

JOINT RESEARCH CENTRE  
Institute for Reference Materials and Measurements

# CERTIFICATE OF ANALYSIS

ERM<sup>®</sup> - EF413

<b>FURNACE COKE</b>			
	Certified value <sup>2)</sup>	Uncertainty <sup>3)</sup>	Unit
Gross calorific value (GCV) <sup>1)</sup>	29.5	0.4	MJ/kg
Net calorific value (NCV) <sup>1)</sup>	29.4	0.5	MJ/kg
	Mass fraction		
	Certified value <sup>2)</sup>	Uncertainty <sup>3)</sup>	Unit
C <sup>1)</sup>	87.8	1.9	g/100 g
N <sup>1)</sup>	1.10	0.07	g/100 g
S <sup>1)</sup>	0.58	0.12	g/100 g
Ca	2.92	0.22	g/kg
Na	0.64	0.07	g/kg
Se	1.33	0.26	mg/kg
Zn	16.0	2.5	mg/kg

1) as defined by the procedures listed in the section "Analytical methods used for certification"

2) Unweighted mean value of the means of the accepted sets of data, each set being obtained in a different laboratory and/or with a different method of determination. The certified value and its uncertainty are traceable to the International System of units (SI). All values are based on dry mass.

3) The certified uncertainty is the expanded uncertainty with a coverage factor  $k = 2$  corresponding to a level of confidence of about 95 % estimated in accordance with ISO/IEC Guide 98-3, Guide to the Expression of Uncertainty in Measurement (GUM:1995), ISO, 2008.

This certificate is valid for one year after purchase.

Sales date:

The minimum amount of sample to be used is 30 mg for Hg, 200 mg for all other minor and trace elements, 70 mg for C and N, 200 mg for S and 1 g for GCV, NCV and ash.

Accepted as an ERM<sup>®</sup>, Geel, September 2013

Signed: \_\_\_\_\_



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<b>Indicative Values</b>			
	Mass fraction		
	Indicative value <sup>1)</sup>	Uncertainty <sup>2)</sup>	Unit
Cl	0.35	0.13	g/kg
Mg	1.23	0.19	g/kg
Pb	8.41	1.6	mg/kg

1) Unweighted mean value of the means of the accepted sets of data, each set being obtained in a different laboratory and/or with a different method of determination. The indicative value and its uncertainty are traceable to the International System of units (SI). All values are based on dry mass.

2) The indicative uncertainty is the expanded uncertainty with a coverage factor  $k = 2$  corresponding to a level of confidence of about 95 % estimated in accordance with ISO/IEC Guide 98-3, Guide to the Expression of Uncertainty in Measurement (GUM:1995), ISO, 2008.

<b>Additional Material Information</b>		
	Mass Fraction	
	Value <sup>1)</sup>	Unit
Ash (ISO 1171, ASTM D3174)	10	g/100 g
S (ASTM D3177)	0.55	g/100 g
F	64	mg/kg
K	1.5	g/kg
TI	0.15	mg/kg

1) The information values are based on the average of 2-4 laboratory averages obtained in the characterisation study and are traceable to the International System of units (SI). All values are based on dry mass.

## NOTE

European Reference Material ERM<sup>®</sup>-EF413 was produced and certified under the responsibility of the Institute for Reference Materials and Measurements of the European Commission's Joint Research Centre according to the principles laid down in the technical guidelines of the European Reference Materials<sup>®</sup> co-operation agreement between BAM-IRMM-LGC. Information on these guidelines is available on the internet (<http://www.erm-crm.org>).

## DESCRIPTION OF THE MATERIAL

The material consists of a coarse furnace coke powder. It is packed in an aluminium-laminated sachet and is provided in units of 50 g.

## **ANALYTICAL METHODS USED FOR CERTIFICATION**

The following methods were used to obtain the assigned values:

GCV, NCV: ISO 1928, ASTM D5865

Ash: ISO 1171, ASTM D3174

C: ISO 29548, ASTM D5373

N: ISO 333, TS12902, ASTM D5373

S: ISO 19579, ASTM D4239

Cl: neutron activation analysis, combustion-ion chromatography, ASTM D4208, ISO 10304, DIN 51727

Trace elements: neutron activation analysis, inductively-coupled plasma mass spectrometry and inductively coupled plasma atomic emission spectrometry, with different digestion procedures

F: ASTM D3761, ISO 11724, combustion-ion chromatography, ISO 10304

## **PARTICIPANTS**

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(measurements under the scope of ISO/IEC 17025 accreditation BMFWJ 20)

## SAFETY INFORMATION

The usual laboratory safety precautions apply.

## INSTRUCTIONS FOR USE AND INTENDED USE

Before use, the complete contents of each sachet shall be ground to < 250 µm. All analytical samples shall be taken from this ground material, sampling of the coarse material is not permitted.

The ground samples shall be left to equilibrate with the laboratory atmosphere before taking analytical subsamples.

Dry mass determination shall be carried out according to ISO 5068-2 or ASTM D3173:

A separate portion of at least 1 g of the ground and equilibrated material shall be dried in an oven at 105 – 110 °C until constant mass (separate weighings should not differ by more than 5 mg) is attained.

The main purpose of this material is to assess method performance, i.e. for checking accuracy of analytical results/calibration. As any reference material, it can also be used for control charts or validation studies.

### Comparing an analytical result with the certified value

A result is unbiased if the combined standard uncertainty of measurement and certified value covers the difference between the certified value and the measurement result (see also ERM Application Note 1, [www.irmm.jrc.be](http://www.irmm.jrc.be)).

For assessing the method performance, the measured values of the CRMs are compared with the certified values. The procedure is described here in brief:

- Calculate the absolute difference between mean measured value and the certified value ( $\Delta_m$ ).
- Combine measurement uncertainty ( $u_m$ ) with the uncertainty of the certified value ( $u_{CRM}$ ):  $u_{\Delta} = \sqrt{u_m^2 + u_{CRM}^2}$
- Calculate the expanded uncertainty ( $U_{\Delta}$ ) from the combined uncertainty ( $u_{\Delta}$ ) using an appropriate coverage factor, corresponding to a level of confidence of approximately 95 %
- If  $\Delta_m \leq U_{\Delta}$  then there is no significant difference between the measurement result and the certified value, at a confidence level of about 95 %.

### Use as a calibrant

It is not recommended to use this matrix material as calibrant. If used nevertheless, the uncertainty of the certified value shall be taken into account in the estimation of the measurement uncertainty.

### Use in quality control charts

The materials can be used for quality control charts. Different CRM-units will give the same result as heterogeneity was included in the uncertainties of the certified values.

## **STORAGE**

The materials shall be stored at  $(18 \text{ }^{\circ}\text{C} \pm 5) \text{ }^{\circ}\text{C}$  in the dark. Care shall be taken to avoid change of the moisture content once the units are open.

However, the European Commission cannot be held responsible for changes that happen during storage of the material at the customer's premises, especially of opened samples.

## **LEGAL NOTICE**

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## **NOTE**

A detailed technical report is available on [www.irmm.jrc.be](http://www.irmm.jrc.be). A paper copy can be obtained from the Joint Research Centre, Institute for Reference Materials and Measurements on request.

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