

## 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 µm-radius

- Extreme high temperature (up to 5.000 C°)
- Extreme high pressure (up to 1.000 bar)
- Extreme high acceleration  $\longrightarrow$  Shear forces



Multiply enlarged cavitation bubble in the moment of implosion



#### тм

### TRADITIONAL ULTRASOUND TECHNOLOGY

- Relative high erosion
- Inhomogeneous ultrasound field, due to spot irradiation
- Often decrease of power by tressing
- Thereby higher maintenance because permanent rinsing is neccessary
- Reactors easily clogg
- Higher operating and maintenance costs
- Direct contact between ultrasound transducer and medium









### ULTRASOUND REACTOR BIOPUSH – THE NEXT GENERATION ULTRASOUND



#### тм

### 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**

![](_page_11_Picture_2.jpeg)

![](_page_11_Picture_3.jpeg)

Mechanical Pre- treatment Improved sound efficiency and machine protection RotaCut 3.000

#### Feeding pump

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

#### <u>4</u> <u>Sensors</u>

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

![](_page_12_Picture_1.jpeg)

### POSSIBLE INTEGRATION EXAMPLES IN BIOGAS PLANTS

![](_page_12_Picture_3.jpeg)

![](_page_13_Picture_1.jpeg)

#### **POSSIBLE INTEGRATION EXAMPLES IN** WWTP

![](_page_13_Picture_3.jpeg)

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

![](_page_14_Picture_12.jpeg)

![](_page_15_Picture_2.jpeg)

# 01 REFERENCE LIST CASE STUDIES

![](_page_16_Picture_1.jpeg)

#### 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

![](_page_16_Picture_7.jpeg)

#### 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

![](_page_17_Picture_8.jpeg)

![](_page_17_Picture_9.jpeg)

![](_page_18_Picture_1.jpeg)

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

![](_page_18_Picture_4.jpeg)

![](_page_19_Picture_1.jpeg)

#### **Result:**

- ▶ 15% higher gas production
- Improved flow properties

![](_page_19_Figure_6.jpeg)

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

![](_page_20_Picture_1.jpeg)

## 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.

![](_page_20_Picture_4.jpeg)

![](_page_21_Picture_1.jpeg)

## 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.

![](_page_21_Picture_4.jpeg)

![](_page_22_Picture_1.jpeg)

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.

![](_page_22_Picture_4.jpeg)

![](_page_23_Picture_1.jpeg)

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

![](_page_23_Picture_4.jpeg)

![](_page_24_Picture_1.jpeg)

![](_page_24_Figure_3.jpeg)

![](_page_25_Picture_1.jpeg)

**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
Profit	53.500 €/a

### **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

![](_page_26_Picture_4.jpeg)

![](_page_26_Picture_5.jpeg)

![](_page_26_Picture_6.jpeg)

![](_page_27_Picture_1.jpeg)

## **BIOGAS PLANT 395 kW KLEVE**

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

![](_page_27_Figure_4.jpeg)

![](_page_28_Picture_1.jpeg)

### **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 Nm³/h
Ultrasound power	4 kW
Feed stock	corn silage

![](_page_28_Picture_5.jpeg)

![](_page_28_Picture_6.jpeg)

![](_page_29_Picture_1.jpeg)

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

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

![](_page_29_Figure_4.jpeg)

![](_page_30_Picture_1.jpeg)

## **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

![](_page_30_Picture_5.jpeg)

![](_page_30_Picture_6.jpeg)

![](_page_30_Picture_7.jpeg)

![](_page_31_Picture_1.jpeg)

## **BIOGAS PLANT 777 kW TECHENTIN**

#### **Result:**

22,8% higher biogas production

![](_page_31_Figure_5.jpeg)

![](_page_32_Picture_1.jpeg)

### **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

![](_page_32_Picture_5.jpeg)

![](_page_32_Picture_6.jpeg)

![](_page_33_Picture_1.jpeg)

### **BIOMETHANE PRODUCTION PLANT** KÖNNERN

#### **Result:**

More than 12% higher biogas production

![](_page_33_Figure_5.jpeg)

![](_page_34_Picture_1.jpeg)

## **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

![](_page_34_Picture_5.jpeg)

![](_page_35_Picture_1.jpeg)

### **BIOGAS PLANT 250 kW RASTDORF**

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

![](_page_35_Figure_4.jpeg)

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

![](_page_36_Picture_1.jpeg)

## **BIOGAS PLANT 999 kW MAGLIANO**

#### Aim: 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

![](_page_36_Picture_5.jpeg)

![](_page_36_Picture_6.jpeg)

![](_page_37_Picture_1.jpeg)

## **BIOGAS PLANT 999 kW MAGLIANO**

#### **Result:**

More than 13% higher biogas production

![](_page_37_Figure_5.jpeg)

![](_page_38_Picture_1.jpeg)

## **BIOGAS PLANT 330 kW ROSENBACH**

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

![](_page_38_Picture_5.jpeg)

![](_page_38_Picture_6.jpeg)

![](_page_39_Picture_1.jpeg)

## **BIOGAS PLANT 330 kW ROSENBACH**

#### **Result:**

More than 21% higher biogas production

![](_page_39_Figure_5.jpeg)

## 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

![](_page_40_Picture_4.jpeg)

![](_page_40_Picture_5.jpeg)

![](_page_41_Picture_1.jpeg)

## 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.

![](_page_41_Figure_4.jpeg)

![](_page_42_Picture_2.jpeg)

## WWTP SINGAPORE

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

Location	Singapore
Population equivalents	1.500.000
Ultrasound power	32 kW

![](_page_42_Picture_6.jpeg)

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.

