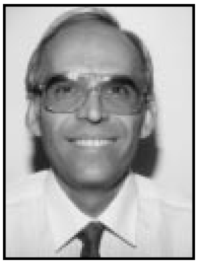
Finishers' Think Tank



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Filtration of Cleaners

There has been a great deal of activity concerning filtration of cleaners over the past 10 years. Several driving forces have kept this method of purifying cleaners active, some of which are:

- Extending bath service life
- Providing optimum cleaning effectiveness on a continual basis
- Reducing reject rate of processed parts that had been caused by insufficient cleaning
- Minimizing dragging contaminants into down-line process tanks
- Easing the burden on waste treatment
- Generating less sludge
- Economizing the overall operation

Realizing the maximum benefits does not just relate to the filtering process itself. There are other contributions that complete the overall picture of successful cleaner filtration. These include chemistry of the specific cleaner, operating within fixed parameters, design of the cleaner tank, selection of filtration equipment and payback on investment. There is, of course, no simple way to make the best selections in each criteria. Trial studies, including lab testing and field evaluations, are needed to arrive at quantitative results that can guide the overall process determination. Suppliers of cleaners and filtration equipment lend their expertise to help run, monitor and rationalize test data. Practical information will help the finisher determine what is right for their cleaning operation. We can review some of the items that should be considered.

Soak Cleaner

Soak cleaners are predominantly alkaline-type cleaners. They consist of builders, such as caustics, silicates, phosphates, soda ash and borates, which contribute to the overall cleaning process. Surfactants, detergents, dispersants and water conditioners usually round out concentrate blends. Formulators combine constituents in specific concentrations and ratios to other ingredients. The resulting working soak cleaner effectively removes a range of certain oils and greases that are related to concentration, temperature and time. The cleaning mechanism is either by displacement or emulsification. The latter type are designed to encapsulate and suspend varying amounts of oil in solution. Minimal oil separation in the working cleaner usually occurs. Cooling sometimes releases a little more oil. The bulk of oil separation actually occurs during waste treatment of the spent cleaner bath itself. A good emulsifying soak cleaner should be able to retain a large reservoir of oil, perhaps five to 15 percent v/v when spent.

Soak cleaners are also formulated in unique combinations of specific ingredients to provide working solutions that displace oils. Concentration, time and temperature are important operating factors, similar to emulsifying cleaners, to determine best operating conditions. There is one important difference, however. Agitation is very beneficial to displacement cleaning. This can be accomplished by movement of parts, mild air or mechanical effect. It results in short-term emulsification. This has practical benefits. Oils will not be picked up on exiting parts, barrels or baskets, thereby preventing re-soiling parts or dragging oily contaminants into down-line tanks.

The key to a good displacement soak cleaner is this short-term emulsification. At the end of the working shift, solution agitation stops. Temperature can be maintained at operating conditions or reduced. This "dead time" or solution "relaxation" can result in a significant release of oils. Displacement-type soak cleaners generate more readily separated oils on a continual basis. Displacement cleaners float oils to varying degrees of volume and quality. An oily layer enriched in amber/brown color, or matching the color of oil on the precleaned parts, is preferred. Whitish or tea-colored oily layers may indicate incomplete displacement of oil, or in sync with a reliable mechanical filter, may remove at least five percent v/v of oil per oil loading, square feet of parts processed, cleaner concentration and temperature. These are parameters to be determined based on the individual process line. This facilitates the use of filtration devices. Certain filtration equipment may also be useful on emulsifying cleaners. In either type soak cleaner application, however, practical testing should be conducted to determine the right choice.

Equipment

Industry-wide, there is a good selection of filtration equipment available. Types vary in sophistication, size, maintenance and application. The common link they share is removal of displaced—preferably floating—oils on a continual basis. In some instances, the oils displaced may be more dense than water. In this case, sloped-bottom cleaner tanks can be sufficiently drained to remove accumulated oils, grease and sludges. Let's review a few different filters for cleaners and operating tips.

Belt & Disk Skimmers

These take up the least amount of space. There is usually one connection—a C-clamp to the lip or edge of the tank—in a quiet collection zone or in an overflow side tank. The belt skimmer consists of a motor that rotates a fixed-length of stainless steel or polypro plastic belt. The disk may be polypro or CPVC. The belt or disk is adjusted so that a portion of either is submerged in the soak cleaner (to just below the oil layer depth) during rotation. Floating oils are attracted to either device, adhere and are mechanically removed. A positioned squeegee then pushes the oil off the medium before it reaches the cleaner solution, channeling it to a discharge hose that leads to a drum or similar oil-collection container. The limiting factor for optimum success is how hydrophobic (oil-loving) the belt or disk is. From experience, I have monitored materials that exhibit poor and good oil pickup. Plastics seem to attract more oil. Another concern is the temperature stability of the skimming device. Be certain it will not warp when exposed to the working cleaner temperature, or the squeegee won't be very effective. Maintenance involves periodic replacement of belt or disk and squeegee.

