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Conversion of biowaste to biogas: A review of current status on techno-economic challenges, policies, technologies and mitigation to environmental impacts

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ABSTRACT

Anaerobic Digestion (AD) could be a promising methodology to convert biowastes to sustainable fuel for applications like power generation, heating, drying, cooling and so on. Forceful amendment in technologies, government policies, social behavior and economic aspiration cause vital analysis of those factors for successful generation of energy from biowastes. To accomplish the need, the current review deals with the status of biowastes utilization, biowaste conversion technologies and influencing parameters of the conversion process. This paper conjointly reviews totally different pre-treatment and co-digestion ways that improve the effectiveness of AD. Moreover, the economic merits of these well-studied technologies are summarized and compared in terms of autoclave performance, environmental advantages, and the status of real-world applications.

1. Introduction

The environmental factors and depletion of conventional fuels create a huge demand for technologies to substitute conventional energy with Renewable Energy Sources (RES). The International Energy Outlook (IEO) states that the global primary energy demand will increase to 48% between 2012 and 2040 [1]. The share of non-renewable (liquid fuels, coal, natural gas and nuclear) energy will decrease from 91% in 1990 to 84% in 2040. Meanwhile, renewable energy sources will continue to grow from 9% to 16% to fulfill world's energy demand. The demand for energy sources in the world also reveals that the share of non-renewable energy in electricity generation will decrease from 78% to 71% in 2040.

RES such as solar, wind, tidal and biomass are available abundantly in developed and developing countries and they can be harvested without environmental degradation. The use of such energy sources could substitute non-renewable energy sources such as coal and petroleum which might be expensive due to their increasing demand and scarcity in the near future. Moreover, emissions from such conventional fuels pollute atmosphere and lead to global warming. RES emit only minute level of carbon, and so it helps to combat climate change caused by the use of fossil fuels [2]. Among the various renewable energy conversion technologies, biochemical conversion has been one of the best techniques to convert biowaste to useful form of energy (biogas). This technology can convert any organic wastes to biogas which can be further used as fuel for cooking, lighting, power generation, and so on. [3]. The growth in installed capacity of renewable energy sources in India shows that the share of renewable energy had risen from 15.9% in 2016 to 23% in 2019 with the generation of energy from wind power (43%), solar power (39%), biomass (11%), small hydro (6%) and energy from urban waste (1%) as shown in Fig. 1 [4]. The energy from urban waste is observed to be the lowest among the renewable energy mix of the country as it is one of the new classifications. The major concept of biowaste utilization technique is to recover energy from urban wastes to reduce environmental pollution and also to generate energy. Fig. 2 shows that the installed capacity of bio-power energy sources has been increasing every year; hence, the same can be utilised for about 70% of the rural basic energy needs in India [4]. The energy from urban waste technique is found to be very less among the renewable energy mix in the country as it is one of the new classifications. Bio-power produced from thermochemical (biomass gasification) and biochemical conversion (biogas) techniques plays an important role to supply energy for

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