Radiation-Free Online Elemental Analyzer

Continues and safe online chemical analysis of material streams for real time process optimization and Industry 4.0 solutions

LYNCIS

Real-time process optimization in Cement Industry

Online Analyzer for Cement Industry

Main Features:

- **Stable analysis for process control with high accuracy measurement** of Ca, Si, Fe, Al, Mg, Na, other elements of interest and product parameters (moisture, LSF, SR, AR)

- **Safe and environmentally friendly laser technology** with no gamma ray, neutron or X-ray radiation

- **Flexible installation option on a conveyor belt or airside with fully automatic 24/7 operation and SCADA integration**

- **Low cost of ownership and maintenance with remote support**

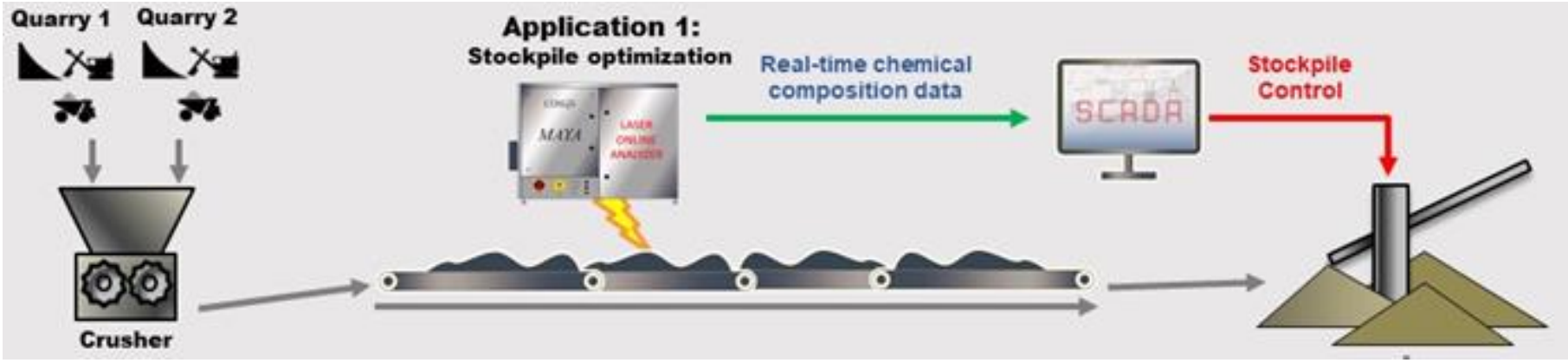
Applications

1. Stockpile Formation

The analyzer installed after the crusher to analyze incoming raw material from the quarries. The control signal controls stockpile formation.
Crushed limestone, clay, mudstone or shale, iron ore or metallurgical slag can be analyzed in the quarry to ensure quality and consistency of formed stockpiles.

Benefits:

