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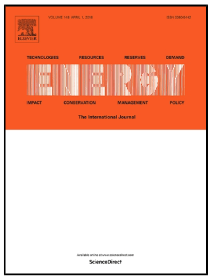

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ABSTRACT

The paper reports numerical and experimental investigation of a vent-augmented elliptical-bladed Savonius rotor. In this study, the advantages of a newly developed blade profile and an augmentation technique have been combined. To begin with, the cut angle of an elliptical profile is optimized by numerical simulation using ANSYS FLUENT. Thereafter, the optimized elliptical profile is studied with vents. Initially, 2D unsteady simulation is carried out around the vented elliptical profile using Shear Stress Transport *k-ω* turbulence model. The torque and power coefficients are calculated at rotating condition for various tip speed ratios. The results obtained are compared with those of non-vented elliptical and semicircular profiles. Subsequently, 3D unsteady simulation is carried out with the vented and the non-vented elliptical-bladed rotor. Finally, the wind tunnel experiments are conducted to validate the 3D numerical results. For the vent-augmented elliptical-bladed rotor, the 3D numerical simulation shows a maximum power coefficient (C_P) of 0.132, while the experiments demonstrate a maximum C_P of 0.146 at TSR = 0.49.

Keywords: Savonius rotor, Venting-slot, Elliptical blade, Turbulence model, Power coefficient, Tip-speed ratio.

1 INTRODUCTION

During the past few decades, energy has become a topic of debate due to its increased consumption, increased cost and depletion of conventional energy sources like coal, natural gas and others [1]. These conventional sources of energy have also become a reason for creating pollution that lead to environmental problems like the greenhouse effect, ozone depletion and global warming [2, 3]. This has motivated the researchers to explore various renewable energy sources such as biomass, solar, wind, hydro and others which could create a pollution-free environment. Among these, the wind energy is abundant, inexpensive, and clean with minimal impact on landscapes, biodiversity and watersheds. This affluent energy is captured by means of wind turbines and is utilized for various purposes including electrical power production [1, 4-6]. As the wind power is proportional to the cubic power of wind speed approaching the turbine, any small increase in wind speed can lead to a significant increase in the turbine power output.