The Design and Investigation of Novel Mechanical Filters for Molten Salt Reactors

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ABSTRACT:

Mechanical filters can contribute to molten salt reactors in two significant ways. Fission product fragments and other impurities generated in molten salt reactors (MSRs) carry a risk of precipitating out-of-solution and fouling pumps, heat exchangers, and other critical components that have large surface area to volume ratios. Expected insoluble fission fragments are noble metals and primarily consist of Mo, Ru, Ag, Sb, Te, and Nb [1]. A mechanical filtering system may contribute to safety by ensuring that no large contaminants such as broken moderator pieces cause coolant pump or other system failures, and serve as a way to monitor particulate generation in the reactor system [2]. Mechanical separation and removal of the various precipitates from fuel salt prolongs the lifetime of reactor components, and may also enable timely access to medical isotopes of interest to the medical community for radiation therapies. This proposal addresses the need for a novel mechanical filtration system, filter media performance data, filter regeneration performance data, as well as the need for a filter design that facilitates remote filter removal, cooling, replacement, and assay of fissile material hold-up in the filter media.

The project will design a set of tests that will generate filtration data for sintered nickel-based (fiber and porous) molten salt filters. The data will include filtration efficiency, pressure drop, and contaminant penetration of the filter media as a function of molten salt velocity, media pore size, and contaminant size and type. The filter lifetime and regenerative properties of the filters of different pore sizes will also be studied. Data will be disseminated to the molten salt community and used to design and prototype a novel molten salt filter. The prototype will address the need for filter designs to be not only effective in removing fission fragments, corrosion products, and/or debris from molten salt, but also remotely replaceable, shielded, cooled, and surveyed for fissile materials.

[1] R.J. Kedl, *The Migration of a Class of Fission Products (Noble Metals) in the Molten-Salt Reactor Experiment*, ORNL TM- 3884 (1972).

[2] David E. Holcomb, Roger A. Kisner, Sacit M. Cetiner, *Instrumentation Framework for Molten Salt Reactors.* ORNL TM-2018/868 (June 2018).