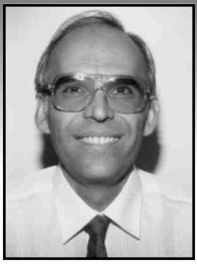

Finishers' Think Tank

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Rinsing: More is Better . . . Less is Better

This month we review the practice of rinsing. There are several ways to accomplish adequate rinsing, matching the operation to preferred surface conditioning. Which is best for you? By considering the limitations (cycle, shape of parts, geometrical racking orientation, barrel or basket loading, temperature, requirements, what to remove, step in the cycle, etc.), we can design it to be simple or complex.

For me, simple but effective is the path of least resistance, affording the best success. There's no need to make it a complex issue. Resolve the problems, utilize the operating parameters, maximize the cycle, and finish those parts. This is July—it's hot and dry in many parts of the U.S. Let's go to the well, refresh ourselves, and determine the best rinsing route to take.

The Rhyme of The Ancient Mariner in part exclaims: "water, water everywhere, but not a drop to drink." In the metal finishing industry, we may consider this a reminder that water is a most treasured commodity and raw material, not to be wasted. This is especially true with regard to usage limitations, hazardous wastes, and permissible limitations of dissolved metals and other contaminants. Water is unique, and can be found in three forms: solid, liquid and gas. As Ralph Kiner taught us some years ago, "two-thirds of the earth is covered by water, the other third is covered by Bake McBride." As metal finishers, our industry would certainly dry up without sufficient quality water. Perhaps the National Academy of Engineering put it best by rating water supply and distribution as the fourth greatest achievement of the 20th century (right behind the airplane). Let's consider some important aspects and issues with regard to rinsing. Not a treatise or complex examination—just the facts for a practical approach to quality rinsing.

To rinse means to dilute and remove surface films or contaminants. It's a dynamic process of washing the surface, conditioning the part for the next treatment step, and polishing the final finish before drying. There are probably more rinse tanks in a given cycle than process baths. Yet rinsing can be seriously overlooked. Some critical factors are: water contamination, mechanical agitation, magnitude, temperature and time. The following points can make rinsing easier, yet more effective. The application can be plating, painting, chromating, anodizing, oxidizing, or any number of metal finishing processes.

- Dial in a dilution ratio of at least 1000:1 to provide a good start to effectively remove and dilute soils off the surface.
- A double rinse is more beneficial than an equal time spent in one rinse.
- Quality rinsing *improves* with increasing rinse water temperature. Too hot won't help. But the ideal water temperature should be 75-85°F (24-29°C). In a few months well water and city water entering the plant may be as low as 35°F (2°C)! Many plating deposit hazes and adhesion problems occur in winter and magically disappear in the spring. Residual cleaner films and soaps are more readily soluble in warm water. Cold water may cause these materials to gel and become tacky on the surface.

Warm the rinses in winter? Reminds me of the fellow working at a factory during a particularly cold spell in Alberta, Canada. Early in the shift the boiler broke down, causing the plant's work floor temperature to rapidly drop. Management sent everyone home for the day. A few hours later, this fellow answered a rap on his apartment door. It was the landlady, seemingly scared out of her wits. Asking what's wrong, she handed him a slip of paper on which was written the message, "The heat's on, we're sending someone over to get you."

- Yes, warm the rinses in winter. Does the plant have steam waste? Baking ovens? Other sources of heat being channeled around the plant? Consider some extra use of this heat to take out the big chill. If the heat's not on, rejects may be coming after you.

