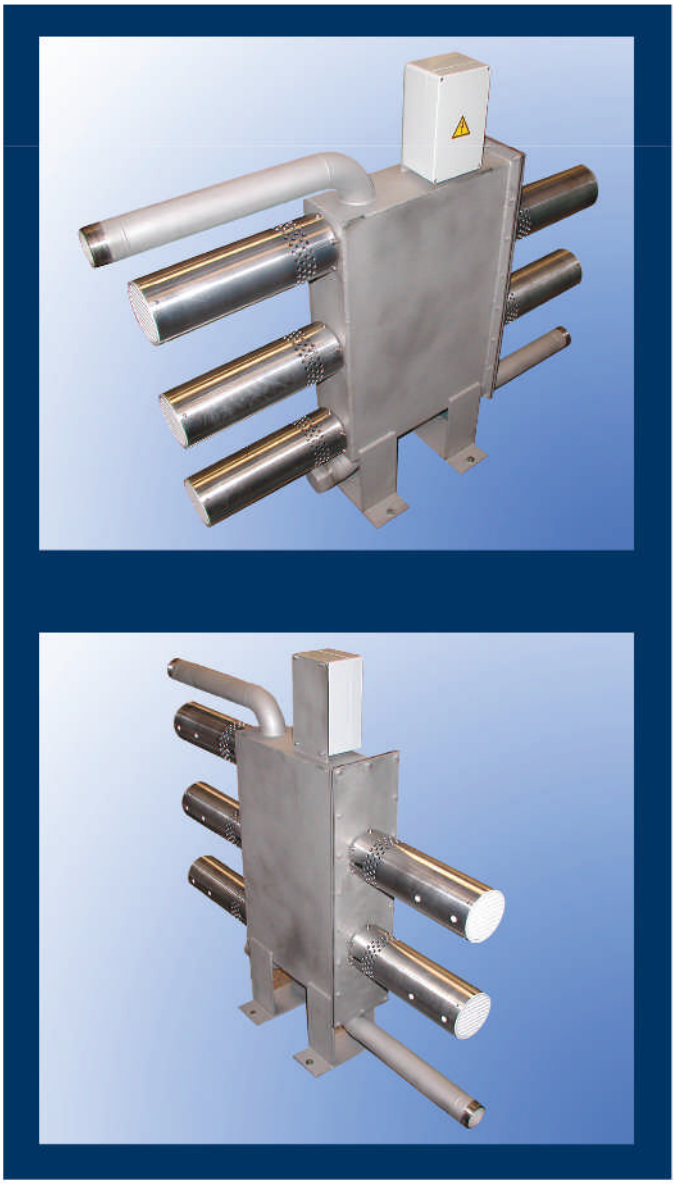
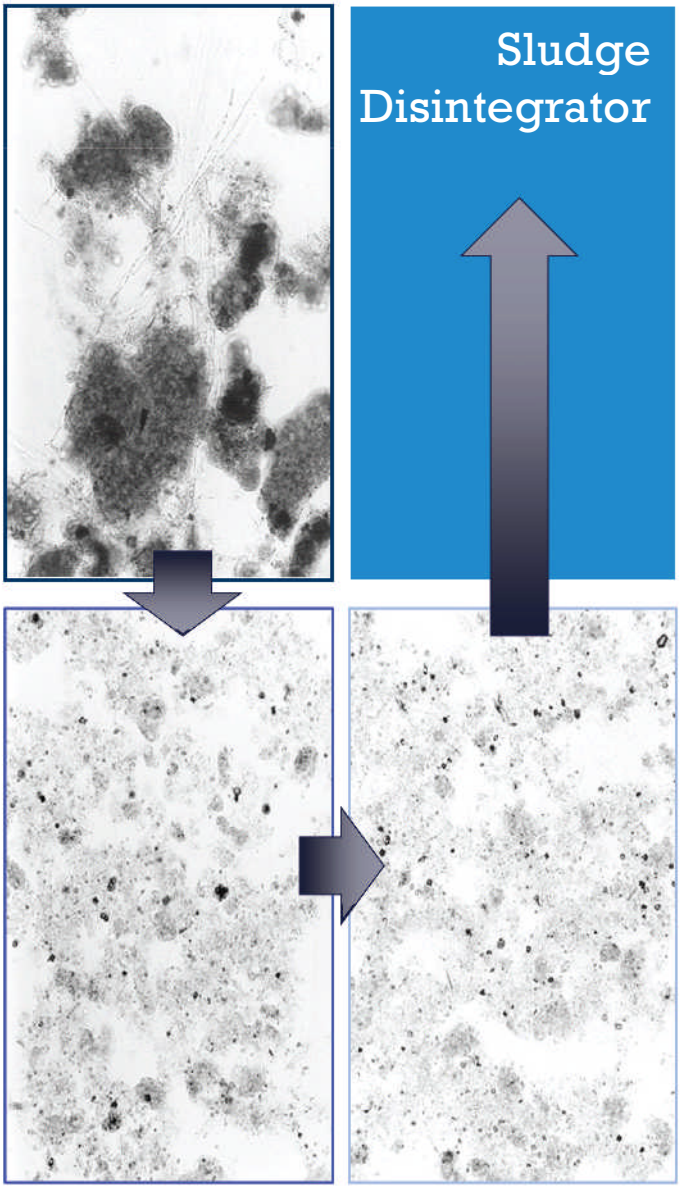


