Eco-friendly conveying

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The increasing level of attention on environmental issues requires a reduction in the impact that plant operations have on the environment. There are many practical and simple ways to improve operations that actually pay for themselves in very real terms in relatively short periods of time.

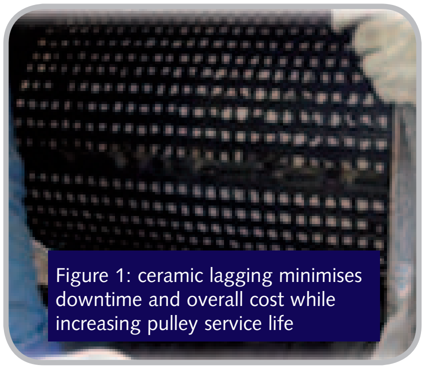


Figure 1: ceramic lagging minimises downtime and overall cost while increasing pulley service life

Addressing a variety of issues up front and putting deeper thought into the selection and application of conveyor components is a practical and cost-effective way to employ eco-friendly conveying. When serious consideration is paid to the overall impact that the appropriate selection of these components has on the environment and the bottom line we can weigh a wide variety of options that will result in a quick return on investment while improving overall performance and helping to improve the environment.

Conveyor pulley lagging

Whether to lag a pulley and what lagging material to select are two of the most important issues that a designer can make when it comes to component selection for most conveyor systems. Vulcanised pulley lagging, normally an SBR compound with a hardness of 55-65 durometer, will increase the coefficient of friction between the belt and the pulley by as much as 50 per cent over a bare faced (steel) pulley. The rubber lagging helps to improve belt tracking by moving the belt to the centre of the pulley in crown-faced pulleys. The lagging provides the additional benefit of extending pulley life by protecting the pulley face from abrasion that commonly eats away at the rim. Additional traction is gained by applying grooves that help to shed water and material away from the pulley face just as the grooves in a car's tyres serve to do the same.

One of the highest performing types of lagging available is ceramic lagging. There are many types of this material available with many design features and unique attributes. In general, this material is characterised by unequalled wear performance, durability and load carrying capacities. These are achieved due to special wear-resistant ceramic tiles coupled with an advanced rubber compound and bonding process. Some of the attributes of ceramic lagging include:

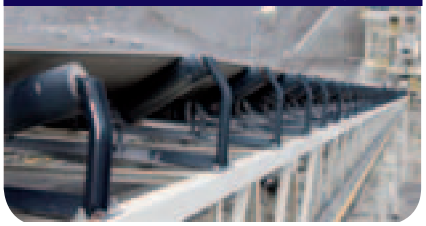
- Up to twice the coefficient of friction over non-lagged pulleys
- Up to 50 per cent higher coefficient of friction over standard rubber lagging
- Virtually eliminates belt slippage
- Lower belt tension and less take-up weight increases life of components and belt
- Easily sheds water and dirt
- Belt tension in the take-up system is reduced
- The counter-weight mass is reduced
- May reduce the shaft and bearing sizes required
- Drive pulleys with ceramic lagging will last up to eight times longer than standard SBR rubber lagged pulleys
- Belt tracking is vastly improved
- On many type 3 and 4 belt conveyors, required horsepower can be reduced up to 1.3 per cent.

What is immediately noticed is the increase in the coefficient of friction between the belt and the lagging material. This is the heart of the matter when it comes to ceramic lagging and this is what results in the wide ranging benefits achieved by its application. Since the ceramic is highly durable it will not wear out in the same manner that plain lagging or a steel pulley face will wear out. In fact, it may last up to eight times longer in many applications. The direct result is energy savings coupled with longer component life. This is a win-win for both the overall budget and the environment.

As can be seen from Figure 1, ceramic replaceable rim lagging installed with the pulley still in the application minimises downtime and overall cost while increasing pulley service life.

Figure 2: used pulleys shown before rebuild (top) and after rebuild, ready to return to service (bottom)

Figure 3: high levels of roll drag associated with idler sets increase energy consumption



Reduce, reuse and recycle

Protect the environment and the bottom line by recycling old pulleys that are still in good structural condition. Structurally-intact pulleys can be cleaned and re-lagged at around 25-35 per cent the cost of a new pulley. If necessary, the pulley can be repaired and new bushings, bearings and shafting can be provided to complete the assembly. Although the addition of the extra parts will increase the total cost of the rebuild, the result is a completely-rebuilt pulley assembly that is immediately available to be placed back into service or set aside as a spare for future use during a planned shutdown or regularly scheduled maintenance cycle (see Figure 2). It never hurts to have a spare pulley assembly available should one need to be replaced in a hurry. This type of responsible thinking can actually help to improve the bottom line of the average plant and serve to improve the environment by the elimination of waste and through conservation by applying the tried and true axiom of 'Reduce, Reuse and Recycle'.

