Introduction to Ultrasonic Cleaning For Manufacturing
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Imagine it’s World War I and you’re aboard an Allied submarine, silently cruising the dark, murky depths of the Atlantic. The crew is on edge, uncertain if an Axis sub is within striking distance. Yet all are acutely aware of the mission and lives at stake.

Now, picture the remarkable transformation of underwater combat strategy and survival thanks to the invention of the *hydrophone*: a transducer device capable of both receiving and transmitting sound underwater. These underwater microphones enabled submarine operators to track an enemy U-boat by the sound of its propellers, detonate an explosive, and sink it.

American, French and British scientists first used the hydrophone as a passive listening device during World War I to detect icebergs. It wasn’t long before the Anti-Submarine Detection Investigation Committee realized that this tool—ASDIC, which evolved into SOund NAvigation and Ranging technology or sonar—could also be used for detecting the presence of enemy submarines. The ability to “ping” ahead for underwater hazards became a game-changing advantage during battle.

But how does sonar work, and in what other ways has it benefited society?

*Source: www.theleansubmariner.com*
What is sonar technology

Although science is constantly finding exciting new uses for sonar technology, these acoustic signals are nothing new. They’ve always been nature’s navigation system, used by mammals like bats, whales and dolphins (and even by insects like cockroaches) to dodge obstacles, find food and interact socially.

*Source: www.askabiologist.asu.edu/echolocation

Sonar is the technique of sending longitudinal sounds waves traveling through the mediums of gas, liquid or solid. If the sound waves have a frequency well above a human’s normal range of hearing, they are known as ultrasonic waves. When ultrasonic waves pass through water, for example, their returning echoes can be observed to identify submerged objects such as an enemy submarine.
As the waves travel, they vibrate in the same direction of travel. Ordinarily, when something vibrates, it creates sound. However, since ultrasonic waves have frequencies above the normal range of hearing for humans, we cannot hear them—making them an undetectable, stealthy tool.

Between World War I and II, the use of ultrasound in battle inspired scientists to explore a variety of ways humankind could benefit from the technology. Important (and lifesaving) uses include medical imaging and diagnosis, and detecting structural flaws and fatigue in various structures and materials. High-intensity ultrasound, in particular, has been making waves for a variety of significant applications, one of the most versatile being ultrasonic cleaning.

**An accidental breakthrough**

One of the first known—and quite accidental—instances of using ultrasonic technology for cleaning purposes occurred in New Jersey in the early 1930s. While cooling the internal components of a radio by using Freon, lab workers at the Radio Corporation of America (RCA) noticed the intriguing phenomenon of a wave action surrounding a crystal that was operating at 300 kHz. However, it would be 20 more years before ultrasonics were seriously pursued and developed as a legitimate cleaning method.
How does ultrasonic cleaning work?

In the simplest terms, ultrasonic cleaning involves the use of high-frequency sound waves (about 40 kHz, which is above the range of human hearing) to remove a variety of debris from items that are immersed in a tank filled with a specially formulated, aqueous cleaning agent. The basic components of an ultrasonic cleaning system are an electrical generator, ultrasonic transducers, and a tank of cleaning solvent. The leading tank designs in the business feature heavy duty, all stainless-steel construction and come in a variety of shapes and sizes, from one to 200+ gallons.
In the ultrasonic cleaning process, turbulence in the liquid is created by vibration and “cavitation.” The primary cleaning mechanism is the energy released through cavitation. The bubbles are so tiny they are not visible to the eye, yet when each bubble collapses, it creates a huge shock wave on a microscopic level and a powerful cleaning action that removes dirt, grease, oil, and more.

Although cavitation offers unparalleled ability to deliver exceptional cleaning results on any surface area the cavitation bubbles can reach, it could have the ability to etch and damage softer materials when not used appropriately. Thus, using ultrasonics as a cleaning tool requires checks and balances, such as choosing the correct detergent, reducing cleaning timeframes, and minimizing power intensity levels with certain substrate, to name a few or increasing the ultrasonic frequency as needed. Proper education, preparation and monitoring of the step-by-step cleaning process are essential for success.
**Pros and cons of the process**

Besides damage that may occur from extended exposure to cavitation, part surfaces may be affected by standing waves caused by alternating highs and lows of acoustic energy present at 1/4 wavelength intervals, about one centimeter at 40kHz. The result would be alternating spots every 1/2 wavelength as a result of more or less intense cavitation. Most modern systems avoid this by continually changing or “sweeping” the frequency to prevent the standing wave.

