ostec corporate group

future's in the making

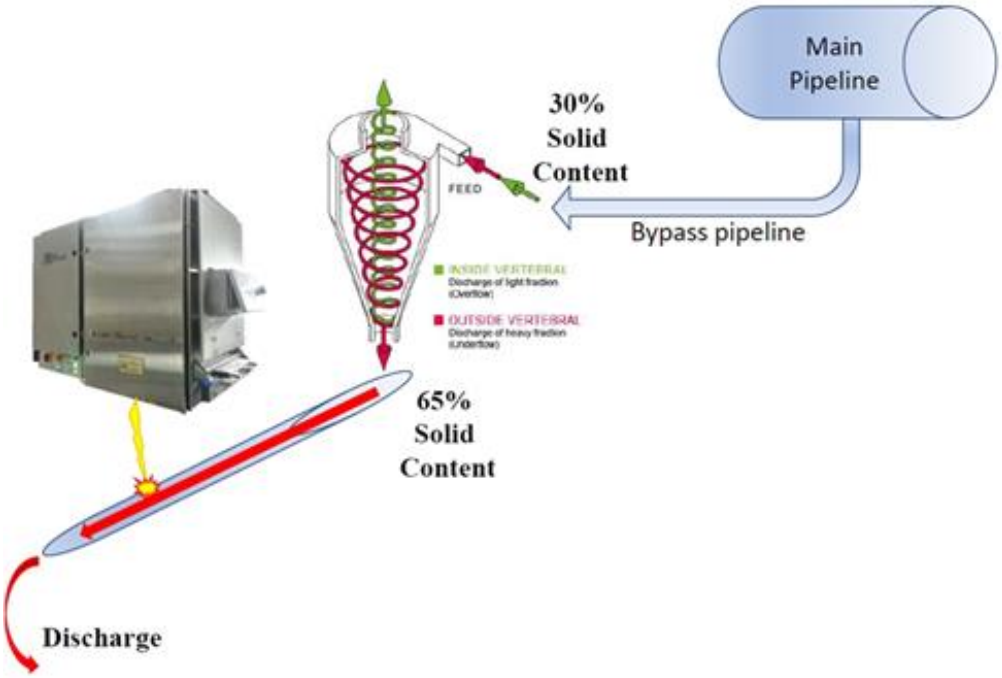
Quantitative analysis of flotation feed using Laser Induced Breakdown Spectroscopy (LIBS) in On-Line, Real Time mode

1. Technical task

- Evaluating possibility of on-line, real time LIBS analysis of slurry (60-65% Solid Content) directly in a unpressurized pipe after the hydrocyclone.
- Quantitative analysis SiO_2 and other impurities (Fe_2O_3, Al_2O_3) in low concentrations as well as matrix elements ($CaCO_3$, $MgCO_3$). Online LIBS analysis accuracy estimation.

2. Installation site

For measurement, the industrial hydrocyclone was used to increase the solid content from 30% up to 60-65%. The LIOS OnLine system was installed after the hydrocyclone directly over a unpressurized half-pipe, allowing receiving the chemical analysis of slurry in real time.



3. Samples

The samples taking during the calibration process have the following chemical composition as per laboratory XRF results:

Analyzed Parameter	Minimum, %	Maximum, %
SiO_2	0.3	1.0
Fe_2O_3	0.1	0.3
Al_2O_3	0.009	0.25
$CaCO_3$	94	97
$MgCO_3$	2	5

