

Finishers' Think Tank

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Stripping Organic Coatings

uring the past 10 years, the metal finishing industry has made significant strides in diversifying and implementing new and modified processes. The driving forces are related to cost reduction, improved wear resistance and performance, as well as simplifying waste treatment and compliance. One of the heavy hitters in this regard has been application of organic coatings-paint, powder coat, E-coat, lacquers, melamines and vinyls, to name a few. One survey determined that the general class of paint and powder coat has replaced about 30 percent of previously electroplated finishes on specific parts. What to do about reject parts themselves? The finisher has two distinct choices: scrap or strip. The latter involves reconditioning and reprocessing-no different than plating rejects. Economics and cost effectiveness dominate decisionmaking. If stripping is the desired route, the methods are burning off the coating or chemically removing it. In this column, we'll focus on chemical immersion stripping. The breakdown will be solution types, base metals mix, stripping mechanisms and handling of spent solutions.

Solution Types Cold, Organic

This class was a workhorse for many years. Several general formulations had been prepared for commercial use, which included some very active ingredients, such as formic acid, phenols, methylene chloride and cyclohexanone—all strictly liquid formulations, but without water. For almost any stripping application to remove most organic coatings, the cold, organic strippers did an excellent job. Coatings strip rapidly sometimes in less than 10 minutes at room temperature—with no chemical

attack on sensitive metals such as aluminum, brass, copper alloys, white metal and zinc. Normally, the solution components attack the polymeric cross-linkages of the organic coating, destroying the bond, then either dissolving portions of the coating or wrinkling it off the substrate. A thin surface layer of water (with a lower density than the stripping solution or melted wax) is poured on the surface of the bath to minimize evaporation loss. Maintenance additions of concentrated solution are made to replace drag-out losses and consumption resulting from the stripping process. Sludges consisting of the removed coatings are filtered or decanted. By monitoring process control, effect of maintenance additions and speed of chemical stripping, the active service life of the bath is determined. This type of solution contains many of the hazardous, toxic, corrosive constituents described as well as organic materials from the coatings stripped. The only compliant handling of the spent solution is by proper, certified incineration.

Global concerns related to critical items-VOCs, The Montreal Protocol, elimination of chlorinated solvents and carcinogens, and toxicity-have greatly curtailed the use of cold, organic solvent strippers. These solutions are, however, still in use, and must adhere to strict emission controls, periodic reclamation by distillation and cost of proper disposal. The greater expense and liability is typically offset by desired cycle operating parameters (low time and temperature) and adherence to still-existing process specifications. A popular application still in use is the stripping of organic coatings from aluminum and steel wheels prior to electroplating. For the majority of stripping cycles, alternatives to the

traditional cold organic types are available and effective. There are some differences to operating parameters, control procedures and solution types to use.

Hot, Aqueous Inorganic/Organic This type of solution is 100-percent free of chlorinated solvents, phenols and formic acid. In their place, unique blends of specialty components such as glycol and propylene glycol ethers, organic alcohol (straight chain and cyclic), gluconates, acids or caustics, and surfactants are combined, with water as the carrier. Some of the solvents used may even be SARA Title III exempt. Working solutions may range from 25-75 percent v/v, diluted with water, remaining clear or becoming opaque. Also, the working solution may form a di-phase at recommended use conditions. This is normal, based on the particular chemical bath makeup. Heating is essential to obtain acceptable stripping rates, and solutions may operate at 150-200 °F (66-93 °C). Many of the typical paints, powder coats, epoxies, melamines and lacquers are completely stripped by these solutions. The critical parameters are concentration and temperature to desired strip time. Polymer cross linkages are also attacked, dissolved or wrinkled off the substrate. The solution can be analyzed by titration to determine alkalinity or acidity, permitting appropriate maintenance addition of product. This can be misleading. In some applications, the solvents are consumed at rates significantly different from the acid or alkali constituency. It is not unusual for the working solution to be 150 percent v/v concentration, and yet strip slowly. That is why some chemical stripping systems provide two separate additives: base or acid

with accelerators and solvent mixture. In this way, the correct level of both additives maintains optimum performance of the solution.

Filtration is recommended to remove organic sludges that would be dragged out on stripped parts or, even worse, insulate immersion heaters. Baths are normally replaced by certified, compliant incineration or, per analysis of constituents, the local POTW or appropriate government agency will recommend alternative compliant disposal. Even though the cold organic chemistry has been replaced, some of the organic coatings have probably dissolved into the solution, requiring these disposal considerations.