**Thorough Cleaning**

In the big picture of ultrasonic cleaning technology, the pros far outweigh the cons. Ultrasonic cleaning is inherently gentle, considering there are no harsh solvents, vigorous scrubbing or high-pressure spraying involved. As cleanliness tolerances and non-solvent cleaning specifications are becoming more stringent, ultrasonics are ideal for effective cleaning of tiny cracks and crevices that other cleaning methods can’t reach.
Saves Time
Using ultrasonic technology also saves time. The high-frequency wave action removes oil and debris faster than other cleaning methods. Parts of all types can be dried, reassembled and returned to duty more quickly, also improving productivity.

Versatile Cleaning Process
Versatility is another advantage of the ultrasonic cleaning process. Somewhere in the timespan between World War I and today’s teens blasting music through oversized headphones, scientists determined that ultrasonic technology is an effective tool for use in a variety of industries and products, including:

- Machined parts
- Surgical instruments
- Musical instruments
- And much more

Additionally, ultrasonic technology removes practically every contaminant possible:

- Oil
- Dirt
- Dust
- Rust
- Grease
- Algae
- Fungus
- Pigments
- Lime scale
- Blood and other bio contaminants
- And more
Optimization for maintenance plants

Ultrasonic cleaning continues to make its way into different facets of industry and industrialization, and comes as a great gain when presented to manufacturing plants and facilities. Many of the industries today that have incorporated ultrasonic cleaning into their manufacturing process include automotive, electronics, aerospace, medical, metal processing, and many more. Manufacturing companies have optimized their plants in several different ways using ultrasonic technology.

**Precision Cleaning.** When compared to other methods of cleaning, ultrasonics is the superior choice when it comes to a precision and uniform clean. Spray-wash cabinets do well at removing surface dirt, but cannot reach into crevices of parts or equipment. Hot tanks melt away grease and grime, but are not reliable when it comes to getting a consistent clean every time. With ultrasonic cleaning, the vibrating molecules and non-toxic detergents can reach all area of any part or piece of equipment, while guaranteeing a consistent and thorough clean. Parts being produced may also undergo the ultrasonic cleaning treatment, and there never has to be concern over whether a part goes out to a client or customer being anything less than immaculate.
Reduced Maintenance. With ultrasonic cleaning, not only is it precise, but it is fast and efficient, as well as easy to operate. After filling an ultrasonic tank with the proper cleaning solution and placing the parts safely in via a basket, the ultrasonic transducers will do the rest of the work. This allows time to take care of other tasks while the ultrasonic cleaner does its job. Ultrasonic cleaners don’t require you to stand over a bath and hand-scrub and brush every inch of surface on a given part or piece of equipment. As well, you keep your equipment running longer and more efficiently after an ultrasonic clean. Any parts a facility needs to clean before packing and delivering can be cleaned at an excelled rate. Ultrasonic cleanings’ fast and efficient work can move product lines along quicker than before.

Reduced Cost. Thanks to ultrasonic cleaning, parts and equipment get cleaned more thoroughly than any manual clean could do. This leads to longer periods of time in-between cleanings, as well as a reduction in equipment failure due to dirty and under-maintained parts. Any parts a facility makes to be distributed also benefit, and with less returns or complaints due to a client receiving something not up to standards, your bottom line won’t be affected. As well, costs for safety equipment, protection systems, hazardous material disposal, etc. may be eliminated as ultrasonic cleaners use non-toxic solvents and require little clean-up afterwards.

Investment in Equipment. When using ultrasonic cleaning for equipment and parts being produced, not only will the life of that machinery or product be extended, but any machinery associated with it. Better cleanings means increased reliability, less cross contamination, more thorough removal of organic debris, and more. Whether it comes down to less reliable equipment, or having to replace broken parts faster than expected, a consistent ultrasonic cleaning can help preserve equipment far beyond the normal lifespan. Cleaner parts also show clients and customers that the manufacturing facility they do business with only provides the best and most pristine products. Less repair costs, little to no downtime fixing broken equipment, machinery that lasts, and a higher quality of assurance for your clients is what you receive when using an ultrasonic cleaner.
Although the overall cost of ultrasonic parts cleaning has dropped dramatically, cheaper is not always better, so use caution when selecting cleaning and lubricating solutions. Make sure they are specifically designed for the equipment being used and that the dilution ratio has not made the concentration too weak. Proper cleaning of parts and equipment also requires the correct power level, frequency and more.

Beyond this general introduction, and before investing in this high-tech and helpful equipment, it’s important to research the process and read the instructions to prevent unsatisfactory cleaning results or damage to machined parts.

For more information on industrial ultrasonic cleaning systems including those designed for industrial and machined parts, visit Ultra Sonic Power Corporation at www.upcorp.com or call the experts at 1-800-575-0168.
To learn more, contact the professionals at

**Ultrasonic Power Corporation**

[www.upcorp.com](http://www.upcorp.com)

1-800-575-0168