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Mill maintenance, it's all in the planning

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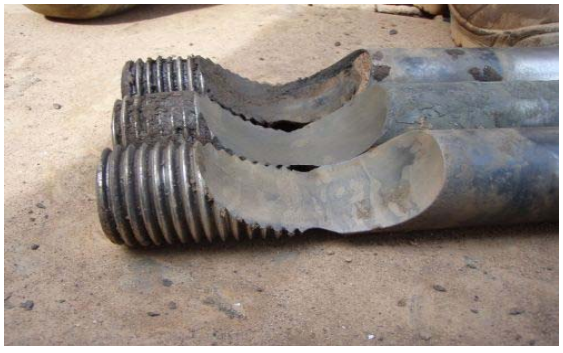
With the grinding mill critical to a plant's throughput, it pays to ensure it receives the necessary care and maintenance. Too often mill maintenance is reactive, occurring due to a breakdown, often costing more in repairs as resources are rushed to site, and causing unnecessary stress to site maintenance staff as they battle to get the mill operational again. In an ideal world, mill maintenance would only ever take place over planned shutdowns. Whilst this ideal may never be achieved, with good planning, steps can be taken to identify potential problems early and minimise unexpected mill breakdowns, saving thousands of dollars and wasted hours in the process.

Step 1 – Cleaning the mill

A fundamental part of mill care is cleaning the mill equipment, which sounds obvious, but is an area often overlooked and neglected. If a mill is kept clean, then 'leaks and creaks' (such as grease leaking from bearing seals) will be identified earlier, cost less to repair, and are fixed before major equipment failure. A faulty bearing seal, when identified early, can be quick and inexpensive when compared to a complete bearing overhaul from a significant bearing failure. Weeping from shell flanges, hard to identify unless the mill is clean, is a critical indicator in diagnosing loss of fastener tension or failure issues. In addition, damage to equipment, protective coatings and cracking of grout will be more visible. Early repair can prevent more extensive damage.

However straightforward cleaning a mill may sound, it is not as simple as hosing equipment down periodically. Hosing down a hot casting may cause it to crack, or shrink it onto its contained bearing, reducing the bearing clearance and spinning the bearing on the shaft. A thoughtlessly directed high-pressure-spray could lead to water ingress behind a bearing seal, causing premature bearing failure. It is important, therefore, to ensure that staff are trained and competent for the cleaning task, to prevent unnecessary damage; this is where it pays to consult with your mill supplier, who should be able to talk you through important steps and offer useful hints and tips.



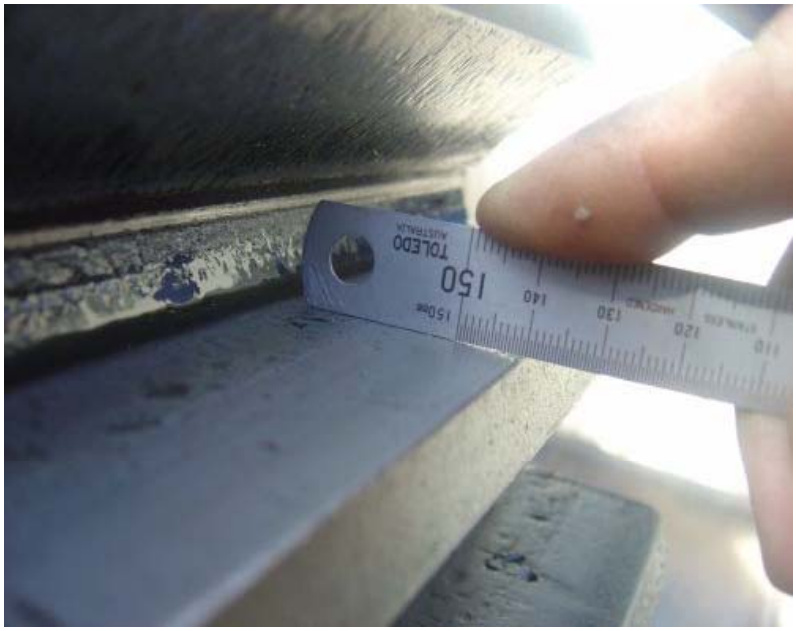
Studs damaged through slurry racing

5 key pointers when cleaning your mill are;

- Clean the mill regularly
- Do not clean hot components (especially castings)
- Do not clean seals with water sprays or jets
- Ensure staff are trained
- Get advice from the mill supplier

Step 2 - Inspecting the mill

After ensuring that the mill is kept clean, the next logical step is to inspect it regularly which, as discussed above, will assist with the early detection of any leaks or damage. Most mill control panels show sensor readings from critical parts of the mill, and this can be reliably used to inspect these parts during operation. Some areas, such as gear tooth temperatures and gearbox bearing vibrations, may need specialist instruments to take readings, whilst other parts will simply need visual inspections (e.g. leaks from seals). Some inspections will not be possible during operation, so scheduling minor shutdowns to inspect areas like the ring gears, bearings and shaft alignments might be necessary.



