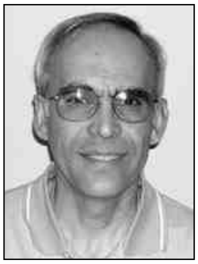
Stephen F. Rudy, CEF
Hubbard-Hall Inc.
563 South Leonard Street
Waterbury, CT 06708
E-mail: sfrudy@optonline.net



Replacing Chlorinated Solvents with Aqueous Based Cleaning Processes II: Aqueous Cleaning

Last month we reviewed the process, status and environmental ramifications associated with chlorinated solvents as used in parts cleaning. This month, we consider the application of aqueous, or water based cleaning, as an alternative to chlorinated solvents. Our industry has utilized and thrived with aqueous cleaning technology. It has always been with us, upgraded, improved, to satisfactorily clean parts, as a first step in a multitude of finishing processes. Operations such as: plating, phosphating, black oxide, chromate, painting, passivation, electropolishing and more, attest to the versatility of aqueous cleaning. In these line cycles, it is almost universal to employ a soak cleaner.

Soak cleaning background

Stable concentrates are available in powder and liquid forms. These commercially blended products are formulated based on types of metals being processed (ferrous and non-ferrous), desired cleaning mechanism (displacement or emulsification), types of soils to be removed, temperature range, analysis and control, and disposal considerations. Based on application, blends may consist of alkalinity builders, caustics, water hardness conditioners, surfactants, wetting agents, deflocculants and metal reducing agents. Operating baths can be either high or low foaming, accommodating mechanical agitation considerations. pH sensitive metals, such as aluminum, brass and zinc, can be efficiently soak cleaned (no etching) in mildly alkaline cleaners versus the higher pH, or caustic containing cleaners prevalent for steel. Acidic cleaners are also used to remove organic soils as well as oxide scales and rusts off base metals. Other applications include conditioning the surface for specific steps, such as zincating aluminum, iron phosphate, general preparation and activation before plating.

Equipment requirements

- Suitable tank construction, such as stainless steel, plain steel and plastics. The materials of construction should tolerate anticipated heating requirements and be tolerant to the specific cleaner chemistry.
- Heating is very important. Most aqueous systems require a temperature range of 140-180°F (60-82°C), for optimized cleaning cycles that may range from 3 to 10 minutes. Steam coils, electric immersion or gas fired sources for heat are typical.
- Agitation can be very important and critical to successful soak cleaning. Solution movement facilitates soil removal and promotes uniform solution temperature.
- Filtration. In my experience this is a very important complement to maintain optimized cleaning. Solids, oils and grease are continually removed. It also extends the cleaner bath service life, thereby minimizing dumps. This reduces the work load in waste treatment, and keeps desired line production operating longer between maintenance down time.

Soak cleaning action

Oily soils, grease, fine solids, polishing and buffing compounds, etc… are typically removed by either emulsification or displacement. Unique chemical formulations, balancing alkalinity with specific surfactants and wetting agents, can provide either type of cleaning action. Emulsification suspends and holds the soils in solution. My experience has been that an effective soak cleaner, properly maintained, should hold a range of 10 - 15% of these soils, to bath exhaustion.

In displacement cleaning, the soils are released by a different cleaning mechanism. Unlike emulsification, in displacement, the soils are not held in a chemical "cage," but allowed to settle out physically, separating from the aqueous phase. Most oily organic soils are less dense than water, and will float to the surface of the cleaner bath. Many cleaner tanks incorporate an overflow weir into a small side tank for recirculating the solution. This is an ideal place to install and operate a belt skimmer or disk, to remove the separated and collected oily soils. In fact, any cleaner can benefit from oil removal. During operation there can be at least a 20° cooling of the solution in the overflow, resulting in oils separating. Even emulsifying cleaners will release some oils upon cooling.

Small steel stamped parts are usually heavily oiled. I prefer displacement cleaning in these types of barrel applications, especially in tandem with oil removing equipment.

Soak cleaners analysis and control

Alkalinity titration, to an indicator, or pH endpoint has been the most accepted, readily available, and quickest method. It is equally applied for liquid- and powder-based cleaners. Based on analysis to neutralize alkalinity, a quantitative amount of product concentrate is added to adjust and maintain desired operating concentration. A simpler alternative to titration, although not as accurate, is the method by which a sample of the bath is neutralized to a color change, by drop-wise addition of testing solution. In both methods of analysis, the wetting agents, surfactants and other non-titratable components in the cleaner are not determined. However, by adding the cleaner as a whole product, this usually provides a sustainable, working balance of all components for effective cleaning. The alkalinity titration also applies to multi-component cleaner systems, such as separate alkalinity and detergency addi-

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The automobile industry is a key user of lasers for surface treatment operations. Lasers are used by OEMs to remove oxides and oil residues from body parts in fully automated manufacturing lines prior to welding and soldering applications. Tier 1 suppliers use lasers to clean surfaces prior to gluing or other joining operations. The removal of oxides, which absorb Nd:YAG laser energy extremely well, allows for high production rates and is a main application. Low operating and initial investment costs, in combination with very high reliability and consistent quality are the key decision drivers for laser cleaning in automotive related applications.

Summary

In a relatively short period of time, many fields of application have emerged for laser surface cleaning. Over 300 installed laser cleaning systems are currently in use. Research, demand and economics have enabled a growing future and have created huge potential for this technology in the U.S., where new applications are continually materializing.

Finishers Think Tank

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tives. Titration to a determined endpoint provides a quantitative addition of the alkali additive. By the operating ratio, the detergency additive is calculated, and added to maintain the desired operating ratio of both in the bath.

Other supporting analyses of the cleaner can be incorporated to monitor age, soil loadings, and if effective service life has been achieved. Usually a ready-to-dump cleaner can be tested for specific levels of contaminants. These values can be used as a guide to monitor service life of a newly made-up cleaner. Examples include metal contaminants (*e.g.*, chromium, copper, iron and zinc), extent of soil emulsification, solution density, and effect of water break test on previously cleaned coupons.

Soak cleaner waste treatment

Spent solutions are effectively treated by adjusting pH, releasing emulsified oily soils, precipitating metals and filtration. Clear solution is discharged per local POTW or municipal waste water authority regulations. Depending on plant processes, treated water may be recycled for use in previously tested for or non critical applications.

Complete waste treatment of a spent aqueous cleaner may be one quarter or less when compared to proper shipment and incineration of spent chlorinated solvents.

Next month we will review ultrasonic and mechanical cleaning. ***P&SF***

Answers to I.Q. Quiz #456

From page 20.

1. Aluminum and zinc
2. A cold shut is a condition where metal has not completely melted into itself, in a situation where two flows within the die cavity meet
3. (a) Molten metal must be smoothly delivered throughout the cavity and (b) air within the cavity is expelled completely the cavity as the molten metal enters
4. Gating design - the geometry of that introduces the molten metal into each part cavity.
   Die temperature - maintaining molten flow until the cavity is completely filled.
   Die wear - lack of maintenance.
   Mold release compounds - casting sticking to the die on removal
5. Plating over pores results in blistering and/or peeling. Surface pores can trap chemicals in the cleaning and acid pickling operations, and can be held in place through the rinsing operations. Ultimately, trapped chemicals can leak out through cracks in the plating, leading to staining at least and blistering at worst.