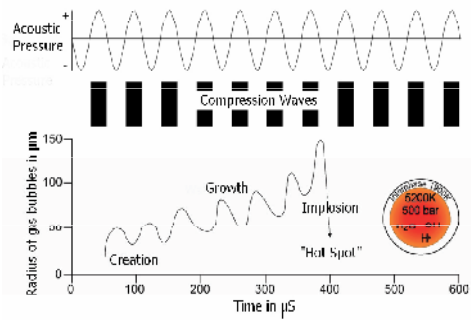


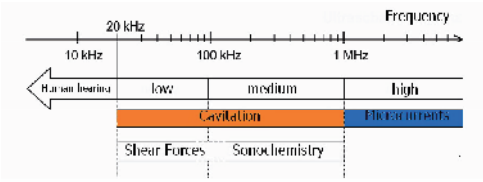

ULTRAWAVES

# BioSolids Treatment Innovation

# The Technology

As with other acoustic waves, ultrasound subjects substances (water in this case) to alternating compression and expansion. At high intensities ultrasound breaks up the aqueous medium during the expansion phase. As a result, microscopically small cavities filled with water vapor or gas are formed in the fluid.




During the subsequent compression phase these bubbles implode as a result of the extreme conditions generated on the micro level – this process is known as cavitation. Pressures as extreme as 500 bar and temperatures up to 5,200 Kelvin are attained. The implosion of the gas bubbles produces powerful shear forces that break up the surface of bacteria, fungi and other cellular matter.

At lower frequencies (20kHz–100kHz), large cavitation bubbles are produced, the collapse of which cause these extreme hydraulic shear forces and effects. In the middle frequency (100kHz-1MHz) smaller, but nonetheless effective cavitation bubbles are produced and radical "sonochemical" reactions occur in the water.

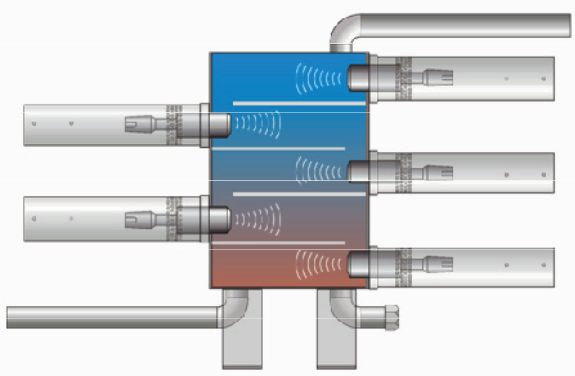
When sonicated at frequencies higher than 1MHz the liquid starts to stream on the molecular level.

At different acoustic frequencies the following remediation effects can be obtained:

| 20kHz-100kHz | 100kHz-1MHz | 1MHz-10MHz |
|---|---|---|
| Disintegration of cells, disinfection, destruction of polymers, release of enzymes | Break up of the structure of (chloro-)organic compounds such as chlorophenol, TBT, MTBE, release of enzymes | Desorption of absorbed organic molecules from solid surfaces, biologically available matter, simultaneous biological degradation |

# The Ultrawaves Reactor

Ultrawaves offers a specially developed ultrasonic reactor for a more efficient wastewater treatment method. The key aim in constructing the ultrasound apparatus is to produce a high degree of efficiency by rupturing the organic matter suspended in the fluid treated. This is why the reactor space in the Ultrawaves reactor has been optimized to obtain cavitation uniformly through out the flow area.

