Comparing Conveyor Finishes: Paint, Powder Coat, Galvanized, Stainless Steel

Published May 3, 2019

It's understood that the components in a drag chain conveyor affect its operational costs. A conveyor's finish does the same. Rust—the quick-to-form result of a poor choice in finish—can lead to costly repairs, downtime, and mess if it forms holes through which material can escape. Ultimately, rust can shorten the useful life of a conveyor. Understanding what causes rust and which finish you should choose for your conveyor is therefore important in getting the most out of your purchase.

Options in drag conveyor finishes include paint, powder coat, galvanized, and stainless steel. Each differs in price and durability. Of these options, Biomass Engineering & Equipment offers paint, galvanized, and stainless-steel finishes. We currently do not offer powder coating but are discussing adding it in the future, as there are advantages to this coating over paint.
Factors Influencing Corrosion in Conveyors

Before we dive into finishes, let’s first discuss what influences corrosion. We’ll cover five factors: moisture, salt, acidity, temperature, and metal-to-metal contact.

**Moisture**

Of these five factors, moisture is the main enemy, as water provides a means by which the corrosive reaction across a metal’s surface can take place. Because of this, the more water to which your conveyor is exposed, the more corrosion you can expect. And there are plenty of sources of moisture—rain, sea spray, fog, humidity, water injection streams, and the material being conveyed, to name a few. Condensation that collects as material cools in the conveyor is also often a serious issue, especially in the wood industry.

You shouldn’t disregard dry material as a potential source of moisture, either. Nearly all materials have some amount of water in them. At 20°C (68°F) and with a relative humidity of 55%, a cubic meter of air and a dry, 6cm wooden cube have the same amount of water, approximately 10ml (about 0.3 fluid oz), for example.

**Salt**

Salt is another contributing factor in rust formation. While salt, in and of itself, won’t corrode a conveyor, it acts as an electrolyte when dissolved in water and accelerates oxidation. For this reason, you’re at greater risk for corrosion if you live near salt water or handle salty material.

Even if your conveyors aren’t directly by the sea, they may still be exposed to sea salt. Wood, although it doesn’t naturally contain salt, is sometimes stored in or barged across salt water. In either scenario, it absorbs saltwater and in turn exposes your machinery to this corrosive chemical.
Acid

Acid is corrosion enemy number three. Acids aid in the formation of corrosion two ways. First, it can dissolve the oxidized layer that forms over metals to protect them from further corrosion. Second, it will react with and corrode the metal itself.

Different types of acid react differently with different kinds of metals, but in general, the more acidic a solution, the faster it will eat your steel.

Now, your material need not be steeped in acid for it to eat your conveyor. Repeated exposure to low amount of acid will affect it. That exposure may come from materials you may not even think of as being acidic.

Virtually all species of timber, for example, produce small amounts of corrosive carboxylic acids, particularly acetic and formic acids, the quantity of which increase when the timber is warm and damp. Acetic acid, which isn’t as strong as formic acid, will corrode steel at air levels as low as 0.5 ppm.

Different wood species produce different levels of these acids and have different acidities. In general, hardwoods are more acidic than softwoods. In particular, woods more commonly associated with corrosion when damp include oak, sweet chestnut, Western red cedar, and Douglas fir. Below is a table of acidity levels in some North American trees.
<table>
<thead>
<tr>
<th>Softwoods</th>
<th>Average pH</th>
<th>Hardwoods</th>
<th>Average pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpine Fir</td>
<td>6</td>
<td>American Beech</td>
<td>5.5-6.2</td>
</tr>
<tr>
<td>Amabilis Fir</td>
<td></td>
<td>American Black Ash</td>
<td>5.5</td>
</tr>
<tr>
<td>Balsam Fir</td>
<td>5.4</td>
<td>American Hite Ash</td>
<td>5.4-6.0</td>
</tr>
<tr>
<td>Black Spruce</td>
<td>5.7</td>
<td>American White Elm</td>
<td>6.0-7.6</td>
</tr>
<tr>
<td>Canadian Red Spruce</td>
<td>5.5</td>
<td>Balsam Poplar</td>
<td>6.4</td>
</tr>
<tr>
<td>Douglas Fir</td>
<td>3.3</td>
<td>Black Locust</td>
<td>5.3</td>
</tr>
<tr>
<td>Eastern Canadian Spruce</td>
<td>5.5</td>
<td>Cherry Mahogany</td>
<td>5.1-6.7</td>
</tr>
<tr>
<td>Eastern Hemlock</td>
<td>5.5-6.2</td>
<td>Chestnut</td>
<td>3.6</td>
</tr>
<tr>
<td>Jack Pine</td>
<td>5.4</td>
<td>Largetooth Aspen</td>
<td>5.8</td>
</tr>
<tr>
<td>Red Pine</td>
<td>5.2-6.0</td>
<td>Oak</td>
<td>3.3-3.9</td>
</tr>
<tr>
<td>Sitka Spruce</td>
<td>4.0-5.5</td>
<td>Quaking Aspen</td>
<td>5.4</td>
</tr>
<tr>
<td>Western Hemlock</td>
<td>4.8-5.4</td>
<td>Red Alder</td>
<td>5.9</td>
</tr>
<tr>
<td>Western Red Cedar</td>
<td>2.9-4.0</td>
<td>Silver Maple</td>
<td>6.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Striped Maple</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sugar Maple</td>
<td>5.1-5.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sweet Gum</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tamarack Larch</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White Birch</td>
<td>5.3-5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yellow Poplar</td>
<td>5.2-5.4</td>
</tr>
</tbody>
</table>
Keep in mind that pH itself is a poor indicator of corrosiveness. Different types of acid are more corrosive than others. And for the acid in timber to even corrode the steel, it must first be released. That depends on the wood’s constitution, its temperature, and its moisture level. Acidity within a single tree species also varies greatly due to the composition of the soil in which it grows.

