

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 of NIES CRM No.29

Element	Mass fraction			Analytical method
	Unit	Certified value	Uncertainty	
Na	%	0.665	± 0.050	AAS, ICP-AES, ICP-MS
Mg	%	0.856	± 0.042	AAS, ICP-AES, ICP-MS, NAA, XRF/WDX
P	%	0.515	± 0.056	AAS, ICP-AES, XRF/WDX
S	%	0.231	± 0.023	IC, ICP-AES, XRF/WDX
Ca	%	1.63	± 0.13	AAS, ICP-AES, ICP-MS, NAA, XRF/WDX
Mn	mg/kg	53.9	± 5.6	ICP-AES, ICP-MS, NAA, XRF/WDX
Fe	mg/kg	345	± 21	ICP-AES, ICP-MS, XRF/WDX
Co	mg/kg	0.499	± 0.034	HR ICP-MS, ICP-MS
Cu	mg/kg	4.48	± 0.36	HR ICP-MS, ICP-AES, ICP-MS
Zn	mg/kg	145	± 15	ICP-AES, ICP-MS, XRF/WDX
Sr	mg/kg	60.0	± 4.0	ICP-AES, ICP-MS
Mo	mg/kg	3.06	± 0.27	HR ICP-MS, ICP-MS, ID-ICP-MS
Ba	mg/kg	48.2	± 3.0	ICP-AES, ICP-MS

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 a confidence interval of approximately 95 %. AAS, atomic absorption spectroscopy; HR ICP-MS, high resolution inductively coupled plasma – mass spectrometry; IC, ion chromatography; ICP-AES, inductively coupled plasma – atomic emission spectrometry; ICP-MS, inductively coupled plasma – mass spectrometry; ID-ICP-MS, isotope dilution ICP-MS; INAA, instrumental neutron activation analysis; XRF/WDX, wavelength dispersive X-ray fluorescence spectroscopy

Reference Values of NIES CRM No.29

Element	Mass fraction		Analytical method
	Unit	Reference value	
C	%	39.1	EA
N	%	2.1	EA
K	%	4.50	AAS, ICP-AES, ICP-MS, NAA, XRF/WDX
Y	mg/kg	0.0668	ICP-AES, ICP-MS
Cd	mg/kg	0.099	HR ICP-MS, ICP-MS
Pb	mg/kg	0.531	ICP-MS

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-AES, inductively coupled plasma - atomic emission spectrometry; ICP-MS, inductively coupled plasma - mass spectrometry; INAA, instrumental neutron activation analysis; XRF/WDX, wavelength dispersive X-ray fluorescence spectroscopy

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; 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 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 stabilized by ^{60}Co irradiation (2.5 Mrad) .

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 ($\leq 30^{\circ}\text{C}$).
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.

Expiration Date of Certification

The expiration date for the certified values of this CRM is September 2021 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 research reports regarding this material can be obtained from the following address.

Correspondence should be addressed to:

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