APPLICATION NOTE

No. 61001

Application of on-line elemental analysis for control of sinter feed basicity

This application note describes the application and benefits of using the Thermo Scientific™ CB Omni™ Agile Online Elemental Analyzer for sinter as a primary sensor for basicity control in the iron ore sintering process.

Sinter is the primary feed material for making iron in a blast furnace. Sinter is created by mixing iron ore concentrate with several additives such as limestone and silica to control the chemistry and then igniting it at 1200°C in a continuous belt-fed furnace.

The basicity of sinter feed material is an important parameter in the efficient operation of the sintering and iron making process. Basicity is a calculated chemical parameter composed of the ratio of two or more elements that are known to affect the alkalinity of the material. Stabilization of the basicity of the sinter product delivers benefits not only to the Sinter operations but to the downstream iron making process. With the Thermo Scientific CB Omni Agile for sinter it is now possible to measure sinter feed chemistry on-line and provide minute by minute data to enable control of basicity in real time.

The CB Omni Agile for sinter (Fig. 1) provides accurate, reliable chemical analysis of material on conveyor belts with high availability and minimal maintenance. In installations around the world, the CB Omni Agile configured specifically for Sinter feed applications has proven to be a valuable tool for optimizing sinter feed basicity by providing the essential on-line analysis data

needed to control sinter feed chemistry. The resulting control and stabilization of sinter feed has delivered significant economic benefits both for the sintering process and the blast furnace.

Sinter feed composition control is important because the various sinter feed materials are not perfectly characterized and their chemical make-up varies within a batch and between batches. Therefore the raw feed material chemistry changes and the additives feed rates should be adjusted to smooth out these variations in the sinter strand feed chemistry.

In a typical sintering operation the control of the sinter feed chemistry is based on composite samples of the final sinter product. In addition to errors normally associated with sampling and analytical lab errors there is a lag of many hours between receipt of composite sample assays and current sinter feed chemistry. The sinter operation may also lack sampling equipment on the sinter feed conveyor. Sinter product composite

Not only can variability be reduced but set point targets can be quickly reached and verified allowing greater operational flexibility for the both the optimization of additives usage and stabilization of sinter feed.

CB Omni Agile product key advantages

Bulk material analysis
The CB Omni Agile uses Prompt Gamma Neutron Activation Analysis (PGNAA) to determine elemental concentration in bulk materials. The method is deeply penetrative and measures through many centimeters of material making it an ideal technology for real-time analysis of bulk materials on conveyor belts. Because the entire process stream is analyzed there are no errors normally associated with mechanical sampling. The combination of real-time analysis, full process stream analysis, accurate and reliable elemental analysis delivers a practical tool for sinter feed quality optimization.

Factory calibration
The factory testing and pre-calibration of the CB Omni Agile on sinter calibration standards delivers accurate analytical results during and after the in-plant start-up phase. This eliminates costly and time consuming stop belt sampling campaigns requiring the acquisition of many calibration samples to develop and validate robust calibration models. Confidence in this initial CB Omni Agile sinter feed analysis is further deepened through the implementation of dynamic calibration using the sinter product composite sample chemistry.

Automatic Belt Load Compensation (ABLC)
The automatic belt load compensation feature ensures analyzer accuracy over a range of changing production rates and belt loading. As the material loading on the belt changes so do the signals from the analyzed volume and the conveyor background. If not compensated for, these signal changes would increase the analyzer measurement error. This ABLC feature, unique to the Thermo Scientific CB Omni Agile, ensures that the Sinter feed chemical analysis remains accurate through the expected range of belt loading conditions found in typical sinter feed operations.

Installation considerations

To achieve a successful installation, key criteria about the process and physical installation are required. This information is obtained in a pre-sales questionnaire. The data required includes the full chemical analysis (100% basis) of the sinter feed material including the expected range of calibration for key analytes. The location chosen for the CB Omni Agile should be after the agglomeration drum, taking into account safe access for installation and maintenance as well as environmental protection for service personnel.

Other critical factors that will be used to design the CB Omni Agile for a specific sinter feed application include:
- Belt width and troughing angle
- Maximum and minimum feed rates
- Belt speed
- Range of belt loading
- Maximum burden height of material
- Location of existing sampling infrastructure
- Iron ore mineralogy
- Intended process control strategy

Figure 4: Graph of sinter feed chemistry with and without basicity control. B1 expected is the control set-point.

Conclusions

Since 2007, through sinter plant installations across the globe it has been demonstrated that reliable and accurate on-line elemental analysis of sinter feed can be achieved using a factory calibrated CB Omni Agile that has been configured for the sinter feed application.

From the constituent elements on-line basicity can be accurately determined and used for automatic control of sinter feed basicity resulting in meaningful economic benefits for the downstream iron making process. Interestingly it has been found that sinter plants do not commonly have sinter feed conveyor belt sampling stations from which validation or dynamic calibration samples could be obtained.

This would pose a challenge for a lesser analytical technology. It has been shown that the CB Omni Agile

can be dynamically calibrated against the sinter product composite sample chemical data that historically has been used to control the sinter feed additives feed rates prior to installation of the CB Omni Agile.

In several cases plant operators were reluctant to incur capital or lost production costs to implement sinter feed sampling systems or even a stop-belt calibration sampling campaign.

In these cases the unique precalibration feature of the CB Omni Agile has delivered meaningful benefit and return on investment.

A well implemented CB Omni Agile basicity control scheme can deliver the following benefits:

- More consistent sinter product – improves sinter quality and stabilizes feed to the blast furnace
- Increased sinter strand and blast furnace throughput due to reduced sinter product variability
- Decreased return fines lowers material handling costs
- Reduced load on laboratory allowing capacity to be used elsewhere without incurring additional costs
- Net reduction in cost per ton of sinter production

CB Omni Agile advantages include:

- Reliable and accurate with high availability and low maintenance requirements
- Variability of basicity in sinter feed can be reduced significantly and controlled
- Real time analysis of sinter feed chemistry
- Factory calibrated - lower commissioning costs and more rapid realization of return on investment
- Entire material on belt analyzed resulting in dramatic reduction of fundamental sampling error
- Automatic compensation for variable belt loading results in more reliable results

Africa-Other +27 11 776 0000
Australia +61 8 208 8200
Austria +43 1 333 50 34 0
Belgium +32 53 73 42 41
Canada +1 800 530 8447
China +86 10 8419 3588
Denmark +45 70 23 62 60
Europe-Other +43 1 333 50 34 0
Finland /Norway/Sweden +46 8 556 468 00
France +33 1 60 92 48 00
Germany +49 6103 408 1014
India +91 22 6680 3000
Italy +39 02 950 591
Japan +81 45 453 9100
Latin America +1 608 276 5659
Middle East +43 1 333 50 34 0
Netherlands +31 76 579 55 55
South Africa +27 11 776 0000
Spain +34 914 845 965
Switzerland +41 61 716 77 00
UK +44 1442 233555
USA +1 800 532 4752

Find out more at **thermofisher.com/pgnaa**

ThermoFisher SCIENTIFIC