CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
J0129

Project Title
Change Is in the Wind: A Study of How the Design of a Wind Turbine's Blades Can Affect the Electrical Output Generated

Abstract

Objectives/Goals
My goal was to measure the effects of blade design on electrical output generated by a wind turbine. I created 3 different blade designs; a V-shaped blade, an airplane wing shaped blade, and a design inspired by the aerodynamic shape of a dolphin's tail.

Methods/Materials
I calculated the surface area of 3 new blade designs. I cut balsa wood to create 6 blades of each design. There is less that 1% difference between the surface areas of all 3 blade designs. I assembled the wind turbine kit, attached the turbine to a water bottle with rocks to keep it stable, and taped my first blade design to the turbine blades. I turned on the fan to high and measured the energy output with a voltmeter in mA. I recorded the data. I did this 5 times for each of my 3 blade designs.
I used: a voltmeter, to measure electrical output, balsa wood to create different blade designs, plastic water bottle, for the base of the wind turbine, rocks to weigh down the water bottle, 3-speed fan to create wind, tape to hold new blade designs, and a Wind Turbine kit that included: fixed position plastic wind turbine blades, a tail and generator.

Results
After 5 trials the averages were: Dolphin Tail Fin Blade=29.4 mA, V-Shape Blade=17.1 mA, Airplane Wing Blade=23.2 mA. My dolphin tail blade produced about 70% more energy than my V-shaped blade, approximately 25% more energy than the airplane wing.

Conclusions/Discussion
In my hypothesis I predicted that the V shaped blade would generate more electricity and be more aerodynamic because it would scoop the wind from all directions. I disproved my hypothesis. The aerodynamic qualities of the curved dolphin fin shaped blades moved through the air with less drag, so the blades moved faster. This is similar to why a dolphin can move so fast through the water. I observed that when the dolphin tail fin blade moved fast, the shape created by the blades moving together was smooth and concave, like a dish. The other blade designs created shapes that were very angular. I believe that what was created was an aerodynamic vacuum that pulled air into the center of the wind turbine better than the other designs creating faster moving high and low wind forces that moved the blades faster. Because of the improved aerodynamic qualities of my dolphin tail fin blade design, the high and low pressure exchange as seen in the Bernoulli Principle is occurring at a more efficient rate, making the blades move faster.

Summary Statement
After creating three different blade designs, I discovered that by using aerodynamic properties inspired by nature, greater efficiency of electrical output could be produced by wind turbines.

Help Received
Mom helped type some parts of the report; dad helped with calculating the surface area of the blades to ensure the blades I cut were almost identical in surface area.