真空热处理炉风机叶轮叶片进出口角变化对冷却效率的影响研究 *

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摘　要:为实现真空热处理炉的高效运行,本文以某型真空热处理炉风机为对象,研究风机叶轮叶片入口角和出口角对冷却效率的影响。基于 SST $k-\omega$ 湍流模型,对风机流体域进行仿真模拟,分析不同叶轮叶片入口角和出口角时叶轮内压力分布及速度矢量变化、风机出口处风速及风速均匀性,得出优化的叶片入口角和出口角参数。针对优化前后的叶轮进行测试,探究真空热处理炉冷却效率的变化及节能降耗情况。研究结果表明:当叶片入口角为 36°,出口角为 54°时,风机蜗壳出口处风速和风速均匀性较好,满足真空热处理炉的工艺要求;通过优化风机叶轮叶片进出口角,真空热处理炉风冷系统性能显著提升,整机冷却效率提升 15.6%,整机能耗降低 14.3%;双侧出风结构的真空热处理炉,出口关闭侧蜗壳内会出现局部高压区,应尽可能降低高压区域对叶轮出口处的影响。

关　键　词:真空热处理炉;离心风机;叶片进口角;叶片出口角;冷却效率;数值仿真

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Study on Influence of the Change of Inlet and Outlet Angle of Impeller Blade of Vacuum Heat Treatment Furnace on Cooling Efficiency

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Abstract: In order to realize the efficient operation of the vacuum heat treatment furnace, this paper takes a certain type of vacuum heat treatment furnace fan as the object, and studies the influence of the inlet and outlet angles of the fan impeller blades on the cooling efficiency. The SST $k-\omega$ turbulence model is used to simulate the fan fluid domain. The pressure distribution and velocity vector change in the impeller, the wind speed and wind speed uniformity at the outlet of the fan are analyzed, and the optimized blade entry angle and exit angle parameters are obtained. The impeller before and after optimization are tested to explore the changes of cooling efficiency and energy saving and consumption reduction of vacuum heat treatment furnace. The results show that when the blade inlet angle is 36° and the outlet angle is 54°, the wind speed and wind speed uniformity at the outlet of the fan volute are better, which meet the technological requirements of the vacuum heat treatment furnace. By optimizing the inlet and outlet angles of the fan impeller blades, the performance of the air cooling system of the vacuum heat treatment furnace is significantly improved. The cooling efficiency of the whole machine is increased by 15.6%, and the energy consumption of the whole machine is reduced by 14.3%. For vacuum heat treatment furnaces with a double-side air outlet structure, there will be a local high pressure area in the volute on the side where the outlet is closed, and the impact of the high pressure area on the impeller outlet should be minimized as much as possible.

Key words: vacuum heat treatment furnace; centrifugal fan; blade inlet angle; blade outlet angle; cooling efficiency; numerical simulation

工业技术的高速发展,对工业材料的性能要求越来越高,真空热处理技术因此得到大规模的推广和应用。真空热处理技术将真空技术与热处理工艺相结合,能实现金属材料或零件性能的大

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