

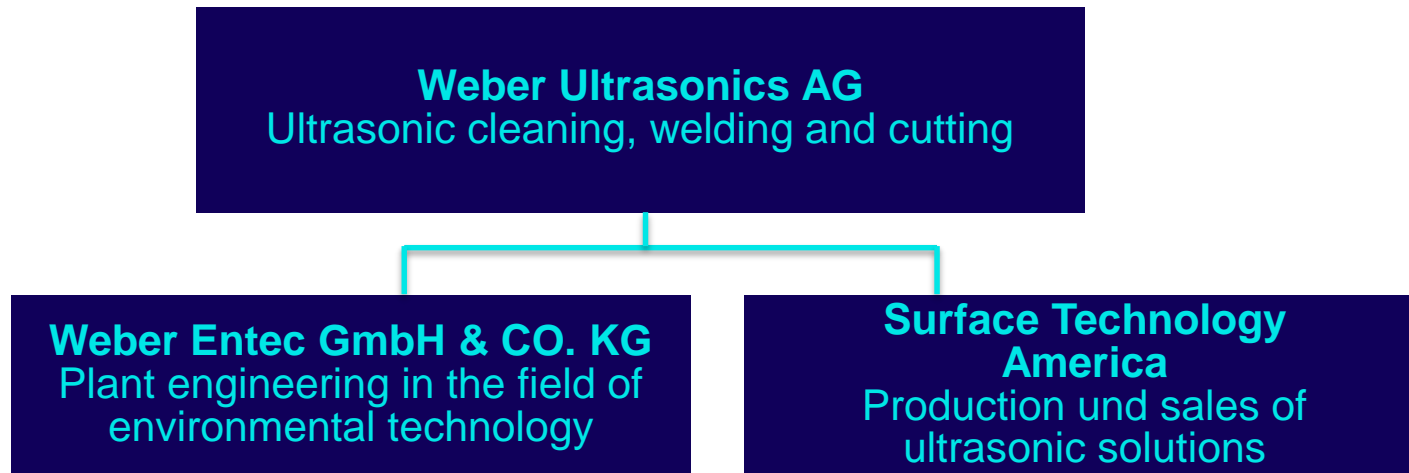


WEBER  
ENTEC

# INCREASE OF BIOGAS YIELD THROUGH ULTRASOUND



# STRATEGY: UNITED COMPETENCE IN ULTRASOUND





# WEBER ULTRASONICS PORTFOLIO



Solving complex tasks in ultrasonic cleaning, ultrasonic welding or in environmental technology is all in a day's work for us. With a broad range of products, Weber Ultrasonics offers innovative ultrasonic components ideally tailored to the diverse requirements.

# APPLICATION OF ULTRASOUND DISINTEGRATION

## BIOGAS PLANTS



- Increase of biogas production
- Reduction of feed stock at equal performance
- Acceleration of organic degradation
- Consistent decrease of viscosity
- Reduction of pump- and stirring energy demand

## WWTPs



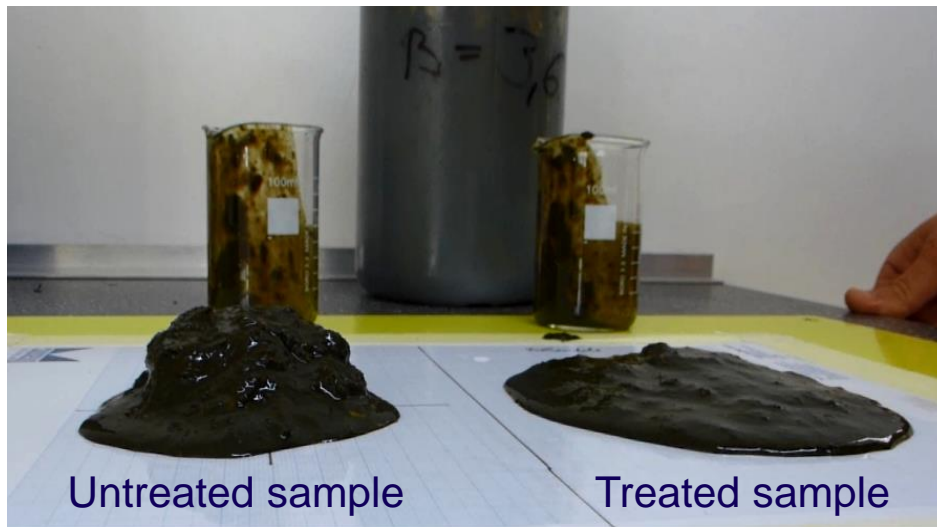
- Increase of biogas production
- Reduction of sludge to be disposed
- Consistent decrease of viscosity
- Improved decanting
- Elimination of foam / fibrous bacteria



# EFFECTS OF THE ULTRASOUND DISINTEGRATION

Increase of biogas yield		8 - 25%
Decrease of sludge to be disposed		8 - 25%
Decrease retention time in fermentation		8 - 15%
Decrease of energy consumption (pumping, stirring)		5 - 20%
Increase of dewaterability		5 - 20%

# IMPROVED FLOW PROPERTIES



Direct comparison of the untreated and treated sample just after operation of the disintegration machine

## After BioPush Treatment:

- Reduced viscosity
- Improved flow properties
- Decrease of energy consumption (pumping, stirring)
- More stable biology
- Higher proportion of difficult substrate usable (grass, manure,...)



