

Enhancement Of Biogas Methane Content Through Pressure Swing Adsorption (PSA) System: A Pilot-Scale Study On Goat Manure Digester
Supervisor: Dr. Ir. Yuana Susmiati S.TP., M.Si.

Abdul Aziz Muji Rahmawan
Renewable Energy Engineering Study Program
Department of Engineering

ABSTRACT

The Indonesian government is committed to increasing the use of new and renewable energy to a minimum of 23% by 2025 through the utilization of local potential such as biogas from goat manure waste, which unfortunately still contains 35.87% carbon dioxide (CO₂) as an impurity gas, thereby reducing the combustion efficiency of methane (CH₄). This study aims to design, implement, and test the performance of a pilot-scale Pressure Swing Adsorption (PSA) system based on Zeolite 13X dual-column adsorbent at contact times of 7, 9, 12, and 15 seconds (pressure 23–26 psi) using Gas Chromatography (GC). The results show that the Zeolite 13X PSA system was able to remove CO₂ to undetectable levels at all contact-time variations, with the optimum purification point at a 9-second contact time, producing the highest CH₄ content of 50.67%. One-Way ANOVA analysis confirmed that contact-time variation had a statistically significant effect on CH₄ content ($F = 19.078$; $p = 0.008 < 0.05$), far outperforming conventional commercial filters, which only managed to remove CO₂ down to 17.49% with CH₄ content of 31.59%, thereby demonstrating the effectiveness and feasibility of this PSA system for farm-scale biogas purification.

Keywords: *Biogas, Gas Purification, Goat manure, Pressure swing adsorption (PSA), Zeolit 13X.*