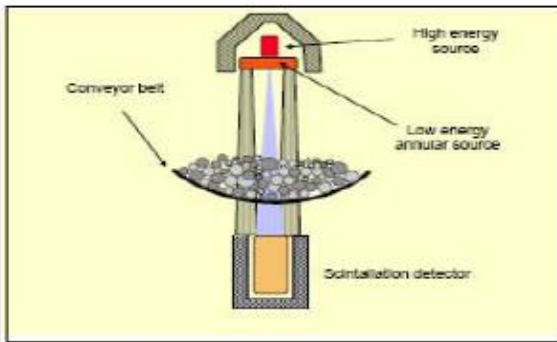


Penetrating (PGNAA) vs Surface online measurements

Question:

Is PGNAA as penetrating measurement better than “surface measurement” technology in delivering online measurements on a conveyor belt?

Influence of material distribution on a conveyor belt for PGNAA

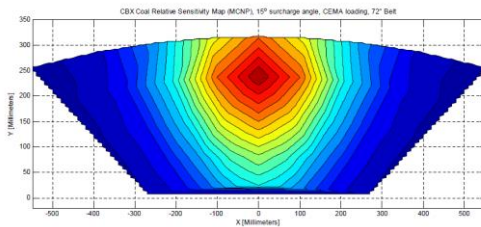


PGNAA online analyzer

Neutron radiation does not penetrate to the full depth and volume of the material on the conveyor. Neither do gamma rays which are consequently detected by PGNAA analyzer for chemical analysis.

The accuracy of PGNAA online analysis is affected by:

- Material segregation over the width of the belt
- distribution of layers of different materials
- Conveyor belt load changes
- Grain size of material and any existing voids



PGNAA Penetration modeling

PGNAA manufacturer recommendations on how to optimize performance of the analyzer*

Effect of material distribution:

- Avoid layering by using transfer point
- Minimize bed depth variation
- Add material evenly across the belt
- Avoid large voids in material flow
- Conveyor load >40 kg/m, hold kg/m constant
- Don't switch and combine additives

Effect of conveyor load changes:

- Use calibrated and accurate Belt Scale

Effect of conveyor belt type:

- Avoid steel cords
- Avoid fire resistant coatings (chlorine)

**Based on the recommendations
material segregation and presents of layers
affects PGNAA measurements no matter the fact that it is penetration
measurement**

Real-time PGNAA analyzer correction

Initial static calibration of PGNAA online analyzer and real-time performance

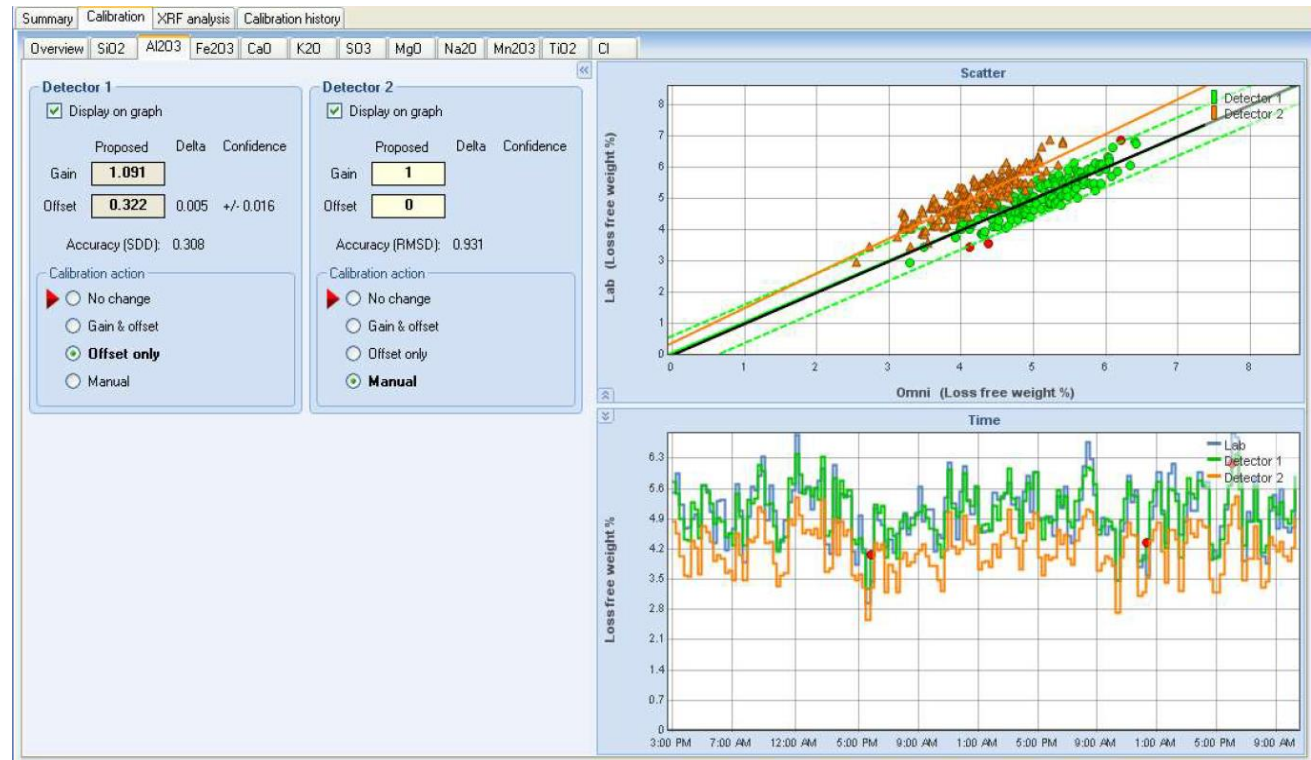
The initial calibration of PGNAA analyzers is done using artificial samples. These are either manufactured blocks or multiple bags with powder of known chemical composition. Such samples have no or very little relation to how the real material feed will be distributed on a conveyor.

