

热能工程

超临界压力直流锅炉蒸发管超温预报

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摘要: 超临界直流锅炉实际运行中, 炉膛蒸发管爆漏多发生在热偏差管或水力偏差管。采用改进的炉膛传热算法, 以理想的均值管为纽带, 将偏差管工作状态和炉膛燃烧参数关联在一起, 建立了偏差管流动和传热模型。根据均值管和偏差管两端压力相等, 通过迭代计算确定偏差管工质流量, 采用该模型考察了炉膛燃烧强度和工质冷却流量的匹配性, 对蒸发管吸热不均、阻力偏差、异物堵塞或节流孔设计欠合理等引起的超温问题进行了模拟, 并选用合理的换热系数关联式, 对超临界锅炉全负荷变压运行蒸发管的壁温场进行了计算。结果表明, 对于某1 000 MW超超临界锅炉, 锅炉最大连续工况负荷运行时, 当偏差管热偏差系数达到1.45, 炉膛下辐射区受热面出现超温; 锅炉100%汽轮机热耗验收工况负荷运行时, 当局部阻力偏差达到0.292 MPa, 偏差管工质的冷却流量降低到平均流量的57%, 超温随即出现。

关键词: 超(超)临界压力锅炉 受热管阻力分析 偏差管 流量分布 金属温度

Overheating Prediction of Evaporating Tubes in Supercritical Pressure Once-through Boiler

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Abstract: Thermal-hydraulics deviation used to cause furnace tube explosion in operation of supercritical pressure once-through boiler. Heat transfer calculation suitable for engineering application were employed to associated thermal-hydraulics inside the deviated tube with furnace burning conditions. Iterative computations were used to determine mass flux in the deviated tubes with the fundamental criterion of same pressure at both end of the averaged and deviated tube. A model coupled thermal processes of furnace gas with thermal-hydraulics inside the evaporating tube was developed to investigate the matching of combustion intensity with coolant mass flux in an evaporating tube. The model provides a detailed insight into impacts of deviated heat flux distribution, resistance deviation, abnormal blockage and inappropriately designed orifice on the deviated tube overheating, correlations of internal heat transfer coefficients are carefully selected to calculate tube wall temperature when the boiler operating at different pressures in the whole range of loads, it shows that the lower furnace tube is over-heated when the deviated heat flux coefficient reach 1.45 for a 1 000 MW boiler operating at boiler maximum continuous rating (BMCR) load, the mass flux in the deviated tube decreases to 57% of average flux when deviation of local resistance increases to 0.292 MPa at 100% turbine heat acceptance (THA) load, and this leads to tube wall overheating as well.

Keywords: supercritical and ultra supercritical pressure boiler thermal-hydraulic analysis the deviated evaporating tube mass flux distribution metal temperature

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