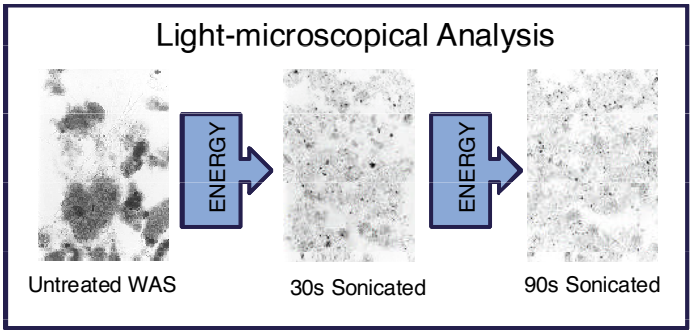


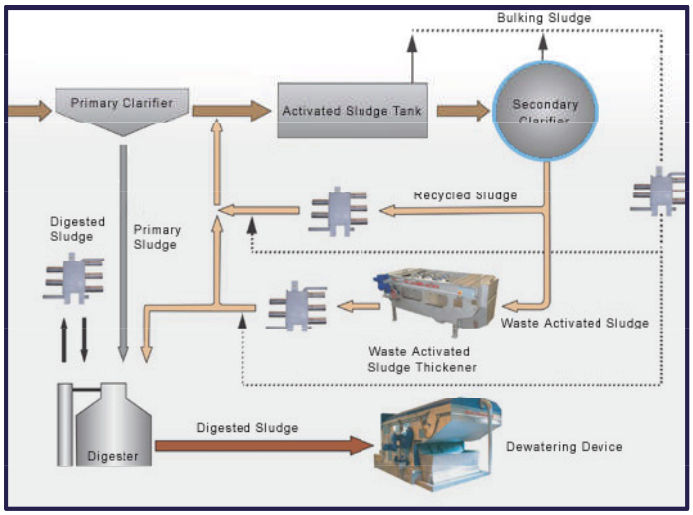
The result is an exceptionally compact patented machine with a volume of only 28 liters. In comparison to traditional tanks/basins this is a "micro-reactor". The standard model is normally fitted with five oscillating units. Air-cooled piezo-ceramic transducers perform the transformation of electrical energy into mechanical acoustic energy.

With the standard model it is possible to treat a sludge flow of up to thirty cubic meters per day. For wastewater containing a lower concentration of biosolids the flow rate can be set higher.

FEATURES:
* Compact Construction
* Easy Attachments
* Traditional Pump System Interface
* Safety in Use
* Modular Characteristics
* Working Capacity of 30m3/day

BENEFITS:
* Decrease in digestion time (by up to 60%)
* Reduction in digested sludge mass (by up to 30%)
* Increased biogas production (by up to 50%)



# Applications

Ultrawaves Reactors can be usefully employed for the following:

*Aerobic or anaerobic stabilisation of sewage sludge and biomass by:*

- ✓ Intensifying the degradation process
- ✓ Reducing time required for treatment
- ✓ Reducing digester tank volume necessary
- ✓ Reducing quantity of sludge/biosolids disposal
- ✓ Increasing exploitable biogas production
- ✓ Improved dewatering capability

*Combating foam and bulking sludge by:*

- ✓ Preventing flotation by destroying the filamentous bacteria causing it
- ✓ Improved settling of sludge
- ✓ Avoiding foaming in the digestion process

*Biological elimination of nitrogen (denitrification) by:*

- ✓ Production of internal hydrogen sources
- ✓ No need to purchase external substrates

*Disinfection of "murky media" (wastewater, industrial water, water sludge):*

✓ A new procedure using ultrasound in combination with ultraviolet light is about to be introduced.

# Case Study Example 1

Ultrasound Sludge Disintegration for Anaerobic Digestion Acceleration and Enhancement

*Bamberg WWTP, Germany*

Since 2002, the Ultrawaves ultrasonic reactor has been used very effectively in the Bamberg Wastewater Treatment Plant. As a result of the installation the planned construction of a new digestion tank has been abandoned.

**Brief Snapshot of the Plant:**

Design Capacity: 230,000 PE

Actual Load: 280,00 PE, Overloading conditions

Sludge Feed: Primary and thickened waste activated sludge

Facilities: three mesophilic anaerobic digester tanks (2 X 2000m3, 1 X 3000m3)

Detention time: 18 day HRT

Sludge Disposal: Incineration after dewatering of the digested sludge

**Initial Plan for the Anaerobic Digestion Facilities Upgrade:**

Construction of a brand new 3000m3 digester in order to increase HRT from 18 days to 25 days

**The trial of the Ultrawaves Ultrasound Disintegration System:**

The plant decided to use the Ultrawaves innovative ultrasound reactor for sewage sludge cell disintegration in order to speed up anaerobic sewage sludge digestion and to eliminate the need for the construction of a new digester as follows: Four month test from May 2002 to August 2002 by treating 30% of total TWAS flow.