# PHYSICAL PRINCIPLE – CAVITATION

Ultrasound liberates enzymes and shears up the substrates

## Physical principle: Cavitation

Short term local  $\mu\text{m}$ -radius

- Extreme high temperature (up to  $5.000\text{ }^{\circ}\text{C}$ )
- Extreme high pressure (up to  $1.000\text{ bar}$ )
- Extreme high acceleration  $\longrightarrow$  Shear forces

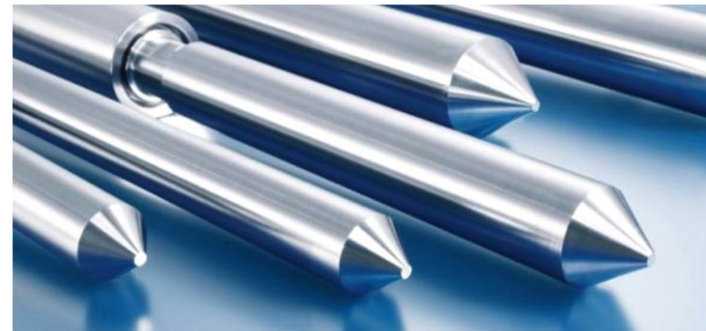


Multiply enlarged cavitation bubble  
in the moment of implosion



# TRADITIONAL ULTRASOUND TECHNOLOGY

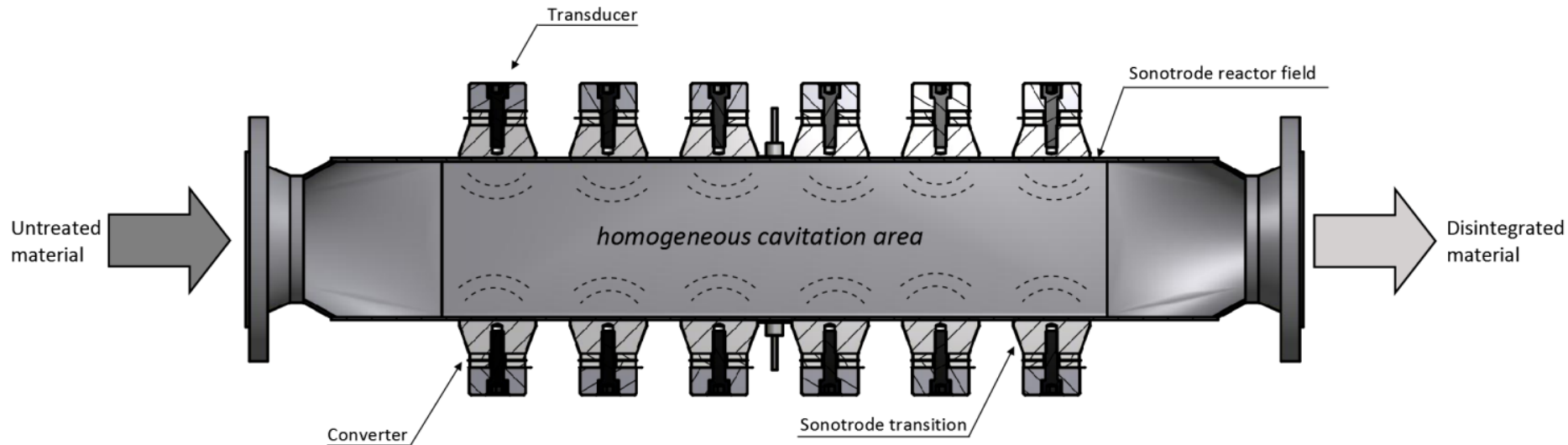
- ▶ High erosion
- ▶ Inhomogeneous ultrasound field, due to spot irradiation
- ▶ Significant performance decrease due to erosion
- ▶ Thereby higher maintenance because permanent rinsing is necessary
- ▶ Reactors obstruct easily
- ▶ Higher operating and maintenance costs
- ▶ Direct contact between ultrasound transducer and medium







# ULTRASOUND REACTOR BIOPUSH – THE NEXT GENERATION ULTRASOUND





# ULTRASOUND REACTOR BIOPUSH – THE NEXT GENERATION ULTRASOUND

- ▶ Designed specifically for agricultural and municipal fermentation plants
- ▶ Treatment of non homogenous substrates with high demand of total solids (up to 15% TR)
- ▶ 2.000 W or 3.000 W ultrasonic energy input per flow cell
- ▶ Optimized energy input because of homogenous ultrasonic field
- ▶ Absolutely maintenance free
- ▶ High operational safety – 100% clogging free
- ▶ High durability (up to 3 years and more)





# ULTRASOUND REACTOR BIOPUSH – THE NEXT GENERATION ULTRASOUND

Enables continuous processes

- ▶ Continuous processes (Inline process instead of batch process)
- ▶ No stirring necessary → Lower maintenance costs and energy consumption





