Comparing Shroud Design on the Electrical Power Output of a Small-Scale Horizontal-Axis Wind Turbine

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This study was conducted to determine if utilizing a shroud around a small-scale horizontal-axis wind turbine can increase its electrical power output. Three shrouds were constructed out of foam and fiberglass in the following shapes: 45° funnel, concave, and convex. Each shroud was tested with a non-conventional turbine and the power outputs were compared to those of a bare turbine. A bicycle wheel was used for the turbine with magnets mounted onto the rim, which swept over stationary copper coils. This design allowed for lower mechanical resistance, a higher turning velocity, and is quieter than a conventional turbine. In phase I, fifteen trials were conducted for each design at two fan speeds. The results showed that every shroud allowed the turbine to produce more power than the bare turbine. At both fan speeds, the 45° funnel shroud configuration produced the most power of the four designs and yielded a 74% average increase in power versus the bare turbine. The concave and convex configurations produced a 67% and 65% increase, respectively, though an ANOVA test found that the results were not statistically different. A second phase of testing investigated the effect of placing the turbine at 20°, 30°, and 40° angles to the fan. At 20°, the results were similar to phase I testing, while at 30° and 40°, the convex configuration generated the most power. This experiment demonstrated that utilizing shrouds increased the efficiency of the turbine, thus expanding the viability of wind as a sustainable source of renewable energy.

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