



ABSTRACT

Energy is always a major issue in this life. The renewable hybrid power system is a promising idea to keep the sustainability of energy. Wind and solar energy are two of many renewable energy sources which are clean as it will not produce any greenhouse gases and available in most of the world. The combination of a wind turbine and a solar cell to integrate as a hybrid system is one of the solutions to make a sustainable power generation.

This study aims to analyze the performance of a hybrid system that consists of a wind-lens turbine and a solar cell. The power production and heat transfer aspects of this hybrid system were analyzed using a numerical simulation. The numerical simulations of the wind-lens and solar hybrid systems were performed under two different wind speeds, which are 6 and 8 m/s. The rotor blade used the NACA 4412 airfoil and the lens in this study is the Cii-Lens type. The power raise of 116% compared to the bare turbine was achieved from the simulation at the wind speed of 6 m/s and a tip speed ratio of 4. The bare turbine power result is 36.70 W, while the power result from the wind-lens turbine is 79.36 W. The addition of the lens to the wind turbine affected the heat transfer coefficient on the solar cell to decrease at the maximum percentage of 11% compared to the bare turbine. The surface heat transfer coefficient result on the bare turbine configuration is 15.56 W/m².°C, while the result from the wind-lens turbine is 13.86 W/m².°C at the wind speed of 8 m/s and the tip speed ratio of 3. Those results were then validated by comparing it to the existed journal and the experimental data.

The design of the wind-lens and solar hybrid system was then created and consist of several components which are the rotor, lens, main shaft, nacelle, lens holders, solar cell, frame, and tower. The stress analysis of the wind-lens and solar hybrid system was performed to calculate the strength of the construction. From the stress analysis, the maximum Von Mises stress value was found to be 119.69 MPa which is not exceeded the tensile strength of the materials used in the wind-lens and solar hybrid system.

Keywords: Wind Turbine, Wind-Lens, Solar Cell, Hybrid, Energy