

用于冷却塔的超低比转数混流式水轮机设计 Study on Francis Turbine with Super-low Specific Speed Applied in Cooling Towers

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关键词: 超低比转数水轮机 冷却塔 数值模拟 试验

摘要: 工业冷却塔的循环冷却水出口一般具有一定的富余水头(4~15 m)。利用冷却塔的富余水头,开发一种超低比转数混流式水轮机,代替冷却塔中风扇电动机,可以达到节能的目的。结合冷却塔水轮机工作环境特点,进行了超低比转数混流式小水轮机全流道三维非定常数值模拟,重点对超低比转数小水轮机转轮叶片设计与优化。为了尽量减少水轮机尺寸,在结构设计方面提出金属梯形蜗壳和单列环形导叶。通过数值模拟对比分析确定最优性能的水轮机方案进行物模试验。通过物模试验证明设计的超低比转数混流式节能水轮机尺寸满足了冷却塔要求,效率高,性能稳定。 The surplus water head at industrial cooling towers is generally 4 to 15 meters. Using the surplus water head, a Francis turbine with super-low specific speed was designed to replace the fan motor in the cooling tower for energy saving. Based on the features of the surrounding environment, the runner blade airfoil was designed and optimized with 3-D numerical simulation through the whole flow passage of the turbine. Metal elliptical volutes and single-row ring guide vanes were applied in the structural design. After analyzing the numerical simulation results, an optimal model of 86% efficiency was selected for the physical model. The model test showed that the super-low specific speed Francis turbine met the dimensional requirement and had a high efficiency of 85.3%. Its stable performance can be popularized and applied in the capable local facilities.

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