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Effects of Phenolic Compounds on Methane Production from Maize Silage

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Extended Abstract

Renewable energy sources, such as biomass, are playing an increasingly important role in the global energy transition. Climate change and growing concerns over pollution are driving the international community to seek alternative and cleaner energy sources. Against the backdrop of limited fossil fuel resources, growing energy demand and changing economic conditions, renewable energy sources are becoming a key component of modern energy policies. The development of biogas technologies is particularly important because of their potential to convert plant biomass, including corn silage, into energy in the form of biogas. The process of anaerobic digestion, which is the basis of biogas production, can help reduce greenhouse gas emissions and guarantee energy security through local sources of energy production. In the context of the European Union's energy policy, the development of biogas technologies requires a coherent approach that takes into account support for innovative solutions, stimulation of investments and the creation of an appropriate legal and economic framework. These measures can accelerate the transformation of the energy sector towards sustainable energy production and the reduction of negative environmental impacts.

Phenolic compounds, naturally occurring in various plant materials, can affect biogas production in fermentation processes. Their presence in lignocellulosic substrates used for methane fermentation can have both beneficial and negative effects on biogas production efficiency. These compounds can act as fermentation inhibitors because they have antimicrobial properties that can inhibit the activity of microorganisms responsible for decomposing organic matter into methane. The literature indicates that phenols can interfere with the metabolism of methanogenic bacteria, leading to reduced biogas production. The research focused on evaluating the effects of thermohydrolysis under conditions of varying pressure and temperature on the efficiency of anaerobic digestion in the production of biogas from lignocellulosic substrate.

Thermohydrolysis under elevated pressure and temperature conditions was carried out using a prototype HL-P reactor. The fractional-scale test rig used in the study allowed simultaneous microwave-induced hydrothermal depolymerization and low-pressure steam explosion. The test material was Maize silage, and the variable manipulated in different series of experiments was the duration of pretreatment: 0, 5, 15 and 25 minutes. The most promising results were achieved after thermohydrolysis treatment lasting 25 minutes, where a high efficiency in biogas production of 697,01 N ml/g was obtained. - which was an 86% increase compared to the control sample. The study showed no inhibitory effect of the concentration of phenolic compounds on the methane fermentation process.

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