SVC Topics

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PVD Processes: Cleaning Lines

A cleaning line comprises a sequence of procedures that complement each other, resulting in a surface that is cleaned to the desired level. Cleaning lines may be manual, where parts are transferred from one step to the next by an operator, or automated, where the movement of the parts is automatic and pre-timed—or they may be a mixture of the two.

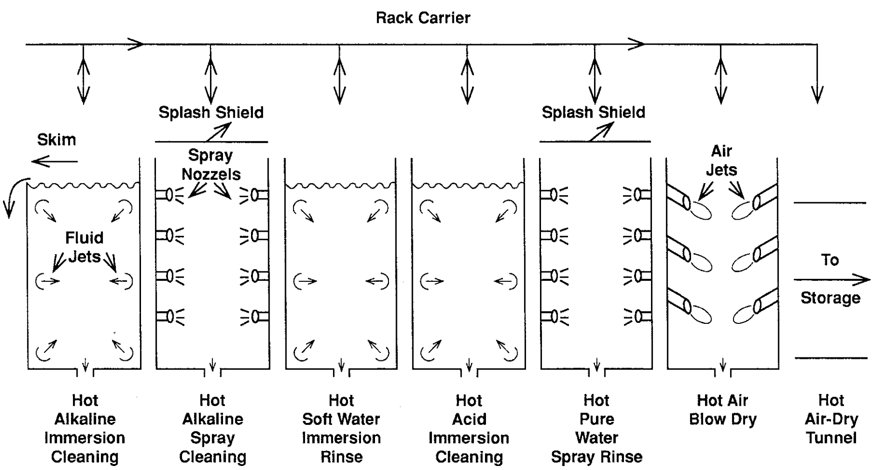
Racking the Parts

In some cases, the parts to be cleaned may be held by special cleaning fixtures (racks). Parts must be placed (or "racked") on these holders and then removed from the racks after cleaning. In other situations, the cleaning rack is also used as the deposition fixture. This has the advantage that only the fixture has to be handled in transferring the parts from the cleaning line to the deposition system. A disadvantage, however, is that the racks usually have to be stripped of deposited film before they can be used for cleaning again. In some cases, the cleaning line is integrated into the deposition line, to eliminate handling or storage between the cleaning sequence and the film deposition process. More commonly, however, cleaned parts are handled, stored and transported—either individually or in their fixture—after the cleaning operation.

Cleaning & Rinsing

Figure 1 shows a typical tank-type cleaning line using aqueous alkaline cleaning applied both by immersion and spraying; both spray and immersion rinsing and hot-air blow drying. Immersion cleaning with agitation and perhaps brushing is often effective in removing exposed contaminants. In some cases, ultrasonic agitation is desirable. Care must be taken that ultrasonic cavitation does not adversely change the substrate surface by fracturing brittle materials or micro-roughening of ductile materials. Electrocleaning can be incorporated into the alkaline cleaning tank. If there is appreciable oil contamination, the first tank should be equipped with a "skimmer," or it should use overflow to skim the surface so that the parts are not extracted through an oil film when they are lifted out of the tank. One advantage with spray cleaning and rinsing is that "hideouts," such as cavities, are continuously drained and refilled, whereas in immersion cleaning, the cavities fill with fluid, which can become stagnant in that region. Spray pressure should be as high as possible without damaging the substrates or knocking them loose from the rack. It may be helpful to mechanically move the parts in each step to aid in cleaning and draining.

Parts should not be allowed to dry between steps. This means that the transfer between tanks should be as rapid as possible, and the air above the tanks should be humid. In some cases, the cleaning line should be enclosed in a plenum to obtain better control of the environment surrounding the cleaning line. The plenum can be solid and have doors or a "soft wall"—made of plastic sheets or strips—to allow access to the cleaning line at any point. It also can be slightly pressurized with clean, filtered air to further control the cleaning environment.



- Fluids agitated by fluid jets
- Mechanical movement of parts in tanks
- Fluids continuously recirculated and filtered for particulates and organics
- Alkaline electrolytic cleaning can be used instead of alkaline immersion cleaning
- Ultrasonic agitation can be used in fluid tanks

Fig. 1—Typical tank-type cleaning line for parts mounted on a rack.

