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Bearing Monitoring Keeps Coal Safely On The Move

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Here's how proactive condition monitoring is helping an energy-services provider defuse a process safety challenge.

Conveyor systems aren't just subject to considerable wear. Even in normal use, they can face the risk of fire due to equipment failure or ignition of the materials being transported. In Amarillo, TX, energy-services provider Savage is successfully employing state-of-the-art online condition monitoring on a coal-conveyor system to help eliminate that concern and ensure safe and uninterrupted supply of fuel to Xcel Energy's Harrington Generating Station.

The challenge of PRB coal

The coal-conveyor system plays an important part in the operation of the Harrington Generating Station: A reliable and trouble-free supply of fuel is critical to secure energy production. The Harrington plant, owned and operated by Xcel Energy, gets its coal primarily from the Powder River Basin (PRB) in Wyoming. A special property of the PRB coal is its propensity to self-ignite. Another characteristic of this coal is its friability, creating combustible dust that can penetrate into bearings and other parts of the conveyor system.

While PRB coal has become popular—*based, in large part, on its low cost and low sulfur content*—that popularity comes at a price. The potential for spontaneous combustion calls for safe operation and maintenance in coal transportation systems and stockyards. Good housekeeping practices, such as properly managing coal stock piles, limiting dust accumulation, preventing spills and conducting regular cleanups are extremely important. For the Savage maintenance department, handling PRB coal has introduced extraordinary hazards. Careful management of these hazards is a must. A mechanical fault in the bearing of a roller, for instance, could cause ignition of the belt or coal. Friction between a seized roller and the belt could also lead to fire. The site's online condition-monitoring program plays an essential role in dealing with the safety issues that come with the handling of PRB coal.

Condition monitoring: a proactive strategy

Savage implemented its condition-monitoring program to monitor plant machinery and detect potential failure at an early stage. In late 2009 and early 2010, the Intellinova® online system from SPM Instrument was installed to monitor 40 conveyor and crusher bearings. The condition of these bearings is measured with SPM HD®, a new and advanced shock-pulse measurement technique. Particularly well-suited for low-RPM applications, this new technology can be utilized on rolling-element bearings throughout the range of 1-20,000 RPM. At the Savage Harrington location, the conveyor system runs at approximately 120 RPM.

A prominent feature of the SPM HD technique is its capacity to detect machine problems at a very early stage and provide reliable diagnostic information months before replacement of a damaged part becomes necessary. SPM HD delivers immediate condition evaluation in green-yellow-red and presents measuring results with remarkable detail, giving a clear picture of bearing condition.

Savage's condition-monitoring program was off to a flying start. Initial readings in June 2010 indicated deteriorating condition on one of the pulley bearings. With the online monitoring system, Savage personnel were able to keep a watchful eye on development of the damage for a full 15 months before the bearing needed replacement.

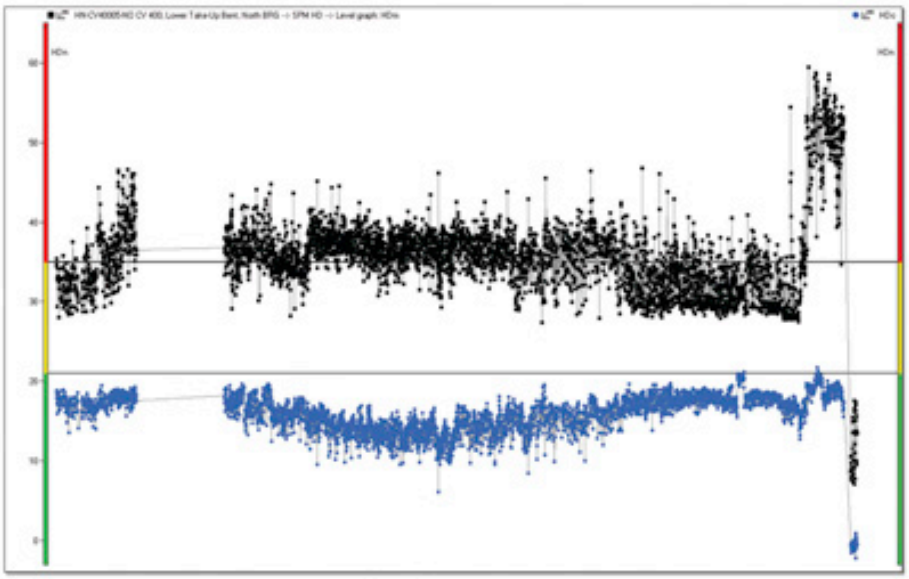

Fig 1. Trend graph of measurements on the pulley bearing. HDm (black) is a scalar value expressed in decibels. It represents the strongest impact found during the measurement time, and is the primary parameter for assessing damage severity. HDc (blue) is a scalar value expres-sed in decibels, representing the level where 200 collisions per second are found. HDc is very useful for determining lubrication condition. (Click to enlarge)

As can be seen in the trend graph in Fig. 1, taken from Condmaster® Nova software, the HDm readings (black) were already in the yellow warning zone when measurements began. Shortly thereafter, they started to move into the red, but the condition degradation was relatively slow. In September 2011, a significant increase was seen, leading to a decision to replace the bearing in a planned maintenance action. Immediately after replacement, the readings dropped into the green zone.

