# Method validation of determination of $^{210}$Po in water with solvent extraction method and extraction chromatography method

Myung Ho Lee, Euo Chang Jung, Kyu Suk Song
*Korea Atomic Energy Research Institute 150 Deokjin-Dong, Yuseong, Daejeon 305-353, Korea*
mhlee@kaeri.re.kr

Polonium-210 is a naturally occurring alpha emitter and exists in the environment as a result of decay within the $^{238}$U decay chain. $^{210}$Po is considered to be one of the most toxic naturally occurring radionuclides, and one of the most important environmental radionuclides due to its wide distribution and potential for human radiation exposure through ingestion and inhalation. In addition, for many sample types (for example, soils and sediments) determination of $^{210}$Po may be used as a means of determining its progenitor $^{210}$Pb.

The results of a recent proficiency test organized by the IAEA demonstrated that a number of laboratories are experiencing difficulty in obtaining reliable results for $^{210}$Po determination in water samples. This is most likely due in part to the limited number of methods available for its determination, the most commonly-used being alpha spectrometry. In addition, there is a general lack of suitable, recently-characterized reference materials for use in quality control.

As a part of its activities to support its Member State laboratories, the IAEA is developing recommended procedures for determination of selected radionuclides in environmental samples. In the case of $^{210}$Po, this started with the collection and review of about 130 papers from the scientific literature. Based on this review, two candidate methods for determination of $^{210}$Po in water samples were selected for testing, refinement and validation. The results of this work are the subject of this paper.

For determination of a low level activity concentration of $^{210}$Po in a water sample, it is necessary to handle a large volume of sample. Direct evaporation of water samples has been used for reducing a small volume of a water sample as a simple process [1,2]. However, this method is very time consuming for a large amount of a sample (> 1 L). Therefore, coprecipitation with iron hydroxide or $MnO_2$ have commonly been used to preconcentrate Po from water samples. When iron hydroxide is used for sample preparation, it is necessary to remove Fe from the sample solution using a solvent extraction step with an extractant such as di-isopropyl ether, because bulk iron may interfere with the purification of Po using solvent extraction or extraction chromatography as well as in the auto-deposition of Po. In the case that $MnO_2$ is used, manganese can be removed easily from Po by several alternative chemical separation procedures. Therefore, in this work $MnO_2$ coprecipitation was selected as the method for sample preparation.

Two Po separation procedures, based on DDTC solvent extraction (DDTC-SE) [3] and extraction chromatography using Sr resin (Sr-EC) [4], were selected for testing. Reports in the literature indicate that both methods have been successfully used for determination of $^{210}$Po in a variety of sample matrices. The method validation of both methods was carried out in terms of trueness, repeatability and reproducibility with a tap water spiked with a known amount of $^{210}$Po. This paper also describes the optimized conditions for auto-deposition of Po.

REFERENCES

[1] W. W. Flynn, "The determination of low levels of polonium-210 in environmental materials," Anal. Chim. Acta, 43, 221-227 (1968).
[2] J. D. Smith and T. F. Hamilton, "Improved technique for recovery and measurement of polonium-210 from environmental materials," Analytica Chimica Acta, 160, 69-77 (1984).
[3] J. D. Smith and T. F. Hamilton, "Improved technique for recovery and measurement of polonium-210 from environmental materials," Analytica Chimica Acta, 160, 69-77 (1984).

[4] N. Vajda, J. LaRosa, R. Zeisler, P. Danesi and G. Kis-Benedek, "A novel technique for the simultaneous determination of $^{210}Pb$ and $^{210}Po$ using a crown ether," J. Environ. Radioactivity, Vol. 37(3), pp. 355-372 (1997).