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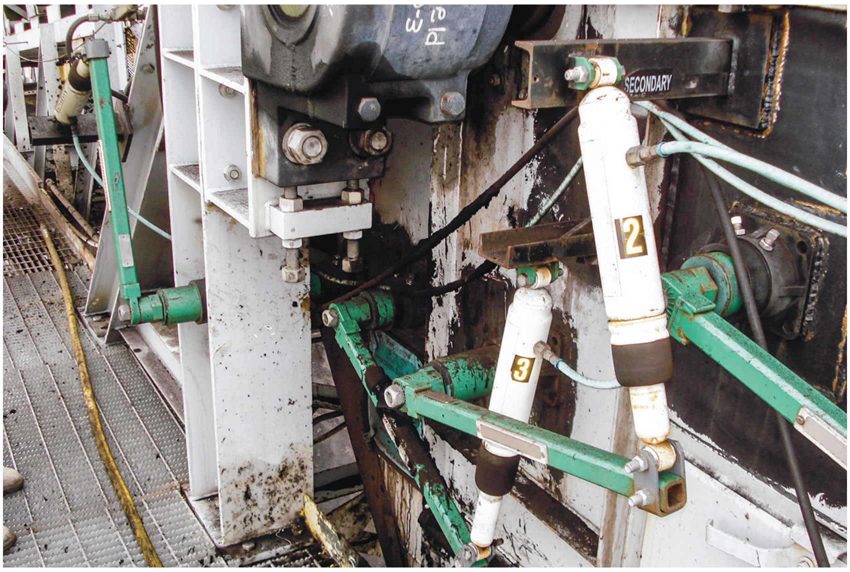
INVESTIGATING CARRY BACK

Richard Shields and Daniel Marshall, Martin Engineering, US, chart an investigation into conveyor belt cleaning practices at a Powder River Basin coal mine.

Ineffective conveyor belt cleaning can result in excess carryback (material that clings to the return side of the belt after the cargo has been discharged), leading to the accumulation of dust and spillage along the length of the conveyor structure. This accumulation interferes with plant operations and exposes personnel to unnecessary safety risks when cleaning up the material in close proximity to a moving conveyor. Fugitive material also represents a loss of usable product, which is particularly expensive if it has undergone any level of processing before the spill points.



Company management questioned the purchase price and replacement blade costs for the existing system, as well as the overall cleaning effectiveness.

The Martin Conveyor Belt Carryback Gauge is a patented tool designed for estimating the amount of carryback on the return side of a conveyor belt.

Carryback builds up on return rollers and pulleys, contributing to a multitude of costly mechanical problems, such as induced belt vibration and dynamic loads on bearings that can cause premature equipment failures. The resulting tracking problems can lead to belt damage and possible emergency outages. Fugitive material generates combustible dust and, with it, the potential for health, safety or regulatory issues. Further, valuable manpower is invariably wasted in the clean-up process, taking time away from core business activities. Overall, ineffective belt cleaning increases maintenance costs, reducing process efficiency and manpower availability.

At a Powder River Basin (PRB) opencast coal mine, an additional concern to ineffective belt cleaning was the difficulty of inspection and maintenance of the existing system, which could only be serviced from inside the chutes, requiring confined space entry.

Aims, objectives and processes

In early 2012, the operator of the mine contacted Martin Engineering and expressed concern over the initial and ongoing costs of operating its conveyor belt cleaning systems. Company management questioned the purchase price and replacement blade costs for the existing system, as well as the overall cleaning effectiveness, based in part on the amount of dust and spillage that was observed.

Martin Engineering agreed to conduct extensive testing of the primary and secondary cleaners already in place, in order to establish a performance baseline for the existing components, then to replace those units with its own designs and compare the purchase/replacement costs and performance using the same criteria and test procedures. Objectives included measuring the effectiveness of the belt cleaning systems, estimating the amount of lost material and quantifying the ownership costs. Factors incorporated into the analysis included the following:

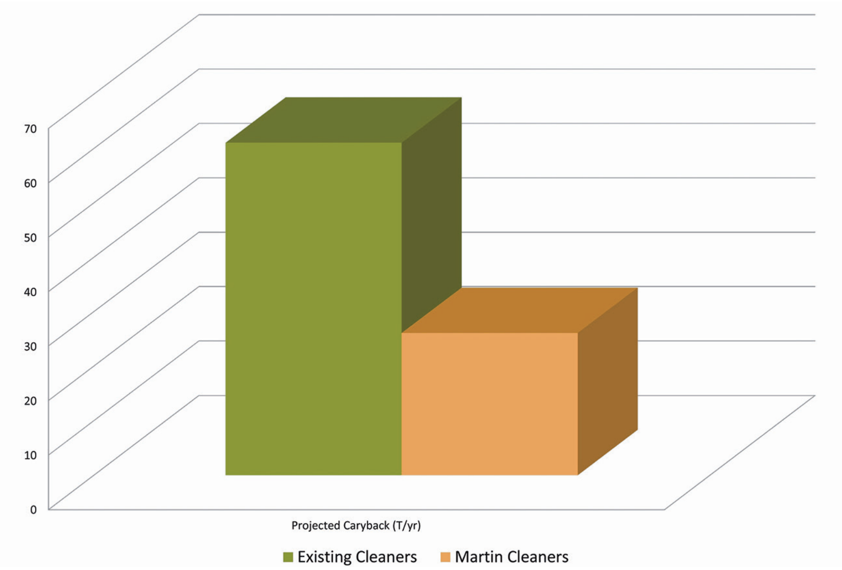
- Amount of carryback passing the cleaners.
- Assembly price.
- Replacement blade price.
- Price per man hour.
- Man hours to install.
- Labour price to install.
- Blade changes per year.
- Man hours to change blades.
- Annual labour price to change blades.
- Annual product price to change blades.

Equipment tested

The carryback tests were performed on two belts at the northeastern Wyoming mine. Both belts were part of the overland conveyor system that delivers coal from the face of the opencast strip mine to the coal preparation plant approximately three miles away and into multiple short-term storage silos.

Table 1. Comparison of belt cleaners: carryback projection		
Configuration	Number of cleaners engaged	Carryback projection (tpa)
Existing cleaners	8	61.1
Martin cleaners	4	26.1

Table 2. Comparison of belt cleaners: costs and expenses		
Configuration	Purchase price of cleaners (including installation cost)	Annual replacement blade cost
Existing cleaners	US$ 57,000	US$ 26,660
Martin cleaners	US$ 26,000	US$ 5294



Comparison of carryback.

A Martin technician installs the new cleaning system, which used just two blades per belt instead of four.

Conveyor 1 is 72 in. wide and travels at 1153 ft/min, fed from a variable speed feeder breaker under a large in-pit hopper that is loaded by 300 t haul trucks. Conveyor 2 has a 54 in. belt travelling at 850 ft/min that allows ROM coal to be blended before delivery to the silos. Both of these belts were equipped with four cleaning blades.

The feeder breaker tonnage is controlled by a variable speed drive, which receives signals from sensors in the hopper. As the material in the hopper draws down, the feed rate is reduced in an effort to maintain some material in the hopper. This reduces the impact to the feeder breaker pan and drag chain. As a result, the coal stream on the belt can vary from just a trickle of coal to 4000 tph, a scenario constantly being affected by what is happening at the mine face.

Procedure

The test regime was designed to provide a quantitative means of measuring carryback and tracking improvements from adding or adjusting components, upgrading existing equipment and/or implementing a routine maintenance programme. Protocols were intended to ensure consistent handling of the material, from collection, labelling and drying to weighing and reporting.

The methodology used for measuring the amount of carryback was the Martin Conveyor Belt Carryback Gauge (Model 38840), a patented tool designed for estimating the amount of carryback on the return side of a conveyor belt. The gauge places a blade against the belt, removing carryback and depositing it in a collection cup. Representative 60 sec samples of carryback are taken at three locations across the belt surface, one on each side located a third of the distance from each edge of the belt, as well as one in the exact middle. In an effort to obtain statistically meaningful test results, each individual test required three samples.

weight of the cup was subtracted, leaving only the true weight of the carryback.

Results

Samples were analysed independently by two different engineers and averaged to provide a representative total amount of carryback on each belt. That total was mathematically converted into the standard measurement of g/m^2, then converted into projected carryback per year using operation times and belt geometry. The annual carryback amounts were then compared.

