

Updated list of 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/.

Resume of relevant industrial applications of Sonocrystallisation:

- a) Oil (or other fluids) pipelines remote ultrasonic cleaning (optimization, stimulation)... long range, non-intrusive cleaning...
- b) Oil and water wells optimization (stimulation, cleaning)... long range and non-intrusive ultrasonic cleaning...
- c) Boilers, heat exchangers, and nuclear reactors remote, long range cleaning from scaling and mineral layers... (in real time, in process, without stopping operation, non-intrusive).
- d) Accelerated ultrasonic precipitation/sedimentation/segregation of particles dissolved in liquids. Interesting for heavily contaminated liquids, for mineral and bio-materials extractions, for nuclear decontamination, for liquids charged with scaling and fouling minerals.

2. Ultrasonic Pumping, Propulsion Systems, Long Range Sonicators

Pumping of large quantity of liquids without moving mechanical parts. Creating long-living and long penetrating cavitation activity. Ultrasonic propulsion engine for boats and submarines. Remote cleaning of oil and water wells and long pipelines. This project only for big investors in strategic technologies.

3. Extractive Liquids Processing 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/.

One of industrial applications is: **Ultrasonically Assisted Mining or Direct Minerals extraction:** For direct minerals mining (for instance mining of Uranium and radioactive minerals) it is possible to drill boreholes in a soil rich with desired minerals, continuously fill such well with convenient extracting liquid, and submerge MPI, multi-frequency (MMM) ultrasonic transducer in a hole. Ultrasonic activity will dissolve surrounding minerals in a liquid, and it will be sufficient to pump such minerals-saturated liquid and inject new non-saturated liquid...

4. 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_melt_treatment_presentation_v8.pdf

5. **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/

6. **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.
7. **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.
8. **Hydrogen production technology.** Ultrasonically optimized and accelerated water electrolysis for hydrogen and oxygen mass 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...
9. **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.).

10. **Ultrasonic gas injection and or degassing applications.** 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/.

Resume of relevant industrial applications of Degassing and/or Gas Injection:

Ultrasonic liquids degassing (at ambient temperature and pressure) is very efficient technology and MPI multi-frequency (MMM-technology) sonicators are very good for such some way acoustically specific and non-linear, but ultrasonic degassing should work well). Important degassing parameters are: ultrasonic power, how many transducers to apply, and how long will be processing time, but it will work very well.

Ultrasonic gas (or CO₂, ozone etc.) injection in liquids, including sea water (at ambient temperature and pressure): First, it will be necessary to remove dissolved gas from water (to apply degassing process using MPI sonicators), and then to inject CO₂ and other polluting gasses inside (using MPI ultrasonic gas injectors)... MPI Ultrasonic reactor will facilitate Introduction of CO₂ micro bubbles (till saturation) into ambient degassed seawater (<20micron). We can also apply similar technology to inject and stabilize (or chemically transform) other contaminating gasses and fluids in water. This is our present planetary problem (producing global heating and macro-climatic changes).

11. **Other Ultrasonically assisted technologies.** Ultrasonically assisted extrusion, injection-molding, machining, cutting, drilling, polishing, grinding, filtering, accelerated aging and stress removal, sintering, powders compacting technologies etc.


See more here:

http://www.mastersonics.com/documents/mmm_applications/machining-drawing-extruding-cutting/

12. **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](#) 209.7 Mb 21 Mar 2013

(http://www.mastersonics.com/documents/mmm_applications/liquids_processing/)

ULTRASONIC WASTE WATERS PROCESSING FACTS

1. Relatively expensive technology
2. Necessary to use highly educated experts (meaning engineers)... operational prices are elevated compared to traditional technologies
3. Durability of ultrasonic equipment will be significantly affected by environmental operating conditions (corrosion, chemical attack of vapors and aggressive chemistry)
4. Necessity to use several levels of liquid processing and preparation, such as: mechanical filtering from big and relatively solid parts, mechanical maceration, mixing and blending before ultrasonic processing, need to apply very high intensity ultrasonic processors (sonicators)...
5. High intensity sonicators (sonotrodes) are wearing and eroding (relatively fast) because of ultrasonic cavitation and ultrasonically intensified chemical activity of wastewaters. Sonotrodes should be periodically inspected and replaced... (high cost). High-level technicians and engineers should be involved.
6. In addition, it will be very useful to inject ozone in wastewaters in order to secure decontamination...
7. Of course, ultrasonic liquid processing is very much beneficial for wastewaters' fast decontamination... but it is effectively much more expensive compared to traditional, old methods.
8. Good sides of ultrasonic technology in water processing are related to descaling and internal deposits removal from pipelines, heat exchangers, boilers...

