SpectraFlow On-Line Analyzer Applications in the Copper/Nickel/Platinum Industry
SpectraFlow Minerals Online Analyzer Timeline

2006: ABB started development for near infrared online Crossbelt Analyzer

2007 - 2010: First test and commercial installations in Cement & Iron Ore applications in Europe & USA

2010: Development of Airslide Application

2011 - 2012: Commercial installations around the globe

2013: SpectraFlow Analytics incorporated as an independent company & management buy-out of the NIR Online analyzer technology from ABB

2013 - today: >45 orders received for Cement, Iron Ore, Bauxite, Platinum, Gold clients globally, since 2016 approved supplier with FLS
SpectraFlow Copper/Nickel/Platinum Analyzer
Objective and Benefits

▪ Process Improvement
  ▪ Mine Feed Monitoring
  ▪ Optimized blending possibilities

▪ Use safe and proven method
  ▪ NIR method uses no ionizing radiation – safety first
  ▪ Reliable systems for fast real time on-line analysis for
    ▪ Moisture, Mineral Phases and Molecules
  ▪ Easy to use equipment

▪ Return on Investment Objectives
  ▪ Have a very low cost of ownership
  ▪ Homogeneous Stockpiles
  ▪ Continuous Quality control (incoming and final product)
SpectraFlow On-Line Analyzer
A new development
SpectraFlow Copper/Nickel/Platinum Analyzer
NIR Analysis Technology

- FTIR Spectrometer
- Rails for lamp positioning
- Light and dust shield
- 8 lamps 50 Watt each
- Entry lens of spectrometer
- Bulk Material
SpectraFlow Copper/Nickel/Platinum Analyzer

Spectral information comparison

- Discrete lines for each element
- Calibration based on integral intensity of elemental line
- Total information of the material
- Minerals and organic Molecules
- Model based calibration for each element according the occurrence as a phase in the raw material to be analyzed
Each of the measurements per sample gives a spectrum.

The chemical composition for each sample is given by the laboratory analysis.

The final step is now to correlate, for each constituents, the spectra with the laboratory values. The procedure is called multi-linear regression.

The calibration models are loaded into the SpectraFlow system and are ready to use when the analyzer is delivered.

After 1 or 2 month of operation a fine tuning is performed, possibly remotely and does not require an engineer on site.
## SpectraFlow Copper/Nickel/Platinum Analyzer

### Comparison of different analytical methods

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<tr>
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<th>XRF</th>
<th>PGNAA</th>
<th>SpectraFlow</th>
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<tbody>
<tr>
<td>Measurement method</td>
<td>Off-line</td>
<td>On-line</td>
<td>On-line</td>
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<td>Goal</td>
<td>Quality Control by DIN/ASTM</td>
<td>Process Control, Trending</td>
<td>Process Control, Trending</td>
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<td>Operational Expenses</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
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<tr>
<td>Analysis Basis</td>
<td>Electron Shells</td>
<td>Nucleus</td>
<td>Molecules and Minerals</td>
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<tr>
<td>Elements possible</td>
<td>Depends on calibration: F(WDX) or Na (EDX)</td>
<td>From Na (Cf source) or from O (neutron tube)</td>
<td>All elements incl. H, moisture</td>
</tr>
<tr>
<td>Dependency</td>
<td>Vacuum / Helium, sample preparation</td>
<td>Belt speed, belt load</td>
<td>No nonlinear layering</td>
</tr>
<tr>
<td>Analysis timeframe</td>
<td>40 – 60 Minutes</td>
<td>Rolling average</td>
<td>1 Min. with avg. of 48 measurements</td>
</tr>
<tr>
<td>Depth of Analysis</td>
<td>µm</td>
<td>Up to 500 mm</td>
<td>µm - mm</td>
</tr>
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<td>Area of measurement</td>
<td>Laboratory</td>
<td>Conveyor belt</td>
<td>Conveyor belt, Air-slide</td>
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<tr>
<td>Reports</td>
<td>Elemental Analysis</td>
<td>Elemental Analysis</td>
<td>Molecules and Phases</td>
</tr>
<tr>
<td>Safety</td>
<td>Low energy x-rays, local legal requirements!</td>
<td>Ionizing radiation, legal requirements!</td>
<td>No radiation at all, no legal requirements</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Analytical precision</td>
<td>High to low depending on element</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Sampling acc.</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Total accuracy</td>
<td>Medium to High</td>
<td>High</td>
</tr>
<tr>
<td>Consumables</td>
<td>X-ray tube</td>
<td>Radioactive source or neutron tube</td>
<td>Halogen light bulbs</td>
</tr>
<tr>
<td>Annual cost</td>
<td>USD 40,000 – USD 60,000</td>
<td>USD 1,000 – USD 2,000</td>
<td></td>
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SpectraFlow On-Line Analyzer
Crossbelt Application
SpectraFlow Copper/Nickel/Platinum Analyzer
Crossbelt Application – Analyzer Installation

- Spectrometer compartment
- Illumination unit and dust protection cover
- Electronic cabinet and communication unit
- Mounting frame supplied by the customer
SpectraFlow Copper/Nickel/Platinum Analyzer
Crossbelt Application – Analyzer Pictures

- Spectrometer Compartment
- Service Flap which can be opened to access the lights
- Entry for the reflected Infrared into Spectrometer
- Spots as Infrared Sources
- Overall view
- Service flap open
- View on rails and lamps
- Electronic cabinet

(C) SpectraFlow
SpectraFlow Copper/Nickel/Platinum Analyzer Crossbelt Application – Mine Optimization

- Raw Material delivery
- On-line analysis
- Decision by quarry management or Blending Software on material demand
- Stockpile composition
  - Mineral Phases and Molecules of interest,
  - Moisture
  - Tonnage normalized
SpectraFlow Copper/Nickel/Platinum Analyzer Crossbelt Application – Mine Optimization

- Online Data
- Control Software
- Switch setpoint in real time
- Rejects
- Mine Ore
- High Quality Pile

(C) SpectraFlow
SpectraFlow On-Line Analyzer
Benefits
SpectraFlow Copper/Nickel/Platinum Analyzer

Benefits

- No radioactive materials used
  - very low cost of operation and maintenance
  - no operational permits or extra personnel required
- Most accurate measurement for organic and inorganic constituents
  - Real time analysis of Mineral Phases, Molecules and moisture
- Independent of belt load changes
- No sampling or by-pass required
- No re-calibrations required
- Low maintenance
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