

Production Of Electricity From Anaerobic Digestion

S. H. Manoj, S.T.M. Aravindharajan., D. Vijay sri

Division of Microbiology, ICAR-Indian Agricultural Research Institute,

New Delhi, India- 110012

Corresponding Author: vijayashreed1997@gmail.com

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Abstract

Anaerobic digestion is the decomposition of organic materials by various hydrolytic, acid-forming, acetogenic and methanogenic microorganisms under anaerobic conditions, mainly producing biogas and digestate. Biomethane, commonly known as biogas, is a mixture of methane, carbon dioxide, nitrogen, ammonia, hydrogen, and oxygen, and has long been used for cooking, transportation fuel, and lighting purposes. Biogas is produced by anaerobic fermentation of various organic wastes. Different types of anaerobic digesters are used around the world. Biogas production and methane content are highly dependent on the substrate used, but can also be increased with appropriate pretreatment prior to anaerobic digestion. The choice of a specific technology depends on the substrate, investment, and amount of biogas produced. Once biogas is produced and stored in a biogas plant, it can be used in a variety of areas, including cooking, lighting, and as a fuel for engines and industry. Recent approaches are renewable and focus on power generation from biogas to reduce external dependence on electricity. Electricity can be generated from biogas using fuel cells, generators, and engines. Therefore, using biogas that can be generated from various wastes for power generation not only provides electricity, but also helps reduce environmental problems such as waste disposal, greenhouse gas emissions, and global warming.

Introduction

Biogas, which is produced through the anaerobic digestion of organic waste materials such as agricultural waste, manure, sewage, and food waste, can be a valuable source of renewable energy (Arshad et al., 2022). This process takes place in a biogas plant, which provides an oxygen-free environment for the anaerobic digestion to occur. The plant typically consists of three major components: a reception area where the raw materials are prepared, a digester (or fermentation tank) where the organic matter is transformed into biogas, and a gas holder that collects the biogas produced. These organic materials are introduced into the digester, where they undergo a fermentation process (Syahri et al., 2022). The production of biogas typically involves four main steps, referred to as hydrolysis, acidogenesis, acetogenesis, and methanogenesis. In the hydrolysis step, complex organic compounds such as carbohydrates, proteins, and fats are broken down by enzymes into simpler compounds. This process makes it easier for organic materials to break down further. During acid production, the hydrolysis products are further converted by acidogenic bacteria into simple organic acids, alcohols, and other intermediate compounds. This step is important for preparing the material for subsequent stages. In acetogenesis, the intermediate compounds produced in the acidogenic step are further converted to acetic acid and hydrogen by acetogenic bacteria. This step is critical for the subsequent conversion to methane. The final step in methane production involves methanogens, which convert acetic acid, hydrogen, and other simple compounds into methane (CH₄). At this stage, biogas is produced, mainly consisting of methane (Syahri et al., 2022).

One of the main uses of biogas is power generation. Converting biogas to electricity requires several key steps and techniques. Once biogas is produced, it must be converted into electricity. This is usually done through the use of internal combustion engines (gas or diesel engines) or fuel cell technology. The biogas is carefully mixed with the appropriate amount of air and introduced into the combustion engine. The combustion engine then uses the biogas as fuel to generate mechanical energy. This mechanical energy is then used to rotate an electric generator, which produces electricity. The electricity generated can be used for various purposes, including powering homes, businesses, or even feeding back into the power grid. It is worth noting that the quality of biogas plays a crucial role in the efficiency and effectiveness of the electricity generation process. The biogas should ideally have a high methane content, low carbon dioxide and water

vapor content, and minimal amounts of impurities such as hydrogen sulfide. Producing biogas to generate electricity has several advantages. First, it is a renewable energy source that reduces dependence on fossil fuels. Second, it helps in the proper management and disposal of organic waste, reducing its impact on the environment. Third, the produced biogas replaces the need for fossil fuels in power generation, thus helping to reduce greenhouse gas emissions (Nindhia et al., 2021). This process offers a sustainable and efficient way to produce electricity while also addressing waste management and environmental concerns. It is an important and promising technology in the field of renewable energy.

Reference

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