405d Evaluation of Candidate Salts for Use as High Temperature Heat Transfer Agents

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Molten fluorides were initially developed for use in nuclear systems as a high temperature fluid-fuel ("molten-salt reactors"). Now they are being considered for various high temperature coolant applications. The Office of Nuclear Energy, in the framework of the Nuclear Hydrogen Initiative (NHI), is evaluating molten salts as the secondary coolant that carries heat from a nuclear plant to a hydrogen plant. The Office of Nuclear Energy is also investigating the use of molten fluorides as a primary coolant (rather than helium) in an Advanced High Temperature Reactor (AHTR) design. For both of these coolant applications there is a need for a new look at the criteria and methods we use to evaluate candidate salts for the particular application. The criteria developed for fluid-fuels in the past are not directly applicable. The Office of Nuclear Energy is supporting a study to assist coolant selection for the AHTR and for the NHI. The purpose of this effort is to provide a critical review of relevant properties for use in evaluation and ranking of candidate coolants for the Advanced High Temperature Reactor and the NHI. Because the AHTR and NHI heat transfer loop will see higher temperature service than in past development, because the AHTR primary coolant is a new application, and because new salt compositions are under consideration - a fresh examination of coolant properties is underway. This paper presents some preliminary results from the evaluation effort. Physical properties that are relevant to both the AHTR and NHI applications are reviewed and metrics for evaluation are recommended. The properties most relevant to coolant service are thermochemical properties (melting point, vapor pressure, density, heat capacity) and transport properties (viscosity, thermal conductivity). Because there are many molten salt choices, the effect of various compositional parameters on properties will be reviewed. Salts are also ranked on the basis of estimated cost and toxicity.