热能工程

基于矩量法的超临界锅炉水冷壁温度场数值计算

李春燕 阎维平 李均 米翠丽 鲁许鳌

华北电力大学 华北电力大学 华北电力大学 华北电力大学 华北电力大学

摘要： 超临界、超超临界锅炉水冷壁尤其是燃烧器区水冷壁温度场计算对锅炉的安全运行具有重要意义。该文建立了燃烧器区螺旋管圈水冷壁及鳍片截面的二维稳态导热方程，推导了基于矩量法的有限元数值计算公式，采用双线性四边形单元对截面进行剖分。用分区段热力计算方法确定水冷壁各区段热负荷。依据机组实测的水冷壁入口和出口工质温度和压力，通过计算热负荷引起的焓增确定各校核截面的工质温度和压力。从而确定管内的对流换热系数。计算了不同启动方式下水冷壁管壁内侧温度及其变化率，为指导锅炉的安全稳定运行和锅炉管壁选材提供了依据。

关键词： 超临界机组　膜式水冷壁　有限元　温度场　矩量法　温度变化率

Temperature Profile Calculation for Water-wall Tube of Supercritical Boiler Based on Moment Method

LI Chun-yan YAN Wei-ping LI Jun MI Cui-li LU Xu-ao

Abstract: The temperature field calculation of water wall of supercritical and ultra-supercritical boilers, especially those located at the burner region, is of significant importance for boiler safe operation. The two-dimensional steady thermal model for the cross section of spiral water-wall tube and rectangular fin was established. The finite element formula for numerical calculation based on moment method was deduced, and bilinear quadrilateral unit was used to subdivide the cross section of the spiral water wall tube and rectangular fin. The flux rate of every zone of the water-wall is determined by thermal calculation in sections. The temperature and pressure of the working fluid of every cross section was determined by the enthalpy increase induced by heat flux of every zone based on the practically gained temperature and pressure of the working fluid at the inlet and outlet of the water-wall. Besides, the convection heat transfer coefficient inside water-wall tube was determined. The temperature variation rates of the inner side of the water-wall were predicted and analyzed under different boiler start-up modes, which offer reference for the safe and stable boiler operation, as well as for the tube material selection.

Keywords: supercritical boiler　spiral water wall　finite element　temperature field　moment method temperature variation rate

通讯作者: 李春燕

作者简介:

作者Email: lichy1973@163.com

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