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Storing and Harnessing Energy through Pumped Micro-Hydroelectric Systems

Micro-hydroelectric energy, in its most basic form, is hydroelectric energy for small-scale or home use. Based upon the principle of gravitational potential energy, these systems convert mechanical energy to electrical potential. Though many are used as “run-of-river” systems, micro-hydro systems can also, like a battery, be used to store energy from other renewable sources. Micro-hydro is safer and cleaner than batteries and can sustain higher voltages and currents for longer periods of time. This project focused on the feasibility of storing excess energy created from other generators and sources, such as photovoltaic and wind energy, in micro-hydroelectric systems. Initially the efficiency curve of the experimental motor as a function of rpm speed was determined and the optimum range occurred between 1600 and 1900 rpm. The micro-hydro experimental setup consisted of a water source (a trashcan) connected via a 2” bulkhead fitting to ¾” vinyl garden hose. The hose ran down to a landscape box in which an impulse turbine and DC motor were outfitted. The voltage and current produced by the motor was recorded as a function of the head height, and the net head (head minus frictional losses) was calculated. As a function of net head, the water velocity and head losses had a linear relationship, while efficiency and power increased exponentially. The head range (1m - 10m) simulated the height of a typical 3-story home, including a basement. Future tests will work to optimize the output of the system and aid in engineering the most efficient system possible.