PURDUE FLUIDS SEMINAR SERIES

UNIQUE ASPECTS OF GASEOUS COOLANT FLOW AND HEAT TRANSFER IN HIGH TEMPERATURE GAS REACTORS

FRIDAY NOVEMBER 7, 2025
SEMINAR 2:00PM-3:00PM WALC 1121
DISCUSSION 3:00PM-3:30PM WALC 1121

MASAHIRO KAWAJI

Professor of Mechanical Engineering
City University of New York--City College

Abstract

Gas flows through heated channels exhibit different flow and heat transfer characteristics from liquid flows. As the gas temperature increases, viscosity and thermal conductivity increase, resulting in decreasing Reynolds and Nusselt numbers. These characteristics present some challenges in the design of High Temperature Gas Reactors (HTGRs) which utilize helium as a gaseous coolant at a high pressure (~70 bar) and high temperature (800 ~ 1000 oC). In strongly heated gas flows, degradation of turbulent heat transfer can occur due not only to the reduction in the Reynolds number but also due to flow acceleration near the heated wall and buoyancy force resulting in suppression of turbulence generation. Experimental verification of turbulence suppression using a Hot Wire Anemometer (HWA) will be shown as well as degraded turbulent heat transfer in strongly heated helium and nitrogen flows in a vertical flow channel under high pressure and high temperature conditions. In addition, recent results from natural circulation experiments in a multi-channel flow loop simulating an HTGR will be presented, including the measurement of low gas velocities in vertical tubes using the Thermal Time-of-Flight technique.

Biography

Masahiro Kawaji is Michael Pope Chair and Professor of Mechanical Engineering at the City College of the City University of New York. After receiving a PhD degree from the University of California, Berkeley in 1984, he taught at the University of Toronto from 1986 until 2008, and then moved to the City College of New York in 2009. He has investigated a wide range of thermofluids-related topics including multiphase flow and heat transfer, phase change heat transfer, thermal energy storage, nuclear reactor thermal-hydraulics, microfluidics, and microgravity fluid physics. He is a Fellow of ASME and Canadian Academy of Engineering. From 2017 until 2023, he served as a PI and Director of the NSF-sponsored Partnerships for International Research and Education (PIRE) project on complex fluids.

PURDUE UNIVERSITY | College of Engineering