Such a static calibration is used to readjust the analyzer measurements to compensate for radiation source (^{252}Cf) output decay over time or after online analyzer repairs.

In real life, the raw material feed on a conveyor belt changes all time. Such changes are related to mineralogical material changes, material distribution, and different conveyor loads. Such changes drift PGNAA measurements. In order to correct measurements, continuous lab sampling and XRF analysis is used.

In the cement industry, PGNAA online analyzer is corrected every 2-4 hours. Even special software is sold by a PGNAA vendor to automate such a process.

This means to ensure accurate measurement of the PGNAA analyzer you still need continuous lab sampling and lab analysis running at all times.

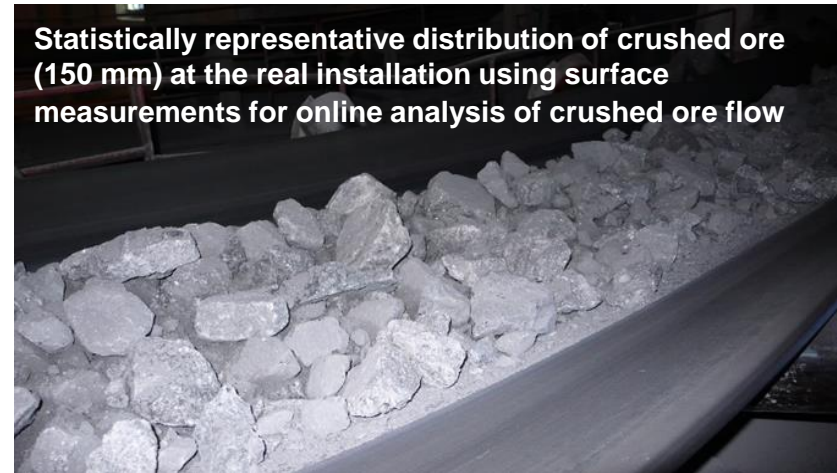


Typical software for regular corrections of PGNAA online analyzer based on lab sampling and lab XRF lab data.

Effect of material segregation and ways to reduce it

Although the LIBS is the surface measurement, this does not influence the accuracy of the online measurements if the location for the installation is selected correctly:

- The measurement should be done in a place where there is **no systematic segregation of the material** – meaning, where the surface **statistically represents** the volume of material over the measurement period (1-10 min = 100-1000 m of material on the conveyor)
- The material can be defined as statistically representative on a conveyor belt at such locations:
 - **after crushing/milling**
 - **after mixing (in drums)**
 - **after transfer point from one to another conveyor**



- To reduce the segregation of the material (up to 50 mm) material, simple mechanical devices (plows, chains) can be used to mix the material directly on the conveyor.



PGNAA – penetrating measurements

Question:

Is PGNAA as penetrating measurement better than “surface measurement” technology in delivering online measurements on a conveyor belt?

Answer:

Surface online measurement technologies (XRF, IR, LIBS) can deliver the same or better measurement performance than PGNAA in delivering bulk flow online analysis.

It is only the case of choosing the correct location for the installation in your plant.

The concept that “penetrating” measurement is better than “surface” for online measurements is just a marketing trick formed by some big vendors of PGNAA starting from 1990 -1980 when such technology was introduced for mineral processing control applications. There was no competition then and such technology became a de-facto option for years to come especially in the cement and coal industry. It is 2020 now and with improved sensor technologies and increased computation power, there are new more accurate, safe and clean technologies to consider. LIBS is one of them. Libs can collect hundreds and thousands of measurements a minute and can provide accurate and representative bulk flow on a conveyor belt. The stability of pulsed laser energy output ensures that online measurements can be done without frequent recalibrations in comparison with PGNAA systems.