$ 1,000,000 savings on a primary crusher

[BACKGROUND]

In the past, existing predictive maintenance equipment could not identify damage to a bushing, leading to a catastrophic failure of a primary crusher costing $1,000,000. To enhance lubrication management and machine maintenance, the customer conducted a comprehensive assessment of predictive maintenance technologies for their primary crusher. They then integrated Atten[2]'s OilWear S sensors into their operations. Before this implementation, their lubrication management cycles typically took at least a week, involving sampling, laboratory analysis, and decision-making.

[CHALLENGES]

- Short time interval from start of damage to catastrophic machine failure
- Damage difficult to detect with conventional monitoring technology
- Possible mistakes during oil sampling
- Long response time of the lab

[SOLUTION]

Given this customer's needs, Atten[2] recommended the installation of OilWear S sensors. The ISO code display and real-time particle shape classification enabled quick decision-making:

- The lubrication management cycle went from one week to one or two days, reducing risks in sampling, reducing lab and labor costs, and thus increasing machine lifetime.
- The sensors also optimized asset management and prevented a catastrophic failure that would have shut down the mine production. (See page 2).

Atten[2] sensor offers a unique combination of:

Shape analysis

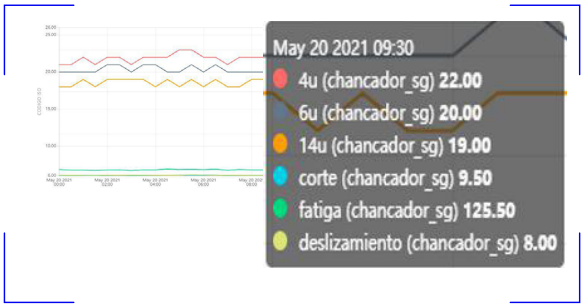
Air bubble detection and discrimination

Particle counting ISO 4406 and NAS 1638

Oil degradation

Image storage

[SEQUENCE OF FAULT DETECTION]



May 20th, 2021

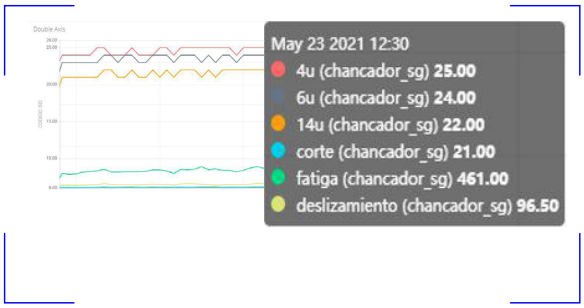
"Normality line" of primary crusher operation was set to an ISO code 22/20/19, as seen in the box, the average data before the failure began.

May 22nd, 2021

At the precise moment when the values showed a notable deviation, increasing beyond the normal ISO code (24/23/21), an increase in sliding wear was detected. *

Armed with this information and mindful of the previous catastrophic bushing failure, the operator conducted on-site inspections, leading to the discovery of a fault in one of the bushings.

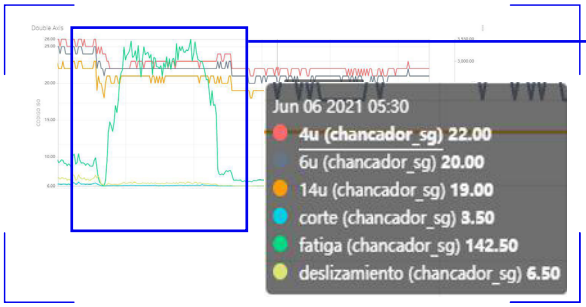
* Note: The increase in fatigue wear (natural wear) is not in itself an abnormality that requires attention!



May 23th, 2021

The graph shows a sustained upward trend in the ISO code (25/24/22). Similarly, the classification of particulate matter indicates a continuous increase in cutting and sliding particles.

To stabilize the crusher's performance, several corrective actions were implemented, including partial lubricant changes, enhanced lubrication practices (such as lifting and balancing the bushing with additional oil supply), reducing the machine's operating speed, and maintaining frequent filter replacements.



June 06th, 2021

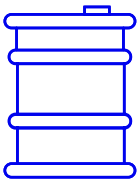
Thanks to continuous monitoring, an issue with a bushing was detected, associated with the presence of cutting and sliding particles deviating from normal operating parameters. Without Atten[2]'s imaging technology and shape analysis, detecting this damage in time would have been impossible or very difficult. The ability to provide reliable measurement results even with high oil viscosity and strong bubble formation in lower ISO classes, compared to conventional particle counters, is another key advantage that enables early damage detection under harsh conditions as given here with this particular crusher.

Prompt actions were taken to rectify the situation, allowing production to proceed as planned. On June 6th, 2021, corrective measures were implemented during the scheduled plant shutdown, replacing the bushing. After the crusher's startup process, it returned to its established 'normal line' of operation, indicated by the ISO code (22/20/19). During the monitoring period, a bell-shaped curve in fatigue particles was noted, a typical phenomenon linked to the machine's startup phase.

[CUSTOMER´S BENEFITS]

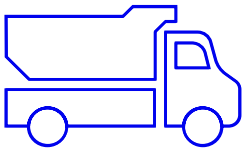
An unexpected failure in this type of machine significantly impacts the mine's operation, leading to substantial production losses. Atten2 technology played a crucial role in diagnosing a failure early, allowing timely decisions and actions to prevent catastrophic breakdowns. This proactive approach not only extended the machine's lifespan until the next planned shutdown but also helped the mine avoid potential failure-related costs amounting to **USD$1,000,000*.**

Production hours



Lubricant replacement
Waste

Man-hours



Logistics
Coordination

Production hours	40.000$	12 hours	480.000$
Oil change	16$	8.000 liters	128.000$
Handling, removal, disposal of used oil	8$	8.000 liters	64.000$
Labor, structures, spare parts, logistics and commissioning			300.000$

*This same event occurred years ago at the primary crusher, resulting in the customer reporting losses and expenses of approximately **one million dollars**. This includes direct costs of production hours and expenses associated with the shutdown.