CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

36543

Project Title

The Effect of Winglet Cant Angle on the Speed of a Windmill

Abstract

Objectives/Goals

Winglets are used on airplanes to reduce the wingtip vortex and associated drag, thereby improving performance. I wanted to see whether a green energy-producing windmill would also be more productive by adding winglets, therefore creating more energy at a faster pace. My objective was to discover the cant angle on a windmill blade that allows optimum performance. A cant angle is an inclination from the horizontal plane. I hypothesized that the 35 degree cant angle winglet would perform best because it would balance out the loss of surface area of the blades with decreasing the vortices which cause drag.

Methods/Materials

I made a model windmill using a box fan and attached metal winglets to the blades. I used two more box fans to simulate wind and created a wind tunnel out of paper tubes to straighten out the airflow. The assembly was placed behind the windmill. The cant angles were 20 degrees, 35 degrees, 65 degrees, and 90 degrees; the control was 0 degrees. I used a digital photo tachometer to measure the revolutions per minute (RPM) of the blades. Three trials of ten measurements per angle were conducted. Between trials, the wind-producing fans were turned off, and everything was allowed to fully stop before starting the next one.

Results

The test results showed there are benefits to adding winglets to windmills. For the cant angles tested, there was a maximum one at which the windmill rotated the fastest and any angle higher or lower resulted in slower speeds. More specifically, the 35 degree cant angle winglet was the optimum angle and thus validated my hypothesis. The difference in the average RPM between the winglet with the 35 degree cant angle and the average of the control was 6.8 RPM.

Conclusions/Discussion

My objectives of discovering whether winglets would improve the performance of windmills and finding the optimum cant angle of that winglet were fulfilled. After creating a simulated windmill and wind source, I found that the 35 degree cant angle winglet allowed the fan blades to spin at the highest speed. In future work, I would test more cant angles to determine whether there might be an even better winglet cant angle to use. This work could be applicable to commercial windmills to produce more green energy quicker.

Summary Statement

In my project, I studied the effect of different cant angles of winglets on the speed of a windmill.

Help Received

I built and tested my project by myself. My dad helped me to understand the forces acting on the blades and winglets.