Calculation of results for Po-210 in sediment by alpha spectrometry

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Po-210 and Po-209 tracer alpha spectrum
Calculation of results

\[ A_{\text{Po-210}} = \frac{(R_{\text{Po-210}} - R_{b,\text{Po-210}})A_{\text{Po-209}}m_{\text{Po-209}}}{(R_{\text{Po-209}} - R_{b,\text{Po-209}})m_s} \]  \hspace{1cm} (1)

\[ R_X = \frac{N_X}{t_m} \]  \hspace{1cm} (2)

- \( A_{\text{Po-210}} \) → activity concentration of Po – 210 [Bq/L]
- \( R_{\text{Po-210}} \) → Po – 210 count rate [1/s]
- \( R_{b,\text{Po-210}} \) → Po – 210 background count rate [1/s]
- \( R_{\text{Po-209}} \) → Po – 209 count rate [1/s]
- \( R_{b,\text{Po-209}} \) → Po – 209 background count rate [1/s]
- \( A_{\text{Po-209}} \) → activity concentration of Po – 209 tracer [Bq/g]
- \( m_{\text{Po-209}} \) → mass of Po – 209 tracer added [g]
- \( m_s \) → sample mass [g]
- \( R_X \) → count rate of radionuclide X or background [1/s]
- \( N_X \) → number of counts of radionuclide X or background
- \( t_m \) → measurement time [s]
Calculation of measurement uncertainty

\[ u_{c,Po-210} = A_{Po-210} \]
\[ \sqrt{ \left( \frac{u_{R_{Po-210}-R_{b,Po-210}}}{R_{Po-210} - R_{b,Po-210}} \right)^2 + \left( \frac{u_{A_{Po-209}}}{A_{Po-209}} \right)^2 + \left( \frac{u_{m_{Po-209}}}{m_{Po-209}} \right)^2 + \left( \frac{u_{m_s}}{m_s} \right)^2 } \]

\[ u_{R_{Po-210}-R_{b,Po-210}} = \sqrt{u_{R_{Po-210}}^2 + u_{R_{b,Po-210}}^2} \]  

\[ u_{R_{Po-209}-R_{b,Po-209}} = \sqrt{u_{R_{Po-209}}^2 + u_{R_{b,Po-209}}^2} \]

\[ u_{R_X} = \frac{1}{\sqrt{N_X}} \]

- \( u_{c,Po-210} \rightarrow \) combined standard uncertainty for Po – 210[Bq/g]
- \( u_X \rightarrow \) standard uncertainty of X

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Reporting of the results

\[ U_{Po-210} = k \ u_{c, Po-210} \]  \hspace{1cm} (7)

- \( U_{Po-210} \) → expanded uncertainty for Po-210 activity concentration [Bq/g]
- \( k \) → coverage factor (\( k = 2 \) for 95% coverage)

\[ A_{Po-210} = A_{Po-210} \pm U_{Po-210} \]