The Technical Association of Refractories, Japan

Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

J R R M　7 0 1　(Alumina-Zirconia-Silica Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Cr_2O_3	ZrO_2 (+HfO_2)	HfO_2	ZrO_2 *3	Uncertified value	
														MnO	P_2O_5
Certified value		28.47	10.10	2.010	4.965	2.075	0.477	1.847	0.024	1.011	48.96	0.850	48.11	0.007	0.027
Laboratories	L_1	28.28 p	10.16 e	2.018 i	4.968 i	2.093 i	0.455 i	1.868 a	0.031 a	1.000 i	48.60 m	0.830 x	—	0.008 i	0.022 c
	L_2	28.41 p	10.10 e	2.034 c	4.941 i	2.054 i	0.475 i	1.842 f	0.026 f	0.989 i	48.81 m	0.837 i	—	0.008 i	0.037 c
	L_3	28.42 h	10.30	1.980 c	4.986 c	2.084 a	0.476 a	1.842 a	0.021 a	0.992 a	49.26 m	0.827 x	—	—	—
	L_4	28.30 p	10.02 c	2.025 i	4.961 i	2.135 i	0.505 i	1.858 a	0.026 a	1.007 i	49.15 m	0.855 i	—	0.009 i	—
	L_5	28.66 h	10.09 e	1.990 c	4.953 c	2.009 a	0.483 a	1.838 a	0.019 a	1.052 a	48.93 m	0.853 x	—	0.001 a	0.022 c
	L_6	28.53 h	10.00 e	2.028 c	4.985 i	2.091 i	0.487 i	1.862 a	0.024 a	1.011 i	48.72 m	0.870 i	—	0.006 i	0.030 c
	L_7	28.67 p	10.09 e	1.984 c	4.941 x	2.041 a	0.446 a	1.809 a	0.020 a	1.039 a	49.00 g	0.865 i	—	—	—
	L_8	28.50 p	10.04 v	2.006 c	4.979 c	2.091 a	0.486 a	1.860 a	0.022 a	0.988 a	49.15 m	0.868 x	—	0.007 c	0.022 c
Average	($\bar{X}$)	28.463	10.108	2.0095	4.9651	2.0753	0.4768	1.8474	0.0236	1.0109	48.956	0.8504	48.106	0.0070	0.0266
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.139	0.098	0.0206	0.0192	0.0392	0.0184	0.0196	0.0039	0.0236	0.210	0.0170	—	0.0017	0.0068
deviation (Reproducibility without laboratories)	$s_{I(T)}$ *1	0.100	0.083	0.0101	0.0085	0.0112	0.0056	0.0195	0.0022	0.0065	0.128	0.0070	—	0.0006	0.0057
Uncertainty C (95%) *2		0.11	0.08	0.017	0.018	0.033	0.015	0.018	0.003	0.026	0.18	0.014	0.18 *4	0.002	0.008

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.　* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$　* 4 $s_{\bar{x}ZrO_2} = \sqrt{\left(s_{\bar{x}ZrO_2(HfO_2)}\right)^2 + \left(s_{\bar{x}HfO_2}\right)^2}$

(1) List of laboratories : Kurosaki Corporation, Kawasaki Refractories Co.,Ltd., Yotai Refractories Co.,Ltd., Asahi Glass Co.,Ltd., Harima Ceramic Co.,Ltd., Shinagawa Refractories Co.,Ltd., Toshiba Ceramics Co.,Ltd., Toshiba Monofrax Co.,Ltd.

(2) Analytical techniques : JIS R 2013(Method for chemical analysis of refractory containing alumina, zirconia and silica) a;AAS, c;colorimetry,e;Ionexchange-chelatometry, f;flametry, g;Cupfrron Gravimetry, h;dehydratmetry+colorimetry, i;ICP-AES, m;Mandelic acid Gravimetry, p;coagulatmetry・+colorimetry,v;Cupfrron Separation-chelatometry, x;XRF

(3) Analytical values : Each value is the average of two values obtained by two measurements on different days. These analysis values are shown converted into LOI (Loss on ignition) component free values from the February 22, 2008 v20080222 version on.

(4) Outlier tests were carried out by Grubbs test. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was determined whether the outliers should be adopted or not.

(5) Date of preparation : June, 1996

Prepared, and Values given and certified by

The Technical Association of Refractories, Japan
New Ginza Bldg., 3-13, Ginza 7-chome, Chuo-ku, Tokyo 104-0061, Japan
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The Technical Association of Refractories, Japan

Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

J R R M　7 0 2　(Alumina–Zirconia–Silica Refractory)