13. Solar powered ultrasonic technologies.

1^o 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^o 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^o 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. [Contact: Dr Sinisa Djordjevic at sinova52@gmail.com].

14. 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. Degassing works very well with potable and industrial water.

COMMENTS:

For instance, let us take the project under number 9. This can be addressed as luxury and extraordinary body treatment (for medical therapy clinic) applied on humans and also on bigger animals.

There are many possibilities (how to develop such projects, equipment and related business), and some of proposal are:

1. To design kind of sufficiently big/large/high/modern-looking stainless steel cylinder or bath (with stairs, platform, crane or lift, holders etc.), sufficient that an adult can enter inside (and be taken out, after the treatment). Inside will be water on certain comfortable temperature, with certain medical chemistry inside (such as vitamins, tea plants, minerals...).
2. Such stainless steel bath (reservoir) will be sonorized (sonicated) using specific, high-tech ultrasonic transducers, operating on low ultrasonic frequency (between 20kHz and 40 kHz with modulation) in order to produce mentioned medical and therapeutic effects. Patient under treatment will enter inside and adjust his (acceptable, comfortable) power level, frequency and signal modulations of ultrasonic vibrations. Of course, water level, temperature and medical or chemical content inside can be regulated and personalized in order to create optimal treatment for specific patient. Such ultrasonic body treatment will take 5 to 10 minutes per patient (per treatment) and be applied few times per day. Results of such ultrasonic treatment, using the language of ordinary (and also uneducated) people would be: rejuvenation or getting younger, removing any kind of pain, skin reparation, acting against worst kind of skin infections, stimulating body cells of any kind to reproduce, to replace old and missing cells, to make neural stimulation, to make reparations of neural connections like in cases of Parkinson illness, to act against cancerous cells, to activate/mobilize paralyzed people... Of course, such extraordinary ultrasonic treatment will be only for rich clients able to pay a lot... The goal could be to establish such ultrasonic therapy clinics in rich countries around you (where clients are able to afford such expensive treatment).
3. Practically, we need to produce mentioned ultrasonic bath with all kind of accessories and fixtures, to have safe operating system, and to enable easy manipulations with patients. We need to organize: professional mechanical design (CAD) in order to create 3D and 2D documentation of such ultrasonic bath. Later, we need to produce the prototype. We need to find medical practitioners who are educated in medical therapy and start ... we need medical clinic or space where such ultrasonic equipment will be installed... I can organize design work in order to create proper equipment and I already have necessary ultrasonic generators and transducers. Everything else should be organized by medical experts. Since such project cannot easily pass European and USA regulations (because of legal regulations, monopoly of big companies, competition practices...), we will probably establish such clinic in certain of countries around you, where is easier to get an authorization from certain powerful person. Until here is easy to explain. Now is coming a more difficult part related to financing...

Please make the download and see the presentation here (web links):

http://mastersonic.com/documents/mmm_applications/liquids_processing/tubular_clamp_on_reactors.pdf

And here: Directory of / documents/ mmm_applications/ Stress-Relief

http://www.mastersonics.com/documents/mmm_applications/Stress-Relief/



[mmm ultrasonic stress relief.mp4](#) 230 Mb 10 Oct 2016



[mmm ultrasonic stress relief.zip](#) 219.6 Mb 10 Oct 2016

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.

Vibrations, oscillations, resonant states and united theory of macro and microcosmic matter-waves phenomenology is here (e-book for download):

http://mastersonics.com/documents/revision_of_the_particle-wave_dualism.pdf

www.UltrasonicsWorldGroup.com

www.MPI-Ultrasonics.com

www.UltrasonicMetallurgy.com

www.Mastersonics.com

Strategic Projects Resume:

1. Ultrasonic agitation of big and small, arbitrary shaped metal masses for stress relief, deposits removal, descaling and cleaning. Not necessary to stop the process. Ultrasonic agitators can be installed externally and make liquids processing and stress relief internally or structurally. There are different ways for such installations, such as: Clamp-On, direct by screwing or welding, combined axial-radial-torsional... Applications: heat exchangers, tubular conduits, boilers, power reactors...

