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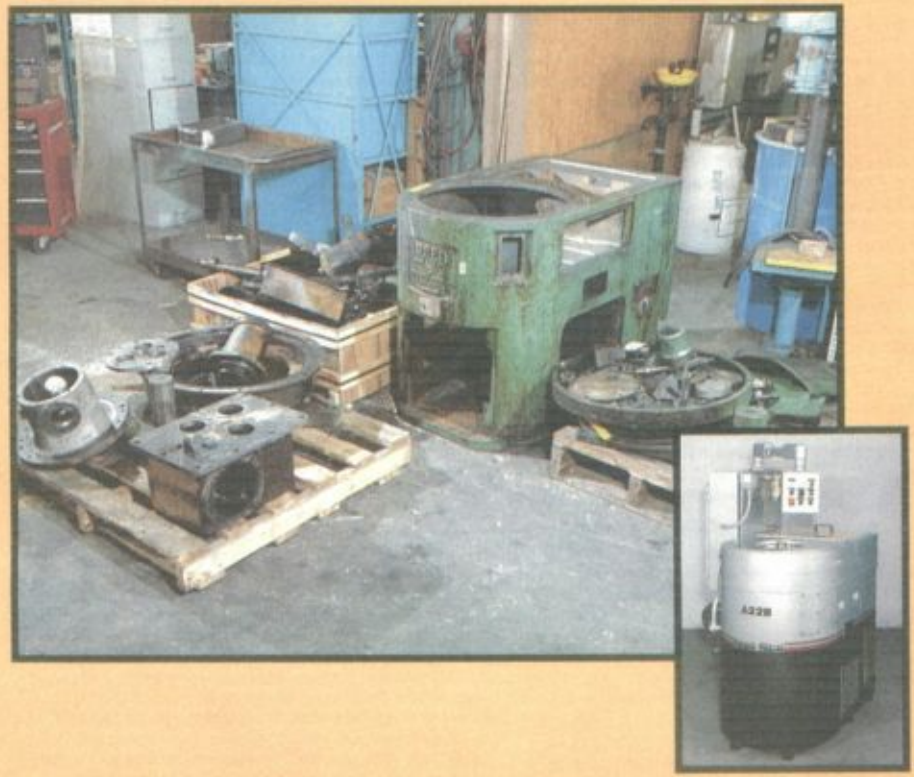

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Cleanability of Fasteners Before Plating

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Cleaning fastener surfaces prior to coating is essential, but not always easy. Today, there are aqueous cleaning technologies that cover a range of contaminant-removal problems.

Good corrosion life is a requirement for today's automotive fasteners. No longer may these fasteners slowly rust when the areas surrounding them have been upgraded to years of cosmetic corrosion protection. While numerous coatings have been invented, patented and touted by their respective owners, the fact remains that all successful coatings need to be used on parts with a clean slate. With fasteners, this means that the parts going into the baths and organics must be as clean and scale-free as possible.

The old adage of "garbage in/garbage out" holds true for fasteners as much as with any other parts to be coated for corrosion protection.

Sources of Dirt on Fasteners

Where does surface dirt on fasteners come from? The origins are varied, but surface contamination usually results mainly from the manufacturing process.

Some cases of extremely heavy rust that was not sufficiently removed during wire material drawing and subsequent processing stages have been found in overseas products, but these cases are rare and found on low-grade fasteners only. Significantly long and harsh pickling to remove this rust leaves badly pitted and gouged areas that carry over to the finished product. Thankfully, little of this type of fastener ever finds its way into automotive usage.

The most common fastener surface contamination results from heat treat scale and burned-on chemicals. Here, the wire used in the manufacture of the fasteners is often coated with a lime solution to retard rusting and scaling. Also, it is drawn through a lubricating compound consisting of fatty acids, stearates, calcium and sodium salts and other organics when it is drawn down to proper diameter before going into the cold headers. Machined rod is also often coated with oils, greases and other rust preventives. Die lubes and oils in the forming operation and even sulfur-based cutting oils and synthetic compounds can also contaminate the surfaces of fasteners.

