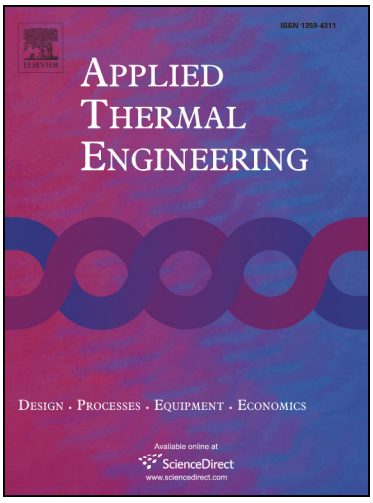

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Aerodynamic Design and Numerical study for Centrifugal Turbine with Different Shapes of Volutes

Ying Wang[1, 2] Xin Tan[1, 2] Naian Wang[1, 2] Diangui Huang[1, 2 *]

(1.School of Energy and Power Engineering, University of Shanghai for Science and Technology, Shanghai, 200093;

2. Shanghai key laboratory of multiphase flow and heat transfer of power engineering, Shanghai, 200093)

(Tel: 021-55897317, Email: dghuang@usst.edu.cn)

Abstract: Centrifugal turbine has good compatibility between aerodynamics and geometry. The straight blade can be directly used without significant effect on three dimensional flow field, and therefore the optimum values of the speed ratio and reaction degree can keep constant along the spanwise direction with higher turbine efficiency and simpler manufacturing. Furthermore, the closed impeller which is made by fixing the blade tip using cover band shows larger impeller strength and is suitable for high-speed rotation. In recent years, the centrifugal turbine with many potential advantages is gradually becoming a research hotspot in the field of turbine. In this paper, three kinds of volutes with different cross section shapes were designed for a single-stage centrifugal turbine unit. Based on the CFD simulation in the whole flow passage, the analysis of three-dimensional steady flow for the designed centrifugal turbine was carried out both under design and off-design conditions, and the following results were obtained: the aerodynamic performance of centrifugal turbines with three kinds of volutes are almost the same under design and off-design conditions. Besides, the pear shaped volute shows slightly higher total efficiency and its overall efficiency, stage internal efficiency and power are 87.36%, 85.79% and 484.88kW, respectively.

Keywords: Centrifugal Turbine, Numerical Simulation, Aerodynamic Design, Volute

Nomenclature

a_1	Half of horizontal axis of shroud elliptical Arcs [mm]	P_0^*	total inlet pressure [kPa]
a_2	Half of horizontal axis of hub elliptical Arcs [mm]	P_1	temperature in stator
b_1	Half of vertical axis of shroud elliptical Arcs [mm]	P_2	outlet backpressure [kPa]
b_2	Half of vertical axis of hub elliptical Arcs [mm]	r	radius of guiding cone at inlet [mm]
c_0	flow speed when entering the stator blade	r_3	inlet diameter of volute [mm]