

阶梯隔舌对离心泵压力脉动和径向力影响的数值模拟 Numerical Simulation on Pressure Fluctuations and Radial Hydraulic Forces in Centrifugal Pump
with Step-tongue

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关键词: 离心泵 阶梯隔舌 动静干涉 径向力 压力脉动 数值模拟

摘要: 通过改变隔舌形状, 采用SST模型分别对常规隔舌和阶梯隔舌蜗壳的离心泵进行全流道非稳态数值模拟。通过模拟分别获得了常规隔舌和阶梯隔舌蜗壳的离心泵压力脉动特性、作用在蜗壳和叶轮上的径向力特性, 并对其进行比较分析。结果表明: 采用常规隔舌和阶梯隔舌时, 离心泵进出口压力、作用在蜗壳和叶轮上的径向力均随时间呈周期波动, 脉动频率均以叶片通过频率为主; 采用阶梯隔舌蜗壳后, 进出口压力大小值和脉动幅值均明显减弱, 高频脉动成分减少, 作用在蜗壳上的径向力数值和脉动幅值也减小; 作用在叶轮上的径向力大小和方向时刻都在变化, 且整体变化趋势基本呈圆形分布。

Using the shear stress transport turbulent model (SST), the 3-D unsteady numerical method was applied to simulate the flow of the centrifugal pump with the common-tongue and step-tongue. Various pressure fluctuations, radial hydraulic force on the impeller, and volute were obtained for the rotor-stator interaction. The analysis results indicated that the blade-passing frequency dominated the pressure fluctuation, the radial hydraulic force on the impeller and volute, which had periodic fluctuations. The amplitudes of the pressure fluctuation on the inlet and outlet detecting points of the pump were smaller with step-tongue than with common-tongue; the high-frequency components were also fewer. The radial hydraulic force on the volute of the pump with the step-tongue and its amplitude were also smaller than with the common-tongue. The distribution of radial hydraulic force on the impeller vector coordinates were almost circular using common-tongue and step-tongue.

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