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Effectiveness of Waste to Energy Technologies for Municipal Solid Waste Management in Urban India

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Abstract

India's energy consumption is quickly growing day by day, and it is becoming increasingly challenging to meet the enormous demand while still pursuing sustainable goals. In addition to this, the garbage dumps outside of the cities are accumulating like a mountain. Reducing trash and finding creative ways to use garbage produced by humans are urgently needed in this circumstance. The waste and rubbish that are solid in form may be put to different uses. The best approach is to turn the garbage into energy. This method is now being used to produce electricity from solid waste in various nations. Urbanization, which may be regarded as a quick multiplier in countries like India, has also led to the production of more and more trash. Most of the trash or other waste is deposited in bodies of water or land, which pollutes the land, air, and water. It is crucial to properly handle this waste and utilize it to its full potential.

Keywords: Solid Waste Management, Solid Waste Management Technologies, Waste to Energy, Municipal Solid Waste, Urban Waste Management

Introduction

India's growing urbanization has aided in the production of trash of various kinds. Managing such a massive amount of waste has become quite challenging because it just serves to worsen pollution in all its forms. The health of those who live close and come into contact with the pollutants is also impacted. As many nations, including India, move towards sustainability, traditional and careless waste disposal methods like burning and dumping are suddenly becoming unsustainable. In addition, the traditional methods have undesirable outcomes and negative repercussions. Therefore, it is crucial that the nation transition to cost-effective and environmentally friendly waste management methods. As conventional fossil fuel power projects encounter growing transition uncertainties, it is anticipated that waste to energy will experience strong growth and favorable policy support from the government going forward. Through the provision of financial aid and other incentives for the projects, the ministry is actively promoting the production of energy from waste. In addition to encouraging the creation of electricity from garbage, waste-to-energy technology also helps to reduce pollution. Solid waste management has become a common industrial practice because of the nation's rising trash volumes, which are creating new economic opportunities for those involved in the value chain. Every sector of the country is getting commercial prospects from the renewable energy industry (Charles, Majid, 2019 and Vashi, Desai, 2018).

Several health issues have been reported as a result of the nation's poor waste management practices. There are significant problems in political, social, and environmental studies as a result of the increasing use of technologies including composting, landfill gas recovery, anaerobic digestion, bio-methanation, fuel derived from waste, and incineration. It is essential to use correct disposal techniques that preserve the equilibrium between economics, technology, and the environment. Achieving the balance requires ongoing R&D to implement cutting-edge methods, apparatus, and instruments for the conversion of waste to energy. A major public health issue is being raised by recent biomedical wastes because of their detrimental environmental consequences. The management of biomedical wastes involves a variety of procedures, including autoclaving and incineration. However, because of these techniques, concerns about severe environmental issues keep arising. The slurry produced during the waste to energy operations also serves as an efficient fertiliser in addition to producing electricity from waste. Waste to energy technological advancements will surely support industrial expansion, which will have an effect on the area and India's rising economy (Kumar, Smith, Fowler, Velis, Kumar, Arya, Rena, Kumar, & Cheeseman, 2017).

Literature Review

In a study, it was found that a variety of waste types from the industrial, domestic, and agricultural sectors are possible renewable energy sources to attain sustainability and transition to waste-to-energy programmes. Due to urbanisation, population growth, and rising living standards, there are now more people and wastes created by more activities. Energy is produced in the form of heat or electricity during the early stage of waste treatment. This energy recovery is produced by waste to energy through a variety of methods, including thermal, biochemical, thermochemical, and electrochemical conversion. All of these strategies are based on the kind and volume of trash, the desired energy source, the client's requirements, the national environmental ministry's regulations, and the financial soundness of the private or public enterprises performing the waste to energy (Patel, Gotawala, Shah, 2016 and Kumar, 2018).

