ANALYZING METAL FAILURE:

ABRASIVE DAMAGE

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FOUR WAYS METAL ITEMS FAIL

Certain metals (like tungsten) and alloys (like stainless steel) are some of the hardest, strongest materials that the average person will ever encounter. But even manufactured metal items, for all their strength, can–and do–fail.

How can that be?

What could cause a metal tool or machine to stop functioning?

1 Four main forces have a destructive effect on metal. One is **corrosion**. This process converts a refined metal to a sulfide or oxide. It does so because those states are more chemically stable.

2 Another process that works to break down metals is **contact fatigue**. In this case, tiny cracks develop as the item has force or weight applied to it again and again. Ultimately, the metal becomes unstable due to a loss of integrity.

3 **Erosion** occurs when particles, liquids, or shock waves continually remove material from an item's surface. This is the same force being demonstrated when coastal waves eat away at a rocky cliff.

4 And finally, metal can fail as a result of **abrasive damage**. Similar to erosion, abrasion is the wearing away of material from a surface. However, in this case, the physical cause is scuffing, scratching, or other mechanical forces that occur when two surfaces rub against one another.

If you own or use metal tools or equipment, understanding these forces—and more importantly, how to protect your assets from them—can help you keep your people working and your machines operating longer and more effectively.

This guide, the second of a series of four guides to cover each type of metal failure (check out the guide on corrosion damage here), addresses abrasion and how advanced coatings can be used to protect metal items from abrasive damage and eventual failure.

WHERE AND WHY ABRASION IS PROBLEMATIC

Anywhere that two materials—particularly of different hardnesses—are driven against one another with sufficient energy and repetition, abrasion can occur. In business and industry, it is often two metals that are exerting force on each other. Those collisions may be by design or because some buffering material between the two surfaces has been lost, enabling them to touch.

What types of businesses tend to be fighting this force continuously? Industries that rely on repetitive mechanical processes—manufacturing, oil and gas, plastic injection molding, food processing, medical, and aerospace tools and machines are some prime examples of abrasion caused damage.

While broken tools and temporarily inoperable machines are dismissed by some as part of the "cost of doing business," it is important to be aware of the full cost of abrasion damage, including:

LOST PRODUCTIVITY

When an assembly line stops because an abraded part fails, what starts is the counter on how many dollars are lost as a consequence of the downtime.

SHORTENED ASSET LIFETIME

Every tool, part, and machine wears out eventually. But the longer you can keep them functioning, the less money you spend over time on replacing them.

DECREASED QUALITY

When metal assets are not functioning as they should, they become less and less effective, and the quality of the results they produce often declines.

LOST REVENUE

It does not take long for customers—or worse, competitors—to learn that a business is using tools or machines that are providing subpar performance. And once a customer or prospective customer is lost over a quality issue, it is very difficult to get them back.

THE ABRASION DAMAGE SOLUTION

A person is riding their bike down the road at a brisk pace on a warm summer day when a pothole engulfs their front tire and they find themself airborne first, and then on the ground with their exposed legs and arms skidding along the asphalt.

At that moment, they wish they were wearing long pants and long-sleeves. Instead, they are being reacquainted with the form of abrasion damage commonly referred to as "road rash."

It would not have taken much to protect the rider. A thin but strong layer of fabric could have kept the road's rough surface from peeling away portions of their skin. And that thin layer would not have negatively impacted the way they ride their bike.

When it comes to metal parts, the material that is often analogous to that thin fabric is a metal called chromium. Chromium is the hardest metal on earth. It's also a key component of stainless steel—a particularly durable metal alloy.

Armoloy's protective chromium coatings come in two different forms. Along with three other types of coatings, they provide an array of options for defending metal assets against abrasion:

THIN DENSE CHROME (TDC)

This material is often used in situations where tight tolerances and high precision are involved.

DIAMOND CHROME

Armoloy's XADC coating has a variety of uses and can be applied to many types of industrial equipment.

NICKEL TEFLON

What Armoloy calls "nyflon" is a co-deposit of electroless nickel and PTFE (Teflon©) that can be used with all common steels, including stainless steel, aluminum, brass, and copper.