**The results and Benefits of Using Ultrasound**

Volatile solids destruction improved from 42% to 54%

Digested sludge VS reduced from 60% (as % of TS) to 54%

Biogas production increased 30%

Payback time 2 years

Avoided construction of new anaerobic digester saving 3.3 million Euro

**Successful full scale installation since 2004**

# Case Study Example 2

Ultrasound Sludge Disintegration for for Intensification of Aerobic Sludge Stabilization resulting in Sludge Minimization

*Leinetal WWTP, Germany*

The wastewater treatment plant in Leinetal has been using the Ultrawaves ultrasonic reactor successfully since 2002. As a result of the installation the construction of a new wastewater treatment plant has been abandoned.

**Brief Snapshot of the Plant:**

Design Capacity: 50,000 PE

Sludge Stabilisation: extended aeration (simultaneous aerobic sludge digestion)

Facilities: Two activated sludge tanks, aerobic sludge age 18 days. High amount of waste activated sludge production. Floating sludge due to excessive growth of filamentous micro organisms.

**Initial Plan for the Anaerobic Digestion Facilities Upgrade:**

Construction of a brand new activated sludge tank in order to increase the aerobic sludge age.

**The trial of the Ultrawaves Ultrasound Disintegration System:**

The plant decided to use the Ultrawaves innovative ultrasound reactor for sewage sludge cell disintegration in order to intensify aerobic sewage sludge disintegration and to eliminate the need for the construction of a new activated sludge tank

**The results and Benefits of Using Ultrasound**

Waste activated sludge quality: Minimization of sludge mass by 30%. Better stabilized end product (reduced organic content). 2% increase in cake dryness after WAS dewatering. No foam and no floating sludge in the aeration tank. Reduction in sludge volume index SVI from 140mg/l to 85mg/l.

Avoided construction of new aeration tank

Solved operation problems (no bulking sludge)

Payback time less than 3 years

Reduction of sludge mass for disposal

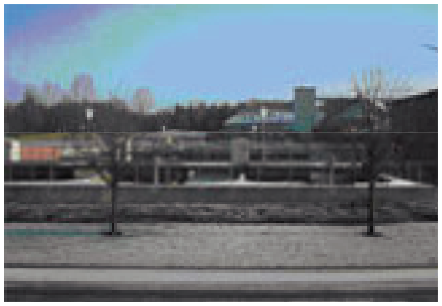
**Successful full scale installation since 2003**

# Installation Examples

| Enhancement of anaerobic sludge digestion | |
|---|---|
| Meldorf STP, Germany (70,000 PE)<br>Installed December 2004<br>•30% Increase in VS destruction<br>•30% increase in biogas production<br>•Elimination of filamentous organisms in sludge digester | Zeist STP, Netherlands (75,000 PE)<br>Installed May 2005<br>•25% Increase in VS destruction<br>•25% increase in biogas production |
| Marselisborg-Arhus STP, Denmark (220,000 PE)<br>Installed March 2006<br>•15% Increase in sludge reduction<br>•35% Increase in biogas production<br>•20% Decrease in polymer use | Kleinsteinbach STP, Germany (40,000 PE)<br>Installed July 2006<br>•25% Increase in VS destruction<br>•25% increase in biogas production |

| Enhancement of aerobic sludge stabilisation | |
|---|---|
| Heiligenstadt STP, Germany (52,000 PE)<br>Installed July 2003<br>•Sonication of return sludge<br>•Elimination of foam and filamentous organisms in aeration tank<br>•20% Reduction of WAS | Tanba City STP, Japan<br>Installed October 2004<br>•Sonication of return sludge<br>•74% Reduction of WAS |
| Pecs STP, Hungary (200,000 PE)<br>Installed March 2006<br>•Sonication of return sludge<br>•25% Reduction of WAS | Datansha STP, China (550,000 PE)<br>Installed June 2006<br>•Sonication of return sludge<br>•15% Reduction of WAS |

After many years of of testing, trialing and design enhancements since 2004 until now over 60 Ultrawaves reactors are installed and operational in over 12 countries around the world.



# Award Winning Design

German Innovation Award 2006


Innovation Award Baden Württemberg 2007


# More Information & Contact Details

Additional information for the Ultrawaves ultrasonic reactors is available through the web site: www.ultrawaves.de

Local enquiries and assistance is available through the Australian agent Royce Water Technologies Pty. Ltd. There are many case studies and papers of installations available on this innovative technology. Please contact us to provide you with the appropriate information that best suits your requirements.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ULTRAWAVES

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