

Design of a Control System for the Biogas Distribution Process in Karangsirih

Hamlet, Suco Village, Mumbulsari, Jember

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ABSTRACT

Biogas development in rural areas has significant potential, particularly in Suco Village, Mumbulsari District, Jember Regency, where sheep manure is abundantly available as a feedstock. The quality of biogas can be improved using the Pressure Swing Adsorption (PSA) method, which operates through cyclic adsorption and desorption processes. This study aimed to design, test, and evaluate a timer-based open-loop control system for automated biogas distribution using an Arduino Uno microcontroller. The system regulates biogas flow through two adsorbent beds by controlling six solenoid valves according to predetermined operating cycles. An MPX5700AP pressure sensor was employed to monitor the operating pressure, while an MQ-4 sensor was used to monitor methane (CH₄) concentration. Performance testing was conducted using cycle times of 7, 9, 12, and 15 seconds. The results showed that the control system operated with high accuracy, achieving an average valve switching error of only 0.19%. The monitoring sensors also demonstrated satisfactory performance, with an average MQ-4 sensor error of 6.32% and an MPX5700AP pressure sensor error ranging from 0.78% to 4.55%. Based on the monitoring and evaluation results, the 9-second operating cycle produced the best purification performance. Under this condition, the highest methane concentration recorded by the MQ-4 sensor was 55.08%, while laboratory analysis measured a methane concentration of 50.67%, indicating that the 9-second cycle is the optimal operating parameter for the automated biogas distribution system.

Keywords: *Biogas, Control System, Pressure Swing Adsorption (PSA).*