CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

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Project Number

31054

Project Title

Exploring Micro-Size Hydro-Electric Generators

Abstract

Objectives/Goals

Our objective was to explore micro-size, hydro-electric reaction turbines by experimenting with turbine sizes, materials, baffles, and blade-shapes to discover which combination would most efficiently generate energy in a controlled water trough - simulating a low-flow, perennial creek.

Methods/Materials

A plywood water trough was made and fitted with a used, spa pump to circulate water through plastic pipes in a closed system. We obtained a submersible generator/rotor assembly for mounting the turbine blades. Four experimental trials were run with the different blade characteristics and adjustments to the angles (pitch) of the blades. By measuring voltage, using an electrical multi-meter, we determined the speed of the turbine rotor and the efficiency of each blade design.

Results

For generating voltage, water velocity rate was more important than the rate of water flow. When we understood the difference between the two rates, we then constructed turbine blades and baffles to best utilize the constant flow rate. Together the blades and baffles constricted the flow rate and added pressure behind the turbine blades. The pressure deformed the plastic blades, so we replaced them with wood blades which did not deform. By using the best blade design, we plotted the test results of turbine blade pitch versus voltage to obtain the greatest, rotational velocity (60 degrees offset) from the water flow.

Conclusions/Discussion

Visually, we noticed the water level rising behind our turbine baffle. We concluded the baffle, turbine blade assembly, and high degree of pitch combined to restrict the water flow enough to increase back pressure on the turbine assembly. The back pressure increased the height of the water behind the turbine. There were 2 watts of available power for every inch of height change in our experiment. With just 10 feet of water height difference and two times the water flow rate, 480 watts would become available for a water turbine. Thus, small reaction turbines in creeks with modest flow rates and height change would generate sufficient hydro-power for an average, single house.

Summary Statement

This project explores micro-size, hydro-electric, reaction turbines to come up with the most efficient design parameters.

Help Received

Partner's father provided supervision with woodshop equipment and helped generate graphs through Excel. Partner's mother helped type procedures.