NUCLEAR ENERGY UNIVERSITY PROGRAMS

Liquid Salt Heat Exchanger Technology for VHTR Based Applications

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Abstract

The objective of this research is to evaluate performance of liquid salt fluids for use as a heat carrier for transferring high-temperature process heat from the very high-temperature reactor (VHTR) to chemical process plants. Currently, helium is being considered as the heat transfer fluid; however, the tube size requirements and the power associated with pumping helium may not be economical. Recent work on liquid salts has shown tremendous potential to transport high-temperature heat efficiently at low pressures over long distances. This project has two broad objectives:

- To investigate the compatibility of Incoloy 617 and coated and uncoated SiC ceramic composite with $MgCl_2$-KCl molten salt to determine component lifetimes and aid in the design of heat exchangers and piping.
- To conduct the necessary research on the development of metallic and ceramic heat exchangers, which are needed for both the helium-to-salt side and salt-to-process side, with the goal of making these heat exchangers technologically viable.

The research will consist of three separate tasks. The first task deals with material compatibility issues with liquid salt and the development of techniques for on-line measurement of corrosion products, which can be used to measure material loss in heat exchangers. Researchers will examine static corrosion of candidate materials in specific high-temperature heat transfer salt systems and develop an *in situ* electrochemical probe to measure metallic species' concentrations dissolved in the liquid salt. The second task deals with the design of both the intermediate and process side heat exchanger systems. Researchers will optimize heat exchanger design and study issues related to corrosion, fabrication, and thermal stresses using commercial and in-house codes. The third task will focus on testing with flowing liquid salts using a flow loop. The project team will study plugging issues associated with flow of liquid salts though small channels and will investigate heat transfer, pressure drop, corrosion, and erosion of materials in the flowing system. They will construct a scaled model of a helium-to-liquid salt heat exchanger and test it in the flowing liquid salt system.