Contract No:

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Plant Directed R&D PDRD

Future Recovered Gas Dryer Development (SR19009)

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Objectives:

Develop a method to remove strongly adsorbed tritium from 5A zeolite that require only slight modification in the future RGD process.

Summary:

Recovered Gas Dryers (RDGs) remove tritiated moisture and ammonia from the recovered gas stream. As such, the RGD bed remained at elevated temperatures due to tritium decay heat. It is highly desired to remove or reduce the amount of tritium in the bed. Due to RGD limitations, a catalytic isotope exchange process with protium (H_2) is proposed for next generation RGD. This concept builds on our recent and successfully developed water detritiation process and extends it to ammonia detritiation.

Background:

Temperature-Programed-Desorption (TPD) analysis of 5A zeolites

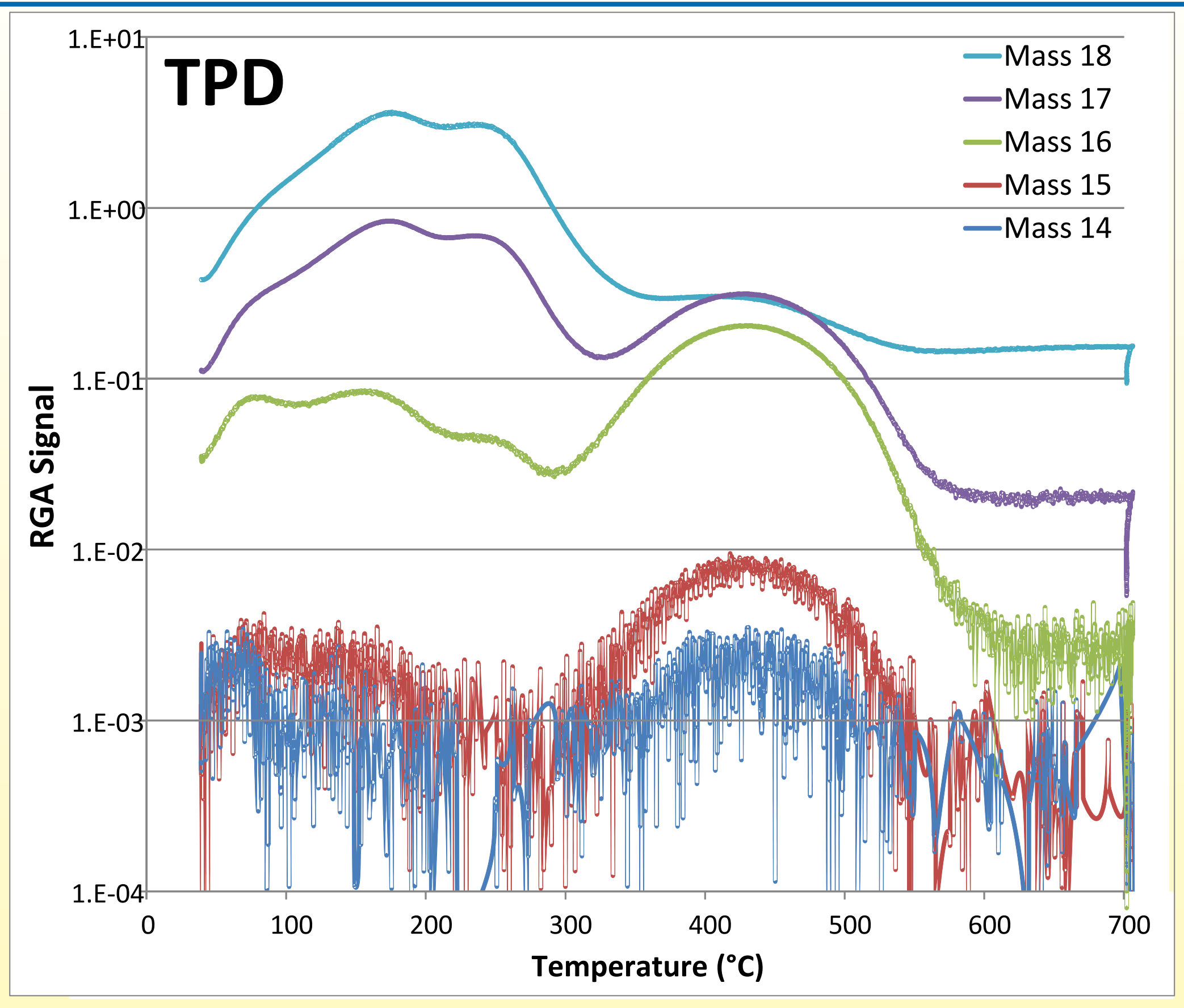
- Moisture desorbs by 350 °C
- Ammonia desorbs by 600 °C
- High temperature bake-outs is not an option due to RGD limitation

