



BUREAU OF ANALYSED SAMPLES LTD

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Certificate No. Q3993

BRITISH CHEMICAL STANDARD CERTIFIED REFERENCE MATERIAL

CERTIFICATE OF ANALYSIS

BCS-CRM No. 372/1

ORDINARY PORTLAND CEMENT

Prepared under rigorous laboratory conditions and, AFTER CERTIFICATION ANALYSIS IN GREAT BRITAIN,
issued by the Bureau of Analysed Samples Ltd.

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ANALYSES

Mean of 4 values - mass content in %.

All values relate to ignited (925°C) sample

Analyst No.	SiO ₂	Al ₂ O ₃	TiO ₂	Fe ₂ O ₃	Mn ₂ O ₃	CaO	MgO	Na ₂ O (Acid Soluble)	K ₂ O (Acid Soluble)	SO ₃	Cr ₂ O ₃	SrO	P ₂ O ₅	Cl
1	20.3	5.33	0.26	3.40	0.074	65.2	1.32	...	...	2.94	<i>0.010</i>	<i>0.055</i>	<i>0.076</i>	<i>0.006</i>
2	20.2	5.39	0.30	3.43	0.074	65.3	1.29	0.10	0.75	2.94	<i>0.011</i>	<i>0.050</i>	<i>0.074</i>	<i>0.007</i>
3	20.5	5.34	0.26	3.46	0.079	65.2	1.31	0.10	0.77	2.96	<i>0.012</i>	<i>0.048</i>	<i>0.069</i>	<i>0.004</i>
4	20.5	5.38	...	3.42	...	65.4	1.29	0.10	0.79	2.95	...	...	...	<i>0.013</i>
5	20.4	5.23	0.30	3.46	0.079	65.3	1.35	...	...	2.94	<i>0.013</i>	<i>0.053</i>	<i>0.079</i>	<i>0.014</i>
6	20.4	5.38	0.26	3.42	...	65.2	1.32	0.09	0.76	2.94	...	...	...	<i>0.009</i>
7	20.4	5.56	...	3.44	...	...	1.34	0.11	0.72	3.01	...	...	...	<i>0.003</i>
8	20.1	5.35	...	3.36	0.078	65.4	1.31	0.09	0.75	2.98	...	...	<i>0.065</i>	<i>0.009</i>
9	20.3	5.38	0.25	3.40	0.060	65.4	1.26	0.10	0.73	2.91	...	<i>0.040</i>	<i>0.070</i>	...
M_M	20.3	5.37	0.27	3.42	0.074	65.3	1.31	0.10	0.75	2.95	...	...	...	...
<i>s_M</i>	0.2	0.09	0.02	0.03	0.007	0.1	0.03	0.01	0.03	0.03	...	...	...	...
<i>s_w</i>	0.1	0.06	0.01	0.02	0.002	0.1	0.04	0.01	0.01	0.02	...	...	...	...

M_M: Mean of the intralaboratory means. **s_M**: standard deviation of the intralaboratory means. **s_w**: intralaboratory standard deviation.

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

Values given above in small italic type are for information only.

Analyst No. 1 also provided the following information: F 0.04%, ZnO: 0.02%, BaO: 0.01%

CERTIFIED VALUES (C_v)

mass content in %

	SiO ₂	Al ₂ O ₃	TiO ₂	Fe ₂ O ₃	Mn ₂ O ₃	CaO	MgO	Na ₂ O (Acid Soluble)	K ₂ O (Acid Soluble)	SO ₃
C_v	20.3	5.37	0.27	3.42	0.074	65.3	1.31	0.10	0.75	2.95
C(95%)	0.2	0.07	0.02	0.03	0.008	0.1	0.03	0.01	0.03	0.03

The half width confidence interval $C(95\%) = \frac{t \times s_M}{\sqrt{n}}$ where "t" is the appropriate Student's t value and "n" is the number of acceptable mean values

For further information regarding the confidence interval for the certified value see ISO Guide 35:1989 section 4.

DESCRIPTION OF SAMPLE

Bottles of 100g of finely divided material for chemical analysis

BCS-CRM No. 372/1

ORDINARY PORTLAND CEMENT

NOTES ON METHODS USED

SILICA

Analysts Nos. 1, 6, 7 and 9 determined silica by X-ray Fluorescence Spectrometry, fused bead technique (XRF), No. 1 according to the Standard method BS 1902: 9.1: 1987 and No. 6 according to a draft method by the BSI Committee CAB/1/2. All other Analysts determined the bulk of the silica gravimetrically, and the residual silica in the filtrate photometrically, as molybdenum blue, according to the Standard Method BS 4550: Part 2: 1970, section 4.2.

ALUMINA

Analysts Nos. 1, 6, 7 and 9 determined alumina by XRF as for silica. Nos. 2, 3, 4 and 8 used the gravimetric method of BS 4550: Part 2: 1970, section 7.2. No. 5 determined alumina titrimetrically with CDTA.

Analyst No. 5 also determined alumina by Flame Atomic Absorption Spectrometry (FAAS) and Inductively Coupled Plasma – Optical Emission Spectrometry (ICP-OES) and obtained mean values of 5.26% and 5.34% respectively.

