Sample Abstract Format

Energy Generation using Reciprocating Small Scale Hydropower System

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Abstract

Energy can be generated constantly and stored from an ambient source such as fluid in motion. This process is known as energy harvesting. The most conventional energy harvesting from water movement is the hydropower which is generally for the large energy production with either high flow discharge or high head for water movement or both. But at an especially remote location where wireless system or sensors have to be powered or batteries have to be charged large energy production is not necessary. At such places energy can be harvested from the reciprocating motion of a properly design structural system created by the fluid motion. River, stream flow, wave and current power generation is categorized as low- head hydropower. Hydropower systems developed to date for low-head water movement require substantial flow rate. The hydropower system discussed here is a unique system that can take advantage of low head as well as low flow to produce energy.

The objective of this paper is to study concept behind a reciprocating hydropower model and to optimize the lift force generated from the system with analytical modeling and lab tests. A finite element analysis of the model is also done to understand the displacements and forces created.

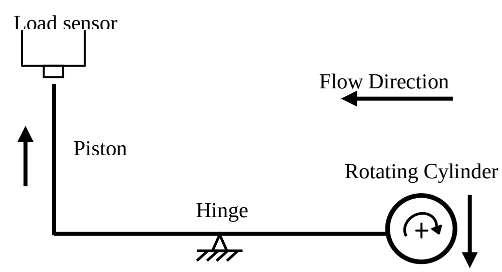

Fig. 1: Schematic of Lift force measurement

The technology is based on the fact that flow past a rotating cylinder results in the generation of extra lift. It is known as the Magnus Effect. The lift force on rotating body in fluid takes place from the side where cylinder rotation and fluid flow are oriented opposite to each other to the side where they have same direction. The Reciprocating small hydropower system studied here consists of a rotating cylinder and a moving piston at opposite sides with hinge in the middle (Fig. 1) to facilitate see-saw (up and down) motion between them. This alternating movement of the piston can be used to generate power using electromagnetic, piezoelectric or electrostatic mechanisms.

Laboratory tests on a prototype system were done for different angular speeds of the cylinder and velocities of water flow. The lift force on the top of the piston was measured using a load sensor and LVDT was used to record the displacement pattern of the piston with the generated lift force. A 3-dimensional finite element analysis was also performed using ABAQUS software code to simulate the structural response. Two methods of power harvesting from the output displacement obtained from the hydropower system are discussed. Results these various tests and simulations have been presented.

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