WEBER ENTEC

INCREASED EFFICIENCY ON BIOGAS PLANTS AND WWTP THROUGH ULTRASOUND DISINTEGRATION

WEBER ENTEC
ULTRASOUND AT ENVIRONMENTAL SECTOR

- Founded in 2010
- Worldwide sales and support network
- > 200 installations in 17 countries
- Market leader at ultrasound disintegration

SELECTED CUSTOMERS

WEBER ENTEC

Shell Low Carbon Solutions Biogas

nature energy

ABWASSERVERBAND ALTENRHEIN

NAWARO BioEnergie AG

BIOCIRC

enercity

agri.capital

swb

Haslachhof Familie Wiggert

e·on

PUB SINGAPORE'S NATIONAL WATER AGENCY

ATAGO CORPORATION

KTG Energie AG

OptiGas BY NEF

TSK TSUKISHIMA KIKAI

渠務署 Drainage Services Department

(주) 성진엠텍 Sungjin M-Tec Co., Ltd.

KURITA

APPLICATION OF ULTRASOUND DISINTEGRATION

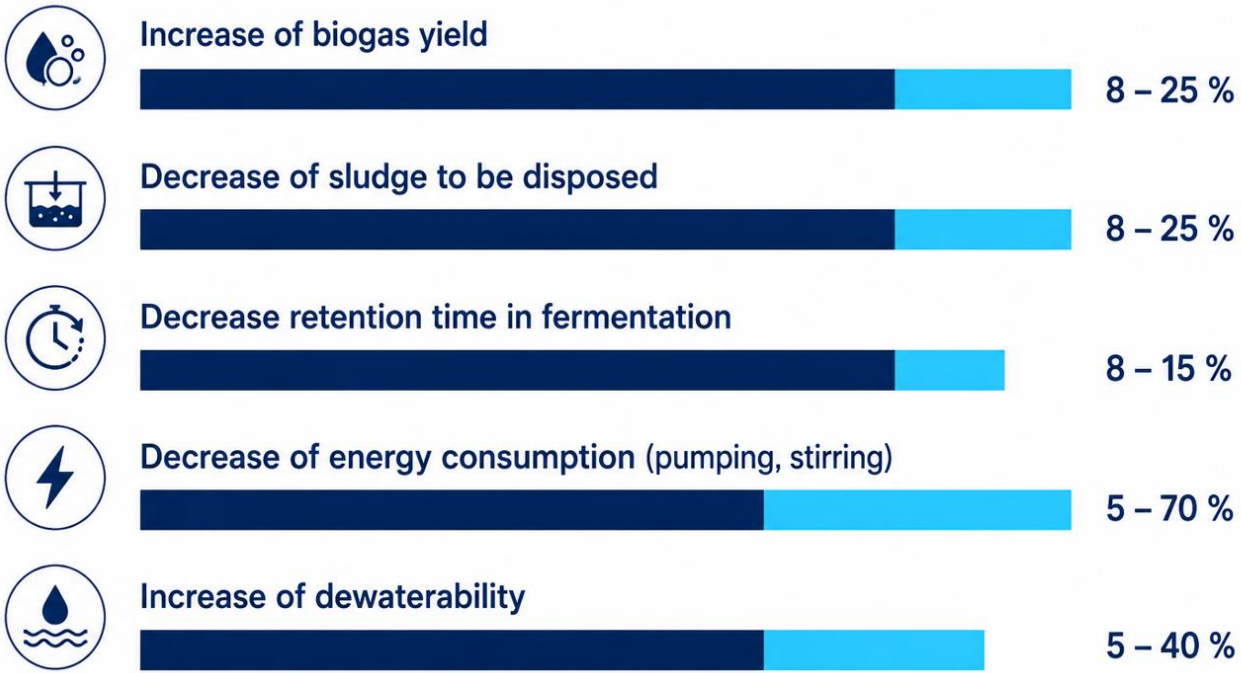
- Increase of biogas production
- Reduction of feed stock at equal performance
- Acceleration of organic degradation
- Consistent decrease of viscosity
- Reduction of pump- and stirring energy demand

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

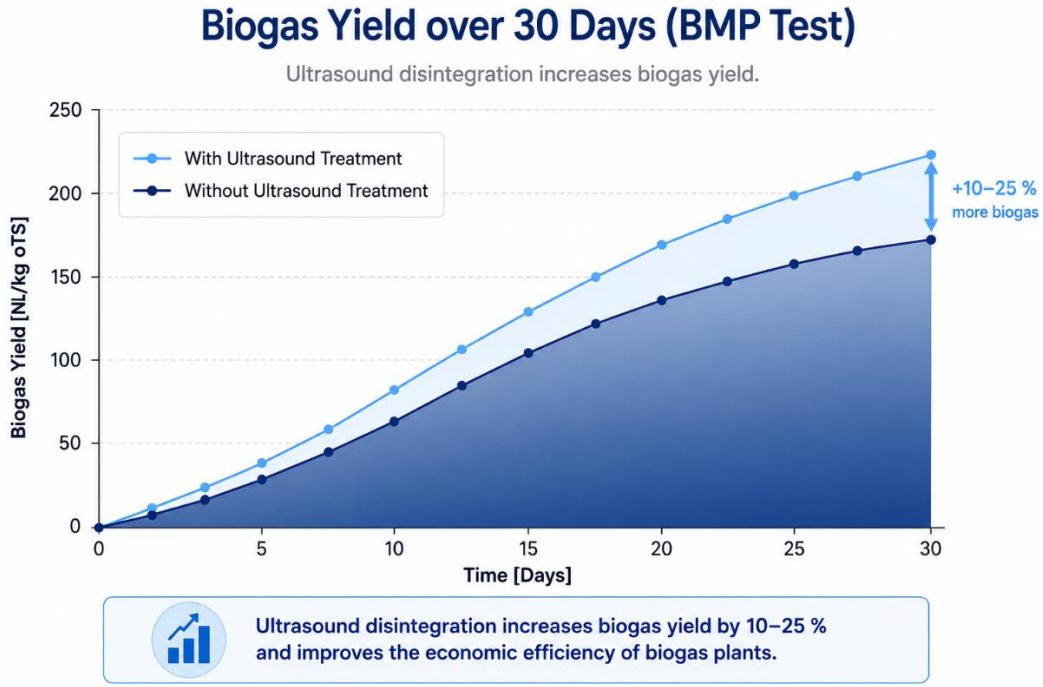
RANGE OF PERFORMANCE

WEBER ENTEC

EFFECTS OF ULTRASOUND DISINTEGRATION



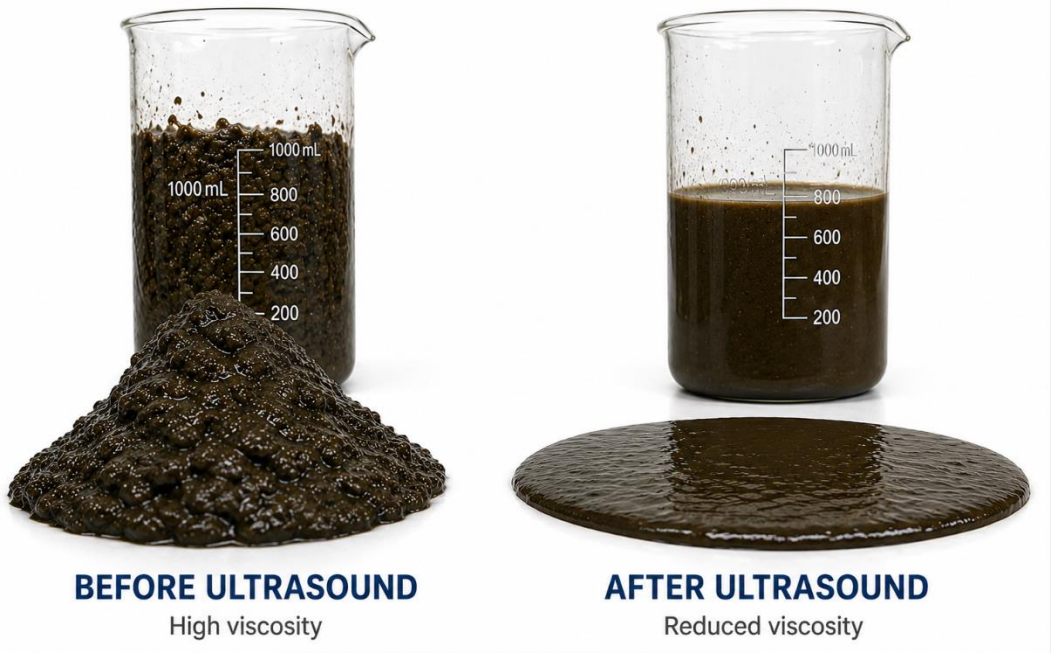
HIGHER GAS YIELD



How ultrasound drives performance

- Increases effective biomass surface area for microbial activity.
- Improves contact between microbes and substrate, boosting mass transfer.
- Accelerates biological conversion (faster hydrolysis and downstream steps).
- Delivers higher gas yield from the same feedstock, or the same yield with less substrate.
- Supports processing of more challenging substrates by improving conversion kinetics.

