# Abstract


## Determination of mixed convection in the moderator gaps of a nuclear reactor with the porous media approach

Aim of this study is to predict temperature, velocity and possibly natural convection of the moderator water for an advanced pressurized water reactor with supercritical water in the primary loop. The simulation of the gap water flow between fuel assemblies in a reactor core is done with aid of the porous media approach.
The analysis of flow and heat transfer is usually based on the Navier-Stokes and energy equation, but the geometric complexity of the flow region of the gap prevents general solutions of the detailed velocity and temperature fields. Instead, macroscopic conservation equations have to be employed by volume averaging of the microscopic conservation equations. The equations are derived in dependency of specific parameters like the porosity. Due to the volume averaging, an additional coefficient, called permeability, and a resistance function have to be determined. This determination has been done both with the aid of pressure loss correlations and with a CFD analysis using the software STAR-CD. The results have been compared and applied to the macroscopic conservation equations. Finally the parameters and equations are implemented in a simulation software called Comsol (Femlab).
A parametric study with different moderator mass flow rates at a given coolant temperature distribution showed that a minimum moderator mass flow rate will be required to avoid natural convection in the gap volume, and thus to ensure a stable neutron flux distribution in the core.