

## **INSTALLATION LIST**

### **ULTRAWAVES Ultrasound Technology**

#### **Improvement of Anaerobic Sludge Digestion**

##### **Germany, STP Ahrensburg (50,000 PE or 5.0 MGD)**

- 1) *Preliminary test on pilot-scale by Technical University of Hamburg-Harburg 1999 and full-scale test 2007*
- 2) *Full-scale installation since June 2009*
  - increase in VS destruction of 15%
  - increase in biogas production of 15%

##### **Germany, STP Au, Illertissen/Ulm (70,000 PE or 7.0 MGD)**

- Full-scale test, 3 months, 2004/2005*
- increase in VS destruction of 15%
  - increase in biogas production of 25%

##### **Germany, STP Bad Bramstedt (85,000 PE or 8.5 MGD)**

- First fundamental study on pilot scale by Technical University of Hamburg-Harburg, 3 years, 1997 - 1999*
- reduction in digestion time from 20 to 4 days without losses in degradation efficiency
  - increase in biogas production by a factor of 4 (renewable energy!)
  - reduction of digested sludge mass of 25%

##### **Germany, STP Bad Liebenzell (25,000 PE or 2.5 MGD)**

- Full-scale test, 6 months, 2006*
- increase in VS destruction of 35%
  - increase in biogas production of 35%

##### **Germany, STP Bamberg (230,000 PE or 23.0 MGD)**

- 1) *Preliminary full-scale test, 4 months, 2002*
- 2) *Full-scale installation since June 2004*
  - increase in VS destruction of 30%
  - increase in biogas production of 30%
  - avoided the construction of a new anaerobic digester (3,000 m<sup>3</sup> vol.)
  - first net energy producer on STP in Europe without co-substrate

**Germany, STP Bargteheide (34,500 PE or 3.45 MGD)**

*Full-scale test since May 2012*

**Germany, STP Beverungen (25,000 PE or 2.5 MGD)**

*Full-scale test, 3 months, 2004/2005*

- increase in VS destruction of 30%
- increase in biogas production of 30%

**Germany, STP Bünde (54,000 PE or 5.4 MGD)**

*1) Preliminary full-scale test, 4 months, 2007*

*2) Full-scale installation since July 2007*

- increase in VS destruction of 15%
- increase in biogas production of 15%
- improved nitrogen removal of 3 mg/L

**Germany, STP Celle (120,000 PE or 12.0 MGD)**

*Full-scale test since April 2012*

**Germany, STP Ellmendingen (28,000 PE or 2.8 MGD)**

*Full-scale test, 3 months, 2010*

- increase in VS destruction of 15%

**Germany, STP Eschwege (67,500 PE or 6.75 MGD)**

*Full-scale installation since October 2009*

**Germany, STP Freising (130,000 PE or 13.0 MGD)**

*Fundamental full-scale study by University of Armed Forces, Munich, 4 months, 2003*

- increase in biogas production of 15%
- improved sludge dewatering of 10%

**Germany, STP Harsewinkel (57,500 PE or 5.75 MGD)**

*Full-scale test, 6 months, 2010*

- increase in VS destruction of 15%

**Germany, STP Hennef (55,000 PE or 5.5 MGD)**

*Full-scale installation since September 2006*

**Germany, STP Jockgrim (21,000 PE or 2.1 MGD)**

*Full-scale installation since 2011*

- increase in VS destruction of 20%
- increase in biogas production of 20%
- increase in dewaterability of the digested sludge of 7%

**Germany, STP Kleinsteinbach (40,000 PE or 4.0 MGD)**

*Full-scale installation since June 2010*

- increase in VS destruction of 25%
- increase in biogas production of 25%

**Germany, STP Meldorf (72,000 PE or 7.2 MGD)**

*1) Preliminary full-scale test, 3 months, 2004*

*2) Full-scale installation since May 2005*

- increase in VS destruction of 26%
- increase in biogas production
- no foam or filamentous organisms present in the anaerobic sludge digester