TITANIA

Analysts Nos. 1, 6 and 9 determined titania by XRF, No. 1 as for silica. Nos. 2 and 3 determined titania photometrically with hydrogen peroxide according to the Standard Method BS 1902: Part 2E: 1970. No. 5 used FAAS

Analyst No. 1 also determined titania by ICP-OES and obtained a mean value of 0.24%.

IRON OXIDE

Analysts Nos. 1, 6, 7, and 9 determined iron oxide by XRF as for silica. Nos. 2, 3, 4 and 8 titrated with potassium dichromate solution after reduction with tin (II) chloride in accordance with the Standard method BS 4550: Part 2: 1970, section 8. No. 5 determined iron oxide photometrically with 2, 2'-bipyridyl.

MANGANESE OXIDE

Analysts Nos. 1 and 9 determined manganese dioxide by XRF as for silica. Nos. 2, 3, 4 and 8 used a photometric method after oxidation with periodate according to the Standard Method BS 4550: Part 2: 1970 section 14.1. No.5 used FAAS.

CALCIUM OXIDE

Analysts Nos. 1, 6 and 9 determined calcium oxide by XRF as for silica. No. 2 used a gravimetric method after precipitation as oxalate, as described in BS 4550: Part 2: 1970 section 6.1. Nos. 3, 4, 5 and 8 used titrimetric methods with EDTA or EGTA according to BS 4550: Part 2: 1970 section 6.2

Note: The determination of CaO by both gravimetric and titrimetric methods is subject to interference from strontium. If determined gravimetrically the apparent calcium oxide is the total of both calcium and strontium oxides (CaO + SrO). If determined titrimetrically the apparent calcium oxide content includes part of the strontium (CaO + 0.54SrO). All results have been corrected for strontium interference.

MAGNESIA

Analysts Nos. 1, 6, 7 and 9 determined magnesia by XRF as for silica. Nos. 2, 5 and 8 used FAAS. Nos. 3 and 4 used a titrimetric method according to the Standard Method BS 4550: Part 2: 1970, section 9.2.

SODIUM OXIDE

Analysts Nos. 2, 3, 4, 6, 7, 8 and 9 determined acid-soluble sodium oxide by Flame Atomic Emission Spectrometry (FAES) after dissolution with nitric acid according to the Standard Method BS 4550: Part 2: 1970 section 9.2 as amended by AMD 4260.

Analysts Nos. 1, 2, 5, and 9 also determined total sodium oxide. No. 1 used XRF, as for silica; Nos. 2 and 9 used FAES and No. 5 used FAAS, after dissolution using hydrofluoric acid. They obtained mean values of 0.10%, 0.10%, 0.09% and 0.10% respectively.

POTASSIUM OXIDE

All Analysts determined acid-soluble potassium oxide using similar methods as for acid-soluble sodium oxide.

Analysts Nos. 1, 2, 5, 7 and 9 also determined total potassium oxide, using similar methods as for total sodium oxide, and found 0.80%, 0.78%, 0.80%, 0.74% and 0.77% respectively.

SULPHURIC ANHYDRIDE

Analysts Nos. 1 and 7 determined sulphuric anhydride after combustion in a high frequency induction furnace, No. 1 by iodometric titration and No. 7 by infrared absorption. All other Analysts determined sulphuric anhydride gravimetrically as barium sulphate according to the Standard Method BS 4550: Part 2: 1970, section 10.

CHROMIC OXIDE

Analyst No. 1 determined chromic oxide using XRF as for silica, Nos. 2, 3 and 5 used FAAS.

STRONTIUM OXIDE

Analysts Nos. 1 and 9 determined strontium oxide using XRF as for silica, Nos. 2, 3 and 5 used FAAS.

PHOSPHORUS PENTOXIDE

Analysts Nos. 1 and 9 determined phosphorus pentoxide using XRF as for silica. Nos. 2, 3, 5 and 8 used photometric methods, Nos. 2, 3 and 8 as phosphovanadomolybdate (Bowley, Analyst, 98, 1973, 739-744) and No. 5 as molybdenum blue.

Analyst No. 2 also used the Standard Method BS 4550: part 2: 1970, section 14.2.2 and obtained a mean value of 0.107%.

CHLORIDE

Analyst No. 1 determined chloride by ion chromatography after aqueous extraction. Nos. 2, 4, 5, 6 and 8 used titrimetric methods according to the draft amendment to the Standard Method BS 4550: Part 2: 1970. No. 3 determined chloride turbidimetrically with silver nitrate and No. 7 used XRF.

INTENDED USE & STABILITY

This sample is intended for the verification of analytical methods, such as those used by the participating laboratories, for the calibration of analytical instruments in cases where the calibration with primary substances (pure metals or stoichiometric compounds) is not possible and for establishing values for secondary reference materials.

It will remain stable provided that the bottle remains sealed and is stored in a cool, dry atmosphere. When the bottle has been opened the lid should be secured immediately after use.

TRACEABILITY

The traceability of this BCS-CRM is ensured by the use of either stoichiometric analytical techniques or methods which are calibrated against pure metals or stoichiometric compounds.

This Certified Reference Material has been prepared in accordance with the recommendations specified in ISO Guides 30 to 35, available from the International Standards Organisation in Geneva.

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For BUREAU OF ANALYSED SAMPLES LTD.
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Chairman

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