Thermohydraulic Study of a Fixed Bed for the Core of a Nuclear Reactor

J. C. Almachi[1], J. A. Montenegro[1]

[1]Departamento de Formación Básica, Escuela Politécnica Nacional, Quito, Pichincha, Ecuador

Abstract

Faced with the growing demand of energy of world population, nuclear energy captures attention because is secure, competitive and does not produce greenhouse gases, there more covered the 15% of demand the electricity worldwide in 2015 [1][2].
Since 2000 until today so as to potentiate the inclusion of nuclear energy in the energy matrix, are being developed new concepts of nuclear reactors, known as nuclear reactors of fourth generation, through which seeks to improve the efficiency of heat transfer in comparison with reactors of previous generations, therefore the importance of thermohydraulics study of fixed beds has like advantage their larger surface area of heat transfer in the reactor core [3]. Under this concept are being developed the reactor FBNR, thus this reactor uses as fuel elements spheres of CERMET [4], the same as for a fixed bed in the reactor core, has cylindrical form, their graphic representation can be seen in the Figure 1. The characteristics of the reactor are [5]:
• Diameter 1.7 m
• Height 2m
• Thermal Power 218.4 MWt
• Electric Power 70 MWe
• Nominal pressure core 16 MPa
• Coolant inlet temperature 290 °C
Inside of study of fixed beds is important to define the following parameters: flow minimum and velocity profile of cooling fluid, temperature profile of cooling fluid and the fuel elements.
In order to determine the parameters before described the COMSOL Multiphysics® software was used, the geometry was established in 3D for core of nuclear reactor, and for termohydraulic study, the Heat Transfer Module of the COMSOL Multiphysics® software was used, with coupled laminar flow and heat transfer. In this study was considered to nuclear fuel spheres as heat sources, the cooling fluid used in the simulation was water and the type of study was stationary.
The study of termohydraulic parameters is important to establish safe operating conditions to verify that the thermal limitations of the materials involved in the reactor core are not exceeded, in addition to these parameters are useful in neutronic research reactor core.

Reference

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Reactor”. URL: http://www.sefidvash.net/publications/141_article.pdf

Figures used in the abstract

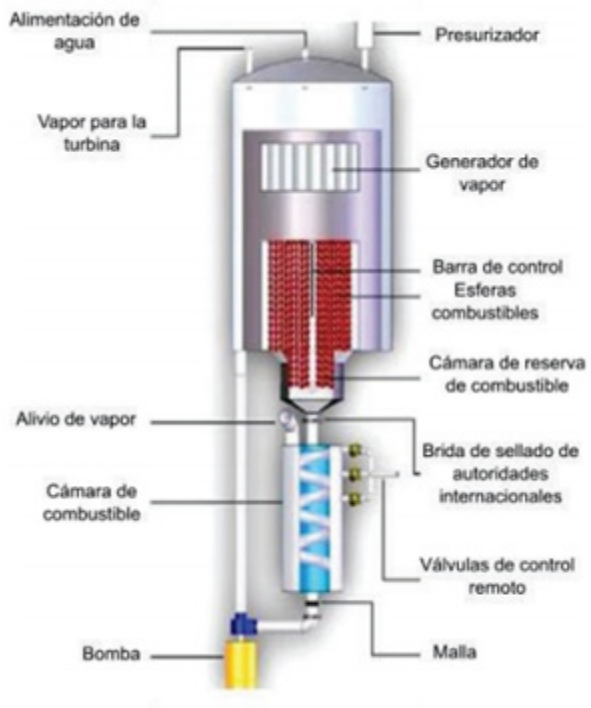

Figure 1: nuclear reactor

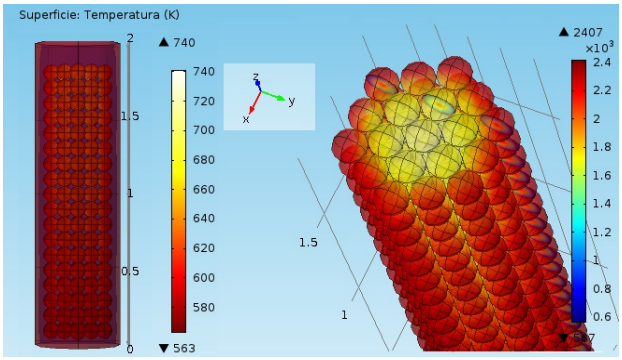

Figure 2: Heat Transfer

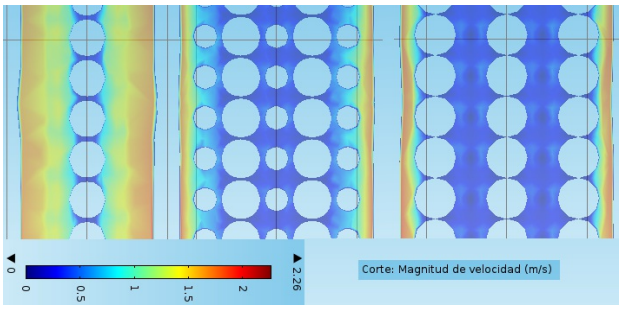

Figure 3: Fluid velocity

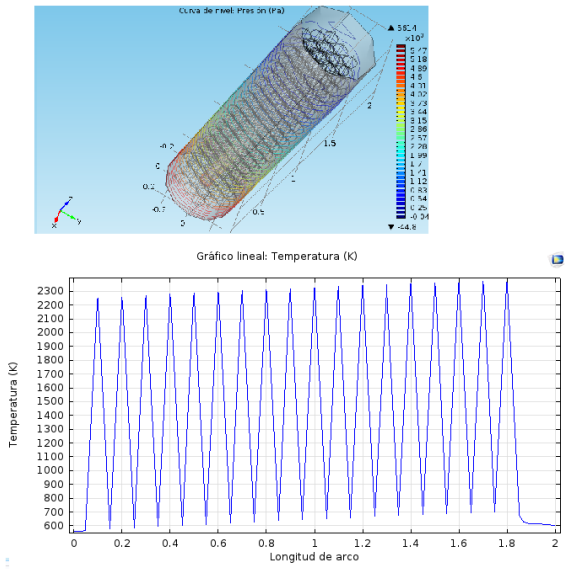

Figure 4: Pressure field