Experimental Investigations on the Performance Characteristics of a Modified Four Bladed Savonius Hydro-Kinetic Turbine

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Abstract:- Torque variation along the angular positions of the rotor blade and lower efficiency are the main drawbacks of Savonius turbine. To overcome these problems several attempts have been made by the researchers in the recent past. In this work, an attempt has been made to increase the torque along the angular positions where the torque is low, by placing a set of additional blades called secondary blades in front of the concave side of main rotor blades. These secondary blades are interacting with the flowing fluid when the main blades are not in action. The performance of the modified Savonius turbine is compared with the conventional single blade 0 overlap and 0.2 overlap Savonius turbines, by carrying out the experiments in the open irrigation canal of size 42 cm x 45 cm. Results shows that, the efficiency is improved from 16 % to 19% and the torque values increased along the angular positions of 90°, 120°, 270°, 300°, 330°. From the observations, it has also been noted that, the modified four bladed Savonius turbine rotates smoothly in comparison with the conventional Savonius. The negative torque a common problem in conventional Savonius is also effectively eliminated in the modified design.

Keywords Savonius Rotor; Hydro-kinetic Turbine; Coefficient of Torque; Coefficient of Power; Overlap Ratio; Blade Aspect Ratio; Tip Speed Ratio.

1. Introduction

Energy from wind, solar, hydro ocean currents, ocean waves and tidal are considered as renewable energy sources, whereas the energy from coal, oil, gas and nuclear are considered as non renewable energy which are essentially stored as stocks in the earth. The use of renewable energy reduces the emission of green house gases also helps in meeting out the energy demands of the future. Hydrokinetic turbines are the low head hydro turbines converts kinetic energy of the flowing water into mechanical energy. The wind turbines and hydrokinetic turbines are working on the same principle of operation except the varied range of speed. Wind turbines operate in the range of 11-13 m/s, whereas hydro-kinetic turbines operate in the range of 1.75-2.25 m/s water velocity [1].

Islam et al.,[2] have studied the potentiality of small-scale hydro power plants at Gumati and Surma rivers of Bangladesh and observed that the hydrokinetic turbines have greater potential in the power generation and the kinetic energy possessed by the flowing water might be of greater source of energy for rural areas.

Turbines which convert energy from the flowing water are termed in various names such as water current turbine, ultra low head hydro turbine, free flow stream turbine and zero head hydro turbine. The stream hydro turbine, basically a river current energy conversion system is also commonly called as Savonius turbine in the name of the inventor. Savonius is simpler in design, has less moving parts and hence low noise and cost [3]. Generally the Savonius turbines lacked with poor efficiency and torque variation along angular position of the rotation. So for several attempts have been made by researchers to improve the coefficient of performance and torque variation of the turbine.