

Bulk Ore Sorting in Base and Precious Metals



Ore sorting is a very broad concept that includes sorting by grade, particle size and mineralogy across many different mineral processes. This application note focuses on bulk ore sorting by grade using a CB Omni Fusion, which delivers rapid online elemental analysis, with either PGNAA (Prompt Gamma Neutron Activation Analysis) or PFTNA (Pulsed Fast Thermal Neutron Activation).

Due to the penetrative capability of PGNAA/PFTNA and specific analyzer design, the CB Omni Fusion is an ideal bulk ore sensing technology for continuous analysis of ore in base and precious metal applications.

Installing a CB Omni Fusion analyzer enables early and accurate measurement of the grade of material being sent to the process plant and enables a decision to sort material that is below target grade and divert it to a low-grade or waste stockpile. This enables a plant to increase the average grade of ore being processed to maximize metal recovery.

Additional benefits include the opportunity to divert or bypass material that is detrimental or not economically viable to the process and in doing so reduces the usage of water, power and reagents.

What are the benefits of Bulk Ore Sorting? Why is CB Omni Fusion the right choice for Bulk Ore Sorting?

Social License to operate

Social license to operate is one of the biggest issues facing the mining industry today. Often, the footprint, water and energy consumption are at the top of the list of community concerns. Bulk ore sorting can have a positive impact on all three of these.

- In a conventional flotation plant, up to 700L/t of water is needed for processing. Processing less waste and low-grade materials results in a reduction in the use of water, which can reduce water supply costs or operating costs of a desalination plant and the filtering of water at the end of the process. It also reduces the amount of water that ends up in a tailings dam.
- Grinding and crushing of ore is energy intensive and accounts for approximately 3-5 % of the world's power usage. Every ton of waste that is not processed reduces comminution costs and the associated wear and maintenance costs of the equipment.
- Early waste rejection can reduce the processing plant and tailings dam footprint and capital.

Improving the economics of marginal operations

Declining grades can lead to revenue reduction if throughput is at a maximum. Traditionally, the solution has been to increase capacity to offset this through adding to the plant infrastructure by large capital investment. Bulk ore sorting has the potential to either delay or eliminate this capital spend, while delivering higher grade material to the mill. The increased recovery and profitability results in an extension of the mine life, increases the return on investment in the mine and delays costly site rehabilitation.

Bulk ore sorting can be an enabler for marginal deposits to be exploited due to smaller plant sizes and environmental impacts. This may be essential in the future as discovery rates decline.

Bulk ore sorting can also be used to extract valuable material from low-grade waste dumps to provide extra tons to the operation.

CB Omni Fusion

The Thermo Scientific PGNAA/PFTNA family of analyzers, including the CB Omni Fusion, has the largest installed base of PGNAA/PFTNA online elemental analyzers, with over 1200 successful installations across more than twenty different applications.

The CB Omni Fusion, incorporating Thermo Scientific's industry leading neutron generator and large volume detectors, is designed to deliver the superior performance demanded in bulk ore sorting applications. Uniform sensitivity to the full flow of ore is critical when designing an analyzer for bulk ore sorting applications and should be a key consideration for optimal performance.



The CB Omni Fusion incorporates a multi-detector and source configuration to achieve optimal sensitivity, with each detector having more than 10 times the gamma ray detection volume of detectors used in other PGNAA systems, resulting in significantly improved precision and accuracy. An analyzer with a lesser specification will not sufficiently differentiate between different grades and will therefore send valuable high-grade material to waste and dilute the grade sent to the process.

PGNAA technology has been used for decades to provide online elemental analysis of material on conveyor belts and has been particularly prominent in the cement and coal markets. As the world progressively moves away from the use of isotopes, the mining industry is moving towards the use of a neutron generator as the source of neutrons instead of Cf-252.

Benefits of a Neutron Generator

PFTNA, Pulsed Fast Thermal Neutron Activation, utilizes a neutron generator instead of Cf-252, while retaining all other aspects of the PGNAA analyzer that the industry has come to rely on.

While the Thermo Scientific CB Omni Fusion will continue to have the flexibility to accommodate Cf-252 isotopes, up to 80µg, there are significant advantages to using a neutron generator in an ore sorting application. To provide the level of accuracy and precision required to differentiate between very low grades of material a significantly higher specification analyzer than has traditionally been used in cement and coal markets is needed.

The benefits of a neutron generator are as follows:

- In applications that require a higher precision, the neutron output of the neutron generator can be increased to meet the needs of the application.
- A neutron generator can output neutrons at a consistent level, meaning that a neutron generator system will continuously deliver the same analytical performance throughout the lifetime of the system, whereas, Cf-252 naturally decays over time and performance degrades.
- A neutron generator can be turned off when not in use, whereas Cf-252 continues to decay and emit neutrons continuously.

Development of a Bulk Ore Sorting system

The first step of any bulk ore sorting system development should be the installation of a CB Omni Fusion to measure the variability of the ore. A clear understanding of the real-time variability of grade is critical to the correct design and size of a sorting system. The CB Omni Fusion analysis also enables calculation of the expected grade and the resultant economic impact that an ore sorting system can provide. This will provide valuable input to building the business case for the investment in the complete system that will include diverters and conveyors for materials handling of the rejected materials.

The variability data obtained during this first step might also highlight the need to change the analyzer specification, e.g. increase the neutron output, to enable the required precision for sorting at a frequency required to exploit the grade heterogeneity.

Thermo Fisher offers a range of commercial models and partners to suit this approach to developing an ore sorting solution. Please contact our local sales representative for further information.



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