According to a study, waste thermal processes include pyrolysis, gasification, refuse-derived fuel, and incineration. This process generates a large number of byproducts, which may be processed in a number of ways to recover resources and generate energy. Incineration is one of the most popular waste treatment techniques because it may reduce waste bulk by 70% and garbage volume by up to 90%. An incinerator may burn waste that is high in caloric content. With this method, electricity is produced using generated energy. The thermal waste process known as pyrolysis uses heat between 300 and 800 C to break down organic materials in an anaerobic atmosphere. Methane, carbon dioxide, hydrocarbons, hydrogen, carbon monoxide, liquid waste, and solid waste are all produced. The produced gas may be used in a variety of energy-related devices, including heat pumps, turbines, boilers, and motors. In addition, plastic waste may be pyrolyzed at low temperatures to create synthetic diesel fuel. The process of gasification is another. During the gasification process, waste is partially burnt to create power. By adding some amount of air and high temperature this can be achieved. Char, tar, and syngas are the byproducts of the gasification process. When burnt in a petrol turbine or engine, syngas is an environmentally friendly fuel that might provide power and heat. Waste may be reduced by this process by around 70% in mass and 90% in volume. Refuse-derived Another thermal waste management technique that uses fuel technology and is safe and environmentally good is waste management. In place of fossil fuels, the energy generated can be utilised as a substitute fuel in boilers (Gupta, Srivastava, Agrahari, & Detwal, 2018).

According to a study, biological waste treatment for energy conversion is a method that is far safer, more economical, and ecologically friendly than thermal procedures. One technique for treating biological waste is composting. The processing of organic waste by microorganisms under regulated aerobic conditions in a warm, humid setting is known as composting. Compost or humus, the finished composting product, is nutrient-rich. Compost solid fertiliser is used to feed crops in addition to biogas, a combustible gas made of carbon dioxide and methane, which is utilised to generate heat and electricity. The second sort of biological waste treatment technology employed is anaerobic digestion. Anaerobic digestion of garbage is usually referred to as the bio methanation process. This process microorganisms operating in anaerobic environment breaks down waste organic material. In addition to producing biogas for the generation of electricity and heat, this lowers rubbish output. Electricity production from garbage is not the most effective method. It is a technique for recovering resources from municipal solid trash and is regarded as a byproduct of waste management. If done in compliance with international emission regulations, it might be a means to create some much-needed power and a way to dispose of municipal solid waste in a sustainable and scientific way given the paucity of urban space in the country (Goel, 2017 and Srivastava, Ismail, Singh, & Singh, 2015).

A study found that the favoured method for addressing India's expanding garbage problem has been technology focused on combustion and burning. The waste inputs for these systems must be readily available, have a high calorific value, and have a low moisture content to be effective. Recycling and waste to energy are said to be complimentary waste management solutions, despite opposition, according to proponents in government and business. If India aspires to be the global leader in economic growth, it must invest in its civil infrastructure. Building first-rate infrastructure that meets public needs and protects the environment is essential for effective economic growth. Sustainable growth cannot occur without a waste management system. Natural resources in India are being depleted due to its rapidly expanding population. Wastes are potential resources, and efficient resource extraction and waste management are necessary for efficient solid waste management. Resources including food, energy, and materials that can support many people's lifestyles may be recovered from trash. The only way to achieve this is to make investments in solid waste management, which depend on a coordinated effort to create markets and maximise the recovery of recyclable and reusable resources (Goswami, 2018 and Vij, 2012).