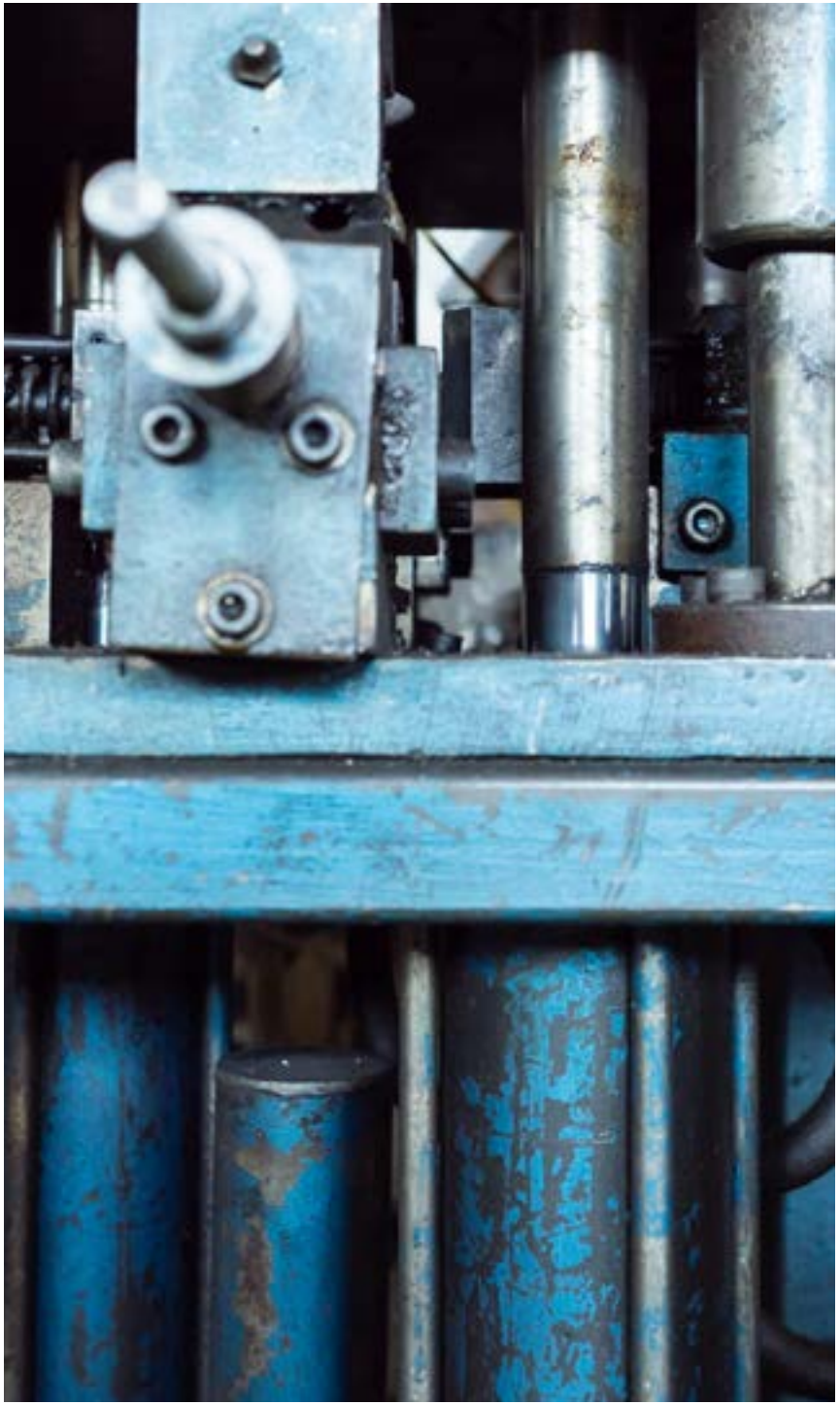
HYBRID COATINGS

Armoloy's Bi-Protect process combines electroless nickel with an overlay of Armoloy TDC or XADC.

ELECTROLESS NICKEL

This coating covers items uniformly, even if they have holes, curves, or recessed areas.

With chromium coatings, in particular, the key to reduced abrasion is what is called nodularity. Nodules are bumps—in this case, microscopic bumps. Their presence in a chromium-treated surface minimizes the ability of an opposing surface to adhere to it. This allows the surfaces to glide over one another with significantly less friction.



HOW MINIMIZING ABRASION BENEFITS A BUSINESS

Protecting metal tools and equipment with state-of-the-art coatings can be a company's advantage in many ways, including:

INCREASED ASSET LONGEVITY

From individual tools to complex, the addition of a coating can extend the working life of valuable assets, which ultimately has a positive impact on a company's bottom line.

FEWER PROCESS INTERRUPTIONS

When a system goes down or has to be taken out of service unexpectedly, that impacts productivity and profitability. Smooth-gliding surfaces are less likely to fail.

ENHANCED FUNCTIONALITY

Whatever a tool or device is designed to do, it does it more effectively when abrasion between surfaces is reduced.

PROTECTION WITHIN SPECS

Armoloy coatings are both incredibly strong and incredibly thin. That means they can protect an item without changing its dimensions significantly.

MORE EFFECTIVE BUSINESS DEVELOPMENT/RETENTION

When tool and equipment breakdowns are minimized, a company becomes known for its dependability, and reliable companies are better able to retain their customers and land new ones.

GETTING AHEAD BY PLANNING AHEAD

Advanced metal coatings can be applied to existing tools and equipment at any point in their lifecycle–even including when there is a time-sensitive need. However, the protective power of coatings—and the effectiveness of the items to which they are applied—is maximized when that layer is taken into account in an item's design.

Armoloy's coating experts can work with a company's product engineering team to determine the optimal solution and incorporate it into the asset's specifications. Then, as the item is being tested, the assessment is being made of its characteristics exactly as they will be when finished products are produced.

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PERFECTION IS OUR STANDARD

A licensee of the Armoloy Corporation, Armoloy Southeast has been in operating since1995 in its original location in Sumner, SC.

Providing a full range of Thin Dense Chrome surface coatings, Armoloy Southeast serves the greater manufacturing community in the Southeastern United States, as well as many customers in the international market.

Armoloy Southeast works in concert with the chemistry lab and innovation center at the Armoloy Corporate headquarters located in DeKalb, IL, which allows us to address and engineer solutions to the most difficult coating challenges. Armoloy is often the first place customers in the nuclear power, aviation, food-manufacturing, and other sectors turn to for solutions to “impossible” coatings challenges.

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