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Experimental study on a pendulum type device supported by a float to extract sea wave energy

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Extraction of sea wave energy at the shore is cheap compared to doing it off shore because offshore structures and operations are relatively costly. Sea waves gain kinetic energy when the wave approaches the shore. This research aims at extracting both kinetic energy and the potential energy of the sea wave at the shore.

A device called “Pendulum” was invented in Japan and has proven 40%-50% of wave energy conversion efficiency at the sea of Muroran, Japan. The low wave energy density oceanic climate of Sri Lanka makes this device more preferred, because of its high energy conversion capability. Only kinetic energy of the moving wave could be extracted by such pendulums alone. In this research, a float has been attached to the pendulum (flap) to extract potential energy of the wave, while the kinetic energy is extracted by pendulum flap. The rotation of the heavy flap about its hinge axis is a measure of extracted energy.

The device was tested at a location in the shore where the sea waves frequently break. The flap was gradually loaded with extra weights in addition to its own weight to check the device’s ability to extract energy from the waves. The experiment also helps to prove the necessity of a float to extract potential energy component of the breaking waves. It was found that the device performed satisfactorily extracting a significant amount of energy from the sea waves. At certain instances the extracted energy exceeded 10kJ per wave. In average, the 1m long device extracted 100W of power from the sea waves.

It is clear that the combined profile of the flap and the float influences the energy extraction. Therefore maximum energy extraction can be done by an optimized profile which is best suitable for extracting both kinetic & potential energies. The other factors affecting the energy extraction are; water level with respect to axis of the flap, back flow of the water and self weight of the flap.

It is obvious from the results that the wave energy can be extracted by this device and can be used as the reciprocating shaft power. Since the waves occur intermittently, additional devices are required to continuously use the energy extracted by a torsionally reciprocating shaft. The device can be used in arrays to catch more and more waves so that the array could continuously produce useful power.

Keywords: wave energy, pendulum and float, energy extraction

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