

A Guide to Ultrasonic Cleaning

by
Technowash Ltd

Aqueous Washing &
Degreasing Equipment
Specialists

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Introduction to Ultrasonic Cleaning

Ultrasonic Cleaning is a highly effective precision cleaning process, which delivers a quick, safe, consistent and exceptional standard of cleaning.

The very nature of ultrasonic cleaning ensures it is a powerful force, which can clean both hard to reach areas such as blind holes and complex internals as well as remove ingrained surface contaminants such as paint or wax. Yet it is a cleaning method which is gentle on component parts, and is most suited to cleaning small, delicate and intricate parts that cannot stand the aggressive action of other cleaning methods such as spray washing.

The versatility of ultrasonic cleaning means it is used for a wide range of component parts throughout many different Industries, including:

Medical and Dental Laboratories:

- Orthopaedic Implants
- Dentures
- Surgical Instruments
- Syringes
- Optics Laboratory Equipment

Automotive and Aerospace Industry:

- Switches
- Bearings
- Assemblies
- Metal and Plastic Parts
- Relays & Motors

Scientific Laboratories:

- Lab Glassware
- Tubes
- Pipettes
- Degassing liquid

Electronics Industry:

- PC Boards
- Packing Components
- Capacitors
- Micro-Electronic parts

Other

- Jewellery
- Brass Clock parts
- Watches
- Musical Instruments



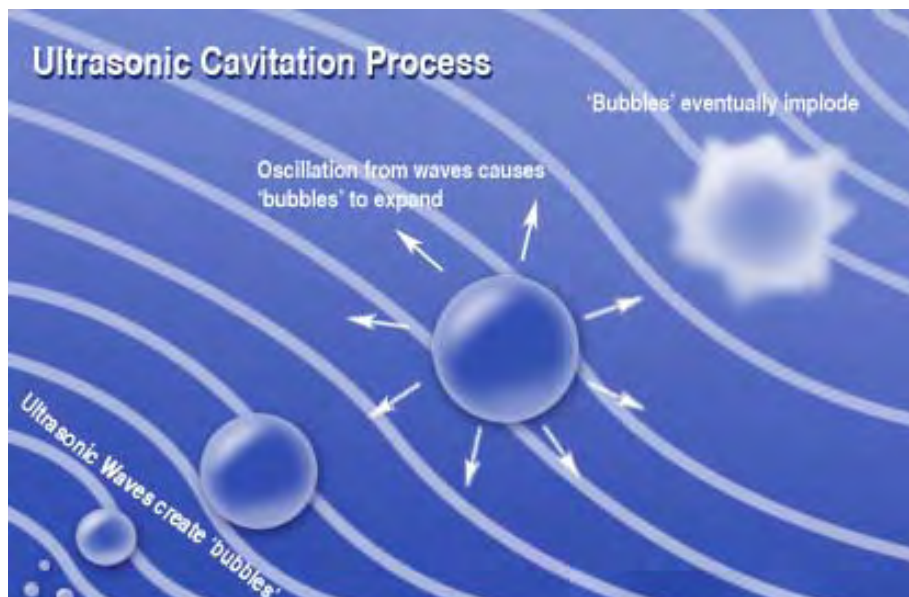
What is 'Ultrasonic'?

Ultrasonic cleaning technology is based on sound waves. Any frequency of sound wave, which exceeds 18 kilohertz, is considered to be ultrasonic. Typically the frequency in an ultrasonic cleaning tank is between 20Khz and 80Khz.

A sound wave is produced when a solitary or repeating displacement, is generated by a sound conducting medium, such as a vibratory movement. When high amplitude levels of sound waves are placed in liquid, a negative pressure is created. If continuous, this negative pressure will eventually build up to such a level that the liquid will fracture. This is known as cavitation. During the ultrasonic process millions of cavitation 'bubbles' are created in this way.

The cavitation 'bubbles' are oscillated in the liquid as the sound wave passes. This in turn causes a build up of positive pressure, which makes the cavitation 'bubbles' become unstable. Eventually the positive pressure causes the violent collapse of the cavitation bubbles, which results in implosions, and shockwaves radiating from the collapsed 'bubbles'.

It is this collapse and implosion of the millions of cavitation 'bubbles', throughout the ultrasonic tank, which is the foundation of ultrasonic cleaning technology.



How does it work?

