Separated waste stream immobilization of iodine and offgas caustic scrubber solution

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Collaborators:

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ABSTRACT:

This proposal aims to develop an innovative pathway for the disposition of caustic scrubber solution containing iodine and other anions, to ensure the safe immobilization of radioactive volatiles released during the aqueous reprocessing of used nuclear fuel. The project will be performed by a partnership of the US universities and the US and Australian national laboratories.

The US DOE plans to use a caustic scrubber (CS) followed by a silver-based solid sorbent polishing bed to capture iodine from the off-gas of a potential nuclear fuel reprocessing facility in the US. The process will result in the formation of an AgI-loaded sorbent along with a leftover CS solution rich in Na^{+}, OH^{-}, $^{14}CO_3^{2-}$, and other non-fission-product halogens, thus creating two separate waste streams that will need to be immobilized. This 2-year proposal, a collaboration between two US universities, WSU and Rutgers, and supported by Pacific Northwest National Laboratory (PNNL) and Australian Nuclear Science and Technology Organization (ANSTO), aims to produce a set of waste forms for the immobilization of these waste streams. The CS liquid will be immobilized in a glass-bonded composite of cancrinite/sodalite powders containing the waste. The synthesis of ceramic waste forms will be accomplished by low-temperature (~90°C) processes developed by the team in the framework of a previous NEUP project. In the case of AgI-based sorbents, iodine from AgI will be stripped off by converting it to NaI(aq) followed by immobilization of the latter into a durable glass-bonded iodosodalite based waste form (AgI→NaI→iodosodalite→glass-bonded-iodosodalite). By building on our earlier efforts for iodine waste forms, we minimize the schedule and technical risk while still providing novel process demonstrations for the off-gas waste forms. The waste form samples will be provided to the US DOE national laboratory partner for testing beginning no later than 15 months into the project and will continue until the project conclusion.

Major outcomes of this effort include training of graduate students in waste form engineering, producing high-quality samples for testing, publications in peer-reviewed journals, and formal technical exchange between the US and Australian scientists and engineers. Nuclear waste management is a long-term problem involving a worldwide technical community, and these projects solidify international cooperation towards joint technical goals. The assembled group of researchers constitute over 100 years of combined experience designing and testing nuclear waste forms. The team already has a formal Memorandum of Understanding (MOU) in place between WSU/PNNL/ANSTO to allow this joint research. Principal investigator Prof. McCloy (WSU) has extensive experience with ceramic materials, nuclear waste forms, and managing complex technical projects. Prof. Goel (Rutgers) and Dr. Riley (PNNL) are experts in the synthesis and characterization of glass and ceramic waste forms. Dr. Asmussen (PNNL) has recent relevant experience testing chemical stability of iodine waste forms, and Dr. Chong (PNNL) performed his major Ph.D. work on sodalite waste forms for iodine. Additionally, Dr. Gregg (ANSTO) is an expert in hot isostatic press consolidation of various nuclear waste form ceramics including sodalite. DOE-NE (NEUP or MRWFD Campaign) will fund the US portion of the research, and ANSTO will fund the Australian portion.