

Shock Pulse and Vibration Monitoring Optimize Hoist Reliability at Boliden

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Figure 1 The multi-rope friction hoist at the Renström mine

Shock pulse measurement and vibration analysis are both widely used for monitoring the condition of industrial equipment. The two complement each other perfectly, providing an ideal reliability solution for mining applications.

At Swedish mining company Boliden, the integration of a recently developed shock pulse technology with vibration analysis brings peace of mind to maintenance engineers.

Mine operators are increasingly recognizing the benefits of investing time and effort in predictive maintenance strategies. In this capital-intensive industry, equipment uptime is the key to profitability. The higher the complexity of equipment, the greater the risk of breakdowns and costly downtime. Maximum productivity at minimum cost is a prime objective.

At the Renström mine in northern Sweden, Boliden successfully monitors the mechanical condition of the multi-rope friction hoist using a combination of vibration and high definition shock pulse measurement. First installed in 1953 in a tower mounted setup, the Renström mine hoist had its second revamp in 2013, converting it to a ground mounted hoist system.

The Renström mine hoist case

The hoist is a critical application and its performance vital to mine operations. Tough operating conditions and high availability requirements makes it imperative to know the mechanical condition of the hoist at all times. To ensure peak performance and maximum equipment life, an online condition monitoring system now monitors the new hoist at Renström, providing real-time, condition based information on the status of critical components.

Mats Johansson, Maintenance Manager at Renström stated that:

‘The mine hoist is critical equipment (Arated) for us and the heart of our business. If the hoist malfunctions, production more or less comes to a halt. On this type of equipment, we need good control and that makes online monitoring necessary.’

The hoist basically is made up of a frequency controlled motor, a two-stage gearbox, a drum, the wires and two skips. The skips are mounted at the tail end of the wires with a lifting capacity of approximately 5 tons each. Delivered by ABB, the 400 kW motor and gearbox has a total ratio of 13.609:1. Upon installation of the new hoist at Renström in July, 2013, the online system Intellinova Compact with the SPM HD shock pulse measurement technology was also installed and commissioned, providing very good baseline measurements from the brand new hoist.

The combination of vibration and shock pulse measurement is ideal for monitoring mine hoist performance. The shock pulse technology is very suitable for detection of bearing damages in typical industrial environments, while vibration technology is optimal for low frequency-related fault conditions like unbalance, loose gears and misalignment.

The technical solution

Fifteen transducers are used to cover the motor, gearbox and drum; ten shock pulse transducers to monitor bearing condition, and four vibration transducers to detect low frequency vibrations like gear mesh frequencies in the gearbox or unbalance in the drum. In addition, RPM is measured on the motor drive shaft, one pulse per revolution.

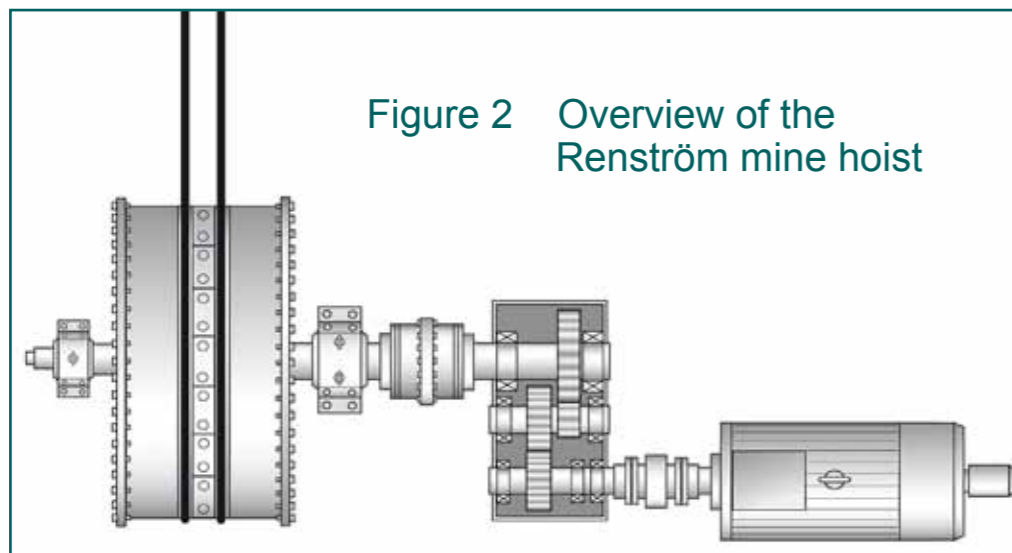


Figure 2 Overview of the Renström mine hoist

Using shock pulse transducers with the SPM HD technology renders superior capability to detect bearing condition. The multiple gear-mesh frequencies in a gearbox significantly affect normal vibration transducers, making the spectrum and overall values very hard to interpret. The shock pulse transducer however is not affected by normal mesh frequencies - as long as the gear teeth are in good condition and no impacts are emitted - but the slightest irregularity in the contact surfaces between the gearbox teeth will trigger an immediate response with precise and easily interpreted readings. The shock pulse and vibration combination hence covers this application very efficiently.