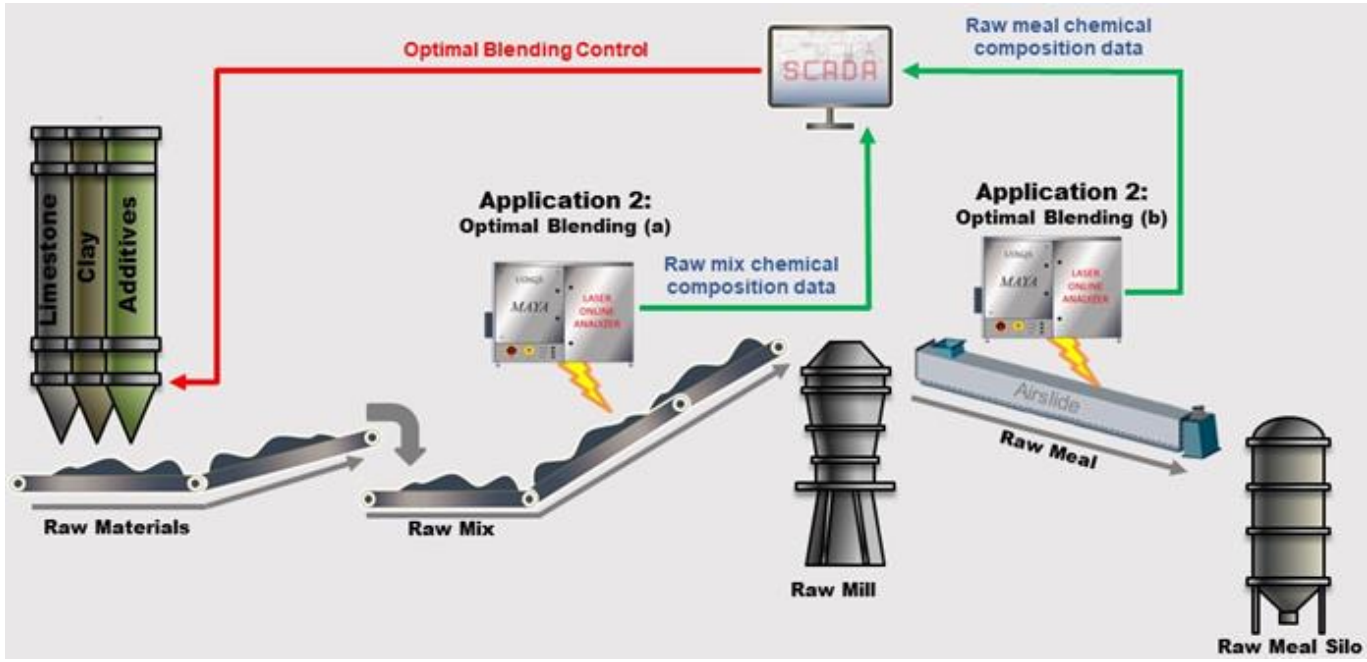
- **Desired set quality raw materials**
- **Ability to use low-grade raw materials prolonging quarry life**



Applications

2. Optimal Blending of Raw Meal

To guarantee the desired quality of raw meal online analyzer can be installed either on a raw mix conveyor belt before the raw mill (a) or on the airslide (b) after the mill. Real-time chemical composition data is used to adjust weight feeders delivering required mix blending.



3. Quality control of clinker or cement

The elemental analyzer can be installed after the kiln or finishing mill to analyze clinker or cement quality. Dosage of gypsum, flyash and other additives can be controlled to achieve desired final product quality.

Benefits

- Improved and stable high quality of clinker and cement
- Decrease standard deviation of LSF, SR, AR
- Reduced frequency and labor cost in lab testing and sample preparation
- Reduced fuel and energy costs
- Kiln stability

Technology

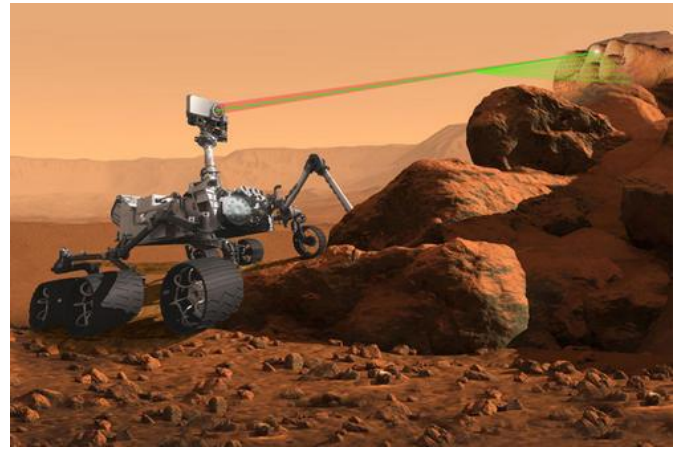
Laser Induced Breakdown Spectroscopy (LIBS)

LIBS technology use laser-based optical emission spectrometry to analyze elemental composition of various materials. First practical application was developed in 1980 and now it used in Military, Industrial and Medical applications.

