SUSTAINABILITY, WASTE MANAGEMENT AND CLEAN POWER GENERATION IN INDIA

Sustainability of the environment has gained momentum in the recent past across the world, COP 26 being the most recent one. While some countries are performing better in sustainable development than the others, achieving it in India is more difficult with rapid population growth and improvements in living standards.

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The Stats in India

In India, the volume of waste generation has been increasing rapidly. According to the 'Swachhata Sandesh Newsletter'of the Ministry of Housing and Urban Affairs (MoHUA), as of January 2020, 147,613 metric tonnes (MT) of solid waste is generated per day, from 84,475 wards. The earlier report of the Planning Commission, 'Task Force on Waste to Energy' estimated that urban India will generate 4,50,132 Tonnes Per Day (TPD) by 2031 and 11,95,000 TPD by 2050.

The per capita waste generation is approx. 0.17 kg per person per day in small towns to 0.62 kg per person per day in cities. Hence, Solid Waste Management (SWM) is the need of the hour but is a major problem for many urban local bodies (ULBs) in India, where urbanization, industrialization and economic growth have resulted in increased municipal solid waste (MSW) generation per person. According to the 12th Schedule of the 74th Constitution Amendment Act of 1992, urban local bodies (ULBs) are responsible for keeping cities and towns clean. However, most ULBs lack adequate infrastructure and face various strategic and institutional weaknesses.

Various legislations have been passed for regulating the manner of waste disposal. The Ministry of Environment, Forest and Climate Change (MoEFCC) and MoHUA have together rolled out policies/ programmes to address these issues. Under the SWM Rules 2016, municipalities are directed to include the informal waste-pickers in their waste-management process. The SWM Rules however do not provide any incentives for waste-pickers, nor do they recognise the economic value of informal waste recycling work. Under the Swachh Bharat Mission-Urban (SBM-U), the Government of India has published a guide, 'An Inclusive Swachh Bharat through the Integration of the Informal Sector: A Step by Step Guide,' to help ULBs and states integrate informal waste-pickers and promote the reuse and recycling of solid waste.

The SWM Rules of 2016 have mandated the door-to-door collection of segregated waste, with waste generators obligated to pay a 'user fee' to the waste collectors. However, the Rules do not provide details on how the fee is decided–whether it is charged based on the quantity or type of waste generated. According to the 'Swachhata Sandesh Newsletter 2020', 81,135 wards (96.05%) out of 84,475 wards across India have achieved 100% door-to-door waste collection as of January 2020.

The total estimated energy generation potential from urban and industrial organic waste as per MNRE is approximately 5690 MW. Hence it can be said that the waste certainly has the potential and is also in a way helping the power sector to develop and enable it in producing clean fuel

Waste Management

Waste composition is changing in India, with the amount of high calorific waste generally increasing. The waste processing technologies adopted in India include composting, biomethanation, recycling, refuse-derived fuel, incineration, pyrolysis, waste-to-wealth and waste-to-energy. A significant increase in the use of waste-to-energy technologies has been proposed, but this depends on location, climate, demographics and other socioeconomic factors.

The problems associated with improper waste disposal could be significantly mitigated by having 'material recovery'. Source separation of inert and high moisture content fractions would maximize the potential for thermal recovery and other treatment options in India. Waste-to-energy technologies produce energy, recover materials and free land that would otherwise be used for dumping. The composition of residual waste is very important for energy recovery.

To recover energy from waste and effluent generated from industries, India has set up 186 waste-to-energy projects for generation of biogas, bioCNG power with a cumulative capacity of 317.03 MW so far. Out of the 186 projects (as on January 2020), 5 projects are based on municipality solid waste thus generating a total capacity of 66.5 MW of energy. Meanwhile, 181 projects are agricultural, urban and industrial waste-based waste-to-energy projects. Out of this, 94 projects are biogas and bio compressed natural gas (CNG) off-grid purpose. There are a few Waste to Energy (WTE) power plants also that are coming up.

Clean power generation

In different cities of India, WTE methods have been long attempted but this has remained unsuccessful for various operational and design problems, lack of awareness, inadequate funding, unaccountability and inappropriate technical knowledge. Of the 55 million tonnes of Municipal Solid Waste (MSW) generated every year, only about 15 per cent is non-biodegradable, non-recyclable, high-calorific value waste. There are two kinds of WTE projects operating in India i.e. power plants based on MSW and power plants based on biomass waste. Biomass waste is produced during agricultural and forestry operations i.e. straws and stalks, husks, shells, de-oiled cakes, wood etc. MSW is commercial and residential waste generated in a municipal or notified area in either solid or semi-solid form.

Both MSW and Biomass waste are a heterogeneous combination, inherently variable in nature in terms of its potential to generate energy.

MSW to energy plants, in order to eliminate the risk of variability in the fuel, have to pre-process the waste and convert it into 'Refuse Derived Fuel' ("RDF"). RDF is segregated combustible fraction of solid waste other than chlorinated plastics, made in the form of pellets or fluff produced by drying, de-stoning, shredding, dehydrating, and compacting combustible components. RDF is then used to generate electricity. Pre-processing of solid waste adds to project costs for the developer. Biomass to

energy plants use agricultural waste which is again heterogenous having variation in type, size/ shape of waste, bulk density, moisture content, source, stone, inert content, seasonal variation etc.

