MAIN EDITION

BUREAU OF ANALYSED SAMPLES LTD

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4004

BRITISH CHEMICAL STANDARD CERTIFIED REFERENCE MATERIAL

CERTIFICATE OF ANALYSIS
BCS-CRM No. 394/1
CALCINED BAUXITE

Prepared under rigorous laboratory conditions and, AFTER CERTIFICATION ANALYSIS IN GREAT BRITAIN, THE NETHERLANDS, INDIA, CHINA AND MALAYSIA
issued by the Bureau of Analysed Samples Ltd.

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ANALYSES

Mean of 4 values - mass content in %.

All results relate to the dried (105°C) sample.

Analyst	Al_2O_3	SiO_2	TiO_2	Fe_2O_3	CaO	MgO	P_2O_5
1	88.862	6.5940	2.9558	1.3605	0.0128	0.0061	0.0553
2	…	6.4745	2.9443	1.3855	0.0150	0.0050	0.0563
3	89.000	6.4675	2.9850	1.3675	0.0135	0.0053	0.0578
4	88.883	6.5725	2.9993	1.3644	0.0180	0.0031	0.0566
5	89.045	6.4100	2.9450	1.3525	…	…	0.0588
6	88.883	6.4105	…	…	…	0.0032	0.0596
7	88.780	6.3975	2.9700	1.3550	…	…	0.0578
8	88.794	6.4700	2.9253	1.3890	0.0178	0.0063	0.0578
9	88.812	6.4211	2.9567	1.3870	0.0205	0.0046	0.0568
10	88.747	6.3900	2.9990	1.3745	0.0200	…	…
11	…	…	…	…	0.0210	0.0043	…
12	88.959	6.5620	3.0090	1.3815	…	…	…
13	…	…	…	…	…	…	…
M_M	88.877	6.4700	2.9689	1.3717	0.0173	0.0047	0.0574
s_M	0.099	0.0746	0.0281	0.0137	0.0033	0.0012	0.0014
s_w	0.059	0.0438	0.0172	0.0110	0.0014	0.0008	0.0014

Analyst	*Na_2O*	*K_2O*	*LOI*	*ZrO_2*	*Cr_2O_3*	*V_2O_5*	*Ga_2O_3*	*Mn_3O_4*	*La_2O_3*
1	…	*0.0060*	*0.0453*	*0.1293*	*0.080*	*0.0432*	*0.0165*	*0.0041*	*0.0063*
2	*<0.022*	*<0.006*	*0.032*	…	…	…	…	…	…
3	*0.0040*	*0.0070*	…	…	…	…	…	…	…
4	*0.0050*	*0.0052*	*0.1070*	…	…	…	…	…	…
5	*<0.05*	*<0.05*	*<0.01*	…	…	…	…	…	…
6	*0.0050*	*0.0054*	*0.1025*	…	…	…	…	…	…
7	*<0.001*	*<0.001*	*0.0300*	…	…	…	…	…	…
8	*0.0070*	*0.0070*	*0.0350*	*0.1250*	*0.070*	*0.0375*	…	…	…
9	*0.0014*	*0.0045*	*0.0175*	…	…	…	…	…	…
10	*0.0018*	…	*0.1075*	*0.1150*	…	…	…	…	…
11	…	*0.0048*	…	…	…	…	…	…	…
12	*<0.01*	*<0.01*	*0.0648*	…	…	…	…	…	…
13	…	…	…	…	…	*0.0426*	*0.0164*	*0.0039*	*0.0055*

The above figures are those which each Analyst has decided upon after careful verification

Values given in italics are for information only

Additional Information: Analyst No.8 determined SrO using XRF and found a value of 0.01%.

M_M: Mean of the intralaboratory means. s_M: standard deviation of the intralaboratory means. s_W: intralaboratory standard deviation.

CERTIFIED VALUES (Cv)

mass content in %

	Al_2O_3	SiO_2	TiO_2	Fe_2O_3	CaO	MgO	P_2O_5
Cv	**88.88**	**6.47**	**2.969**	**1.372**	**0.0173**	**0.0047**	**0.0574**
C(95%)	0.08	0.06	0.021	0.010	0.0027	0.0010	0.0011

The half width confidence interval **C**(95%) = $\frac{t \times s_M}{\sqrt{n}}$ where "t" is the appropriate two sided Student's t value at the 95% confidence level for "n" acceptable mean values

For further information regarding the confidence interval for the certified value see ISO Guide 35:2006 sections 6.1 and 10.5.2

NB: Although widely accepted within the industry "mass content in %" is neither an SI nor an IUPAC supported quantity. Multiplication of the certified value (Cv) by 10^4 will yield the value in µg/g.