NASA Curiosity rovers are equipped with LIBS instrument for chemical analysis of rocks in Mars.

Operation Principles:

1. Pulsed laser beam is focused on the material on conveyor
2. Solid / liquid material transforms to plasma around the focus point
3. When cooling, plasma emits light
4. Spectrometer collects this light and produce wavelength-based spectrum
5. This process repeats with frequency up to 100 Hz



https://spinoff.nasa.gov/Spinoff2020/ip_9.html

As process engineers need data on chemistry during short period, usually within
30 sec to 10 min
we collect some hundreds or thousands spectra
for representative statistics

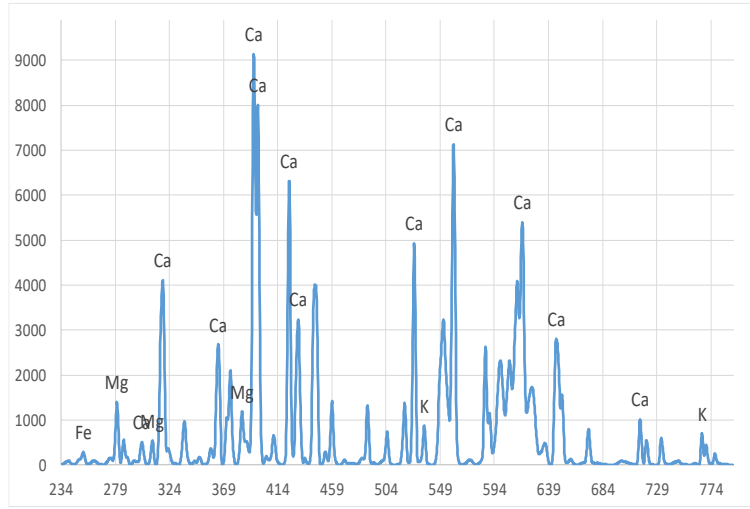
LIBS Spectrum

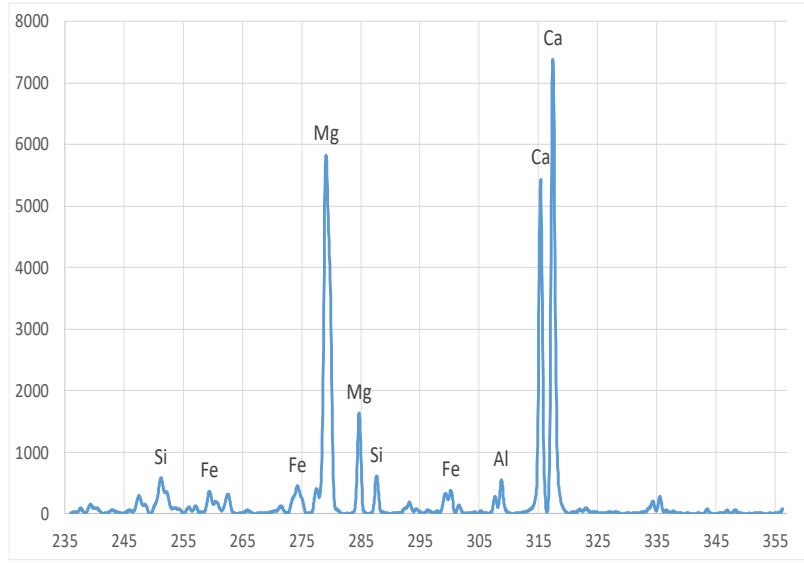
LIBS Signal Features:

- Clear analytical lines of Ca, Si, Fe, Al, Mg, Na, other elements of interest with no interference
- High signal/background ration

A product parameter such as moisture, LSF, SR, AR can be determined based on spectrum information

