ULTRASONIC CLEANING MAGIC: BASICS AND PITFALLS

by
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Every day dive operators face the daunting task of cleaning and maintaining gear that is being used in harsh, unforgiving environments. One of the easiest and most effective ways to clean small parts from scuba regulators, valves and other dive gear is by means of ultrasonics. Also, in this era of burgeoning TEK diving, ultrasonic cleaning well may be the best method to routinely produce certain oxygen-clean materials used in that discipline. Yet relatively few dive businesses employ ultrasonics at the present time. So we must ask: Why?

The answer is probably in two parts: (1) Most dive technicians simply are not fully aware of the versatility and effectiveness of ultrasonic cleaning, and (2) they are put off by the cost of the machine and related supplies, unconvinced that they will get their "money's worth." Conversely, if you ask any technician who has invested in this paraphernalia, he/she invariably concludes: "How did I ever get along without it!" They all praise the amount of time saved and the degree of cleanliness achieved by this technology.

Ultrasonics (also called "hydrosonics" or "sonics," for short) are high frequency sound waves which create alternating high and low pressure waves within a suitable cleaning solution. With as many as 40,000 cycles per second occurring, millions of microscopic vacuum bubbles form which then violently implode upon any material placed within the cleaning solution. This process, called cavitation, literally blasts the material into a state of immaculate cleanliness, at least 10 times better than can be achieved by manual methods.

The secret to efficient and successful ultrasonic cleaning of dive gear involves three important factors: (1) A suitable ultrasonic machine, (2) a fairly aggressive acidic solvent, and (3) use of a special technique employing interchangeable pans which allows a variety of additional solvents to be used quickly and effectively. Today's marketplace offers a variety of ultrasonic machines for cleaning everything from false teeth to auto parts. It is important to select a unit with a sufficiently large tank to handle the items to be serviced and with adequate power to do job within a reasonable time frame. (These prerequisites usually eliminate most cleaners used for dentures or jewelry.)

Global Mfg. Corp. exclusively sells the ultrasonic machines produced by the L & R Mfg. Company, and has done so for almost 20 years. This is an importa nt fact because it means the GMC technical staff is thoroughly familiar with the ultrasonic paraphernalia we sell, its performance level, and its specific application for cleaning scuba equipment. We normally stock and feature two ultrasonic cleaning machines that have a long and successful track record in the dive industry, but a wide variety of additional types and sizes are available from L& R.

GMC's #43070 (Q-90) has a stainless tank that will handle the largest scuba regulator or valve body and has sufficient power (160 watts) to clean most parts within 10-20 minutes. Model 2014 (GMC #43050) has a much larger pan, capable of handling multiple regulator or valve parts at one time. Moreover, this unit is somewhat unique in that its transducers (320 watts) are especially tuned to create vibration patterns that penetrate into cavities and recesses. This is truly beneficial for the cleaning the internal bores and crevices so common to regulator and valve components. In general, the watt-power of cleaners is not terribly important because the amount of ultrasonic power generated is roughly proportional to tank dimensions. Therefore, the net cleaning ability among various machines is quite similar.

However, cleaning efficiency can be effected by tank size. If one overfills the tank with materials to be cleaned, the effectiveness can be decreased by the overcrowding. Likewise, if few items are placed in a very large tank, the time required for cleaning may be somewhat increased. The moral here is to select a tank size that can readily hold the items you wish to sonicate, but not so large that there is a disproportionate relationship between tank size and the mass of the materials to be normally cleaned!

Nothing is more important for successful ultrasonic cleaning than the proper solvent! Contaminants deposited by aquatic environments will not be removed unless a moderately acidic solvent is employed. Most commercially available ultrasonic cleaning chemicals have proved to be worthless on saltwater residues. Manufacturers of ultrasonic wares have traditionally shied away from producing acidic solvents in fear (and rightly so) that they would attack the machine itself. GMC spent three years developing its Hydrosonic Solvent (#43101) to ensure it would not dissolve metallic components of the system, while still actively attacking salt-and-hard water residues or similar pollutants. To our knowledge, it is the only truly successful solvent available for this unique purpose. It can be readily recognized by its lime green color. Unfortunately, because of its acid content, Hydrosonic Solvent is classified by the DOT as a HAZMAT material and is assessed special handling / HAZMAT fees for domestic transport, and cannot be shipped outside of the USA.

A common and expensive mistake made by newcomers to the world of ultrasonics involves the assumption that solvents approved for general regulator and valve cleaning can also be used in ultrasonic machines. In most cases, these chemicals are far TOO AGGRESSIVE for that purpose and will attack the machine or accessory items within a few months. For example, GMC's Regulator Cleaner #43190 is NOT approved for ultrasonic machines and can seriously damage them if so used. If acidic fluids perforate the cleaner's main pan, the liquids drain directly into the underlying electronics, which may prove fatal to the entire apparatus.

Another common mistake involves using concentrated solvents that must be precisely diluted before use. A human tendency to experiment with (or foul up) dilutions often leads to disastrous results within the cleaner machine. For these reasons, GMC's Hydrosonic Solvent is formulated to the correct strength and is used as purchased; no dilutions or alterations are required. Because most commercial solvents are so poor for scuba-cleaning purposes, some technicians have attempted to create their own "home-brews." While this can be done successfully with certain limitations, in many instances it can also lead to a destroyed machine! When or where no suitable solvents can be obtained, GMC can advise you about formulating suitable home-brews.

