CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
S0311

Project Title
Producing Electric Power from Wind Energy

Abstract

Objectives/Goals

My objective is to test two different airfoil cross sections in three wind conditions and compare the electrical power generated to the Betz's Law Theoretical Limit and to that produced by the control blade with a rectangular cross section.

One airfoil has a rounded cross section and the other has a flat bottom. I wanted to test a 3-inch blade and a 2-inch blade in three wind speed conditions. I tested the blades with an angle to the wind from 5 degrees to 50 degrees with 5 degree increments (static angle measurement, that is without taking into account the velocity vector due to rotation, which would be a dynamic measurement) I also wanted to test the best performing blade and test that blade in a two blade and four blade configuration. I hypothesized that the rounded blade would perform the best.

Methods/Materials

I made a long wind tunnel out of heavy plastic sheeting and attached two fans to it at one end and an array of pre-cut plastic pipe I found at Home Depot to smooth the air at the other. The windmill was inspired by a US Department of Energy report on building windmills out of sprinkler pipe. I purchased the blades online from Flying Foam and I glued the blades to small pieces of pipe which then fit into a pipe fitting that served as the rotor hub. The blades fit so snugly that I could get 5 degree increments to the wind. The angle was measured using a device I made from the packing foam in the box that came from Flying Foam. After reaching steady state, I measured the airspeed with ten readings from across the face of the smoother and then averaged them. For the blade output, after reaching steady state, for each experiment, I recorded ten output statistics; five each of millivolts and milliamps. I averaged, then multiplied and graphed the results.

Results

My hypothesis was wrong. I found that the flat bottomed airfoils consistently out performed the rounded. The flat bottomed 3 inch blade produced the most power in the high wind tests. This figure was 1.53% of the Theoretical Betz Limit. I also found that the two inch blades outperformed the three inch blades when compared to the control.

The tests of four blades vs two blades: In the high wind condition, I found that the two blade configuration produced 76% more power. In the low wind conditions, the results were just the opposite.

Summary Statement

Testing the power generated from two sizes of two types of blades, in three airspeeds, at 5 degree increments from 5-50 deg.

Help Received

Parents bought some materials, Dad helped move the smoother, Profs Farhat & Duraisamy helped describe the basic science