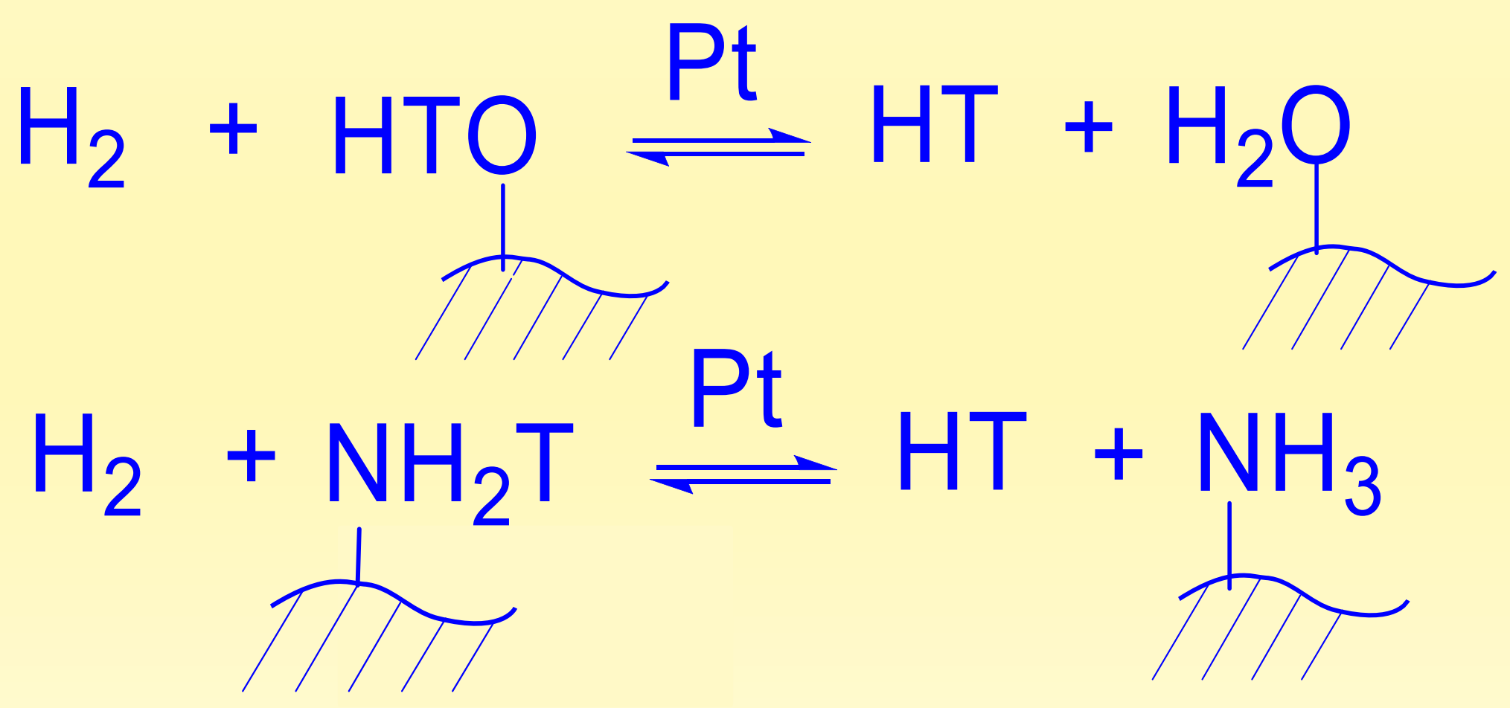
Moisture-Ammonia Isotope Exchange

- Does not require high temperature bake-outs
- SRTE RGD location does not have a moisture source to perform task