A study found that the 3R idea has gained importance over time. The hierarchy of waste management places reuse at the top since it requires little time and money. Only solid segmentation is required for the reuse strategy. Reusable material may be easily cleaned, washed, and utilised for the same or any other purpose if it is kept apart from other garbage. Reuse reduces trash production, which lowers disposal expenses in the long run. If waste is used as a raw material in another operation, the cost of purchasing raw materials is decreased. This strategy also protects natural resources that are utilised as raw materials. Recycling is ranked second in the hierarchy of waste management since it demands sufficient work, time, money, and treatment. Recycling is the practise of reusing waste materials to create brand-new or enhanced goods. It is essential that there be a market for recycled goods. If there is no incentive for the sale of recycled goods, the entire system will fail. Recovery becomes important when there are many precious metals and other recoverable items in the waste. The only problem with the recovery system is the outrageous expense. It cannot be used by smaller trash stations since it requires a substantial financial investment from installation through operation. Rethink has just been added to the 3Rs as a new concept. It highlights that before throwing away any rubbish, everyone should reconsider their choice. It should be considered beneficial if it is helpful to someone else (Paul, Chattopadhyay, Dutta, Krishna, & Ray, 2018 and Singh, 2019).

Methodology

This study is descriptive in nature in which data is obtained from 205 respondents who have wasted energy technologies for waste management. In the study the urban areas of India have been covered. A checklist question was used to analyze and interpret the data. In a checklist question respondents choose “Yes” or “No” for all the questions.

Table 1. Effectiveness of Waste to Energy Technologies for Municipal Solid Waste Management in Urban India

	Effectiveness of Waste to Energy Technologies for Municipal Solid Waste Management in Urban India	Yes	%Yes	No	%No	Total
1	Waste to energy technologies reduces greenhouse gas emission	187	91.22	18	8.78	205
2	Waste to energy technologies provides alternate source of energy	176	85.85	29	14.15	205
3	Waste to energy technologies provides cost effective solution of waste management	169	82.44	36	17.56	205
4	Waste to energy technologies helps to reduce pollution	191	93.17	14	6.83	205
5	Waste to energy technologies provides compost from bio waste	182	88.78	23	11.22	205
6	Waste to energy technologies generates job opportunities	179	87.32	26	12.68	205
7	Waste to energy technologies generates revenue from energy	185	90.24	20	9.76	205
8	Waste to energy technologies promotes waste material recycling	193	94.15	12	5.85	205

Table1 Shows that 94.15% respondent agree that Waste to energy technologies promotes waste material recycling while 93.17% respondents agree that Waste to energy technologies helps to reduce pollution. 91.22% respondents agree that Waste to energy technologies reduces greenhouse gas emission while 90.24% respondents agree that Waste to energy technologies generates revenue from energy. 88.78% respondents agree that Waste to energy technologies provides compost from bio waste while 87.32% respondents agree that Waste to energy technologies generates job opportunities. 85.85% respondents agree that Waste to energy technologies provides alternate source of energy while 82.44% respondents agree that Waste to energy technologies provides cost effective solution of waste management.

Conclusion

According to the studies mentioned above, as MSW is a natural consequence of civilization, it must be handled in a way that is both beneficial to human health and considerate of the environment.

When compared to using WTE, which produces different types of energy, landfilling trash 30 times more than usual increases health risks. Most of the waste that would often wind up in landfills may be reused thanks to WTE. Since the current landfill sites can be excavated and the landfill materials can be used as fuel, there will be a good supply of fuel from the trash. WTE is an intriguing technological waste management option, despite the fact that combustion-based MSW treatment technologies are now the subject of intense global debate. Dangerous compounds that might endanger human health and the environment could be released into the air, land, and water during WTE operations if insufficient safeguards are in place. Incineration technology is the controlled ignition of waste employing heat recovery to create steam, which then powers steam turbines. In the petrochemical industry, pyrolysis is widely used to treat municipal garbage, turning organic waste into gas and combustible byproducts. Another option is gasification, which generally operates at higher temperatures and lower air volumes than pyrolysis. Although pyrolysis and gasification are technologies that can deal with municipal waste, neither has seen a lot of commercial use. In political, social, and environmental circles, there has been a lot of discussion over the usage of incineration-based processes. The growing cost of energy from traditional energy sources makes it more important than ever to use garbage to create electricity. The garbage management techniques are well known, cost-effective, and environmentally benign. Greater advantages of trash management are coming to light, including reduced greenhouse gas emissions, less trash, revenue from energy sales, and waste material recycling.

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