ULTRASONIC PROCESSING RELATED TO STRESS RELIEF, DESCALING AND CLEANING APPLICATIONS

DESCALING OF PIPELINES AND HEAT EXCHANGERS
 INTERNAL CLEANING OF BOILERS, PIPELINES, AND HEAT EXCHANGERS
 EXTERNAL CLEANING OF BOILERS PIPELINES AND HEAT EXCHANGERS
 ON-LINE PREVENTIVE CONTINUOUS CLEANING WITHOUT STOPPING THE PROCESS

Application methods:

1. External Clamp-On
2. External screw/weld/bond – On
3. Installing internal submersible sonorod transducers.

Application fields:

1. Nuclear and other power plants based on heat exchangers... (where descaling is necessary)
2. Water pipelines deposits removal
3. Chemical conduits of liquids with mineral content (mining and metals extractions...)... removing deposits.
4. Petrochemical conduits cleaning of deposits. Oil industry applications.
5. Liquid food conduits.
6. Optimization of filtering
7. Water reservoirs descaling, biofilm removal, algae and barnacles repealing.
8. Optimization of liquids heating, boiling, evaporation
9. Optimization of electrochemical and galvanic technologies.

2. Ultrasonically assisted metallurgy (www.UltrasonicMetallurgy.com)

3. Ultrasonic Liquids Processing and Sonochemistry for:

Mineral extractions, precipitations, removal of deposits, pipelines maintenance, boilers and heat exchangers preventive and continuous maintenance, nano powders technologies, waste-waters treatment, clean and potable water processing, swimming pools and water reservoirs maintenance, cleaning and optimization, oil and water pipelines, deep potable water wells ultrasonic cleaning, heat exchangers and nuclear reactors cleaning in in real time, without stopping operation, decolmating and maintenance...

4. Ultrasonic Sonochemical mining based on minerals extractions and sonochemistry. By drilling deep boreholes (for instance with diameters about 200 mm large), and when reaching geological layers with mining

raw materials (with minerals or ores), we fill such hole with water or convenient liquid and submerge ultrasonic transducer (sonorod) inside. Sonorod will perform dissolving, mixing and extraction of minerals, and we can pump such saturated liquid (with dissolved, useful oxides, salts and minerals), and use it for further electrochemical processing (like electrolysis). This way, mining of critical, dangerous, radioactive and similar minerals will become much simpler.

5. Medical and therapeutic application of high power, industrial, low frequency ultrasound are still presenting unexplored field of good applications... but this is specific field and we need significant and complex support (chain of activities and relations).
6. Ultrasonic Powders Compacting in sintering technologies.
7. Ultrasonically assisted extrusion, injection molding and mixing.
8. Ultrasonically stimulated and accelerated gases injection in different liquids. For instance, air, ozone CO₂, waist gasses... injectors. Ultrasonic liquids sterilization, by ozone injection, CO₂ injection in water, and/or ultrasonic degassing...
9. Agricultural applications of ultrasound: almost 100% of seeds germination, and water optimization for watering...
10. Sonochemistry related, ultrasonically stimulated modifications of complex, acoustically non-linear, biological and similar liquids, with combined axial-radial and turbulent or vortex agitation. Liquid processing and modifications are much better and faster, compared to simple, fixed frequency and uniform ultrasonic activity sonicators.
11. Accelerated solid matter precipitation, sedimentation and granulation (from a liquid phase). Good for combination with filtering technologies. Also good for pharmaceutical production of active substances.
12. Ultrasonic propulsion or jet engine based on fluidic friction removal.
13. We can offer assistance and equipment in Ultrasonic Welding, Cutting, Sieving, Machining... Only question of organizing and support...

www.MPI-Ultrasonics.com

www.UltrasonicsWorldGroup.com

www.UltrasonicMetallurgy.com

www.UltrasonicsRevival.com