Performance Analysis of a Prototype Seawater Desalination System with Off-Grid Solar Panels Using IoT-Based Automation System Mochammad Nuruddin, S.T., M.Si. as a counsellor

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ABSTRACT

The availability of clean water is a fundamental need that has not been met evenly throughout Indonesia, especially in coastal areas and small islands that are far from freshwater sources. This research aims to develop and analyze the performance of a simple renewable energy-based seawater desalination system prototype equipped with an Internet of Things (IoT) automation system and operates off-grid using solar panels. The prototype is designed with four 3 mm thick glass sides and is capable of working independently. The system relies on solar energy stored in batteries to operate the heater, pump, and microcontroller. Tests were conducted in three scenarios: a combination of solar thermal and electric heating, electric heating alone, and solar thermal alone. Data was collected every ten minutes for three consecutive days, from 08:00 to 14:00 WIB. The results showed that the treatment using solar heat alone gave the highest thermal efficiency of 96.69%, followed by the combination of electric heating and solar heat 40.32%, and electric heating alone 25.49%. In addition, the desalinated water showed a significant reduction in Total Dissolved Solid (TDS) values, approaching clean water standards. These findings indicate that a cost-effective and environmentally friendly solar energy-based desalination system has great potential as an alternative solution for clean water supply in areas with limited water resources.

Keywords : Desalination, Solar Panel, Off-Grid, IoT, Energy Efficiency, Seawater, Renewable Energy