Results of Analyses

Unit : mass%

Constituent	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Cr_2O_3	ZrO_2 (+HfO_2)	HfO_2	ZrO_2 *3	Uncertified value	
													MnO	P_2O_5
Certified value	10.01	38.21	0.374	0.211	1.555	1.982	2.027	0.585	0.111	44.71	2.090	42.62	0.004	0.028
Laboratories L1	9.96 p	38.31 e	0.367 i	0.204 i	1.567 i	1.993 i	2.045 a	0.581 a	0.120 i	44.72 m	2.061 x	—	0.004 i	0.027 c
L2	9.967 p	38.04 a	0.375 c	0.210 i	1.536 i	1.949 i	2.035 f	0.587 f	0.114 i	44.75 m	2.070 i	—	0.004 i	0.030 c
L3	10.18 h	38.25	0.377 c	0.198 c	1.582 a	2.002 a	1.999 a	0.561 a	0.108 a	44.82 m	2.069 x	—	—	—
L4	9.929 p	38.14 v	0.371 i	0.205 i	1.562 i	1.997 i	2.043 a	0.601 a	0.111 i	44.75 m	2.121 i	—	0.004 i	—
L5	9.995 h	38.29 e	0.375 c	0.198 c	1.545 a	1.989 a	2.039 a	0.549 a	0.105 a	44.62 m	2.035 x	—	0.002 a	0.027 c
L6	9.992 h	38.16 e	0.369 c	0.221 c	1.559 i	1.987 i	2.013 a	0.579 a	0.104 a	44.54 m	2.115 i	—	0.004 i	0.029 c
L7	10.15 p	38.38 e	0.383 c	0.231 c	1.541 a	1.983 i	2.017 a	0.591 a	0.112 a	44.79 g	2.107 i	—	—	—
L8	9.946 p	38.14 v	0.379	0.220 c	1.542 a	1.959 a	2.027 a	0.585 a	0.112 a	44.70 m	2.138 x	—	0.005 a	0.025 c
Average ($\bar{\bar{X}}$)	10.012	38.214	0.3745	0.2106	1.5548	1.9824	2.0273	0.5796	0.1109	44.711	2.0899	42.621	0.0038	0.0278
Standard (Reproducibility) $s_{\bar{x}}$	0.090	0.101	0.0056	0.0122	0.0161	0.0183	0.0163	0.0161	0.0050	0.094	0.0360	—	0.0010	0.0014
deviation (Reproducibility without laboratories) $s_{I(T)}$ *1	0.057	0.079	0.0076	0.0034	0.0116	0.0119	0.0175	0.0122	0.0024	0.108	0.0093	—	0.0008	0.0013
Uncertainty C (95%) *2	0.08	0.08	0.005	0.010	0.013	0.015	0.014	0.013	0.004	0.08	0.030	0.08 *4	0.001	0.002

(Note) ＊1 $s_{I(T)}$ is intermediate precision without a time condition.　＊2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

＊3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$　＊4 $s_{\bar{x}\,ZrO_2} = \sqrt{\left(s_{\bar{x}\,ZrO_2(HfO_2)}\right)^2 + \left(s_{\bar{x}\,HfO_2}\right)^2}$

(1) List of laboratories : Kurosaki Corporation, Kawasaki Refractories Co.,Ltd., Yotai Refractories Co.,Ltd., Asahi Glass Co.,Ltd., Harima Ceramic Co.,Ltd., Shinagawa Refractories Co.,Ltd., Toshiba Ceramics Co.,Ltd., Toshiba Monofrax Co.,Ltd.

(2) Analytical techniques : JIS R 2013(Method for chemical analysis of refractory containing alumina, zirconia and silica) a;AAS, c;colorimetry, e;Ionexchange-chelatometry, f;flametry, g;Cupfrron Gravimetry, h;dehydratmetry+colorimetry, i;ICP-AES, m;Mandelic acid Gravimetry, p;coagulatmetry・+colorimetry, v;Cupfrron Separation-chelatometry, x;XRF

(3) Analytical values : Each value is the average of two values obtained by two measurements on different days. These analysis values are shown converted into LOI (Loss on ignition) component free values from the February 22, 2008 v20080222 version on.

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Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

J R R M　7 0 3　(Alumina-Zirconia-Silica Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Cr_2O_3	ZrO_2 (+HfO_2)	HfO_2	ZrO_2 *3	Uncertified value	
														MnO	P_2O_5
Certified value		14.66	46.39	0.059	0.072	0.037	0.011	0.535	0.002	0.006	38.12	0.728	37.39	0.000	0.035
Laboratories	L_1	14.51 μ	46.63 e	0.058 i	0.070 i	0.036 i	0.012 i	0.522 n	0.004 n	0.010 i	38.22 m	0.719 x	—	0.000 i	0.037 c
	L_2	14.68 p	46.28 n	0.060 c	0.073 c	0.035 i	0.008 i	0.532 f	0.000 f	0.004 i	37.91 m	0.703 i	—	0.000 i	0.034 c
	L_3	14.77 h	46.34	0.064 c	0.081 c	0.038 n	0.014 n	0.538 n	0.002 n	0.022 n	38.30 m	0.709 x	—	—	—
	L_4	14.58 p	46.22 v	0.056 i	0.061 i	0.041 i	0.011 i	0.559 n	0.000 n	0.000 i	38.20 m	0.743 i	—	0.001 i	—
	L_5	14.58 h	46.43 e	0.060 c	0.068 c	0.035 c	0.010 n	0.546 n	0.001 n	0.002 c	38.16 m	0.713 x	—	0.000 n	0.032 c
	L_6	14.69 h	46.25 c	0.054 c	0.072 c	0.040 i	0.011 i	0.520 n	0.006 n	0.000 n	38.03 m	0.740 i	—	0.000 i	0.040 c
	L_7	14.88 μ	46.51 e	0.058 c	0.083 c	0.034 n	0.010 i	0.530 n	0.004 n	0.004 n	38.00 g	0.742 i	—	—	—
	L_8	14.61 μ	46.44 v	0.062 c	0.067 c	0.038 n	0.014 n	0.538 n	0.002 n	0.004 n	38.10 m	0.753 x	—	0.000 n	0.030 c
Average	($\bar{\bar{X}}$)	14.660	46.389	0.0585	0.0720	0.0373	0.0113	0.5353	0.0024	0.0058	38.115	0.7278	37.387	0.0002	0.0348
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.121	0.143	0.0034	0.0067	0.0025	0.0020	0.0122	0.0021	0.0081	0.131	0.0188	—	0.0009	0.0041
deviation (Reproducibility without laboratories)	$s_{l(T)}$ *1	0.087	0.078	0.0019	0.0030	0.0052	0.0013	0.0050	0.0019	0.0040	0.086	0.0062	—	0.0003	0.0011
Uncertainty C (95%) *2		0.10	0.12	0.003	0.006	0.002	0.002	0.010	0.002	0.007	0.11	0.018	0.11 *4	0.001	0.005

