REFERENCE SHEET
CERTIFIED REFERENCE MATERIAL
IAEA-372
RADIONUCLIDES IN GRASS

Date of issue: March 2010

Certified Quantity: Massic Activity
(Based on dry mass)

Reference date for decay correction: 1st June 2006

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Certified Value Bq kg(^{-1})</th>
<th>Uncertainty* Bq kg(^{-1})</th>
<th>(\nu)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>(^{40})K</td>
<td>1060</td>
<td>56</td>
<td>7</td>
</tr>
<tr>
<td>(^{137})Cs</td>
<td>11320</td>
<td>360</td>
<td>7</td>
</tr>
</tbody>
</table>

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

** Number of accepted laboratory results used to calculate the certified massic activities and the associated uncertainties.

The certified values listed above were established on the basis of results reported by 5 National Metrological Institutes (NMIs):
- Czech Metrology Institute, Czech Republic
- National Centre of Metrology, Bulgaria
- National Institute of Standards and Technology, USA
- National Physical Laboratory, UK
- Physikalisch-Technische Bundesanstalt, Germany

and two expert laboratories
- Japan Chemical Analysis Centre, Japan
- IAEA Terrestrial Environment Laboratory, Austria

within the frame of a certification campaign organized by the IAEA [3].
Description of the material

The material was obtained from the “Vladimirovka” collective farm, Polesskoe, Kiev, Ukraine in summer 1990. The material was air dried and milled to less than 0.3 mm by the Brjansk Centre for Agricultural Radiology and Chemistry. Then 75 kg of the bulk material was recombined and homogenized at an IAEA collaborating centre (the Hungarian National Institute for Food Inspection) by mixing the powder in a 300 liter drum for 72 hours, and then dispensed into plastic bottles, sealed with polyethylene caps in 100 g units, and labelled with the code IAEA-372. Subsequently, the samples were irradiated to a dose of 25.5 kGy minimum using a $^{60}$Co source according to EN ISO 13485:2003 to ensure long-term stability of the material by inhibiting microbial action.

Intended use

IAEA-372 can be used for calibration when measuring $^{40}$K and $^{137}$Cs massic activity in grass or in a material with a similar matrix and density. It can also be used for quality assurance/quality control of the analysis of these two radionuclides in vegetation, for the development and validation of analytical work and for training purposes.

Instructions for use

The reference material is supplied in 100 g units. The recommended minimum test portion is 5 g. Homogenize the material and then let the powder settle down before opening the bottle. Please take all necessary precautions when opening the bottle to prevent any spread of the fine powder in the laboratory.

Homogeneity of the material

Within and between bottle homogeneity tests were carried out by measuring the activity of $^{40}$K and $^{137}$Cs in 10 sub-samples from 10 randomly selected bottles. Gamma spectrometry measurements were performed on 5 g test portions. Results from these measurements were evaluated using analysis of variance ANOVA [4, 5]. The uncertainty originating from “between-bottles” [3] heterogeneity was below 0.25% for the studied radionuclides. The "between-bottles" variances showed no significant differences from the "within-bottle" variances for both radionuclides. Thus the material could be considered sufficiently homogeneous for the tested radionuclides at the range of mass used.

Dry mass determination

The average moisture content of the sample after bottling, determined by drying several test portions in an oven at 80 °C for 24 hours, was found to be approximately 4 %. Since the moisture content can vary with ambient humidity and temperature, it is recommended that the water content be determined prior to analysis and that all results be reported on a dry mass basis.

Metrological traceability and uncertainty of assigned values

The quantity values assigned to the grass certified reference material are massic activities of $^{40}$K and $^{137}$Cs, expressed in the derived SI unit Bq kg$^{-1}$. Values were derived from individual results reported by participating laboratories using the Mixture Model Median [1, 2]. For all results used in the calculation of the assigned values, the evidence on metrological traceability to the SI Units was provided. Measurement uncertainty was calculated based on the MM-median Standard Deviation S(MM-median) which was calculated from the span of the central 50% of the MM-PDF density [1,2].
Based on defined metrological traceability and the relatively small uncertainty of the assigned quantity values, the material is considered suitable as a calibrator.

**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 reference values for $^{40}$K and $^{137}$Cs are valid until 31 December 2020, provided the original bottle is handled and stored in accordance with the instructions given in this reference sheet (see “Storage”). This certification is nullified if the bottle is damaged. 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.

**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.

**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.

**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. : +43 1 2600 28226
Fax. : +43 1 2600 728226
E-mail : aqcs@iaea.org
References


---

Paul Martin
Head, Terrestrial Environment Laboratory

Abdulghani Shakhashiro
Reference Materials Specialist