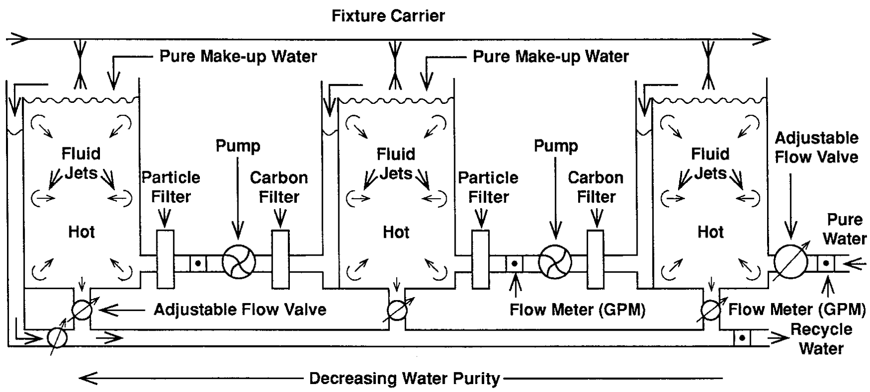


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Fig. 2—Cascade (or counterflow) rinse tanks.

Rinsing is important at several stages of cleaning. Rinsing between cleaning steps prevents drag-out of chemicals from one cleaning step to the next. This rinsing step can often be done with "soft water" rather than pure or ultrapure water. The final rinse should use pure or ultrapure water. Pure water is produced by membrane filtering with reverse osmosis. Ultrapure water uses ion exchange columns to lower the ionic content of the water below that achieved by reverse osmosis, along with carbon filtering to remove organics and mechanical filtering to remove particulates. One key to effective rinsing is to use copious amounts of water. Some method of recycling the rinsewater is therefore desirable.

Ultrasonic agitation can be used in any of the fluid tanks. Ultrasonic power should be about 100 watts per gal of fluid. For some materials, care must be taken when using ultrasonics, because prolonged high-power ultrasonic cavitation can fracture the surface of brittle materials and deform, erode and micro-roughen the surface of ductile materials. These surface features can then affect film growth and resulting film adhesion.

When the cleaning requirements are very stringent, it may be better to use "cascade" or counterflow rinsing. A cascade rinsing arrangement is shown in Fig. 2, where three rinse tanks are utilized with increasing water purity. Parts move from the lowest- to the highest-purity tank, and the water between each stage is filtered. Activated carbon is used to remove organics, and mechanical filters are used to remove particulates.

The condition of the water in each tank is monitored by measuring the ionic conductivity, which is controlled by the flow of water from the previous tank and the amount of pure or ultrapure make-up water used. It should be noted that the conductivity measurements do not indicate the presence of organic or particulate contaminants, which can build up in the system if they are not removed by filtering.

Drying—The Final Step

The last step in the cleaning line is drying, which ensures that there is no significant amount of undesirable residue on the surface. In the cleaning line shown, drying is achieved by blow-off with hot air, along with movement of the parts to allow draining from the hideouts. The parts can be further dried on their way to the storage or unracking area through a low-humidity hot-drying tunnel. Drying can also be accomplished using an enclosed vapor dryer. This is particularly useful when there are hideouts that retain water by capillary action.

After drying, cleaned parts should be stored and transported in a manner that does not unduly recontaminate the parts. This is achieved by incorporating the cleaning line into an in-line deposition system—a common practice when coating mirrors and architectural glass panels. P&SF

Powder Coating Commentary

Continued from page 55

As you can tell, I believe that preparation means much more than getting the part ready for painting. Preparation, to me, means the quality of the finish is "prepared" at each step of the finishing process.

On a closing note, other commentary in this issue—from columnists or expressed in various advertisements—will concern what is available and/or new in stripping. Whether it is part reclamation or rack stripping, the trend in the industry that is gathering momentum is a move away from dangerous chemical and salt stripping, as well as away from batch or continuous burn-off technology. Aside from the labor and cost issues, residue remaining on the parts plays a tremendous role in a typical plant's pretreatment and cleaning costs—not to mention often contributing to surface contamination.

Feel free to drop me a line at Doryan@compuserve.com and we can see if your technology is right for you ... or what might be better.

Hope this helps in looking at your preparation techniques, and gives you something to think about. See you next month. P&SF