Iron Ore Composition Monitoring Using an Automated On-Line X-Ray Spectrometer Analyzer

Sidney A. A. Viana, Allan S. Souza, Wallace C. Araujo, Rilei V. Ribeiro

VALE

Stefan W. Brauer, Ronald Polski, Gerhard Pflug

APC Analytics GmbH
Summary

- Quality Control in Mining Plants
- What is SOLAS?
- Plant Installation
- Principle of Operation
- Off-Line & On-Line Calibration
- Practical Results
- Advantages and Limitations
Quality Control in Mining Plants

- Well established standards and procedures.

- Time-consuming tasks for samples extraction, preparation and analysis.

- Necessity for faster - and yet reliable - analysis.

- Improvements from advances in analysis technology and equipments (e.g.: on-line spectrometers for chemical; on-line laser diffractometers for size distribution).

- Automated quality control.
What is SOLAS?

SOLAS (Sampling On-Line Analyzer System) is an analyzer system composed of several mechanical, pneumatic, electrical, and electronic equipments, fully integrated into an unique system housed in a container.
What is SOLAS?

Sampled material handling system
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Plant Installation

< 8" input from the Primary Crushings

recirculating load

< 75 mm (90%)

> 75 mm (10%)

secondary crushers

output

to SOLAS container

can for already analysed samples

can for already analysed samples

sampling tube

sampling point in the shut

sensing tube
What is SOLAS?

Operation Principle:
What is SOLAS?

- SOLAS is the combination of pneumatic sampling, pneumatic transport, pneumatic milling and EDXRF analysis, all integrated by a specific control unit.
- First step is Airmill for rapid grinding of the sample material < 200 µm
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X-Ray Analysis

Problems of x-ray analysis:
• Absorption of x-rays in ambient air
• Sensitivity only on surface / grain size effects

Solutions:
• Helium Flushing
• Fine grinding

<table>
<thead>
<tr>
<th></th>
<th>Al</th>
<th>Si</th>
<th>Fe</th>
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<tbody>
<tr>
<td>[keV]</td>
<td>1.49</td>
<td>1.74</td>
<td>6.40</td>
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</table>
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X-Ray spectrum of lignite

- Peak Area proportional to concentration
- Helium flushing amplified peaks Al + Si

Energie [keV]

Al, Si, S, Rh, Ca, Ti, Fe
Calibration

Example of spectrum provided by SOLAS for iron ore:
Calibration

● Off-Line Calibration

A set of samples is divided in two parts: one to be analysed in Laboratory, and the other to be analysed by SOLAS.

Chemicals of interest: Fe, Mn, Si, P, Al, and Ti.
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**Calibration**

**Off-Line** Calibration Results (Laboratory x SOLAS)

- **Fe**
  - Iron (Fe) concentration results (%) vs. sample number.
  - Laboratory vs. SOLAS comparison.

- **Mn**
  - Manganese (Mn) concentration results (%) vs. sample number.
  - Laboratory vs. SOLAS comparison.

- **Si**
  - Silicium (Si) concentration results (%) vs. sample number.
  - Laboratory vs. SOLAS comparison.

- **P**
  - Phosphor (P) concentration results (%) vs. sample number.
  - Laboratory vs. SOLAS comparison.

- **Al**
  - Aluminium (Al) concentration results (%) vs. sample number.
  - Laboratory vs. SOLAS comparison.

- **Ti**
  - Titanium (Ti) concentration results (%) vs. sample number.
  - Laboratory vs. SOLAS comparison.
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**Calibration**

**On-Line Calibration Results (SOLAS x Plant Laboratory)**

- **Iron (Fe)**
  - Content results (%): 60.0 to 70.0
- **Manganese (Mn)**
  - Content results (%): 0.0 to 2.0
- **Silicium (Si)**
  - Content results (%): 0.0 to 3.0
- **Phosphor (P)**
  - Content results (%): 0.00 to 0.10
- **Aluminium (Al)**
  - Content results (%): 0.0 to 2.0
- **Titanium (Ti)**
  - Content results (%): 0.00 to 0.16

*Note: The graphs show the concentration results for each element compared to laboratory values and SOLAS values.*
**Practical Results**

On-Line Monitoring shows:

- The process has fast changes in ore-quality
- Fast changes demand high sampling & analysing frequency
Practical Results

- To compare Online Analyser results in practice is very difficult, because no comparison system was available.
- We tried to have an impression by comparing SOLAS prediction with results from the existing sampling tower (provided by plant laboratory).
- In between the sampling of SOLAS and the sampling-tower:
  - Varying time delays, processes, adding other material.
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**Practical Results**

Plant Sampling Tower x SOLAS

**Iron (Fe)**

- Laboratory
- Predicted using SOLAS

**Manganese (Mn)**

- Laboratory (averaged)
- SOLAS

**Silicium (Si)**

- Laboratory (averaged)
- SOLAS

**Phosphor (P)**

- Laboratory (averaged)
- SOLAS
Limitations

- Material aggregation inside sampling tubes, depending on the characteristics of the ore.

Problematical Conditions:
Advantages

- No problems regarding sampling and handling the sample material in normal dry conditions.
- Accurate on-line analysis results.
- Remote monitoring from the Control Room.
- Provide support for fast decision-making.

Normal Conditions:
What is SOLAS?

SOLAS was initially developed to analyze sulfur content of lignite and bituminous coal. Later, its applications were extended to analyze the ash content and the mineral composition of these bulk materials.

<table>
<thead>
<tr>
<th>SOLAS #</th>
<th>Material</th>
<th>Company - Plant Site</th>
<th>Country</th>
<th>Start-Up</th>
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<tr>
<td>1</td>
<td>Lignite</td>
<td>RWE Rheinbraun - Fortuna Bergheim Mine</td>
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</tbody>
</table>

* In installation.
Thank you.

sidney.viana@vale.com
engineering@apc-analytics.com