

Updated list of the high-tech applications of ultrasonic technologies

The most recent list of the most popular traditional and emerging high-tech ultrasonic technologies includes industrial, technological and scientific applications of ultrasound, as follows:

1. **Sonocrystallisation.** Ultrasonically accelerated and stimulated, micro and nano crystallization (or sonocrystallization), and forced, fast precipitation of solid minerals from liquids.

Applications:

1° Extraction. High intensity sonication of organic and inorganic content, mixed with certain liquid, will stimulate and accelerate extraction of ingredients useful in pharmaceutical and food industry (for producing specific medicaments and food ingredients). Homogenous liquid solutions with pharmaceutical or nutritive biological and mineral content can be ultrasonically forced to crystallize, agglomerate and precipitate precious particles (this way separating liquid from solid phase).

2° Water purification. (1) For instance, if we take sea, salt water (which has many minerals and it is not potable), ultrasonically (and using innocent powder additives) we can directly create sufficiently purified water, which will be OK for agricultural applications (like irrigations). (2) From ordinary, healthy, potable water we can eliminate almost all minerals like calcium etc., by applying specific ultrasonic radiation and producing forced Sonocrystallisation...

3° Water conditioning. (1) In thermoelectric power plants (also nuclear, electric power plants) and big boilers of any kind, we can make ultrasonic water modification (conditioning based on sonocrystallization), producing effects that hard mineral layers will not be created on heaters, heat exchangers and boiler walls... practically separating and precipitating hard particles content from water. Water purified on such way (equivalent to certain demineralization by acoustic means) is even able to attack old, existing scaling and hard mineral layers, already created on boiler walls and heat exchangers, meaning that such (acoustically-modified) water is chemically active and performing cleaning, "eating", destroying, or dissolving solid formations from boilers and pipelines. (2) Water polluted with radioactive particles can be forced by sonocrystallization to precipitate radioactive and other particles, and to enable separation of relatively (or sufficiently) clean water from mud phase which has radioactive content.

(3) Also significant application of Sonocrystallisation is to sonicate water towers and water reservoirs in order to eliminate minerals scaling and to repel, suppress and stop bio flora, algae and bio films formations.

To see ultrasonically assisted Sonocrystallisation in action please visit:

http://www.mastersonics.com/documents/mmm_applications/liquids_processing/sonochemistry_and_cavitation/Orchid-Sonicator/. For another way of inline, flow-through water processing by using our Clamp-On ultrasonic reactors please see the following presentation: http://www.mastersonics.com/documents/mmm_applications/big_and_thick_masses_agitation/engine-block-atomizing/

Sonocrystallisation related publications can be found here:

http://www.mastersonics.com/documents/mmm_applications/liquids_processing/sonochemistry_and_cavitation/Sonocrystallization/

2. **Extractive Metallurgy.** Ultrasonically optimized and enormously accelerated extractions of minerals and metals from natural raw materials. **1°** Example: accelerated extractions of gold and platinum from sand and granite stones, or from waste materials and ores remaining after ordinary (old fashion) mining. Mineral (organic and inorganic) extraction could be accelerated until 1000 times... **2°** Ultrasound is also good for medical or pharmaceutical

extractions from plants and other materials... This is the field of Sonochemistry... (most of known chemical reactions can be optimized and accelerated, and final products will be significantly improved...). In some cases, new, extraordinary, naturally impossible chemical reactions will be realized. Please see one of presentations (related to extraordinary ultrasonic extractions of precious metals) here:

http://mastersonics.com/documents/mmm_applications/ultrasonic%20extractions%20and%20liquids%20processing.pdf. Another way of inline, flow-through liquid solutions (with

minerals content) processing is to use our Clamp-On ultrasonic reactors is presented here:

http://www.mastersonics.com/documents/mmm_applications/big_and_thick_masses_agitation/engine-block-atomizing/

3. **Ultrasonically assisted metallurgy.** Metals in liquid phase can be ultrasonically transformed into much better alloys than any known, natural, ordinary metallurgical process is producing. Please visit: www.UltrasonicMetallurgy.com. Examples of technological results are: metals degassing, better alloying, eliminating and integrating non-metallic inclusions, increasing density, improving micro-crystallization, and creating new alloys (which are naturally not mixing). Short presentation about that is here:

http://mastersonics.com/documents/mmm_applications/ultrasonic_metallurgy/Ultrasonic%20Metallurgy%20presentation.pdf

4. **Nanoparticles.** Production of nano-particles (by ultrasonic liquids processing... generally sonochemistry). For instance, nano-diamonds, or carbon nano-tubes production, including production of new medicaments... Thanks to ultrasonic cavitation (during ultrasonic liquids processing) and locally generated high temperature (5000°C) and very high pressure spots, we can transform certain liquid solution, which has active and technologically precious ingredients, and disintegrate such ingredients until nano-scale particles, by high intensity sonication. Nano particles are now becoming very advanced, significant and strategic ingredients of new composite materials, new metals, new plastics and rubbers, new electric power storage cells and batteries. Please visit here:

http://www.mastersonics.com/documents/mmm_applications/liquids_processing/sonochemistry_and_cavitation/Nano-Diamonds-Reactor/

and here:

http://www.mastersonics.com/documents/mmm_applications/liquids_processing/sonochemistry_and_cavitation/