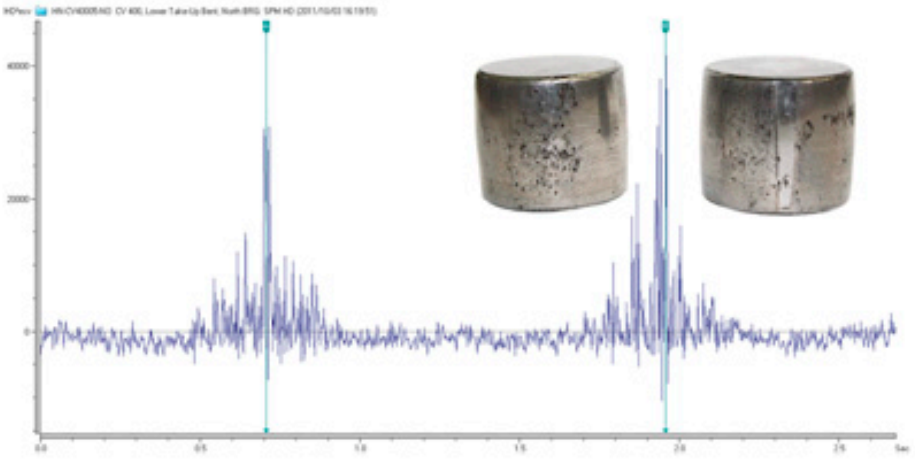

Fig. 2. Time signal from the pulley bearing; signals dominated by damaged rolling elements. Click to enlarge.

The time signal in Fig. 2 shows that in the late stages of the damage process, the majority of the signals were dominated by damaged rolling elements. The periods between the "bursts" in the time signal are equal to the cage frequency—*i.e., how often the rolling element enters the load zone of the bearing.*

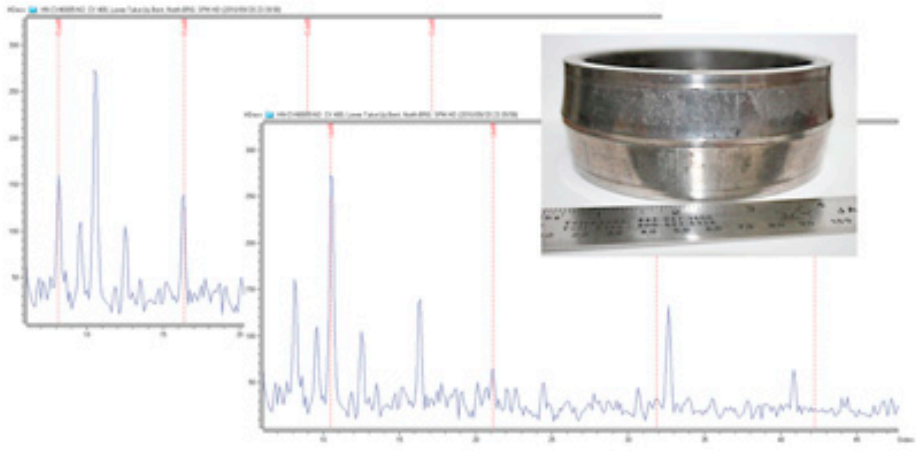

Fig. 3. Spectrums showing clear indications of inner and outer race damage. Click to enlarge.

By September 2011, clear indication of both inner and outer race damages was visible in the Condmaster® Nova spectrums (see Fig. 3).

Examination of the replaced bearing showed severe damage on both its inner and outer rings, as well as the rolling elements. Still, no secondary damage to the shaft or bearing housing had resulted, and since the bearing was replaced during normal downtime, no loss of production was incurred.

Clear and tangible benefits
In general, a majority of industrial accidents happen during cleaning or other maintenance activities. When equipment failures occur during normal production runs, production requirements may call for hurried maintenance efforts to get the machinery back up and running as quickly as possible. This can be an invitation for accidents to happen. In contrast, when maintenance can be carried out only when confirmed necessary and under planned stops, risks are significantly reduced.

To Savage, the condition-monitoring program brings indisputable benefits beyond the ability to provide a reliable delivery of coal to its valued Harrington Generating Station customer. A substantial reduction in equipment failures, improved worker and equipment safety and an increase in plant availability and productivity are results that speak for themselves. Assuring dependable, safe and trouble-free operation of the coal conveyor system is a smart business strategy—*in more ways than one*.

When asked about the cost savings for this particular bearing change, Mark Kilgore, Operations Manager at the Savage Harrington site, noted, "We could still run if this bearing would have failed during a run, but had it failed outside the normal hours of the maintenance team, we would have had to call them [maintenance] in and this would have been an extra expense." According to Kilgore, if the bearing had catastrophically failed, it could have caused a fire. It also could have damaged the belt—*one of the longest belts in the plant*.

The pulley bearing in question is located about halfway up a conveyor belt system rising over 200 feet from the ground to the top. If the bearing were to overheat, both it and the coal traveling on the belt could catch fire. That burning coal, in turn, could then fall onto the returning belt below. On its way to the top of the conveyor system, a fire would pull air in from underneath the conveyor system, fueling an inferno-like situation akin to the inside of a blast furnace. Such an incident clearly could be devastating to workers and equipment alike.

The early detection of potential bearing problems saves users downtime and money. Kilgore sums it up this way: "As we all know, when you have a catastrophic failure, it never happens when it is convenient, and it usually causes severe damage. With this system [SPMs], we are able to catch these problems before complete failure, and we can schedule the repair when it is convenient for us." **MT**

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