

National Institute for Environmental Studies

Certificate of Analysis

NIES CRM No. 29 Water Hyacinth

This environmental certified reference material (CRM) was developed and certified by the National Institute for Environmental Studies (NIES) for the determination of multi-elements in water hyacinth (*Eichhornia crassipes*) and similar water plants.

Certified Values

Element	Mass fraction			Analytical method *
	Unit	Certified value	Uncertainty	
Calcium (Ca)	%	1.63	0.13	AAS, ICP-MS, ICP-OES, NAA, XRF-WDX
Magnesium (Mg)	%	0.856	0.042	AAS, ICP-MS, ICP-OES, NAA, XRF-WDX
Phosphorus (P)	%	0.515	0.056	AAS, ICP-OES, XRF-WDX
Sodium (Na)	%	0.665	0.050	AAS, ICP-MS, ICP-OES
Sulfur (S)	%	0.231	0.023	IC, ICP-OES, XRF-WDX
Barium (Ba)	mg/kg	48.2	3.0	ICP-MS, ICP-OES
Cobalt (Co)	mg/kg	0.449	0.034	HR-ICP-MS, ICP-MS
Copper (Cu)	mg/kg	4.48	0.36	HR-ICP-MS, ICP-MS, ICP-OES
Iron (Fe)	mg/kg	345	21	ICP-MS, ICP-OES, XRF-WDX
Manganese (Mn)	mg/kg	53.9	5.6	ICP-MS, ICP-OES, NAA, XRF-WDX
Molybdenum (Mo)	mg/kg	3.06	0.27	HR-ICP-MS, ICP-MS, ID-ICP-MS
Strontium (Sr)	mg/kg	60.0	4.0	ICP-MS, ICP-OES
Zinc (Zn)	mg/kg	145	15	ICP-MS, ICP-OES, XRF-WDX

All certified values were determined based on dry mass. The uncertainty attached to the certified values is the expanded uncertainty using a coverage factor $k = 2$, corresponding to the half-width of a confidence interval of approximately 95 %.

* AAS, atomic absorption spectroscopy

HR-ICP-MS, high resolution-inductively coupled plasma-mass spectrometry

IC, ion chromatography

ICP-MS, inductively coupled plasma-mass spectrometry

ICP-OES, inductively coupled plasma-optical emission spectrometry

ID-ICP-MS, isotope dilution inductively coupled plasma-mass spectrometry

NAA, instrumental neutron activation analysis

XRF-WDX, X-ray fluorescence spectroscopy-wavelength dispersive X-ray spectrometry

Reference Values

Element	Mass fraction		Analytical method *
	Unit	Reference value	
Carbon (C)	%	39.1	EA
Nitrogen (N)	%	2.1	EA
Potassium (K)	%	4.50	AAS, ICP-MS, ICP-OES, NAA, XRF-WDX
Cadmium (Cd)	mg/kg	0.099	HR-ICP-MS, ICP-MS
Lead (Pb)	mg/kg	0.531	ICP-MS
Yttrium (Y)	mg/kg	0.0668	ICP-MS, ICP-OES

All reference values were determined based on dry mass.

* AAS, atomic absorption spectroscopy

EA, elemental analysis

HR-ICP-MS, high resolution-inductively coupled plasma-mass spectrometry

ICP-MS, inductively coupled plasma-mass spectrometry

ICP-OES, inductively coupled plasma-optical emission spectrometry

NAA, instrumental neutron activation analysis

XRF-WDX, X-ray fluorescence spectroscopy-wavelength dispersive X-ray spectrometry

Characterization

The property values of the material were statistically determined based on chemical analyses by 13 organizations (including 20 laboratories) using a wide range of methods. A property value satisfying the following conditions was accepted as a certified value:

- 1) the relative standard deviation associated with the mean of the laboratory means was 5 % or less,
- 2) the number of laboratories contributing to the mean of the laboratory means was at least eight, and
- 3) the number of analytical methods contributing to the mean of the laboratory means was at least two.

The uncertainty attached to the certified values is the expanded uncertainty using a coverage factor $k = 2$, corresponding to the half-width of a confidence interval of approximately 95 %. A property value failing to satisfy one or two of the NIES criteria for certification but supplying valuable additional information about the material is given as a reference value. All certified and reference values were determined based on dry mass.

Description of the Material

The water hyacinth for this CRM was control-cultivated in a managed water pool in the NIES Aquatron. The raw material (about 300 kg) was washed with distilled water, dried, crushed in a rotor mill, sieved (106 μm sieve), and homogenized with a V-blender. All procedures complied with ISO Guide 34. The powdered water hyacinth (about 9 kg) was placed in amber glass bottles (5 g in each bottle), and sterilized by ^{60}Co irradiation (25 kGy).

Homogeneity

Mass fractions of multi-elements, including those for which certified values are given, were determined by ICP-AES and ICP-MS in material taken from 10 bottles selected from the total 1054 bottles by stratified random sampling. The between-bottle variation evaluated by a one-way analysis of variance (ANOVA) showed the homogeneity standard deviations between bottles for the analytes to be less than 1 %. The material, therefore, is sufficiently homogeneous for its intended use as a reference material.

Instructions for Use

1. Care should be taken to avoid contamination when opening the bottles. It is desirable to use up the contents as quickly as possible after opening.
2. This CRM should be kept tightly closed in its original bottle and stored in a desiccator at room temperature (≤ 30 °C).
3. Prior to weighing aliquots for analysis, the contents of the bottle should be shaken gently.
4. It is recommended that a sample intake of 0.1 g is the minimum for convenient handling.
5. Precautions should be taken to avoid inhalation of the material.
6. This CRM should not be used for purposes other than research. When disposing of the material, local laws concerning processing and disposal of waste materials should be strictly adhered to.
7. The mass fractions of elements in this CRM are reported on a dry mass basis. This CRM, as received, contains 2-4 % water measured in NIES by drying a separate sub-sample for 4 h at 85 °C. Correction to dry mass should be determined by drying a separate sub-sample at the time of use.

Expiry Date of Certification

The expiry date for the certified values of this CRM is September 2031 assuming that the recommended storage conditions are adhered to. NIES will notify via its website if any changes in the contents are recognized within the term of validity.

Collaborating Laboratories in Analysis

The certified and reference values for this CRM were based on the analytical values from the following participating organizations:

National Institute for Environmental Studies; AMCO Inc.; Geo-Science Laboratory, Inc.; Green Blue Corporation; IDEA Consultants, Inc.; Japan Environment Sanitation center; Japan Food Research Laboratories; JFE Techno-research Corporation; Kanagawa Industrial Technology center; Murata measuring instrument service Ltd.; Nittech Research Corporation; Shimadzu Techno-Research, Inc.; Sumika Chemical Analysis Service, Ltd.

Technical Information

Technical information and the latest reports regarding this material can be obtained from the website.

<http://www.nies.go.jp/labo/crm-e/index.html>

September 1, 2011

Takashi Imamura

Director

Center for Environmental Measurement and Analysis
National Institute for Environmental Studies

Health and Environmental Risk Division,
National Institute for Environmental Studies,
16-2 Onogawa, Tsukuba, Ibaraki 305-8506 Japan
FAX: +81-29-850-2900, Email: nies.crm@nies.go.jp

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Certificate revision date: October 3, 2016 (Correction of error of certified value for Co, from 0.499 to 0.449)

Certificate revision date: April 1, 2021 (Editorial changes)

Certificate revision date: August 10, 2021 (Update of expiry date)

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