Application Report Cement (Fused Beads with VITRIOX® ELECTRIC)

Topic

In the cement industry, x-ray fluorescence analysis (XRF) is one of the major techniques employed for raw material and final product quality control. Typically, “pressed pellet” sample preparation is used; however, the disadvantage to this is that this technique shows only relative data to known and accepted reference methods like fusion or wet chemistry and takes no account of the different mineralogical effects that may or may not occur.

In this report we document the use of an XRF fusion technique to build up a reference method independent of sample geology.

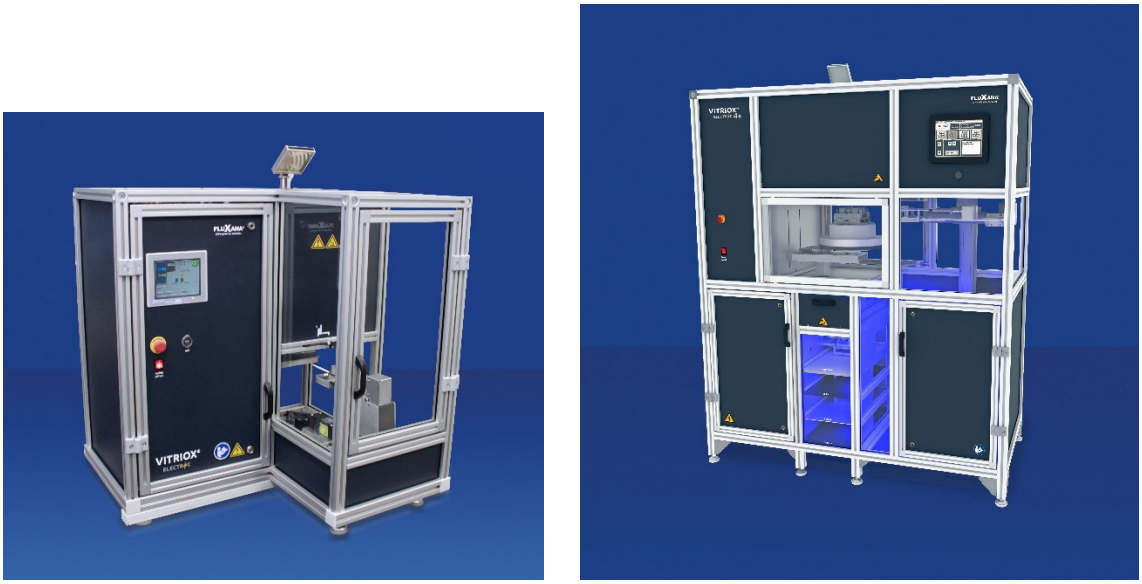

Fig. 1: VITRIOX® ELECTRIC Mono and 4+ for XRF and ICP.

Sample preparation

Flux	8g FX-X65 66% Lithiumtetraborate : 34% Lithiummetaborate
Sample	1g ignited cement, raw meal or clinker
Fusion system	VITRIOX® ELECTRIC from FLUXANA
Temperature	1200°C
Time	10 min fusion, 5 min cooling

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Calibration

A set of 20 international cement CRM materials (CS-0001) was used prepared as duplicates to establish calibration curves for 14 elements.

The following table compares the given maximum calibration errors from cement industry with the achieved calibration errors of FLUXANA.

SEE / RMS	Al2O3	CaO	Fe2O3	K2O	MgO	Na2O	P2O5	SiO2	SO3
Request	<0,10	<0,20	<0,05	<0,03	<0,05	<0,03	<0,03	<0,15	<0,05
FLUXANA	0,02	0,05	0,01	0,009	0,026	0,018	0,004	0,05	0,04

SEE / RMS	Cr2O3	Mn2O3	SrO	TiO2	ZnO
request	n.g.	n.g.	n.g.	n.g.	n.g.
FLUXANA	0,001	0,003	0,003	0,004	0,001

Validation

The validation was done with 2 control samples which were prepared on 6 different fusion stations of the electrical fusion machine. The following tables show the certified values in comparison with the mean values and also compares the bias with cement industry **accuracy targets** according to table 2 of **ISO 29581-2:2010**. All concentrations are given in mass%.

