Novel Processes for Capture of Radioactive Iodine Species from Vessel Off-Gas Streams

PI: Vivek Utgikar, University of Idaho

Program: FC-1.3a: Off Gas Capture: Iodine Capture from Vessel Off Gas Streams

Collaborators: Krishnan Raja – University of Idaho

Piyush Sabharwall – Idaho National Laboratory

ABSTRACT:

Development of advanced fuel cycles is essential for the sustainability and growth of the nuclear power. The advanced fuel cycle, in turn, requires the development of innovative techniques for the separation and reuse of the useful components of the used nuclear fuel (UNF), as well capture and isolation of harmful radioactive contaminants for the protection of environment and human health. Proposed research addresses a key need in development of treatment processes for the off-gas resulting from UNF recycling operations, targeting the capture of organic radioiodine components that predominate in the vessel off-gas (VOG) streams.

The goal of the proposed research is to develop a comprehensive understanding of the sorption system performance and effectiveness for capture of radioiodine species present in the off-gas streams from the used nuclear fuel (UNF) recycling operations, focusing particularly on the organic iodine species.

The specific objectives defined for the research are:

1. To obtain experimental data on the capture of radioiodine species by target sorbent (silver mordenite) as a function of parameters including gas composition and temperature,
2. To examine the effectiveness of novel modification of the sorption system involving incorporation of a pretreatment stage upstream of the sorption apparatus, and
3. To develop comprehensive process models that explain the mechanism of capture and quantify the kinetics of sorption.

These objectives will be accomplished through the execution of three research tasks: the first task involves conducting dynamic sorption studies in a continuous column apparatus to obtain performance characteristics of the sorbents as a function of system parameters. The second task involves conducting detailed experimentation pretreatment stages that can significantly enhance the capture of target compounds, followed by obtaining performance characteristics of the integrated system. The third task will involve developing mathematical models for quantitative description of the capture process.

Studies conducted to accomplish the objectives outlined above will yield data on the sorption characteristics of the contaminants on silver-mordenite, the preferred sorbent for iodine capture, as a function of parameters such as temperature, presence of other species, and sorbent aging. Experimental data will also be obtained the sorption system performance modified to incorporate novel techniques to enhance the capture. Theoretical modeling of the processes will offer fundamental insight into the mechanisms, quantify the kinetics and allow us to design and predict the performances of the system. Research proposed herein thus supports the DOE goal of developing innovative techniques to support advanced fuel cycles for sustainability and growth of nuclear power.