KidWind PVC Turbines Blade Test Results (Summer '05)

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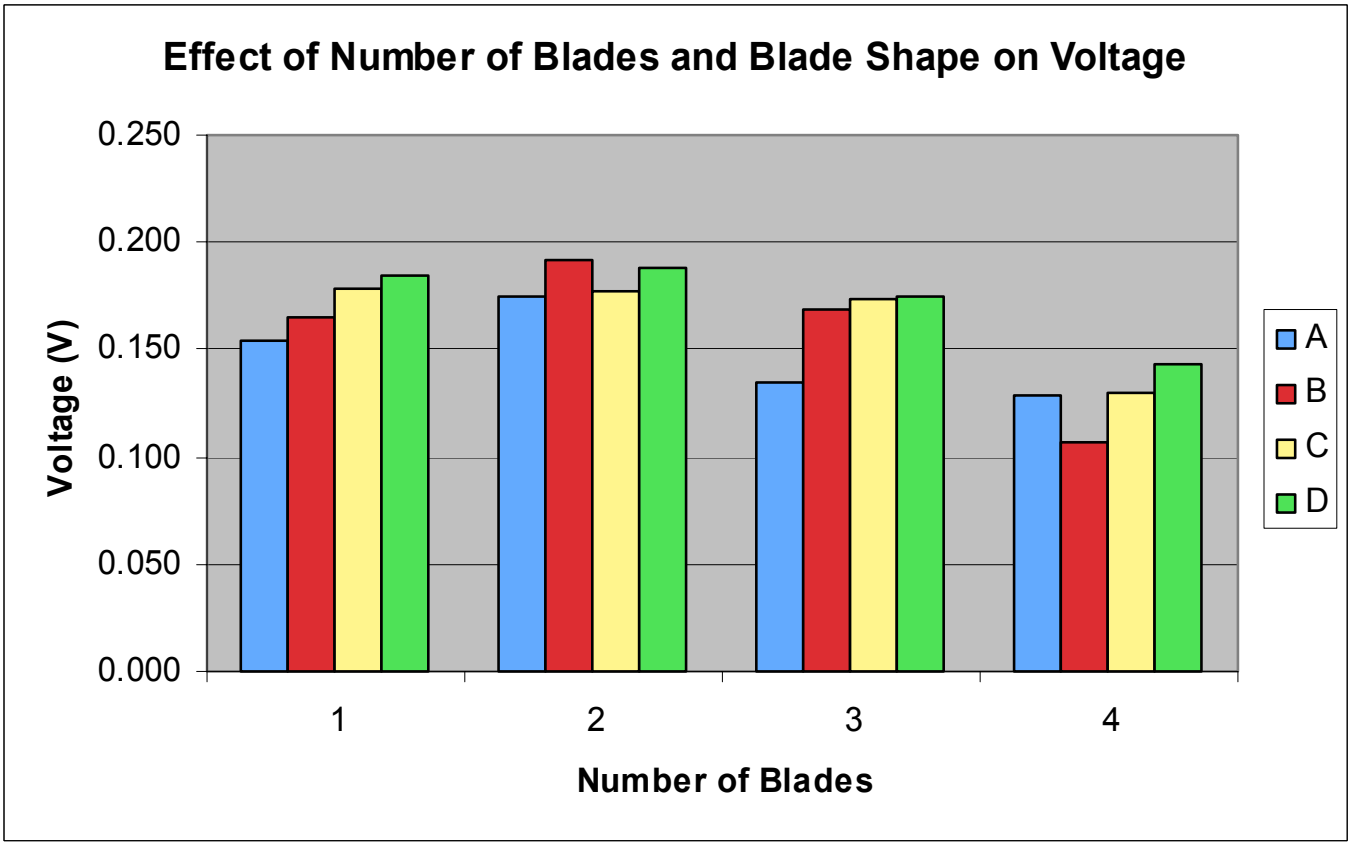
Purpose:
We experimented with different shapes and sizes of turbine blades in order to get an understanding of the effects they have on voltage produced in a constant wind setting.

