Wear-Resistant Materials: Value and Application

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We’ve all seen what happens when conveyors handle abrasive or corrosive material. Panels need replaced. Often. And it’s not a cheap fix. It’s for this reason manufacturers offer liners and finishes that decrease wear. UHMW plastic, abrasion-resistant (AR) steel, and stainless steel are three such materials. Each of these has its advantages and limitations. Price is not the only difference. Which is right for your application depends on a number of factors.

Where to Place Wear Liners

Before selecting a wear liner, you first need to consider where to place the material. Wear-resistant materials need only go where abrasion or corrosion compromises mild steel. While this may seem obvious, personnel sometimes go overboard. We’re aware of an engineering firm that requested bids for a conveyor with heads and tails constructed with AR steel, for instance. The firm did not take into account that only a small percentage of the head and tail would be exposed to wear (and the specific type of wear against which AR steel protects) or the outrageous manufacturing cost. Complete construction with AR steel was (and is) unnecessary.

What Causes Wear in Your Conveyor System?

Before making your selection, you also need to consider the cause of wear. Is the material your equipment handles acidic? Abrasive? Is it both? The characteristics of the material will inform the protection you select.

If the material is abrasive or contains abrasives, you should further consider the type of abrasion it causes, whether it is impact, high-stress, or low-stress. Impact abrasion occurs when an abrasive strikes a surface and spalls, gouges, or cuts it. While this abrasion can occur at the bottom of a chute connection in mechanical conveyors, it typically occurs in high-speed, pneumatic conveyance systems. High-stress abrasion occurs when an abrasive slides, cuts, or plows over a surface under a high load.
How to Reduce Abrasive Wear in Industrial Conveyors

Lessen Directional Change
There are several ways to reduce abrasive wear. The first involves designing the conveyor system to lessen the degree of directional change material must undergo, such as by decreasing the bend angle in a conveyor curve. In pneumatic conveyance systems, this decreases the amount of energy material expels into the conduit wall during impact: rather than a direct impact in which, all or much of the energy is expelled. The particles ricochet off the wall and only part of their energy is expelled. Wear still occurs but to a lesser degree.

In mechanical systems, the same holds true. Wear tends to isolate in the curves, particularly top curves. Decreasing or (better yet) eliminating the angles will decrease the wear and increase systems’ overall efficiency.

Reduce Velocity
The second way to decrease wear is to decrease the material’s velocity. The faster the material, the more energy it contains and the more wear it will produce. Thus, you should keep the velocity of your systems as low as possible. In a mechanical conveyor, it may be prudent to increase its width so it can handle the same volume but at a lower speed. Doing this will not only decrease wear from the material but, by slowing things down, decrease mechanical wear between system components. Remember, the up-front costs of increasing the conveyor width are a one-time expense; wear and maintenance are ongoing. If you can decrease ongoing costs, you’re likely come out ahead financially over the course of the conveyor’s working life. It is possible to oversize a conveyor, of course. You don’t need something designed that can handle hundreds of tons an hour if your operation produces a mere two tons of wood fiber an hour. There’s a balance between speed and size—choose what provides the best value.

Not only should you consider linear speed within your system but the height of connections. The farther material must fall, the greater its velocity upon impact. You should, therefore, minimize the distance between chutes generally—there are instances where the distance between chutes need increased. When discharging onto a belt conveyor, for instance, it is sometimes necessary to increase the distance and deliver material at an angle so it picks up speed in the direction of the belt. If the velocity of the material is too low when it hits the belt, it will bounce in place until it picks up enough velocity in the direction of the belt travel.

Where reducing speed and directional change isn’t possible or where such changes will not sufficiently reduce abrasive wear, AR steel may be a necessary addition.
Wear-Resistant Materials: AR Steel Wear Liners

AR steels are characterized by hardness. Hardness refers to the material’s ability to resist abrasion, cutting, and penetration. A higher hardness value does not automatically mean the material is better at resisting abrasion, however. Manufacturers of AR steel measure hardness differently. As a result, the same grade of AR steel from different manufacturers will have different specs.