# GENERAL MACHINE DESIGN – DESIUS

## 1 Ultrasound unit

Cell rupture and surface augmentation

Mobilization of  
Exo-Enzymes

Sustained decrease  
of viscosity in fermenter

Ultrasonic power  
2 kW per unit

High durability –  
up to 3 years and more



## 2 Mechanical Pre- treatment

Improved sound efficiency  
and machine protection  
RotaCut 3.000

## 3 Feeding pump

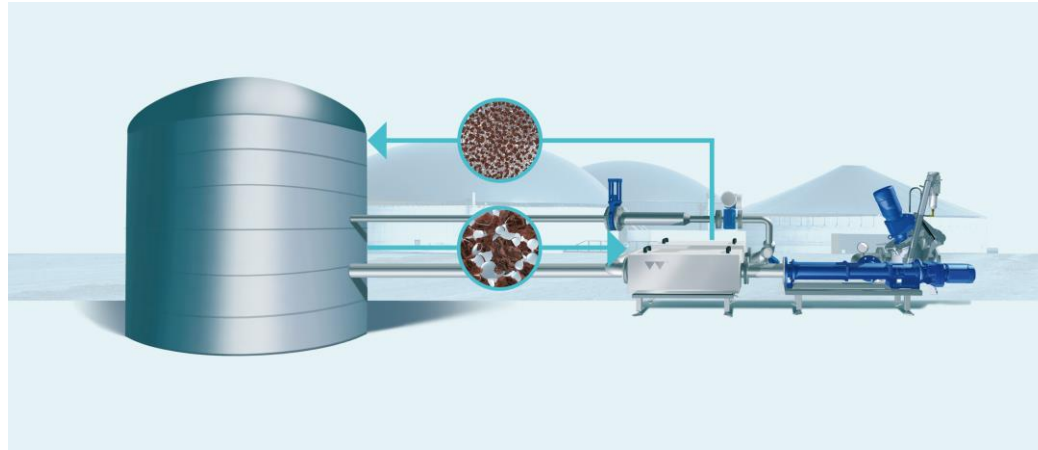
Excentric screw pump  
0.5 to 2.6 m<sup>3</sup>/h

## 4 Sensors

2 x pressure gages,  
2 x temperature sensor,  
1 x flow meter



# POSSIBLE INTEGRATION EXAMPLES IN BIOGAS PLANTS



Main digester

Ultrasound disintegration unit



# POSSIBLE INTEGRATION EXAMPLES IN WWTP



Thickener   Ultrasound disintegration unit   Digester



# YOUR BENEFITS

Increased gas yield / substrate savings

Significantly increased degree of degradation

Stabilisation of biology

Improved flow properties

Avoidance of floating layers

Reduced wear of stirring components

Reduced energy requirements for pumps and agitators

Use of substrates that are difficult to process but often cheaper can be increased, thus reducing the use of maize

Operational reliability of the biogas plant is increased



# 01 REFERENCE LIST CASE STUDIES





# BIOGAS PLANT 716 kW BIOENERGIEDORF JÜHNDE

## Jühnde is Germany's first bio-energy-village

- ▶ Founded in the year 2005
- ▶ 30.000 interested visitors until now
- ▶ Only in Germany 150 villages followed this model





# BIOGAS PLANT 716 kW BIOENERGIEDORF JÜHNDE

## Aim of ultrasound disintegration plant :

- ▶ Higher gas production
- ▶ Improved flow properties of biomass
- ▶ More stable biology
- ▶ Decrease of energy consumption
- ▶ Less wear and tear on pump and stirring aggregates



# BIOGAS PLANT 716 kW

## BIOENERGIEDORF JÜHNDE

Location	D-Jühnde
CHP	716 kW
Ultrasound power	4 kW
Feed stock	Maize silage, schredded crops, manure



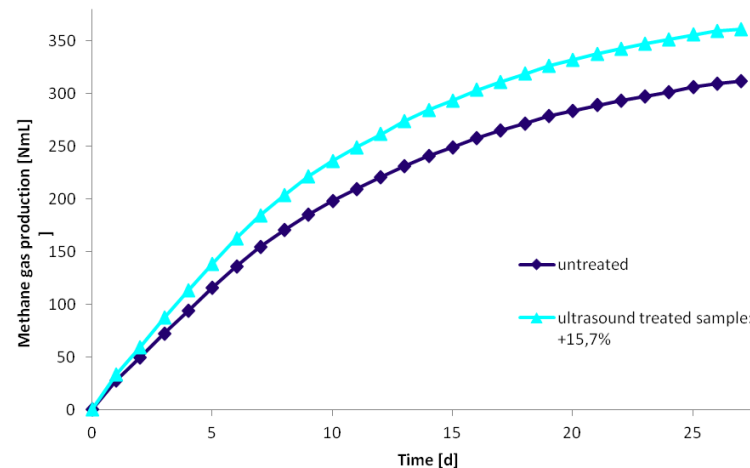


# BIOGAS PLANT 716 kW

## BIOENERGIEDORF JÜHNDE

### Result:

- ▶ 15% higher gas production
- ▶ Improved flow properties



→ The guaranteed performance improvement was clearly exceeded and the performance proof provided by an independent 3rd party laboratory.



# WWTP– ALTENRHEIN SWITZERLAND

In the year 2013 a test plant with 2 kW ultrasound power was integrated at a Swiss WWTP with 80.000 population equivalents for a test period of one year. The effect of the ultrasound disintegration on the organic degradation of different substrates should be proved.



# WWTP– ALTENRHEIN SWITZERLAND

After one year of testing, the full scale implementation with an ultrasound power of 12 kW for treating digested sludge and co- substratum takes place in the year 2016.



# BIOGAS PLANT 250 kW VREDEN

**Aim:** The generator was operating only at 75% load. Target was to achieve 100% of generator load by reducing retention time. Afterwards successive substitution of maize silage with lower value like grass.