REDUCED VISCOSITY



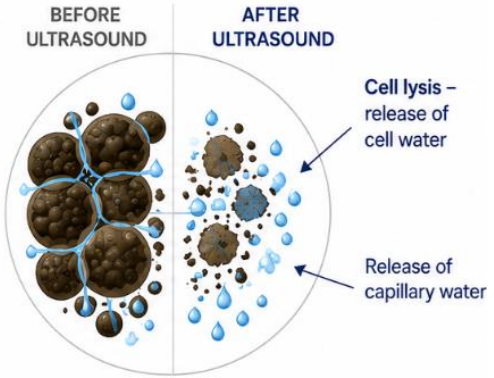
After BioPush Treatment:

- Reduced viscosity
- Ultrasound improves dewaterability through cell lysis
- Improved flow characteristics
- Lower energy demand for pumping, stirring
- Increased biological stability
- Higher share of difficult substrates can be processed (e.g. grass, manure, etc)

IMPROVED DRAINABILITY

WEBER ENTEC

- Ultrasound causes **cell lysis**
  → **Intracellular water** is released
- **Capillary water** is also liberated
  → Water is **less tightly bound**
- **Improved floc structure** and drainability
- **Higher solids** content
- **Reduced sludge volume** and disposal costs



INTEGRATION AT DEWATERING PLANT

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Usual installation

3-5 % DS

Dewatering machine

25 % DS

50 % improvement

Installation with US

3-5 % DS

Ultrasound unit

Dewatering machine

37,5 % DS

SIGNIFICANT CO_2 REDUCTION !

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Operating a biogas plant requires energy

- Stirrers
- Pumps
- Feeding
- Recirculation, etc.

Production of substrates requires energy

Substrates emit CO_2

Disposal of the fermentation product requires energy

Ultrasound technology reduces energy demand at multiple points and significantly lowers CO_2 emissions.

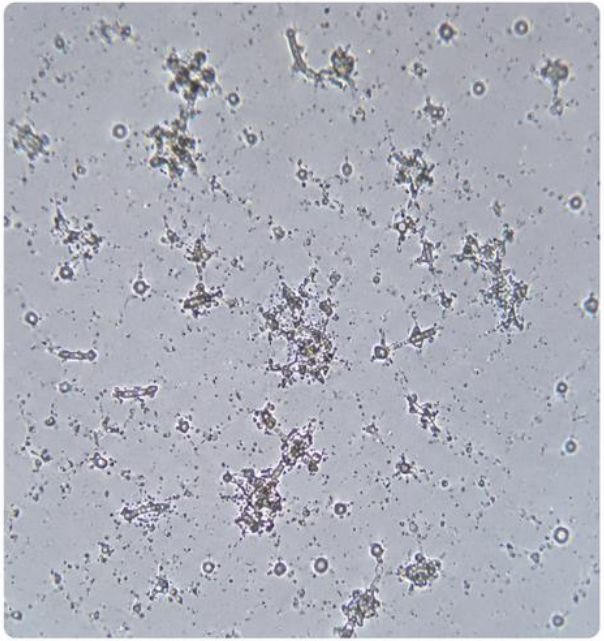
ELIMINATING FILAMENTOUS BACTERIA

WEBER ENTEC

BEFORE ULTRASOUND TREATMENT

Intact filamentous bacteria (e.g. Microthrix parvicella) cause foam formation and can lead to fermenter overflow.

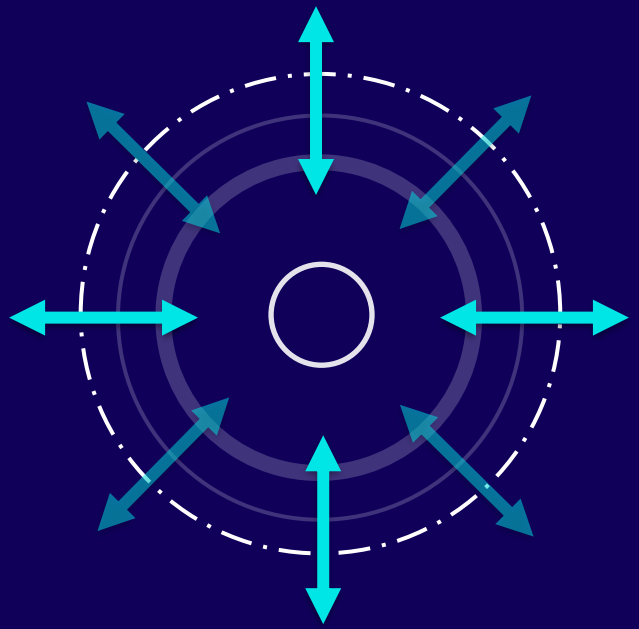
AFTER ULTRASOUND TREATMENT



Ultrasound effectively destroys filamentous bacteria reliably and energy-efficiently – without chemicals.

Filamentous bacteria such as *Microthrix parvicella* frequently cause foam formation and can even lead to fermenter overflow. Ultrasound destroys filamentous bacteria reliably and energy-efficiently — without the use of chemicals.

Physical Principle

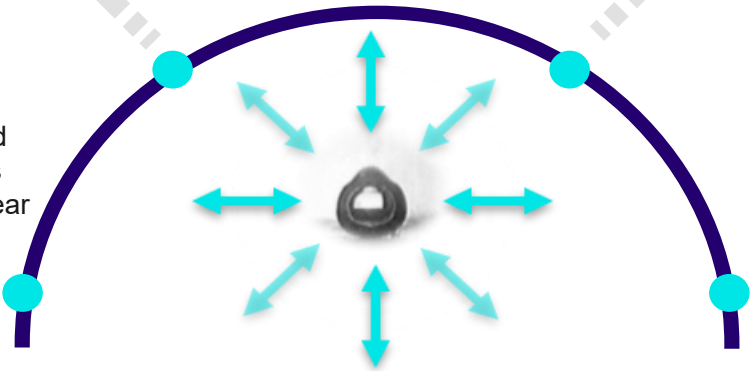


CAVITATION- BENEFITS

high shear force
+ shears up the substrates
+ liberates enzymes
+ accelerates biological degradation process

better mixing
+ mixes incompatible liquid, emulsification
+ increases reaction area
+ better mass transport
+ better energy transport

lower viscosity
+ lower energy demand
+ lower operation costs
+ reduce equipment wear



high temperatur and hign pressure
+ releases OH-Radical
+ accelerates the chemical reactions
+ Temperature up to 5.000 C°
+ Presssure up to 1.000 bar

