



REFERENCE SHEET

REFERENCE MATERIAL

IAEA-327

RADIONUCLIDES IN SOIL

Date of issue: April 2001[⊕]

Recommended Values
(Based on dry weight)

Reference Date for decay correction: 31st December 1994

Radionuclide	Recommended Value	95% Confidence Interval	N*
	Bq/kg	Bq/kg	
⁴⁰ K	621	612 – 630	143
⁹⁰ Sr	2.37	2.23 – 2.51	30
¹³⁷ Cs	24.9	24.6 – 25.2	152
²¹⁰ Pb	58.8	53.9 – 63.7	26
²²⁶ Ra	34.1	32.7 – 35.5	56
²²⁸ Ra	38.7	37.8 – 39.6	109
²²⁸ Th	38.2	37.2 – 39.2	56
²³⁰ Th	34.1	32.4 – 35.8	10
²³² Th	38.7	37.2 – 40.2	22
²³⁴ U [#]	31.9	30.4 – 33.4	32
²³⁸ U	32.8	31.4 – 34.2	32
²³⁸ Pu	0.020	0.018 – 0.022	20
²³⁹⁺²⁴⁰ Pu	0.58	0.56 – 0.60	51

* Number of accepted laboratory means which were used to calculate the recommended values and confidence intervals.

The recommended value for ²³⁴U was calculated from the ²³⁸U recommended activity concentration in combination with the median of the ²³⁴U/²³⁸U activity ratio calculated from participants results.

⊕ Revision of the original reference sheet dated May 2000.

Information Values
(Based on dry weight)

Reference Date for decay correction: 31st December 1994

Radionuclide	Information Value Bq/kg	95% Confidence Interval Bq/kg	N*
¹⁰⁶ Ru	< 3	–	45
¹²⁵ Sb	< 0.8	–	48
¹⁵⁴ Eu	< 3	–	40
¹⁵⁵ Eu	< 2.3	–	4
²³⁵ U	1.43	1.22 – 1.64	12
²⁴¹ Am ^{##}	0.22	0.19 – 0.25	15

* Number of accepted laboratory means which were used to calculate the information values and confidence intervals.

NB: The ²⁴¹Am value quoted is only valid for the reference date, as decay correction to alternated dates requires knowledge of the ²⁴¹Pu concentration which is not currently known.

The values listed above were established on the basis of statistically valid results submitted by laboratories which had participated in an international intercomparison exercise organized in 1994. The details concerning the criteria for qualification as a recommended value can be found in the report (IAEA/AL/100) "Report on the Intercomparison Run for the Determination of Radionuclides in Soils IAEA-326 and IAEA-327." [1]. This report is available free of charge upon request.

Intended Use

This sample is intended to be used as a reference material for the measurement of radionuclides in soil samples. It can also be used as a quality control material for the assessment of a laboratory's analytical work, for the validation of analytical methods and for quality assurance within a laboratory.

Origin and preparation of the material

The podsollic soil was obtained from the Moscow region of Russia in 1990. The material originated from the surface layer with a depth ranging from 0 to 20 cm and was collected and processed on behalf of the IAEA by the Khlopin Radium Institute, St. Petersburg, Russia in 1994. The total weight of material collected was approximately 350 kg.

The bulk sample was air-dried and then milled in a MVO-200 vibration mill (USSR). The mill was loaded with 100 kg of material per cycle and each milling cycle lasted 2 hours. Each batch of ground material was homogenized in an NX-6 mixer (Japan) for 3 hours; the degree of pulverization of the material was checked by measuring the grain-size distribution of the particles.

Approximately half of the final product was packed into polythene sacks and stored at the Khlopin Radium Institute. The remaining half of the batch was dispensed into plastic bottles in 250 g units (400 bottles) and dispatched to the Agency's Laboratories at Seibersdorf where the samples were irradiated at the Austrian Research Centre to a dose of 2.5×10^4 Gy using a ⁶⁰Co source to ensure long-term stability of the material by inhibiting microbial action.

Homogeneity

The material was checked for homogeneity at the Khlopin Radium Institute, using uranium as the indicator element. The concentration of uranium was determined by a Laser-induced fluorescence method which had a precision of $\pm 4\%$ (one relative standard deviation (RSD)). The procedure was as follows: five 1g sub-samples were taken from each of 12 bottles, selected at random, and were analyzed following dissolution in a mixture of hydrofluoric, hydrochloric and nitric acids. The sample solutions were analyzed by Laser-induced Fluorimetry and the results were tested for difference of means between and within bottles using one-way analysis of variance at the $\alpha=0.05$ significance level. No significant differences were detected.

A somewhat less rigorous test was performed in the Chemistry Unit of the Agency's Laboratories at Seibersdorf, using Sr-90 as the indicator radionuclide. It was found that the materials tested could be considered homogeneous with respect to Sr-90 for sample masses greater than or equal to 10 g.

Dry weight determination

All recommended values are expressed on a dry weight basis. Therefore the dry weight must be determined at the time of analysis, using separate sub-samples of at least 500 mg dried to constant weight in a drying oven set to 105 °C. Subsequent weighings should differ by less than 5 mg.

Instructions for use

The recommended minimum sample masses for analysis of α -emitters, β -emitters and γ -emitters are 0.5g, 0.5g and 30g respectively.

Analysts are reminded to take appropriate precautions in order to avoid contamination of the material during handling. No special precautions are required for the storage of this material.

Legal disclaimer

The IAEA makes no warranties, expressed or implied, with respect to the data contained in this reference sheet and shall not be liable for any damage that may result from the use of such data.

References

- [1] Bojanowski R., Radecki Z., Campbell M.J., Burns K.I., and Trinkl A., Report on the Intercomparison Run for the Determination of Radionuclides in Soils IAEA-326 and IAEA-327. IAEA/AL/100, IAEA, Vienna, Austria, 2001.

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