

Design and Development of a Biogas-Fueled Power Generation System Using a Conventional Generator at Kaliwates Slaughterhouse

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ABSTRACT

The Kaliwates Slaughterhouse (RPH Kaliwates) produces a large volume of cattle rumen waste that has the potential to pollute the environment if not properly managed. At the same time, the increasing demand for electrical energy encourages the utilization of environmentally friendly alternative energy sources. Biogas generated from the anaerobic fermentation of cattle rumen waste can be converted into electrical energy through a Biogas Power Plant (PLTBg) system using a modified conventional generator. This study aims to design and assemble a PLTBg system at RPH Kaliwates and to identify potential occupational hazards based on Occupational Safety and Health (OSH) aspects. The research method employed was Research and Development (R&D), including system design, assembly, installation, and testing. The system consists of an 8 m³ biodigester, a biogas purification unit, a 30-liter biogas storage tank, an inverter, a 12 V 100 Ah battery, and a 1000 W generator set equipped with a modified biogas converter kit with a 2 cm gas inlet diameter to improve biogas flow stability. The gasoline carburetor was removed and replaced with the biogas converter kit, and a control panel was used to operate a 13 W Deep Flow Technique (DFT) hydroponic pump. Test results show that the system produces 219 V and 1.73 A with an output power of 378.87 W; however, the generator operation duration is limited to 20–30 minutes due to unstable biogas production. Fishbone and HIRADC analyses indicate that occupational risks range from moderate to high but can be controlled through the implementation of standard operating procedures, personal protective equipment, and protection systems. Overall, the PLTBg system based on cattle rumen waste has the potential to become a sustainable and environmentally friendly alternative energy source at RPH Kaliwates.

Keywords : Biogas, renewable energy, conventional generator, occupational safety and health (OSH), cattle rumen waste, PLTBg.