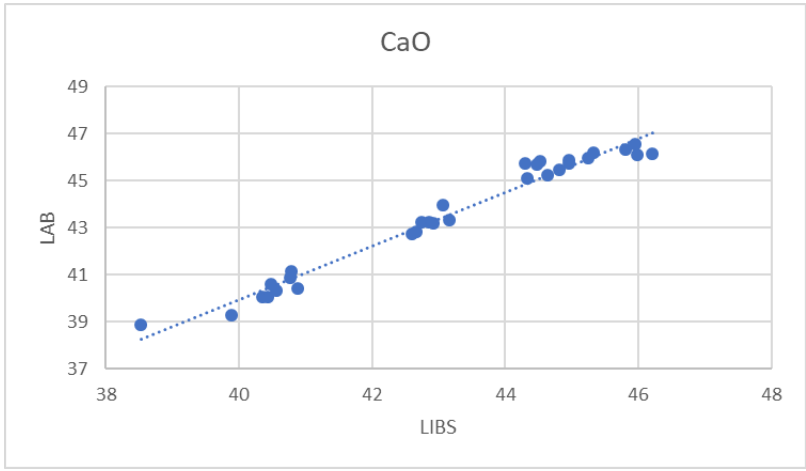
LIBS spectra

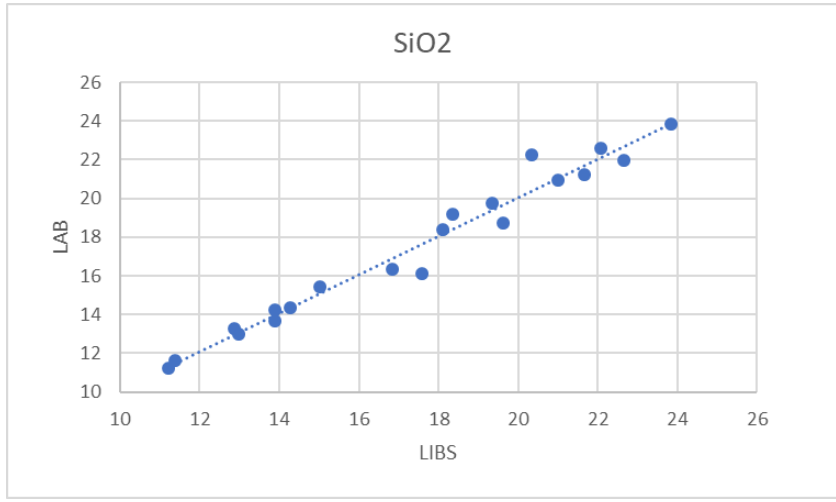


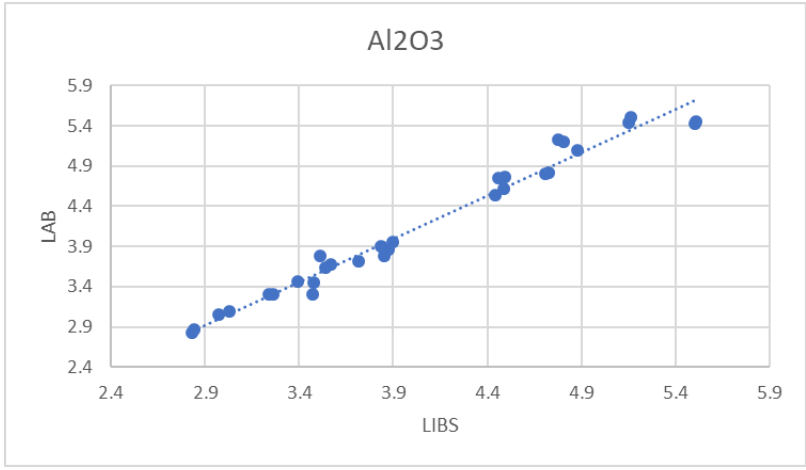