Other Sources of Acid

Other materials that you may not think of as “acidic” (as you would citric fruit) may actually be so. Take DDGS for example. It averages 4.1 pH but can range from 3.6 to 5.0. So, it too will speed corrosion in your conveyor, especially if it is warm.

“Secret” sources of acid may also damage your conveyor. If your conveyors are exposed to exhaust from fossil fuel engines, the sulfuric dioxide in the exhaust will dissolve in water to create sulfuric acid, which will attack your conveyor.

Alkaline material will also corrode metals, but not as much as acidic materials. Some alkalines won’t even corrode metal unless temperatures are elevated.

Temperature

Temperature is the forth corrosive enemy. The reason temperature makes the list is because the higher the temperature, the faster the chemical reactions that destroy your steel. This is why hot pellets will corrode mild steel conveyors so quickly. Not only are the pellets hot after exiting the pelletizer, but they’re emitting moisture and acids. All this makes for a hostile environment.

Bimetallic (Galvanic) Corrosion

The fifth and final source of corrosion we’ll discuss is metal-on-metal corrosion, or bimetallic corrosion (also called galvanic corrosion). When different metals come in contact, an electrical charge passes between them when an electrolyte like water is present. The result is corrosion. Bimetallic corrosion is sometimes unwanted—stainless steel will corrode through this process when it contacts other metals. Other times, it is helpful. The zinc layer on galvanized steel will corrode through this process when it’s penetrated and the underlying steel exposed; it “sacrifices” itself, saving the steel from corrosion.

Now that we’ve covered sources of corrosion, let’s analyze finish options.
Finishes for Conveyors: Paint, Powder Coat, Galvanized, Stainless Steel

Paint

Good for: basic protection on mild steel, extra protection on galvanized steel

Paint protects conveyors from rust by providing a barrier between air and the structural steel. Customers often choose paint to protect their conveyor, as it costs less than other options.

Of course, paint has its drawbacks. With a bond strength of roughly 600 psi, paint is vulnerable to chipping and scratching. Because it’s easy to damage paint, manufacturers and customers must spend extra effort to care for it. During shipping and storage, manufacturers must ensure no painted parts rub each other or other hard surfaces; the painted parts must rest on wooden beams or be otherwise separated. Even with additional care, chips can form during shipping and installation.

Normal wear and tear inevitably chip off paint, too, and maintenance teams must repaint the surface if they want to prevent rust.

How well paint holds up depends on several factors. The first is whether the conveyor has been properly primed. Priming can be done by spray application or through electrostatic coating (E-coat). Of the two, electrostatic coating is better, as it produces an even, higher-quality result. Paint itself can be applied electrostatically, as well. Paint applied using this method likewise produces a higher-quality finish.

Another factor is the chemicals to which it’s exposed. If the conveyor moves wood, it may be exposed to a number of volatile alcohols, esters, and oils, which wood releases when damp. Over time, these chemicals can dissolve paint. Any chemical which can break down paint is a therefore threat to your conveyor’s steel.

Powder Coat

Good for: better protection of mild steel, superior protection on galvanized steel

Powder coats are produced by spraying dry powder molecules onto a component. The coated component is then baked to cure the powder into its final, hardened state. Like paint, powder is available in a variety of colors. While it is more expensive than paint, it provides superior protection.

Powder coating produces a finish more evenly distributed than paint, which is often thinner on vertical surfaces and curves than on horizontal surfaces. Powder also will not drip or run like paint can. It furthermore better resists abrasion and chemical damage.
Another advantage to powder coating is that it takes less time to process than paint. Manufacturers need only apply one powder coat (they may need to apply several coats of paint), and the coat requires no dry time.

Customers who want a coating that will better withstand the elements and everyday wear may consider the additional cost for powder coating well worth the expense.

**Galvanized Finish**

**Good for:** improved abrasion resistance, protection from mild acids, protection from moisture, performance through elevated temperatures, protection from salt

The most common method to galvanize steel is a process called **continuous hot dip**. During the process, manufacturers clean and then dip a steel component into molten zinc. The zinc bonds to the steel, forming a thin coat.

