Contract No:

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Plant Directed R&D PDRD

Zeolite Material Development for In-situ Regeneration/Exchange (SR19009)

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Objectives:

Develop new zeolite material, bed design, and optimize operating conditions that will reduce potential tritium hold-up

Summary

Zeolites can be used to selectively remove water and impurities from gas streams. In a tritium-rich environment absorbed tritium represents product loss and the beta decay of captured tritiated gases can alter the temperature profile of bed. This requires periodic regeneration which may only have limited success.

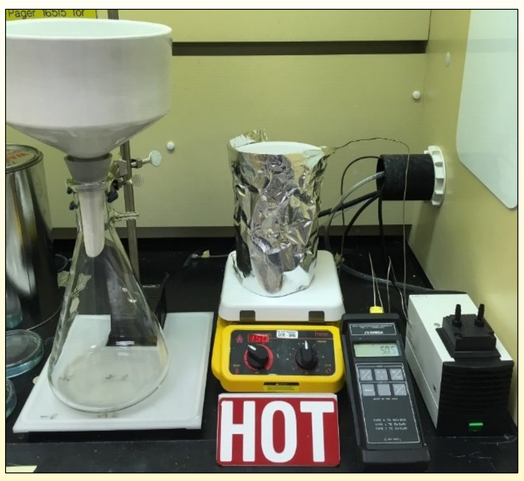
In the proposed alternative method, isotopic exchange between flowing H_2 with adsorbed impurities (i.e., ammonia and D_2O as surrogates) is catalyzed by elevated temperatures and/or trace amounts of an active catalyst component (e.g., Pt) that is loaded onto the zeolite. Performance will be evaluated for isotope exchange efficiency, impurity adsorption, and precious metal loadings. If developed successfully, tritium hold-up in future zeolite beds can be removed by CIE with H_2, into the HT/H_2 stream.

Background:

❖ **Material Preparation**

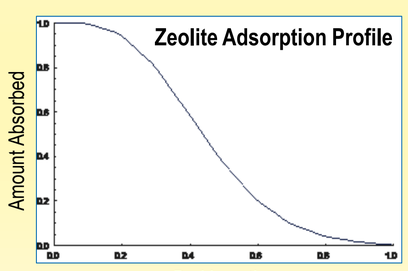
Several zeolites selected to act as substrate for catalytic precious metal loadings of varying weight percent.

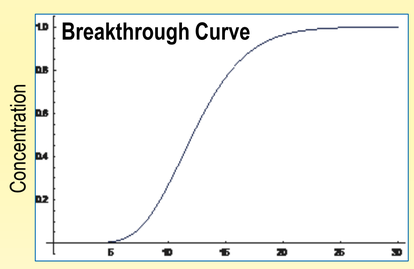
Two methods of preparation being employed:
- incipient wetness impregnation
- ion exchange.



❖ **Predictive Modeling**

Using experimentally obtained data with specific variables (e.g., bed length, impurity concentration, flow rates, etc.) with equilibrium constants (i.e., Langmuir[1]), optimal operating conditions may be determined computationally, potentially saving time, money, and other resources.



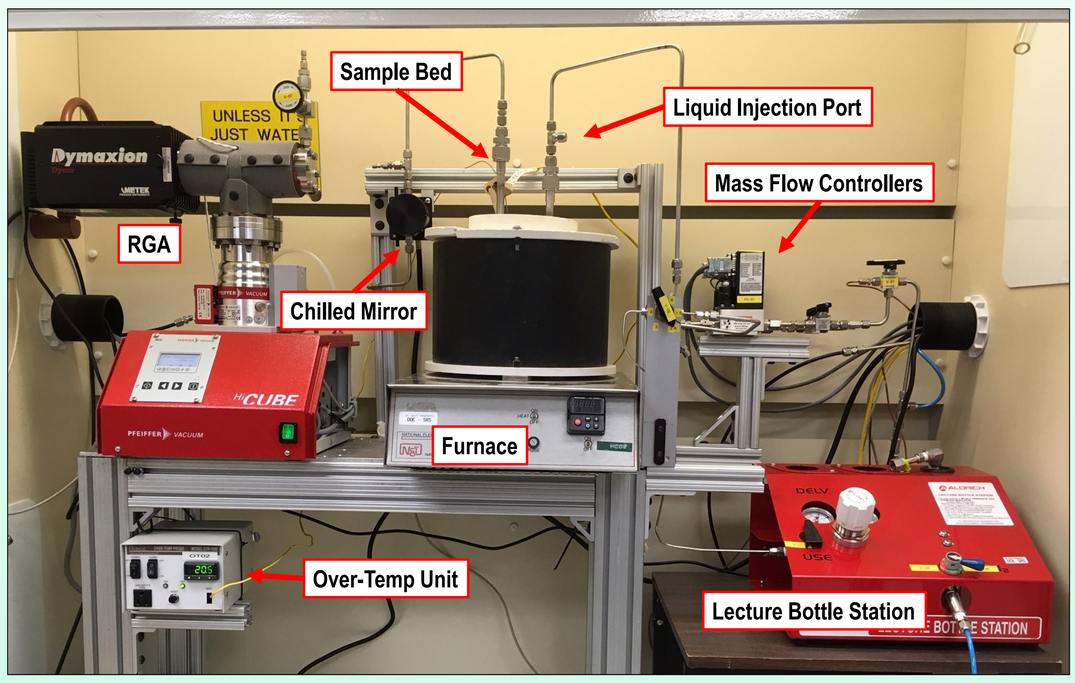


FY19 Accomplishments:

❖ **Manifold Design and Set up**

The test manifold has been designed to allow for repeatable and reliable separation material evaluation with reduced risk.

- Furnace for temperature effects on isotope exchange efficiency and bakeout
- Capable of liquid or gaseous impurity introduction to the zeolites.
- A hygrometer and residual gas analyzer (RGA) monitor dosing progress.
- Isotopic exchange is monitored via RGA analysis of the effluent vapor.



❖ **Ion Exchanged Materials**

Materials will be screened and evaluated for precious metal dispersions, surface area, isotopic exchange performance, and capacity.

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References: Helminen, J.; Helenius, J.; Paatero, E., *J. Chem. Eng. Data*, **2001**, *46*, 391-399.