(Note) * 1 $s_{l(T)}$ is intermediate precision without a time condition.
* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$ (ℓ = number of laboratories)
* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$
* 4 $s_{\bar{x}\,ZrO_2} = \sqrt{\left(s_{\bar{x}\,ZrO_2(HfO_2)}\right)^2 + \left(s_{\bar{x}\,HfO_2}\right)^2}$

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J R R M　7 0 4　(Alumina–Zirconia–Silica Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Cr_2O_3	ZrO_2 (+HfO_2)	HfO_2	ZrO_2 *3	Uncertified value	
														MnO	P_2O_5
Certified value		42.64	19.59	0.554	1.026	0.155	0.515	0.228	0.402	0.516	34.16	0.685	33.48	0.089	0.130
Laboratories	L_1	42.42 p	19.71 e	0.550 i	1.032 i	0.148 i	0.494 i	0.222 a	0.400 a	0.503 i	34.29 m	0.670 x	—	0.092 i	0.138 c
	L_2	42.74 p	19.50 e	0.552 c	1.011 i	0.149 i	0.513 i	0.234 f	0.402 f	0.511 i	34.09 m	0.689 i	—	0.094 i	0.111 c
	L_3	42.72 h	19.57	0.553 c	1.030 c	0.164 a	0.518 a	0.229 a	0.392 a	0.511 a	34.32 m	0.659 x	—	—	—
	L_4	42.48 p	19.57 e	0.541 i	1.033 i	0.162 i	0.535 i	0.241 a	0.404 a	0.508 i	34.17 m	0.693 i	—	0.090 i	—
	L_5	42.73 h	19.50 e	0.559 c	1.031 c	0.152 a	0.512 a	0.210 a	0.402 a	0.541 a	34.16 m	0.697 x	—	0.058 a	0.112 c
	L_6	42.69 h	19.53 e	0.560 c	1.031 i	0.158 i	0.510 i	0.226 a	0.402 a	0.518 i	34.12 m	0.688 i	—	0.091 i	0.172 c
	L_7	42.70 p	19.72 e	0.565 c	1.017 x	0.152 a	0.512 i	0.236 a	0.410 a	0.532 a	34.10 g	0.693 i	—	—	—
	L_8	42.65 p	19.65 v	0.550 c	1.020 c	0.154 a	0.528 a	0.224 a	0.400 a	0.518 a	34.05 m	0.690 x	—	0.096 a	0.116 c
Average	($\bar{\bar{X}}$)	42.641	19.594	0.5539	1.0260	0.1549	0.5150	0.2281	0.4026	0.5178	34.164	0.6849	33.479	0.0888	0.1304
Standard deviation	(Reproducibility) $s_{\bar{x}}$	0.118	0.091	0.0076	0.0086	0.0061	0.0118	0.0102	0.0049	0.0126	0.098	0.0140	—	0.0152	0.0259
	(Reproducibility without laboratories) $s_{I(T)}$ *1	0.086	0.102	0.0064	0.0071	0.0040	0.0043	0.0054	0.0056	0.0083	0.107	0.0067	—	0.0018	0.0032
Uncertainty C (95%) *2		0.10	0.07	0.008	0.007	0.005	0.010	0.008	0.004	0.010	0.08	0.011	0.08 *4	0.012	0.021

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.

* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$ (ℓ = number of laboratories)

* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$

* 4 $s_{\bar{x}ZrO_2} = \sqrt{\left(s_{\bar{x}ZrO_2(HfO_2)}\right)^2 + \left(s_{\bar{x}HfO_2}\right)^2}$