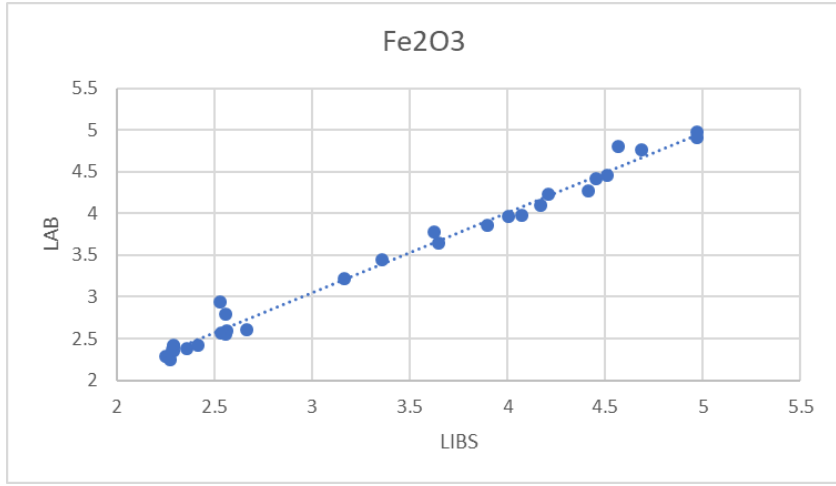
Accurate real time measurements

Good correlation with laboratory analysis in real time conditions with materials on conveyor belt