5. **Biofuels.** 1° Production of new fuels and combustion liquids (with better energetic or burning performances) can be realized by using ultrasonic water-fuel homogenization and cavitation-based transformations of different liquid fuels, oils and other petrochemical liquids (presently very much known and hot item with lot of information on Internet). 2° Also ultrasonically we can optimize and stimulate biogas production from organic materials, from waste paper, wood chips, plants..., because ultrasonically treated organic materials, cellulose, waist liquids... are becoming much better for further biological and chemical transformations. This is also interesting for oils and fuels extractions from certain sea algae.
6. **Electroplating and metallization.** Ultrasonically optimized and stimulated electroplating and metallization (especially for difficult electroplating technologies). Such technology is applicable in modern electronic industry, solar cells and integrated circuits production, jewelry, surface protection of metals in almost any industry where metals are used.
7. **Hydrogen technology.** Ultrasonically optimized and accelerated water electrolysis for hydrogen and oxygen production. Traditional electrolysis can be enormously accelerated if

we introduce ultrasonic vibrations in such processes. There is a chance to accelerate and stimulate direct extraction of hydrogen from diesel...

8. **Medical applications.** High power, low frequency ultrasound has a number of new, medically/therapeutically healthy effects (pay attention that this is very new ultrasonic treatment, different than what is known and practiced in traditional and modern, medical ultrasonic therapy). For more information, see here: www.UltrasonicsRevival.com. For instance, with such (low frequency) ultrasonic therapy, or irradiation, or massage it is possible to activate and stimulate stem cells to start reproducing, to create lost neural cells connections, to stimulate neurons to reproduce, to remove pain from mechanical and sports-related injuries... to create neural-psychological conditioning for specific situations, like initiating states for faster and better learning, for deeper sleeping, for mental and physical relaxation, for increased and focused perceptual (sensorial and mental) attention in critical situations... (not to mention number of similar applications on animals, horses etc.).
9. **Ultrasonic gas injection.** Ultrasonically stimulated, very fast gasses injection in liquids (until saturation). **1°** For instance, ozone injection in water is very good for total (perfect) biological sterilization (including all odors and poisons neutralization and elimination). **2°** The second strategic application is **decarbonization** or forced injection of high-carbon-content burning, waste gasses, CO, CO₂, Sulfur... (for instance, produced by coal power plants...) into stabilized liquids, convenient for long storage (as a measure for environment protection), or for fertilizers and chemicals production... For more information, see here: http://www.mastersonics.com/documents/mmm_applications/liquids_processing/gas%20injectors/
10. **Ultrasonically assisted technologies.** Ultrasonically assisted machining, cutting, drilling, polishing, grinding, filtering, accelerated aging and stress removal, sintering, compacting technologies etc. See more here: http://www.mastersonics.com/documents/mmm_applications/machining-drawing-extruding-cutting/
11. **Agricultural applications.** **1°** Water for agricultural irrigations (basically technical water from rivers, lakes, wells, including muddy waters that are not for drinking, but still useful for irrigation) can be ultrasonically conditioned and modified, and plants treated with such water will grow much faster (because ultrasonic cavitation will modify properties of water, by disintegrating different molecular and particles agglomerations, and liberating internally captured and inactivated minerals)... **2°** Also seeds and grains, if ultrasonically treated before planting, are dramatically increasing plants germination (almost 100% of such seeds will produce new plants). One of methods for inline, flow-through water conditioning is to use our Clamp-On ultrasonic reactors; see presentation here: http://www.mastersonics.com/documents/mmm_applications/big_and_thick_masses_agitation/engine-block-atomizing/.
Another way for water sonication and conditioning is to use our resonating rod sonicators; -see here: [Spring-mixer.zip](#)
(http://www.mastersonics.com/documents/mmm_applications/liquids_processing/)
12. **Solar powered ultrasonic technologies.** **1° Solar powered ultrasonic aeration of oxygen depleted waters.** The problem is fish kill in polluted waters (rivers, lakes, sea) due to the growing algae that consume the oxygen from water and suffocate the fish. A solution to that problem could be pumping air (or oxygen) into the water and keep the oxygen concentration steady. Ultrasound is a powerful and efficient in aeration (or oxygenation) of water.

2° Solar powered ultrasonic dispersion of water cleaning agents. One of the materials used for that purpose is TiO₂. There are many of publications about that.

3° Solar (and ultrasonic) watering of ore stockpiles at mining sites. There are stockpiles at mining sites that have to be kept wet to prevent lost by wind and dust. The pumping can be powered by solar PV systems instead of diesel engines. That is the saving of fuel and environment. Ultrasound can be a powerful tool for very fine water dispersion.

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13. Typical ultrasonic technologies. Here is not necessary to mention traditionally known technologies like ultrasonic cleaning, welding, homogenizing... which are now widely applicable and very much known (lot of competitors and profits are small).

Each of the above listed applications and trends could be developed on a large industrial and profitable scale. MPI-ULTRASONICS can assist and contribute in any of mentioned applications.

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