Blade Shapes Used



Variables Held Constant

- 12" blades were used
- Turbine was placed 6 feet away from box fan wind source
- A non-geared turbine was used
- Average wind speed was about 3.5 mph at the turbine

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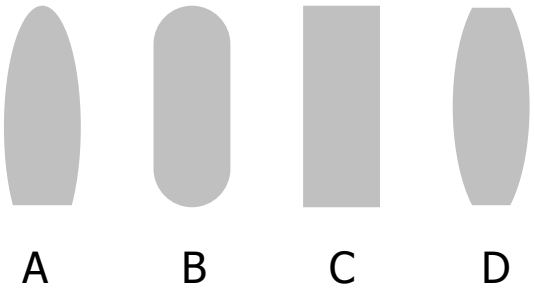

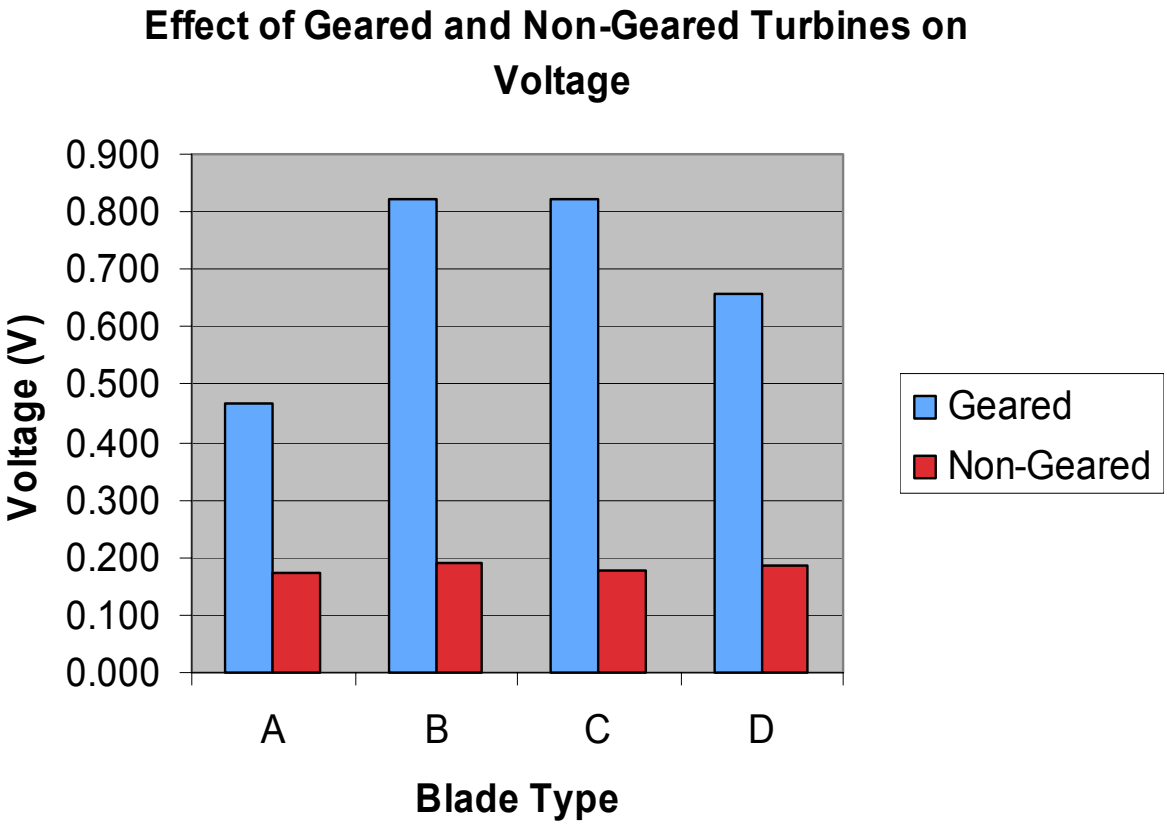

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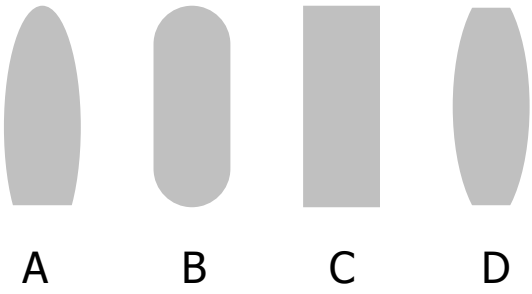

