BY STEPHEN D. TEMPLE, RANSOHOFF

Cleaning you can count on

Traditional aqueous parts-cleaning operations work great on day one, but rapidly become contaminated. Adding an ultrafiltration process to a parts cleaning system can dramatically extend and improve its performance.

Traditional aqueous parts-cleaning operations can be inconsistent and costly. Machine shops and contract manufacturers dealing with a range of contaminants and heavy contaminant loads are finding they need something more. In many cases, adding an ultrafiltration (UF) system to an existing parts cleaning system can provide cleaner parts as well as dramatically lower maintenance and operating costs.

This is not to say that traditional systems cannot be effective in certain situations. For example, a shop can realize good bath life and part cleanliness when primarily cleaning with non-emulsified oils and when the system's cleaning chemistry can effectively split the oil to the surface of the parts bath. This splitting allows removal via conventional oil skimming or decanting methods. (A typical industrial parts washer includes a wash stage where most contaminants are removed, followed by rinsing and drying stages. Newer systems may include only a single-stage wash with dry off.)

However, a more likely scenario for most shops and manufacturers is that they are dealing with water-soluble oils, emulsifiable fats and oils and a high level of fine particulates. In these cases, conventional oil skimming and particle filtration methods are not sufficient to maintain solution bath integrity and achieve optimal cleaning. The result is that metalworking operations start out on day one with fresh water and a new chemical charge to create the cleaning solution. Assuming the parts washer is functioning properly, they will initially have clean parts, but cleaning performance quickly degrades until parts are no longer being cleaned effectively. At that point, usually after 1 week, a tank dump, refill and chemical recharge are required (Figure 1).

All images: Ransohoff

Deerfield Manufacturing installed a 360 gal./day UF system that effectively turns over its wash tank every fourth day.

This is an inefficient and inconsistent process, particularly for operations that must meet stringent parts cleanliness specifications, such as in Six Sigma manufacturing systems. Continuous dumping and recharging of the cleaning fluid also adds considerable cost to the process. Replacing a full charge of chemistry, reheating the solution and associated labor costs add up quickly (see sidebar on page 52).

Tank dumps are required when the

cleaning solution is contaminated with excessive levels of emulsified or soluble oils and fine particulate. No amount of chemistry can overcome an oily cleaning solution. Traditional parts cleaning systems often filter and remove nonemulsified oils and particulates from 50 to 100 microns. Unfortunately, this is not sufficient to maintain consistent part cleanliness.

Today's manufacturing operations must meet three key objectives: part quality, cost efficiency and process consistency. The typical aqueous cleaning process does not deliver on any of these objectives.

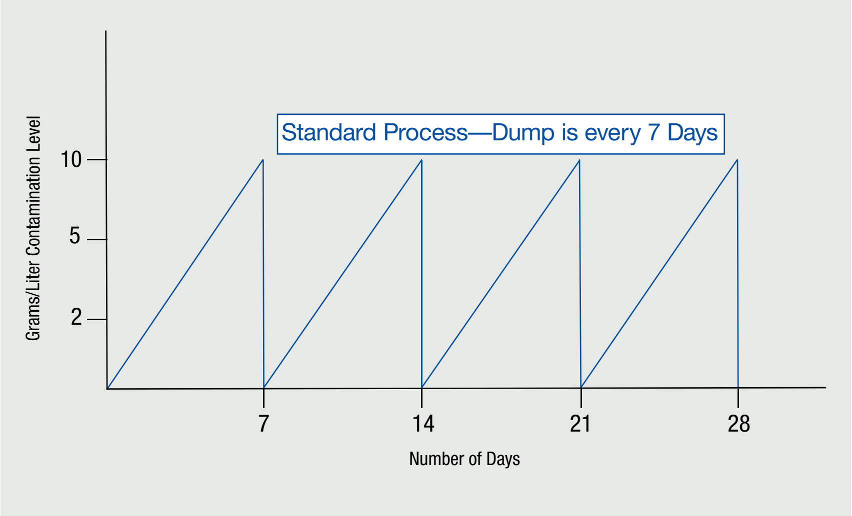

Figure 1: Typical aqueous cleaning process without ultrafiltration.

