When Packaging, No Rust is a Must

In the battle against oxidation, new-generation volatile corrosion inhibitors fit the bill for parts large and small.

BY LOUIS A. KREN, SENIOR EDITOR

Corrosion is the nature of the beast in metalforming. Metallic parts can corrode during processing, storage and transport. For years, corrosion-preventive oils and greases were the solutions. That meant a lot of time, effort and money spent cleaning parts for further processing or upon delivery to the customer.

The advent of volatile corrosion inhibitors (VCIs) in films and packaging wraps signaled a clean, dry method of rust protection.

How VCIs Work

Chemicals in the packaging environment surrounding parts volatilize to form a protective molecular layer on part surfaces. So what does it mean when these chemicals volatilize? Corrosion-inhibitor compounds vaporize from the paper or film packaging, and attract to the charged metallic surface due to their polar orientation. The VCI molecules align on metallic surfaces to a depth of three to five molecules, migrating into recesses on parts. At this point, the corrosion cell—the flow of electrons in the part alloy and the flow of ions in the electrolytic surface layer—cannot establish itself, thus the layer of molecules passivates the charged surface and creates a barrier that prevents oxidation. The VCI packaging prevents salt, dirt and other corrosive contaminants from contacting the part surfaces.

Airtight packing is not required for VCIs to work. When the parts are unwrapped from VCI packaging, the protective layer immediately begins to dissipate. No part washing, dipping or other cleaning is necessary.

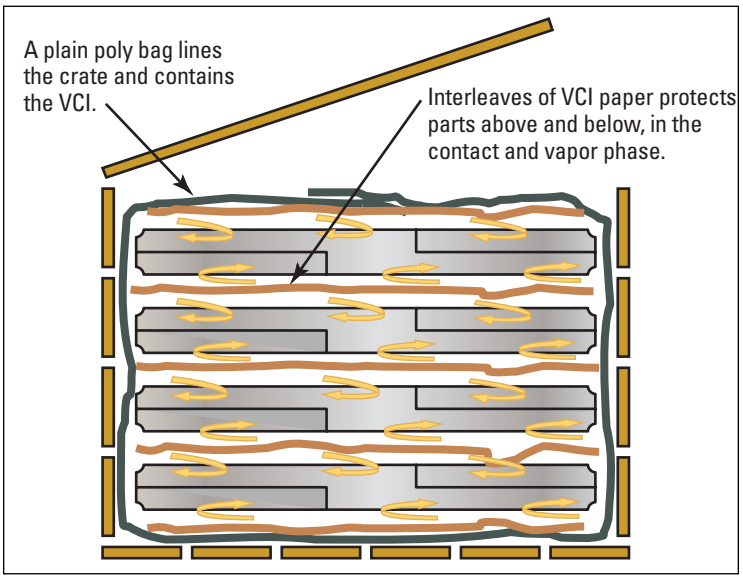
VCI molecules align on metallic surfaces to a depth of three to five molecules, migrating into recesses on parts. The layer of molecules passivates the charged surface and creates a barrier that prevents corrosion-causing materials such as moisture, salt, dirt and oxygen from depositing directly on the parts.

Military Needs Spurred Technology Growth

VCI technology grew out of military needs following World War II, according to Martin J. Simpson, president and CEO of Daubert Cromwell, a

VCI pioneer and packaging supplier based in Alsip, IL.

"George Daubert, our company's founder, was contracted by the military to provide corrosion-preventive methods for munitions and arms slated for storage after World War II," explains Simpson. "He invented this VCI technology under contract to the U.S. Navy. The standard back then was to use heavy oil or grease to protect the surfaces of stored metallic parts. Obviously, those kinds of products needed to be removed before the parts could be put back into operation. Research focused on developing means to lighten the oil or eliminate it completely so that parts could be removed from packaging and placed immediately into operation or undergo further processing."



To protect large metal stampings from corrosion during shipment and storage, the stamper lines the crate with a low-density polyethylene bag impregnated with VCIs that protect the parts that contact the bag as well as parts in proximity to the bag. Interleaves or paper or film VCI sheets may be added, laid at intervals as the parts are stacked to ensure delivery of enough VCI to protect parts in the center of the crate.

VCI protection can function on high and low volumes of parts large and small. Take electrical connectors for example.

"Suppose a metalformer produces connectors from strip steel or copper or even silver-plated strip," offers Simpson. "A strip of VCI paper can be fed onto a roll as an interleaf that delivers chemicals to the metallic parts. So as these finished connections are rolled into a coil, the thin strip of VCI paper feeds in with the coil and provides continuous protection throughout the length of that coil, ensuring corrosion-free parts throughout shipment and storage."

Fineblanked parts yield a more traditional mid-volume application, according to Simpson. "Consider the stamper that stacks several hundred fineblanked parts—about as large as your hand—into a bulk crate," he says, "lined with a VCI bag. The bag, constructed of low-density polyethylene, is impregnated with VCIs that protect those parts that contact the bag as well as parts in proximity to the bag. Interleaves or paper or film VCI sheets may be added depending on the size of the crate, laid at intervals as the parts are stacked to ensure delivery of enough VCI to protect parts in the center of the crate. Just close the bag and crate for shipment. So, VCI packaging is not terribly different from what is done with conventional packaging materials."

Part size represents no limitation for VCI applications, making the protection viable for large components and assemblies, and various alloys can be protected within a single bag. Attesting to those facts, Simpson notes that Daubert Cromwell has even wrapped complete engines for export.

"The engine is placed in a VCI bag along with one or two VCI emitters that add more chemicals for improved or prolonged protection," he says. "The engine may have parts made from various alloys or featuring zinc-galvanized or phosphate coatings, and the engine block itself may be cast iron. All of those metallic species need protection within that bag, requiring a VCI composition that will actively protect each one. That may require a complex packaging design, with a number of VCI barrier layers along with VCI emitters placed inside the package."

Some Homework Required

A VCI formulation functioning ideally under one set of conditions may not work under another, according to Daubert Cromwell officials. The success of a VCI application rests upon:

- Which materials are in need of protection;
- Corrosion inhibiting chemicals used and their effectiveness on the materials;
- Ratio of chemicals in the formulation;
- Amount of VCI on the paper or in the film;
- pH of the finished product;
- Water solubility and effectiveness of the corrosion inhibitor in the presence of moisture and high humidity; and
- Overall packaging design and conditions expected during packing, shipping and storing.

Deciding on the right VCI protection also demands consideration of the length of protection required, climate conditions for storage and transport, size and weight of parts, chemicals or residues on the parts, current processing and cleaning methods, and proximity of packaging-station location to other processes.

A supplier to metalformers looking for VCI protection also will discover whether parts will be shipped domestically or internationally.

"Obviously, international shipping demands increased protection because the parts will be exposed to more severe elements over a longer period of time," says Simpson, noting that a number of paper and plastic-film packaging solutions are available to fit a metalformer's current packaging process and can be introduced easily into its operations. **MF**