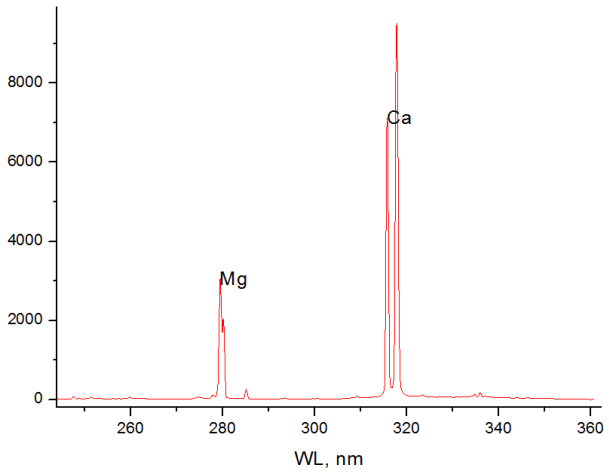
4. Experimental section

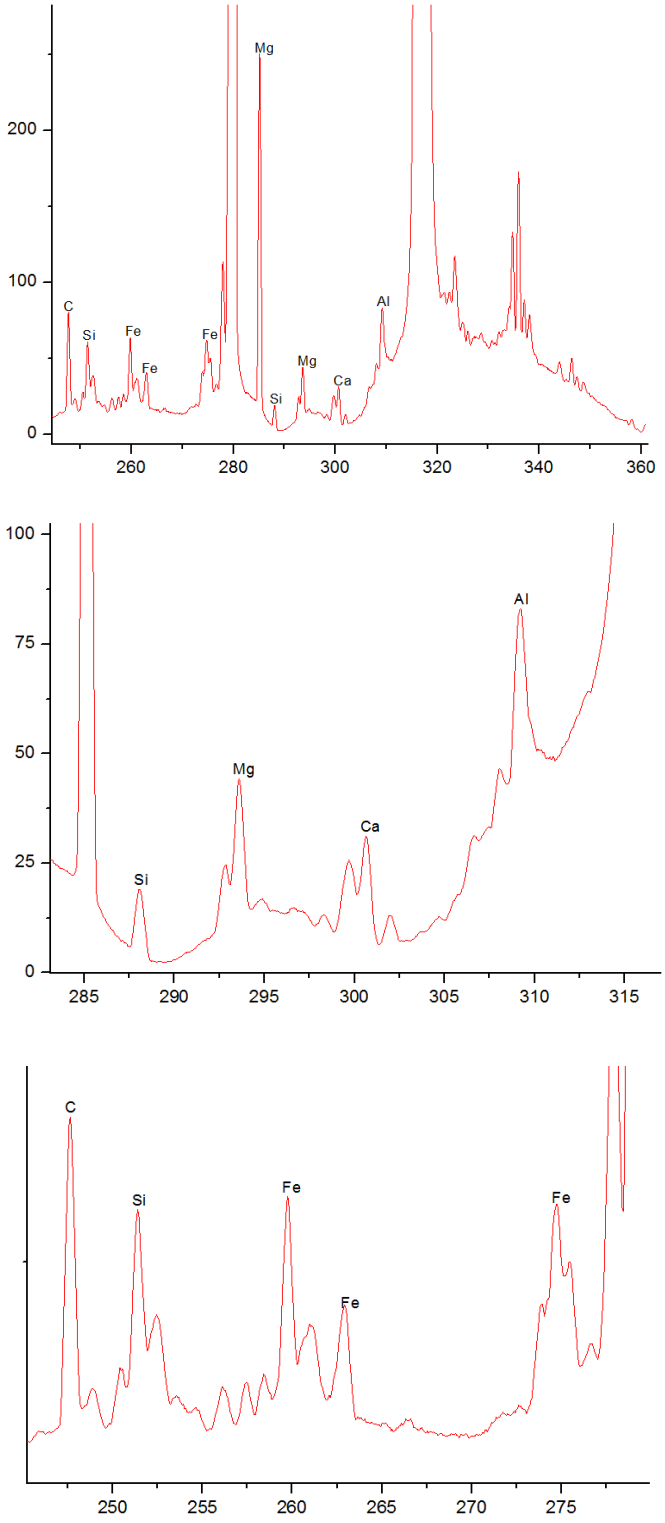
The experiments were conducted using the LIOS OnLine analysis system based on LIBS and equipped with two lasers of 100 mJ energy each. Spectral data was received using spectrometers with the following ranges: λ = 244-360 nm. These ranges were chosen as most suitable for elements of interest.

Comparing XRF and LIBS analysis, errors derived from sampling, splitting and lab analytical error should be taken into the consideration.

5. Qualitative spectral analysis

As can be seen from the spectra received, elements of interest can be clearly detected and identified. Range: λ = 244-360 nm.



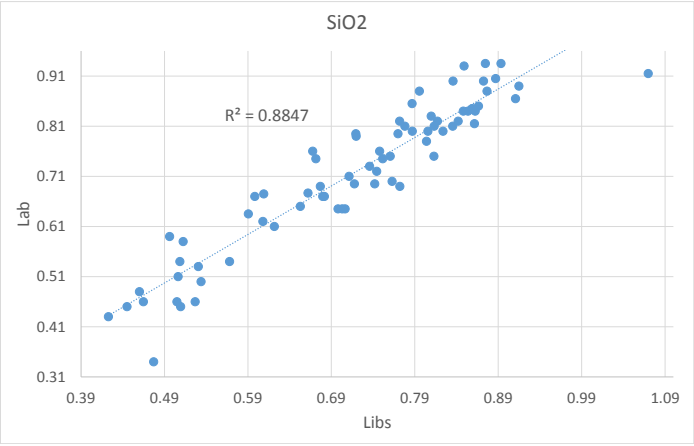


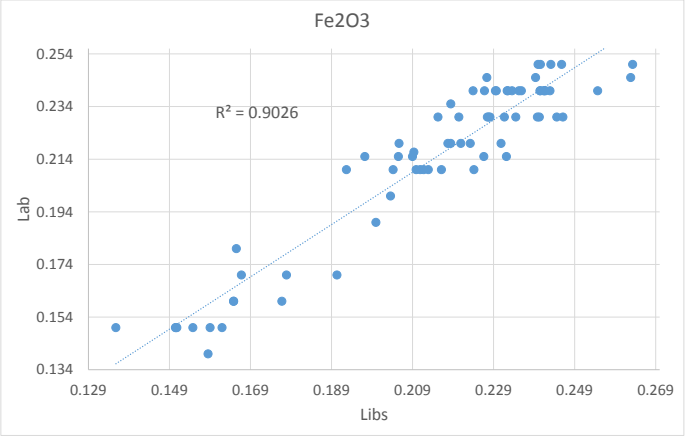
Thus, calibration curves for quantitative analysis could be calculated for all of the identified analytes.