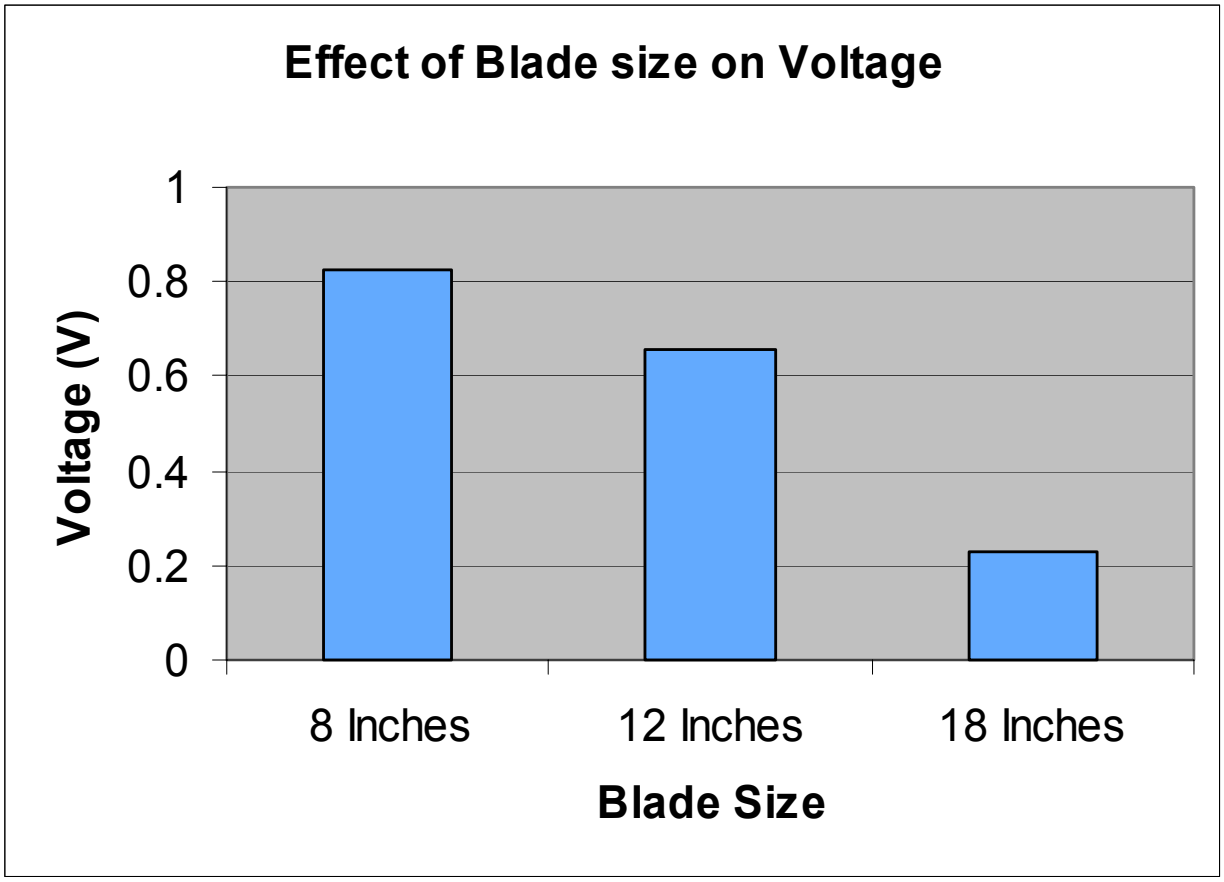

Variables Held Constant

- Blade **Type D** was used for all experiments
- Turbine was placed 6 feet away from box fan wind source
- A geared turbine was used
- Average wind speed was about 3.5 mph at the turbine

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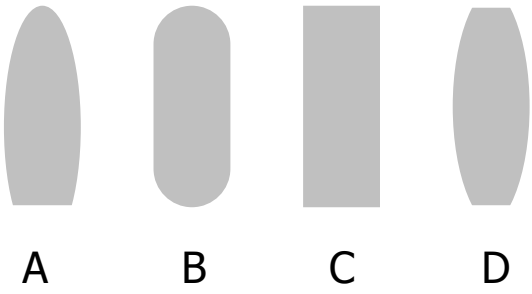