What's the Solution?

Ideally, an initial cleaning solution charge remains stable, requiring only periodic chemical concentration checks and additions. This goal is achievable by implementing a properly designed UF system. Most UF systems require a fluid to pass through a polymer membrane under pressure or via vacuum action, returning the cleaned fluid back to the system. In many cases, UF devices can be retrofitted to an existing parts-cleaning system. For small- to medium-sized applications, UF systems have footprints from 4 to 8 sq. ft.

Some end users might be skeptical about UF systems. They may have heard about or experienced UF system failures, primarily due to premature fouling of the filtration membrane. Some operations have experienced fouling in less than one shift of operation. Once a UF membrane is fouled, it must be taken out of service and cleaned. At worst, the UF membrane has to be replaced.

However, many types and styles of UF membranes have been proven effective at removing emulsified oils and fine particulate from parts washer solutions to a level of 0.05 microns and are not prone to premature fouling and failure. UF system suppliers should be able to guarantee at least 4 weeks between cleanings. Some suppliers have installed systems that operate for 6 months or more between cleanings.

Also, in a well-designed system, users should expect to replace the membrane at least annually, though membranes in many applications have gone far longer before replacement. Membrane cleaning or replacement is relatively simple, and shops can typically handle it on their own after training. New membranes cost from $500 to $1,500 each.

One of the primary challenges for parts washer filtration systems is the different types of contaminants that end up in the system depending on the parts in production, workpiece materials and coolants used. Contaminants include a range of cutting, forming, stamping or drawing fluids used during manufacturing. In addition, particulates can include chips and lapping grit from machining processes. It is vital to select a UF membrane that can handle these different types of contaminants.

Three Key Considerations

There are three key variables in a UF process: water quality, chemical recyclability and chemical compatibility.

Water Quality: Untreated municipal potable water, or tap water, cannot be used to feed and replenish the solution

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Deerfield cuts parts cleaning costs by 85 percent

Deerfield Manufacturing Inc., Mason, Ohio, produces stamped and drawn automotive sheet metal components. The company's previous aqueous parts cleaning operation was costly to operate, required frequent operator intervention and created quality problems.

Process Engineer Joe Carter wanted to improve the quality and consistency of the company's parts cleaning operation while reducing operating costs. Deerfield operated a dual-stage aqueous parts washer with two 1,200-gal. tanks. The system processed a high volume of heavily contaminated parts, and both tanks had to be dumped and recharged weekly. Every Sunday, a maintenance technician (being paid overtime wages) dumped the tanks, cleaned out the system, refilled it and added a full charge of chemistry (approximately 40 gal. each) to the two tanks. Since Deerfield does not have in-plant waste treatment, it paid a waste hauler 25 cents/gal. to dispose of the wastewater. Weekly system operating costs were nearly $2,000 (Table 1).

Table 1: Weekly Costs Without Ultrafiltration

Spent solution haulage, 2,400 gal. @ 25 cents/gal.	$600
Chemistry to recharge two tanks, 80 gal. @ $8.45/gal.	$676
Premium-time labor expense, 8 hr. @ $55/hr.	$440
Utility cost to reheat cleaning solution and water usage	$225
Total weekly expense	$1,941

The continuous dump and recharge routine cost Deerfield more than $100,000 annually while producing an unacceptable level of part cleanliness quality and consistency much of the time. Deerfield looked at several alternatives and ultimately purchased a Waste Wizard point-of-use UF system manufactured by GE Osmonics, Minnetonka, Minn., which was retrofitted to Deerfield's existing parts cleaning system. Deerfield purchased the UF system from Ransohoff, Cincinnati, which also installed it.

The Waste Wizard incorporates a spinning disc antifouling device with a patented UltraFilic pancake-style membrane. It is integrated in a small package for mounting directly on top of a 55-gal. drum, which also serves as the concentration tank.

