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Task

Evaluating the possibility of online, real-time analysis of a material used in cement production.

Technical requirements

Quantitative analysis of target elements: CaO, Fe_2O_3, Al_2O_3, SiO_2.

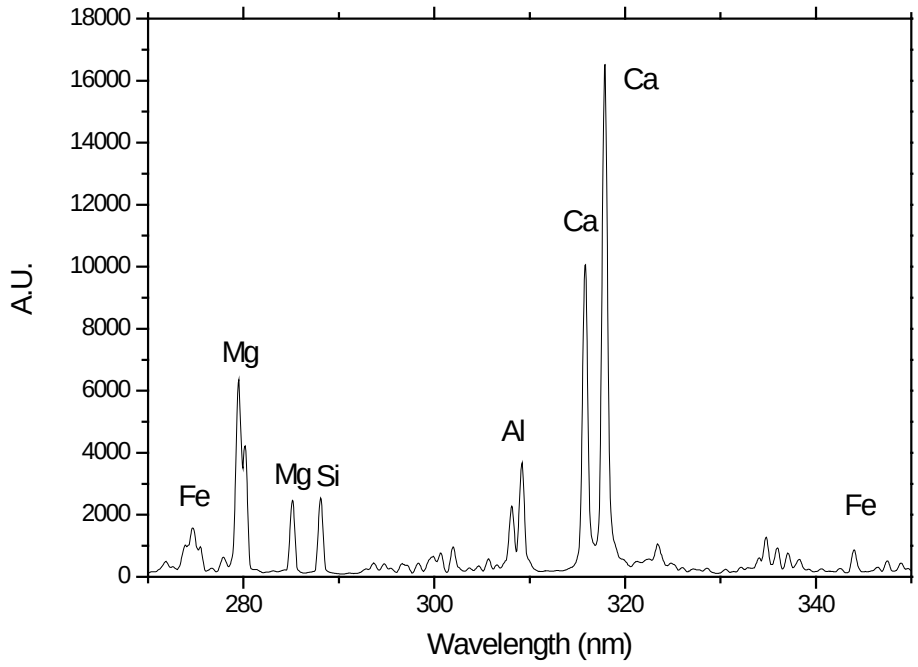
Samples description

The 15 samples are off-white, dry ground powder with the following chemical content:

ID	SiO_2	Al_2O_3	Fe_2O_3	CaO
1	24.36	5.87	4.26	37.99
2	22.68	5.43	3.85	39.43
3	20.66	5.21	3.75	40.87
4	16.82	4.36	3.24	42.31
5	16.62	4.02	3.04	42.88
6	16.08	3.91	3.04	42.88
7	15.38	3.68	2.84	44.18
8	14.86	3.4	2.63	43.46
9	13.82	3.12	2.73	43.75
10	13.7	3.29	2.33	45.04
11	13.48	3.06	2.33	45.33
12	12.6	3.23	2.33	45.19
13	12.4	3.29	2.13	45.62
14	11.42	3.12	2.03	46.19
15	10.86	3.01	1.72	46.62

Analytical section

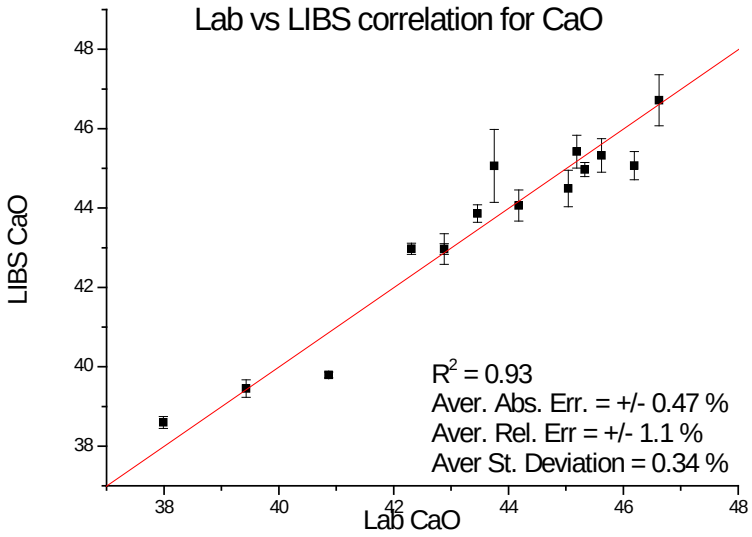
A typical spectrum of analyzed material is shown below:

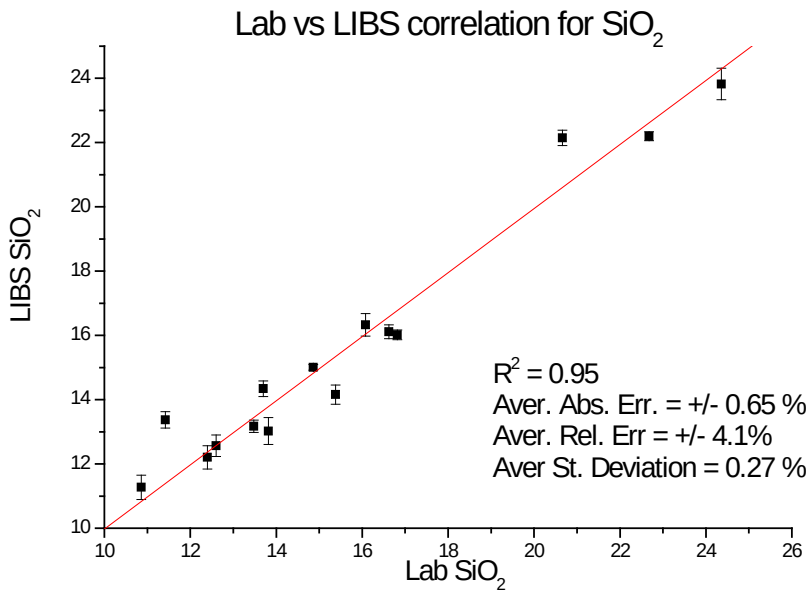


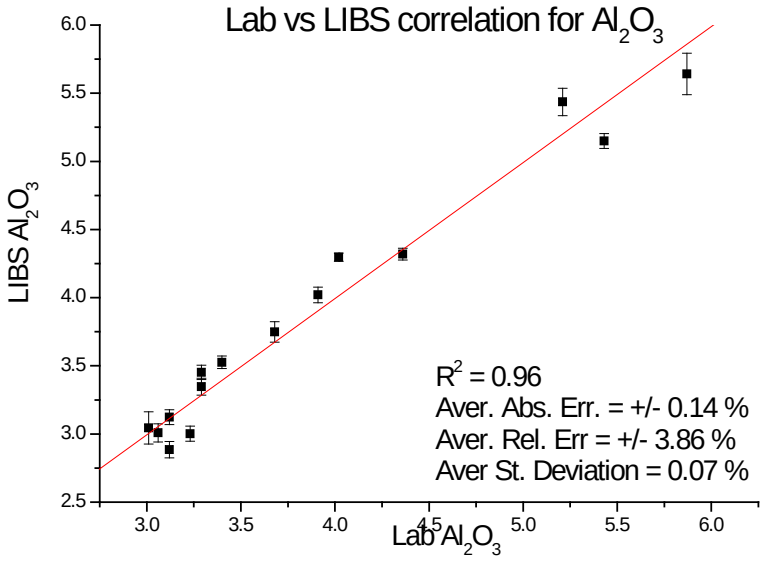
As seen in the spectrum, in addition to the required CaO, Fe_2O_3, Al_2O_3 and SiO_2 , also MgO analysis is possible.

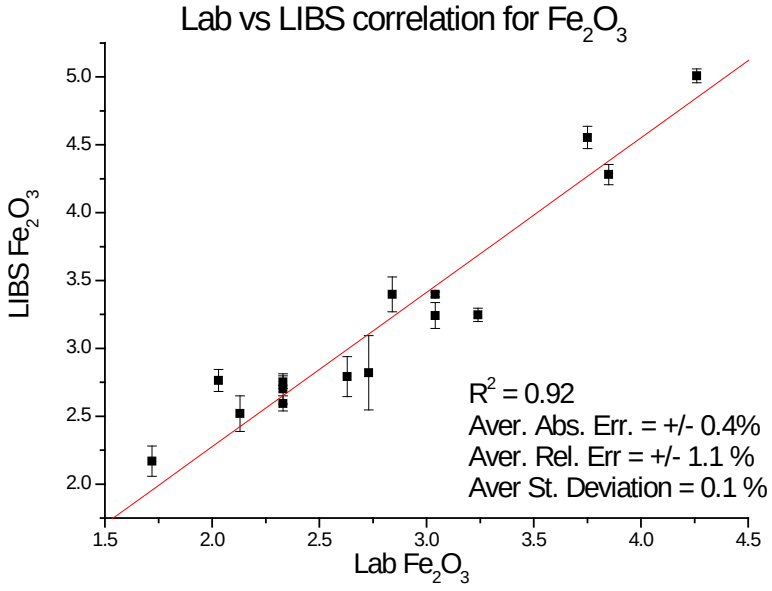
Quantitative calibrations.

The quantitative calibrations were performed according to chemical analysis and spectral data:
(Maximum Standard deviation, describing reproducibility of the experiment for each sample measurement is represented by vertical line)









Errors summary table				
Material		Average Error		
Analyzed material (%)	Linearity R^2	Absolute ± %	Relative ± %	Standard Deviation %
CaO	0.93	0.47	1.1	0.34
SiO_2	0.95	0.65	4.5	0.27
Al_2O_3	0.96	0.14	3.9	0.07
Fe_2O_3	0.92	0.4	1.1	0.1

Conclusions

- On-line, real-time analysis of Cement material is possible for each of the required oxides.
- In addition to required elements, MgO analysis is available.
- As can be seen in “Errors summary table”, low errors and high accuracy and reproducibility can be achieved.