Hot, Powder Inorganic/Organic This class differs from the previous ones in that the concentrated formula is a powder blend. These are exclusively alkaline formulations, consisting of caustics, highly alkaline organics, accelerators and specialty solvents, typically used at 1-3 lb/gal (120-360 g/L), 150-200 °F (66-93 °C). Good process applications include stripping powder coats and organic coatings off large steel parts in galvanizing operations. Titration is used to determine bath concentration. One product or two additives as described previously can be added in ratio to maintain optimum working bath concentration, relative to alkalis, accelerators and solvents. In some applications, the customer can provide caustic, adding the specially blended additives package. Filtration is recommended. Disposal requirements and considerations are similar to the hot, aqueous bath type.

Hot, Nonaqueous

This class is composed of accelerators, compliant solvents and alkalis that do not contain water. Most of these blends are safe to use on all base metals, ferrous and nonferrous. The alkaline level does not result in attack on the sensitive metals (i.e., aluminum and zinc), because absence of water prevents ionization of the alkalis. Baths are typically used as full concentrate at 245-350 °F (118-177 °C). The solvency types and their levels determine flash point and temperature application, which relate to stripping effectiveness. Because of flash point, steam is the only permissible heat source. Flames and electric

heaters are forbidden. Analysis by measuring pH, a titration and test stripping on standard panels are typical control methods. The same disposal considerations will hold as in the discussion on hot, powder inorganic/organic solutions.

Hot, aqueous and nonaqueous solutions are not necessarily slower than the cold, organic type. At the predetermined correct temperature and concentration, the hot solutions will strip as fast or faster than the cold types. The controlling factor is selection of the optimally effective solution, which is done by trial evaluation. Here are some tips on conducting an evaluation to properly pre-screen candidate formulations.

- Prepare a suitably small working volume, but one that is sufficient for the purpose. 500 mL, 1 L or 1 gal may be required.
- If possible, consult with the supplier of the organic coating to determine its chemical nature and sensitivities.
- Consider agitation and mechanical aids such as ultrasonics.
- Use parts suitably sized that will be totally immersed in the prepared solution, or have panels prepared that can be used.
- Do **not** use parts or panels where the organic coating is scratched or knicked. This will allow the solution to effectively undercut the organic coating, readily attack and lift it. Almost any solution will do this, so providing a false observation result.
- How flexible are time and temperature?
- Is the required source of heating in place? Can it be installed?
- Start at the low end of recommended concentration and temperature. Modify temperature and time to obtain the desired strip rate. Determine how many ft²/gal of solution are stripped. Analyze and make appropriate maintenance additions. Confirm strip rate. Repeat stripping in the aged solution, looking for effectiveness and an approximation of strip bath service life.
- Confirm that base metals mix is compatible with solution chemistry. If there is an underlying iron phosphate or chromate coating, it may be stripped, requiring this step to be repeated before reapplication of the organic coating.
- Based on mix of base metals, it may be necessary to use an acidic

stripper for zinc and aluminum, but an alkaline solution for steel. Also, the hot, nonaqueous solution may be used for all types of metals.

- After how many passes in the coating cycle will hooks require stripping? How many mils of coating are to be removed? Time limitation or off-line tank?
- Reprocess stripped parts to confirm quality and adhesion.
- Install a pilot tank as the next step, scaling up to actual process strip tank.

It is much preferred to conduct a proper evaluation first. The worst thing that could happen is that the solution is not appropriate and a minimal amount of it must be disposed. That's much better than taking that chance with a 500-gal tank. There are many proprietary stripper formulations that provide quality action, especially on certain coatings. All of them have the goal of cost effectiveness, environmental compliance, and improved worker safety and handling. Some installations rotate stripper baths, using the older solution to soften or initiate the cut, then transfer to the newer bath to complete removal of the organic coatings. A few finishers that strip powder coat off steel use a bath consisting of 100percent v/v concentrated sulfuric acid. The critical requirement is to avoid water contaminating the bath and to acknowledge the use and handling of a very corrosive, dangerous material. Most finishers, after evaluating candidate solutions, find the cycle becomes standardized because most coatings to be stripped remain of the same chemical types. In many practical respects, cold, organic solvent strippers have given way to any of the alternative chemical solutions discussed that meet operating, cost, safety and compliance considerations.

Stainless Steel: A Tough Material Four men are distinguished as developers of stainless steel: Murrow & Strauss of Germany, Beckett of the U.S., and Brealey of England—all in the first decade of this century.

Stainless steel's chromium content is most critical to the corrosion protection afforded by way of a chromium oxide surface layer. Type 316 has greater corrosion resistance than Type 304, particularly toward chloride. PRSF