

DESIGN AND ANALYSIS OF A STEAM POWER PLANT PROTOTYPE USING A PELTON TURBINE

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ABSTRACT

This study aims to design and analyze a prototype of a mini-scale Steam Power Plant (PLTU) using a Pelton turbine, fueled by 3 kg of LPG and 500 grams of charcoal briquettes. The system is equipped with a 3.57-liter boiler and an automatic water filling mechanism based on water level sensors (high and low). The water volume at full condition (10 cm from the base) is 2.54 liters, and at the low point (7 cm) is 1.78 liters, with a volume difference of 0.76 liters. Water filling from the base to the high level takes 90 seconds, while the decrease from high to low takes 27 seconds.

Test results show that LPG fuel produces a maximum pressure of 1.42 bar and energy of 82.82 Joules, while briquettes generate significantly lower pressure and power. The Pelton turbine rotation is connected to a DC generator through a pulley system with a 5:1 ratio. However, analysis results indicate that the Pelton turbine fails to produce continuous rotation due to unstable steam pressure, which is insufficient to maintain the impact force on the turbine buckets. Therefore, it can be concluded that the Pelton turbine is less suitable for low-pressure steam-based systems, and it is recommended to use a more appropriate type of turbine, such as a reaction turbine or a small-scale axial turbine.

Keywords: Mini steam power plant, pelton turbine, steam pressure, water level sensor, electrical energy