

Measurement of Methane Generation Gas From Agricultural Waste

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Structured Abstract

Background: This study investigated the potential of sugarcane bagasse and coconut husk, two commonly available agricultural residues in Malaysia, as feedstocks for methane generation through anaerobic digestion (AD). The selection of these substrates was based on their abundance and the need for sustainable waste management alternatives that contribute to renewable energy generation. Given the challenges posed by agricultural waste disposal, identifying optimal feedstocks for biogas recovery is crucial to improving the circular bioeconomy and reducing environmental impact.

Methods: To support this investigation, both substrates underwent laboratory characterization to determine moisture content, volatile matter, ash content, fixed carbon, pH, bulk density, and elemental composition (C, H, N, S). These parameters are essential for understanding biodegradability and methane production potential. Anaerobic digestion experiments were conducted in batch reactors maintained at 37°C, with simulated rainfall of 40 mm/day to replicate local tropical conditions. Methane production was monitored over a 47-day period using gas chromatography with flame ionization detection (GC-FID) for accurate measurement of gas composition and volume. The first-order kinetic model was applied to determine the methane generation rate constant (k) and ultimate methane potential (L_0).

Results: The results showed that sugarcane bagasse had higher moisture and carbon content, which contributed to greater biodegradability and methane yield. It produced a cumulative methane yield of 0.09031 L/kg, while coconut husks yielded 0.06525 L/kg. Interestingly, coconut husks exhibited a slightly higher k value (0.0504 day^{-1}) than sugarcane bagasse (0.0447 day^{-1}), indicating a faster initial degradation rate. However, both had comparable ultimate methane potentials ($L_0 = 0.4544 \text{ L/kg}$ for coconut husks; 0.4715 L/kg for sugarcane bagasse).

Conclusion: Sugarcane bagasse demonstrated better suitability for mono-digestion due to its steady methane production, while coconut husk may benefit from pretreatment or co-digestion. This study highlights the role of feedstock selection and pretreatment strategies in optimizing methane recovery from agricultural waste.

Keywords: Anaerobic digestion, methane generation, agricultural waste, biodegradability, first-order kinetic modelling

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