# BIOGAS PLANT 250 kW VREDEN

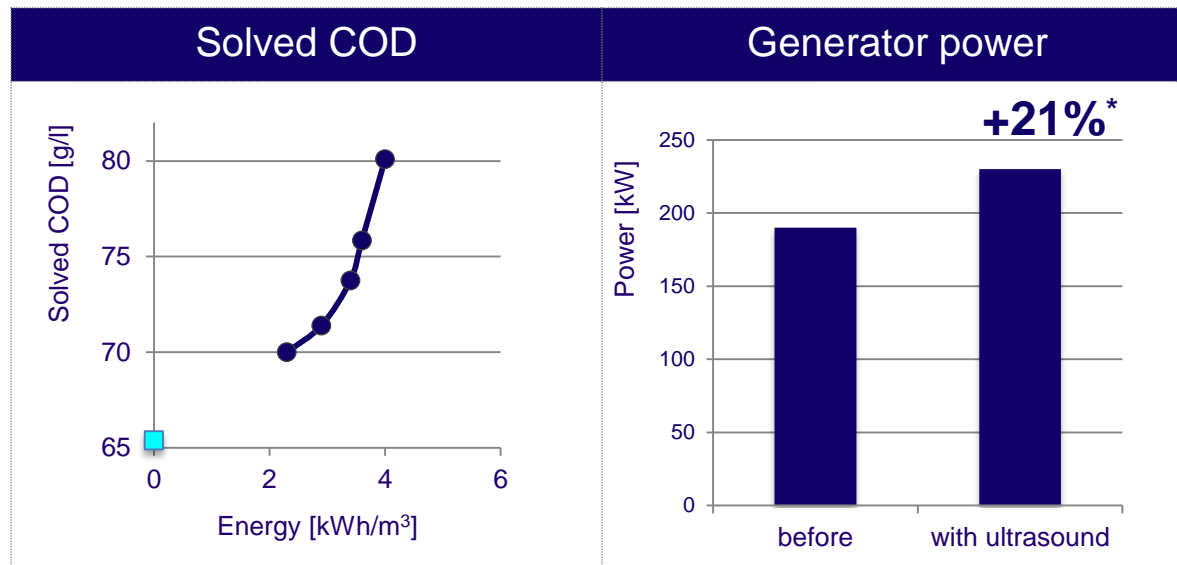
Location	D-Vreden
CHP	250 kW
Ultrasound power	2 kW
Feed stock	manure, maize, silage, grass, corn







# BIOGAS PLANT 250 kW VREDEN





# BIOGAS PLANT 250 kW VREDEN

**Result:** The generator operated at 230 kW after 3 months (now under full load). Maize silage could be reduced and substituted by lower cost substrates.

Data	
Higher yield	> 20%
Power before	190 kW
Power after	230 kW
Operating time	8.300 h/a
Energy gain	332.000 kWh/a
Monetary gain	70.000 €/a
Op. costs	2.490 €/a
Maintenance	7.500 €/a max.
Depreciation (5 p.a.)	14.000 €/a
<b>Profit</b>	<b>53.500 €/a</b>

# BIOGAS PLANT 395 kW KLEVE

**Aim:** Increase of biogas yield, reduction of feed stock

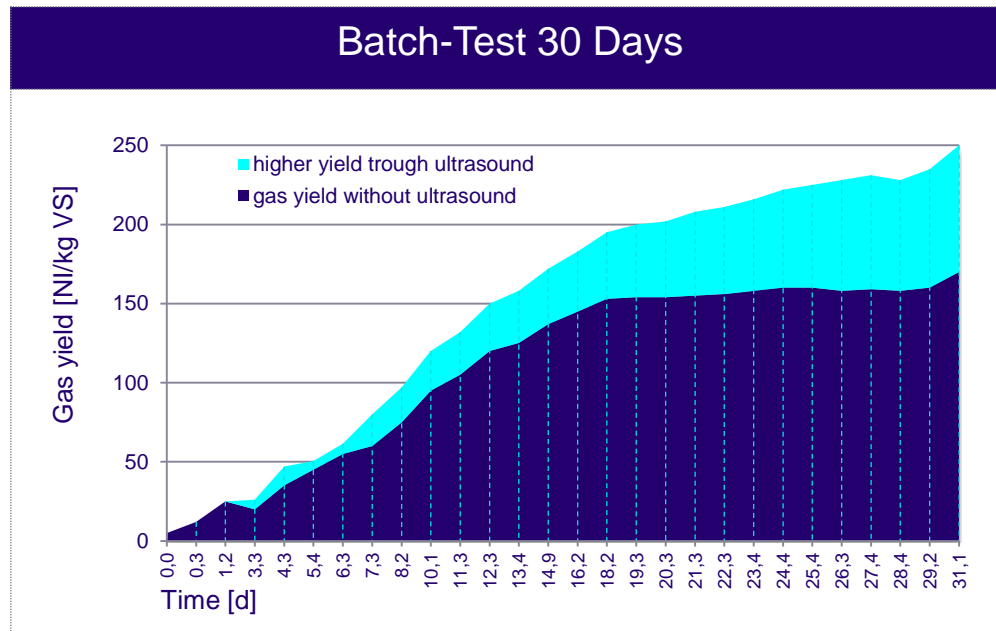
Location	D-Kleve
CHP	250 kW
Ultrasound power	2 kW
Feed stock	manure, maize silage, poultry manure





# BIOGAS PLANT 395 kW KLEVE

**Result:** The generator operated at 450 kWh instead of 395 kWh before.



# BIOMETHANE PRODUCTION PLANT

## 500 Nm<sup>3</sup>/h (~1MW<sub>EL</sub>) MÜHLACKER

**Aim:** Increase of efficiency – More biogas, less feed stock

Location	D-Mühlacker
Biomethane Nm <sup>3</sup> /h	500 Nm <sup>3</sup> /h
Ultrasound power	4 kW
Feed stock	corn silage



