THE AERODYNAMIC SHAPE OPTIMIZATION FOR A SMALL HORIZONTAL AXIS WIND TURBINE BLADES AT LOW REYNOLDS NUMBER

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ABSTRACT

In this research paper, the main focus is on small wind turbine blade performance of two mixed airfoils such as SG 6043 and NACA 4412 and different composite materials are compared by using Numerical with software analysis. The aerodynamic geometry and materials of blade are key parameters to determine starting of the wind turbine and performance of the rotors. The best selection of airfoil and material gives better performance of the wind turbine blade design based on the available wind velocity, Reynolds number. The author wants to compare the performance of mixing for airfoils (SG 6043 and NACA 4412) at Low Reynolds number; less than 250,000.

A parametric numerical study and Simulation was conducted, in order to determine the optimum distribution of chord length and twist angle along the 1 m length of the blade at rated wind speed of 8 m/s. A Blade Element Momentum (BEM) theory based on MATLAB program was developed. The numerical simulation is carried out by Matlab and X-Foil software. The lift-drag ratio are compared based on different angles of attack 2°, 4°, 6°, 8°, 10° at wind velocity 8m/s, rated wind velocity for rural areas. The design chord length of the blade is 1 m and width of the wing is 0.311m. The numerical results from Matlab are compared with the results of X-Foil software; by doing this simulation, understand their blade geometry optimization and the performance of two mixing airfoil profiles is compared. Therefore, the best airfoil will be used in small horizontal axis wind turbine in rural areas where the wind velocity is less. The main focus in this research paper is Reynolds number effect, axial induction effect, Tip loss, Drag effects were considered in the aerodynamic shape optimization and maximized Power coefficient by varying the different of blade sections with optimized tip speed ratio (TSR).

KEYWORDS: Composite; Reynolds Number; Solidity; X-Foil & Angle of Attack.

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