Catalytic Isotopic Exchange with H_2

- H_2 exchanges with adsorbed water and ammonia, catalyzed by Pt





$$H_2 + HTO \xrightleftharpoons{Pt} HT + H_2O$$

$$H_2 + NH_2T \xrightleftharpoons{Pt} HT + NH_3$$

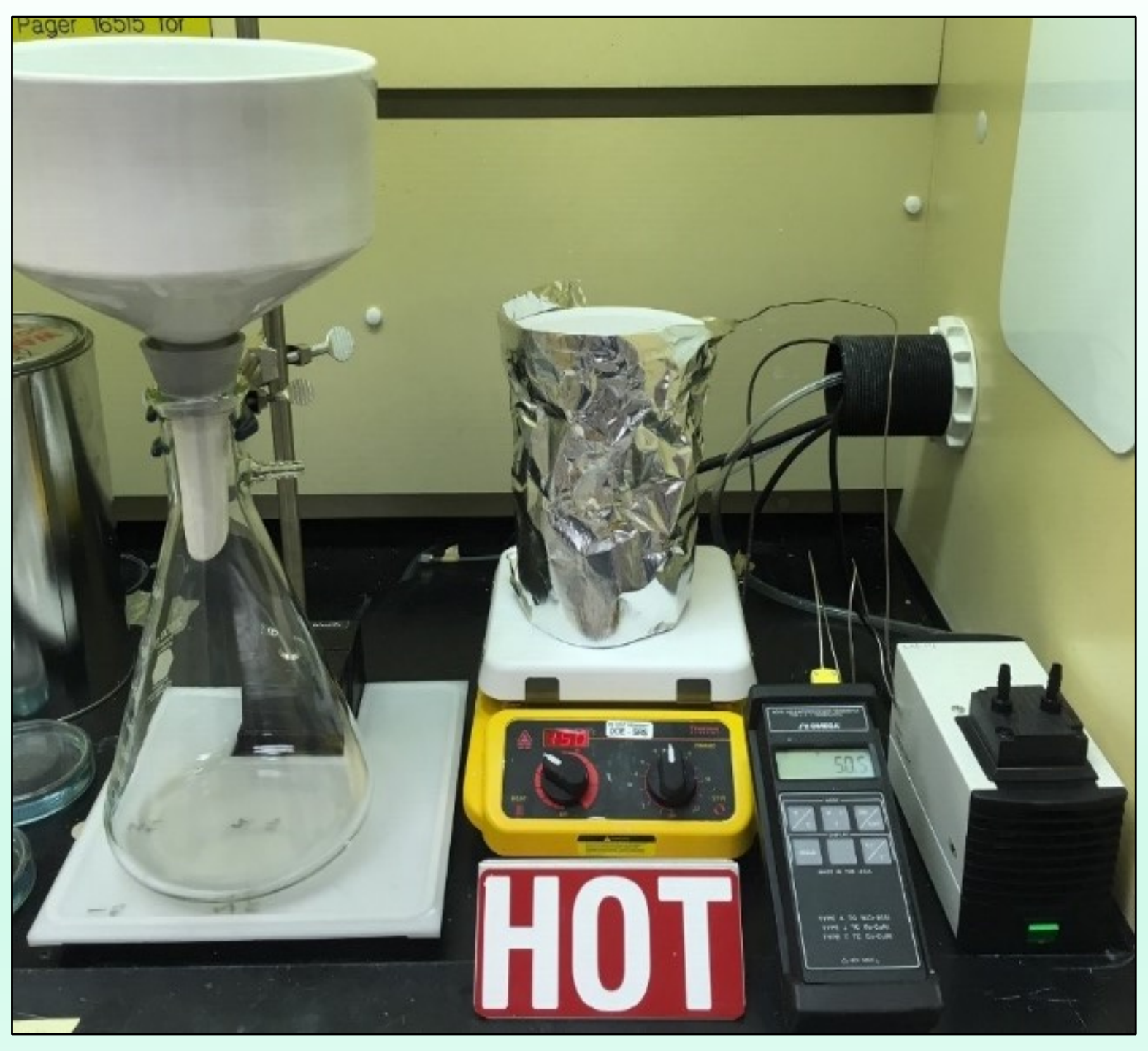
FY19 Accomplishments:

Material Development

Material synthesis and screening for future RGD material with catalytic isotope exchange functionality.