Implosion of Cavitation bubbles

WEBER ENTEC APPLICATIONS

Weber Entec GmbH & CO. KG

Turn Key Ultrasound Equipment

> 200 Installations

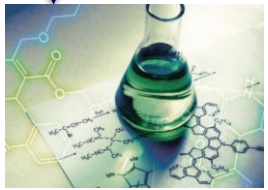
In 17 Countries

Biogas plants

WWTPs

Olive Oil Production

Pharma Industry

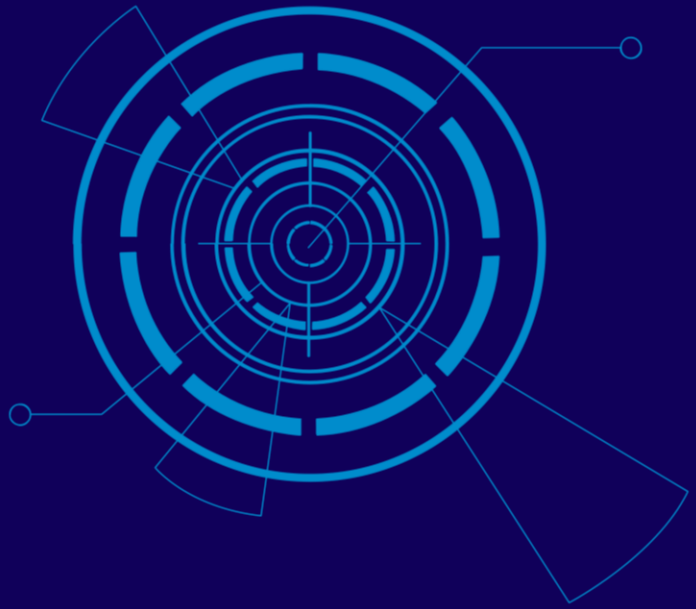


Chemical Industry

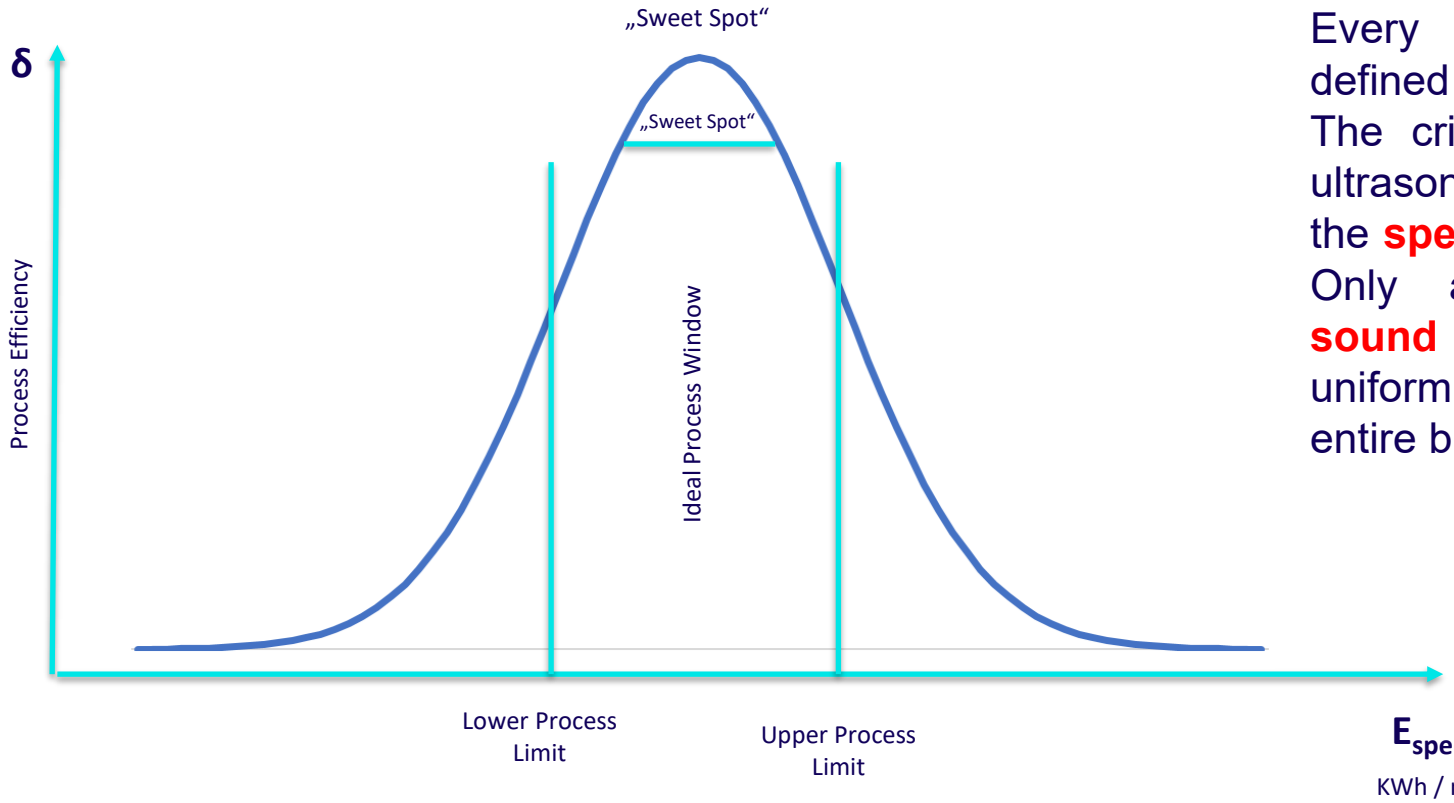
Paper Industry

USP, Technical advantages,

Product structure and performance



SPECIFIC ENERGY – PROCESS WINDOW



Every process has a defined **process window**. The critical parameter in ultrasonic disintegration is the **specific energy** input. Only a **homogeneous sound field** ensures uniform treatment of the entire biomass.

ULTRASOUND REACTOR BIOPUSH

WEBER ENTEC

- Clogging free, maintenance free, high durability
- Homogeneous treatment
- Defined intensity of treatment

TRADITIONAL ULTRASOUND TECHNOLOGY

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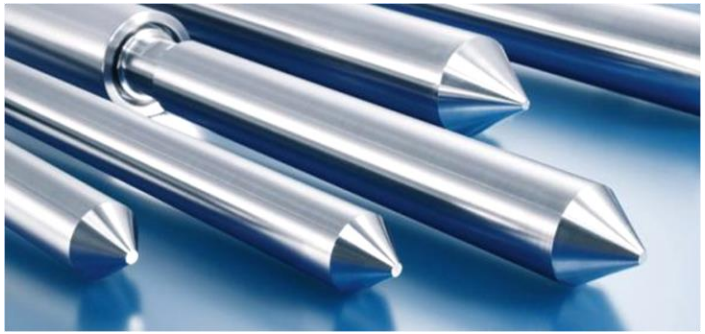
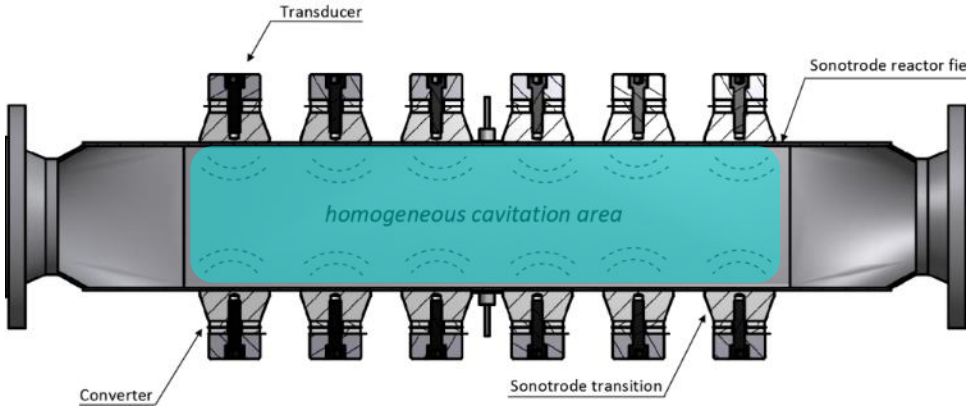
- High erosion
- Inhomogeneous ultrasound field, due to spot irradiation
- Significant perforamance decrease due to erosion
- Thereby higher maintenance because permanent rinsing is necessary
- Reactors obstruct easily
- Higher operating and maintenance costs



STD ULTRASOUND VS BIOPUSH IN FLOW

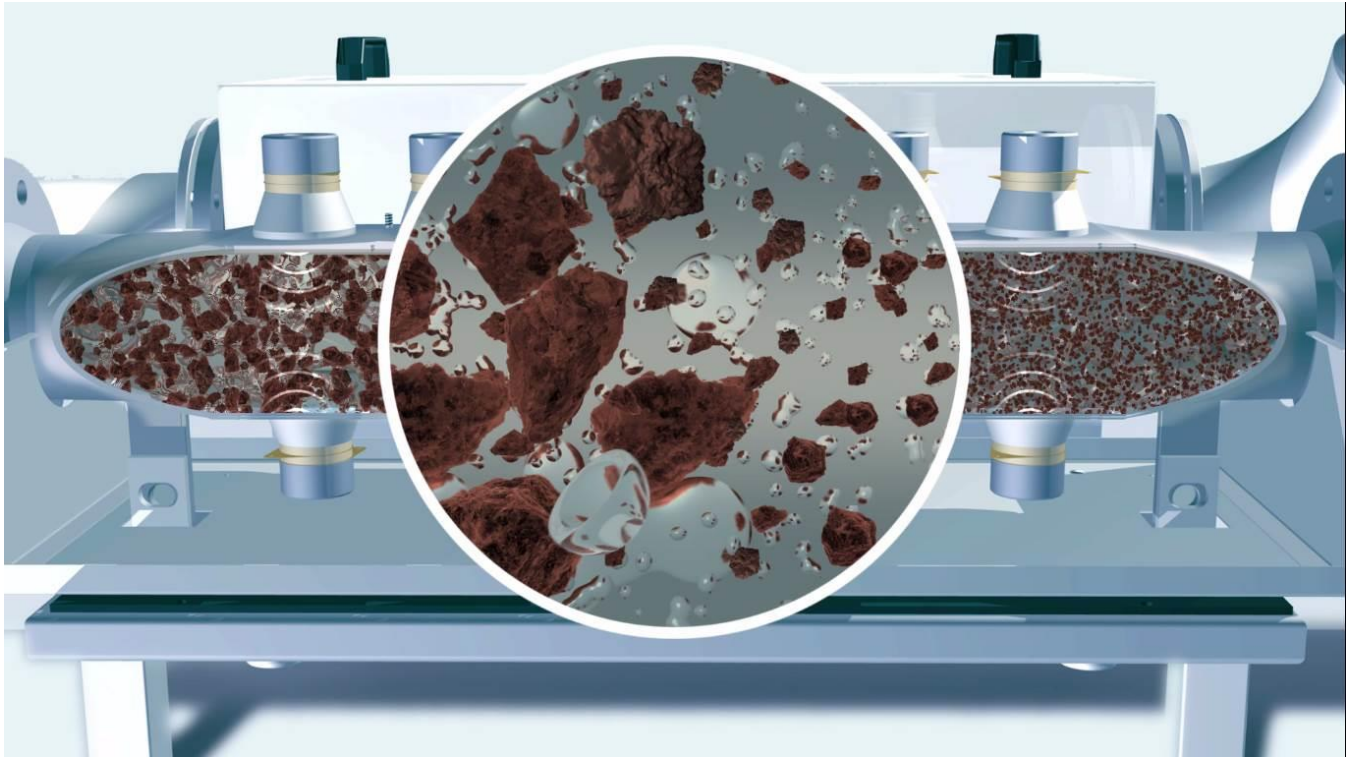
- ***Hot Spots*** – Inhomogeneous sound field
- High **erosion**
- **Poor** energy yield
- High **maintenance** / risk of clogging



