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Project Title

Rapid Discrimination of Anthropogenic and NORM Alpha Emitters on Air Filters

Project Objective

Development of a rapid, conservative and defensible transuranic alpha activity estimate for air filters.

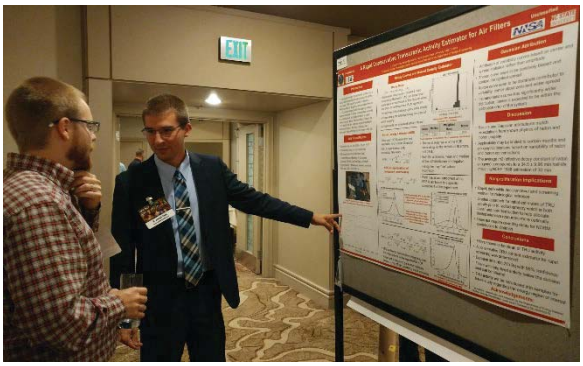
Project Description

Radon (^{222}Rn) and thoron (^{220}Rn) progeny (primarily bismuth and polonium) are known interferents when rapid evaluation of transuranic content on air filters is of interest. These complexities stem from the overlapping energies of the progeny alpha particles onto the transuranic region of interest (3-5.5 MeV) where naturally occurring alpha emitters can overwhelm the spectra. Due to the immediacy of the alpha counting methods employed, coupled with the half-life of thoron progeny dominated by ^{212}Pb ($t_{1/2}$=10.6 h), a conservative transuranic activity estimate with rigorous uncertainty is sought. The transuranic activity estimate will incorporate any thoron progeny present on the filter providing 95% confidence decision levels in which a filter may be evaluated for emergency response applications. 46 samples of various duration having no transuranic content were taken over a two month period. The resulting filters were counted in a time series before non-linear least squares decay curve fitting was applied to the decay profile. For the samples considered, a transuranic activity estimator decision level was determined at 0.2 Bq for the given geographic location and months analyzed.

Project Relevance to Nuclear Nonproliferation

Investigating the uncertainty for air filter activity estimates, even if large, allow for defensible emergency response decisions when the uncertainty is rigorous. The techniques employed act as a rapid non-destructive assay screening technique to reduce the burden of throughput placed on limited radiochemistry resources such that samples are prioritized for analysis prior to arrival at the laboratory.

Products and Outcomes of Project



A rapid, conservative and defensible transuranic activity estimate for emergency response applications was developed. This "go/no go" activity decision level for clearing air filters was established at 0.2 Bq for the samples considered. Attribution of the variability in the transuranic activity estimate included contributions from the instrument uncertainty along with the radon progeny and thoron progeny activities.

Publications and Reports

Cope S.J., Hayes R.B. (2017) Preliminary work toward rapid discrimination of anthropogenic from NORM in air samples. *Health Phys.* (accepted pending revision)

Cope, S.J., Cambareri, J.J., Sorrell, N.C., and Doster, J.M., "Nuclear and Thermal Hydraulic Design for a Low-Enriched Nuclear Thermal Rocket," in proceedings of *Nuclear and Emerging Technologies for Space (2017)*, NETS Conference Proceedings, Orlando, pp. 9-18, (2017).

Presentations

Cope, S.J., Hayes, R.B. "Preliminary Work toward Discrimination of Anthropogenic and NORM in Air Samples", *62nd Annual Health Physics Society Meeting*. Raleigh, NC, July 9-13, 2017.
Cope, S.J., Hayes, R.B. "Preliminary Discussions on Air Filter Discrimination of Anthropogenic and NORM", *North Carolina Health Physics Society 2017 Spring Meeting*. Carolina Beach, NC, March 2-3, 2017.
Cope, S.J. "Characterization Techniques for Emergency Response Monitoring", *28th Annual Air Monitoring Users Group (AMUG) Meeting*. Las Vegas, NV, October 11-12, 2016.
Cope, S.J. "ORNL Airborne Debris Collection Planning Tool (APTool)", *28th Annual Air Monitoring Users Group (AMUG) Meeting.* Las Vegas, NV, October 11-12, 2016.