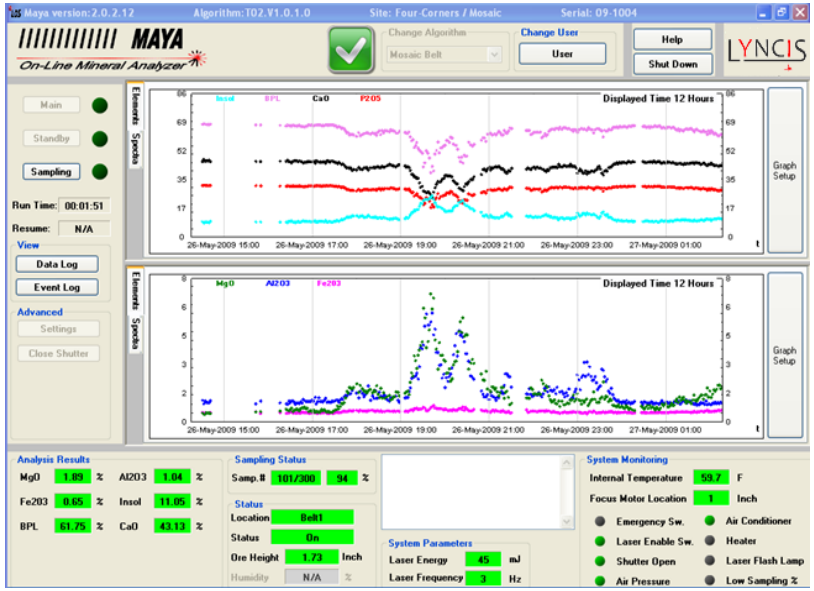


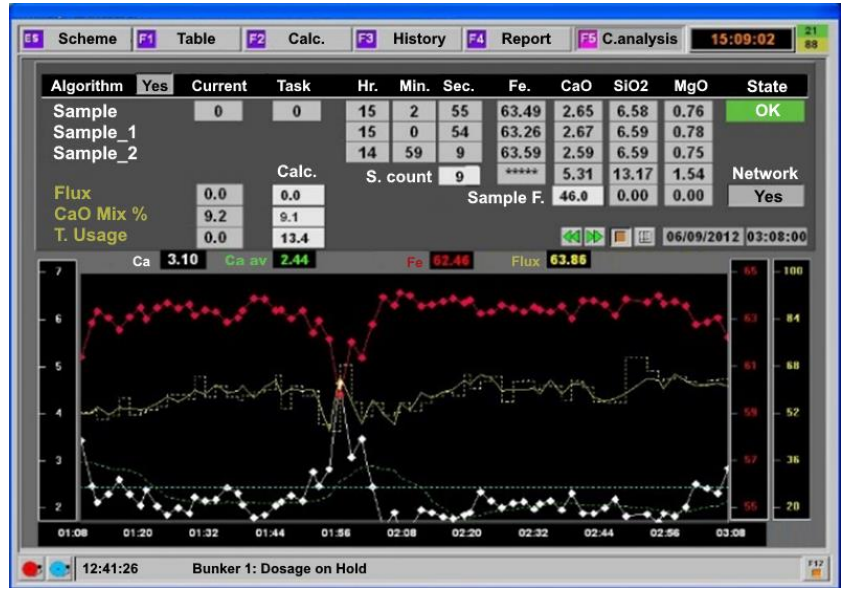


Long term stable continuous automatic operation

Fully automatic 24/7 operation provides real-time chemistry of material streams without sampling and sample preparation

Integration with customer's SCADA for prompt process control





Safety

LIBS Technology

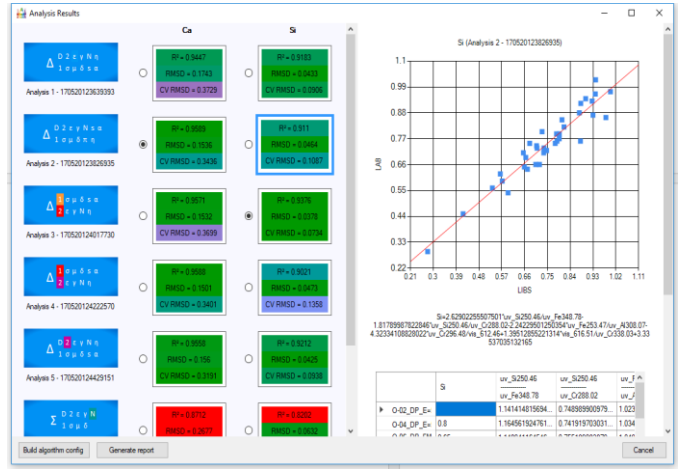
- **Environmentally and personal safe technology**
- No gamma-ray, neutron or X-ray radiation.

No governmental permissions and licenses are needed for operating and transporting the equipment making it simpler and cheaper to manage the production.

