Characterization of Wet Aerosol Transportation for Online Chemistry Experiments

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Introduction:

Beam From Cyclotron

Target

MARS Physical Pre-Separator

RTT Window

Recoil Transfer Chamber (RTC)

Variable Angle Degrader

Chemistry Experiment
The efficiency of aerosol transportation depends on a number of factors, including:

- Chemical properties of the radionuclide.
- Gas flow rate inside the chamber.
- Size of the aerosol particles.
- Half-life of the radionuclide.

Using a $^{228}\text{Th}$ source will make a simple, affordable, and easy-to-manipulate system, and eliminates the need to use accelerator time for these experiments.
Project Brief Summary:

• Why use wet aerosol instead of dry?

• Why a $^{228}$Th radioactive source?
Experimental Setup:

Inlet gas pressure: ~15 PSI
Flow rate: 4.5-4.7LPM

Legend:
- Empty line (air flow)
- Helium Gas
- KCl Solution
- KCl Aerosol + He
- KCl Aerosol + He + Radionuclide
- Clean Air

“Simulated AC Chamber” Setup For Characterization Experiments
Results and Data Analysis:

Mass collected by sorbent in a 2 min interval:
Results and Data Analysis:

Drierites on HPGe:

Energy, keV

Count per second

2 min collection

10 min collection

30 min collection

Background

220Rn 224Ra 216Po 212Pb 212Bi 212Po 208Tl

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220Rn 224Ra 216Po 212Pb 212Bi 212Po 208Tl
Results and Data Analysis:

Charcoal on NaI Detector:

2 min collection

Energy, keV

Count per second

Background

Energy, keV
Conclusions:

✓ A system for testing “wet” KCl aerosols without the RTC has been developed.

✓ KCl generator has been checked with a “simulated AC chamber”.

✓ Four different sorbent materials have been studied for aerosol particle collection.

✓ Intensity of the $^{228}$Th source was too low.

✓ Additional work is needed to optimize the use of wet aerosols before they can be used in online experiments.
Future Work:

• Use a radioactive source with greater activity and more suitable decay properties for future characterizations.

• Incorporate an aerosol dryer to allow the aerosols to be used with the actual RTC.

• Add a generator reservoir bottle in order to maintain constant concentration of the KCl solution.

• Add an aerosol particle neutralizer to prevent aerosols from being influenced by stray electric fields in the RTC.
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