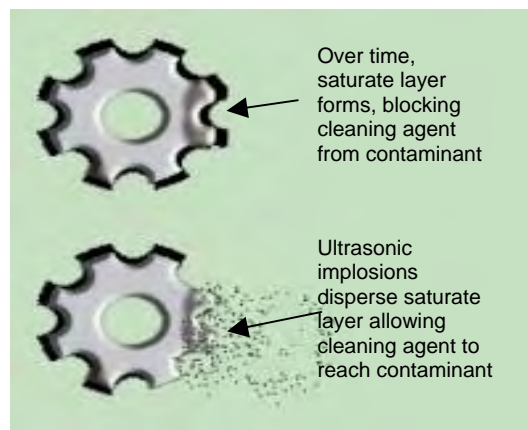
Removal of contaminant from any type of component is achieved either via dissolution (for soluble contaminants), or displacement (for insoluble contaminants). The process of ultrasonic cleaning is an extremely effective aid during both these processes.

The dissolution of contaminant

In order for soluble contaminant to be dissolved from the component part, it must be in constant contact with the cleaning agent. However over a period of time, the strength of the agent can become weakened and a saturation layer can form, acting as a barrier between the contaminant and the cleaning agent.

The ultrasonic implosions are highly effective at displacing the saturation layer, and thus allowing fresh cleaning agent to reach the contaminant.

In this way, ultrasonic cleaning is capable of speeding up dissolution processes and is especially beneficial when cleaning irregular surfaces or component internals.



The displacement of contaminant

Where contaminants are insoluble (such as surface dust), it is vital that all cohesive forces, formed between the contaminant and the component are sufficiently broken down to allow the contaminant to be removed.

The ultrasonic implosions are of such a force that they are incredibly effective at displacing and removing insoluble contaminants. The micro size of the cavitation 'bubbles' ensures that they can clean hard to reach areas such as hinges, screw thread and valves.



Ultrasonic Equipment and Applications

All ultrasonic cleaning equipment consists essentially of an ultrasonic generator, and ultrasonic transducers. The ultrasonic generator supplies the electrical energy at the required frequency, whilst the ultrasonic transducer converts the electrical energy into the mechanical vibrations.

There is a wide range of ultrasonic equipment available, varying in capability and additional functions, making them a versatile choice for a wide range of cleaning processes.



Ultrasonic cleaning is used throughout a vast number of industries, and for a wide range of cleaning applications. It is most often used for components, which have one or more of the following criteria:

- Parts requiring a high precision clean.
- Delicate parts which need a gentle cleaning action
- Intricate parts often with complex internals
- Parts which require a deep clean
- Components with ingrained contaminant such as paint or wax.



Types of Ultrasonic Equipment: Bench Top Ultrasonic Cleaners



Bench top ultrasonic cleaning tanks, are small compact units, which consist of a simple heated ultrasonic tank. These ultrasonic units are ideal for cleaning a wide variety of small and intricate parts, and typical applications ideal for these tanks, include:

- Jewellery cleaning
- Micro Electronics
- Optic Laboratory Equipment
- Intricate Castings.
- Brass clock part cleaning
- Dental Surgery Equipment
- Surgical instrument cleaning
- Electronic assembly systems
- Small machine components

Technowash Ltd offers the 'Cleanex' range, which is a compact and simple to use range of bench top cleaners varying in tank size from 8ltrs to 28ltrs.

All ultrasonic tanks are manufactured entirely from stainless steel, which makes them robust and also durable.

The heater element is manufactured from silicon rubber foil, which ensures oxidation and corrosion is prevented. A temperature controller for the heater is provided on the control panel, as well as a cycle timer, which allows the operator to pre-set the exact cycle time required.

The ultrasonic frequency generated is between 28-40kHz, and this is controlled via a three-way switch, which allows the operator the flexibility to choose either 50%, 75% or 100% power dependant on the application. The ultrasonic transducers are high efficiency piezoelectric with special ceramics.

Other standard features of this range include the stainless steel mesh component basket, low fluid level protection and a gravity fed drain tap.



Types of Ultrasonic Equipment: Standalone Ultrasonic Cleaners

Standalone ultrasonic cleaning tanks are the next size of ultrasonic cleaning tank available and are ideal for cleaning small to medium size parts. The units (as with the bench top cleaners), are suitable for a wide range of industries, and are exceptional at removing all type of contaminant including:

- Oils,
- Swarf
- Polishing compounds,
- Brazing flux
- Solder flux
- Carbonised deposits
- Moulding residues



Technowash Ltd offers the 'Cleanmax' range, which is a range of standalone units that vary in tank size from 25ltrs to 160ltrs.