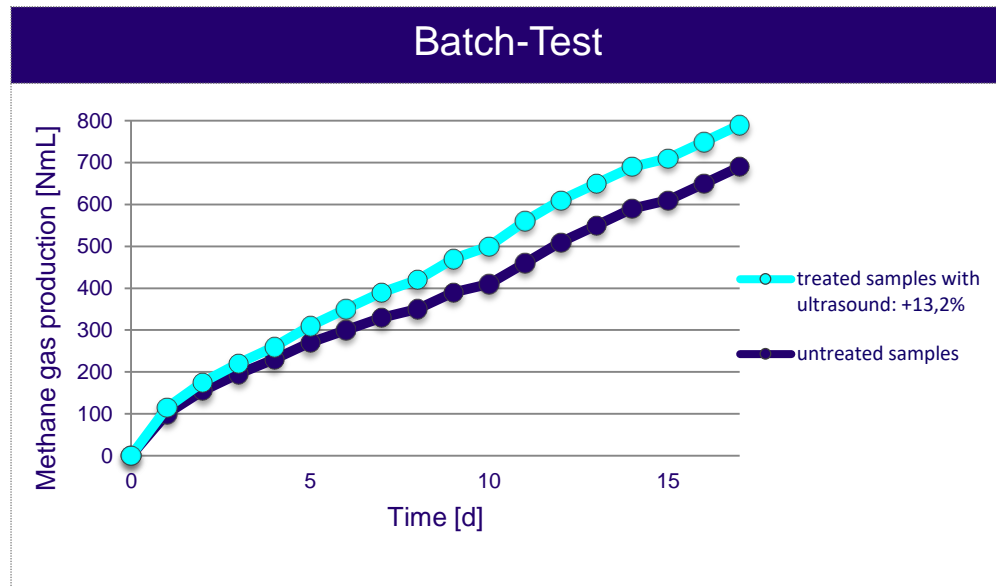


# BIOMETHANE PRODUCTION PLANT

## 500 Nm<sup>3</sup>/h (~1MW<sub>EL</sub>) MÜHLACKER

### Result:

More than 13% higher  
biogas production



# BIOGAS PLANT 777 kW TECHENTIN

**Aim:** Increase of biogas yield, reduction of feed stock

Location	D-Techentin
CHP	777 kW
Ultrasound power	4 kW
Feed stock	maize silage

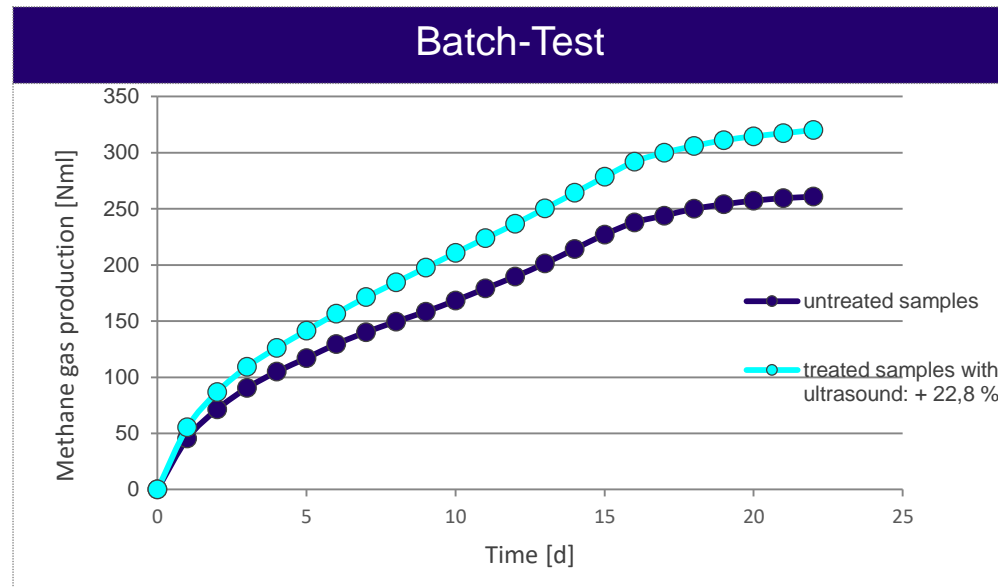




# BIOGAS PLANT 777 kW TECHENTIN

## Result:

22,8% higher biogas production





# BIOMETHANE PRODUCTION PLANT KÖNNERN

**Aim:** Increase of efficiency – More biogas, less feed stock

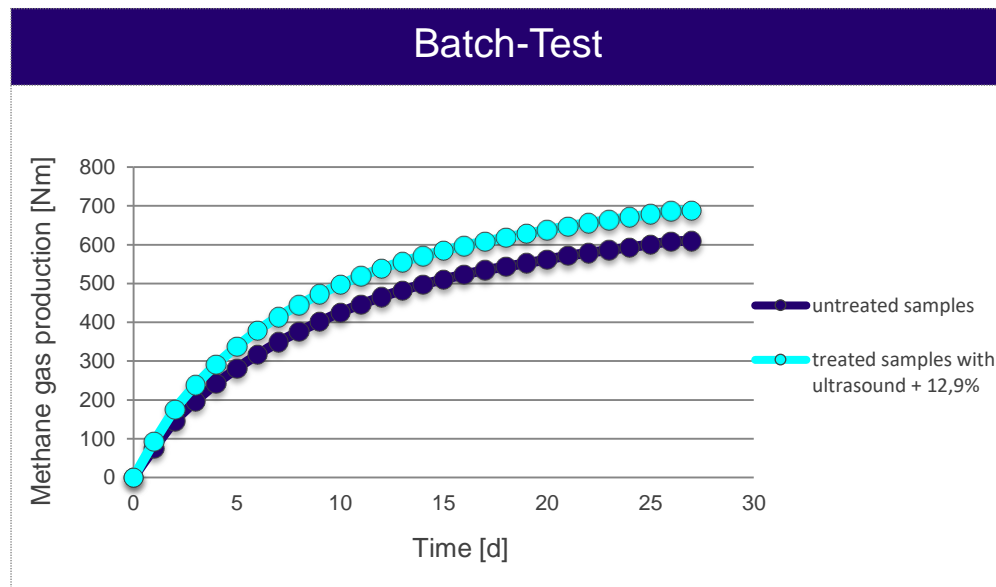
Location	D-Könnern
Biomethane Nm <sup>3</sup> /h	150
Ultrasound power	4 kW
Feed stock	maize silage, liquid manure



# BIOMETHANE PRODUCTION PLANT KÖNNERN

## Result:

More than 12% higher biogas  
production