Measurement setup

A common working principle for all hoist types is the cycle time; a hoist is in operation for a limited time, followed by a stop time for loading and unloading. From a condition monitoring viewpoint, the measurement 'window' is limited by this cycle time. In shallow mines, short cycle times may be a challenge in terms of very limited measuring times. For the hoist at the Renström mine however, this is not a problem. The hoist completes one cycle – lifting one skip from 900 meters up to ground level - in 120 seconds. It accelerates fast and the drum quickly reaches a stable 51.3 RPM. Based on the 120 second cycle time at 51 RPM, one hoist cycle equals 102 revolutions of the drum. Selecting a measuring

time of 20 revolutions for all measuring points on the slowest shaft ensures enough readings without using triggered measurements. All other shafts will make more revolutions so for them, the measuring time is less critical. Even though some measurements may be lost if the measurement window happens to hit a rapidly changing RPM due to acceleration or retardation, most of the readings will be taken during stable RPM conditions.

The parameters measured and trended are HDm for all shock pulse measurements (a moving average filter with ten readings has turned out to be useful to avoid false alarms caused by single impacts) and vibration velocity RMS (here too a moving average of ten values is used). Due to the relatively high 1 X readings on the drum, a trend showing the 1 X symptom trend was added.

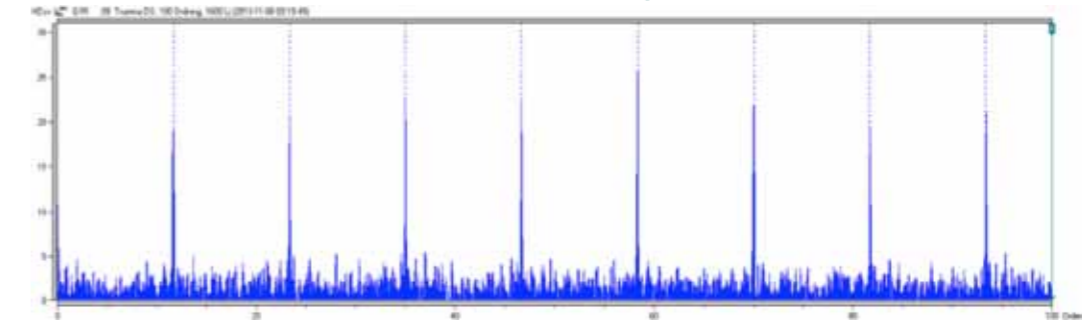
The measurement interval is set to thirty minutes for each measuring point. The long cycle time of 120 seconds gives plenty of time to measure, resulting in many readings per day on all measuring points. The number of readings per day is fifteen, on average. This is more than enough, so fewer readings per day might be considered to avoid a rapidly growing database - two readings a day for example might suffice.

Reliable results and optimal control

During the first six months of measurements - from July, 2013 to January, 2014 – a number of interesting observations were made. Early on, very good quality readings revealed that gearbox data provided by the supplier were incorrect, since the readings did not match the expected results according to gearbox specifications.

Furthermore, an exact 1 X vibration peak on the drum is higher than expected for this 50 RPM application. Slightly higher than 2 mm/s, this may be caused by wire oscillation but more likely by unbalance.

Figure 3 An SPM HD spectrum perfectly matching outer race defect frequencies.



There are also signs of outer race damage on the drive side bearing of the drum (see Figure 3); although still very small, it can be clearly seen in the readings. Measurements also occasionally show relatively high random impacts close to the coupling between gearbox and drum.

The levels are very low with an HDm value of 10 dB. With the exception of these deviations, the hoist is running very smoothly with low and stable readings in general. The suspected unbalance and small bearing defect are closely monitored through continuous measurement and trending.

Taken together, the monitoring results and system performance thus far have provided full control of this mission critical application. Shock pulse monitoring integrates perfectly with vibration analysis, providing an ideal reliability solution for all types of hoist systems as well as other critical mining equipment. Boliden implements the same condition monitoring solution on an Autogenous Mill at the Garpenberg mine in central Sweden with very good results.

Boliden Renström

The Renström mine is currently Sweden's deepest mine at 1340 m. The ore is polymetallic and contains zinc, copper, lead, gold and silver, which is extracted using the cut-and fill method.

www.boliden.com/Operations/Mines/Boliden-Area/Mills

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