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Improved Pressurized Marinelli Beaker Measurements of Radioactive Xenon in Air

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Content

The international monitoring system (IMS) of the Comprehensive Test-Ban Treaty Organization (CTBTO) is in the process of implementing radioactive xenon monitoring at 40 locations across the globe. The goal is to be able to capture and measure radioactive xenon, which indicative of a detonation being from nuclear fission. The present systems capture air and separate the xenon from the bulk air prior to analysis. INL has shown that the Marinelli beaker geometry can be used for the measurement of radioactive xenon in unprocessed air. This was achieved through the construction of an aluminum Marinelli beaker geometry container for gamma ray analysis using high purity germanium crystal detectors. The Marinelli beaker geometry was evaluated for analysis of air that has been spiked with radioactive xenon. Limitations of the technique were the maximum pressure of 1000 psi and the attenuation of the aluminum container surface between the sample and the crystal. More pressure in the container would put more of the sample close to the detector. A material of construction that is less attenuating of the radioactive xenon gamma emissions would result in a higher efficiency for the geometry. A new Marinelli was designed and constructed from carbon fiber to address both the higher allowed pressure and less attenuating material of construction limitations. The newly constructed Marinelli can achieve higher pressures of 4000 psi and is built with a lower Z material of carbon between the sample and the detector. This has led to improvements in the reported efficiencies of the aluminum models. The experimental results of the carbon fiber Marinelli beaker are reported as the efficiency for four radioactive xenon isotopes; 131mxe, 133Xe, 133mxe and 135Xe. There is an improved performance for the carbon fiber Marinelli beaker geometry compared to the aluminum Marinelli beaker. The results are also compared to modelled expectations for the performance of the carbon fiber Marinelli beaker.

About the Presenter

Dr. Troy Robinson received his bachelor's degree in Chemical Engineering from Brigham Young University in 2005. He received his doctorate degree in Radiochemistry from University of Nevada, Las Vegas in 2011. Dr. Robinson focused on the speciation of select lanthanides in the presence of acidic ligands in both aqueous and organic phases. Dr. Robinson has been working at the Idaho National Laboratory since 2013 in the areas of radioactive noble gas isotope production, purification and quantification, and the production radioactive noble gas calibration standards for users in the international community.

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