National Institute for Environmental Studies, Japan

Date

No.

National Institute for Environmental Studies

Certificate of Analysis

NIES CRM No. 28 Urban Aerosols

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 aerosol particulate matter.

Preparation of the CRM

The origin of this material is atmospheric particulate matter collected on filters in a central ventilating system in a building in Beijing city center. The collection period was 10 years, from 1996 to 2005. The particulate matter was recovered from the filters by mechanical vibration; a total of 3 kg was collected. The recovered material was sieved using a 32 μm sieve, and then homogenized. The sieved material (2 kg) was subdivided into 1031 pre-washed amber glass bottles with each bottle containing 1.5 g material. Then material was sterilized by ^{60}Co irradiation (25 kGy). The CRM production was conducted in accordance with ISO Guide 34.

Homogeneity

Twelve bottles were randomly selected from the entire batch and elemental analyses were carried out on the contents of each bottle using ICP-OES. The between-bottle standard deviation for each element was less than 3 %. It was adjudged that the prepared material was sufficiently homogeneous for its intended use as a reference material.

Stability

The results of stability tests demonstrated that any long-term variations in the values of all the measured elements in the material were insignificant.

Certified and Reference Values

Elemental analyses were reported by 17 organizations (see below). Certified values are given for element mass fractions that were determined by at least two analytical methods, and were decided in accordance with ISO Guide 35 (Table 1). 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 %. Reference values are given for elements with relative standard deviations of the mean of the analytical laboratory means of 6-10 %, or with 3-9 laboratories contributing to the mean (Table 2). All certified and reference values were determined on an “as received” basis, that is, the values were determined without drying the material.

Precautions for Storage and Handling for Analysis

1. This CRM should be kept tightly closed in its original bottle and stored in a desiccator at room temperature

(≤30 ℃).

2. Prior to weighing aliquots for analysis, the contents of the bottle should be shaken gently.
3. A minimum sample intake of 0.02 g is recommended.
4. Precautions should be taken to avoid inhalation of the material.
5. Do not use for purposes other than research. When disposing of the material, adhere strictly to local laws concerning processing and disposal of waste materials.

Expiry Date of Certification

The expiry date for the certified values of this CRM is January 2028 assuming that the above mentioned storage conditions are adhered to. NIES will notify via its website if any changes in the values 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; Chikyu Kagaku Kenkyusho Co., Ltd.; China Institute of Atomic Energy; Environmental Control Center Co., Ltd.; Green Blue Corporation; Idea Consultants Inc.; Japan Chemical Analysis Center; Japan Environmental Sanitation Center; Murata Keisokuki Service Co., Ltd.; Musashi Institute of Technology; Naitoh Environmental Science Co., Ltd.; Nittech Research Inc.; Norwegian University of Science and Technology; Shimadzu Techno-Research Inc.; Sumika Chemical Analysis Service, Ltd.; University of Sheffield; University of Shizuoka, Institute for Environmental Science

Organizations Cooperating in the Preparation of the Material

Institute for Reference Materials of the State Environmental Protection Administration, P.R. China; Japan International Cooperation Agency (JICA), The Shino-Japan Friendship Center for Environmental Protection Project Phase III JICA Expert Team

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

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Original certificate date: January 1, 2008
Certificate revision date: July 25, 2012 (Addition of reference values for Be and Cr)
Certificate revision date: December 28, 2017 (Update of expiry date)
Certificate revision date: September 30, 2020 (Addition of Appendix)
Certificate revision date: April 1, 2021 (Editorial changes)

Certified Values

Element	Mass fraction			Analytical method *
	Unit	Certified value	Uncertainty	
Aluminum (Al)	%	5.04	0.10	ICP-MS, ICP-OES, INAA, XRF
Calcium (Ca)	%	6.69	0.24	ICP-MS, ICP-OES, INAA, XRF
Iron (Fe)	%	2.92	0.17	ICP-MS, ICP-OES, INAA, XRF
Magnesium (Mg)	%	1.40	0.06	ICP-MS, ICP-OES, XRF
Potassium (K)	%	1.37	0.06	AAS, ICP-OES, XRF
Sodium (Na)	%	0.796	0.065	AAS, ICP-OES, INAA, XRF
Titanium (Ti)	%	0.292	0.033	ICP-MS, ICP-OES, INAA, PIXE, XRF
Zinc (Zn)	%	0.114	0.010	ICP-MS, ICP-OES, INAA, PIXE, XRF
Arsenic (As)	mg/kg	90.2	10.7	HG-AAS, HG-ICP-OES, ICP-MS, ICP-OES, INAA, XRF
Barium (Ba)	mg/kg	874	65	ICP-MS, ICP-OES, INAA
Cadmium (Cd)	mg/kg	5.60	0.43	ICP-MS, ICP-OES
Copper (Cu)	mg/kg	104	12	ICP-MS, ICP-OES, PIXE, XRF
Lead (Pb)	mg/kg	403	32	ICP-MS, ICP-OES, XRF
Manganese (Mn)	mg/kg	686	42	ICP-MS, ICP-OES, INAA, PIXE, XRF
Nickel (Ni)	mg/kg	63.8	3.4	AAS, ICP-MS, ICP-OES
Strontium (Sr)	mg/kg	469	16	ICP-MS,ICP-OES, XRF
Uranium (U)	mg/kg	4.33	0.26	ICP-MS, INAA
Vanadium (V)	mg/kg	73.2	7.0	ICP-MS, ICP-OES, INAA

