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Pebble Bed Thermo-mechanical Modeling for Water Cooled Ceramic Breeder Blanket for CFETR

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The beryllium pebble bed and Li2TiO3/Be12Ti mixed pebble bed are selected to realize neutron multiplication and tritium breeding in the Water-cooled ceramic breeder blanket (WCCB) of China Fusion Engineering Test Reactor (CFETR). In order to evaluate and improve the performance of WCCB, studies of the thermo-mechanics of the concerned pebble beds are necessary.
In the current research, a numerical model was constructed by using distinct element meth-od (DEM) to analyze behavior of prototypical blanket pebble bed. A thermal contact model based on SZB model was developed to analyze heat transfer in pebble bed. Besides, a numerical analysis program for uniaxial compression test was performed to estimate the macro-meso mechanical behaviors of pebble beds. The suitability and validity of the current numerical model were evaluated by comparing with the previous experimental or numerical data. According to the current calculations, the results of both effective thermal conductivity estimation and pebble bed loading/unloading analysis agree well with the previous experiments.
Finally, the model was extended to the pebble bed analysis of WCCB. A series of numerical simulation work, including steady-state thermal analysis, uniaxial compression test were con-ducted to obtain basic pebble bed characteristic parameters, such as effective thermal conductivi-ty and strain-stress relation. This study will be dedicated to present the heat transfer features, macro-meso mechanical behaviors and the thermo-mechanical coupling characteristics of the blanket pebble beds, especially the Li2TiO3/Be12Ti mixed pebble bed for WCCB.

Eligible for student paper award?

Yes

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