Webinar 2 *Using Science to Maximize Sorting Efficiency* - Q&A

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Audience Question	SRC Answer
Could we use multiple criteria for sorting on the feeding conveyor prior to reaching sorting?	Yes. We assume you mean multiple criteria of the ore, such as density and colour and its inductance, etc.
What is the capacity (tonnage) for the ore sorting machines?	This depends mainly on the size fraction of the sorting. Generally, the capacity range is 15-30 tph for XRT. Bear in mind that most sorters have limitations on the size ratios that they can handle (i.e., a ratio of 2:1 would mean that you can only sort sizes from 10 mm to 20 mm, not the whole distribution). The general formula we use is 1.5 x mean size fraction diameter (d50) per meter width of the conveyor belt. However, this could change if the belt speed is reduced to obtain a better sort, etc.
How would you use the homogeneity factor as an indication for potential for sorting of the material as shown in the example with grade? Do you have the homogeneity factors of the fractions you presented for ore grade and recovery?	The homogeneity factor (H.F.) is a measure of how easy it is to sort the particles from each other given each particle's homogeneity. It is relatively simple to sort ore with H.F values of 100 or with values above 70. When an ore has an H.F value below 70, optimizing the sorting process becomes more complex and one needs to closely study the mineralogy and the economics of upgrading as in this situation; both the accept fraction and the reject fraction will have some mineralization.

Can you potentially apply this new tech into industrial minerals such as potash?	Yes, we can for potash and limestone, as we have worked on them before. For other industrial minerals, as long as there's heterogeneity in the orebody (i.e., multiple minerals are present), then this new technique could be applicable.
to sort out KCl from NaCl	We have done some work on sorting out KCl from NaCl. Please watch our CIM potash webinar from last November, *Break the Code, Not the Rock* (https://magazine.cim.org/en/voices/the-potash-webinar-series-en/)
In a business case, how many samples would you recommend analyzing? I doubt that the analysis of one sample gives representative results for the entire ore.	Analysis of a single sample is unlikely to be representative of an ore body, but this depends on the homogenous nature of the orebody itself. The appropriate number of samples that need to be analyzed will depend on the mineralogy and mineralization style of the ore. Selecting samples for representation is coordinated between SRC and the client's team.
When you increase the intervals, the number of blocks increases significantly. Will that slow down the sorting efficiency and reduce the throughput of the mill?	Increasing the intervals in order to improve the sortability of the ore (amenability of the ore to sorting) by definition means a decrease in the particle size (size fraction) that corresponds to a lower throughput/capacity through the sorter. Throughput = 1.5 x mean diameter of size fraction. The sorting efficiency in terms of how well it sorts would not be affected necessarily, but the throughput would be.

How efficient is ore sorting in refractory gold by a carbonaceous matrix?	It depends—sorting efficiency depends on the specific mineralogy of each ore and needs to be analyzed on a case-by-case basis. When sorting gold ore (refractory or other) the first priority is the removal of gangue-only particles (non-gold bearing minerals), whether those are carbonaceous or another waste type from the gold. If additional upgrading is required, then we can look at the mineralogy in more detail. The gold grain size distribution of the gold and the associated minerals are important mineralogical information. If the gold grain size was adequate, then XRT can be investigated, otherwise the associated minerals are to be investigated. If the associated mineral was quartz, then laser technology is investigated. If the associated mineral was tourmaline or chloride, then IR techniques. The mineralogy should be accompanied with an economic study of the upgrading potential since you will always lose some mineral in the waste when upgrading (as opposed to just waste removal). Once we have a viable solution then practical test work needs to follow.
Can you provide a cost estimate and turnaround time for this QEMSCAN service assessment on maybe 10 rocks?	The cost and turnaround time for a project largely depends on the complexity of the problem and the data density required. Please feel free to contact us with more details on your project.