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Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Cr_2O_3	ZrO_2 ($+HfO_2$)	HfO_2	ZrO_2 *3	Uncertified value	
														MnO	P_2O_5
Certified value		2.00$_2$	64.2$_4$	0.14$_1$	2.02$_4$	0.19$_1$	0.46$_1$	0.30$_1$	0.01$_8$	2.02$_2$	28.5$_0$	0.48$_5$	28.0$_1$	0.00$_4$	0.01$_7$
Laboratories	L$_1$	2.00$_4$ c	64.2$_5$ e	0.13$_1$ i	2.04$_0$ i	0.19$_4$ i	0.45$_5$ i	0.28$_6$ n	0.01$_9$ n	2.02$_6$ i	28.3$_5$ m	0.47$_9$ x	—	0.00$_4$ i	0.04$_6$ e
	L$_2$	1.97$_4$ c	64.1$_3$ e	0.14$_0$ e	2.02$_9$ i	0.18$_0$ i	0.46$_9$ i	0.30$_0$ f	0.01$_8$ f	2.01$_9$ i	28.5$_4$ m	0.48$_7$ i	—	0.00$_5$ i	0.01$_1$ e
	L$_3$	2.01$_1$ h	64.0$_5$	0.14$_1$ e	2.03$_8$ e	0.20$_8$ n	0.46$_1$ n	0.32$_6$ n	0.02$_3$ n	1.99$_6$ n	28.6$_8$ m	0.47$_2$ x	—	—	—
	L$_4$	1.93$_7$ p	64.1$_5$ e	0.14$_3$ i	2.04$_8$ i	0.19$_8$ i	0.48$_3$ i	0.30$_3$ n	0.01$_9$ n	2.03$_1$ i	28.7$_3$ m	0.50$_4$ i	—	0.00$_6$ i	—
	L$_5$	2.08$_5$ c	64.3$_2$ e	0.13$_9$ e	1.97$_0$ e	0.18$_2$ n	0.45$_7$ n	0.28$_9$ n	0.01$_8$ n	2.02$_9$ n	28.4$_0$ m	0.47$_1$ x	—	0.00$_9$ n	0.01$_1$ e
	L$_6$	2.06$_5$ c	64.4$_2$ e	0.13$_1$ e	2.04$_8$ i	0.19$_8$ i	0.46$_7$ i	0.29$_9$ n	0.01$_4$ n	2.01$_6$ i	28.4$_1$ m	0.48$_3$ i	—	0.00$_4$ i	0.01$_2$ e
	L$_7$	2.01$_0$ c	64.4$_9$ e	0.15$_0$ e	1.99$_4$ x	0.18$_1$ n	0.45$_4$ n	0.31$_3$ n	0.01$_8$ n	2.03$_7$ n	28.5$_1$ m	0.48$_7$ i	—	—	—
	L$_8$	1.93$_1$ c	64.1$_2$ v	0.15$_2$ e	2.02$_6$ e	0.18$_6$ n	0.44$_1$ n	0.29$_6$ n	0.01$_8$ n	2.02$_1$ n	28.3$_7$ m	0.49$_6$ x	—	0.00$_6$ n	0.01$_2$ e
Average	($\bar{\bar{X}}$)	2.002$_3$	64.24$_1$	0.141$_3$	2.024$_1$	0.191$_3$	0.460$_9$	0.300$_8$	0.018$_4$	2.022$_3$	28.49$_5$	0.484$_8$	28.01$_1$	0.004$_2$	0.017$_2$
Standard deviation	(Reproducibility) $s_{\bar{X}}$	0.054$_5$	0.13$_7$	0.007$_8$	0.028$_8$	0.009$_7$	0.012$_3$	0.014$_0$	0.002$_4$	0.012$_6$	0.14$_4$	0.011$_2$	—	0.002$_9$	0.012$_5$
	(Reproducibility without laboratories) $s_{I(T)}$ *1	0.061$_6$	0.11$_4$	0.003$_0$	0.008$_0$	0.002$_4$	0.006$_6$	0.005$_3$	0.001$_7$	0.010$_8$	0.08$_3$	0.004$_2$	—	0.000$_8$	0.001$_2$
Uncertainty C (95%) *2		0.04$_6$	0.1$_1$	0.00$_7$	0.02$_4$	0.00$_8$	0.01$_0$	0.01$_2$	0.00$_2$	0.01$_1$	0.1$_2$	0.00$_9$	0.1$_2$ *4	0.00$_2$	0.01$_6$

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.　* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$　* 4 $s_{\bar{x}\,ZrO_2} = \sqrt{\left(s_{\bar{x}\,ZrO_2(HfO_2)}\right)^2 + \left(s_{\bar{x}\,HfO_2}\right)^2}$

(1) List of laboratories : Kurosaki Corporation, Kawasaki Refractories Co.,Ltd., Yotai Refractories Co.,Ltd., Asahi Glass Co.,Ltd., Harima Ceramic Co.,Ltd., Shinagawa Refractories Co.,Ltd., Toshiba Ceramics Co.,Ltd., Toshiba Monofrax Co.,Ltd.

(2) Analytical techniques : JIS R 2013(Method for chemical analysis of refractory containing alumina, zirconia and silica) a;AAS, c;colorimetry,e;Ionexchange-chelatometry, f;flametry, g;Cupfrron Gravimetry, h;dehydratmetry+colorimetry, i;ICP-AES, m;Mandelic acid Gravimetry, p;coagulatmetry ・ +colorimetry,v;Cupfrron Separation-chelatometry, x;XRF

(3) Analytical values : Each value is the average of two values obtained by two measurements on different days. These analysis values are shown converted into LOI (Loss on ignition) component free values from the February 22, 2008 v20080222 version on.