We tend to use AR 400 steel in our applications because it is at the low-end of the price spectrum and sufficiently reduces abrasion. Harder and exotic AR steels exist, but they are expensive; their cost outweighs their benefit as a conveyor wear liner.

As an added benefit, AR steel plates are easy to install. They can be welded or bolted in place, and they have the same thermal expansion coefficient as the mild steel around it, so there will not be issues with expansion.

While AR steel is good for abrasive wear, it is not a good choice for acidic wear. AR steel will not protect against corrosion. The steel itself will corrode and can actually add to mechanical wear when corrosion is extensive. Your best bet for handling acidic material when abrasives are not a primary factor is to galvanize the conveyor. Galvanization offers low-maintenance protection for the lifetime of the machine. Unlike paint, it won’t fade in the sun and need reapplied, and it's stronger than a powder coat finish. Even if it gets scratched, it will continue to protect the conveyor.

As a note, you should not galvanize AR steel with a hardness rating above 300, as the process will embrittle the steel. Also, be careful when welding AR steel. If done incorrectly, the steel will become brittle or soft around the weld. AR steel also has limitations in its workability. During the hardening process, the metal settles in a grain. AR can thereafter only be bent in the direction of the grain. If it is bent against the grain, it will break.

Wear-Resistant Materials: Stainless Steel

In scenarios where there is both abrasive and corrosive wear, stainless steel is an easy solution. It demands a premium, however, which you’ll need to evaluate against the extra lifespan it provides. A stainless conveyor will eventually wear out, and its cost may or may not be worth the investment.

Whether stainless steel is right for your application comes down to value. In situations where the cost outweighs the benefit, it may make sense to make some components stainless and others of mild steel. The floor could be made of mild steel, for example, while the rest is stainless. Alternatively, you could galvanize the conveyor to combat corrosion and install ultra-high-molecular-weight (UHMW) polyethylene wear liners to protect against abrasion. Galvanization alone is a good compromise when stainless steel is not possible. Without wear liners, however, you must accept the maintenance that accompanies unabated abrasive wear.
Wear-Resistant Materials: UHMW Plastic Wear Liners

UHMW liners alone will protect against a combination of abrasive and corrosive wear. UHMW is advantageous in that it’s a low-cost, low-weight solution. As an added benefit, it has a low coefficient of friction and, depending on how it’s installed, can be easy to renew.

UHMW does not protect against acidity as well as galvanization or stainless steel, however. Its biggest downside, though, is its thermal properties. It has a high thermal expansion coefficient, which can be problematic when you consider how to anchor it, as it expands and shrinks significantly as the temperature fluctuates. (This is why we incorporate short strips with gaps between them in our conveyors.) It also has the tendency to bow when it warms up on one side. When this happens, the UHMW becomes a source of wear, and material gets trapped under the liner, disallowing it to return flat.

There are UHMW plastics with lower thermal expansion properties, but these exotic plastics are expensive. And although their coefficients of thermal expansion are lower, issues with expansion will to some degree remain—the plastics will not have the same coefficients as steel and will therefore grow and shrink disproportionately.

For our systems, we opt for nonexotic UHMW because of its value. It is cheap and easy to replace when anchored well. It is possible to do a poor job anchoring it, which is something else to consider. If the UHMW isn’t easy to renew, it has less value due to the time it will consume during maintenance. This is why we considered the ease of which it would be to replace the UHMW when we designed our conveyors. In our SMART Conveyors™, technicians can replace our wear strips without breaking the chain; the strips are designed to be replaced with the chain under tension. Curve wear strips in our S-Series SMART Conveyors™ can even be replaced from outside the conveyor—it is unnecessary to remove panels. This makes for fast and easy renewal, which minimizes downtime and increases the value.

Value is really the point when considering wear liners. All material—liners and finishes included—wear and need renewed. Whether it makes sense to invest in protection really comes down to cost. Will the time and cost in replacement parts you save with a liner or more expensive finish be greater than foregoing these things? If so, it makes sense to invest in wear protection.