

# All sorted out

A new cyclone diagnostic system is keeping things moving at Copper Mountain

By Eavan Moore

Courtesy of Portage Technologies



Last year Copper Mountain eliminated downstream incidents caused by plugging or roping cyclones using Portage Technologies' cyclone detection system.

In 2014, Copper Mountain Mining Corporation decided it wanted to optimize its 35,000 tonne-per-day copper mine in British Columbia and exceed its nameplate capacity. Therefore, it began moving high tonnages of coarse material through its ball mills. However, this inevitably resulted in plugging and roping incidents with its cyclones at an average of three or four per week, causing downstream interruptions in the flotation circuit.

"We ended up having events where a plugged cyclone would go undetected by mill operators between scheduled checks," said then-mill superintendent and current mill manager Mike Westendorf.

So when Portage Technologies enquired about using Copper Mountain as a testbed for a new cyclone detection system, Westendorf readily agreed. The Portage software analyzes each cyclone's vibration frequencies in relation to process conditions and alerts operators when an anomaly develops. By helping to correct cyclone problems quickly, the system cut downstream incidents down to zero in 2015.

## Good (and bad) vibrations

A cyclone classifies feed by the use of centrifugal force to accelerate the settling rate of particles. Cyclone flow patterns are subject to two opposing forces: differential force upward for the finer particles (overflow) upwards and centrifuging the coarser particles (underflow) out and down. "When a cyclone gets into trouble, it's usually one of two ways," said Michael Schaffer, president of Portage. "Either you plug it, which means material plugs the bottom so everything is forced out of the top. Or you get roping, which is when the internal air core collapses and material just goes up and down, about 50 per cent each way. The cyclone becomes a T injection. In both of these situations, it means you're sending much coarser material than you should be downstream."

Copper Mountain did, and still does, check the cyclones every two hours. But complications develop more rapidly than that. "The float operators would typically pick up on the issue in their circuit within 15 minutes or so," said Westendorf. Isolating and fixing the offending cyclone took an average of 10

minutes. Portage calculated that if one of the 16 cyclones at Copper Mountain were plugged for ten minutes, enough coarse would be sent to the first rougher cell to remove 18 per cent of its capacity if it was not removed.

In contrast, the Portage Cyclone Detection (PCD) system detects problems in seconds. Portage has a partnership with Emerson Process Management tools for the hardware, which consists of accelerometers attached to the top and bottom of each cyclone. The accelerometers provide output of vibration variables which are analysed and sent to Portage's technology which then determines if an incident has occurred. "What that PCD server is doing is decoupling the frequencies into their components so that we can isolate the ones that are most relevant," said Schaffer.

The PCD software contains proprietary algorithms that interpret those frequencies using both physical parameters around the cyclone and process parameters like feed density and the number of open cyclones. If the cyclone is roping or plugging, the control room operator receives an alarm within five seconds specifying which problem has arisen and can close that cyclone. He can then request that maintenance looks into the problem. The full response time, with adjustments, lasts about a minute.

That low response time is very helpful, according to Schaffer. "A plugged or roped cyclone will kick up between 10 and 25 cubic metres of coarse in a 10-minute period," he said. "It's a linear relationship, so by getting it down to below a minute you're already down to only two cubic metres of coarse."

The availability figures for Copper Mountain's on-stream analyzer show what that can accomplish. In the two weeks before commissioning PCD, its availability at the rougher recovery assay point averaged 70 per cent. During the two weeks after commissioning, availability averaged 93 per cent.

When first commissioned between August and December 2014, the system had only diagnostic capabilities. Portage then incorporated a control system that reduces the number of roping and plugging incidents. The Portage Pumpbox Control (PPC) code instantaneously responds to potentially problematic variations in the cyclone feed. As opposed to controlling the pumpbox based on level stability, the PPC allows the pumpbox level to float, absorbing disturbances.

### **A joint development project**

The PCD was the first technological solution Copper Mountain had considered, and it came about because Portage had already been working with Copper Mountain on other projects (see for example "Science in the art of flotation," March/April 2015).

"The only reason we considered this was because Portage provides a number of different solutions to site already," Westendorf said. "It just made sense to let them tie it in. So essentially, it was a no-cost trial for us, and we only took on costs if we liked the system."

In exchange, the project provided Portage's first opportunity to adjust its technology to real-life conditions. For example, the original sensor locations and sticking method evolved. "We had to come up with innovative ways of attaching the sensors to the cyclones to prevent them from getting knocked off or damaged," said Schaffer. Ultimately, the sensors were threaded onto a pad welded onto the cyclone.

It also took a bit of time to incorporate process parameters into the PCD algorithms. "So the operators got some false flags for a bit during startup," said Westendorf. "It only takes a couple before the operator starts ignoring the alarm." But as the system became more accurate, acceptance grew – and one last incident at the end of 2014, which could have been prevented had the alarm been heeded, "really taught the operators to learn and respect the system."

In early 2015, Copper Mountain decided to buy the system. That year there were no further downstream incidents caused by plugging or roping cyclones.

### **Developing a market**

According to Schaffer, Portage is the first company to develop a vibration-based solution. Other technologies include acoustic sensors at the top of the cyclone and cameras or impact sensors at the bottom. In Schaffer's view, the Portage solution excels at maintenance and accuracy; the former because there are no wear parts and the latter partly because there are two sensors to validate each other. Trading on Copper Mountain's success, Portage is providing its PCD to other mines, including Escondida in Chile, for roughly US\$10,000 per cyclone.

"We are working with one of the major cyclone providers," Schaffer added, "where they'll be embedding this technology into their cyclones as an OEM offering and putting fittings on their cyclones to be able to take our sensors."

If plugging and roping detection seem like strangely limited uses for this technology – well, its proponents would agree. Portage is also expanding the technology to measure liner wear. Version two of the system should come out later in 2016. Meanwhile, Copper Mountain is currently trialing vibration monitoring to gauge its SAG mill load.

"It's often hard to find some higher-end technology that the operators actually appreciate," remarked Mike Westendorf, mine manager at Copper Mountain. "And they actually really like this system."

"We're just extremely thankful that Copper Mountain had confidence in us, took the time to understand what we were proposing to them, and were prepared to take the chance in testing the technology in their plant," said Schaffer. "And fortunately it worked out well for both of us. That's the way this industry is going to continue to move forward: by working together as a team to ensure that the technologies can work." 