Mill ring gear inspection, worn gear tooth profile

Step 3 – Monitoring the mill

As discussed above, most mill control panels will show transducer readouts from various inspection points, and even give alarms at 'high' and 'low' warning set points before the mill is tripped on 'high-high' or 'low-low' alarm settings. This is a useful function to protect the mill, but the 'high' and 'low' alarms are reactive, rather than proactive, and sometimes can only warn of the inevitable. The monitoring process is paramount to being able to identify trends of any developing problems. Good monitoring will include:

- Being methodical with inspections
- Keeping good records of inspections
- Tracking records and values over time

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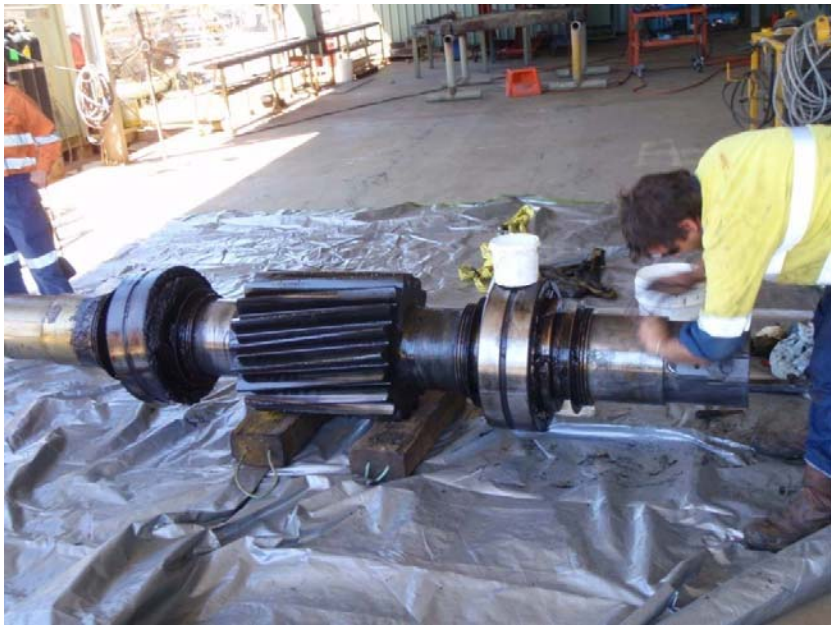
Perhaps the best way to demonstrate this is with an example. Suppose the temperature of the oil for the mill bearings was found to be slowly and steadily increasing, but had not yet tripped a high alarm. This would then be flagged as an area for further investigation, and perhaps after additional inspection and monitoring of the oil tank heaters and oil cooling system, the only irregularity was the cooling water on the discharge of the heat exchanger steadily lowering in temperature. This would indicate that the source of the increase in oil temperature is probably be due to the heat exchanger, and this could be flagged for close monitoring until a detailed inspection at the next shutdown.

Step 4 - Planning for the shutdown

In planning maintenance shutdowns, it is useful to first identify outstanding maintenance and inspection tasks. These will include regular tasks, such as shaft alignments, journal inspections, fastener tensioning, slip ring chamber cleaning, inch brake adjustments, etc with various ad hoc tasks flagged from inspections and monitoring. These tasks can then be grouped according to their importance (low, medium, critical) to the continued mill operation and used to prioritise objectives, balancing this with the usual budgetary and time constraints. All too often a mill shutdown is extended through one task taking more time and resources than expected, but if properly understood non-critical tasks can be postponed until a later shut, or critical tasks assigned more resources.

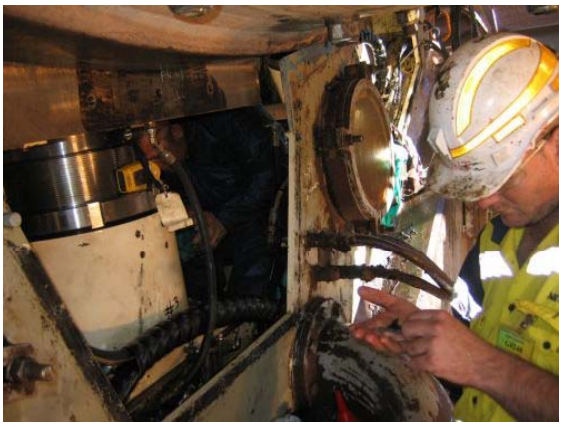


Stripping and rebuilding a spare pinion

Once the maintenance tasks, man-hours and resources are planned, the following need to be identified and secured - specialist tools and equipment, personnel and additional manpower, and spare parts for repairs.

The plan should also give consideration to avoid unnecessary conflicts. For example, some tasks require the mill to be inched periodically, so unless completely unavoidable it is not good planning to schedule high voltage motor inspections at the same time (unless the coupling has been disconnected), as the motor shafts will rotate during inching. Your mill supplier can be key in such a planning process as they are aware of issues such as interrelated tasks, which deliver best results when completed in sequence, and the required resources for each.

Replacing pinion seals during a pinion change



Mill maintenance

Conclusion

With the exception of operational errors, an unscheduled mill stop represents a failure of the last planned maintenance shutdown. A successful mill shutdown should not just be measured by the usual 'on time, on budget', but also by how long the mill operated continuously after the previous shutdown. This is where mill maintenance requires an intimate knowledge of the workings of your mill, through a planned care, inspection and monitoring programme.

The mill is one of the more complex pieces of process equipment and, as such, it will always pay to involve industry expertise in the inspecting, planning and execution of mill maintenance. Outotec have a mill service team dedicated to providing shutdown assistance, pre-shutdown inspections, training and information on current best practices.

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