BCS-CRM No. 394/1
CALCINED BAUXITE
NOTES ON METHODS USED

ALUMINA

With the exception of Analysts Nos. 4, 6 and 9 all Analysts determined Alumina by X-Ray Fluorescence Spectrometry (XRF) using a fused bead, Analyst No. 1 following the method in BS EN ISO 12677:2011. Analyst Nos. 4 and 9 determined alumina gravimetrically as the oxinate, No. 4 following a fusion with sodium carbonate and sodium tetraborate, No. 9 fusing with an equimolar mixture of potassium carbonate and sodium carbonate. No. 6 followed the method given in Scott, Wilfred W (5th Edition vol. 1).

SILICA

All Analysts, with the exception of Nos. 4, 6 and 9, determined silica by XRF using a fused bead, Analyst No. 1 following the method in BS EN ISO 12677:2011. Analyst No. 4 determined silica after fusion with sodium carbonate and sodium tetraborate and dehydration with sulphuric acid. No. 6 followed the method in ISO 6607:1985. No. 9 fused the sample with sodium carbonate and boric acid before dehydrating the silica with hydrochloric acid in the presence of polyethylene oxide as a gelling agent before determining silica gravimetrically with hydrofluoric acid.

TITANIUM DIOXIDE

All Analysts, with the exception of Nos. 4 and 9, determined titanium dioxide by XRF using a fused bead, Analyst No. 1 following the method in BS EN ISO 12677:2011. Analyst Nos. 4 and 9 determined titanium dioxide using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), No. 4 fusing with sodium carbonate and sodium tetraborate and No. 9 with boric acid and potassium carbonate.

IRON (III) OXIDE

All Analysts, with the exception of Nos. 4 and 9, determined iron (III) oxide by XRF using a fused bead, Analyst No. 1 following the method in BS EN ISO 12677:2011. Analyst No. 4 determined iron (III) oxide using ICP-OES after fusion with sodium carbonate and sodium tetraborate. Analyst No. 9 used Flame Atomic Absorption Spectrometry (FAAS) following fusion in boric acid and potassium carbonate.

CALCIUM OXIDE

All Analysts, with the exception of Nos. 4, 9 and 11, determined calcium oxide by XRF using a fused bead, Analyst No. 1 following the method in BS EN ISO 12677:2011. Analyst Nos. 4 and 11 determined calcium oxide using ICP-OES, No. 4 fusing with sodium carbonate and sodium tetraborate and No. 11 fusing with lithium borate and dissolving the melt in nitric and hydrofluoric acids. Analyst No. 9 used FAAS following fusion in boric acid and potassium carbonate.

MAGNESIUM OXIDE

All Analysts, with the exception of Nos. 2, 6 and 9, determined magnesium oxide using ICP-OES, No. 1 following microwave dissolution, No. 4 following fusion with sodium carbonate and sodium tetraborate, No. 8 using standard addition and No. 11 after fusion with lithium borate and dissolution of the melt in nitric and hydrofluoric acids. Analyst No. 2 used XRF with a fused bead, No. 6 followed ASTM E1251-07 and No. 9 used FAAS following fusion in boric acid and potassium carbonate.

PHOSPHORUS PENTOXIDE

All Analysts, with the exception of Nos. 4, 6 and 9, determined phosphorus pentoxide by XRF using a fused bead, Analyst No. 1 following the method in BS EN ISO 12677:2011. Analyst Nos. 4 and 9 determined phosphorus pentoxide photometrically as the phosphovanadomolybdate compound, No. 4 fusing the sample with sodium carbonate and sodium tetraborate before extracting the coloured compound with 4-methyl-pentan-2-one whereas No. 9 fused with boric acid and sodium carbonate and did not extract the complex. No. 6 followed the method in ISO 2829:1973.