Biomass waste

There is no one type of biomass waste available throughout the year. Since these factors of heterogeneity are present, it exponentially increases the risk of variability in electricity generation. Biomass power plants are facing problems related to predictability of quality of fuel and its impact on boiler and steam generation. As different types of biomass have different burning properties, overall combustion process keeps varying. And thus power generator has no control on the predictability of effects of interaction of different types of fuels during combustion and the impact on boiler and steam generation.

Since the burning profile of various types of waste varies and when they are fed in mixed then resultant real time burning profile need to monitor with quantity of air, furnace draft, emission limits etc. This makes the boiler unstable. Apart from this effect of moisture and size of mixed fuel have negative impact on overall combustion of biomass into boiler. Due to blending of different types of waste, the interaction of such fuel also creates issues in being able to control appropriate temperatures. The ash fusion temperature of a blend of waste is not predictable. Due to this high fouling tendency of ash even at lower temperatures on boiler heat transfer area leads to frequency stoppages and cleaning. Between two cleaning cycles there is a gradual loss in heat transfer efficiency of boiler which leads to inherent variation in boiler performance.

Waste-To-Energy plants

Overall, the WTE plants operate in a manner where the steam generation follows the fuel i.e., turbine does not 'demand' steam from boiler but generates only as much steam is being provided by the boiler. This is known as "fuel follow" or "boiler follow" mode. In contrast, conventional power plants operate in "turbine follow" mode where the boiler delivers the steam requirement for turbine to match the schedule.

The WTE plants are slow responding and cannot deliver the steam as quickly as conventional coal/ gas based plants. This is due to the nature of waste used. This in turn causes problems related to maintaining 'scheduled generation' where any deviation in generation is difficult to remedy in 15 minute time intervals.

The above-said issues contribute to boiler combustion performance and adds to project developer's O&M expenditure. Overall increase in project cost ultimately reflects in the electricity tariff which is high compared to other sources of electricity generation. The sector is nascent in terms of generation of electricity from a matter dense source compared to generation of electricity from an energy dense source. The sector thus requires regulatory and policy support to develop and fulfil its foremost objective of processing and disposal of waste for environmental benefit.

Project in Gujarat

Abellon Clean Energy Limited is one such project

company which is working at the forefront of the Swachh Bharat Mission and with a vision to make a significant contribution to the goals laid out under the same. They are the only ones so far in the State of Gujarat. In the rural segment, their focus is on decentralized regional WTE plants that use innovative blends of agricultural and other forms of waste to generate clean power for the grid as well as use of industries to meet their Renewable Power Purchase Obligations.

One of the key features of their WTE projects is the capability to process heterogeneous waste in a sustainable and environment friendly manner. This capability also enables them to partner organizations in meeting their Extended Producer Responsibility (EPR) goals for sustainable disposal of post-consumer plastic waste. Based on globally proven controlled combustion technology, these plants will sustainably process and dispose the waste and preventing it from going to the landfills. They are however facing difficulties in meeting the strict norms laid out for converting waste to energy. We can only hope that with time, waste to energy plants are given due attention with special treatment that they deserve at least in the nascent stages, i.e., similar to the treatment that was afforded to solar and wind projects early on.

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Clean tech in Goa

In another instance, the Goa State Solid Waste Management Cell has set up a biomethanisation-to-electricity plant to treat 40 tonnes of wet waste to produce 0.2-0.3 MW of electricity. The plant collects mixed waste from 25 coastal towns and villages and sorts it using machineries. The plant's WTE technology is based on anaerobic digestion, where micro-organisms break down biodegradable material in the absence of oxygen.

The process provides volume and mass reduction of the input material. Two products are formed by this–system biogas and digestive. The biogas generated is passed through a scrubber to remove hydrogen sulphide and then through a chiller unit to remove moisture. This clean gas is used to generate electricity through a gas engine. Half of the electricity produced is used in-house, while the rest is supplied to the grid.

Recently in September 2021, an MoU was signed between Indraprastha Gas Limited (IGL) and South Delhi Municipal Corporation (SDMC), as an extension of the Sustainable Alternative Towards Affordable Transportation (SATAT) initiative that aims to achieve the target of establishing 5,000Compressed Bio Gas plants by 2023-24 with a production capacity of 15 MMTPA. The waste-to-energy plant to be established in Delhi under the MoU is expected to produce approximately 4,000 kg Compressed Bio Gas per day to cater to expected vehicular demand under CNG.

The total estimated energy generation potential from urban and industrial organic waste as per MNRE is approximately 5690 MW. Hence it can be said that the waste certainly has the potential and is also in a way helping the power sector to develop and enable it in producing clean fuel. At the same time, we cannot ignore the challenges with respect to the way the waste is handled, processed, treated for generating power. For sustainable waste management the focus needs to be firstly on waste reduction, segregation and recycle and then on the waste to energy generation. As it has been rightly said, 'One man's trash is another man's treasure', projects like Abellon are definitely proving the same and give us hope for better waste management in India.

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