(4) Outlier tests were carried out by Grubbs test. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was determined whether the outliers should be adopted or not.

(5) Date of preparation : June, 1996

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Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

J R R M　7 0 6　(Alumina-Zirconia-Silica Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Cr_2O_3	ZrO_2 ($+HfO_2$)	HfO_2	ZrO_2 *3	Uncertified value	
														MnO	P_2O_5
Certified value		39.62	26.14	0.131	3.806	1.599	0.159	3.521	0.959	0.010	24.09	1.199	22.89	0.004	0.016
Laboratories	L_1	39.63 p	26.15 e	0.131 i	3.776 i	1.616 i	0.165 i	3.518 a	0.971 a	0.019 i	24.12 m	1.197 x	—	0.006 i	0.017 e
	L_2	39.63 p	26.09 e	0.135 e	3.819 x	1.592 i	0.158 i	3.568 f	0.969 f	0.011 i	24.04 m	1.134 i	—	0.004 i	0.016 e
	L_3	39.65 p	26.16 e	0.129 e	3.789 i	1.617 i	0.161 i	3.498 a	0.972 a	0.008 i	24.07 m	1.191 i	—	0.008 i	0.014 e
	L_4	39.59 h	26.25	0.139 e	3.822 x	1.588 a	0.146 a	3.514 a	0.963 a	0.008 a	24.09 m	1.183 x	—	—	—
	L_5	39.57 p	26.10 e	0.131 i	3.819 i	1.599 i	0.159 i	3.545 a	0.957 a	0.012 i	24.02 m	1.208 i	—	0.005 i	—
	L_6	39.61 h	26.06 e	0.130 e	3.789 x	1.595 a	0.161 a	3.499 a	0.951 a	0.010 a	24.05 m	1.233 x	—	0.002 a	0.017 e
	L_7	39.63 h	26.20 e	0.129 e	3.826 e	1.611 i	0.166 i	3.506 a	0.943 a	0.008 a	24.12 m	1.212 i	—	0.001 i	0.018 e
	L_8	39.61 p	26.13 e	0.133 e	3.809 x	1.582 a	0.158 a	3.520 a	0.943 a	0.009 a	24.24 m	1.235 x	—	0.003 a	0.011 e
Average	($\bar{\bar{X}}$)	39.615	26.143	0.1310	3.8061	1.5989	0.1593	3.5214	0.9585	0.0095	24.086	1.1991	22.887	0.0039	0.0155
Standard deviation (Reproducibility)	$s_{\bar{X}}$	0.030	0.064	0.0020	0.0192	0.0130	0.0062	0.0243	0.0117	0.0015	0.075	0.0321	—	0.0020	0.0025
deviation (Reproducibility without laboratories)	$s_{I(T)}$ *1	0.084	0.073	0.0017	0.0109	0.0082	0.0040	0.0168	0.0044	0.0015	0.065	0.0128	—	0.0005	0.0016
Uncertainty C (95%) *2		0.03	0.05	0.002	0.016	0.011	0.005	0.020	0.010	0.001	0.07	0.027	0.07 *4	0.002	0.003

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.
* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$ (ℓ = number of laboratories)
* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$
* 4 $s_{\bar{x}\,ZrO_2} = \sqrt{\left(s_{\bar{x}\,ZrO_2(HfO_2)}\right)^2 + \left(s_{\bar{x}\,HfO_2}\right)^2}$

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Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

J R R M　7 0 7　(Alumina-Zirconia-Silica Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Cr_2O_3	ZrO_2 (+HfO_2)	HfO_2	ZrO_2 *3	Uncertified value	
														MnO	P_2O_5
Certified value		21.17	55.78	1.815	0.289	1.086	0.844	0.199	0.155	0.180	18.53	0.367	18.16	0.003	0.056
Laboratories	L_1	21.16 p	55.69 v	1.832 i	0.285 i	1.090 i	0.848 i	0.202 n	0.154 n	0.183 i	18.52 m	0.363 x	—	0.005 i	0.052 c
	L_2	21.20 p	55.70 e	1.812 c	0.288 i	1.083 i	0.845 i	0.193 f	0.159 f	0.176 i	18.44 m	0.378 i	—	0.004 i	0.055 c
	L_3	21.04 p	55.83 e	1.808 c	0.292 i	1.092 i	0.841 i	0.204 n	0.150 n	0.179 i	18.45 m	0.372 i	—	0.004 i	0.058 c
	L_4	21.25 h	55.79	1.807 c	0.290 c	1.082 n	0.848 n	0.208 n	0.154 n	0.178 n	18.73 m	0.349 x	—	—	—
	L_5	21.19 p	55.75 e	1.826 i	0.290 i	1.078 i	0.846 i	0.206 n	0.156 n	0.174 i	18.47 m	0.373 i	—	0.004 i	—
	L_6	21.27 h	55.85 e	1.820 c	0.291 c	1.084 n	0.844 n	0.203 n	0.152 n	0.182 n	18.46 m	0.354 x	—	0.002 n	0.056 c
	L_7	21.02 h	55.89 e	1.826 c	0.294 c	1.092 i	0.841 i	0.177 n	0.153 n	0.182 i	18.48 m	0.376 i	—	0.001 i	0.055 c
	L_8	21.22 p	55.77 v	1.794 c	0.282	1.080 n	0.842 n	0.200 n	0.160 n	0.184 n	18.66 m	0.374 x	—	0.002 n	0.053 c
Average	$(\bar{X})$	21.169	55.784	1.8149	0.2886	1.0855	0.8444	0.1991	0.1548	0.1798	18.525	0.3674	18.159	0.0031	0.0550
Standard deviation (Reproducibility)	$s_{\bar{x}}$	0.093	0.074	0.0122	0.0042	0.0064	0.0029	0.0099	0.0033	0.0035	0.108	0.0110	—	0.0015	0.0023
deviation (Reproducibility without laboratories)	$s_{I(T)}$ *1	0.043	0.124	0.0078	0.0023	0.0064	0.0071	0.0025	0.0044	0.0027	0.074	0.0051	—	0.0012	0.0012
Uncertainty C (95%) *2		0.08	0.08	0.010	0.004	0.005	0.002	0.006	0.003	0.003	0.09	0.009	0.0[0] *4	0.002	0.002

