Is Your Ultrasonic Cleaning System Living Up to Its Potential?

Some guidelines about ultrasonic cleaning equipment and performance.

The use of ultrasonic cleaning equipment to clean or degrease parts has gained wide acceptance over the years in all types of industries. And some systems have made significant advancements. Not only does the ultrasonic method provide economic and quality advantages, also the superior cleanliness it produces can mean that items look better, perform better, and require less frequent subsequent cleaning.

In recent years ultrasonic cleaning has become an indispensable tool for industrial users, including automotive, aerospace, food & drug, utilities, electronics and semiconductors cleaning - anywhere degreasing or getting the debris and contaminants out of passages and crevices is needed, or where like-new surface appearance is beneficial.

At the same time, some performance questions frequently occur among users who have an ultrasonic cleaning system, and those who are considering the purchase of one.

"While there are few specific rules for benchmarking the performance of an ultrasonic system, there are some general considerations regarding the overall need for a new system, or evaluating the day-to-day performance of your present system," says Frank Pedeflous, president of Omegasonics Ultrasonic Cleaning Systems (Simi Valley, CA).

How do I know when it's time to advance to ultrasonic cleaning?

If you are evaluating whether to switch to ultrasonic cleaning, you also need to evaluate how you are cleaning the item(s)-in-question now, and what are the results. Results can be measured in terms of the labor, time and cleanliness of the workpieces you are cleaning now. It can also be measured in terms of safety – the risk via exposure to solvents and other harsh chemicals that may be harmful to workers and the environment.

In a majority of instances ultrasonic cleaning is much more efficient and cost-effective than manual cleaning or other methods of degreasing. Pedeflous recounts a recent instance when his firm performed a comparison for a bottler who had an employee working solely on cleaning filler valves with a powerful acid. This manual work required him to suit-up and wear heavy gloves to clean the valves with a brush. Because there were so many of these relatively intricate valves to clean, the man put in extensive overtime.

"We brought in an ultrasonic unit and proved that the task could be accomplished better, much quicker and with no exposure to the caustic solvent," Pedeflous says. "So, it not only made good economic sense, it also removed a safety issue."

How do I know what size of ultrasonic cleaner is best for my operation?
Pedeflous advises those who are thinking of purchasing ultrasonic systems – either for the first time, or an additional unit – to talk with suppliers who carry a full range of equipment sizes and models.

"In many instances an operation can do fine with a tabletop model at one or more locations. That gives them production flexibility," he says. "In other applications, feature –rich models with capabilities such as 'set-and-forget' tanks may help boost productivity.

In terms of applications, ultrasonic cleaning systems are used to cleanse or sanitize a wide variety of items that are sometimes intricate, require precision or are delicate, such as jewelry or surgical instruments. Of course, the technology is also highly effective in cleaning more robust items such as components used in automotive, marine, aerospace, and other industrial applications.

Why aren't my workpieces getting as clean today as they did yesterday?
"The usual answer to that question is: Something has changed," says Pedeflous. The change, however, is not always found at the cleaning station, he adds. Once temperature, chemical concentration and all other cleaning parameters have been ruled out, the search

should proceed to consider changes in the manufacturing steps. Common sources of problems include changes in lubricants, manufacturing processes, and even raw materials. Clogged filters, misdirected coolant nozzles and improper machining or finishing practices may also cause ultrasonic cleaning problems. Remember, a change that may be considered inconsequential to the manufacturing process may result in less effective cleaning - until the necessary adjustments are made.

How much ultrasonic power does your cleaning tank require?

The right amount of ultrasonic energy (usually expressed in watts/gallon) depends on the size of the cleaning bath and the difficulty of the cleaning requirement. Tanks in the one- to two-gallon range often provide up to 90 watts per gallon of ultrasonic power, plenty for most jobs, even cleaning out the ultra-fine passages of fuel injector nozzles.

“Achieving the same cleaning effect in larger tanks requires less energy density,” advises Pedeflous. “Excellent cleaning has been demonstrated in tanks having 50 gallons capacity with only 25-30 watts per gallon. The more difficult the application, the greater energy density is required for effective cleaning.”

On the other hand, too much ultrasonic power may result in cavitation erosion occurring on delicate or highly polished parts that are near the transducer-radiating surface. Cavitation is the formation and collapse of low-pressure bubbles that can pit the surface of metals. Aluminum, copper, brass and other soft metals are especially susceptible to cavitation erosion.

What is "degassing" and why is it important?

Degassing is the process of removing small, suspended gas bubbles and dissolved gas from a liquid prior to using it for ultrasonic cleaning.

“Unless you remove the dissolved gas, it can migrate into cavitation-bubbles during their formation,” says Pedeflous. “This prevents the bubbles from imploding correctly, which

reduces the cleaning effect. Also, the gas bubbles will absorb ultrasonic energy, reducing the ultra-sound cleansing intensity inside the tank."

Liquids should be degassed by raising the temperature, adding the cleaning chemistry, and operating the ultrasonic energy for a period of time ranging from 10 to 15 minutes minimum (depending on the size of the tank and the nature and concentration of the chemicals being used) prior to use. When completely degassed, small bubbles will not be seen rising to the liquid surface during ultrasonic operation.

Will ultrasonic cleaning damage electrical components?

If you regularly clean electronic parts, an ultrasonic electronics cleaner is the best tool for the job. The common concern is that ultrasonic cleaners will destroy delicate components. However, advances in ultrasonic technology have eased this concern by replacing the single frequency wavelength approach—known to harm electronic parts—with a variable frequency approach, called "sweeping." This advance in ultrasonic technology has not only led to reduced production costs, but has proven to enhance reliability, thus reducing warranty costs as well.

"When electronic parts are immersed in an ultrasonic cleaner, cleaning occurs wherever the liquid makes contact with the parts. Higher ultrasonic frequency can penetrate smaller openings and remove tinier particles. Since the liquid reaches into small crevices and cavities that are impossible to clean manually, ultrasonic cleaning electrical assemblies and electronic components is an ideal approach," explains Pedeflous. "Furthermore, today's advanced ultrasonic cleaning equipment is designed to prevent 'part resonance' – the internal agitation of parts due to recurring harmonic vibrations - that otherwise might damage more sensitive items."

Ultrasonic cleaning of electronic components has become more efficient while improving product reliability, resulting in reduced warranty and replacement costs.

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