Synthesis variables investigated:

- Incipient wetness impregnation
- Ion exchange
- Catalyst loading
- Type of catalyst support



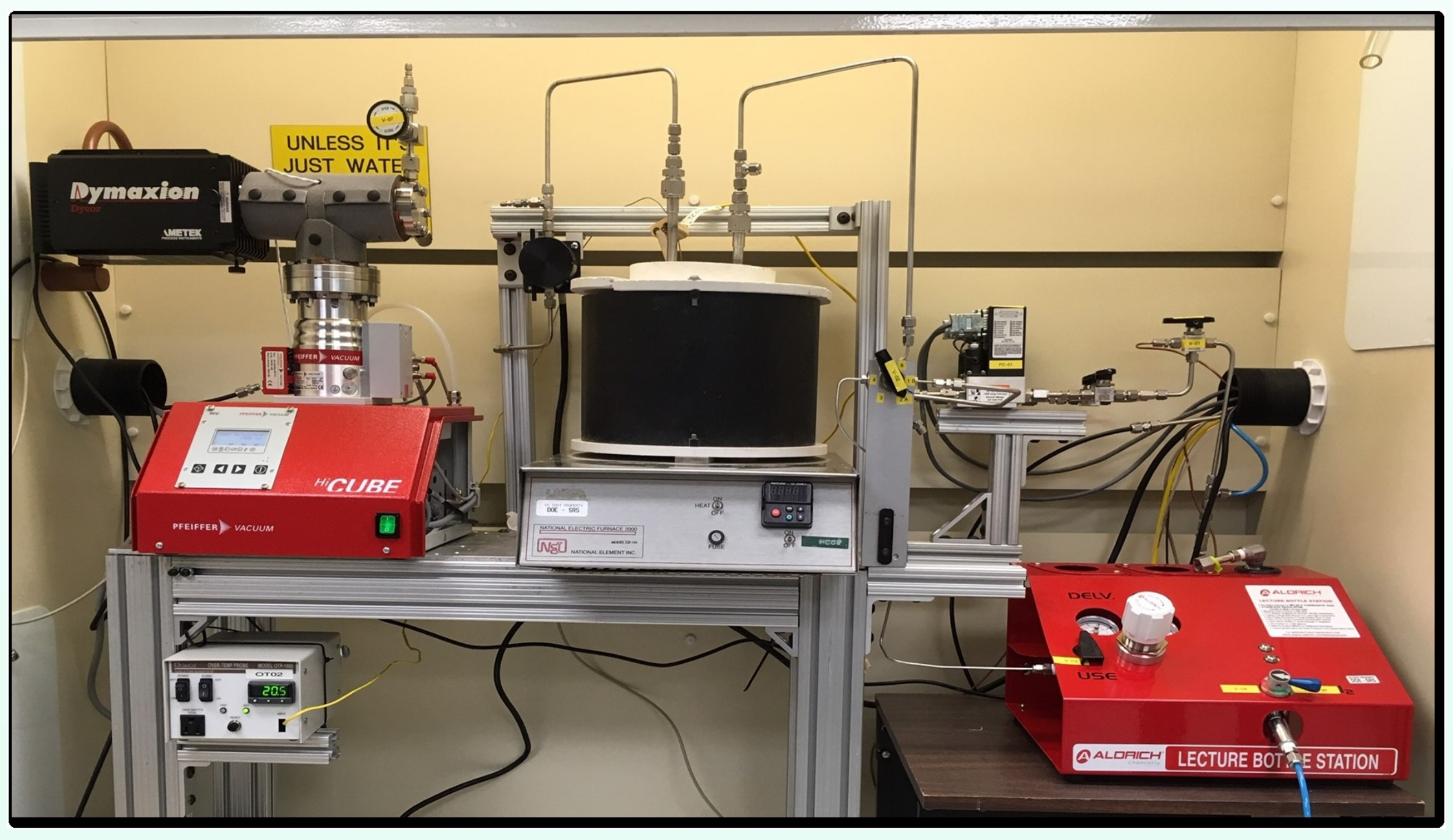
FY19 Accomplishments (continued):