SODIUM OXIDE

All Analysts, with the exception of Nos. 4, 6, 8 and 9, determined sodium oxide by XRF using a fused bead. Nos. 4 and 9 used FAAS, No. 4 after treatment with hydrochloric, hydrofluoric and sulphuric acids and No. 9 following treatment with hydrochloric, nitric and hydrofluoric acids. Analyst No. 6 followed the method in ASTM E1251-07 and No. 8 used ICP-OES with standard addition.

POTASSIUM OXIDE

Analysts Nos. 1, 2, 5, and 12 determined potassium oxide by XRF using a fused bead, Analyst No. 1 following the method in BS EN ISO 12677:2011. Analysts Nos. 3, 7, 8 and 11 used ICP-OES, No. 8 using standard addition, Nos. 4 and 9 used FAAS, No. 4 after treatment with hydrochloric, hydrofluoric and sulphuric acids and No. 9 following treatment with hydrochloric, nitric and hydrofluoric acids. Analyst No. 6 used the method described in IS 9497:1980.

LOSS ON IGNITION

All Analysts determined Loss On Ignition by igniting to constant weight at a temperature of 1000°C.

ZIRCONIUM OXIDE

All Analysts determined zirconium oxide using XRF. Analyst No. 1 followed the method in BS EN ISO 12677:2011.

CHROMIUM OXIDE

Both Analysts determined chromium oxide using XRF. Analyst No. 1 followed the method in BS EN ISO 12677:2011.

VANADIUM PENTOXIDE

Analyst No. 1 determined vanadium pentoxide using XRF. No. 13 used ICP-OES.

GALLIUM OXIDE

Analyst No. 1 determined gallium oxide using XRF. No. 13 used ICP-OES.

MANGANESE OXIDE

Analyst No. 1 determined manganese oxide using XRF. No. 13 used ICP-OES.

LANTHANUM OXIDE

Analyst No. 1 determined lanthanum oxide using XRF. No. 13 used ICP-OES.

BCS-CRM No. 394/1
CALCINED BAUXITE

DESCRIPTION OF SAMPLE

BCS-CRM 394/1 is sold in the form of finely divided material passing a nominal 125 micron aperture and packed into bottles of 100g.

The preparation of representative samples for chemical analysis and the certification by co-operative analysis was undertaken by Bureau of Analysed Samples Ltd.

Bureau of Analysed Samples Ltd is a United Kingdom Accreditation Service (UKAS) Accredited Reference Material Producer, No 4004, and, as the Producer of BCS-CRM 394/1 as defined in ISO Guide 34:2009 section 3.1, is fully responsible for assigning the certified values and their uncertainties in accordance with ISO Guides 34:2009 and 35:2006.

INTENDED USE

This sample is intended for uses such as the verification of the accuracy and repeatability of analytical methods, such as those used by the participating laboratories, for the calibration of analytical instruments, for establishing values for secondary reference materials and for training purposes.

In order to ensure that a fully representative sample is taken users should take a minimum sub-sample size of 1.0g. Users of this material should be aware that the use of a smaller sub-sample size will invalidate the certified values and the associated 95% confidence limits.

The sample should be mixed thoroughly before each use.

STABILITY

BCS-CRM 394/1 will remain stable provided that the bottle remains sealed and is stored in a dry atmosphere. When the bottle has been opened the lid should be secured immediately after use.

TRACEABILITY

The characterisation of this material has been achieved by chemical analysis involving inter-laboratory study, each laboratory using the method of their choice, details of which are given above.

Most of the analytical methods used in the characterisation of this CRM were either international or national standard methods or methods which are technically equivalent. All laboratories used either stoichiometric analytical techniques or methods which were calibrated predominantly against pure metals or stoichiometric compounds, ensuring traceability of the individual results to the SI.

MEASUREMENT UNCERTAINTY

The uncertainty of each of the certified values of BCS-CRM 394/1 has been established by multiplying the standard error arising from the chemical analysis by the appropriate two sided Student's t value at the 95% confidence level for the number of results. Homogeneity has been assessed on the bulk material using one way ANOVA and has been found to be acceptable. It has not, therefore, been included in the calculated measurement uncertainty. The stability of this CRM and its transportation also make negligible contributions to the overall uncertainty of the certified values.

COMMUTABILTY

BCS-CRM 394/1 is intended to be used in the same physical form as that used by the participating analysts and therefore commutability is not of relevance in respect of this CRM.

Further information and advice on this or other Certified Reference Materials or Reference Materials produced by Bureau of Analysed Samples Ltd may be obtained from the address below.

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