# BIOGAS PLANT 250 kW RASTDORF

**Aim:** Preparation of the difficult substrate mixture

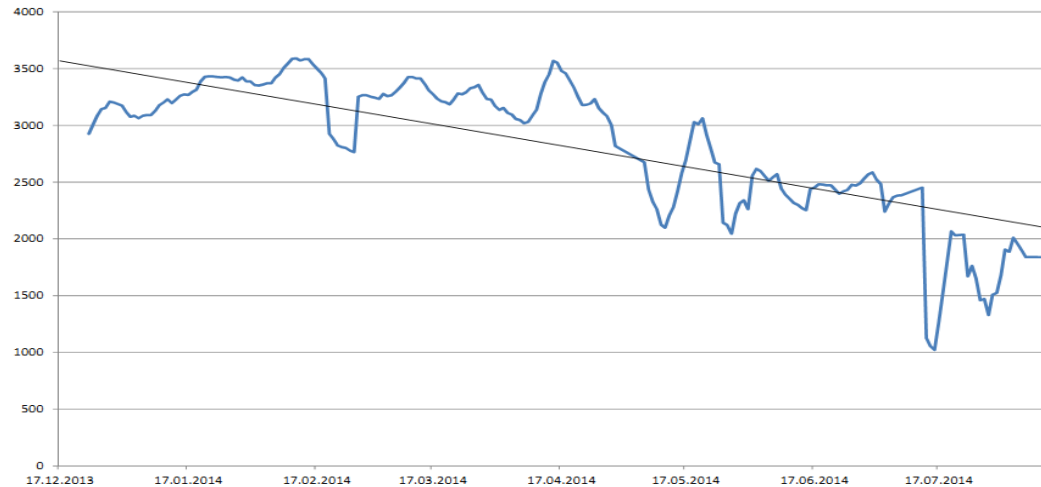
Location	D-Rastdorf
CHP	250 kW
Ultrasound power	4 kW
Feed stock	Cattle and horse manure, maize, catch crops





# BIOGAS PLANT 250 kW RASTDORF

**Result:** more homogenous substrate, reduced viscosity



Feeding VS after installation of disintegration plant in 7-days average

# BIOGAS PLANT 999 kW MAGLIANO

**Aim:** Increase of efficiency – More biogas, less feed stock

Location	I-Magliano i. d. Toscana
CHP	999 kW
Ultrasound power	6 kW
Feed stock	sorghum, maize silage, field beans, oats, clover, pasture grass

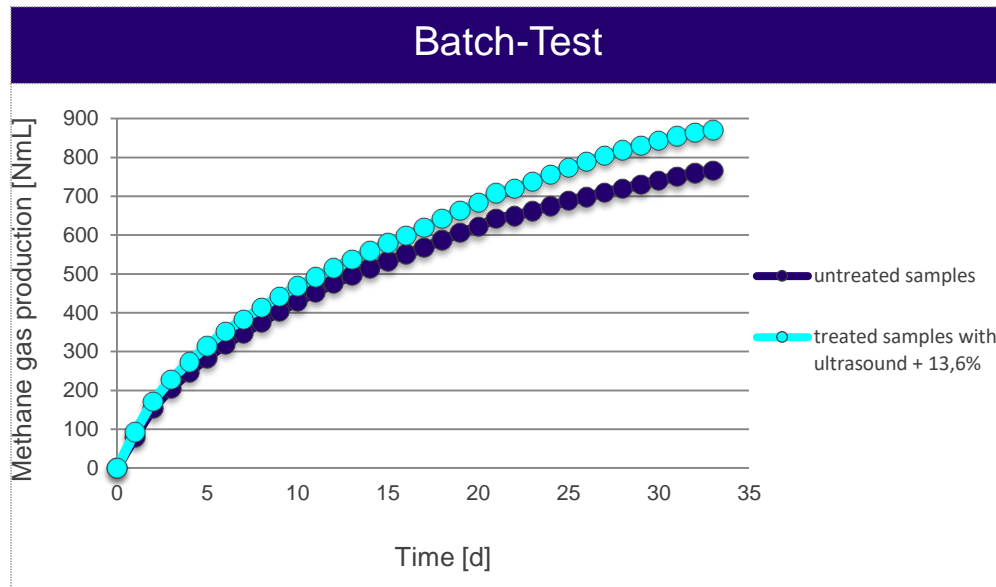




# BIOGAS PLANT 999 kW MAGLIANO

## Result:

More than 13% higher biogas production



# BIOGAS PLANT 330 kW ROSENBAACH

**Aim:** Increase of efficiency – More biogas, less feed stock

Location	D-Rosenbach
CHP	330 kW
Ultrasound power	2 kW
Feed stock	Maize silage, liquid manure