When fasteners processed with these coatings are sent for heat treatment, any surface chemicals or compounds should be removed by the heat treater. However, most heat treaters normally use a wash that is insufficient to remove any but the basic compounds. As a result, the chemicals remaining on the fastener surfaces become burned-on and the fasteners are then quenched in an oil medium. After all of this, the fasteners arrive at the plating operation.

The Plater's Dilemma

Most plating shops have a general degreasing/cleaning operation. However, some customers are unwilling to pay for this cleaning step and so to facilitate a quality plating application, the plater will often times clean the parts for free. The standard cleaning agent used by the plater will almost certainly not be able to remove all the chemicals that may have been used on, and burned into, the fasteners.

Inhibited acids do a fair job of contaminant removal, but I have seen cases where the oils have been so burned-on and the scale so adherent that their removal is impossible. Sulfur-bearing compounds also fuse to the surfaces so strongly that the plating barely adheres, is spotty or not present at all. Heat treat scale presents yet another cleaning problem, especially from some heat treaters who push the processes too hard and generate excessive scale.

With the concerns of some customers about hydrogen generation, the use of caustics is often requested in place of acids. Caustics don't do as good a job of cleaning and are slower and less efficient at scale and chemical removal.

Additionally, having only a "house" cleaning solution, the plater may obtain erratic results when running several of a customer's parts. The cleaner that removes chemicals A, B and C from Acme company parts, may do little to chemicals D and E on Jones company parts. For example, a manufacturer's parts that showed early salt spray rust in the shank area under the heads were tested and found to show high sulfur spikes. These were traced to the use of sulfur die compounds that were baked onto the surface, preventing phosphating. A change in the cleaner solved the problem, but this change caused poor results when another customer sent in parts.

In theory, platers should have several cleaning options available, but in fact, few plating companies could afford the time and space needed to handle incoming parts several ways or to process them through several tanks.

What is the Solution to the Plater's Dilemma?

In determining a solution to the dilemma, first let us state what it is that we need. We need a solution that is capable of cleaning all contamination from incoming parts. This solution should be low in price, environmentally friendly, fast-acting and shouldn't effect the base surface of the fasteners (it should be selective in its attack, or at the very least cause no further deterioration of the surface). What solutions are available (see the accompanying Chart of Cleaning Options)?

- ***Caustics*** are slow, require several rinse stations to prevent drag-out and possible neutralization of bath acids, are not all-in-one-cleaners (so problems may still exist) and are a source of environmental concerns with respect to fumes, employee safety, waste treatment, cleanliness, controls, etc.
- ***Acids*** clean well, but are too rough for most parts unless inhibited (which slows the whole operation), may cause hydrogen concerns and are not nice to be around (hazardous waste products, dissolved metals, odor, fumes, etc.).
- ***Shot Peening*** has always been a nice cleaning method and actually increases surface strength through cold working, but is expensive, slow, requires employee training and stipples the surfaces of most parts causing a dulling effect that carries over to the finished product's appearance.
- ***Special Chemicals*** are available for special jobs, but many of them are dangerous to be around, are very selective in what they clean and are hard to get rid of when spent.

Cleaning Method	Cleans Everything	Effects Base	Hydrogen Generation	Time (Speed)	Operating Cost	Investment Cost	Environmental Impact*
Caustic	Selective	Little	No	Slow	Moderate	Moderate	Unfriendly
Strong Acid	Yes	Yes	Yes	Fast	Moderate	Moderate	Unfriendly
Inhibited Acid	No	Little	No	Moderate	Moderate	Moderate	Unfriendly
Shot Peen	Yes	Some	No	Slow	High	High	Friendly
Special Compounds	Selective	No	No	Slow to Moderate	High	Possibly High	Usually Unfriendly
Aqueous Cleaner (Old Type)	No	No	No	Moderate	Low	Low	Friendly
Aqueous Cleaner (New Type i.e., *Picklex*®)	**Yes**	**No**	**No**	**Fast**	**Low**	**Low**	**Friendly**

Chart of Cleaning Options (Source: Technical Presentations Company).

