

Choice: the new parameter in sample preparation for mining laboratories

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Introduction

Only two or three decades ago, certainly within the experience of many Members of the SMA, there was almost no choice when it came to selecting equipment for sample preparation. There was some choice of supplier, but the crushing was done by a jaw crusher and sometimes a secondary rolls crusher and the pulverising was done by a disc mill or a ring mill. All splitting was done by a Jones riffle. Every machine was operated by someone standing in front, loading and unloading the samples, often in dust laden air, with lots of noise and plenty of opportunities for back problems.

Today there are many choices of equipment, from simple manual machines to fully automated processes. I will describe some of the new choices developed at Rocklabs since the last SMA Conference.

Equipment for a specific purpose

In old fashioned style labs, the same few machines were used for all types of sample. This may have kept the capital cost down but it was not possible to improve productivity or working conditions. Today there are individual machines or combinations of equipment that are specifically aimed at one type of sample. An excellent example is Rocklabs new "Blast Hole Mechanised System" as supplied to the Porgera Gold Mine (Placer Dome) in Papua New Guinea.

In common with many mine, sampling studies showed that to improve the accuracy of the blast hole assay results, the sample size would have to be increased and the whole sample reduced to around 2mm or less before splitting and the portion to be pulverised. Better accuracy of the assay results could improve the selection of ore and waste, but could the sample prep be carried out efficiently on such large samples? A sample weight up to 25kg, i.e. over 50lbs was proposed.

The mine requires up to 400 blast hole sample to be prepared in 24 hours. If the whole 25 kg was to be finely crushed, achieving the throughput would be impossible, without buying more equipment and using more Operators.

At the time this project was discussed we had a visit from Steve Crutcher who was working with ALSChemex in South America. They had faced the same problem and he had added a screening step before crushing. The samples were screened in a screening machine of their design, with a 2mm screen and the "+ fraction" was crushed and recombined with the "- fraction". As the samples were about 40% less than 2mm, this procedure could speed up the process. But, there were some drawbacks. The samples were from exploration projects and they needed a high degree of cleanliness between samples, so the Operator had to clean the screen carefully between samples. At pay rates were lower than in North America, the extra Operator time required, cost less than the savings in time overall.

In the Porgera case, adding to the Operators was not a good option and there was one advantage over Steve's situation. As the samples are blast holes, from a mine, there is not such a high requirement for inter-sample cleanliness, so the question became, could we build a screening machine that would handle the samples and not bind up. A few grains left on the screen are not a big problem, but if the screen bound up, it would require manual work to clean it frequently, increasing the labour cost per sample.

After much testing, we developed a suitable screening machine, so we were able to build a Mechanised System, consisting of two mirror image lines with a central waste removal conveyor. The conveyor takes the waste outside the building and dumps it into a walled area that is cleaned out as required. Each line consists of a sample lifter, to carry the 25 kg sample up to the screen. The screen separates the + and – 2mm fractions, with the + 2mm fraction feeding into a Boyd Crusher and the – 2mm fraction falling down a chute and recombining with the crushed material. The recombined material travels along a feeder to the final RES that takes out an accurate split and the rest is dumped onto the waste conveyor. One Operator can run both lines.

The Porgera System is Mechanised, not automated. There is no PLC. The System is turned on in the morning and all machines and devices run continuously. One line can be operated without the other. The System could have included a CRM pulveriser to do the pulverising as well, but the lab already had several large mills and there was not enough funds available for a more complete System.

The System was installed in mid-December 2003. At the end of 2004, the Laboratory Manager, Arto Karjalainen, reported:

The machines have run so far, between 400-500 hours.

They have processed about 15,000 samples, about 250 – 300 tonnes.

In terms of processing time per sample, we have achieved better than expected at about 4 minutes per sample, for example averaging 15 – 20 kg each. We may have been running the crushers too coarsely at some times.

The screen systems appear to show very little wear at this stage. They tend to retain some samples but not really enough to be of concern for grade control.

At this stage, I have to say that we have had very little problems with the unit. They seem to be quite robust and functional.

We believe the Porgera Mechanised System will be of interest to any mine running 100 or more, large blast hole samples per day. By removing the fines from the sample before crushing there is an added bonus; the stress on the crusher is reduced. No jaw crusher likes to crush material with a high content of fines, so screening prior to crushing reduces the wear on the crusher plates and minimises long term crusher maintenance.

Choice of Pulveriser

In the latest Alchemists Digest there is an Article about an automated ring and puck mill, a variation on the normal manual machine. This machine has been used for several decades for pulverising samples for XRF analysis, where the particle size needs to be small and there may be a need to add a binder for the following, XRF disc pressing operation. It can be automatically cleaned.

At Rocklabs we have spent twenty years developing an alternative to this design, that has some advantages and some disadvantages. Our CRM is simpler and costs much less, it can pulverise any quantity of material from 100grams to several kilograms and is ideal for gold assay samples and it can be included in our Automated Systems. It cannot pulverise very finely and it cannot prepare a sample with a binder for XRF analysis.

These two machines are a perfect example of the choice that labs have now. Each has its own advantages, each has applications where it is the best choice.

Another choice in pulverisers is our Bench Top Ring Mill. This Mill is smaller than a normal ring and puck mill, costs less, is quieter and has a range of Heads made of different materials. A new Head design for this Mill, only available so far in tool steel, includes our patented split discus and can take samples up to 200 grams.

Compared to what was available 20 to 30 years ago, laboratories have far more choice than ever of equipment for sample preparation. Some laboratories have reviewed their operation and made improvements, choosing the best option for their particular needs, but some laboratories seem to be in time warp, continuing on with equipment and procedures that are not the most productive or that cannot guarantee the best results. It is time for all Laboratory Managers to consider all the possible choices and help advance the status of sample preparation in the mining industry.