

Radionuclide Analysis

What Does The Data Mean?



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Questions About The Analyses

- Why do results to vary between labs?
- What factors affect detection limits?
- What is counting uncertainty?
- How is counting uncertainty used?
- What do the uranium results mean?
- Why does the testing take so long?



Why Do Results Vary Between Laboratories?

- Random or systematic problems
- Sampling
- Analysis methods
- Personnel
- Counting instruments
- Counting parameters



What Factors Affect Sensitivity?

$$\text{LLD} = 4.66 \sqrt{\frac{\mathbf{Background}}{\text{Count Time}}}$$

$$2.22 \times \text{Efficiency} \times \text{Volume} \times \text{Decay} \times \text{Ingrowth} \times \text{Yield}$$

Increasing any factor other than background lowers sensitivity



What Is Counting Uncertainty?

The possible range of the “True” value within defined a confidence level.

$$CU = 1.96 \sqrt{\left(\frac{\mathbf{Sample\ Count}}{CountTime^2} + \frac{\mathbf{Background\ Count}}{BkgTime^2} \right)}$$

$$2.22 \times \textit{Efficiency} \times \textit{Volume} \times \textit{Decay} \times \textit{Ingrowth} \times \textit{Recovery}$$

Increasing any factor other than sample and background counts lowers the Counting Uncertainty.



How Is Counting Uncertainty Used?

- Which pair of analytical results are best?
- Gross alpha 6.2 ± 7.8
- Gross alpha 6.2 ± 8.2
- Gross alpha 4.2 ± 2.0
- Gross alpha 6.2 ± 2.0



What Do Uranium Results Mean?

- MCL is in $\mu\text{g/L}$ while alpha MCL is in pCi/L
- Uranium in water may not be in equilibrium
- Methods - Alpha count, ICPMS, Alpha Spec
- Conversion factors for uranium isotopes
- U-234 = $0.0016 \mu\text{g/pCi}$
- U-235 = $0.4626 \mu\text{g/pCi}$
- U-238 = $2.9741 \mu\text{g/pCi}$



Why does the testing take so long to complete?

- Testing is not automated.
- Methods involve ingrowth and separations.
- Testing is performed sequentially.
- Counting times are often long.
- Samples frequently require reruns.



Questions?