The galvanized layer of zinc provides both barrier and cathodic protection to the steel. As a barrier, it keeps air from contacting the steel and corroding it. As a cathodic protector, the zinc acts as a “sacrificial barrier” and rusts instead of the steel, even when steel is exposed due to a scratch or chip. Zinc oxidizes differently and at a lower rate than steel, so it will not quickly disintegrate. In fact, in a rural environment under perfect conditions, a zinc coating can last **more than 100 years**.

Besides acting as a cathodic protector, galvanized finishes offer other advantages. Its bond strength is much higher than paint—3600 psi—so it’s unlikely to scratch or chip. It’s also harder than mild steel and so offers better resistance to abrasion than the underlying steel. When steel is dipped in the molten zinc bath, the zinc reacts with the steel and forms several layers, all but the outermost layer of which are made of iron-zinc compounds. These layers are actually harder than the steel itself.

Compared to paint, galvanized coatings also better withstand high temperatures. While paint may endure temperatures up to 93-121°C (200-250°F), galvanized finishes can **withstand temperatures to about 204°C (400°F)**.

While more expensive than paint or powder coating, customers whose conveyors handle acidic or alkaline material, endure caustic environments, or encounter salt will do well to opt for a galvanized finish. If you’re handling material with a pH lower than 3.5, you’ll have to opt for stainless steel, as **galvanized material breaks down substantially faster** when the pH is this low.

Whether the material is wet or hot will also play into the decision. Just because the pH is lower doesn’t mean the galvanized layer will disappear overnight; it will just dissolve faster than it would otherwise.
Stainless Steel

Good for: high temperatures (over 204°C or 400°F), performance in highly corrosive environments, protection against acids with pH lower than 3.5, increased structural strength; resistance to highly abrasive material

The top-tier finish for a conveyor is stainless steel. (Yes, we understand that stainless steel isn’t technically a finish; it’s a structural material.) Stainless steel provides protection that far surpasses other options, and as an added benefit is stronger than the steel it replaces. It is, however, three to five times more expensive than mild steel.

Stainless steel is made by mixing chromium and steel. The result is an alloy extremely resistant to corrosion. For harsh conditions or for handling highly corrosive materials like as hot pellets, stainless steel becomes mandatory. Other finishes will not stand up to the abuse.

AR Plates, Abrasion, and Corrosion

As a note, if you’re wondering whether you may be able to forego abrasion-resistant (AR) plates in your conveyors if you opt for a galvanized or stainless-steel finish, you can put the thought aside. Although stainless steel and the layers in a galvanized finish are harder than milder steel, neither is suited to replace AR plating.

Galvanized coatings are meant to prevent corrosion, not protect against abrasion. By their nature, galvanized coatings will provide some abrasion resistance, but because they’re so thin, continuous abrasion will wear through them fairly quickly.

Stainless steel also won’t replace AR plates. Although stainless steel is hard—and depending on its chemistry may be harder than AR steel—it will not withstand abrasion as well as AR steel due to differences between its grain structure and the structure of the AR steel. The same is true of galvanized finishes.

On the other hand, if you’re wondering whether you need additional protection against corrosion because your conveyors have AR plates, you can likewise discard the thought. AR plates will not protect your conveyor against corrosion. They will rust like mild steel. And, no, you cannot galvanize or otherwise coat AR plates to protect them from rust. Galvanizing AR plates almost always makes the steel too brittle. The abrasion against which the plates protect the bottom panels of your conveyor would wear through coating anyway.
The Ideal Conveyor Finish

If an ideal conveyor could be made, rust would never be a concern. It wouldn’t corrode. In fact, its performance would get better over time.

Obviously, that ideal conveyor cannot exist. Physics won’t allow it. Instead, our conveyors do rust. Even stainless-steel conveyors eventually need replaced.

But we can make conveyors that resist corrosion better. And we can make design conveyors for increased ROI. Doing so begins with analyzing the corrosive factors to which your conveyor will be exposed and then choosing the finish that will provide the best protection for the cost.

In most applications involving wood or mildly acidic materials, galvanizing your conveyor is the way to go. The fact that it won’t chip and provides cathodic protection in addition to barrier protection gives galvanized coatings an advantage over paint and powder coats. You’re much less likely to fight corrosion, replace panels, and deal with material loss through rusted-out holes with a galvanized coat than with paint. In short, galvanization offers better long-term value than paint or powder.

In certain applications, you shouldn’t bypass stainless steel. If the material and environment are too harsh, even galvanizing your conveyor won’t be enough. If you go cheap just to save money up front, you might as well toss your dollars in a chipper.

Choosing the finish that will provide you the highest ROI and lowest maintenance headaches requires looking past the price point. Consider the environment and materials to which your conveyor will be exposed and choose the finish that what will best protect your machine during its expected lifespan.