

S2 RANGER

ANALYSIS OF BLAST FURNACE SLAGS

This report demonstrates the analytical performance of the S2 RANGER for blast furnace slags, especially regarding the analytical accuracy and short term reproducibility.



Introduction

In Steel Metallurgy, the elemental composition of slags has to be analyzed for process control. Slags are also used as secondary raw materials in industries such as cement production. For these applications, it is essential that the chemistry of the slags is well defined.

Instrumentation

The S2 RANGER is a compact benchtop ED-XRF spectrometer with easy-to-use touch-screen operation, requiring only a mains power supply.

Sample Preparation

Typically, the slag samples are milled and prepared as pressed pellets with the addition of a binder to ensure a stable specimen. For this report, the samples were prepared with the addition of 20% wax. 5 grams of the mixture were pressed with a pressure of 10 tons for 20s.

Measurement

The measurement was performed using the pre-defined and precalibrated Slag Solution of the S2 RANGER with a total measuring time of 300s.

Comp.	Chem. Conc. (%)	XRF Conc. (%)	Abs. Deviat. (%)	Rel. Deviat. (%)
MgO	5.20	5.08	0.12	2.4
Al ₂ O ₃	4.40	4.28	0.12	2.8
SiO ₂	11.66	12.16	0.50	4.3
P ₂ O ₅	2.44	2.39	0.05	2.1
S	0.146	0.137	0.009	6.6
K ₂ O	0.44	0.43	0.01	2.3
TiO ₂	0.50	0.48	0.02	4.2
CaO	40.29	39.94	0.35	0.9
Cr ₂ O ₃	0.48	0.46	0.02	4.4
MnO	5.45	5.35	0.10	1.9
Fe	19.59	19.34	0.25	1.3

Table 1: Typical XRF results of a blast furnace slag sample

	MgO [%]	Al ₂ O ₃ [%]	SiO ₂ [%]	P ₂ O ₅ [%]	S [%]	CaO [%]	TiO ₂ [%]	Cr ₂ O ₃ [%]	MnO [%]	Fe [%]
# 1	4.81	1.79	16.19	8.16	0.111	34.39	0.71	0.636	8.40	14.97
# 2	4.85	1.81	16.21	8.19	0.115	34.37	0.70	0.610	8.39	15.00
# 3	4.75	1.83	16.12	8.16	0.115	34.41	0.72	0.624	8.36	14.99
# 4	4.81	1.83	16.17	8.13	0.114	34.37	0.69	0.630	8.39	14.94
# 5	4.75	1.81	16.19	8.18	0.112	34.51	0.76	0.641	8.41	15.08
# 6	4.87	1.82	16.08	8.16	0.117	34.33	0.69	0.630	8.37	14.96
# 7	4.81	1.86	16.16	8.18	0.117	34.35	0.69	0.630	8.40	14.97
# 8	4.82	1.83	16.11	8.17	0.110	34.38	0.69	0.632	8.36	15.00
# 9	4.88	1.82	16.20	8.19	0.114	34.38	0.72	0.628	8.37	15.02
# 10	4.91	1.83	16.08	8.16	0.112	33.47	0.72	0.608	8.37	14.87
# 11	4.72	1.85	16.14	8.15	0.112	34.24	0.69	0.616	8.35	14.88
# 12	5.01	1.83	16.22	8.18	0.113	34.55	0.69	0.623	8.44	15.07
# 13	4.80	1.84	16.19	8.16	0.114	34.29	0.72	0.607	8.43	14.93
# 14	4.88	1.82	16.18	8.20	0.113	34.53	0.74	0.614	8.38	15.07
# 15	5.01	1.83	16.13	8.21	0.113	34.34	0.69	0.609	8.38	14.93
# 16	4.79	1.80	16.12	8.15	0.113	34.31	0.67	0.621	8.40	14.90
Average	4.84	1.83	16.15	8.17	0.114	34.35	0.70	0.622	8.39	14.97
Abs. Std.Dev.	0.09	0.02	0.05	0.02	0.002	0.14	0.02	0.010	0.03	0.07
Rel. Std. Dev.	1.8	0.8	0.3	0.3	1.7	0.4	3.4	1.7	0.3	0.4

Table 2: Short term reproducibility of a typical blast furnace slag sample

Results

Typical analytical results of a blast furnace slag sample measured with the S2 RANGER are shown in Table 1. The short term reproducibility of the S2 RANGER was demonstrated by running one sample 16 times. These results are shown in Table 2.

Remark:

The given results are typical values and depend strongly on the reference material used, the specimen preparation, and the measuring parameters (such as irradiated sample area, excitation, etc.), and may be improved by optimizing single measuring parameters.

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