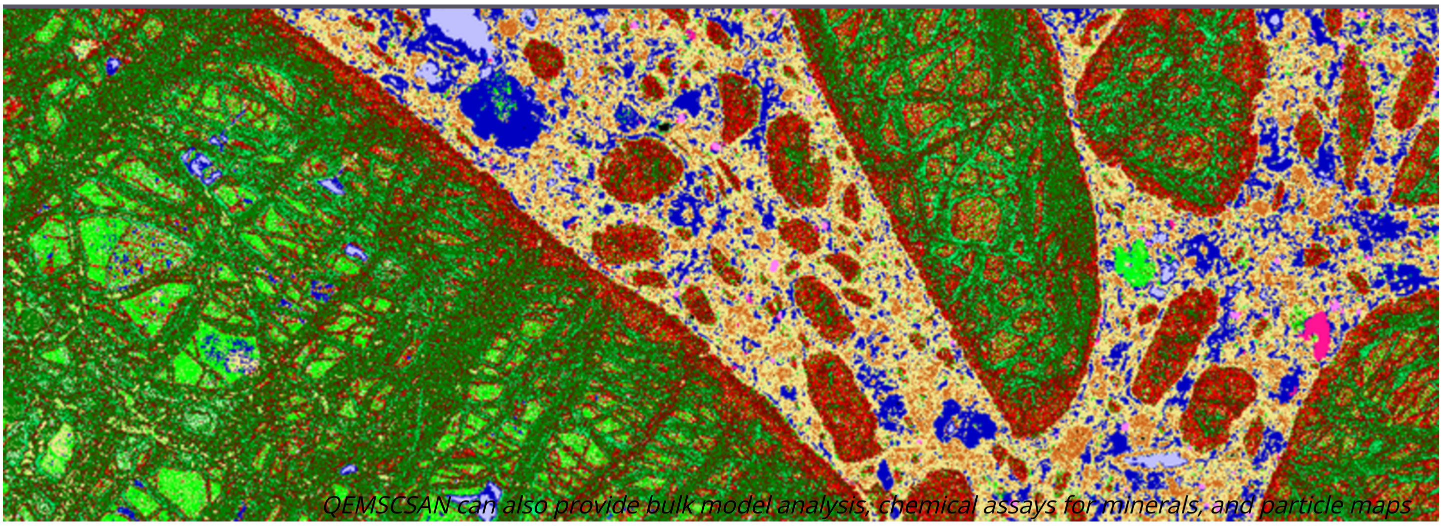
Mining Magazine

Automation enables labs' ESG evolution

It's a brave new world for metallurgical labs



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Technological innovations may have stalled in metallurgical labs, but market and environmental trends will encourage an uptick in technological development.

Metallurgical labs are faced with a growing number of challenges, mineral processing lead at BBA Ben Steyn told *Mining Magazine.*

"I think you're well aware of the new restrictions in mines in terms of GHG emissions, that we have targets to be net zero carbon by 2050," Steyn said. "At BBA, we have a big focus on achieving that goal, we know we need to change course and decarbonise the way that we mine."

Meeting the emissions challenge will be the primary driver for the development of new technologies in the mineral processing space, he said.

This focus has also forced a rethink on all processes in a metallurgical lab, BBA mineral process engineer Julia Gartley said.

/e're changing the way that we're inking about how we use existing chnologies, or flowsheets we're ıtting together to extract a new type metal."

eveloping new methods of extracting e is complicated by the new focus on inerals and metals being developed, eyn said.

"The challenge has changed," he said. "A specific challenge for us in Canada is that we need specific metals [to decarbonise], to use for clean energy technologies. I think we are still predominantly producing gold in this country, which is an industry that we have solutions for. We're sorted with the gold."

Opportunities for automation

There is space for more automation in mineral processing, they said.

"The most important thing we have are the data from a mine's control room, which includes data on the samples you take the measurements, you take, that's where the value lies in the plant," Steyn said.

The way data is currently extracted is very time consuming, he said.

"Someone goes to the plant, takes a hand sample, puts it through the filter, which pulverises it, puts it in an assay lab, and 12 hours later you'll know what happened in the plant. And you can't make decisions in real time."

New automation systems would be able to grab samples at timed intervals, and spit out assays very quickly.

"Speeding up that process of getting data is super important," Steyn said. "I noticed this in Chile, they could check this and have assays every 10 minutes. In other mines, you'd get two to three assays."

Improving automation of data collection in laboratories can move labs closer to meeting social and environmental targets, Hartley said.

"We're all in this together - mining operations, engineering companies, laboratories. The lab is producing the information for mines to be able to operate," she said.

"If we could get the answers in 12 seconds, to help mines make sure they're getting the most metal extracted from whatever reagents they're putting in, instead of 12 hours, that would help."

One technology which has been enormously helpful in achieving this aim is the QEMSCAN microscope, mineralogy manager at Base Metallurgical Laboratories Sarah Prout told *Mining Magazine.*

The device, the Quantitative Evaluation of Materials by Scanning Electron Microscopy, is used to "identify minerals and how they can be liberated," Prout said.

The scanning microscope can run 24/7, 365 days a year, and while it requires a mineralogist to run, uses automation to identify high amounts of data on rock samples and ore samples.

"Mineralogists can also look at it for brine sizes," Prout said.

QEMSCSAN can also provide bulk model analysis, chemical assays for minerals, and particle maps. The technology can determine particle type, shape factor, grains and particle size, as well as the proportion of mineral species present.