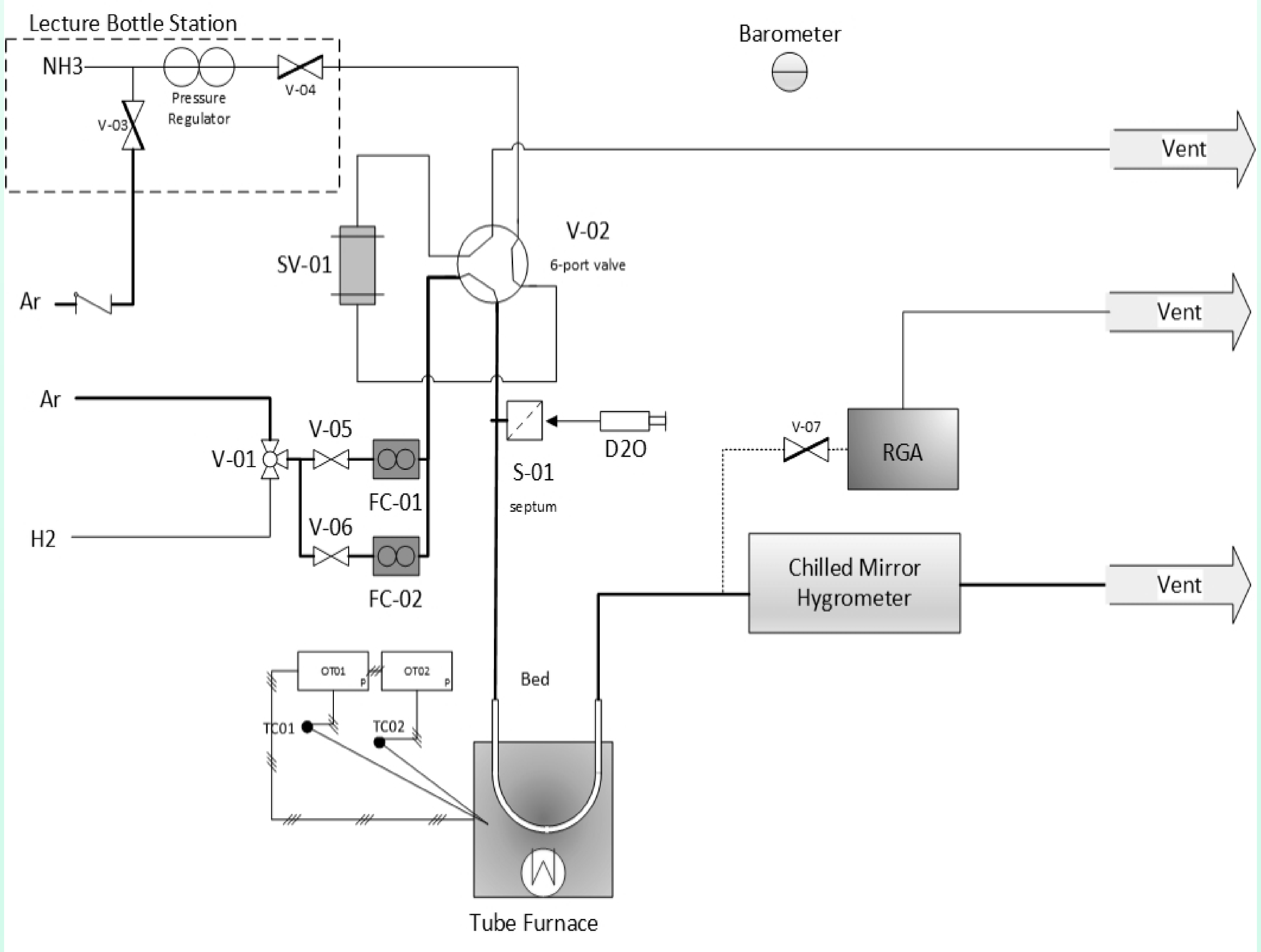
Separation Materials

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

Manifold Design and Set up

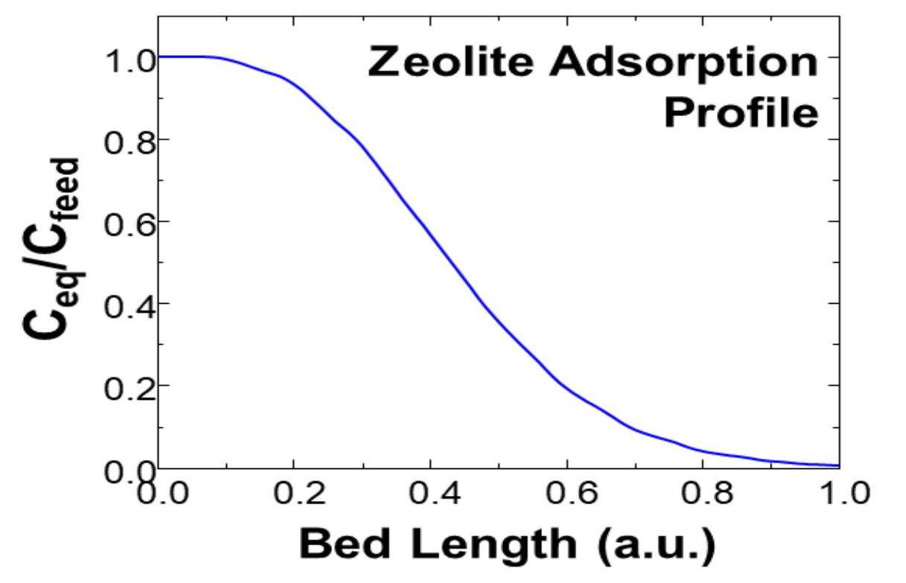
Designed and assembled test manifold for catalytic isotope exchange performance evaluation.

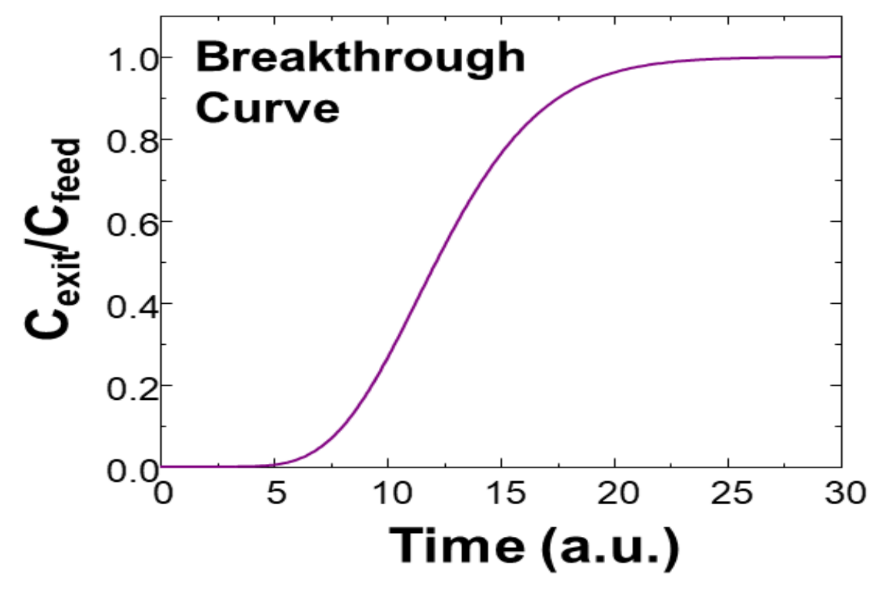




Predictive Modeling

Expected outcome by Langmuir model.





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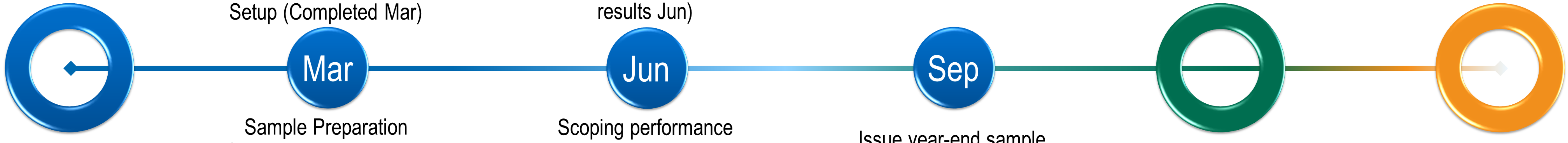

FY19 (year 1)

Manifold Design and Setup (Completed Mar)

Sample Preparation (objective accomplished Mar though work ongoing as discoveries are made)

Performance evaluation of H_2O and NH_3 absorption (anticipated preliminary results Jun)

Scoping performance evaluation of catalytic isotope exchange (anticipated preliminary results Jun)

Future bed design (Anticipated execution Jun)

Issue year-end sample report (anticipated draft by Aug issued Sep)

FY20 (Year 2) Proposed Activities

Predictive modeling tools expanded

Additional catalyst impregnation

FY21 (Year 3) Proposed Activities

Finalize conceptual designs and material specifications

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