

Certificate of the Reference Material

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Name of the Material : Sewage Sludge

Material Code : UME CRM 1210

Issue Date : 26.11.2025

Revision Date : 26.11.2025 (Revision history can be found on the last page)

Validity Period of the Certificate : 12 months from the sales date.

Certified Values :

Parameter ^[1]	Certified Value ^[2]	Uncertainty ^[2,3]	Unit
Al ^{a,b}	30.5	5.7	g/kg
As ^{b,d}	3.08	0.55	mg/kg
B ^{a,b}	27.4	5.1	mg/kg
Ba ^{a,b,c}	363	56	mg/kg
Ca ^{a,b}	28.2	3.2	g/kg
Cd ^{a,b}	9.3	1.4	mg/kg
Co ^{a,b,c}	5.2	1.3	mg/kg
Cr ^{a,b,c}	195	27	mg/kg

- [1] The certified value for each parameter is calculated from the arithmetic mean of the results reported by two or three laboratories, using two or three of the methods ^aICP-OES, ^bICP-MS, ^cWDXRF, ^dHG ICP-OES.
- [2] The certified values and uncertainties are traceable to the International System of Units (SI). Certified values are corrected for dry mass. Moisture content is determined at (105 ± 5) °C until constant weight.
- [3] The expanded uncertainty of the certified value includes characterization, homogeneity, stability components and is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The standard uncertainty of measurement has been determined in accordance with GUM "Guide to the Expression of Uncertainty in Measurement".

Sales Date


Assoc. Prof. Mustafa ÇETİNTAŞ
Director

The following pages are an integral part of the certificate. The use of current certificate is customers' responsibility.

Most recent certificate can be downloaded from www.ume.tubitak.gov.tr.

Certified Values (Continue):

Parameter ^[1]	Certified Value ^[2]	Uncertainty ^[2,3]	Unit
Cu ^{a,b,c}	221	42	mg/kg
Fe ^{a,b}	18.1	3.0	g/kg
Hg ^{d,e}	7.2	1.7	mg/kg
Mg ^{a,b,c}	1.94	0.27	g/kg
Mn ^{a,b,c}	0.94	0.14	g/kg
Mo ^{a,b,c}	21.2	4.1	mg/kg
Ni ^{a,b,c}	413	58	mg/kg
Pb ^{a,b,c}	43.4	9.1	mg/kg
Sb ^{b,d}	2.53	0.59	mg/kg
Se ^{b,d}	5.6	1.7	mg/kg
Sn ^{a,b}	48.9	6.0	mg/kg
V ^{a,b,c}	9.4	2.4	mg/kg
Zn ^{a,b,c}	4.78	0.84	g/kg
pH ^f	6.50	0.15	-
Loss of Ignition (LOI) ^g	74.6	2.0	%

- [1] The certified value for each parameter is calculated from the arithmetic mean of the results reported by two or three laboratories, using two or three of the methods ^aICP-OES, ^bICP-MS, ^cWDXRF, ^dHG ICP-OES. ^fpH and ^gLOI are calculated from the arithmetic mean of the accepted results, applying ISO 10390 by two laboratories and EN 12879 by three laboratories respectively.
- [2] The certified values and uncertainties are traceable to the International System of Units (SI). Certified values are corrected for dry mass (except the pH). Moisture content is determined at (105 ± 5) °C until constant weight.
- [3] The uncertainty of the certified value includes characterization, homogeneity, stability components and is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The standard uncertainty of measurement has been determined in accordance with GUM "Guide to the Expression of Uncertainty in Measurement".

Informative Values

Parameter ^[1]	Value ^[2]	Uncertainty ^[3]	Unit
Ag ^a	0.59	0.34 ⁱ	mg/kg
Be ^b	0.36	0.33 ⁱ	mg/kg
K ^{a,b}	2.8	1.3 ⁱ	g/kg
Li ^{a,b}	4.1	2.4 ^{i,j}	mg/kg
Na ^a	1.96	0.86 ^{i,j}	g/kg
Sr ^{a,c}	83	15 ⁱ	mg/kg
Ti ^a	528	58 ⁱ	mg/kg
Moisture ^d	4.97	0.33 ⁱ	g/100 g
Total Kjeldahl Nitrogen (TKN) ^e	41.6	3.0 ^{i,j}	g/kg
Total Organic Carbon (TOC) ^f	41.1	3.5 ^{i,j}	%
Total Phosphorus (TP) ^g	21.8	3.6 ^{i,j}	g/kg
Conductivity ^h	318	65 ^{i,j}	mS/m