In addition to QEMSCAN, SGS has also added the Tescan Integrated Mineral Analyser (TIMA-X) to its fleet, Stephen Mackie, Senior Director of Metallurgy and Consulting at SGS, said.

The TIMA-X is an automated minerology system which provides rapid quantitative analysis on ores, concentrates, rocks, tailings, leach residues, and smelter products, according to SGS.

The system can also detect rare earths minerals, and can detect sub-micron inclusions.

There are limits to the amount of automation in metallurgical labs, Mackie said.

"The developmental aspect of the metallurgical testing that SGS does cannot be automated without losing the critical involvement of our personnel who conduct, witness, and observe the performance of a test," he said.

"Often such observations are part of the interpretation of the test results that guide the developmental programme."

SGS has introduced automation in other areas, he said.

"Two examples from a testing perspective are SGS' c-SPI [continuous SAG Power Index Test] and MFT [an automated flotation test]s," Mackie said.

Space to develop more testing

One of the frustrating aspects faced by technicians in metallurgical labs is the lack of development of technologies in use to better serve clients.

"In regards to grinding, lots of technologies we use in operations for finer grinding is based on 100-year old technology, particularly for the bond works index," Gartley said.

"But we could use new technology, and try to find the testworks that can give us agnostic answers, and developing those standard tests for equipment that's not based on one specific equipment vendor," she said.

"There's all sorts of vendors that sell fine grinding, but there isn't a standard grinding test that can be easily used against all equipment technologies to size that. That's where the technology needs to evolve to."

But this could also give laboratories room to be creative, Steyn said.

"The challenge for the laboratories is that we've been doing the same things over and over, but now the industries aren't calling for stock standard tests, and want you to think about it," Steyn said.

"We have a small lab in Hamilton [Ontario] which is basically our custom test lab, which doesn't compete with testing companies that churns out results," Steyn said. "So if you have a unique challenge or an idea that is not covered by an [already existing] test, let us do the test and answer that challenge."

Other challenges include the issue of declining ores, Steyn said.

"We have used up a lot of resources, and the result is declining ores," he said.

The other main challenge facing laboratories is the changing types of minerals mining companies are looking to extract, Gartley said.

Canadian metallurgical laboratories are still finding their feet in developing - and optimising - processes for these clean energy metals, she said.

"For so many of these critical minerals and battery minerals, the processes are new, and they're doing different types of leaching."

Many companies in these new metals spaces are developing proprietary methods, keeping them close to the chest.

"Right now, for instance, everybody knows how to mill copper or gold," Gartley said. "It's a very standard process, and the general flowsheet is well understood and well communicated."

It's trickier with the critical minerals, she said.

"The processes are more complicated, the reagents are unique, and there are challenges with emissions, water usage, it's a very complicated science," she said.

Because nearly all of these processes are proprietary, it is not shared among metallurgical laboratories, which makes it harder to understand the processes and identify areas which could be optimised.

"It's not shared information, and we're not all working on it together," Gartley said. "One of the big questions moving forward is, ‘How do we share the information while maintaining proprietary boundaries?"

SGS's Mackie is also expecting technology to change in order to adapt to new demands from critical minerals extraction companies.

"The demand for high-purity products that are used in the battery industry, for example, is driving the need to improve methods for impurity removal and purification of the final process solution," he said.

"Also needed are new and routine analytical methods that can deliver the detection limits required to quantify the ultra-trace impurities within these compounds."

Sea of data an opportunity for AI

For Thomas Chudy, a senior mineralogist at Process Mineral Consulting in Vancouver, the abundance of data received from mining projects will lead to additional technological development.

"With the introduction of automated electron systems and electronic microscopes, it's allowed us to collect huge amounts of quantitative data on ore," he said.

"We can use that data to develop predictive models of how ore will perform on a certain test, to troubleshoot what's happening in a mine, why recoveries may be dropping, or if there's a subtle change in ore composition," he said.

"We can do it now much more quickly, and more accurately, through automation," he said.

It also opens up the possibility for more machine learning techniques, and using the data to create predictive models over a a range of ore composition samples, minerology, and processing parameters, Chudy said.

"We can start developing methods as to how quickly certain minerals will float in flotation," he said. "For any processing step, we can try to develop a model for that specific ore or property that will enable us to make a prediction as to how it will respond, and we can use that data to optimise the operation."

Chudy is already working on this with some of PMC's clients, he said.

"I'm offering to do this work where companies or clients have these data sets all ready," he said. "I help them to come up with predictive models for milling throughput, or recoveries by flotation."

Huge datasets are useful in creating these systems, but they do come with one particular challenge.

"The drawback of these large datasets is the analytical uncertainty, and the sample errors are quite large," Chudy said. "I'm usually spending 50% to 60% of my time just purging the datasets, removing bad analysis, and removing the stuff that is suspicious."

AI is still not able to remove problematic data on its own, he said.

"I think we're a bit far away from that," he said. "Right now there's a lot of human input [required] that would be difficult to train AI to do."

Artificial intelligence and machine learning are most likely to come into play in "predicting responses to ore processing, predicting properties that will affect recoveries in flotation and cyanidation," Chudy said.

"You have to train these models," he said. "And you would have to have a gigantic database of many different testing campaigns for one specific ore type. But if these were to be combined in one coherent data set, it should be able to train an algorithm to identify key parameters that will determine the best recoveries."

It should also be possible to collect similar data points for a new ore type to create a new algorithm, which would then indicate the best processing route for the ore type, he added.

"We're moving towards an optimisation of mining operations," he said.