

Pulley String Catcher

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The Problem

It was identified that over a period of twelve months, there were seven of the same failure modes on the loop take up pulleys on the longwall panel belt. An excessive buildup of string (as in Figure 1), from the edge of a damaged conveyor belt, had wrapped itself around the end of the pulley and worked its way into the labyrinth seal. This resulted in bearing failures and having to change the pulleys out.



FIGURE 1: Buildup of string on pulley

When a bearing failure occurs, there is a real potential for a fire to develop from the excessive heat due to the friction of steel on steel, and the string becomes a fuel source for the fire. The risk of fire in underground coal mines has the potential to cause catastrophic consequences both in the safety and health of personnel in the mine and also cause lengthy production delays. Any fire in the underground environment is serious and the cause needs to

be eliminated or reduced. The risk of injuries to personnel is also increased with pulley failures because of the difficulty in changing out the pulley due to its weight (weighing between 1.5 and 3 tonne) with limited accessibility and restricted access.

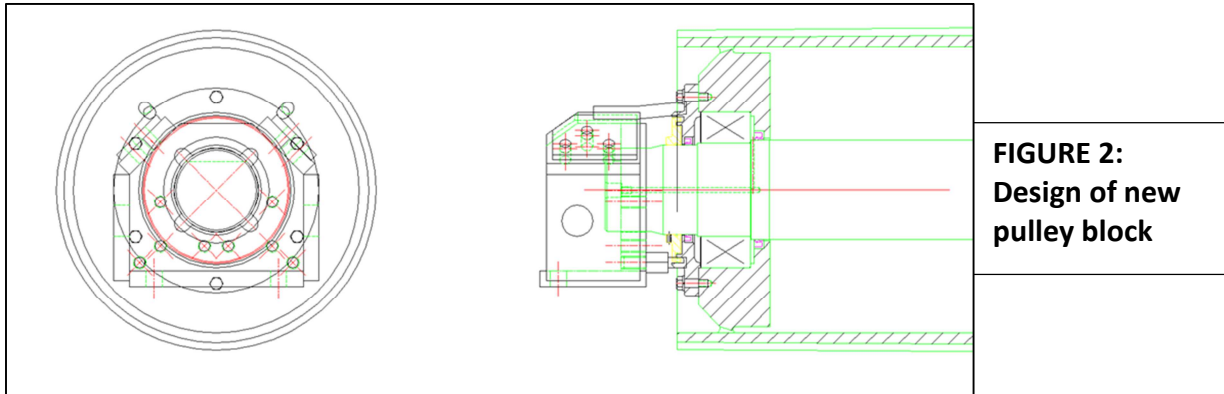
An administrative solution to this problem was to initiate a strategy where coal mine workers were required to inspect the pulleys and remove the string wrapped around the pulley shaft once a shift. This was deemed to be an ineffective solution for the long term because it was introducing the coal mine workers to extra hazards unnecessarily and it was also quite difficult to see if the labyrinth seal was blocked with string and if the bearing was still lubricated sufficiently.

The 'pulley string catcher' was developed as the engineering solution to reduce the risk of the pulleys heating up due to bearing failure and to reduce the risk to coal mine workers

accessing the pulleys. The catcher also allows maintenance to be carried out effectively by providing a visual inspection of the pulley to ensure that the lubrication was sufficient around the labyrinth seal.

The Solution

The original conveyor pulley block design didn't allow for visual inspections to check for sufficient lubrication in the labyrinth seal and string build up on the shaft. The conveyor had to be isolated and guards removed to conduct these inspections.



The design was reviewed by the conveyor engineer, and after consultation with the conveyor engineering team, a new design was created. A change management proposal and a risk assessment were prepared for the new design – the ‘pulley string catcher’. This could be used for visual inspection of string build up and lubrication of the labyrinth seal, without isolating the conveyor. The device had also been shaped to catch the string before it has the chance to enter the labyrinth seal, thus reducing the number of pulley change outs required. The new design was sent to an external source for engineering checks and manufacturing.

Two ‘pulley string catcher’s’ were installed at the loop take up pulley in the longwall belt panel approximately five weeks ago (14/4/15). There has been no ingress of string into the labyrinth seal and the ability to conduct visual inspections on this equipment is much safer and easier. It is now the intention to install these catchers in future longwall panels.

Upon identification of the initial defect, an administrative control was put into place – the development of a maintenance strategy to monitor and remove the buildup of string. To improve this control, it was decided to engineer a new design for the pulley block that would allow visual inspections and eliminate string being able to enter the labyrinth seal. This demonstrates the use of both engineering and elimination in the hierarchy of control.

Benefits / Effects

There are many benefits as a result of the installation of the 'pulley string catcher'. The likelihood of the bearings failing as a result of string ingress has been greatly reduced and non-invasive monitoring is an added benefit of the new design. By eliminating string build up in the labyrinth seal significantly reduces the potential for a fire to develop in the pulley area.

It requires a minimum of four coal mine workers and eight hours to replace a pulley. A pulley weighs between 1.5 and 3 tonne, when replacement is required it's in a restricted work space with a high exposure to harm. The current longwall panel had seven pulley change outs in the first twelve months. The new design will reduce the failure rate significantly with the expectation there will be no failures of this type experienced for the life of pulley. This will greatly reduce that exposure to harm for coal mine workers.

Having to isolate the conveyor belt to inspect the pulley is an inconvenience as it removes the continuity of the longwall production; this is no longer required with the new design. Also, coal mine workers are not required to pull off the guards and remove the string build up every shift, 'just in case'. The new system allows for a quick visual inspection of both the string build up and lubrication of the labyrinth seal, therefore the conveyor is only stopped for schedule maintenance.



FIGURE 3: String gathering on 'pulley string catcher'

Since the 'pulley string catcher's' have been implemented there has been no buildup of string around the pulley shaft and improved monitoring of pulley lubrication. The expectation is that the conveyor string from the belt will be captured on the catchers and this will be removed prior to it damaging the pulley seals. With the improved monitoring of the sealing arrangement there have been no events where the conveyor has been required to be stopped to rectify issues.

Transferability

Many industries use conveyors to transport goods. There is a definite potential for the 'pulley string catcher' to be applied to any conveyor pulleys across any industry, thus reducing down time and exposure to harm for personnel.

The purchase and supply of the 'pulley string catchers' for all conveyor pulleys on the next longwall belt have already arrived on site and installed. The catchers are fairly straightforward to manufacture, transport and install. The design could easily be adjusted to suit another conveyor system.

FIGURE 4: Pulley blocks being set up



Innovation

This innovation has not been used on any other conveyor system. It is a simple, but practical design that is unique from anything in the industry.



FIGURE 5: Before and after set up on the small diameter pulley in the LTU

The pulley block has been specifically designed to simply retro fit out the existing pulley carriers. They also allow for safe and effective visual inspections, whilst the attached barrier device captures any string that may be dangling from a damaged belt. Overall, this new design improves the safety of the coal mine workers by reducing exposure, improves maintenance of the pulleys by allowing uncomplicated visual inspections and reduces the mine production downtime.

Costs

To remove and replace a single pulley can become quite costly. Costs include the cost of the new pulley (approximately \$15,000) and takes at least eight hours for four people to change out. The pulley string catcher costs between \$1000 and \$1500 depending on the size of the pulley block.