CRM 103	Al2O3	CaO	Fe2O3	K2O	MgO	Na2O	P2O5	SiO2	SO3
Certificate	**7,75**	**54,9**	**1,78**	**0,77**	**4,44**	**0,33**	**0,09**	**26,95**	**2,73**
Accuracy targets	0,08	0,25	0,08	0,03	0,08	0,03	0,03	0,15	0,08
Min	7,67	54,65	1,7	0,74	4,36	0,3	0,06	26,8	2,65
Max	7,83	55,15	1,86	0,8	4,52	0,36	0,12	27,1	2,81
CEM V02 - Br2269 - BvB	7,74	54,79	1,78	0,77	4,46	0,33	0,09	27,11	2,73
CEM V02 - Br2268 - BvB	7,72	54,75	1,78	0,78	4,43	0,32	0,09	27,04	2,69
CEM V02 - Br2267 - BvB	7,73	54,72	1,78	0,77	4,46	0,31	0,09	27,06	2,70
CEM V02 - Br2266 - BvB	7,76	54,72	1,78	0,77	4,45	0,31	0,09	27,05	2,69
CEM V02 - Br2265 - BvB	7,72	54,63	1,78	0,77	4,45	0,31	0,09	27,03	2,68
CEM V02 - Br2264 - BvB	7,73	54,73	1,78	0,77	4,47	0,31	0,09	27,07	2,70
Mean	**7,73**	**54,72**	**1,78**	**0,77**	**4,46**	**0,31**	**0,09**	**27,06**	**2,70**
Stdev	0,017	0,052	0,003	0,003	0,011	0,007	0,001	0,027	0,016
Bias	**-0,02**	**-0,18**	**0,00**	**0,00**	**0,01**	**-0,02**	**0,00**	**0,11**	**-0,03**

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NIST 1888b	Al2O3	CaO	Fe2O3	K2O	MgO	Na2O	P2O5	SiO2	SO3
Certificate	**4,37**	**64,44**	**3,13**	**0,67**	**3,64**	**0,14**	**0,07**	**20,85**	**2,69**
Accuracy targets	0,08	0,25	0,08	0,03	0,08	0,03	0,03	0,15	0,08
Min	4,29	64,19	3,05	0,64	3,56	0,11	0,04	20,70	2,61
Max	4,45	64,69	3,21	0,70	3,72	0,17	0,10	21,00	2,77
CEM 1888b - Br2263 - BvB	4,38	64,49	3,13	0,65	3,61	0,15	0,07	20,81	2,64
CEM 1888b - Br2262 - BvB	4,36	64,43	3,12	0,64	3,61	0,14	0,07	20,77	2,65
CEM 1888b - Br2261 - BvB	4,38	64,49	3,12	0,64	3,63	0,14	0,07	20,81	2,66
CEM 1888b - Br2260 - BvB	4,36	64,41	3,12	0,65	3,61	0,16	0,07	20,83	2,66
CEM 1888b - Br2259 - BvB	4,36	64,37	3,11	0,65	3,61	0,14	0,07	20,79	2,66
CEM 1888b - Br2258 - BvB	4,37	64,48	3,12	0,65	3,62	0,15	0,07	20,82	2,66
Mean	**4,37**	**64,45**	**3,12**	**0,65**	**3,61**	**0,14**	**0,07**	**20,81**	**2,65**
Stdev	0,008	0,049	0,007	0,002	0,008	0,008	0,001	0,023	0,009
Bias	**0,00**	**0,01**	**-0,01**	**-0,02**	**-0,03**	**0,01**	**0,00**	**-0,04**	**-0,04**

Conclusion

The FLUXANA VITRIOX® ELECTRIC can produce fused beads that exceeds the requirements of cement industry.