- **Homogeneous** cavitation field
- Long **duration**
- Precise energy entry **control**
- No clogging – **process stability**

ULTRASOUND REACTOR BIOPUSH – THE NEXT GENERATION ULTRASOUND

WEBER ENTEC



GENERAL MACHINE DESIGN DESIUS

WEBER ENTEC

1 Ultrasound unit

Cell rupture and surface augmentation

Mobilization of Exo-Enzymes

Sustained decrease of viscosity in fermenter

Ultrasonic power 1.2 kW per unit

High durability – up to 6 years and more

2 Mechanical Pre- treatment

Improved sound efficiency and machine protection RotaCut

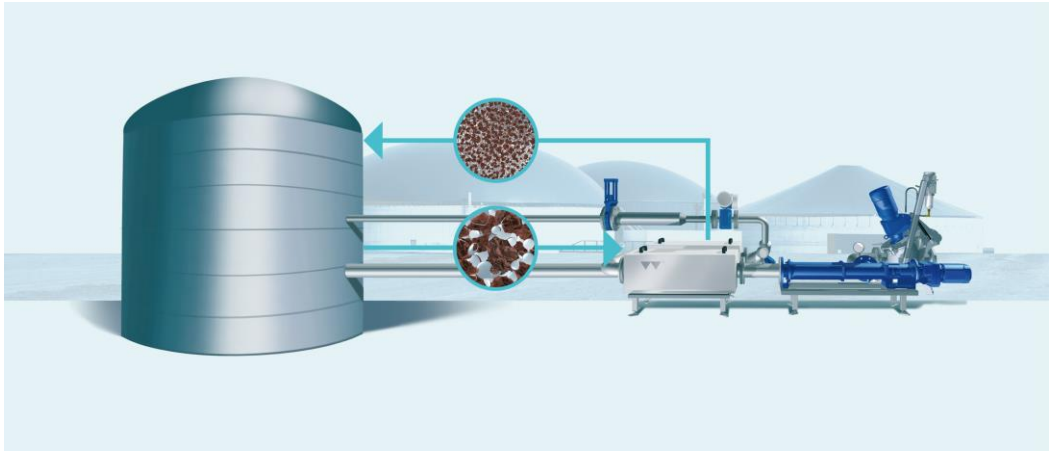
3 Feeding pump

Excentric screw pump

Sensors

4 2 x pressure gages,
2 x temperature sensor,
1 x flow meter

INTEGRATION IN BIOGAS PLANTS



Main digester Ultrasound unit

In most cases, the ideal integration is a recirculation loop at the main digester.
Biomass is continuously extracted, treated with ultrasound, and returned to the digester.

Depending on the process design, recirculation from the secondary digester or feeding from hydrolysis directly into the main digester via ultrasound treatment can also be beneficial.

POSSIBLE INTEGRATION EXAMPLES IN WWTP

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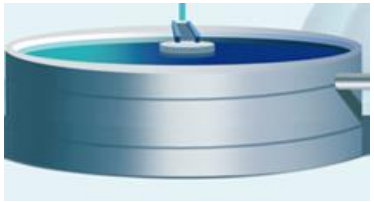
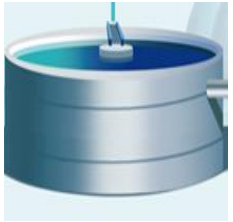


Prethickner

Utrasound unit



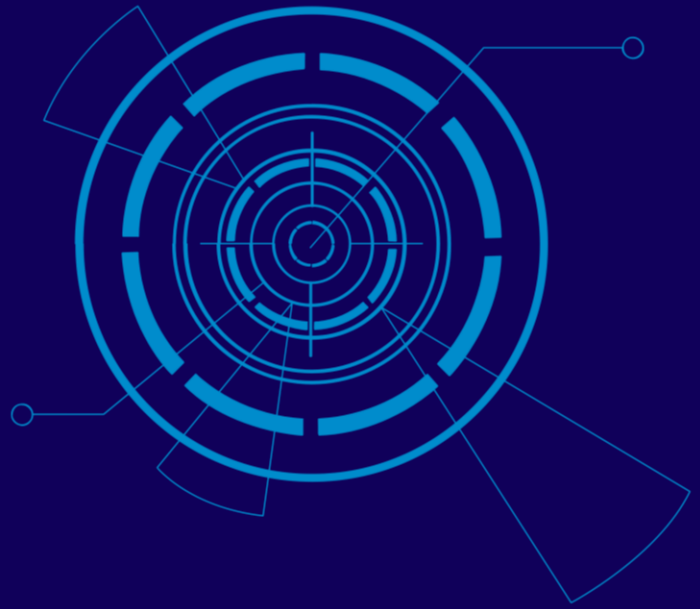
Dosing Tank

Dewatering

REFERENCELIST AND CASE STUDIES

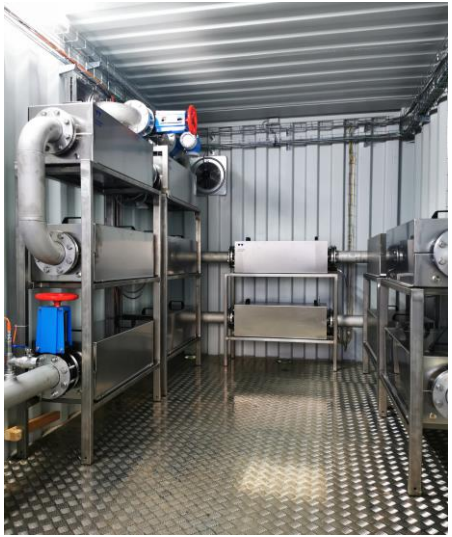
NOTE: WE HAVE NUMEROUS FURTHER CASE STUDIES AND REFERENCES. IN CASE OF INTEREST PLEASE CONTACT US AT:

MAIL@WEBER-ENTEC.COM



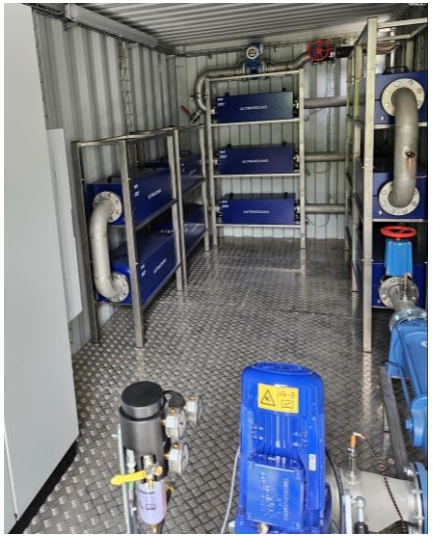
BIOGAS PLANT DENMARK

Location	Mansson
Ultrasound power	24 kW



BIOGAS PLANT DENMARK

Location	Vaarst
Ultrasound power	78 kW



BIOGAS PLANT DENMARK

Location	Vaarst
Ultrasound power	78 kW

- 3 Ultrasound machines
- Each 13 ultrasound reactors
- Current feedstock: Manure, deep litter, food waste, solid biomass

BIOGAS PLANT DENMARK

Location	Midtfyn
Ultrasound power	158 kW

- 5 Ultrasound machines
- 4 containers with 17 ultrasound reactors
- 1 container with 11 ultrasound reactors
- Current feedstock: Manure, deep litter, crops,food waste

BIOGAS PLANT 250 KW RASTEDE

Target: Alternative feeding: Replace maize through grass

Location	Rastede
CHP	250kW
Ultrasound power	2 kW
Feedstock	Maize silage, Grass, slurry, manure, whole plant silage

BIOGAS PLANT 250 KW RASTEDE

Base line: Maximum possible feed of grass is 4 t/d before getting problems at the biogas plant. 10t/d cheap grass are available

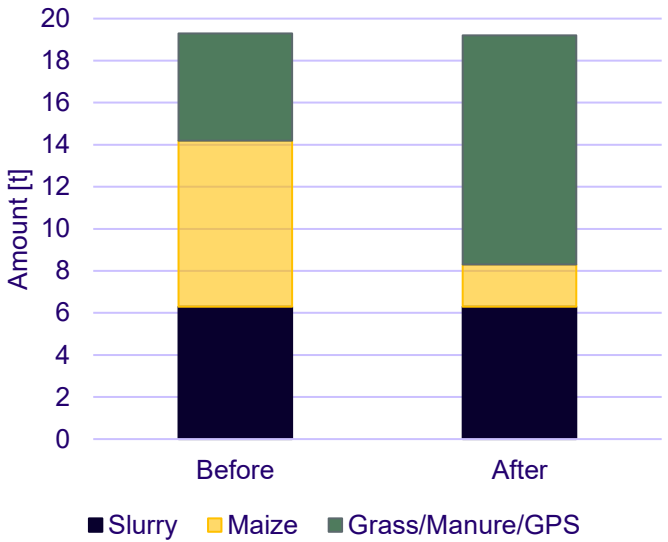
Result:

1) 10 t/d of grass can be fed now

2) reduction of feeding costs: **25 %**

3) Oparation of the biogas plant without any problems

Input before and after installation of ultrasound



BIOGAS PLANT 1250 KW GROSSENWIEHE

Target: Reduction of viscosity, saving of substrate

Location	Großenwiehe
CHP	2570 kW
Rated power	1250 kW
Ultrasound power	12 kW
Feedstock	Maize silage, Grass, Grain-whole plant silage

BIOGAS PLANT 1250 KW GROSSENWIEHE

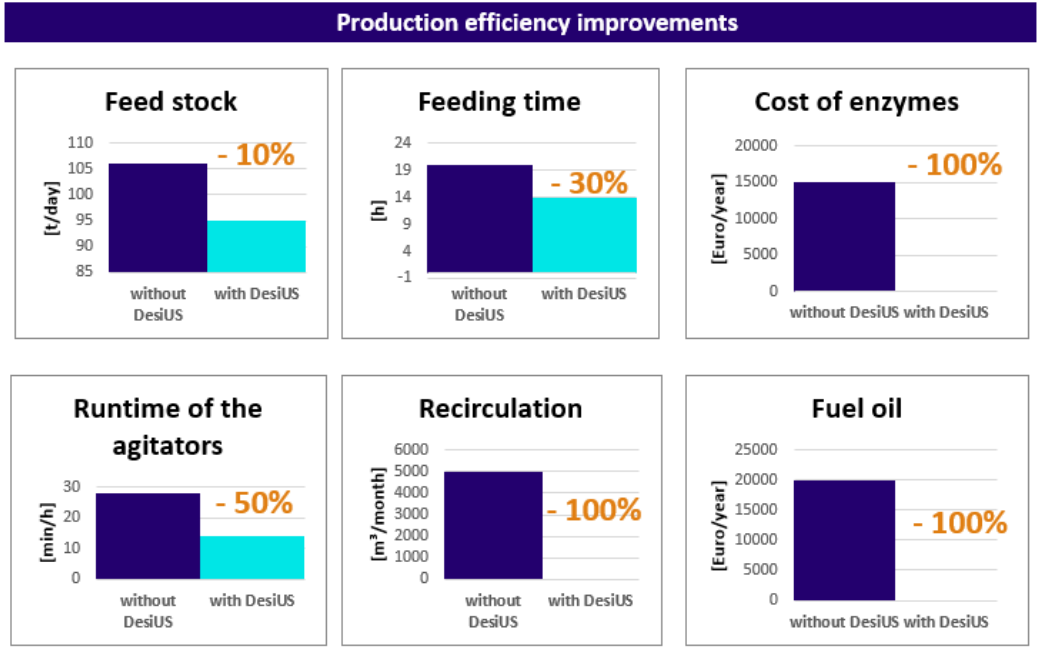
WEBER ENTEC

Result:

Several improvements to the biogas plant increase efficiency.

The overall process stability is improved. This leads to less down times at the biogas plant.

The heating network can now be fully supplied by the biogas plant in winter.



WWTP– ALTENRHEIN SWITZERLAND

WEBER ENTEC

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

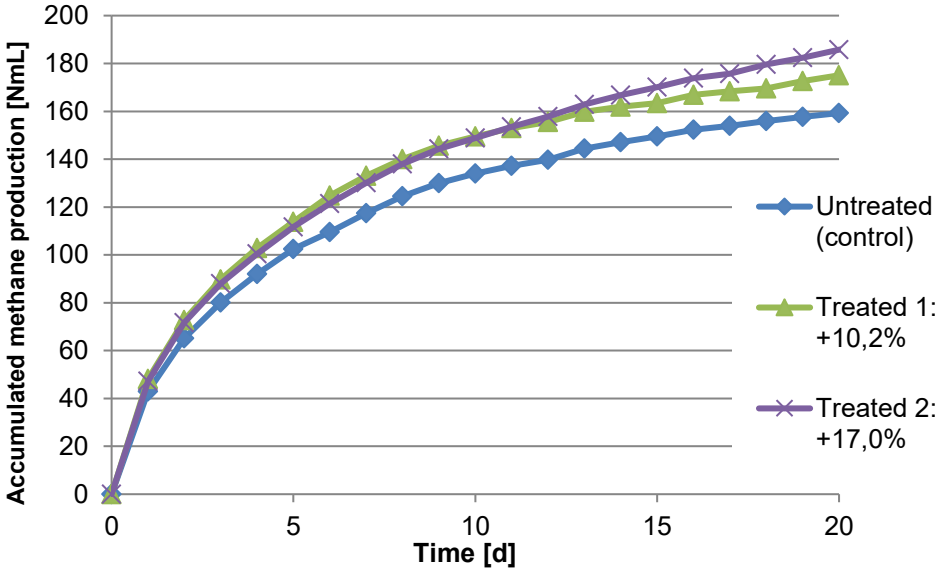
WEBER ENTEC

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.

WWTP– ALTENRHEIN SWITZERLAND

Result:

- 17% higher gas production
- Improved flow properties
- Reduced sludge



WWTP Altenrhein

BIOGAS PLANT 395 kW KLEVE

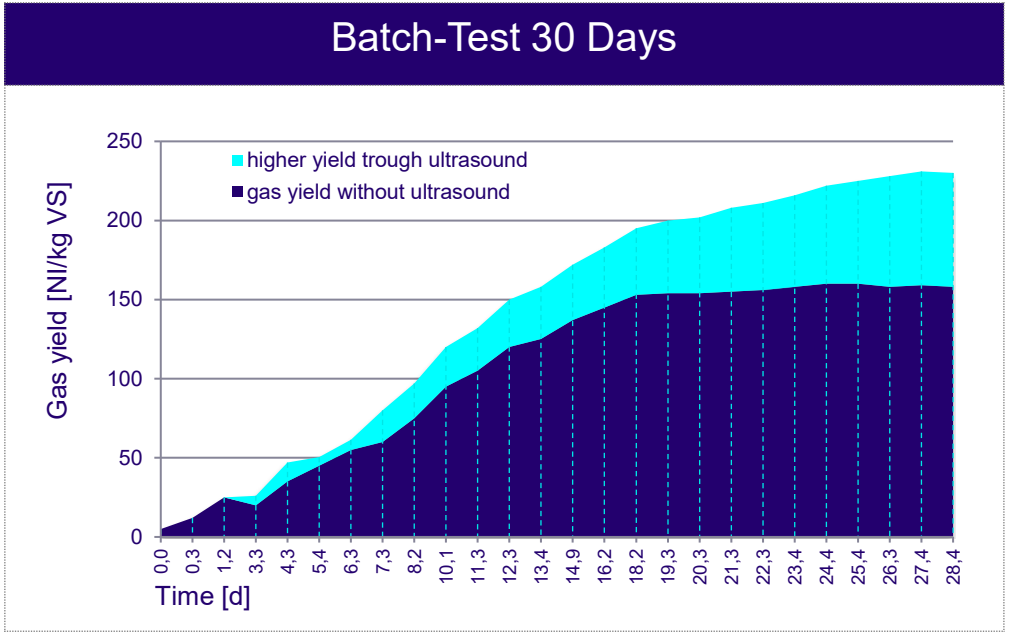
WEBER ENTEC

Target: Increase of biogas yield, reduction of feed stock (maize silage)

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.



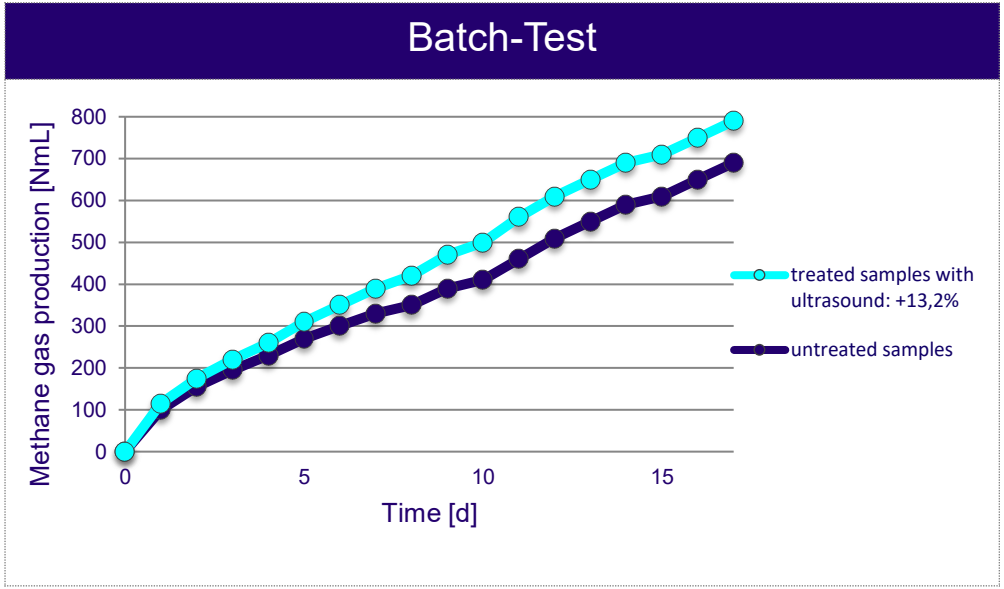
BIOMETHANE PLANT (~2MW$_{EL}$)

