Contribution ID: **23023** Type: **Paper**

Experimental PIV Measurements in a Randomly Packed Isothermal Pebble Bed Core Prototype

Wednesday, 15 November 2023 09:20 (20 minutes)

Pebble Bed Reactors (PBR) are a Generation-IV reactor design which are a subject of extensive research – due to their increased mixing and turbulence characteristics. Packed beds have sophisticated yet randomized geometry with vacant spaces, increasing the flow complexity in PBR cores. This experimental research on a facility of randomly packed pebble bed spheres investigates the complex flow phenomena to simulate fluid dynamics within a PBR core. By utilizing Particle Image Velocimetry (PIV) on the near-wall boundary and among the spheres, high-fidelity velocity measurements were carried out. In this facility, Matched Index of Refraction (MIR) provides a clear view of the packed spheres to analyze the flow at microscopic scales with precise resolution. The flow was investigated for various Reynolds numbers (⌧⌧) by utilizing PIV measurements. In order to provide a comprehensive profile of the flow and geometry that was studied, a three-dimensional reconstruction of the flow was carried out. This serves the primary purpose of providing the geometry for validation of simulation as well as the secondary purpose of illustrating the geometry of the packed bed. The experiments investigated isothermal conditions to examine the differences in flow dynamic patterns within packed spheres. The results characterize first- and second-order flow statistics including instantaneous velocity magnitude, mean velocity, velocity fluctuations, and Reynolds stresses. Moreover, the effect of different Reynolds number and heat flux boundaries and spheres were investigated. Increasing ⌧⌧ and heat flux were observed to affect the fluid dynamics within the pebble bed geometry, highlighting an increase in turbulence and flow mixing between spheres and within the gaps. This experimental campaign provides unique high-fidelity data sets for computational fluid dynamics model development and validation.

Speaker Bio

Primary authors: ALMATHAMI, Abdulaziz (Texas A&M University); MAHER, Blake R.; Prof. HASSAN, Yassin A. (Texas A&M University)

Presenter: ALMATHAMI, Abdulaziz (Texas A&M University)

Session Classification: Day 3- Parallel Session - I : Thermal-Hydraulics

Track Classification: Nuclear Thermal-hydraulics