Another aspect of selecting an ultrasonic cleaning system is the warranty, if for no other reason than the fact that cleaning scuba materials requires the use of rather harsh chemicals that have the potential to damage the machine and accessories. While most warranties are voided by careless operation or the use of "outrageously harmful chemicals," it's worth investigating what latitude any warranty may offer. For example, the machines sold by GMC have a complete 2.5 year coverage on parts and workmanship, 5 years on the housing, and 10 years on the transducer bonding. Our field experience indicates that the L & R Company is very objective about repairing machines which have damaged been under questionable circumstances!

Solvents employed for cleaning should be changed periodically as they lose their activity or become discolored / contaminated. How often to renew them depends on multiple factors that are discussed more fully in GMC's "Ultrasonic Operations Manual" that accompanies each unit we sell. In general, except in some oxygen-cleaning processes, most solvents have good longevity. For example, GMC's Hydrosonic Solvent can be periodically clarified by passing it through a coffee filter-paper and reused until its activity eventually dissipates.

Another important fact that is poorly understood and often over-looked, is that many different solvents can be used for specific cleaning purposes in a single ultrasonic cleaner. Most technicians think that switching solvents must involve the messy task of draining the cleaner's main tank each time one wishes to use a different fluid. NOT TRUE! It so happens that ultrasonic vibrations are transmitted without significant loss from one liquid to another even when passing enroute through a metal or glass container. Therefore, if the machine's main tank is filled only with water, the vibrations will transmit through this water into any container of liquid solvent placed within it. The only trick required is to add some dishwasher wetting agent to the water to break the surface tension. Without this agent, the cavitation process can be drastically compromised.

The wetting agent therefore "activates" the water for optimal sonic operations, creating a so-called "carrier-bath." Now any vessel containing an active solvent and dirty parts can be set into this carrier bath and will be effectively sonicated. (Preparation of carrier-baths is fully discussed in GMC's "Ultrasonic Operations Manual".) Thus solvents can be stored in auxiliary stainless pans or Pyrex glass vessels and used in the carrier bath at will. (Plastic pans / baskets should NOT be used, since they tend to absorb sonic energy.) Popular solvents include alkaline degreasers for oxygen cleaning, diluted alcohol for rubber parts like O-rings, or plain soap for many plastic items. An additional safety benefit is derived if your acidic solvent is used in this manner: if it should ever perforate the container, only that auxiliary receptacle and the carrier bath are ruined, not the machine's main tank and the underlying electronics! This is especially important if home-brewed solvents are being used, since their long-term effect on metal containers is rather unpredictable.

Parts to be cleaned are generally put into mesh or perforated metal baskets that in turn are placed into the pan of solvent. This effectively suspends the parts within the cleaning fluid so that cavitations can hit every surface of the material. Parts should NEVER be placed directly onto the bottom of the solvent pan because the cleaning process will be greatly hampered.

Ultrasonic cleaning does have it's limitations. Occasionally extremely dirty or encrusted dive gear may be encountered. Examples of such items would be equipment used for months in salt water without adequate rinsing, or regulators from divers who retrieve golf balls from ponds where the bottoms are covered with organic residues. Direct ultrasonic cleaning of such items may require extended treatments resulting in immediate and thorough contamination of the solvent. Extremely dirty items should be first "pickled" for a few minutes in a suitable regulator cleaner like GMC's #43190. This pretreatment usually removes much of the concretion and will often loosen any remaining residue so that the subsequent ultrasonic process will yield a "squeaky-clean" product.

Not all materials can be safely cleaned ultrasonically. In fact, absorbed vibrations may harm some plastic polymers and elastomeric rubbers. Using the correct solvents, ultrasonics will remove most grease, stains, salt-water residues, light rust and concretions, oil, and dyes from metals, ceramics, glass, rubber, many plastics and synthetic fibers. Always consult the manufacturer's repair manual or call their technical service when doubt about the compatibility of a given part with ultrasonic treatment.

In years past, technicians were prompted to buy ultrasonic cleaners with built-in heaters that warm the solvents in the main tank, thereby enhancing the chemical activity of the cleaning fluid. Because most commercial ultrasonic solvents were, and remain, ineffective for cleaning scuba materials, technicians hoped for better results with heated solvents. Today , expensive heated units are no longer necessary and are probably undesirable for a number of reasons: (1) Solvents like GMC's Hydrosonic Solvent do not require heating for effective operation. (2) The alkaline degreasers so effective for oxygen-cleaning are destroyed at temperatures over approximately 120° F. (3) When set-in auxiliary pans are used, a long time is often required for both the underlying carrier bath and the cleaning fluid to become warm. If only the carrier bath is heated, the set-in solvent is not enhanced in any way. (4) Certain solvents, especially acidic ones, may give off of obnoxious fumes when heated.

Oxygen-cleaning via ultrasonics is highly effective and simple to do. A number of readily obtainable alkaline degreasers can be diluted and employed for this purpose. GMC's #42100 is one such degreasing solvent and #43101 Hydrosonic Solvent is an excellent solvent for pre-treating metals for oxygen cleaning. Super-clean materials can usually be produced in less than 20 minutes. Oxygen cleaning is discussed in more detail in GMC's "Ultrasonic Operations Manual" supplied with each machine as well as in GMC's "Converting Dive Tanks for Oxygen Service" bulletin.