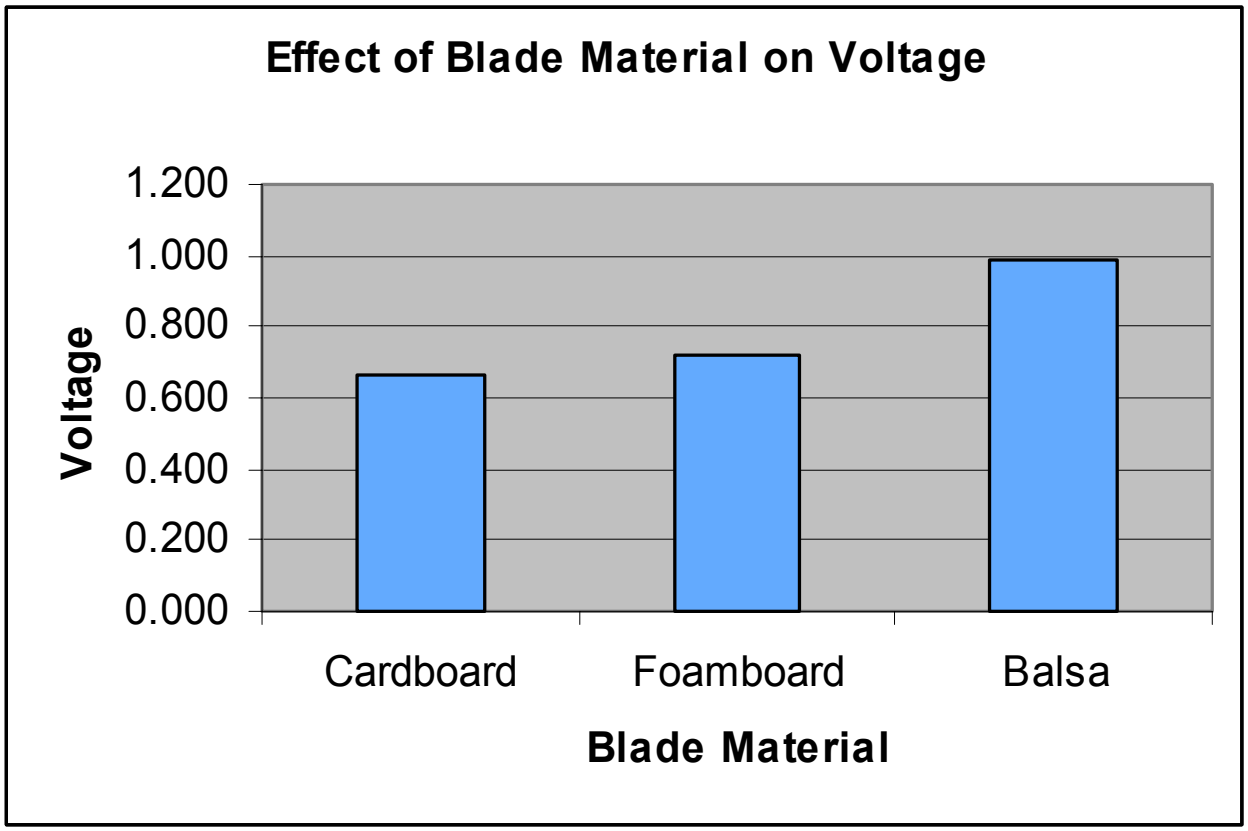

Variables Held Constant

- Two 8" **Type D** blades were used for all experiments
- Turbine was placed 6 feet away from box fan wind source
- A geared turbine was used
- Average wind speed was about 3.5 mph at the turbine

Discussion:
When setting up the experiments we noticed that angle of the rotor blades plays a major part in determining the voltage produced. The most voltage was produced when the blades were angled slightly from the plane of rotation. This configuration however also took the longest to get started and might not be very effective at harnessing the power of wind gusts. When the rotor blades were placed at greater angles the turbine picked up speed faster but it never reached optimal rotational speeds.

Blade shape also played a role in voltage production. We believe that both surface area of the blade and shape are important. Shape D performed very well in most settings. B also did well with the two blade configuration. We believe a bulged blade with a rounded top would work best. This shape is a combination of the best features of B and D

The number of blades was important as well. The two blade configuration seemed to be most efficient. Perhaps more blades tend to create more drag as they rotate at higher speeds. Surprisingly the one blade design also worked very well but the problems of properly counterbalancing the rotor probably lower the output.

We constructed blades out of different materials to see if there was any difference in performance. We found that the balsa rotors performed best. This could be due to the low profile of the balsa sheets. The balsa that we had limited our size so this experiment had to be performed on 8 inch rotors.

Blade size had an effect on our measured results. I believe that we did not have an adequate setup to properly test this variable. In our tests the smallest blades performed best. I think this occurred because the small blades were completely in the wind while the ends of the larger blades were not. The ends of the larger blades probably just caught a lot of drag as they spun around slowing down the turbine. To properly test this parameter a large wind tunnel with constant wind speed would be necessary.

The presence of gears to speed up the drive shaft of the DC more had a great effect on voltage produced. We only performed geared and non-geared trials. It would probably be worth experimenting with differing degrees of gearing to find the optimum combination.

Conclusion:
The most efficient configurations tended to include:

- Gearing up the turbine
- Slight angles on rotor blades
- Two blade configuration
- Blade size that fits within the wind envelope
- Balsa seems to be the best material for the rotors
- Rounded top blades with an outward bulge in the middle