

Design Consideration for Upgrading Raw Biogas into Biomethane

B. C. Dilshan¹, K. P. T. R. Maduranga¹, W.A.L.S. Karunawardana², V. Senanayaka³, K. M. W. Rajawatta^{1*}, K. H. T. Karunarathna¹ and J. Pushpakumara³

¹*Department of Bio systems Technology, Faculty of Technology, University of Ruhuna*

²*Department of Mechanical Engineering National Engineering Research and Development Centre of Sri Lanka*

³*Manufacturing Center, National Engineering Research and Development Centre of Sri Lanka*

*wathsala@btec.ruh.ac.lk

Abstract

Biogas is a renewable energy source produced from organic matter and contains impurities such as carbon dioxide (CO₂), Hydrogen sulfide (H₂S), Nitrogen (N₂), and some water vapors. The initiative will involve the development and implementation of an advanced biogas purification system to upgrade raw biogas by removing impurities such as carbon dioxide (CO₂), hydrogen sulfide (H₂S), and moisture, thus enhancing its suitability as a fuel. This study aims to develop a multi-step purification system for enhancing the methane (CH₄) content of raw biogas to over 95% purity for use in vehicle engines. The project will also incorporate a compression and storage system to facilitate the use of purified biogas as fuel. The purification process includes a water scrubber for CO₂ removal, activated carbon absorption for impurity filtration, sodium hydroxide adsorption for Carbon dioxide elimination, iron wool for H₂S removal, and silica gel adsorption for moisture reduction. The prototype was constructed using PVC pipes and a 200L tank ensuring proper material placement and flow control with a pressure gauge set at 2.5 bars. Purified biogas samples were analyzed by GC meter with capillary columns and advanced flow controller technology. These analyses of raw gas samples and purified gas samples demonstrated a significant improvement in methane (CH₄) concentration from 52.24% to 80.49%, with Carbon dioxide (CO₂) levels reduced from 39.27% to 10.46% and Nitrogen (N₂) from 1.11% to negligible levels under 2:2:1 ratio of Sodium hydroxide, Iron Wool and Activated Carbon respectively. This study highlights the effectiveness of the proposed filtration approach in the purification of biogas and the prototype has the potential for further enhancements to achieve a higher purity level of biogas.

Keywords: *Filter, Methane, Sodium hydroxide, PVC pipe, purification.*