* AAS, atomic absorption spectroscopy
HG-AAS, hydride generation-atomic absorption spectroscopy
HG-ICP-OES, hydride generation-inductively coupled plasma-optical emission spectrometry
ICP-OES, inductively coupled plasma-optical emission spectrometry
ICP-MS, inductively coupled plasma-mass spectrometry
INAA, instrumental neutron activation analysis
PIXE, proton induced X-ray emission spectrometry
XRF, X-ray fluorescence spectroscopy

Reference Values

Element	Mass fraction		Analytical method *
	Unit	Reference value	
Chlorine (Cl)	%	0.807	INAA, PIXE
Phosphorus (P)	%	0.145	ICP-OES, XRF

Silicon (Si)	%	14.9	Gravimetry, PIXE, XRF
Sulfur (S)	%	3.91	ICP-OES, PIXE
Antimony (Sb)	mg/kg	20.1	HG-ICP-OES, ICP-MS, INAA
Beryllium (Be)	mg/kg	5.09	ICP-MS, ICP-OES
Chromium (Cr)	mg/kg	65.6	ICP-MS, ICP-OES, INAA, PIXE
Cobalt (Co)	mg/kg	22.0	ICP-MS, ICP-OES, INAA
Lanthanum (La)	mg/kg	32.7	ICP-MS, ICP-OES, INAA
Molybdenum (Mo)	mg/kg	28.4	ICP-MS, ICP-OES, INAA
Rubidium (Rb)	mg/kg	64.1	ICP-MS, INAA, XRF
Scandium (Sc)	mg/kg	10.7	ICP-OES, INNA
Selenium (Se)	mg/kg	14.4	HG-AAS, HR-ICP-MS, ICP-MS, ICP-OES, INAA
Thorium (Th)	mg/kg	11.1	ICP-MS, INAA
Tin (Sn)	mg/kg	21.5	ICP-MS
Yttrium (Y)	mg/kg	21.9	ICP-MS, ICP-OES

* Gravimetry

HG-AAS, hydride generation-atomic absorption spectroscopy

HG-ICP-OES, hydride generation-inductively coupled plasma-optical emission spectrometry

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

ICP-OES, inductively coupled plasma-optical emission spectrometry

ICP-MS, inductively coupled plasma-mass spectrometry

INAA, instrumental neutron activation analysis

PIXE, proton induced X-ray emission spectrometry

XRF, X-ray fluorescence spectroscopy

Appendix

Information that could be useful for handling this material is provided, though the values are non-certified.

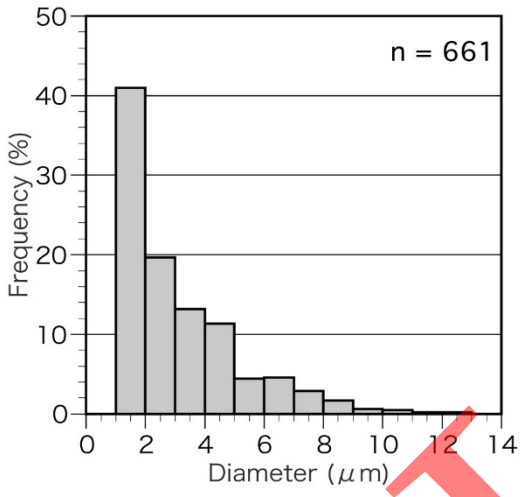

Fig. A1 Size distribution (numbers of particles) of NIES CRM No. 28 Urban Aerosols

This distribution was obtained by analyzing a microscopic image using image analysis software. The detection limit is 1 μm. The diameters of 99% of the particles were less than 10 μm.

Table A1 Mass fraction of carbon and nitrogen in NIES CRM No. 28 Urban Aerosols

Element	Mass fraction		Analytical method *
	Unit	Content	
Carbon (C)	%	12	EA
Nitrogen (N)	%	0.79	EA

* EA, elemental analysis

Table A2 Mass fraction of PAHs in NIES CRM No. 28 Urban Aerosols

Component name	Mass fraction		Analytical method *
	Unit	Content	
Fluoranthene	mg/kg	7	GC-MS, HPLC-FLU
Pyrene	mg/kg	4	GC-MS, HPLC-FLU
Benz (a) anthracene	mg/kg	2	GC-MS, HPLC-FLU, HR-GC-MS
Benzo (b) fluoranthene	mg/kg	11	GC-MS, HPLC-FLU, HR-GC-MS
Benzo (k) fluoranthene	mg/kg	2	GC-MS, HPLC-FLU, HR-GC-MS
Benzo (a) pyrene	mg/kg	0.9	GC-MS, HPLC-FLU, HR-GC-MS
Benzo (ghi) perylene	mg/kg	2	GC-MS, HPLC-FLU, HR-GC-MS
Indeno (1,2,3-cd) pyrene	mg/kg	3	GC-MS, HPLC-FLU, HR-GC-MS

* GC-MS, gas chromatography-mass spectrometry
HPLC-FLU, high performance liquid chromatography-fluorescence detection
HR-GC-MS, high resolution-gas chromatography-mass spectrometry