Low-Infrastructure Hydroelectric Generator

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Objective

To design and build a portable, self-contained, hydroelectric generator that functions without the requisite infrastructure of today’s more common hydroelectric systems. The generator will utilize a floating paddlewheel transducer to harness the kinetic energy of an existing, running water source and convert that to a usable source of electrical power.

Design

A five paddle, three section offset design was created to eliminate significant pulsations to the generator input.

Paddlewheel

Prototype

Three different paddle designs were tested in a fluid channel to better understand power loss. The greatest efficiency was achieved with the semi curved fin.

Analysis

\[ \omega = \frac{R \omega}{4} \]
\[ F_d = \frac{1}{2} C_d \rho (V_w - u)^2 A \]
\[ T = F_d R \]
\[ P = T \omega \]

RPM for Max Power
\[ V_w = 5 - 2(m/s) \]
\[ \frac{dP}{d\omega} = (1/2) ARC_i (V_w^2 - 4V_w R \omega + 3R^2 \omega^2) \]
\[ \frac{dP}{d\omega} = 0 \]
\[ V_w^2 - 4V_w R \omega + 3R^2 \omega^2 = 0 \]
\[ \omega = \frac{V_w}{3R} \]
\[ \omega = 42 - 112 \text{ (RPM)} \]

Fabrication

Assemble the fin mold

Analysis

After baking

Results

The power output depends on the velocity of the water exponentially. Significantly more power can be generated during spring runoff season.

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