PERFORMANCE OF ISOTOPE CORRELATIONS FOR THE ESTIMATE OF $^{242}\text{Pu}$

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The lack of a gamma-ray signature from $^{242}\text{Pu}$ represents an Achilles heel for many plutonium isotope abundance measurements made by high-resolution gamma spectrometry (HRGS). This holds in particular for plutonium materials containing a significant fraction of this isotope. The problem is partially solved through the application of isotope correlations estimating the relative abundance of $^{242}\text{Pu}$ from relations to ratios of other plutonium isotopes measurable by HRGS.

In the mid of the nineties a new type of isotope correlation had been proposed for LWR plutonium based on the following relation /1,2/:

$$\frac{^{242}\text{Pu}}{^{239}\text{Pu}} = C_0 \left[ \frac{^{238}\text{Pu}}{^{239}\text{Pu}} \right]^{C_1} \left[ \frac{^{240}\text{Pu}}{^{239}\text{Pu}} \right]^{C_2}$$

with recommended coefficients $C_0$, $C_1$ and $C_2$ for PWR and BWR fuels, respectively. We have adopted this type of correlation for the routine analysis of safeguards samples in the Euratom On-Site Laboratories and in the Institute for Transuranium Elements. In order to cover the full range of plutonium materials received for analysis, the application of the above correlation has been also extended to AGR and Magnox-type of plutonium. The differing sets of coefficients $C_0$, $C_1$ and $C_2$ approximating best the correlation for the additional types of materials were determined from a set of reference isotopic data.

Since in many instances the origin and the type of the plutonium are not known a priori, criteria for categorization were established helping to select the appropriate isotope correlation. Parametric plots of the ratios $^{238}\text{Pu}/^{239}\text{Pu}$ versus $^{240}\text{Pu}/^{239}\text{Pu}$ generally allow to discern unambiguously Magnox, AGR and LWR plutonium, and to some extent also BWR and PWR plutonium, as long as a mixing of the respective plutonium materials has not occurred. With this kind of categorization implemented in the routine analysis the performance of the $^{242}\text{Pu}$ estimate is substantially improving in most cases.

Performance data for $^{242}\text{Pu}$ in particular, and for plutonium isotope abundance measurements by HRGS in general, as derived from a larger set of measurement data are presented and discussed in terms of their impact on the interpretation of passive neutron coincidence measurements for the plutonium element assay on small samples.

REFERENCES