Deerfield Manufacturing required a 360 gal./day UF system that would effectively turn over its wash tank every fourth day. The filter's spinning disc minimizes membrane fouling while producing positive filtration down to 0.05 microns. The installed cost of Deerfield's UF system was $14,000, but it has extended bath life by a factor of eight or more, with the company dumping its tanks every other month instead of every week. (Deerfield's bath life could be further extended with the purchase of a similarly sized UF system for its rinse tank or a larger UF system turning the tank over every day). Deerfield already had its own in-plant reverse osmosis water supply. Had Deerfield needed to add an in-line RO filtration system working off in-plant line pressure and producing 15 gal./hour (rated for its UF system), total system cost would have increased by about $2,500 to $3,000.

Deerfield's annual parts cleaning operating costs decreased from more than $100,000 to $15,000 (Table 2). The UF system paid for itself in less than 3 months and has eliminated the operation's part cleanliness quality problems.

Table 2: Annual Cost Savings with Ultrafiltration

Spent solution haulage reduction, 105,000 gal. @ 25 cents/gal.	$26,250
Reduced chemical usage, 3,500 gal. @ $8.45/gal.	$29,575
Premium-time labor expense reduction, 350 hr. @ $55/hr.	$19,250
Utility cost and water usage savings	$9,845
Total annual savings	$84,920

Solution recycling with ultrafiltration, like that used at Deerfield, is a proven, reliable process. It can solve key quality and cost problems associated with parts cleaning at many metalworking operations.

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bath in a UF parts cleaning system. Use of tap water will lead to excessive buildup of minerals and hard water salts in the solution that not only damage the UF membrane, but also negatively affect cleaning chemistry, part quality and system maintenance.

In traditional parts cleaning, bath water is dumped each week, so using hard water is generally not a problem. However, in a recycling-based parts cleaning process, where the cleaning solution is not dumped for 6 months or more, hard water is a serious problem.

A typical parts washer bath has an evaporation rate of up to 10 percent and possibly more for each 8-hour shift. Minerals and hard water salts don't evaporate, so each gallon of makeup water makes the problem worse. It doesn't take long for the bath to be overcome with a high level of total dissolved solids (TDS). This can compromise system operations, from filter maintenance to parts cleaning effectiveness. Problems typically start once the parts cleaning bath reaches a level of 1,400 ppm TDS. Water from a typical untreated municipal water supply is in the range of 250 to 350 ppm TDS.

As a result, UF parts cleaning operations require high-quality water, such as reverse osmosis water or deionized water. Many UF packages include filtration systems that convert municipal water into RO or DI water.

Chemical Recyclability: The second key variable in an effective UF system operation is using a chemical solution that is truly recyclable (able to pass intact through membranes with pores at least 0.05 microns in size). If the chemical solution is not recyclable, the UF membrane will filter out key constituents of the cleaning chemistry, requiring continuous additions to maintain proper concentration and chemistry integrity. This defeats one of the primary benefits of solution recycling—reduced chemical usage.

One such recyclable chemistry is Ever-Cycle Ultra, produced by Ransohoff. This product will pass fully intact through a 0.05-micron membrane. Other suppliers produce similar products. The chemical components of these specialty formulas are, in most cases, well-guarded trade secrets.

Also, an ideal UF system chemistry should produce a protective coating on the membrane surface. This can prevent premature fouling and extend membrane life. The coating properties of these chemistries provide the membrane with an ultraslick surface, which helps prevent contamination from adhering to and ultimately fouling the membrane surface. Ever-Cycle Ultra is one of the chemical products that can produce this coating.

Keep in mind that there are situations in which a specific cleaning chemistry may be necessary to achieve process objectives and that chemistry may not be recyclable. If this is the

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case, an end user should probably seek other filtration alternatives because UF will not work effectively.

Chemical and Process Compatibility: The third key consideration for UF systems is chemical and process compatibility. Not all cleaning chemicals are compatible with UF membranes, and different UF membranes require different chemistries. Also, most membranes only operate effectively within certain pH and temperature ranges.