Filter Tubes

These are canisters that are filled with filter medium (such as hydrophobic plastic media, baffles or shards). The soak cleaner is pumped at a predetermined rate through the filter tubes. Oils are retained on the filter medium. The aqueous, oil-free solution is returned to the process tank. The filter medium will become saturated (corresponding to an increase in pressure to pump the cleaner), at which point the canister can be replaced or the oil pressed out and filter medium reused. The equipment requirements are more sophisticated than the belt or disk skimmer. Supportive items include a pump and housing for the filter chambers, as well as a requirement for a separate standing unit for all components. Aside from replacement of the canister, routine mechanical maintenance is required to service the equipment. Care should be taken to confirm seals, parts and piping are compatible with the cleaner chemistry and operating temperature. It may be prudent to include a bag filter (20–50 micron) before the canisters to remove larger particles, such as grease and metal shavings.

Coalescer

This system pumps the cleaner through a filter that removes larger particles before introduction into a coalescing chamber. Within the chamber is a coalescing element (made of hydrophobic materials), which attracts oil drops in the aqueous stream, allowing the water-based solution to return to the process tank. Oils that are lighter in density than water collect in the chamber and are readily discharged into a collection vessel or drum. As long as larger particles are kept out of the chamber, its service life with proper maintenance is indefinite. The fixed equipment requires a suitable space allocation for operation and service.

Ultrafiltration

This method employs unique ceramic membranes that remove oils from the cleaner solution. On a molecular level, oils will exhibit sizes in excess of the membrane's pores. The aqueous solution passes through, but not the oils. Flow rates are evaluated to obtain the best contact time through a number of the ceramic membranes. The rejected oily solution can be recycled through the membranes, substantially dewatering it. I have monitored some excellent field results with ultrafiltration. Aesthetically, with just one pass, an oily, murky, soiled cleaner returns clean and almost clear. Ultrafiltration units are large component systems, requiring a pump, housing to hold the ceramic tubes and collection tank for rejected oils. I prefer the mobile types that can be transferred to different lines for selective cleaner batch treatment. Ultrafiltration membranes are the heart of this process.

Care must be taken to confirm compatibility with the cleaner chemistry (*e.g.*, silicates and pH). Membranes must be serviced, typically by backflushing. They do have a finite life, related to the actual use and contact with cleaner chemistry.

Cleaning Evaluations

Each trial of a cleaner filtration system should include a thorough evaluation for compatibility and effect on the cleaner itself. In some filtration applications, a portion of the detergents and surfactants might be removed. To what degree and to what result should be considered. Standardized soak cleaning tests of the cleaner before and after filtration should be conducted. Operating parameters should be consistent. The test should include, if possible, the parts themselves or the oils that are to be removed. Cleaning effectiveness can be determined by: observation of water breaks (before and after a post-acid dip), use of a black light, immersion copper on steel, plating test for adhesion and appearance, among other methods.

If the treated cleaner requires, by analysis, an addition of the concentrate, will this maintain desired cleaning? Maybe periodic adds of a detergent/ surfactant concentrate is required. The cleaning evaluation is a good fit for the suppliers of cleaner and filtration equipment to coordinate their efforts.

Depending on the cost allocation for cleaning and waste treatment, the economic feasibility of selecting the right cleaner filtration system can be determined by the user. It makes practical sense to filter the cleaner to remove oils, grease and metallic particles. With the growing push toward waste minimization, some type of filtration can be readily justified. In itself, the application of filtration is increasing because of recovery procedures, such as closing the loop. There are several cleaner filtration options available to meet targeted investment and desired effectiveness.

Finishing Trivia

- One of the biggest headaches for nickel platers was solved in the 1920s. Gas pitting was eliminated by the addition of wetting agents. These additives lower the solution surface tension, significantly wetting the plated surface, causing hydrogen gas bubbles to slide off.
- Chromating is a preferred coating over aluminum before painting. It's the way to pass MIL C-5541-D (168 hr nss)
- How might one distinguish a chloride zinc deposit from a cyanide or alkaline type? Strip each deposit separately in 30–50 percent hydrochloric acid. Sufficient wetter co-deposits in the chloride zinc deposit, resulting in a foaming acid. P&SF