原子能科学技术 2008 42 (2): 128-134 ISSN: 1000-6931 CN: 11-2044/TL

中国原子能科学研究院第21届“五四”青年学术报告论文选

快堆燃料组件热工流体力学计算研究

刘一哲，喻宏

中国原子能科学研究院 中国实验快堆工程部，北京 102413

收稿日期 2007-5-29 修回日期 2007-10-30 网络版发布日期: 2008-2-20

摘要 对于钠冷快堆，在燃料和包壳最高温度等设计限值下，为获得较高的堆芯出口温度，需深入分析燃料组件内的热工流体力学问题，准确预测组件内的冷却剂温度分布。本文在CRT模型和F.C.Engel等人工作的基础上，提出了ICRT压降关系式，用以计算冷却剂在湍流区、过渡流区和层流区的棒束压降；引入CRT模型和WEST对流传热模型，改进了SUPERENERGY子通道分析程序，并将改进程序与原程序计算结果进行了对比，结果表明：最热子通道出口温度略有降低，液膜温压略有增加；并用计算流体力学软件CFX对中国实验快堆单盒燃料组件活性段进行了三维数值模拟，将计算结果用CRT模型、ICRT压降关系式及改进后的SUPERENERGY子通道分析程序进行了验证，相互符合较好。

关键词 快堆 单盒燃料组件 压降 流速分布 温度分布

分类号 TL33

Thermal-Hydraulic Analysis of Fuel Subassemblies for Sodium-Cooled Fast Reactor

LIU Yi-zhe, YU Hong

China Institute of Atomic Energy, P.O. Box 275-95, Beijing 102413, China

Abstract Thermal-hydraulic analysis of fuel subassemblies for the sodium-cooled fast reactor is important in respecting design limits while achieving higher outlet temperature， and it is essential to predict, reliably and accurately, the coolant temperature distribution in individual fuel subassembly. Based on F.C.Engel’s work and CRT model, three semiempirical correlations ICRT were developed to calculate laminar, transition, and turbulent parallel flow pressure drop across wire-wrapped rods. With CRT model and the heat transfer coefficient WEST, reasonably accurate temperature distribution in a fuel subassembly was obtained by the improved subchannel analysis code SUPERENERGY. The results indicate lower coolant temperature and higher film temperature in internal regions. The code CFX was used to show the 3D flow field and temperature distribution in a rod bundle, and the numerical results show good agreement with CRT model, ICRT correlation and the improved SUPERENERGY code.

Key words fast reactor _ fuel subassembly _ pressure drop _ velocity distribution _ temperature distribution

DOI

通讯作者