- [1] The value for each parameter is calculated from the arithmetic mean of the results reported by two or three laboratories (except for Ag), using two or three of the methods (except for Ag, Be, Na and Ti) ^aICP-OES, ^bICP-MS, ^cWDXRF, ^dHG ICP-OES. ^eMoisture and ^hconductivity applying EN 15934 and ISO 11265 methods respectively by two laboratories, ^eTotal Kjeldahl Nitrogen (TKN), ^fTotal Organic Carbon (TOC) and ^gTotal Phosphorus (TP) applying the methods of SM 4500-Norg, EN 15936 and SM 4500-P C respectively by one laboratory, are calculated from the arithmetic mean of the reported results.
- [2] The values (except for moisture and conductivity) are corrected for dry mass. Moisture content is determined at (105 ± 5) °C until constant weight.
- [3] The uncertainty of the value includes characterization, homogeneity, stability components and is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The standard uncertainty of measurement has been determined in accordance with GUM "Guide to the Expression of Uncertainty in Measurement".

Description

The material is 25 g of industrial sewage sludge in amber glass bottle. It is dried, milled and sieved to transform into powder (<180 µm) form. The bottle and its content were sterilized by γ-irradiation at a minimum dose of 25 kGy. Detailed information about the content and processing of the material can be found in the certification report.

Intended Use

This material is intended to be used for method validation and verification in the determination of the mass fractions of Al, As, B, Ba, Ca, Cd, Co, Cr, Cu, Fe, Hg, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, V, Zn as well as pH and Loss on Ignition (LOI) in sewage sludge and for quality control of the measurements.

Instructions for Use

Before opening, the bottle should be shaken. It is recommended that the bottle should be opened in a clean environment to prevent contamination. The material can absorb moisture. After opening, the bottle should be protected from moisture, and the cap should not be left open for prolonged periods.

In the certification process, homogeneity studies for the elements were conducted using 0.25 g sample. Minimum sample intake for the elements was 0.25 g since the sample below 0.25 g was not tested. For the other parameters, the study should be conducted using the sample amount specified in the corresponding standard methods.

The material can be dispatched under conditions where the temperature does not exceed +45 °C and the time does not exceed 2 weeks, without additional cooling.

Storage Conditions

The material should be stored at $(24 \pm 3) ^\circ\text{C}$ in dark and clean environment.

TÜBİTAK UME cannot be held responsible for changes that might happen to the material at customer's premises due to noncompliance with the instructions for use, and the storage conditions given.

Safety Information

The material is only for laboratory use. The usual laboratory safety precautions applicable to similar powders should be followed.

It is strongly recommended that the material must be handled and disposed according to the safety guidelines where applicable. Inhaling of the powder material should be avoided. It is recommended to work under adequate ventilation conditions.

Participants

Information about the laboratories participated in the characterization study are given in the following table.

Laboratory	Address
TÜBİTAK MAM the Vice Presidency for Climate and Life Sciences Climate Research and Water Management Research Group	TÜBİTAK Gebze Yerleşkesi, Barış Mahallesi, Dr. Zeki Acar Caddesi No.1, 41470 Gebze - Kocaeli / Türkiye
TENMAK-NÜKEN Istanbul Laboratory of the Technology Development and Nuclear Research Coordination Department/RAÖGGB-ANL Laboratories	Yarımburgaz, Nükleer Araştırma ve Eğitim Yolu D:10, 34303 Küçükçekmece - İstanbul / Türkiye
MTA General Directorate Geochemistry Laboratories	Çukurambar Mahallesi Dumlupınar Bulvarı No:11, 06530 Çankaya - Ankara / Türkiye

Methods and/or Techniques Used for the Determination of the Certified Values

Techniques used in the certification process are given in the following:

Method/Technique	Parameter
Inductively Coupled Plasma Mass Spectrometry (ICP-MS)	Al, As, B, Ba, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, V, Zn
Inductively Coupled Optical Emission Spectrometry (ICP-OES)	Al, B, Ba, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sn, V, Zn
Hydride Generation Inductively Coupled Optical Emission Spectrometry (HG ICP-OES)	As, Hg, Sb, Se
Wavelength-Dispersive X-Ray Fluorescence Spectrometry (WD-XRF)	Ba, Co, Cr, Cu, Mg, Mn, Mo, Ni, Pb, V, Zn
Direct Mercury Analyzer (DMA)	Hg
ISO 10390 - Soil, treated biological waste and sludge - pH determination	pH
EN 12879 – Characteristics of Sludge – Determination of Loss on Ignition of dry mass	Loss on Ignition (LOI)

Revision History

Date	Remarks
26.11.2025	First publication.