All ultrasonic tanks in the range, are manufactured entirely from stainless steel, which makes them robust and also durable.

The heater elements are manufactured from silicon rubber foil, and heating power ranges from 1000 watt to 4000 watt.

The ultrasonic transducers, are high efficiency piezoelectric type with special ceramics. The ultrasonic frequency ranges from 28 to 40kHz, and HF power rating goes up to 4000/2000 watt.

The control panel features a temperature controller, 3-way ultrasonic power switch, and cycle timer. It is available as either a digital panel or analogue panel.

As with all Technowash Ltd ultrasonic units, the Cleanmax range comes with a two year warranty,

Typical applications include:



Surgical Instruments



Automotive Parts



Brass parts



Lab & Veterinary Bottles



Aerospace parts



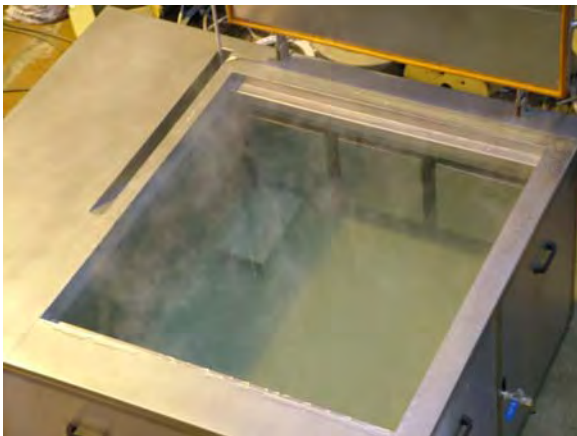
Types of Ultrasonic Equipment: Multistage 2- Wash & Rinse Stage (with optional Dry)

Multistage Ultrasonic cleaning equipment, allows the versatility of having an ultrasonic wash stage followed by a rinse facility, and for some applications, the option of a drying stage.

The heated ultrasonic wash stage removes all type of contaminant including oils, swarf, polishing compounds, brazing flux, solder flux, carbonised deposits and can even strip paint or wax.

Parts are then transferred into a heated immersion rinse facility, which removes all traces of the cleaning solution.

If required parts can then be transferred into a drying stage, which ensures that all components leave the machine clean and dry.



Heated Ultrasonic wash and mains rinse tanks

The Technowash Ltd range of Multiclean 2 machines vary in tank size from 40ltr to 160ltr. Constructed entirely from 316 grade stainless steel, the units are manually operated with baskets being easily transferred from one stage to the next.

The heating capacity of each tank ranges from 0.75kw to 2kw, and is controlled via the digital display control panel. The ultrasonic frequency ranges between 28-40kHz, and transducers are high efficient piezoelectric type with special ceramics. Ultrasonic power is controlled via the 3-way selector, and there are also fluid and air digital control process cycle timers as part of the control panel.

The machine comes with a wide range of optional extras including, oil weir, spray bar and pump arrangement, oil water separation, DI water rinse, auto fresh water refill, auto detergent dosing, effluent disposal pump and fine inline filtration.



Types of Ultrasonic Equipment: Multistage 4

For cleaning applications that require an exceptional high precision clean, there is the option of a fully integrated multistage ultrasonic wash, which can incorporate up to four separate stages or more. Stages can vary dependant on the cleaning application but typically can include some or all of the following:

- Pre-wash stage with spray jets for heavy duty cleaning
- Ultrasonic Wash
- Heated Mains Rinse
- DI Rinse
- Single Hot Air Dry or Double Capacity Hot Air Dry

The Technowash Ltd range of Multiclean 4 machines vary in tank size from 40ltrs to 160ltrs.

They suit a wide range of cleaning applications typically for aerospace, automotive, electronics and other industries.



Optional extras on the Multiclean 4 machines include:

- Oil Weir Spray Bar & Pump Arrangement.
- Automatic Process Sliding Lids
- Rim Type Steam Extraction
- Upgraded Ultrasonics Package
- Compressed Air Fluid Agitation
- Air Powered Basket Load/Unload Platforms
- Oil/Water Separation
- Ultrafiltration Units
- Fine Inline Particle Filtration



Types of Ultrasonic Equipment: Fully Automated Systems

Advanced automated features incorporated as part of the multistage ultrasonic equipment has the potential to save money by reducing labour and overall running costs.



