THE EFFECT OF IMPURITIES ON FUEL SALT PROPERTIES

M A. ROSE
Argonne National Laboratory
Lemont, United States of America
Email: marose@anl.gov

Abstract

Used salt fuels contain corrosion products, contaminants due to oxygen and moisture ingression, fission products, reusable actinides, and stable radioisotopes such as ^{37}Cl and ^{7}Li. Some molten salt reactor developers are proposing limited conditioning of used salt fuels to prolong the life of their fuels, to include removal of oxides, and recovery of noble gases, noble metals, and rare earth elements. Other developers are considering fully recycling molten salt fuels to include actinide recovery, rare earth element extraction, recycling of the ^{37}Cl or ^{7}Li, and repurification and reuse of the base salt. Before a recovery and reuse strategy can be planned it is necessary to determine the impact of build up of fission products, corrosion products and oxygen and moisture on fuel salt properties and how these changes to the fuel salt properties influence fuel salt performance. Current work on determining the impact of fission products, corrosion products and oxygen on fuel salt properties will be presented.

Recent work will be presented where the properties of two FLiNaK salts were doped with simulated low-burnup and high-burnup concentrations of fission products, respectively, were measured. Properties measured included thermal transitions, heat capacity, density, viscosity and thermal diffusivity. The measured properties were compared to measurements of FLiNaK salt without dopants to determine if the effect of the fission product dopants exceeded the uncertainty in the measured properties.

Additional measurements where corrosion products CrF_3 and NiF_2 were added to FLiNaK salts will be presented to examine the impact of corrosion products on measured properties. Properties measured for these salts include thermal transitions and heat capacity. These measurements, like the fission product doped salt measurements, are compared to measurements of FLiNaK without dopants to determine if the corrosion products impact the properties of the salt beyond the uncertainty in the measurements.

The effect of oxide content was investigated by doping FLiNaK salt with ~12 wt% UF_4 from two sources. The first source was as-received from an outside vendor, and contains significant UO_2 contamination. The second source is the same material from the outside vendor after purification using ammonium bifluoride, which reduced the UO_2 contamination level. The thermal transitions and heat capacity of these salts were measured and compared to each other to determine the effect of increased oxide content on these properties.

These measurements of the effect of dopants on salt properties provide data which can be used to evaluate which impurities it is necessary to remove during the course of MSR operations to maintain the fuel within performance parameters.