Target: Increase of efficiency – More biogas, less feed stock

Location	D-Mühlacker
Biomethane Nm³/h	2 x 500 Nm³/h
Ultrasound power	16 kW
Feed stock	maize silage

BIOMETHANE PLANT (~2MW$_{EL}$)

- **Result:**
- More than 13% higher biogas production



BIOGAS PLANT 777 kW TECHENTIN

WEBER ENTEC

- **Target:** Increase of biogas yield, reduction of feed stock

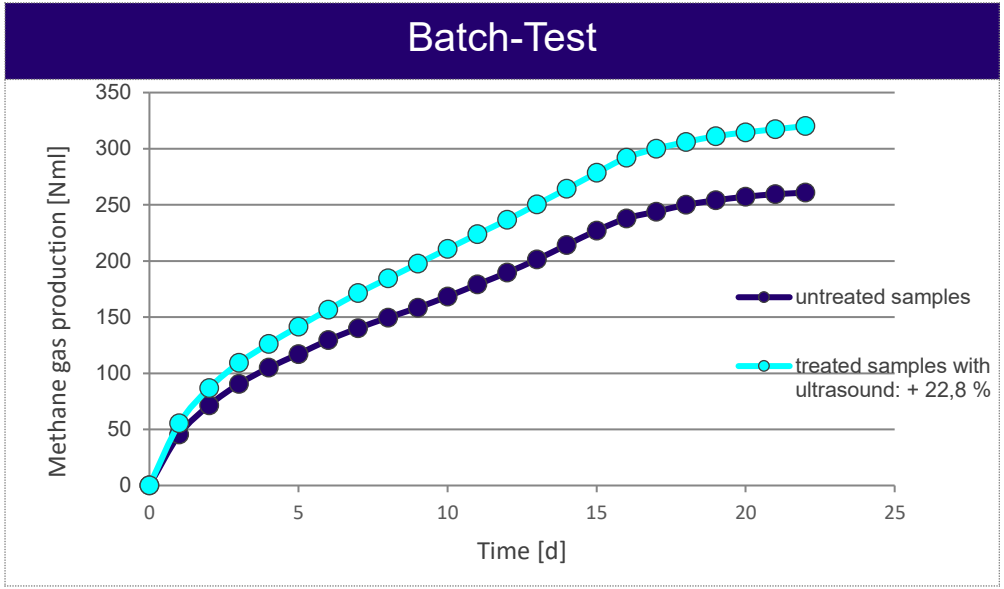
Location	D-Techentin
CHP	777 kW
Ultrasound power	4 kW
Feed stock	maize silage

BIOGAS PLANT 777 kW TECHENTIN

WEBER ENTEC

Result:

22,8% higher biogas production



BIOGAS PLANT 250 kW RASTDORF

WEBER ENTEC

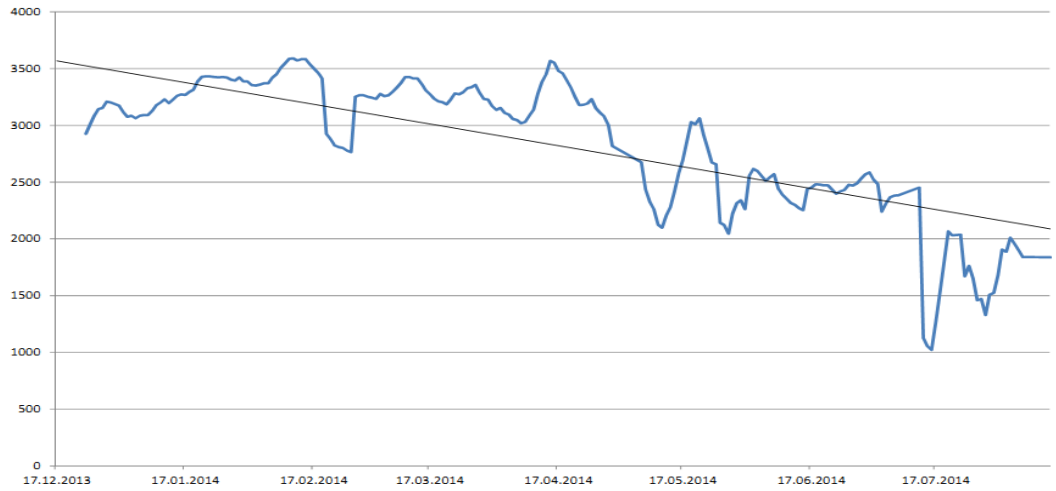
- **Target:** Preparation of the difficult substrate mixture

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

BIOGAS PLANT 250 kW RASTDORF

WEBER ENTEC

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



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

BIOGAS PLANT 999 kW MAGLIANO

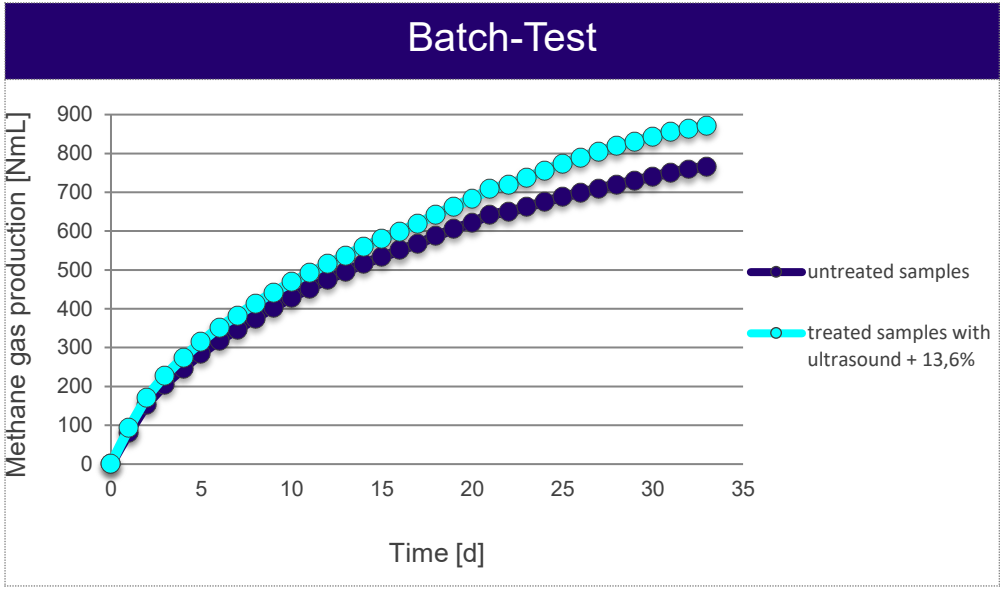
- **Target:** Increase of efficiency – More biogas, less feed stock

Location	I-Magliano i. d. Toskana
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 ROSENBACH

WEBER ENTEC

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

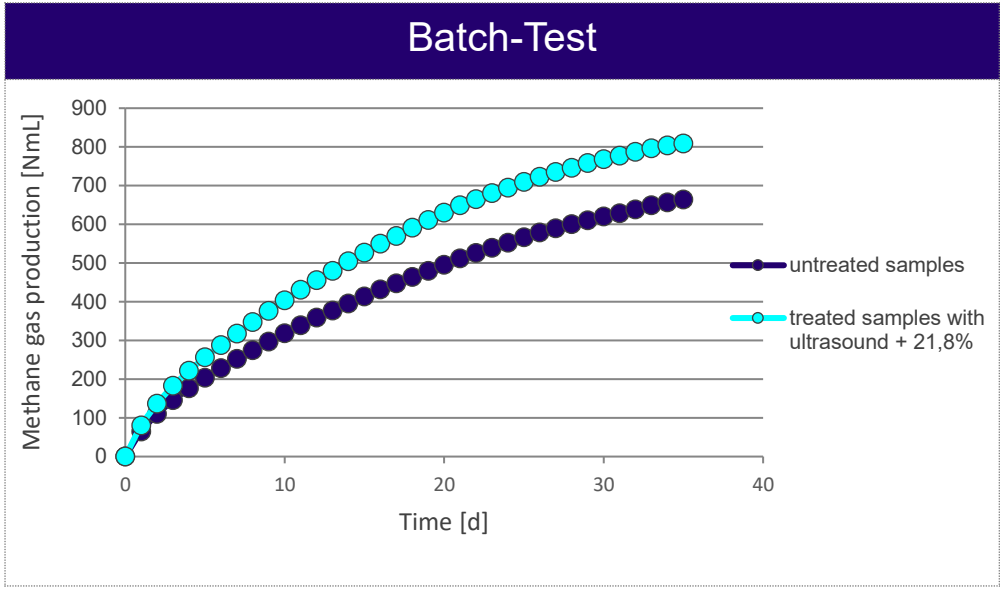
Location	D-Rosenbach
CHP	330 kW
Ultrasound power	2 kW
Feed stock	Maize silage, liquid manure

BIOGAS PLANT 330 kW ROSENBACH

WEBER ENTEC

Result:

More than 21% higher biogas production



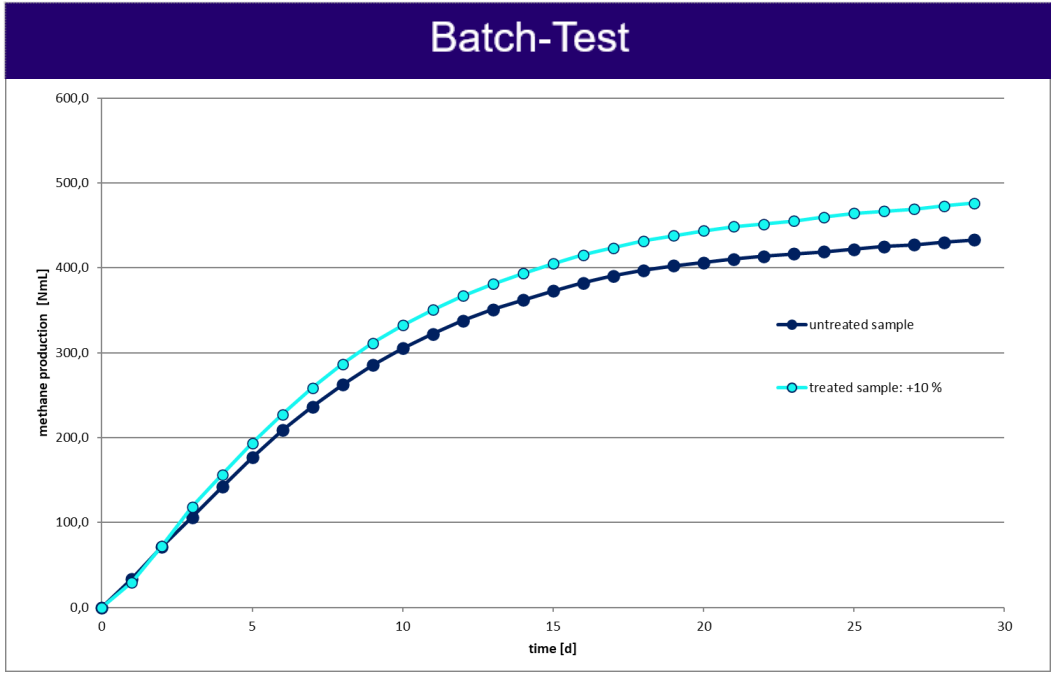
BIOGAS PLANT 1,8 MW

- **Target:** Reduction of viscosity and of feedstock

Location	Germany
CHP	1,8 MW
Ultrasound power	16 kW
Feed stock	Maize, beet, poultry manure liquid manure

BIOGAS PLANT 1,8 MW

- **Result:** 10 % more methane



BIOGAS PLANT 2,2 MW DENMARK

- **Target:** Reduction of viscosity, Increase of biogas production

Location	Denmark
CHP	2,2 MW
Ultrasound power	24 kW
Feed stock	Manure, vegetables, grass, sludge

BIOGAS PLANT 2,2 MW DENMARK

- **Target:** Reduction of viscosity, Increase of biogas production

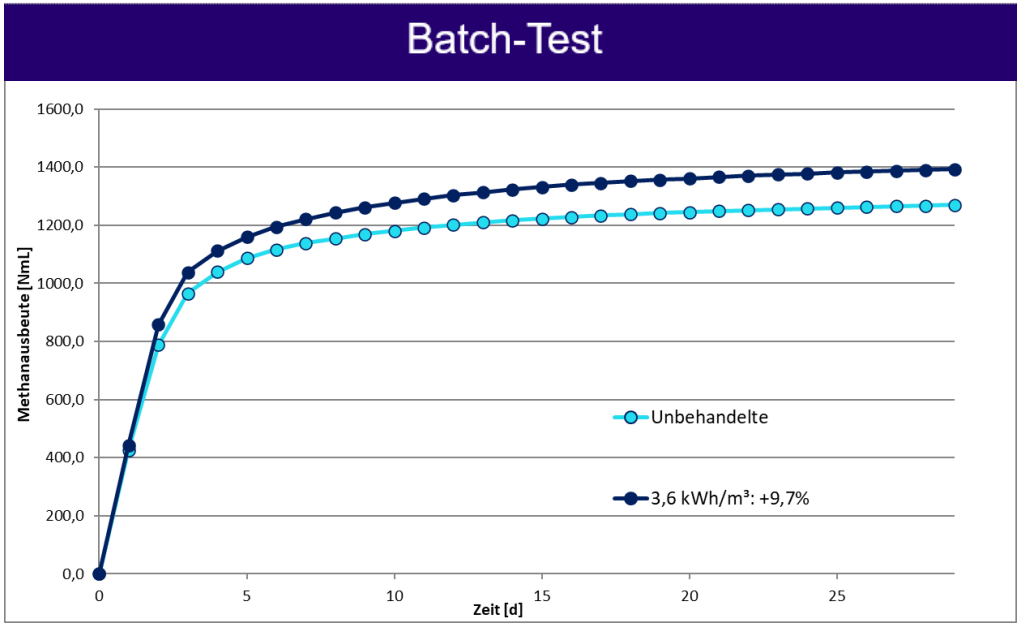
BIOGAS PLANT 296 Nm³/h Netherlands

- **Target:** Erhöhung der Biogasproduktion, Viskositätsreduziering im Hydrolysetank

Location	Niederlande
Heizleistung	1,5 MW/h
Ultrasound power	8 kW
Feed stock	poultry manure, Molke-Konzentrat

BIOGAS PLANT 296 Nm³/h Netherlands

- **Result:** About 10 % higher gas yield



WWTP IN FRANCE

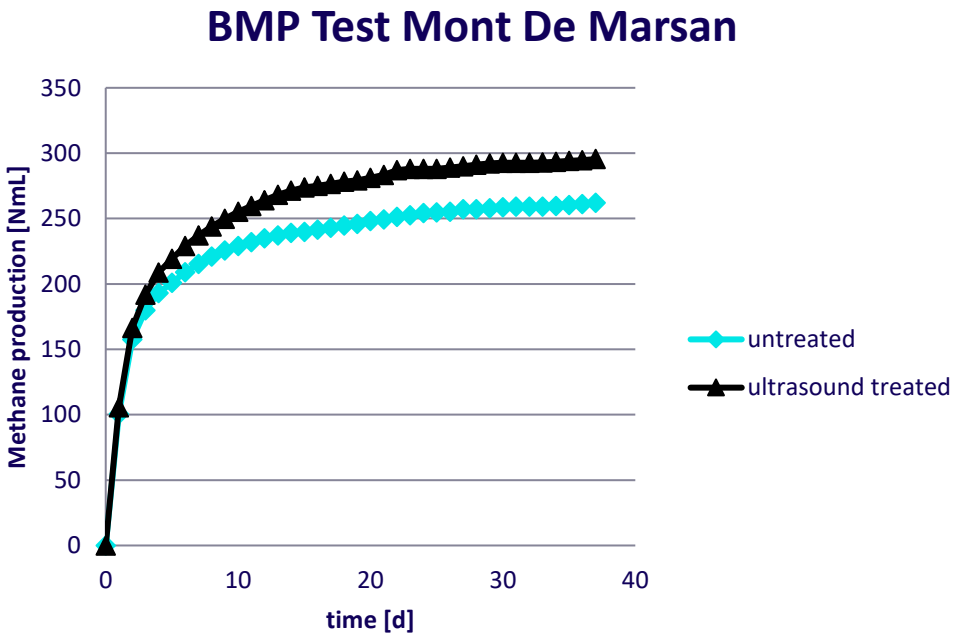
- **Target:** Increase of biogas production, Better grade of organic degradation, Reduction of disposal costs for sludge

Location	France
CHP	950 kW
Ultrasound power	10 kW
Feed stock	secondary & primary sludge, greases, external sludge