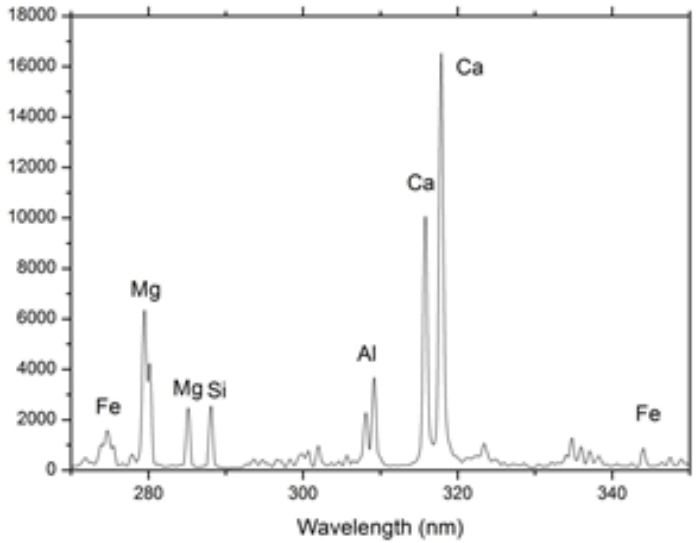
Software

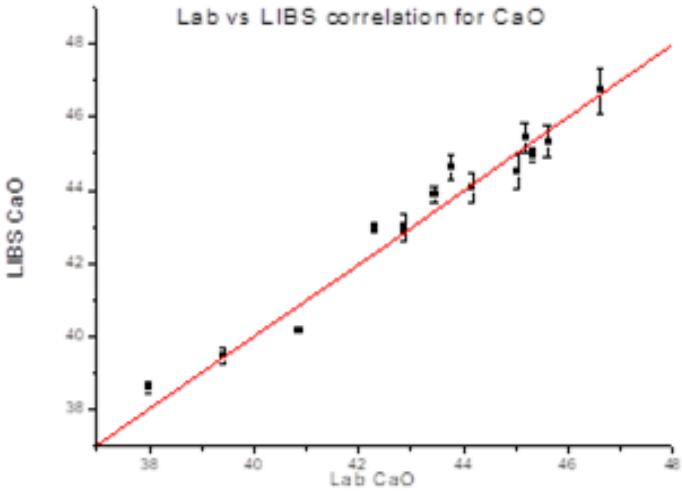
- **Performance monitoring and auto notification if calibration fine tuning is recommended**
- **Easy addition of new sample points to calibration database**
- **Remote Control and assistance in monitoring and adjusting machine performance**
- **Industry 4.0 integration**

  Full SCADA/PLC integration and networking capabilities allow the analyzers to be integrated in any Industry 4.0 and manufacturing ecosystem.



Advanced Data Analytics





Machine Learning and chemometrics

Online elemental analyzers are equipped with data processing modules and use advanced machine learning and chemometrics technics to monitor and learn the material changes during continuous processes.
This ensures accurate and stable measurements through the lifetime of the processing plant.

We use for data reprocessing and optimal calibration:

- **PCA/PCR** - Principal Component Analysis/Regression)
- **Neural Networks**
- **SVM** - Support-vector machine)
- **PLS** - Partial least squares regression)
- **Classification algorithms**

Surface Measurement – True Flow Measurement

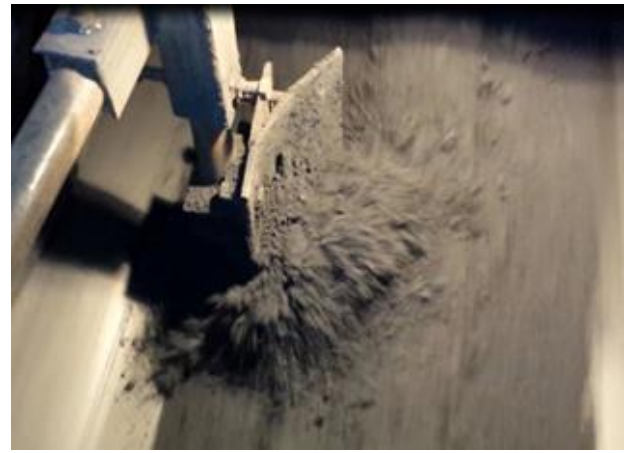
LIBS provides accurate material flow measurement and is not affected by layer thickness, material load or conveyor construction and does not require measurement corrections based on additional sensors or assumed material distribution models.

To achieve representative measurement of the entire flow LIBS analyzer is installed at the location where material distribution has random nature. Locations after raw ore crusher, mill, discharge chute can be defined as having random material distribution and this can ensure that statistically accurate chemical composition of entire flow is measured.

If no random distribution exists at desired measurement point simple mechanical tools (plunges, chains) are used to mix the material on a conveyor and ensure the surface measurement statistically represents an entire flow.