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.
* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$ (ℓ = number of laboratories)
* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$
* 4 $s_{\bar{x}\,ZrO_2} = \sqrt{\left(s_{\bar{x}\,ZrO_2(HfO_2)}\right)^2 + \left(s_{\bar{x}\,HfO_2}\right)^2}$

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Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

J R R M　7 0 8　(Alumina-Zirconia-Silica Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Cr_2O_3	ZrO_2 ($+HfO_2$)	HfO_2	ZrO_2 *3	Uncertified value	
														MnO	P_2O_5
Certified value		0.54$_7$	79.6$_3$	0.80$_1$	1.02$_1$	1.17$_4$	1.64$_9$	0.08$_9$	0.74$_6$	0.29$_8$	13.8$_2$	1.03$_4$	12.8$_9$	0.00$_1$	0.00$_2$
Laboratories	L_1	0.54$_7$ c	79.5$_0$ c	0.80$_5$ i	1.00$_1$ i	1.18$_2$ i	1.66$_4$ i	0.07$_4$ a	0.72$_3$ a	0.29$_6$ i	13.9$_1$ m	1.01$_9$ x	—	0.00$_2$ i	0.00$_2$ c
	L_2	0.56$_3$ c	79.7$_2$ c	0.80$_6$ c	1.03$_5$ x	1.18$_8$ i	1.66$_4$ i	0.09$_4$ f	0.75$_4$ f	0.29$_1$ i	13.9$_6$ m	1.06$_5$ i	—	0.00$_1$ i	0.00$_2$ c
	L_3	0.54$_3$ c	79.6$_7$ c	0.80$_1$ c	1.01$_4$ i	1.18$_5$ i	1.65$_4$ i	0.08$_7$ a	0.75$_6$ a	0.29$_9$ i	13.9$_1$ m	1.03$_2$ i	—	0.00$_1$ i	0.00$_3$ c
	L_4	0.557	79.7$_4$	0.80$_1$ c	1.03$_8$ x	1.16$_2$ a	1.64$_4$ a	0.09$_2$ a	0.75$_1$ a	0.29$_8$ a	13.8$_0$ m	1.01$_6$ x	—	—	—
	L_5	0.55$_9$ a	79.4$_8$ c	0.79$_1$ i	1.00$_9$ i	1.15$_4$ i	1.64$_7$ i	0.09$_6$ a	0.77$_9$ a	0.29$_7$ i	13.8$_2$ m	1.03$_9$ i	—	0.00$_1$ i	—
	L_6	0.54$_7$ c	79.6$_7$ c	0.79$_7$ c	1.02$_5$ x	1.18$_3$ a	1.64$_2$ a	0.09$_1$ a	0.74$_3$ a	0.29$_9$ a	13.8$_7$ m	1.01$_9$ x	—	0.00$_0$ a	0.00$_2$ c
	L_7	0.52$_3$ c	79.6$_1$ c	0.80$_7$ c	1.03$_1$ i	1.18$_8$ i	1.64$_0$ i	0.08$_5$ a	0.74$_3$ a	0.29$_5$ i	13.9$_6$ m	1.01$_6$ i	—	0.00$_0$ i	0.00$_2$ c
	L_8	0.53$_6$ c	79.6$_7$ c	0.80$_1$ c	1.01$_6$ x	1.15$_1$ a	1.63$_4$ a	0.09$_0$ a	0.72$_4$ a	0.30$_0$ a	13.8$_9$ m	1.06$_8$ x	—	0.00$_0$ a	0.00$_0$ c
Average	($\overline{X}$)	0.546$_9$	79.63$_3$	0.801$_1$	1.021$_0$	1.173$_9$	1.648$_5$	0.088$_6$	0.746$_5$	0.297$_5$	13.89$_0$	1.034$_3$	12.85$_6$	0.000$_7$	0.001$_8$
Standard deviation	(Reproducibility) $s_{\bar{x}}$	0.013$_0$	0.10$_5$	0.005$_3$	0.013$_2$	0.015$_4$	0.010$_9$	0.006$_7$	0.018$_0$	0.002$_1$	0.05$_9$	0.021$_5$	—	0.000$_7$	0.000$_8$
	(Reproducibility without laboratories) $s_{I(T)}$ *1	0.007$_3$	0.07$_8$	0.004$_8$	0.005$_9$	0.004$_7$	0.007$_9$	0.001$_8$	0.002$_4$	0.002$_8$	0.07$_4$	0.012$_3$	—	0.000$_7$	0.001$_0$
Uncertainty C (95%) *2		0.01$_1$	0.0$_9$	0.00$_4$	0.01$_1$	0.01$_3$	0.00$_9$	0.00$_6$	0.01$_5$	0.00$_2$	0.0$_8$	0.01$_8$	0.0$_5$ *4	0.00$_1$	0.00$_1$

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.

* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$ (ℓ = number of laboratories)

* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$

* 4 $s_{\bar{x}\,ZrO_2} = \sqrt{\left(s_{\bar{x}\,ZrO_2(HfO_2)}\right)^2 + \left(s_{\bar{x}\,HfO_2}\right)^2}$

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J R R M　7 0 9　(Alumina-Zirconia-Silica Refractory)

Results of Analyses

Unit : mass%

Constituent	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Cr_2O_3	ZrO_2 (+HfO_2)	HfO_2	ZrO_2 *3	Uncertified value	
													MnO	P_2O_5
Certified value	34.45	50.45	0.477	0.091	0.525	1.210	1.040	0.216	2.922	8.523	0.184	8.340	0.002	0.009
Laboratories L_1	34.55 p	50.27 e	0.472 i	0.088 i	0.526 i	1.211 i	1.016 a	0.214 a	2.933 i	8.616 m	0.176 x	—	0.001 i	0.010 c
L_2	34.42 p	50.43 e	0.482 c	0.088 i	0.534 i	1.209 i	1.058 f	0.218 f	2.886 i	8.508 m	0.200 i	—	0.002 i	0.010 c
L_3	34.48 p	50.48 e	0.474 c	0.092 i	0.524 i	1.213 i	1.040 a	0.221 a	2.939 i	8.578 m	0.190 i	—	0.004 i	0.008 c
L_4	34.56 h	50.50	0.473 c	0.092 c	0.519 a	1.210 a	1.036 a	0.224 a	2.943 a	8.525 m	0.158 x	—	—	—
L_5	34.36 p	50.43 e	0.479 i	0.097 i	0.517 i	1.209 i	1.031 a	0.214 a	2.939 i	8.512 m	0.190 i	—	0.004 i	—
L_6	34.41 h	50.46 e	0.479 c	0.092 c	0.526 a	1.203 a	1.048 a	0.218 a	2.928 a	8.526 m	0.179 x	—	0.001 a	0.010 c
L_7	34.39 h	50.54 e	0.477 c	0.091 c	0.515 i	1.211 i	1.034 a	0.212 a	2.911 i	8.365 i	0.193 i	—	0.000 i	0.010 c
L_8	34.45 p	50.47 e	0.470 c	0.088 c	0.539 a	1.218 a	1.054 a	0.209 a	2.896 a	8.558 m	0.182 x	—	0.002 a	0.004 c
Average ($\bar{x}$)	34.453	50.450	0.4769	0.0910	0.5251	1.2105	1.0400	0.2163	2.9223	8.5233	0.1835	8.3396	0.0024	0.0087
Standard deviation (Reproducibility) $s_{\bar{x}}$	0.070	0.083	0.0036	0.0031	0.0085	0.0040	0.0135	0.0048	0.0210	0.0720	0.0128	—	0.0011	0.0025
(Reproducibility without laboratories) $s_{I(T)}$ *1	0.050	0.113	0.0030	0.0018	0.0038	0.0100	0.0124	0.0069	0.0197	0.0767	0.0035	—	0.0015	0.0018
Uncertainty C (95%) *2	0.05	0.07	0.003	0.003	0.007	0.003	0.011	0.004	0.018	0.069	0.011	0.061 *4	0.001	0.003

(Note) ＊1　$s_{I(T)}$ is intermediate precision without a time condition.　＊2　The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$　(ℓ = number of laboratories)

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(5) Date of preparation : June, 1996

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Certified Reference Material Series for X-ray Fluorescence Analysis of Refractories

J R R M　7 1 0　(Alumina-Zirconia-Silica Refractory)