Most traditional parts cleaning systems use alkaline-based cleaners with a pH range from neutral (7) to alkaline (11). For UF system cleaners, chemistries in the neutral to near-neutral range are the most effective. They typically cost about twice as much as conventional chemistries on a per gallon basis. However, in systems that recycle their cleaning fluids, chemical usage can be just 10 percent of that required by traditional cleaning systems. As a result, despite higher initial costs, shops and manufacturers can realize significant chemistry cost reductions by using UF systems.

Keep in mind that cleaning chemicals must be compatible with UF membranes. The typical membrane can withstand pH ranges between 3 and 10 and temperatures up to 140° F. However, there are metallic membranes available that can withstand virtually any pH and temperature. They are considerably more expensive than traditional UF membranes, though.

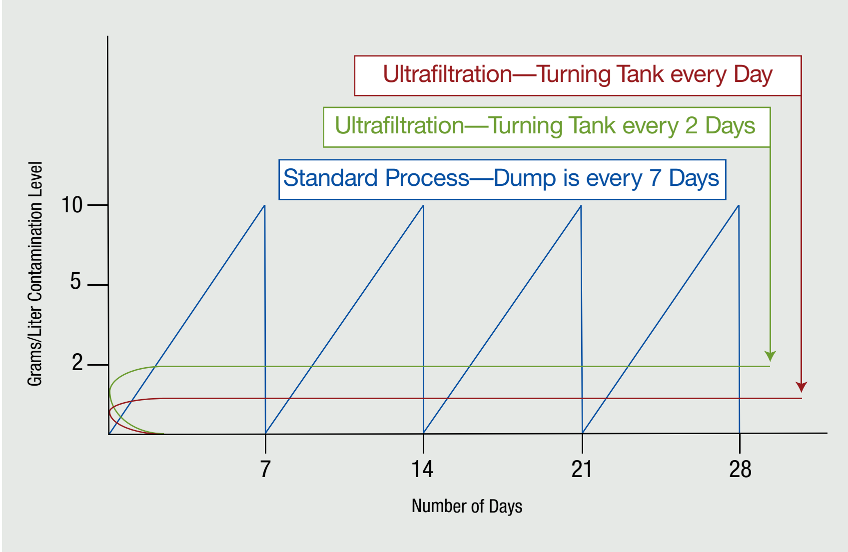

Figure 2: Comparison of contamination levels in a typical aqueous cleaning system and a cleaning system with UF.

Selecting the Right System

An effective, industrial-scale UF system for use in a typical aqueous parts washer usually costs between $8,000 and $35,000. Prices vary depending on the size of the system, the type of membrane used, and if prefiltration or incoming water treatment is required. Some areas of the United States have municipal water that does not require pretreatment. Also, shops and manufacturers would be well served to select a UF system supplier that extends a "try it before you buy it" arrangement or provides a written performance guarantee.

While considering any UF system, potential buyers should ask the following questions:

- Is the UF membrane compatible with the soils and contamination level of my specific application?
- Is prefiltration required, and is it included in the purchase price?
- How often will the wash tank need to be turned over? This will dictate the size of the system. (Turnover is the amount of time it takes to run the entire contents of the wash tank through the filter.)
- What is the recommended time between cleanings?
- How often will the membrane need to be replaced, and what is the replacement cost?
- What is the expected level of solution clarity?

Figure 2 shows the impact a successful UF installation can have on a parts cleaning process. Tank dumps can be virtually eliminated or, at a minimum, greatly reduced. Chemical and utility costs are significantly lower (see sidebar on page 52), and most importantly, a shop or manufacturer has a consistent process that continuously produces the same high level of part cleanliness, eliminating contamination spikes.

Parts cleanliness—typically measured in total residual particulate weight, particle size or level of organics left on the parts—will most always be improved with the addition of a UF system. This, combined with the lower operating and maintenance cost inherent in a UF system, make them a smart investment for many types of metalworking operations.

About the Author

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