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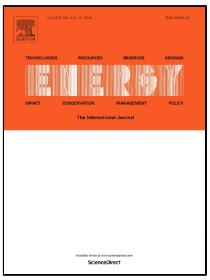

Numerical Investigation of Performance Refinement of a Drag Wind Rotor Using Flow Augmentation and Momentum Exchange Optimization

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ABSTRACT

Numerical ascertainment of improving performance of modified Savonius rotor as decreasing the minimum wind speed required for initiating the rotation is investigated using 3D flow predictions executed in ANSYS-FLUENT. For making the comparison feasible, the design represented in a similar paper is simulated and performance is compared with empirical data. Different types of nozzles are added after observing acceptable agreement between empirical and simulation results. Nozzle acts like an air intake on the advancing blade and fortifies the acting flow; it also eliminates the reverse moment caused by contacting the flow with returning blade. Therefore, increasing in power coefficient is anticipated. Systematic analysis of obtained torque and power coefficients with and without nozzle are presented. In the next step, this work is dedicated to bucket shape optimization. Buckets with multi-curvature are introduced and have been investigated in three stages. By installing a simple nozzle with tail in front of a Savonius wind turbine with double-curved two stage buckets, the Savonius turbine maximum power coefficient is improved from 0.13 to 0.39.

KEY WORDS: Nozzle; Drag turbine; Wind energy; Power Coefficient; CFD

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1. Introduction

Advancement in industrialization results in growing energy demands. This energy is mostly supplied by fossil resources. Not only are these resources being exhausted, but they also cause catastrophic consequences like global emission. Such difficulties have persuaded researchers and political leaders to consider the renewable energy field in a more attentive manner. As a result of conspicuous efforts, research activities especially in the area of wind energy and solar energy have been greatly growing. Thus, wind energy is beginning to play a significant role in solving global energy crisis. Although noticeable progress has already been attained, the available technology in designing a proper wind turbine for challenging conditions of low wind speed, incessant variation in direction and urban area conditions appears to be insufficient [1-5]. The Savonius turbine seems to be particularly favorable for such conditions. The concept of wind device patented by *Savonius* in the 1920s consists of two semicircular buckets placed along each