Hello. Impressive QEMSCAN image. It seems it is a 5 cam x 10 cm image. How long does it take and how much does it cost? It is possible to get representativeness of rock heterogeneity for sorting with that approach?	The QEMSCAN image sizes are determined mostly by the size of the sample being analyzed. We can, and do, scale the step size to meet the needs of the project. For most sorting projects, we are using a step size of 30µm which provides adequate resolution to assess the heterogeneity for sorting and aids in the correlation of greyscale images on the CT (or XRT) to mineralogy. For finer-grained ores, we can reduce the step size to match the style of mineralization (e.g., coarser for pegmatites and finer for gold and PGE).
Regarding Homogeneity factor, how is it linked with the heterogeneity formula used in core data analyses for bulk sorting?	If we understand this question correctly, bulk sorting (e.g., PGNAA) is based on the chemical composition of the ore "in bulk", rather than on the physical characteristics on a particle level used in particle sorting. Please feel free to reach out to us if you would like more clarification on this answer
Does the homogeneity factor evolution versus the size of the considered unit lead to the definition of the liberation size?	The liberation size of a target mineral is controlled mainly by its size. The homogeneity factor is a measure of how mixed an arbitrary volume of rock is. As the grain size approaches the liberation size of all minerals, the homogeneity will, by definition, approach ideal homogeneity.
Did you test the homogeneity/upgrading evaluation using core scanning images? Not QEMSCAN images?	Can be done on either or both.
Can you precise the type of material is scanned with 3D CT? Are we talking about rocks or cores?	CT can be done on core and grab samples.

What are the typical costs and delay per step of the service package? What is the typical representative sample used?	The number of samples used to achieve representation is determined based on the complexity of the ore being studied. The cost is based on the number of samples and types of analyses required.
As block size decreases, does the percentage recovery increase or is the concentrate just higher grade?	This depends on how the mineralized grains are distributed. If the rocks are very homogenous (see H.F. discussion) as particles, then both concentrate grade and recovery increase. Like flotation, the smaller the size, the greater the separation efficiency, which increases both concentrate grades and recoveries. With successful sorting more waste rock is diverted away from the downstream processing, which has the effect of increasing the grade received by the processing plant.
What are the main advantages of using SRC's definition of heterogeneity vs constitutional heterogeneity (CH) value as per Theory of Sampling?	These are two different concepts serving different purposes. Our heterogeneity/homogeneity factor gives a quantitative number for describing whether a certain area of ore is predominately one mineral or not. The higher the homogeneity factor, the better for sorting purpose. For constitutional heterogeneity (CH) value and distributional heterogeneity (DH) as per Theory of Sampling, heterogeneity refers to generated sampling errors. Generally, it discusses representative sampling in practice.
Is there any experience with potassium ores?	Yes, we have studied potash ores using this technique. Please refer to our CIM potash webinar from last November, *Break the Code, Not the Rock* (https://magazine.cim.org/en/voices/the-potash-webinar-series-en/)

By core, do you mean a slice of the core, half core or full core?	We can work on all of them. While QEMSCAN samples have a certain size limit, CT scan can work on versatile sample sizes/geometry, as long as X-rays can penetrate.
With respect to the 2D to 3D - were those assay numbers correct? They look off by a factor of 10 or maybe I did not understand.	To clarify, the volume of a sphere with a diameter of 1 unit is 0.524 cubic units. Let 0.524 = grade of sphere in a unit cube. Taking 8 evenly spaced slices through the cube containing the sphere gives 2D areas of 0.785, 0.736, 0.589, 0.344 and 0 square units. The average of these 8 slices (circles) is = (0.785 + 2x0.736 + 2x 0.589 + 2x0.344 + 0)/8 = 0.515 square units (grade in 2D). Therefore, the 2D grade has an error of 2% ie, .515/.524 = 98%.
Ore sorting amenability seems to be greatly dependent on the mineralization style (finely disseminated versus veined as an example)? Will certain ore varieties be easier to sort?	Absolutely. Our goal is to provide information on which sorting methods would be suitable for a specific ore body. To achieve this, we examine the physical, chemical and mineralogical aspects of the samples and identify which sorting techniques will separate gangue, waste and ore.
Thank you, that was excellent. Mineralogy matters!	We couldn't agree more about the importance of mineralogy!
Have you looked at 'waste rock sorting' looking at deleterious elements?	Yes. Most sorting studies tend towards upgrading but tailings management is just as important to us. We have discussed the possibility of using bulk sorting on waste rock to divert non-acid-forming waste rock to a separate pile. This "safe" pile wouldn't need the additional treatments and monitoring required to reduce or eliminate acid mine drainage.