



A Boughey Pty Ltd at Collahuasi Mine - Chile

Ball Mill Failures

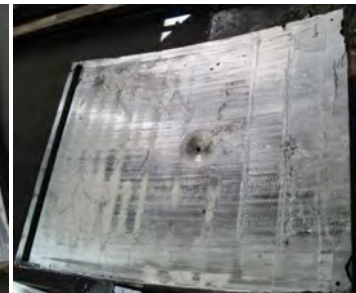
In November 2011, Collahuasi senior management requested the services of A Boughey Pty Ltd to assist in an investigation of a main pad bearing failure that had occurred on one of the ball mills installed at the mine's concentrator plant. During a subsequent site visit in December, the client reported a number of additional failure events on this and another ball mill.



A failure mode assessment, encompassing conclusive results and recommendations for each of the failures were summarised in an investigation report and provided to the client in both Spanish and English. Brief descriptions of the observations during the site visits are summarised below.

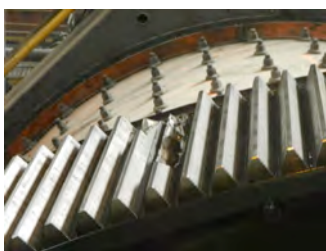
Ball Mill Main Bearing Failure

Damage to the main support bearing pads was evident on both the feed and discharge ends of the mill, with catastrophic failure of one pad observed on the discharge end bearing. There was a significant amount of cracking in the babbitt, most likely as a result of heat stress (see photos to the right).



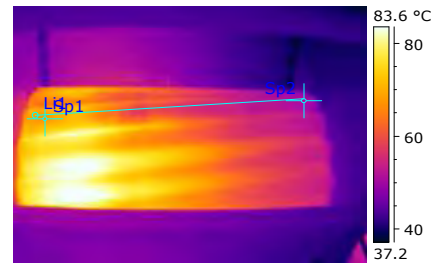
The evidence from the failure mode assessment suggests that the failure was primarily the result of a breakdown of the lubricant film due to contamination. There was significant evidence of high levels of contamination in the oil sampling records.

Ball Mill Gearset Damage



During the site visit, Collahuasi personnel advised that they had identified six broken teeth on the girth gear of the same ball mill. The site advised that there had been a history of failures over a long period of time and that it had been difficult to analyse the actual cause of the failures to date. A number of observations were raised regarding the general operation of the gears, based on the operating parameters. Operating data suggested that damage to the gearset may have been caused by poor alignment and inadequate lubrication.

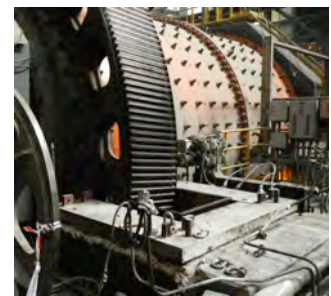
Temperature measurements (thermography) across the pinion face width indicated that the load was not evenly distributed, but rather concentrated towards one end of the pinion. Gear manufacturers typically recommend a maximum operational temperature differential to be less than 8°C. Recorded differential temperatures have been as high as 24°C across the pinion face width.



Apart from periodical temperature measurements using thermography, no monitoring of the gear temperature had been undertaken. The ball mill gearset lacked a continuous on-line monitoring system to provide good protection and timely feedback against sudden changes in operating conditions. A Boughey Pty Ltd highlighted this to Collahuasi Management and it was recommended that a continuous on-line monitoring system be implemented on all mill gearsets.

Ball Mill Pinion Baseplate Foundation Crack

Site personnel reported cracks under the pinion base pedestal. The failure of the grouting and hold-down bolts on the 'B' drive of the Ball Mill is likely to be the result of the reduction in clamping force due to the loosening of the hold-down bolts. The misaligned drive and vibration levels may have further contributed to propagation of the crack. A Boughey Pty Ltd recommended that periodic bolt tightness checks be undertaken on all drive train components, especially the pinion baseplate and housing hold-down bolts.



Grinding Mill Inspections and Audit



In March 2012, A Boughey Pty Ltd was contracted to inspect and audit all the grinding mills operating at Collahuasi. The mills were inspected whilst in operation and during shutdown conditions. Consideration was given to mechanical, electrical and hydraulic operating aspects of those



components that were accessible during the visit. An inspection and audit report was prepared for the client, encompassing critical parts that needed repair or replacement, as well as recommendations on maintenance and operating process improvements for each mill and its surroundings.

Ball Mill Shell Crack

In April 2012, Collahuasi personnel discovered a crack approximately 2 metres in length on the welded joint between the shell and head on the same ball mill that had experienced gearset and pad bearing failures. The crack was detected underneath the riding ring journal of the mill.

A Boughey Pty Ltd was requested to attend site as a matter of urgency to provide technical support and expertise to evaluate the repair options and the relative risks associated with repairing the welded joint. The evaluation resulted in a methodology being developed to repair the crack in-situ.

During the project initiation phase, the knowledge and experience of A Boughey Pty Ltd staff gathered from similar repair projects, proved to be a major advantage in ensuring that the scope of work and weld repair methodology were clearly defined and understood (in Spanish and English) by all parties.