Automated features of the Technowash Multistage 4 range include auto load/unload stations to ensure that components are loaded as smoothly as possible, a PLC controlled overhead basket transfer system which uses a special basket recognition feature to move baskets from one stage to another. Tank lids are fitted with an automatic sliding function to ease basket loading, and the whole process is continuous which reduces labour costs, and increases throughput.



Automated tank sliding lids



Types of Ultrasonic Equipment: Submersible Units

Submersible ultrasonic transducers, are freestanding ultrasonic units, which can be fitted to new tanks, or retro-fitted to existing cleaning equipment. Offering the ultimate in ultrasonic flexibility, any number of submersible units can be fitted, and can be placed in varying positions in the wash tank. Additionally because they are free standing, they can also be moved from tank to tank if required.



With either base or side mounted fixings



Ultrasonic submersible unit and generator

Technowash Ltd offers the Mobilclean range, which are hermetically sealed modular stainless steels submersible ultrasonic units, which range from 8 ultrasonic transducers up to 24, offering a maximum HF power rating of 3000peak/1500.

The transducers themselves are all high efficiency piezoelectric type with special ceramics, and are available with either base or side mounted fixings.

The control panel options are either digital or analogue and all units come with a two year warranty.



Can include up to 24 transducers



Ultrasonic Cleaning - FAQ

How do I achieve the best ultrasonic clean?

The best ultrasonic cleaning results are achieved by ensuring all the variable factors have been considered. This includes ensuring you have the right type of equipment, size and capability for the application in hand. It is also essential that the temperature of the fluid tank, the cleaning solution, and the process cycle time have been optimised, and that maximum cavitation intensity can occur by degassing the fluid tank.

What is 'degassing' the fluid tank?

Degassing is the removal of gases, which are present in the solution. Maximum intensity of cavitation can only occur, once the liquid in the tank has been degassed.

How do you 'degass' the ultrasonic tank?

Degassing should be done after the chemical has been added to the tank. It is achieved by switching on the ultrasonic energy and raising the fluid temperature. 'Degassing' is complete when the small bubbles of gas stop rising to the surface of the fluid tank, and there is a pattern of ripples. Time varies dependant on the tank capacity size.

What is a piezoelectric transducer?

A 'piezoelectric' effect is where certain materials change dimension when an electrical charge is applied to them. In the case of piezoelectric transducer, the piezoelectric element is located inside the transducer. When the electrical energy is then applied to the transducer, the element vibrates and this then becomes amplified as it is then directed through the fluid.

How do I know if cavitation is occurring properly?

There is a simple test called the 'foil test'.



Ultrasonic Cleaning - FAQ

What is the foil test?

Ensure that the tank is at the required operating temperature, has been degassed, and filled with the correct amount of fluid and cleaning solution. Then, using a piece of aluminium foil, suspend the foil in the tank. Turn on the ultrasonics and leave for approx ten minutes. Remove the foil and inspect. If cavitation is occurring the foil should be perforated and wrinkled. Try this in different places in the tank to ensure cavitation is all over.



Foil following cavitation

Why is fluid temperature important?

Heat not only aids the degassing process, but it also enhances and speeds up the actual cleaning process. Additionally most detergents are designed to work best at elevated temperature.

Which cleaning solution should I use?

Technowash Ltd has a large range of aqueous based detergents specifically designed for use with ultrasonic cleaning. Please contact us for more details.

How often should I change the cleaning solution?

Cleaning solution should be changed if there is a noticeable difference in cleaning results, or when the solution is visibly dirty.

What is the recommended cycle time?

Process times vary depending on the application and the level of contaminant. All Technowash Ltd machines are supplied with fully adjustable process cycle timers.



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Technowash Ltd

Technowash Ltd is one of the UK's largest independent manufacturer and supplier of aqueous based degreasing equipment and ultrasonic cleaning equipment. We are based in Northallerton, North Yorkshire, and our customer base reaches across the UK and Europe.

The ultrasonic equipment we supply covers the full range including bench top ultrasonics, standalone ultrasonics, fully integrated multistage ultrasonics systems, automated systems and submersible units.

We also manufacture and supply a comprehensive range of spray wash degreasing equipment including single and multi stage top and front loading spray washers, conveyerised type spray washers, rotary spiral drum systems, immersion washers and manual hand wash units.

We are able to offer our customers a unique bespoke service, and tailor make machines and component cleaning packages to suit individual requirements.



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