- Parts themselves shouldn't be too hot either. The infamous dry-on stains occur when the cleaner is sufficiently hot enough that water evaporates off the surface, leaving a film of cleaner and any diluted soils. Simple water rinsing will not dissolve the film. Acid dipping only solidifies it. The TLFs (three limiting factors) should be defined and fine-tuned: time, temperature, and concentration of the cleaner. The particular cleaning application is a reasonable guide to what your specific TLF should be. Some benefits of the cleaner choice include magnitude of alkalinity, liquid or powder, and whether silicates are required.
- A rinse tank with little or no water inlet flow or plugged outlet gets more contaminated as the amount of surface area passing through increases. Basically, sufficient turnover of rinsewater is a simple visual check. Avoid: cloudiness, water discoloration, floating oil and grease residues (*e.g.,* gasoline spots in water). A more sophisticated but accurate method is to measure water quality by its conductivity. Conductivity of the water increases as the concentration of ionized salts increases. As these salts become more concentrated, rinsing effectiveness decreases. At some value of conductivity, quality of rinsing will be detrimentally affected. This is overcome by using water's conductivity as an effective ally in rinsing. A special probe measures the electrical conductivity of water as related to the concentration of dissolved salts. The calibrated probe can be set to automatically open a valve, adding fresh water until a preset minimum conductivity measurement is achieved. Two benefits are: minimizing water use and readily maintaining desired quality of rinsing.
- Decide if a single rinse station or multiple rinses best meet the requirements of conditioning the surface between steps. One dip is a good start. But one dip, followed by exit and re-immersion in the same rinse tank once or twice is better yet. Or, mix it up by mechanically agitating that single rinse. There is a better chance of fresher water continually bathing the surface. Circulation by pump or eductor is very effective. Air agitation, although good, doesn't provide as effective agitation as the previous examples do.
- Counterflow rinsing (CFR) is a popular and very effective method to improve rinsing quality while minimizing water usage. CFR can be two or more tanks in line, operating as one unit. Let's consider rinse tanks 1,2 and 3. Rinse 1 immediately follows a nickel plating tank. Rinse 3 solution reconstitutes rinse 2, which in turn reconstitutes rinse 1. Rinse 1 is added back to the nickel plating tank to make up for water evaporation from the heated solution and drag-out of plating solution. By evaluating the effect of CFR on contaminant dilution, tanks 2 and 3 may provide a contaminant dilution ratio range of 30–40 : 1. These are certainly great odds, considering the fresh water investment is not much.
- Sometimes a single rinse tank or one of a set may spray exiting parts. This is certainly helpful, especially to accommodate process lines that place a premium on space. Fog nozzles are even better, because the mist tends to dilute and wash contaminants off the surface better than a pressure water spray, but does not minimize the benefits of pressure spraying as long as the projection of water is aimed over all of the part surface area. Be careful to not over/under-spray or waste the water. Fog nozzles also save on water use. When used correctly, pressure sprays and fog nozzles also cool parts, preventing dry-on stains and reducing drag-out of solution.
- Drips and drabs can be a source of problems that are sometimes overlooked. Sometimes the rinsewater solution level is not sufficient to fully immerse the parts. Obviously, the non-rinsed sections may result in dried-on films or contaminant solution bleed-out. Haze, mis-plates or other related finishing defects can be expected. Visually adjust water level, or install an automatic valve that will accurately maintain desired rinsewater level.
- Gravity encourages solutions to flow downward. Deep recesses and blind holes tend to keep them in. Racked parts suspended over a tank encourage solution drainage or seeping from the top rows to the bottom parts. The old saying rings true: "First out, last in." Practical corrective measures include: spray or fog nozzle, adjust geometry of parts to improve drainage, re-immerse parts after initial exiting from the rinse solution, or alternate hot and cold rinsing. The last option induces a favorable pumping action to push contaminant solution out of deep recesses and blind holes. There is one other corrective measure. Design of the part should always include considerations for the intended finishing process. The shape or placement of recesses and holes could be included to facilitate easier handling and optimized metal finishing.
- Ion exchange has become very popular in some finishing operations. Water can be purified

by removing dissolved salts and heavy metal ions. This water can be reused many times.

- Evaporators can boil water, concentrating contaminants as precipitated or concentrated solutions. Reclaimed water is reused.
- De-ionizer units provide low-conductivity, high-resistivity water for cleanliness, rinsing quality, and to prevent spotting and stains on parts before drying.
- Rinses, especially after cleaners, may include an overflow dam. This outlet will collect grease, oils, froth, solids and other contaminants. Design it right and maintain it right. Excessive water flow, outlet, or a too-small dam are design flaws that will reduce the efficient operation of an overflow dam.
- Post-hexavalent chrome process bath rinses should include a chrome reducer, such as sodium metabisulfite. This eliminates staining and dried-on chrome films, and improves rinse-off of chrome solutions.
- Cyanide-containing baths such as copper and brass are known for solution bleed-out and formation of checkered deposit films. The alternate hot & cold rinses as described previously are very helpful to force these solutions out of recesses and difficult-to-rinse sections.

Rinsing challenges us to use water efficiently and with conservation in mind. Certainly, saving water lowers operating expenses and may keep some finishing operations within a desired water-use level with the local POTW or related government water authority. Perhaps the most important aspect to water conservation is pollution control itself. As less is used, demands on waste treatment become more relaxed. Rinsing is an art and a science. It's a very important step before any process bath treatment. There are many practical ways to maximize it: handling of the part and its design, mechanical agitation, equipment applications, chemical treatments, TLF, maintenance, and basically understanding the process. Keep rinsing simple, yet effective. As the unknowing customer requested of the finisher: "Dip it and make it look new again." Conserve water so we can all enjoy water sports during the hot summertime and still be able to maintain green lawns and shrubbery. P&SF

Finishing Facts

- Kronsted is credited with discovering nickel metal in 1751. Nickel was initially referred to as "false copper."
- The first useful nickel plating bath was introduced by a German chemist in 1780. The solution made use of nickel sulfate and ammonium chloride.
- Introduced by Dr. O.P. Watts in 1915-1916, the Watts nickel bath is the most popular and widely used of the nickel bath formulations.
- Schlotter followed Dr. Watts in the 1920s-1930s by developing organic nickel deposit brighteners.