A Study of Precision in Gross Alpha Measurement
Gross Alpha Analysis – Factors Influencing Precision and Accuracy

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Abstract

Results from previous U. S. Environmental Protection Agency performance evaluation samples for gross alpha in water show large variations in the accuracy and precision of the measurement and thus a need to identify and quantitate the sources of deviation. A single laboratory study was performed to determine the intralaboratory precision for gross alpha analysis using natural uranium as a sample source. A comparison between the error determined strictly from Poisson statistics (counting error) and that due to analytical variations is made. Factors that may influence the accuracy of the analyses such as efficiency calibration and type of detector used (windowless versus windowed) were also studied.

Seven analysts analyzed a total of 42 replicate samples (6 replicates/analyst) using a solution spiked with 50 pCi/L of natural uranium. The prepared samples were counted on both a thin-windowed proportional counter and a windowless proportional counter. Error due to variation in sample preparation technique is estimated to be 7.8 % compared to 3.3 % due to Poisson statistics for a total variability of 8.5 %. Analyst experience appears to play an important role in the precision of the analysis. Based on the foregoing study, a statistical computation for a 5 pCi/L activity sample revealed that Poisson statistics (10.4%) predominates over sample preparation error (7.8%) and the total variability was estimated to be 13.1 % under the same conditions.

Different efficiency calibration sources (Am-241, Th-230, natural uranium) introduce variations in the efficiency. For a sample planchet containing 50 mg of solids, variations in efficiency of up to 13.1 % on a windowless detector and 47.3 % on a windowed detector were determined. Additionally different curve fitting models introduced variations in efficiency of up to 12.1 %. Thus in addition to analyst experience, detector type, closeness of standard source used for efficiency calibration and the curve fitting model all make significant contributions to the precision and accuracy of the analysis.