** Environmental Impact conditions include waste treatment & disposal, fumes, toxicity, operator safety, OSH.U/EPA regulations.*

Developments in Aqueous Cleaners

While there have been water-based cleaning compounds available for years, most have done little beyond degreasing and de-oiling. Recently however, aqueous cleaners have made great strides and several show promise in the required areas.

New-generation aqueous cleaning chemicals can now perform descaling, pickling, conditioning of the metal and even provide a protective coating all in a one-step dipping process. Usable from room temperature to about 150°F (66°C), the cleaning process involving these chemicals is fast, cost-effective, and safe to handle in that the chemicals do not fall under any OSHA or EPA regulations. Some of these chemicals leave a long-term rust preventive coating on parts, which prevents flash rusting and allows storage for a period of time before plating (for example, a few days on the plater's dock) with no rust-related problems. The preventive film does not interfere with plating operations and can actually increase weldability.

One typical product from this group of new chemicals that was examined by me is called Picklex® from **International Chemical Products** of Huntsville, AL, USA. Two reports from the EPA's National Risk Management Research Laboratory (September and November 1998) confirm the superior quality of this water-based cleaner over other methods and applaud the zero-waste discharge from the process. This is also confirmed by various tests done by several companies[1,2,3] as well as a **General Motors** test that showed increased weld strength from Picklex protective coated and cleaned parts as compared with parts prepared using standard methods of cleaning.

I conducted a test on M8 flange head sample bolts where some of the bolts were cleaned in the plater's standard descaler and some were cleaned in a Picklex solution for 5 minutes at 150°F (66°C). Both bolt samples were then plated with bright chloride electro zinc to 0.0002" (0.005 mm). When I examined both tested samples, I found that the Picklex cleaned parts, after zinc plating, showed a better cosmetic appearance than the parts processed through the plater's regular cleaning cycle.

Conclusion

With results like those listed above from products currently on the market, little reason exists for poorly plated fasteners. While many water-based cleaning products have been used for quite some time for descaling sheet steel, they have only recently begun to receive attention by fastener coaters.

If problems exist with erratic and spotty salt spray results that are not traceable to obvious fastener finishing defects (thin coating, etc.), then a review of the coater's overall cleaning operation will likely show that existing surface conditions are to blame. Often, as small a change as switching to a more effective cleaner/descaler will correct the problem.

For further discussion, contact the author by telephone at **+1 810 939 0832.** FTI

[1] ***Savage Precision Fabrication, Inc.**, December 1998. Advantages when used in powder coating operations.*

[2] ***ICP Inc.**, June 1997. Improved salt spray with Picklex descaler.*

[3] ***Rockford Products Corp.**, Ongoing testing on fasteners.*

An Alternative Metal Surface Preparation & Pretreatment Process

Picklex® is an environmentally safe, nonhazardous, nonflammable, water-soluble product for use in cleaning, conditioning and coating metal surfaces prior to any finishing such as painting, welding, powder coating, E-coating, electroplating, anodizing, etc.

The four-step (in most cases) Picklex application process eliminates the use of acids, phosphates, chromates, etc., and provides zero waste disposal. In addition to removing light oil, dust and surface rust, Picklex provides 100% conversion of rust (including micro-rust) to a conductive protective coating in one dipping or spraying process.

After heat treatment, metal parts can be dipped in Picklex where descaling, pickling and conditioning are performed, preparing part surfaces for subsequent coating or welding (Picklex increases weld strength considerably). Additionally, the process causes no hydrogen embrittlement.

Picklex is currently under evaluation and testing by the Environmental Protection Agency (EPA). Contact **International Chemical Products, Inc.**, Huntsville, AL, USA or **Circle 202.**

***Company Profile...Technical Presentations Company** provides the fastener industry with technical education and engineering consulation services.*