Conclusions

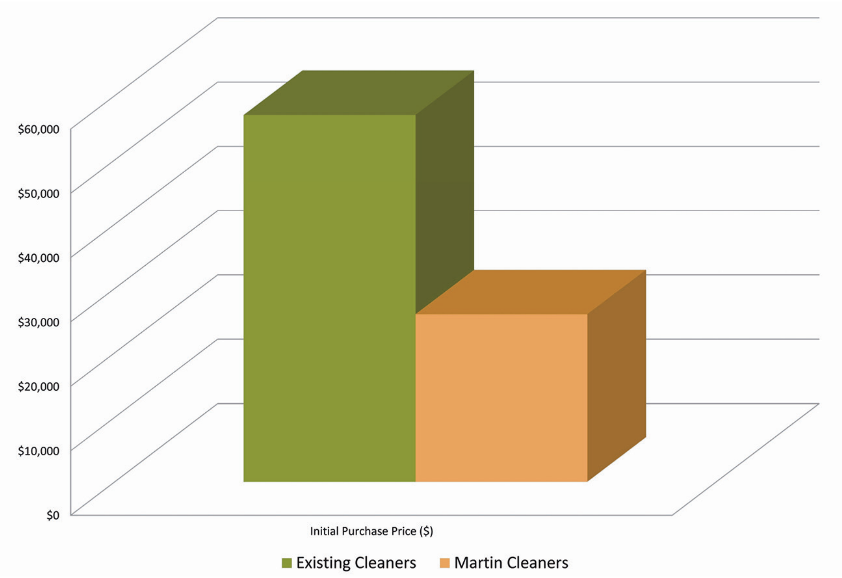
In analysing the cleaning performance of the two competing systems, the team found that two properly installed and maintained blades from Martin reduced projected carryback by approximately 57%.

Comparing the purchase price of each cleaning system yielded a projected 54% reduction in initial costs.

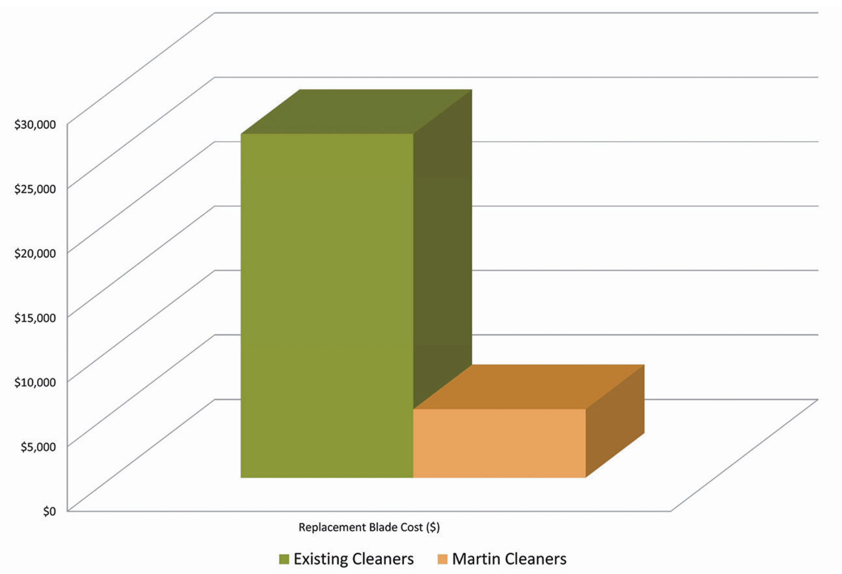
Reducing the number of cleaners cut the cost of annual blade replacements by about 80%.

Overall, the testing demonstrated that the performance of the belt cleaning systems at this plant could be significantly improved, even while employing half as many cleaning blades. The subsequent savings would amount to a sizable sum over time, allowing the facility to reduce long-term operating costs, lost material and wasted manpower, while raising the level of its environmental stewardship. Further, the new belt cleaning system required no confined space entry, allowing maintenance personnel to inspect and service the equipment more easily and safely.

The plant manager at the PRB coal mine said: "My crews tell me there is less carryback and the systems are easier to work on. I know my operating costs are going to go down." WC



Comparison of initial purchase costs.



Comparison of replacement blade costs.

The carryback was collected first with all existing cleaners installed and tensioned as per the manufacturer's recommendation. The equipment was then removed and the Martin cleaners were installed and tensioned. After collection, the filled test cups were removed from the holder assembly, lids were affixed and condition data was recorded, including time, cleaner arrangement and location. The lids were then secured by duct tape to prevent material from escaping. A mine employee observed the removal and sealing of the cup and that employee's name was printed on the tape to verify the sample procedure. The cup and material were then weighed and recorded.

Since the moisture in each sample varied, all water was evaporated in order to measure the actual amount of material carryback. The material was brought to a controlled environment and emptied into a metal pan. It was then placed in an oven for 30 min at 200°F to remove the moisture. Once the material cooled down, it was re-weighed and the tare