Results of Analyses

Unit : mass%

Constituent		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Cr_2O_3	ZrO_2 ($+HfO_2$)	HfO_2	ZrO_2 *3	Uncertified value	
														MnO	P_2O_5
Certified value		5.62$_9$	82.3$_6$	1.15$_1$	3.00$_5$	0.22$_5$	0.04$_9$	1.42$_1$	0.63$_7$	1.02$_8$	4.47$_5$	1.51$_2$	2.96$_7$	0.00$_2$	0.04$_2$
Laboratories	L_1	5.49$_7$ p	82.1$_9$ e	1.16$_1$ i	3.02$_1$ i	0.22$_8$ i	0.05$_0$ i	1.39$_6$ a	0.64$_2$ a	1.04$_1$ i	4.59$_2$ m	1.51$_1$ x	—	0.00$_3$ i	0.04$_1$ c
	L_2	5.59$_8$ p	82.3$_2$ e	1.19$_7$ c	2.99$_1$ x	0.22$_4$ i	0.05$_0$ i	1.46$_9$ f	0.64$_2$ f	1.05$_9$ i	4.58$_5$ m	1.52$_4$ x	—	0.00$_2$ i	0.04$_2$ c
	L_3	5.65$_7$ c	82.4$_0$ e	1.14$_9$ c	3.01$_8$ i	0.22$_6$ i	0.05$_0$ i	1.42$_1$ a	0.63$_9$ a	1.02$_3$ i	4.50$_5$ m	1.50$_0$ i	—	0.00$_3$ i	0.04$_4$ c
	L_4	5.68$_8$ h	82.4$_6$	1.09$_1$ c	3.02$_3$ x	0.22$_4$ a	0.04$_6$ a	1.42$_7$ a	0.63$_2$ a	1.01$_6$ a	4.46$_0$ m	1.49$_3$ x	—	—	—
	L_5	5.59$_6$ c	82.3$_8$ e	1.11$_9$ i	2.96$_0$ i	0.22$_0$ i	0.04$_9$ i	1.42$_0$ a	0.64$_6$ a	1.00$_3$ i	4.27$_9$ m	1.51$_4$ i	—	0.00$_3$ i	—
	L_6	5.79$_5$ c	82.3$_4$ e	1.15$_9$ c	3.00$_2$ x	0.23$_0$ a	0.04$_9$ a	1.41$_5$ a	0.63$_7$ a	1.02$_3$ a	4.40$_1$ m	1.50$_9$ x	—	0.00$_2$ a	0.04$_0$ c
	L_7	5.76$_0$ c	82.3$_2$ e	1.15$_9$ c	3.01$_0$ c	0.22$_1$ i	0.05$_0$ i	1.40$_3$ a	0.62$_8$ a	1.01$_7$ i	4.46$_4$ i	1.47$_8$ i	—	0.00$_0$ i	0.04$_1$ c
	L_8	5.44$_1$ c	82.4$_1$ e	1.17$_1$ c	3.01$_1$ x	0.22$_4$ a	0.05$_1$ a	1.41$_3$ a	0.63$_1$ a	1.04$_1$ a	4.54$_8$ m	1.56$_0$ x	—	0.00$_1$ a	0.04$_4$ c
Average	($\overline{X}$)	5.629$_0$	82.36$_4$	1.150$_8$	3.004$_5$	0.225$_0$	0.049$_4$	1.420$_5$	0.636$_9$	1.028$_1$	4.479$_3$	1.511$_9$	2.967$_4$	0.002$_0$	0.042$_5$
Standard deviation	(Reproducibility) $s_{\bar{x}}$	0.121$_7$	0.08$_3$	0.032$_7$	0.021$_3$	0.003$_0$	0.001$_4$	0.022$_2$	0.006$_9$	0.018$_0$	0.105$_1$	0.025$_4$	—	0.001$_0$	0.001$_4$
	(Reproducibility without laboratories) $s_{I(T)}$ *1	0.025$_7$	0.11$_7$	0.007$_6$	0.005$_3$	0.008$_3$	0.002$_6$	0.008$_1$	0.008$_9$	0.018$_8$	0.025$_7$	0.007$_7$	—	0.001$_4$	0.000$_6$
Uncertainty C (95%) *2		0.10$_2$	0.0$_7$	0.02$_7$	0.01$_8$	0.00$_3$	0.00$_1$	0.01$_9$	0.00$_8$	0.01$_5$	0.08$_8$	0.02$_1$	0.09$_0$ *4	0.00$_1$	0.00$_2$

(Note) * 1 $s_{I(T)}$ is intermediate precision without a time condition.
* 2 The half-width confidence interval C (95%) = $t_{\ell-1,0.05} \times s_{\bar{x}} / \sqrt{\ell}$ (ℓ = number of laboratories)
* 3 $ZrO_2 = ZrO_2(+HfO_2) - HfO_2$
* 4 $s_{\bar{x}\,ZrO_2} = \sqrt{\left(s_{\bar{x}\,ZrO_2(HfO_2)}\right)^2 + \left(s_{\bar{x}\,HfO_2}\right)^2}$

(1) List of laboratories : Kurosaki Corporation, Kawasaki Refractories Co.,Ltd., Yotai Refractories Co.,Ltd., Asahi Glass Co.,Ltd., Harima Ceramic Co.,Ltd., Shinagawa Refractories Co.,Ltd., Toshiba Ceramics Co.,Ltd., Toshiba Monofrax Co.,Ltd.
(2) Analytical techniques : JIS R 2013(Method for chemical analysis of refractory containing alumina, zirconia and silica) a;AAS, c;colorimetry,e;Ionexchange-chelatometry, f;flametry, g;Cupfrron Gravimetry, h;dehydratmetry+colorimetry, i;ICP-AES, m;Mandelic acid Gravimetry, p;coagulatmetry・+colorimetry,v;Cupfrron Separation-chelatometry, x;XRF
(3) Analytical values : Each value is the average of two values obtained by two measurements on different days. These analysis values are shown converted into LOI (Loss on ignition) component free values from the February 22, 2008 v20080222 version on.
(4) Outlier tests were carried out by Grubbs test. The samples rejected by Grubbs tests were discussed in view of analytical techniques and it was determined whether the outliers should be adopted or not.
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