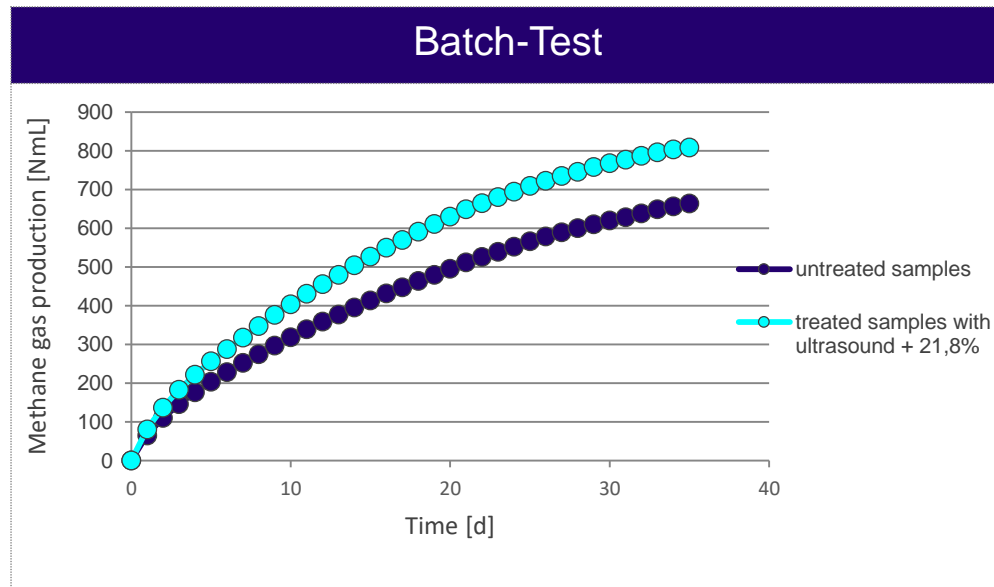




# BIOGAS PLANT 330 kW ROSENBAACH

## Result:

More than 21% higher biogas production







# WWTP– MOSCOW, RUSSIA

**Aim:** More biogas, reduction of disposal costs (less sludge)

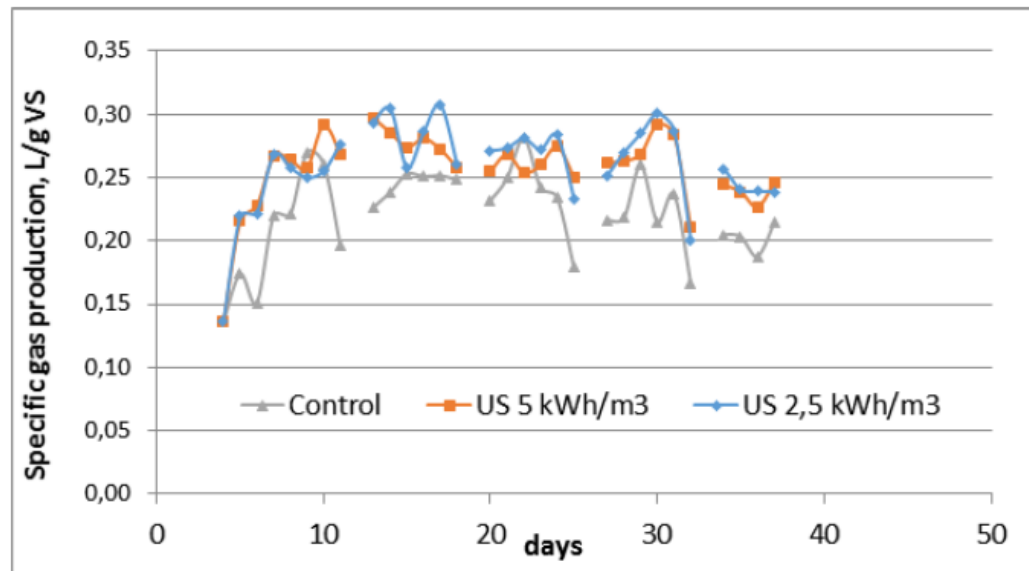
Location	RUS-Moscow
Population equivalents	12.000.000
Ultrasound power	2 kW test plant





# WWTP– MOSCOW, RUSSIA

**Result:** The plant operator bought a test plant from Weber Entec. A laboratory in Moscow carried out tests and wrote a final report. An increase up to 17% of the gas yield of the ultrasound treated samples was confirmed.