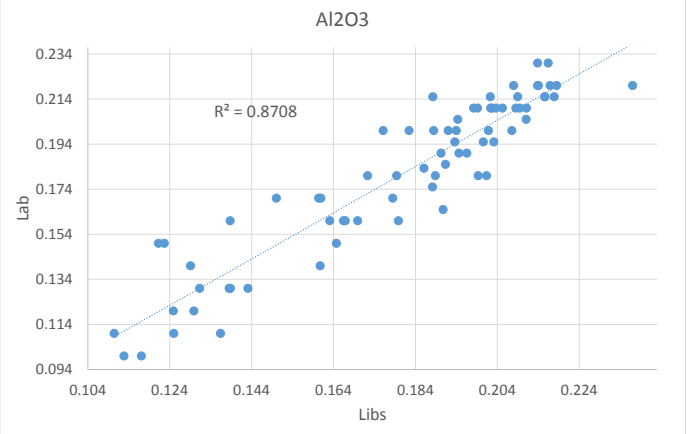
6. Quantitative analysis

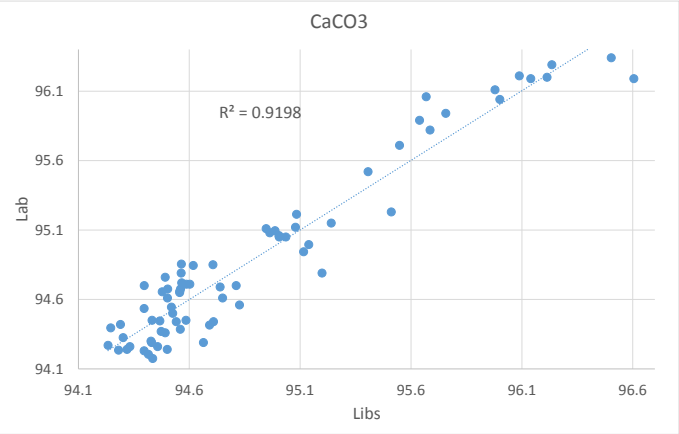
According to chemical data of the samples "Lab vs LIBS" calibration curves were calculated. "Lab" refers to the chemical data, while "LIBS" to the laser analysis.

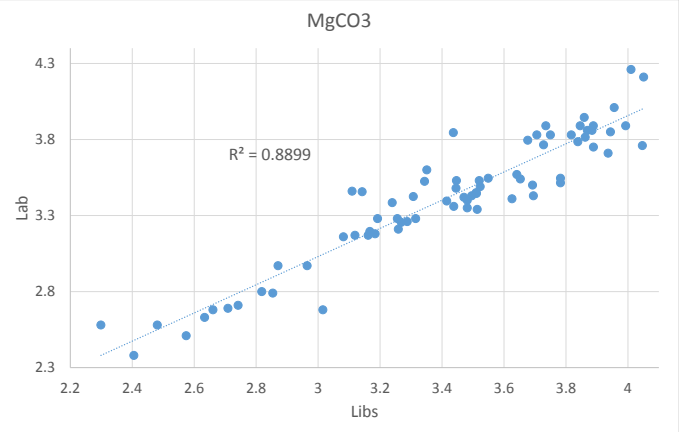
Lab vs LIBS calibration curves











Following table summarizes potential errors that were calculated according to calibration curves:

Analyzed Parameter	R^2	Average error	RMSE
Fe_2O_3	0.9	0.008	0.010
Al_2O_3	0.87	0.01	0.013
SiO_2	0.88	0.037	0.049
$CaCO_3$	0.92	0.149	0.177
$MgCO_3$	0.89	0.104	0.143

In addition to LIBS analysis, the errors summarize the errors derived from sampling, splitting and lab analytical.

6. Conclusions

- Good correlation between laboratory data and LIBS results and low analytical errors provide good possibilities for implementation of the LIOS OnLine system to perform on-line, real-time measurement of Flotation Feed, fulfilling the Customer's analytical requirements.
- In addition to LIBS analysis, the accuracy calculation also includes error, derived from sampling, splitting and lab analytical error.
- Implementation of online LIBS analysis will allow controlling the product quality in real time, every several minutes and not once in several hours.