

Abstract

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Performance analysis of wells turbine blades using the entropy generation minimization method

Wells turbine concept depends on utilizing the oscillating air column generated over marine waves to drive a turbine. As a matter of fact, previous researches on the performance analysis of such turbine were based on the first law of thermodynamics only. Nonetheless, the actual useful energy loss cannot be completely justified by the first law because it does not distinguish between the quantity and the quality of energy. Therefore, the present work investigates the second law efficiency and entropy generation characteristics around different blades that are used in Wells turbine under oscillating flow conditions. The work is performed by using time-dependent CFD models of different NACA airfoils under sinusoidal flow boundary conditions. Numerical investigations are carried out for the incompressible viscous flow around the blades to obtain the entropy generation due to viscous dissipation. It is found that the value of second law efficiency of the NACA0015 airfoil blade is higher by approximately 1.5% than the second law efficiency of the NACA0012, NACA0020 and NACA0021 airfoils. Furthermore, it is found that the angle of attack radically affects the second law efficiency and such effect is quantified for NACA0015 for angle of attack ranging from 15° to 25°.