# WWTP SINGAPORE

**Aim:** More biogas, reduction of disposal costs (less sludge)

Location	Singapore
Population equivalents	1.500.000
Ultrasound power	32 kW



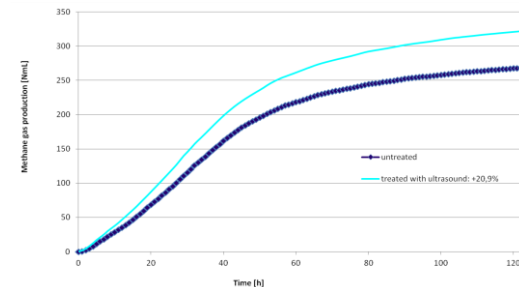
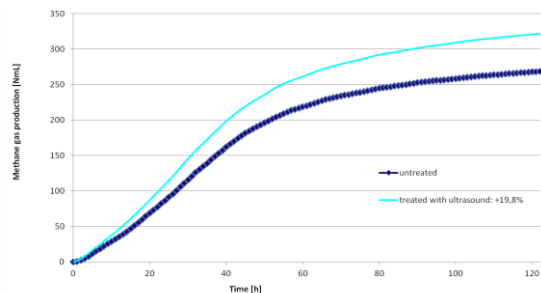
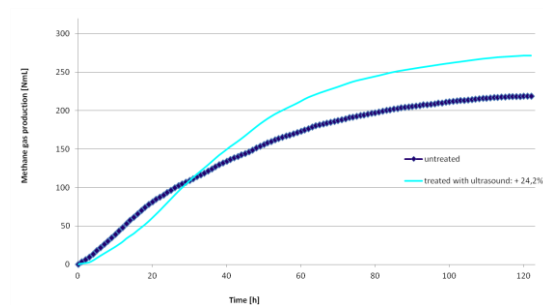
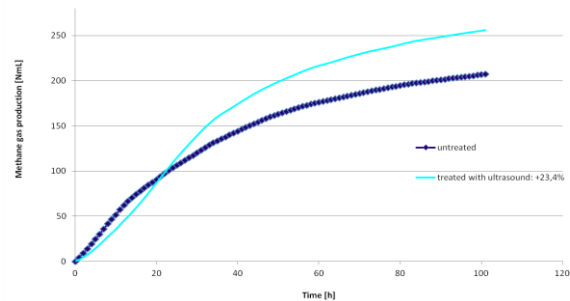
Over a period of 8 weeks, various samples were taken and the increase of gas yield of the ultrasound treated samples compared to the untreated samples.

A selection of these tests is to find on the next slide.



# WWTP SINGAPORE

**Result:** An independent laboratory confirmed the average performance increase as 22%.







# 02 PRESS









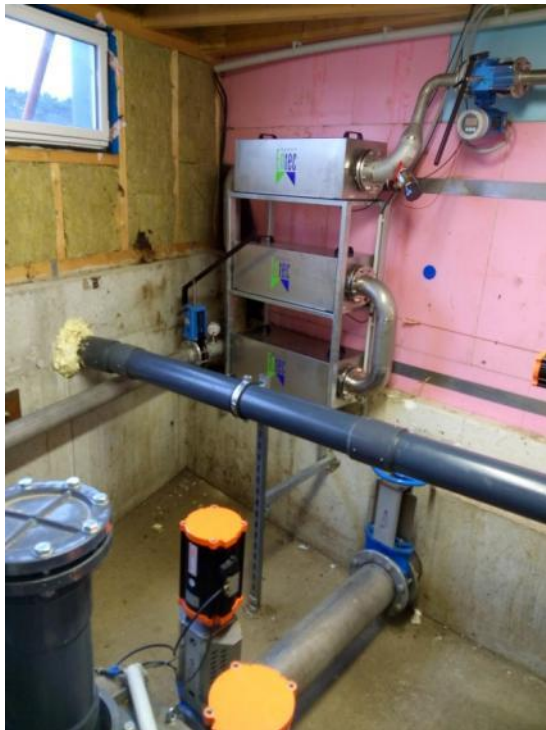


# 03 INDIVIDUAL SOLUTIONS, INSTALLATIONS











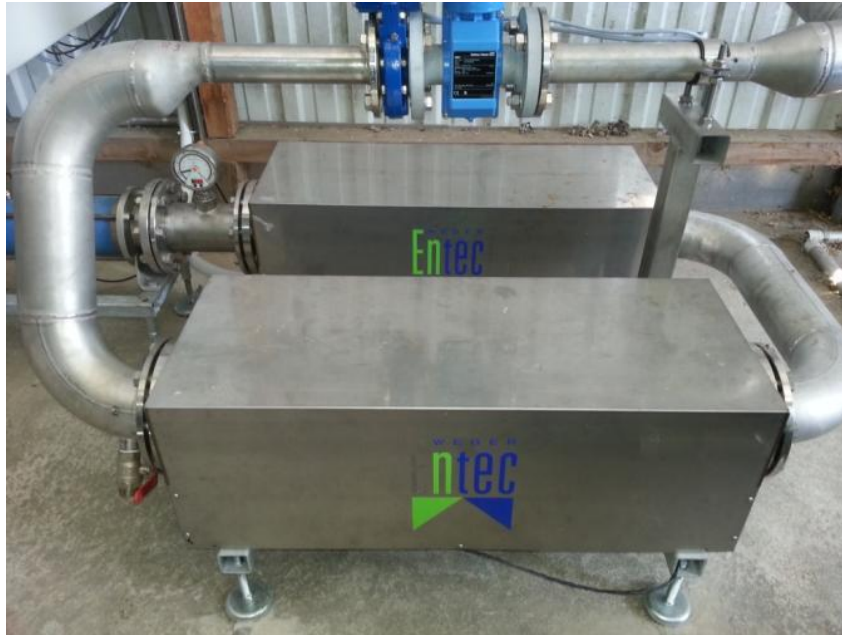






















**THANK YOU**