**Germany, STP Schleswig (60,000 PE or 6.0 MGD)**

*Full-scale installation since March 2011*

- increase in VS destruction of 25%
- increase in biogas production of 23%

**Germany, STP Veitshöchheim (26,000 PE or 2.6 MGD)**

*Full-scale test, 4 months, 2010*

- increase in VS destruction of 20%

**Australia, STP West Camden (230,000 PE or 23.0 MGD)**

*Full-scale test since July 2010*

- increase in VS destruction of 20%
- increase in biogas production of 20%

**Brazil, STP Arrudas (2,000,000 PE or 200.0 MGD)**

*Full-scale installation since August 2010*

- decrease in digestion time of 17% with same degree of VS degradation

**Denmark, STP Frederikshavn (130,000 PE or 13.0 MGD)**

*Full-scale installation since March 2006*

- increase in VS destruction of 20%
- increase in biogas production of 20%

**Denmark, STP Marselisborg-Arhus (220,000 PE or 22.0 MGD)**

*Full-scale installation since March 2006*

- increase in sludge reduction of 15%
- increase in biogas production of 35%
- decrease in polymer consumption of 20%

**Denmark, STP Sonderborg (80,000 PE or 8.0 MGD)**

*Full-scale installation since January 2012*

**France, STP Cherbourg (230,000 PE or 23.0 MGD)**

*Full-scale installation since June 2011*

**France, STP St. Nazaire (200,000 PE or 20.0 MGD)**

*Full-scale installation since September 2011*

**Hungary, STP Szombathely (80,000 PE or 8.0 MGD)**

*Full-scale installation since February 2010*

**Hungary, STP Zalaegerszeg (60,000 PE or 6.0 MGD)**

*1) Preliminary full-scale test, 3 months, 2004/2005*

*2) Full-scale installation in September 2008*

- increase in VS destruction of 20%
- increase in biogas production of 20%

**Ireland, STP Shanganagh (186,000 PE or 18.6 MGD)**

*Full-scale installation since June 2011*

**Netherlands, STP Nieuwgraaf (440,000 PE or 44.0 MGD)**

*Full-scale installation since September 2006*

- increase in VS destruction of 10%
- increase in biogas production of 10%

**Netherlands, STP Willem-Annapolder (55,000 PE or 5.5 MGD)**

*Full-scale installation since September 2006*

- increase in VS destruction of 15%

**Netherlands, STP Zeist (75,000 PE or 7.5 MGD)**

*Full-scale installation since May 2005 – December 2007 (anaerobic sludge treatment was stopped on Zeist STP in December 2007)*

- increase in biogas production of 20%

**Poland, STP Dąbrowa-Górnica (200,000 PE or 20.0 MGD)**

*Full-scale installation in October 2008*

- increase in VS destruction of 25%
- increase in biogas production of 28%

**Poland, STP Kielce (350,000 PE or 35.0 MGD)**

*Full-scale installation in preparation, commissioning August 2010*

**Poland, STP Słupsk (250,000 PE or 25.0 MGD)**

*Full-scale installation since July 2008*

**Spain, STP Arriandi (125,000 PE or 12.5 MGD)**

*TEST-INSTALLATION: Full-scale installation since July 2008 to March 2009*

**Spain, STP La Gavia (268,000 PE or 26.8 MGD)**

*Full-scale installation since June 2008*

- increase in VS destruction of 17%
- increase in biogas production of 20%
- improved sludge dewatering of 17%

**Spain, STP Lorquí (50,000 PE or 50 MGD)**

*TEST-INSTALLATION: Installation of one mobile unit specially designed for R&D since July 2007*

- Demonstration and publication about ultrasound and dewatering
- Demonstration and publication about ultrasound and disinfection
- Demonstration and publication about ultrasound and nitrogen removal