![](_page_43_Picture_1.jpeg)

### **WWTP SINGAPORE**

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

![](_page_43_Figure_4.jpeg)

![](_page_43_Figure_5.jpeg)

![](_page_44_Picture_2.jpeg)

![](_page_44_Picture_3.jpeg)

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#### Weber Entec: Höhere Gasausbeute bei geringeren Kosten in **Biogas- und Kläranlagen**

## Encodings: Status and a status

![](_page_46_Picture_16.jpeg)

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#### Ritter XL Solar: Flakbunker versorgt Stadtteil mit Solarenergie

![](_page_46_Picture_20.jpeg)

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#### Änderung in der VIK-Geschäftsführung

![](_page_46_Picture_23.jpeg)

![](_page_47_Picture_2.jpeg)

48

09.02.2017

Die Ultraschalleinheit Biopush von Weber, hier auf einer Anlage in Jena.

#### **Gute Erfahrung** mit Ultraschall

Der Einbau der Ultraschall-Desintegrationsanlage Biopush von Weber Entec in eine 700 kW-Biogasanlage der "Biogas Jena GmbH & Co. KG" beschert dem Betreiber eine Effizienzsteigerung von 12%. So lautet das Fazit einer sechsmonatigen Testphase, messtechnisch überwacht von der unabhängigen Eurofins Umwelt Ost GmbH. Auf dem Weg zwischen den Fermentern durchläuft ein Teilstrom des vorvergorenen Substrats den Ultraschallreaktor "Biopush". Die Aufbereitung sorge dafür, dass die Fermentationsdauer und der Eigenstrombedarf für die Rührwerke sinke, so der Hersteller (www.weber-entec.com).

#### SUBSTRATAUFBEREITUNG -Biogas 57

Weber Entec: Substratkosten minimieren - Gewinn maximieren

Während der Umgestaltung der Bioenergiedorfes Jühnde zum Bioenergiedorf 2.0 wurde als erste Maßnahme eine Ultraschalldesintegrationsanlage von Weber

![](_page_47_Picture_9.jpeg)

Entec in Betrieb genommen. Das technische Konzept "Bioenergiedorf 2.0" beinhaltet außerdem zusätzliche BHKWs, einen Wärmespeicher, eine ORC-Anlage und ein

Das Bioenergiedorf Jühnde setzt auf die Technik von Weber Entec.

#### Ø Jühnde investiert ins Bioenergiedorf 2.0

![](_page_47_Picture_13.jpeg)

glaubt die Genomenschaft, sich für die Zeit nach dem EEG nun richtig aufgestellt zu haben. Es umfaßt sowohl eine wärme-, als auch eine strommeführte Flesiwir finanziell, und energenisch am meisten", sagt Fangmeier. Für die wärmegeführte Flexib licierung wird eine saisonale Fahrweise eingeführt, Impulse dully hate as durch eines liestariate maidant, eriment sich

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Mir dem zweiten Konzent

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![](_page_47_Picture_17.jpeg)

#### Pushen mit Ultraschall

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# 03 INDIVIDUAL SOLUTIONS, INSTALLATIONS

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![](_page_49_Picture_3.jpeg)

![](_page_50_Picture_2.jpeg)

![](_page_50_Picture_3.jpeg)

![](_page_50_Picture_4.jpeg)

![](_page_51_Picture_2.jpeg)

![](_page_51_Picture_3.jpeg)

![](_page_51_Picture_4.jpeg)

![](_page_52_Picture_2.jpeg)

![](_page_52_Picture_3.jpeg)

![](_page_52_Picture_4.jpeg)

#### 09.02.2017 54 Weber Entec Company presentation

![](_page_53_Picture_1.jpeg)

![](_page_53_Picture_2.jpeg)

![](_page_54_Picture_2.jpeg)

![](_page_54_Picture_3.jpeg)

![](_page_55_Picture_2.jpeg)

![](_page_55_Picture_3.jpeg)

![](_page_56_Picture_2.jpeg)

![](_page_56_Picture_3.jpeg)

![](_page_57_Picture_2.jpeg)

![](_page_57_Picture_3.jpeg)

![](_page_58_Picture_2.jpeg)

![](_page_58_Picture_3.jpeg)

![](_page_59_Picture_2.jpeg)

![](_page_59_Picture_3.jpeg)

![](_page_59_Picture_4.jpeg)

#### 09.02.2017 61 Weber Entec Company presentation

![](_page_60_Picture_1.jpeg)

![](_page_60_Picture_2.jpeg)

![](_page_61_Picture_2.jpeg)

![](_page_61_Picture_3.jpeg)

![](_page_61_Picture_4.jpeg)

**THANK YOU**