## Reference Sheet

**Certified Reference Material**

**IAEA-445**

**Gamma Emitting Radionuclides in Water**

Date of issue: April 2010

Certified Quantity: Massic Activity

Reference date for decay correction: 15 October 2007

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Certified Value(^1,2) Bq kg(^{-1})</th>
<th>Combined Standard uncertainty Bq kg(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(^{54})Mn</td>
<td>4.74 Bq kg(^{-1})</td>
<td>0.05 Bq kg(^{-1})</td>
</tr>
<tr>
<td>(^{60})Co</td>
<td>7.52 Bq kg(^{-1})</td>
<td>0.07 Bq kg(^{-1})</td>
</tr>
<tr>
<td>(^{65})Zn</td>
<td>13.06 Bq kg(^{-1})</td>
<td>0.15 Bq kg(^{-1})</td>
</tr>
<tr>
<td>(^{109})Cd</td>
<td>34.96 Bq kg(^{-1})</td>
<td>0.35 Bq kg(^{-1})</td>
</tr>
<tr>
<td>(^{134})Cs</td>
<td>7.65 Bq kg(^{-1})</td>
<td>0.10 Bq kg(^{-1})</td>
</tr>
<tr>
<td>(^{137})Cs</td>
<td>8.12 Bq kg(^{-1})</td>
<td>0.08 Bq kg(^{-1})</td>
</tr>
<tr>
<td>(^{210})Pb</td>
<td>29.34 Bq kg(^{-1})</td>
<td>0.5 Bq kg(^{-1})</td>
</tr>
<tr>
<td>(^{241})Am</td>
<td>7.11 Bq kg(^{-1})</td>
<td>0.07 Bq kg(^{-1})</td>
</tr>
</tbody>
</table>

\(^1\) Established based on the certified activity value of the standard solutions used for spiking.

\(^2\) The certified values of massic activities are traceable to the SI through the radioactivity standard solutions used for spiking.
**Description of the material**

Demineralised tap water outsourced from Seibersdorf (Austria) was used to prepare this sample. The water was screened for artificial nuclides and $^{210}\text{Pb}$ using high resolution gamma spectrometry, and it was found that all nuclides were below the detection limit and far below the spiked values. The water sample was gravimetrically prepared in one batch. A portion of 200 kg demineralised water was acidified with nitric acid to 3\% (mass/mass) and spiked with a mixture of certified single radionuclide solutions traceable to the international standard of radioactivity units. A pump with multiple outlets was used to homogenize the bulk water sample in a tank of 600 L. The spiked water was dispensed in plastic bottles of 500 ml.

The final reference massic activity of each radionuclide was established based on the certified activity value of the radionuclide standard solutions used for spiking the water, taking into account the successive dilution steps, the mass of spiking mixture and the amount of water being spiked as determined from weighing. The combined standard uncertainty includes two major components: uncertainty of the certified solution and weighing uncertainty.

**Homogeneity of the material**

To test the homogeneity of the IAEA-445, three water test portions at 100 g each were analysed from three different bottles using high resolution gamma spectrometry at the IAEA Terrestrial Environment Laboratory. The relative standard deviation of each analyte was calculated. It was found that the relative standard deviations of ten replicate measurements of all analytes were below the method repeatability relative standard deviation, which demonstrates satisfactory homogeneity of the water sample. More details on homogeneity study results are given in [1].

**Metrological traceability and uncertainty of assigned values**

The quantity values assigned to the IAEA-445 certified reference material are massic activities of $^{54}\text{Mn}$, $^{60}\text{Co}$, $^{65}\text{Zn}$, $^{109}\text{Cd}$, $^{134}\text{Cs}$, $^{137}\text{Cs}$, $^{210}\text{Pb}$ and $^{241}\text{Am}$, expressed in the derived SI unit Bq kg$^{-1}$. Values were established based on the certified activity values of the standard solutions used for spiking, taking into account the successive dilution steps, the mass of spiking solutions and the amount of matrix being spiked. For all values used in the calculation of the assigned values and associated uncertainties, the evidence on metrological traceability to the SI Units was provided.

**Intended use**

The IAEA-445 can be used for the development and validation of analytical work and for training purposes when measuring $^{54}\text{Mn}$, $^{60}\text{Co}$, $^{65}\text{Zn}$, $^{109}\text{Cd}$, $^{134}\text{Cs}$, $^{137}\text{Cs}$, $^{210}\text{Pb}$ and $^{241}\text{Am}$ massic activities in water.

Based on the defined metrological traceability and the relatively small uncertainty of the assigned quantity of massic activities values, the IAEA-445 could be used as a calibrator when water with similar levels of activities is analysed.

**Instructions for use**

The reference material is supplied in 500 ml units. The recommended minimum test portion is 50 g. The water should be homogenized before opening the bottle.
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 of $^{54}$Mn, $^{60}$Co, $^{65}$Zn, $^{109}$Cd, $^{134}$Cs, $^{137}$Cs, $^{210}$Pb and $^{241}$Am are valid until 31 December 2015, 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 certified reference sheet may be updated if more information becomes available. Users of this certified 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://nucleus.iaea.org/rpst/index.htm

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.

References

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