**Spain, STP Montornès (100,000 PE or 10.0 MGD)**

*Full-scale installation since September 2010*

- increase in VS destruction of 20%
- increase in sludge reduction of 15%
- improved sludge dewatering of 12%

**Spain, STP Rubi Barcelona (155,000 PE or 15.5 MGD)**

*Full-scale installation since July 2011*

**Spain, STP San Jeronimo (275,000 PE or 27.5 MGD)**

*TEST-INSTALATION: Full-scale installation since May 2008*

- increase in VS destruction of 20%
- increase in biogas production of 20%

**Spain, STP Son Servera (100.000 PE or 10 MGD)**

*Full-scale installation since July 2008*

- increase in VS destruction of 24%
- increase in sludge reduction of 14%
- improved sludge dewatering of 13%

**Spain, STP Tablada (200,000 PE or 20 MGD)**

*TEST-INSTALATION: Full-scale installation since July 2009 (WWTP works 50% less in digestion volume)*

- increase in VS destruction of 14%
- increase in biogas production of 18%

**Spain, STP Tomelloso (200,000 PE or 20 MGD)**

*Full-scale installation since January 2012*

- increase in VS destruction of 20%

**Switzerland, STP Ergolz 2 (65,000 PE or 6.5 MGD)**

*Full-scale test, 3 months, 2004*

- increase in VS destruction of 15%
- increase in biogas production of 25%

**Switzerland, STP Glarnerland (70,000 PE or 7.0 MGD)**

*1) Preliminary full-scale test, 2007*

*2) Full-scale installation since December 2007*

- increase in VS destruction of 20%
- increase in biogas production of 20%

**Taiwan, STP Danshui (110,000 PE or 11 MGD)**

*Full-scale test in preparation since December 2011*

### Improvement of Aerobic Sludge Stabilization

#### **Germany, STP Bünde (54,000 PE or 5.4 MGD)**

*1) Preliminary full-scale test, 5 months, 2006*

*2) Full-scale installation since September 2006*

- reduction of waste activated sludge production of 25%
- significant improvement in denitrification by providing an internal carbon source

#### **Germany, STP Ditzingen (13,000 PE or 1.3 MGD)**

*First fundamental study on pilot scale, 3 months, 2003*

- reduction of waste activated sludge production up to 50%
- small improvement in denitrification by providing an internal carbon source.

#### **Germany, STP Ellmendingen (28,000 PE or 2.8 MGD)**

*Full-scale test, 3 months, 2011*

- sonication of return sludge
- reduction of nitrogen concentration in effluent

#### **Germany, STP Leinetal (55,000 PE or 5.5 MGD)**

*1) Preliminary full-scale test, 3 months, 2002*

*2) Full-scale installation since July 2003*

- sonication of return sludge
- no foam and floating sludge in the aeration tank
- reduction of waste activated sludge production up to 20%

#### **Germany, STP Ottweiler (7,000 PE or 0.7 MGD)**

*Preliminary full-scale test, 3 months, 2003*

- sonication of return sludge
- reduction of waste activated sludge production of 20%

#### **Denmark, STP Horsholm (35,000 PE or 3.5 MGD)**

*Full-scale installation in March 2007*

- sonication of return sludge
- reduction of waste activated sludge production of 15%



### **Denmark, STP Skagen (110,000 PE or 11.0 MGD)**

*Full-scale installation in March 2007*

- sonication of return sludge
- reduction of waste activated sludge production of 20%

### **Japan, STP Hashimoto/ Yoshiwara**

*1) Preliminary full-scale test, 3 months, 2002*

*2) Full-scale installation since May 2003*

- sonication of return sludge
- reduction of waste activated sludge production up to 61%

### **Japan, STP Matsue City**

*Full-scale installation since October 2004*

- sonication of return sludge
- reduction of waste activated sludge production up to 61%

### **Japan, STP Tanba City/ Nogami**

*Full-scale installation since October 2004*

- sonication of return sludge
- reduction of waste activated sludge production up to 74%

