

IAEA Environment Laboratories
Vienna International Centre, P.O. Box 100, A-1400 Vienna, Austria

REFERENCE SHEET

REFERENCE MATERIAL

IAEA-434

RADIONUCLIDES IN PHOSPHOGYPSUM

Date of issue: March 2010

Certified Quantity: Massic Activity
(Based on dry mass)

Reference date for decay correction: 01 January 2008

Radionuclide	Certified Value Bq kg ⁻¹	Uncertainty* Bq kg ⁻¹
²¹⁰ Pb	680	58
²²⁶ Ra	780	62
²³⁰ Th	211	9
²³⁴ U	120	9
²³⁸ U	120	11

*Uncertainty is expressed as a Mixture model median based standard deviation S(MM-median) at 95 % confidence level [1, 2].

Four National Metrological Institutes (NMI) and seven expert laboratories nominated by their respective NMI took part in the IAEA-434 interlaboratory comparison; namely: ERISS (Australia), PTB (Germany), HAA (Hungary), ARPA (Italy), KINS (Korea), KRISS (Korea), LNHB (France), MNA (Malaysia), IJS (Slovenia), AECS (Syria), and the IAEA Laboratories (Austria).

The property values of all radionuclides were established on the basis of the Mixture Model Median (MM-median) of the analytical results reported by the expert laboratories.

To estimate the standard uncertainty associated with the property value the MM-median based Standard Deviation S(MM-median) was calculated from the span of the central 50% of the MM-PDF density function [1].

Description of the material

The material was obtained from a processing plant located in Gdansk (Poland) in 2003. The material was dried and milled by air jet mill to less than 100 µm and homogenized.

Bottling of IAEA-434 was carried out under normal laboratory conditions, taking all precautions

to avoid segregation. Portion of 250 gram was dispensed into plastic bottles sealed with security polyethylene caps and labeled with the code IAEA-434. After bottling the material was sterilized by gamma ray irradiation with a total dose of 25 kGy using a Co-60 source according to EN ISO 13485:2003 to ensure long-term stability of the material by inhibiting microbial action.

Homogeneity of the material

For the homogeneity study 10 bottles covering the whole bottling range were randomly selected, three independent sample portions at 12.5 g from each bottle were analyzed using gamma spectrometry for ^{210}Pb , ^{226}Ra , ^{230}Th , ^{234}U and ^{238}U . The homogeneity of ^{226}Ra was also tested by analyzing three sample portions of one gram from five bottles using alpha spectrometry technique. The analysis of homogeneity study was performed under repeatability conditions to minimize variations [2].

The homogeneity test results provided experimental evidence that satisfactory level of between and within bottles homogeneity have been attained. Thus the material could be considered sufficiently homogeneous for the tested radionuclides at the range of mass used.

Intended use

The IAEA-434 can be used for quality control purposes in determination of ^{210}Pb , ^{226}Ra , ^{230}Th , ^{234}U and ^{238}U massic activities in phosphogypsum or in a material with similar matrix. The user should check the commutability of the reference material with the analysed samples.

The material can also be used for the development and validation of analytical procedures, and for training purposes.

Instructions for use

The reference material is supplied in 250 gram units. The minimum test portion is 1 gram. The material should be homogenized before opening the bottle. All necessary precautions should be taken when opening the bottle to prevent any spread of the fine powder in the laboratory.

Dry mass determination

All recommended and information values are expressed on a dry mass basis. Therefore the analytical results need to be corrected for the moisture content of the sample at the time of analysis.

It is recommended to dry a separate sample portion of at least 1 gram for 12 hours at 80 °C. If smaller sample test portions are taken, the uncertainty on the dry mass correction factor is increased and should be taken into account for the total uncertainty calculation.

Metrological traceability and uncertainty of reference values

The quantity values assigned to the IAEA-434 reference material are massic activities of ^{210}Pb , ^{226}Ra , ^{230}Th , ^{234}U and ^{238}U expressed in the derived SI unit Bq/kg. Consensus values were derived from individual results reported by National Metrology Institutes and expert laboratories using the Mixture Model Median. For all results used in the calculation of the consensus values, the utmost care was taken regarding the metrological traceability of the property values assigned to this reference material already at the planning phase and during the entire characterization process. Laboratories participating in the characterization campaign have been requested to carefully choose the calibrants and to provide the IAEA with all related information.

However, the selection of measurement methods and measurement procedures, as well as respective calibrants, was based on the decision of the participating laboratory.

A consequence of the use of different calibrants is the fact that the metrological chain(s) for each of the assigned quantity values respectively (combined from number of results), cannot easily be described. Therefore, the assigned property values, the massic activities, although expressed in the derived SI unit, are not intended for calibration purposes, and the reference material as such is not to be used as a calibrant.

Storage

The original unopened bottle should be stored securely at ambient temperature in a dark and dry place. It is recommended to avoid direct exposure to sunlight or to a source of heat.

Expiry date

Based on the experience with similar materials the expiry date of the reference sheet is set to December 2020. The certificate is valid as long as the material is handled and stored in accordance with the instructions given above and the plastic container is not damaged. The IAEA is monitoring the long term stability of the material and customers will be informed in case of extension of the reference sheet beyond the expiry date and if any observed changes. Reference values as stated in this reference sheet may be updated if more information becomes available. Users of this reference material should ensure that the reference sheet in their possession is current. This can be accomplished by accessing the appropriate web page at: <http://www.iaea.org/>.

The IAEA is monitoring the long term stability of the material and customers will be informed in case of any observed change.

Legal disclaimer

Although great care has been taken to maintain the accuracy of information contained in this reference sheet, the IAEA assumes no responsibility for consequences which may arise from its use.

Compliance with ISO Guide 31:2000

The content of this IAEA Reference Sheet is in compliance with the ISO Guide 31:2000: Reference materials– Content of certificates and labels.

Contact information

For further information please contact:

International Atomic Energy Agency (IAEA)
Department of Nuclear Sciences and Applications
IAEA Environment Laboratories
P. O. BOX 100, A-1400 Vienna, Austria

Tel. : +431 2600 28226
Fax. : +431 2600 728226
E-mail : aqcs@iaea.org

References

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- [2] A. Shakhashiro, U. Sansone, Reference material IAEA 434: Naturally occurring radionuclides in phosphogypsum , In press.
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Paul Martin

Head, Terrestrial Environment
Laboratory



Abdulghani Shakhashiro

Reference Materials Specialist