Reduced roll drag idlers

Idlers with reduced roll drag help to save energy (see Figure 3) especially on longer conveyors where roll drag can account for as much as 10 per cent of the total energy consumption on the conveyor. Using less energy to turn every roll is an obvious way to save costs while going green.

Idler sets come in a variety of designs with features and benefits as described by the individual manufacturers. However, in the broader marketplace there are two very different styles of bearings utilised: tapered roller bearings and ball bearings.

Tapered roller bearings use conical rollers that run on conical races. Most roller bearings only take radial loads, but tapered roller bearings support both radial and axial loads. They generally have higher load ratings than ball bearings due to greater surface contact area. The downside to the tapered roller bearing is that they are usually more expensive and they have more drag than ball bearings due to that same surface contact area. Finally, tapered roller bearings will tend to stop if the bearing races are misaligned.

Ball bearings can support both radial and axial loads. For most applications balls offer lower friction than rollers and therefore have lower roll drag than idlers designed and manufactured using tapered roller bearings. In addition, ball bearings will continue to operate for longer periods of time when the bearing races are misaligned.

When one considers which style of bearing is best there are many different criteria employed including load, belt speed and environmental conditions. In addition, due to the design of tapered roller bearings, as discussed, they naturally have a significantly higher drag than ball bearings (see Figure 4). This, in and of itself, is not a serious issue when we consider the case of a conveyor with say an overall length of 50ft. However, when we consider a conveyor with a length of 1000ft the seriousness of this issue becomes very apparent.

Each idler set on the conveyor will contribute to higher or lower energy consumption depending on the bearings utilised and the drag associated with the idler. When you use 250 idler sets this drag is increased to the point where we can calculate the total amount of energy consumed and the difference relative to the two designs illustrated by Figure 4. After running the calculations it becomes apparent that the tapered roller bearing design idler accounts for a 44.8 per cent higher level of energy consumption when compared to the ball bearing design idler.

Of course, there are other criteria involved in this equation including but not limited to the seal design employed by the manufacturer selected. Each manufacturer should be asked to provide the overall level of drag estimated when their idler sets are selected and these values should be compared to help ensure that the idlers selected result in the lowest possible level of energy consumption for the conveyor system.

Belt turnover systems

Belt turnover systems will provide a reliable and long lasting solution to many of the problems associated with carry back including:

- Material buildup that leads to belt training problems
- Maintenance that results from excessive wear and material spillage
- Reduced conveyor component life and performance due to constant exposure to abrasive or wet material.

Belt turnover systems will also improve environmental conditions around the plant

Figure 4: power consumption breakdown of idlers with tapered roller vs. ball bearing design

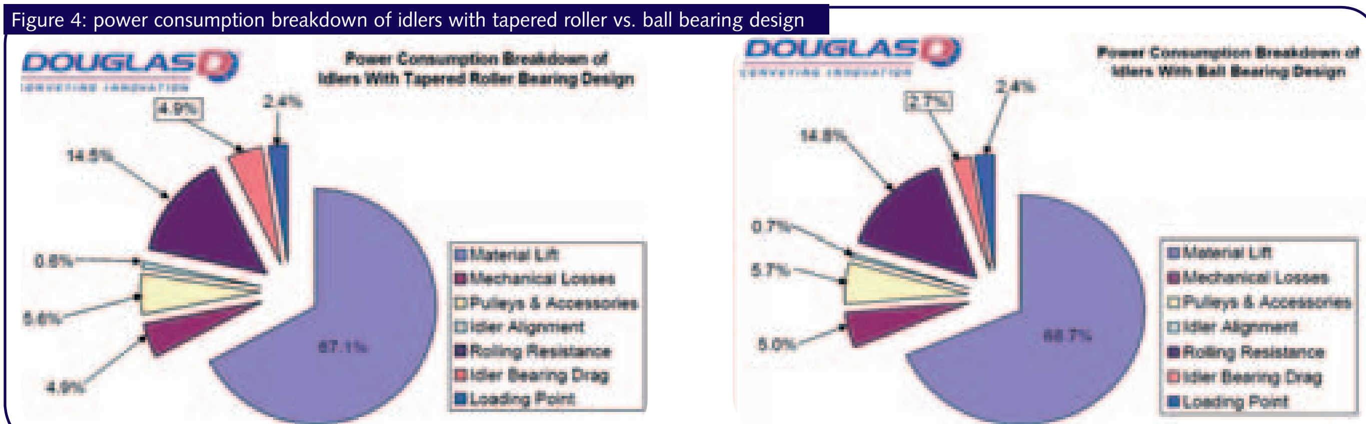


Figure 5: conveyor covers help to protect conveyed material and components from the elements and improve environmental conditions at the plant

by keeping conveyed material where it belongs.

