Sensor-Based Sorting

Sensor-based sorting technologies can help mine operators remove waste and upgrade low-grade stockpiles to increase mine life and lower cut-off grades. While sensor technologies are able to instantly pick up mineralogical differences in solid ore particles, advances in sensor instrumentation and processing capability in the last decade have created the ability to measure, process and evaluate ore in a manner of nanoseconds.

Ore sorting refers to the most common applications of sensor-based technologies and includes a range of solid-solid separation technologies that sort waste from minerals using sensor detection. **Sensor-based sorting** (SBS) offers mine operators significant upgrade potential before ore is transported to milling and hydrometallurgical plants.

There are two major types of sensor-based sorting – bulk sorting and particle sorting.

1. **Bulk sorting** uses sensors deployed on mine equipment or mine-to-plant conveyor belts, for example, to identify waste rock sections within run-of-mine ore and diverts these "bulk" sections elsewhere. This ensures that only mineralized ore makes its way to processing.
2. **Particle sorting** uses sensors to identify differences on a particle level with crushed rock within the mineralized ore sent from the mine on a particle-by-particle basis and separates rocks (usually crushed to a certain size) with high gangue content from particles with higher mineral content.

Which one is best for you? We can help.

How does an operation know if its ore is amenable to SBS and if so, what type—either bulk or particle? SRC has a unique combination of digital, mineralogical and minerals processing expertise to help mining companies navigate their sorting options, even before starting costly testwork programs

SRC's experts apply their understanding of sensor performance, mineral characterization and processing to help assess the economic viability of sorting options. We have experience with sorting technologies and equipment that are on the market, and we have also developed custom-made sensor-based solutions that are used in a variety of novel ways. In addition, we offer sensor-based sorting process development, testing and piloting as part of our full suite of mining services.

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SBS Characterization – A novel test for ore amenability to XRT sorting

X-ray transmission (XRT) is a common sensor-based sorting technology and is often used by mining companies who are in the early stages of evaluating sorting use in their operation. Other technologies include colour, laser, near infra-red (NIR) and optical.

SRC has developed non-destructive tests that combine high-resolution X-ray micro-computed tomography (micro-CT) scanning with QEMSCAN® to help determine an ore's amenability to XRT sorting. These tests also provide important information on upgrading potential and reference parameters for sorting equipment and processing, such as:

- Particle thickness
- Associated X-ray attenuation coefficients
- Desired mineral presence
- Mineralogical information related to associated minerals and clays to assist with developing sorting algorithms

Combining micro-CT and QEMSCAN® can address many limitations of the current method to determine whether XRT sorting technology is appropriate for particular ores. Mineralogy information from QEMSCAN® can identify incidences of mineral encapsulation, problematic clays and detrimental minerals, as well as calibrate the greyscale values of CT data. Additional 3-D micro-CT imaging carried out on cores provides spatial information of the minerals within the ore and mineral grades.

Micro-CT and QEMSCAN® together provide a powerful tool to help mine operators understand the mineralogical differences that micro-CT scanning can detect and the basis for the mineralogical separation through X-ray.

HOMOGENEITY FACTOR™

SRC developed the homogeneity factor method as part of our mineral characterization service to help clients determine the appropriate sorting technology for their ore and the potential benefits from the technology application. Our unique homogeneity factor formula describes the complexity of an ore fragment, which helps our team determine if a rock's mineralogy is homogenous – a key factor to determine amenability and types of appropriate sorting technologies.

Homogeneity factor values range from 100 to negative 100 (-100) or less. The higher the homogeneity factor value (e.g., 100 means the rock fragment is 100 per cent homogenous) for a given particle size, the easier the ore fragment is to identify and sort with a sensor-based sorter. A value of -100 implies a complex rock fragment with many minerals that is generally more difficult to sort with a sensor-based sorter.

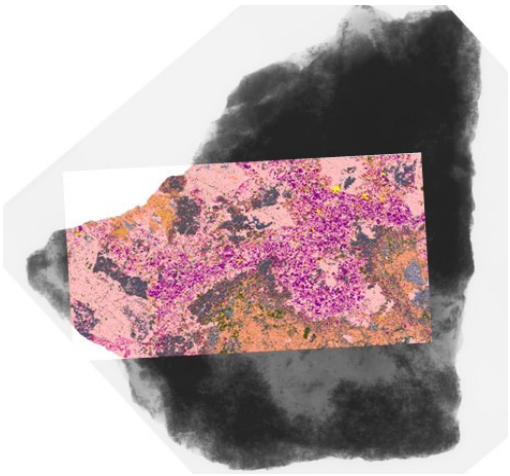

Illustration of mineral map determined by QEMSCAN®; registering with greyscale values obtained from 2-D micro-CT imaging, where darker areas represent high-density rare earth minerals.

Sensor Technology Capabilities

At SRC, we can also provide amenability information for a wide range of sensor and detector technologies on a bench scale, such as:

- X-ray transmission (XRT)
- Near infra-red (NIR)
- Colour
- Electromagnetic induction
- X-Ray induced luminescence (XRL)
- Laser scattering