Analysis And Validation Of Heat Transfer Of Nuclear Material In The FBNR Reactor

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Abstract

The development of new types of reactors potentiates the development of new materials and technologies to improve the efficiency of heat transfer in the reactor core, an example is the Fixed Bed Nuclear Reactor (FBNR), which uses as fuel nuclear spheres of CERMET that form a fixed bed.
In the fixed bed study it is important so as to define technical parameters such as the minimum refrigerant flow, the configuration of the fuel elements that make up the bed, the temperature profile of the fuel sphere, the mentioned parameters are of relevant importance to ensure that the limitations thermal properties of the materials involved in this case specifically in the fuel are not exceeded.
In order to determine the conditions to which the fuel spheres are located in a fixed bed for a steady state, a 3D CAD model of the core was developed that was later examined with Comsol Multiphysics software, using Heat Transfer modules and Conjugated Heat Transfer and Flow, thus established the mathematical model of heat transfer for the bed in its entirety and for each sphere, which was based on an energy balance considering the fuel spheres as a source of generation under convection variable for BCC and FCC bed arrays, these equations were validated with the results obtained in the simulation, in addition to performing a statistic of the obtained error.
The results obtained are shown in the Figures where the minimum refrigerant velocity, the temperature profile of a sphere and the statistical analysis of the errors obtained by validating the equations can be observed determined with the values obtained in the simulation.
The error percentages obtained when validating the equations present percentage errors lower than 9%, reflecting the reliability of the established models.

Figures used in the abstract

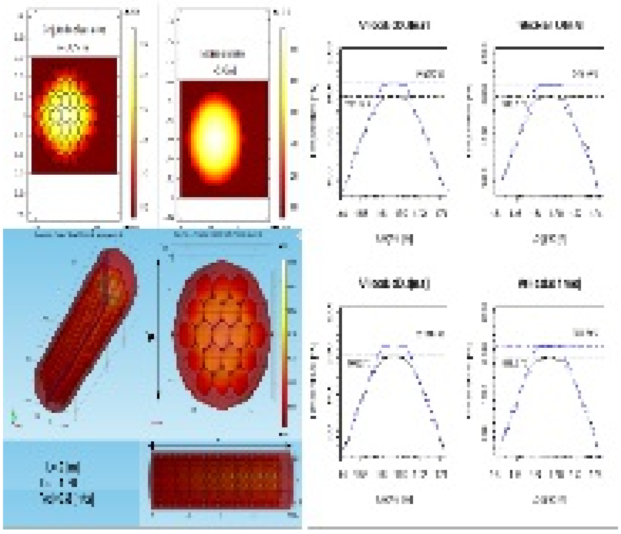

Figure 1 : RESULTS OF TEMPERATURE PROFILE OF NUCLEAR MATERIAL