Generally, belt turnovers use a system of specially-engineered tunnels and rolls to literally flip the belt over after it travels past the head pulley keeping the 'dirty side' of the belt out of contact with the rolls and preventing material from falling off at various points along the return (see Figure 5). Once the belt approaches the tail pulley it enters the second tunnel and reverts back to the normal carrying position. This system may be retrofitted to any existing conveyor to improve the overall performance of the conveyor or used in new conveyor applications to help prevent problems from developing. It is generally recommended for systems with an overall length in excess of 100ft.

The belt turnover system will help to eliminate buildup commonly found on bend pulleys, take-up pulleys and idlers. This will help to extend critical component life and help to eliminate belt tracking problems associated with excessive buildup found on these components. Further cost reduction benefits are achieved as a result of the elimination of material that commonly accumulates under each return idler on the return side of the belt and results in higher labour costs associated with frequent clean-up of the affected areas.

Increasing the duty of the pulley to save money

Investing up front in higher duties of pulleys will pay off in the long run by reducing the total number of change-outs over the life of the system. Oddly enough, even though

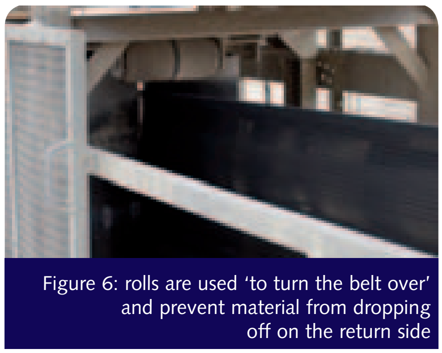


Figure 6: rolls are used 'to turn the belt over' and prevent material from dropping off on the return side

we are using more material at the offset this will ultimately have lower negative ramifications for the environment because the service life of the product is increased and replacements are needed less often. Thicker rims obviously result in a longer life where abrasion is a factor in the life of the pulley. Ceramic lagging, as another example, can wear up to eight times longer than standard the SBR rubber normally used on conveyor pulleys. This can result in a significant cost savings due to reductions in maintenance costs.

That same investment can pay high yields when applied to self-cleaning wing pulleys. Moving from a standard duty wing with 3/4in round bar (or in some cases ¼in flat bar) to a quarry duty wing with 1-1/2in round bar means that the thickness of the primary wear surface is increased by 200 per cent. Where abrasion is a factor in pulley life this will significantly increase the pulley life and will save thousands of dollars by reducing the number of change outs by at least half the normal rate.

Figure 7 illustrates varying standard wing designs by material thickness.

In this case one must be cautious and not apply this lesson too liberally. Increasing material thicknesses does two things: first, it raises the initial cost. So one must weigh the initial cost against the return on projected investment or up-front costs. Second, it increase the overall weight of the pulley (and any other component for that matter). This increases the amount of energy required to move the component. As with many things there is a give-and-take that must be carefully considered and analysed before making any decision in this regard. Most component manufacturers can help analyse this problem and make recommendations on the best decision for the application.

Conclusion

Going green does not necessarily mean losing money nor does it need to require costly long-term investments that don't have immediate and practical implications for the plant. In fact, a responsible approach to new system design and retrofit of existing conveyors can actually result in higher earnings and increased efficiency. When engineers, designers and management pay close attention to the total costs associated with, and the environmental implications of, the decisions made with regard to conveyor components and related systems they can make informed choices that positively impact the bottom line and the environment. By focusing on these issues in the initial stages and addressing the full repercussions of these decisions conveyor systems can be designed for the long haul.

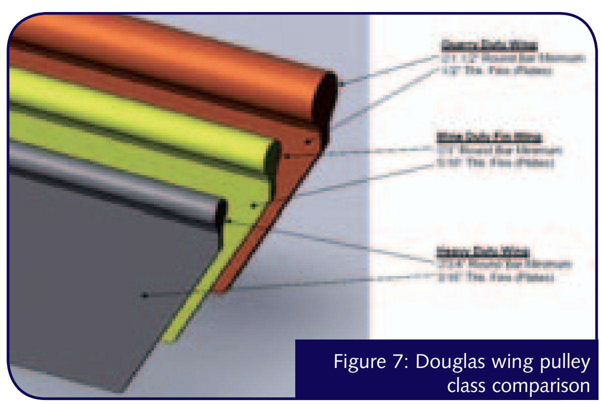


Figure 7: Douglas wing pulley class comparison