

热能工程

超(超)临界垂直管圈锅炉水冷壁流量分配及壁温计算

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摘要: 水冷壁流量分配和壁温计算方法是开发自主知识产权超(超)临界锅炉的关键技术之一。针对垂直管圈结构和炉内热负荷分布特点, 将水冷壁划分为由流量回路、压力节点和连接管组成的流动网络系统。根据质量守恒、动量守恒和能量守恒方程, 建立了超(超)临界锅炉水冷壁流量和壁温计算的数学模型。与传统的图解法相比, 该方法具有精度高、能够处理复杂结构等优点。在此基础上, 通过对185个回路方程和10个压力节点方程组成的非线性方程组进行直接求解的方法, 得到了100%、50%和35%锅炉最大连续蒸发量负荷下玉环电厂1 000 MW超超临界锅炉水冷壁流量分配和壁温分布, 并与国外公司的计算结果进行了比较。结果表明二者符合较为一致, 流量分配的最大误差为9.7%, 壁温误差为3~7 ℃。

关键词: 超(超)临界锅炉 水冷壁 流量分配 壁温 非线性方程组

Numerical Computation on the Mass Flow Rate Profile and Metal Temperature in Vertical Water Wall of an Ultra Supercritical Boiler

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Abstract: The computation of mass flow rate distribution and metal temperature in water wall is a key technology for Chinese manufacturer to develop the ultra supercritical boiler with self-owned property rights. The water wall system can be equivalent to a network consisting of circuits, pressure grids, and connecting pipes. The mathematical model for predicting the profile of water wall flow rate and temperature was established on account of mass, momentum and energy conservations. Compared to the traditional chart-solution, the new method can obtain more accurate results and treat complex circuit constructions. The mass flow rate distribution and metal temperature in the ultra supercritical boiler water wall of Yuhuan Power Plant at boiler maximum continuous rating (BMCR), 50%BMCR and 35% BMCR load were calculated through the solving of nonlinear equations including 185 circuits and 10 pressure grids. The agreement between the present results and the Plant data is good, the maximum flow deviation is 9.7%, and the temperature difference is about 3-7 ℃.

Keywords: ultra supercritical boiler water wall mass flow rate profile temperature nonlinear equations

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