
Bihar	6.0	67.0	73.0
Chandigarh	1.0	5.0	6.0
Chhattisgarh	2.0	22.0	24.0
Delhi	20.0	111.0	131.0
Gujarat	14.0	98.0	112.0
Haryana	6.0	18.0	24.0
Himachal Pradesh	0.5	1.0	1.5
Jharkhand	2.0	8.0	10.0
Karnataka	26.0	125.0	151.0
Kerala	4.0	32.0	36.0
Madhya Pradesh	10.0	68.0	78.0
Maharashtra	37.0	250.0	287.0
Manipur	0.5	1.5	2.0
Meghalaya	0.5	1.5	2.0
Mizoram	0.5	1.0	1.5
Orissa	3.0	19.0	22.0
Pondicherry	0.5	2.0	2.5
Punjab	6.0	39.0	45.0
Rajasthan	9.0	53.0	62.0
Tamil Nadu	14.0	137.0	151.0
Tripura	0.5	1.0	1.5
Uttar Pradesh	22.0	154.0	176.0
Uttaranchal	1.0	4.0	5.0
West Bengal	22.0	126.0	148.0
Total	**226.0**	**1457.0**	**1683.0**

Source: MNRE, 2011 [5]

Indian MSW contains large quantity of moisture and soil. When the soil and moisture is removed considerably, the waste has an appreciable calorific value (2700 - 3000 kcal/kg). Therefore, the MSW has significant potential for energy recovery. The energy content in MSW in urban areas is due to the presence of combustibles such as plastics, paper, rags and various other bio-mass wastes discarded by domestic and commercial establishments. The energy content fraction of garbage in India has been found to be in the range of 55% - 60% by dry weight throughout the year, while the energy content fraction factor of garbage in developed countries is found to be in the range of 70% - 75%. However, it is important to note that the moisture content of Indian garbage is rather high at 50% - 60% and that of paper/plastic fraction is low. This required different technology in Indian context. The major technology options for energy recovery under practice in the developed countries include incineration, anaerobic digestion, land fill gas, fuel pellets etc. (Earth engineering centre, 2012) [1]. These options could also be used in India.

Using Waste to Energy technologies in India has been used in some cases for RDF (Refuse derived Fuel) and biomethanation. Biomethanation, the common word used for anaerobic digestion technology for biogas production in India. Biodegradable waste has a good potential for generating biogas, which can serve as fuel, can also be converted to energy as well as to compost which can improve soil health. This wet waste must therefore be processed either through composting technology for generating biogas, electricity or compost for use as nutrient and prevent such wastes reaching the landfill (Planning Commission, 2014). New technologies offer enhanced material recovery, efficient energy recovery and reduced landfill [2].

One of such technique is plasma gasification. Based on this plasma incinerators are also being used. Plasma-arc gasification uses a plasma-arc torch to produce temperatures as high as 7200 °C to breaks down wastes, forming hydrogen and carbon monoxide, which can be used to generate electricity directly [3].

Being a heavily populated country, the total amount of MSW produced in India is very high. Technology alternatives are available to use these quantities of MSW for energy generation. This can be either done by using MSW as a fuel or in combination with conventional fuels. State wise potential of energy generation using MSW is given in table 2.

Table 2: State Wise Energy Generation Potential of MSW in India

State/Union Territory	Total MSW (Tons/day)	Energy Potential (Mega Watts)
Maharashtra	22434.35	446.44
Uttar Pradesh	13651.39	271.66
West Bengal	12069.24	240.18
Tamil Nadu	9501.77	189.09
Andhra Pradesh	9998.97	198.98
Karnataka	8296.02	165.09
Delhi	11873.06	236.27
Gujarat	7930.91	157.83
Madhya Pradesh	4633.63	92.21
Punjab	4645.00	92.44
Rajasthan	4671.89	92.97
Haryana	2184.78	43.48
Bihar	1956..78	38.94
Kerela	1689.02	33.61
Chhattisgarh	1077.02	21.43
Jharkhand	942.55	18.76
Orissa	839.25	16.70
Jammu and Kashmir	746.24	14.85
Uttarakhand	424.00	8.44
Assam	341.73	6.80
Goa	221.92	4.42
Pondicherry	185.66	3.69
Tripura	137.90	2.74
Andaman and Nicobar Islands	105.46	2.10
Himachal Pradesh	71.53	1.42
Mizoram	64.37	1.28
Manipur	61.03	1.21
Meghalaya	54.25	1.08
Dadar and Nagar Havelli	25.75	0.51
Daman and Diu	25.63	0.51
Nagaland	14.52	0.29
Sikkim	14.71	0.29
Arunachal Pradesh	13.56	0.27
Lakshwadeep	3.74	0.07
Total in India	**120908**	**2406.06**

Source: Saini *et al.*, 2012 [8]

4. Conclusion

Technology alternatives are available to use MSW for energy generation. This can be either done by using MSW as a fuel or in combination with conventional fuels. Using plasma-arc incinerators even hazardous wastes can also be used as a fuel.

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