Example of random distribution of raw ore on conveyor belt from installation site

Examples of mechanical aid to ensure entire flow chemical composition analysis is delivered



Technical specifications

Operation temperatures from -20 ^{o}C to +50 ^{o}C

Protection class - IP65

Corrosion, dust and vibration protection

Integration with all SCADA types; cloud and remote communication capabilities

Nd:YAG solid state impulse laser 1064 nm
Laser safety Class 1

Spectrometers detect 170 – 960 nm range

Fully safe LIBS technology generates only optical wave range during excitation and emission

24/7 continuous operation
Direct on-belt / pipeline analysis
NO sampling
Designed for harsh industrial environment

Installation and Maintenance

Requirements for installation

- Simple frame:
  Installed **30 – 120 cm above the material**
  Dimensions~1.5 (L) x 0.9 (D) x 1.3 (H) m
  Weight ~ 450 kg

- **Compressed Air** – 600-1200 l/min, 8 bar

- **Maintenance**

- Modern power diode laser source replacement **once in 5-10 years**

- Air filters – cleaning or replacement – depends on dustiness **- monthly**

- Protection window manual or air cleaning –**weekly**

Low cost of ownership

Technology Advantages

- High accuracy and stable analysis of Ca, Si, Fe, Al, Mg, Na , other required elements and parameters such as moisture, LSF, SR, AR
- Environmentally and personal safe technology
- Flexible installation option on a conveyor belt or airside with fully automatic 24/7 operation and SCADA integration
- Low cost of ownership and maintenance with remote support

Company

- **LYNCIS** is a successor of Laser Distance Spectroscopy (LDS) in Industrial Applications with HQ in Lithuania – one of the biggest European centres of laser, optical and spectral technologies.

- **Strong analytical team** including PhD specialists in technology, physics and mathematics

- **Engineering team** - all technical personnel have Master or Bachelor degrees

- **HQ and production facilities in Lithuania**. Support Offices in Russia and Ukraine.

- Member of **Lithuanian Laser Association**

Industries

10+ years of experience in various industries

Industry-proven technology, used by clients in N. America, Europe and Asia. First installation - in 2008 (USA)

We operate in the following industries:

- **Fertilizers** (phosphate, potassium, composite NPK – P, K, Na, moisture and others)
- **Iron and Steal** (iron ore and concentrate, sinter mix, limestone, coke -Fe, Si, Ca, Mg, Mn, C, moisture and others)
- **Cement** (limestone, raw meal – Ca, Si, Al, Fe…)
- **Refractories** (Mg, Si, Ca, Fe, Al, Cr, B, Mn and others)
- **Coa**l (C, ash content, volatiles, moisture – Fe, Al, Si, Mg, Ca…)
- **Industrial Minerals** (quartz, clays, nepheline…)
- **Base metals** (Cu, Al, Co, Mo, Zn and others)
- **Bauxite and Alumina**

and others

Examples of Installations:

Iron

Fertilizers

Limestone

Slurry, brines

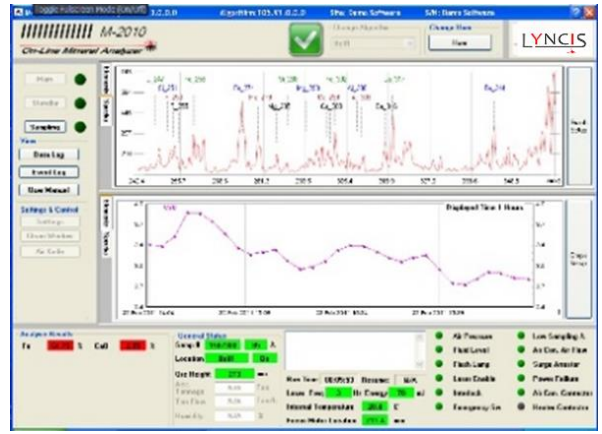
Refractories

Coal

Service

Commissioning

- Initial technical requirements and site assessment
- Physical installation of equipment
- Dynamic on site calibration with existing material flow
- Guidance on lab sample preparation and chemical analysis quality standards
- Training
- Integration with SCADA and Industry 4.0 solutions



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Product Support

- Quality Management System

Remote monitoring of operational parameters and identifying when additional points of calibrations are required to track material or production changes. Timely adjustments and finetuning for optimal operation.

- Regular Maintenance Service

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