### **Hungary, STP Pecs (200,000 PE or 20.0 MGD)**

*Full-scale installation since March 2006*

- sonication of return sludge
- reduction of waste activated sludge production of 25%

### Combating of bulking and foaming sludge

#### **Germany, STP Brunsbüttel (13,000 PE or 1.3 MGD)**

*Fundamental study on pilot scale by Technical University of Hamburg-Harburg, 6 months, 2002*

- reduction in sludge volume index (SVI) from 140 to 55 mL/g
- no more foam and no filamentous organisms in the sludge digester

#### **Germany, STP Niefern (25,000 PE or 2.5 MGD)**

*Preliminary full-scale test, 5 months, 2003*

- reduction in sludge volume index (SVI) from 120 to 80 mL/g
- no more floating sludge in the aeration tank

#### **Germany, STP Reinfeld (13,000 PE or 1.3 MGD)**

*First fundamental study on pilot scale by Technical University of Hamburg-Harburg, 6 months, 2002*

- reduction in sludge volume index (SVI) from 110 to 60 mL/g
- no more foam and no filamentous organisms in the sludge digester

#### **Germany, STP Rendsburg (50,000 PE or 5.0 MGD)**

*Preliminary full-scale test, 4 months (2010) and 4 months (2011)*

- reduction in sludge volume index (SVI)

#### **Germany, STP Reutlingen (245,000 PE or 24.5 MGD)**

*Preliminary full-scale test, 3 months, 2005*

- reduction in sludge volume index (SVI) from 150 to 60 mL/g
- no more floating sludge in the aeration tank

#### **Germany, STP Rostock (300,000 PE or 30.0 MGD)**

*Fundamental study on pilot scale by University of Rostock, 3 months, 2003*

- reduction in sludge volume index (SVI)
- 50% reduction in foaming potential of digested sludge

#### **Germany, STP Schleswig (60,000 PE or 6.0 MGD)**

*Preliminary full-scale test, 3 months, 2010*

- reduction in sludge volume index (SVI)
- no floating sludge in the aeration tank

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**Germany, STP Winsen (50,000 PE or 5.0 MGD)**

*Fundamental study on pilot scale by Technical University of Hamburg-Harburg, 3 months, 2003*

- reduction in sludge volume index (SVI) from 150 to 75 mL/g
- 30% reduction in foaming potential of digested sludge

## Improvement of Digestion Process in Farmland Biogas Plants (FBP) and Food Waste Biogas Plant for Electrical Power Generation

### **Germany, FBP Ansbach**

*Full-scale installation since April 2010*

- saving substrate costs of 15%

### **Germany, FBP Bispingen**

*Full-scale installation since 2008*

- increase in biogas production of 12%
- upgrade of the biogas plant with a second ultrasound-system in May 2011

### **Germany, FBP Bordesolmerland**

*1) Full-scale test, 5 months, 2011*

*2) Full-scale installation since September 2011*

- saving substrate costs of 16%
- increase in methane concentration of 2%
- decrease in viscosity and reduction of electricity consumption of FBP
- upgrade of the biogas plant with a second ultrasound-system in July 2012

### **Germany, FBP Gönnebek**

*Full-scale test since February 2012*

### **Germany, FBP Hermannshof**

*Full-scale test since July 2012*

### **Germany, FBP HKS Wittenburg**

*Full-scale installation in July 2012*

### **Germany, FBP Hoheluft**

*Full-scale test since June 2012*

### **Germany, FBP Lindow**

*Full-scale installation since 2008*

- saving substrate costs of 13%

**Germany, FBP Löhndorf**

*Full-scale installation in July 2012*

**Germany, FBP Wesel**

*Full-scale installation in 2007*

- increase in biogas production of 19%
- increase in power generation of 19%

**Germany, FWBP Mariks**

*Full-scale test, 6 months, 2011*

- increase in power generation of 13%
- reduction of VS content in digestate from 56% to 52%

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