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Determination of $^{226}$Ra in natural water samples by liquid scintillation counting

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Abstract

A relatively fast, simple and reliable method has been developed for determination of $^{226}$Ra from natural water samples, using radioactive separation and liquid scintillation counting (LSC). This method is based on the usage of $^{12}$B as tracer, sorption on MnO$_2$ Resin® and precipitation of Ba(Ra)SO$_4$. Highlights

- A method has been developed for determination of $^{226}$Ra from natural water samples.
- The method is relatively fast, simple and reliable.
- The method is based on radioactive separation and LSC measurement.
- Activity of $^{226}$Ra and $^{228}$Ra were determined from the same LSC measurement.
- $^{226}$Ra in natural water samples was analyzed.

Introduction

$^{226}$Ra can be present in drinking and surface waters, in natural waters and other environmental samples. It is an important radionuclide due to its high radio toxicity. It can be applied for the determination of $^{226}$Ra in natural water samples by the application of MnO$_2$ Resin® and precipitation of Ba(Ra)SO$_4$.

Material and methods

Methods

Methodology for the determination of $^{226}$Ra in natural water samples was developed. The method is based on the usage of $^{12}$B as tracer, sorption on MnO$_2$ Resin® and precipitation of Ba(Ra)SO$_4$. The samples were filtered through a 0.45 µm filter, and the solution was adjusted to 4-7 using 1 M HNO$_3$ or 1 M NaOH. After that 4 Bq $^{133}$Ba tracer and 1.25 g MnO$_2$ Resin® were added. The solution was filtered through a 0.45 µm filter (Application of MnO$_2$ Resin® for Co-precipitation with BaSO$_4$).

Results and discussion

Table 1 shows the results of determination of $^{226}$Ra in natural water samples by the developed methodology. The average chemical recovery was 60(±15)%, and we could not find correlation between recovery and sample composition (alkaline earth content).

Table 2 shows the results of determination of $^{226}$Ra in natural thermal waters of Slovakia and Hungary by the developed methodology. The average chemical recovery was 60(±15)%, and we could not find correlation between recovery and sample composition (alkaline earth content).

Table 3 shows the results of determination of $^{226}$Ra in medicinal thermal waters of Slovakia and Hungary by the developed methodology. The average chemical recovery was 60(±15)%, and we could not find correlation between recovery and sample composition (alkaline earth content).

Conclusions

The developed methodology for the determination of $^{226}$Ra in natural water samples is simple, reliable and cost-effective. It can be used for the determination of $^{226}$Ra in natural water samples with a detection limit of 0.2 Bq/L. The method is based on radioactive separation and liquid scintillation counting.

References

- Council of the European Union, 2013. Council Directive 2013/51/Euratom [3] (namely 40 mBq/L for drinking water) is easily achievable. Typical relative uncertainty of results (in cases they were over MDA) was 5%, calculated using a coverage factor of (1+L).