WWTP IN FRANCE

- **Result:** About 13 % higher gas yield

Batch-Test



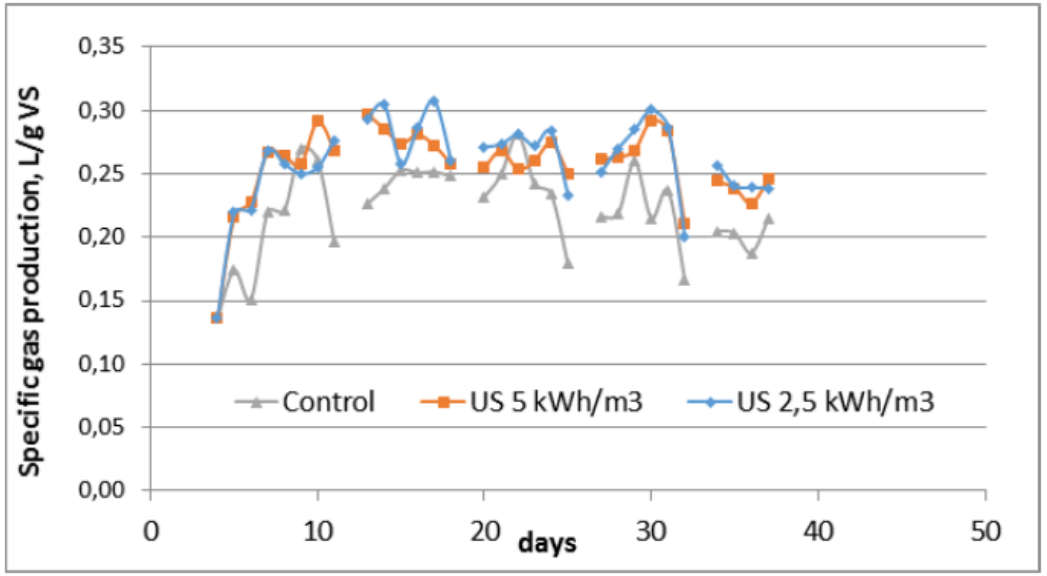
WWTP– MOSCOW, RUSSIA

- **Target:** 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

WEBER ENTEC

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

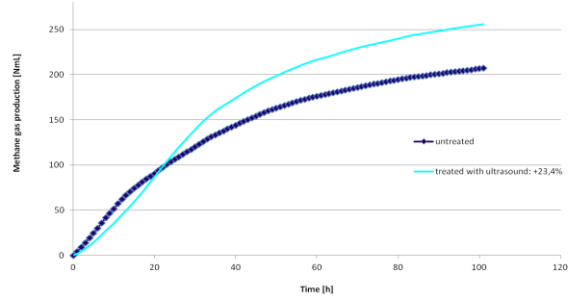
Location	Singapore
Population equivalents	1.500.000
Ultrasound power	32 kW

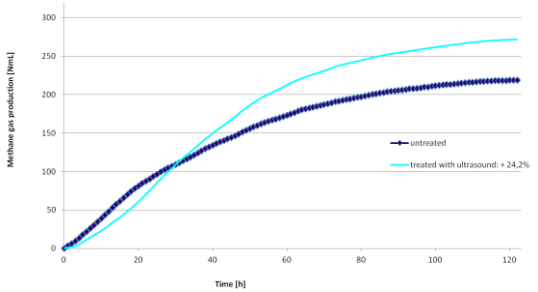
Over a period of 8 weeks, various samples were taken and the increase of gas yield of the ultrasound treated samples compared to the untreated samples.

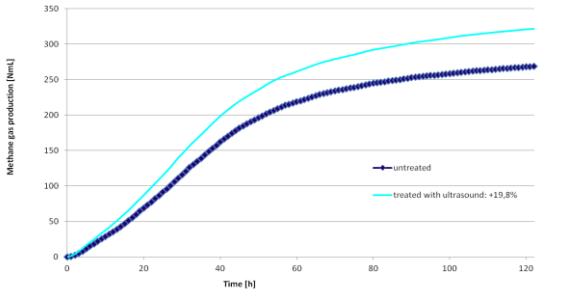
A selection of these tests is to find on the next slide.

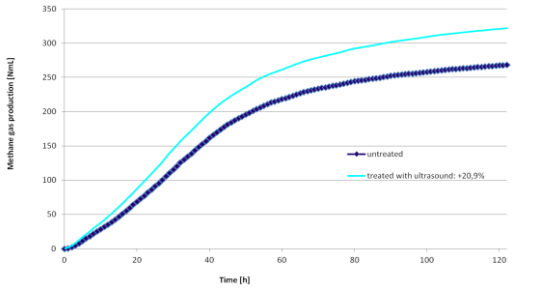
WWTP SINGAPORE

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









WWTP ULLU PANADAN SINGAPUR

WEBER ENTEC

WWTP TAIPO - HONGKONG

Target: More biogas, decrease of disposal costs (less sludge)

PE	900.000
Ultrasound power	24 kW

Customer wanted to improve his plant. Decision for ultrasound disintegration.
Weber Entec won the tender for delivery of the turn key machine.

WWTP TAIPO - HONGKONG

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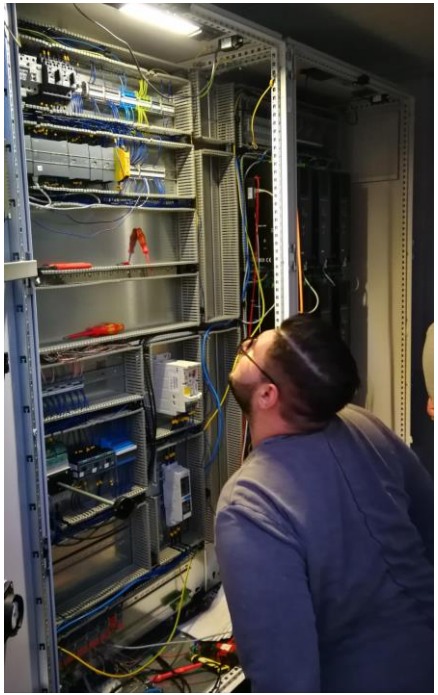
WEBER ENTEC

WWTP TAIPO - HONGKONG

WEBER ENTEC



WWTP KAUNAS, LITHUANIA

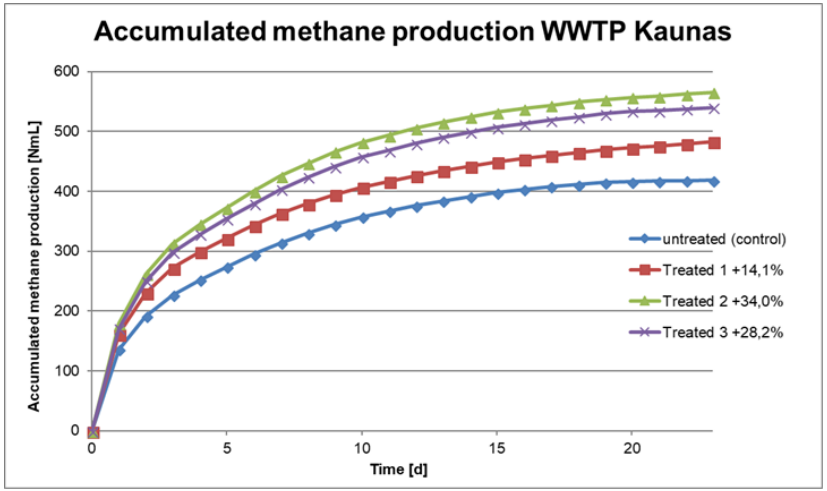
- **Target:** More biogas, decrease of disposal costs (less sludge), reduction of the fiber b

Location	LTU-Kaunas
Population equivalents	900.000
Ultrasound power	28 kW

Customer wanted to improve his plant. Decision for ultrasound disintegration.
Weber Entec won the tender for delivery of the turn key machine.

WWTP KAUNAS, LITHUANIA

- **Result:** A laboratory carried out tests. An increase up to 34 % of the gas yield of the ultrasound treated samples was confirmed. Filamentous bacteria were significant reduced.



BIOGAS PLANT THAILAND

Location	TH - Surat Thani
Ultrasound power	6 kW
Feed stock	POME, Decanter cake

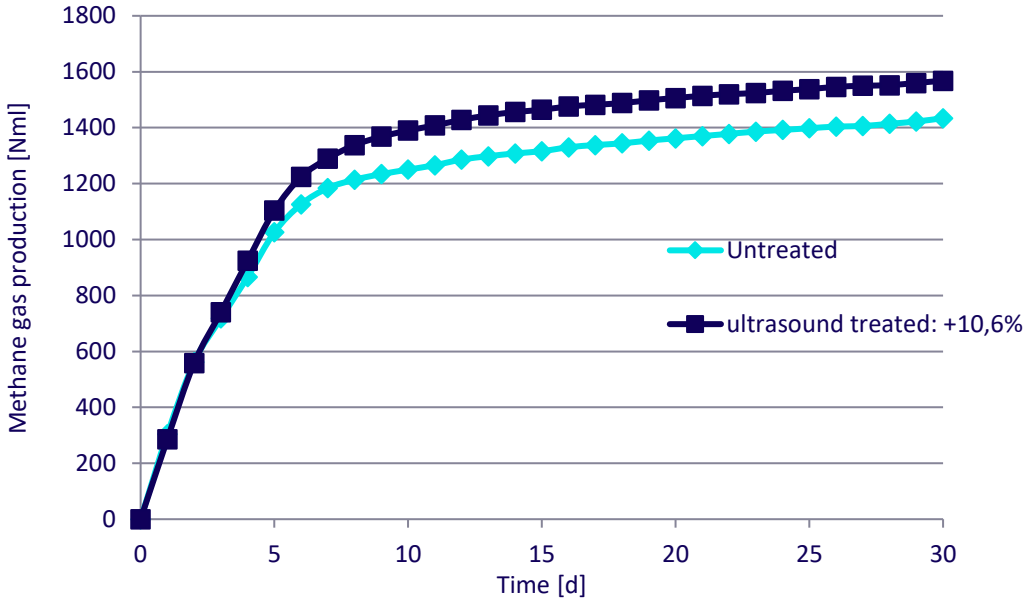
PALM OIL – BIOGAS PLANT THAILAND

WEBER ENTEC

BIOGAS PLANT THAILAND

Result:

- 11% higher gas production



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MANY THANKS!

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