

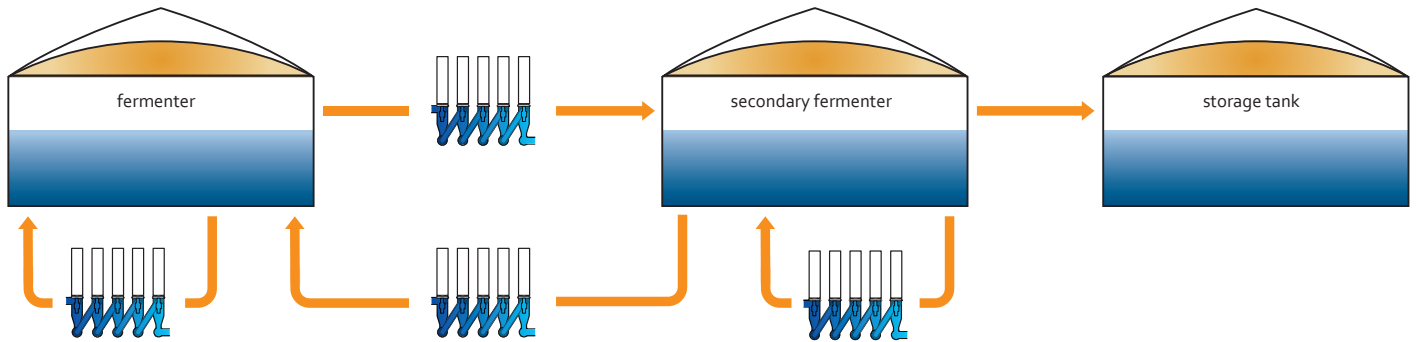
# Biogas plants

More energy from biomass  
by ultrasound



# Ultrasound systems on biogas plants

## Areas of use and advantages



Integration of ultrasound technology into biogas plants

Ultrawaves' ultrasound systems are used in agricultural biogas plants to intensify anaerobic biological degradation of all kinds of added biomass materials, such as, renewable raw materials, maize, green waste, slurry, etc. This results in a wide range of applications for ultrasound technology. Ultrasound usually either enables an increase in biogas production with unchanged substrate supply or saves biomass added without losses in biogas production.

### Technical limits of fermentation and overcoming these with ultrasound

Anaerobic fermentation of organic substrate (biomass) is a perfected, mature technology. The biomass is decomposed by bacteria in the fermenter at temperatures of around 37°C. Biogas is produced as a metabolic product, whose main component and actual energy carrier is methane.

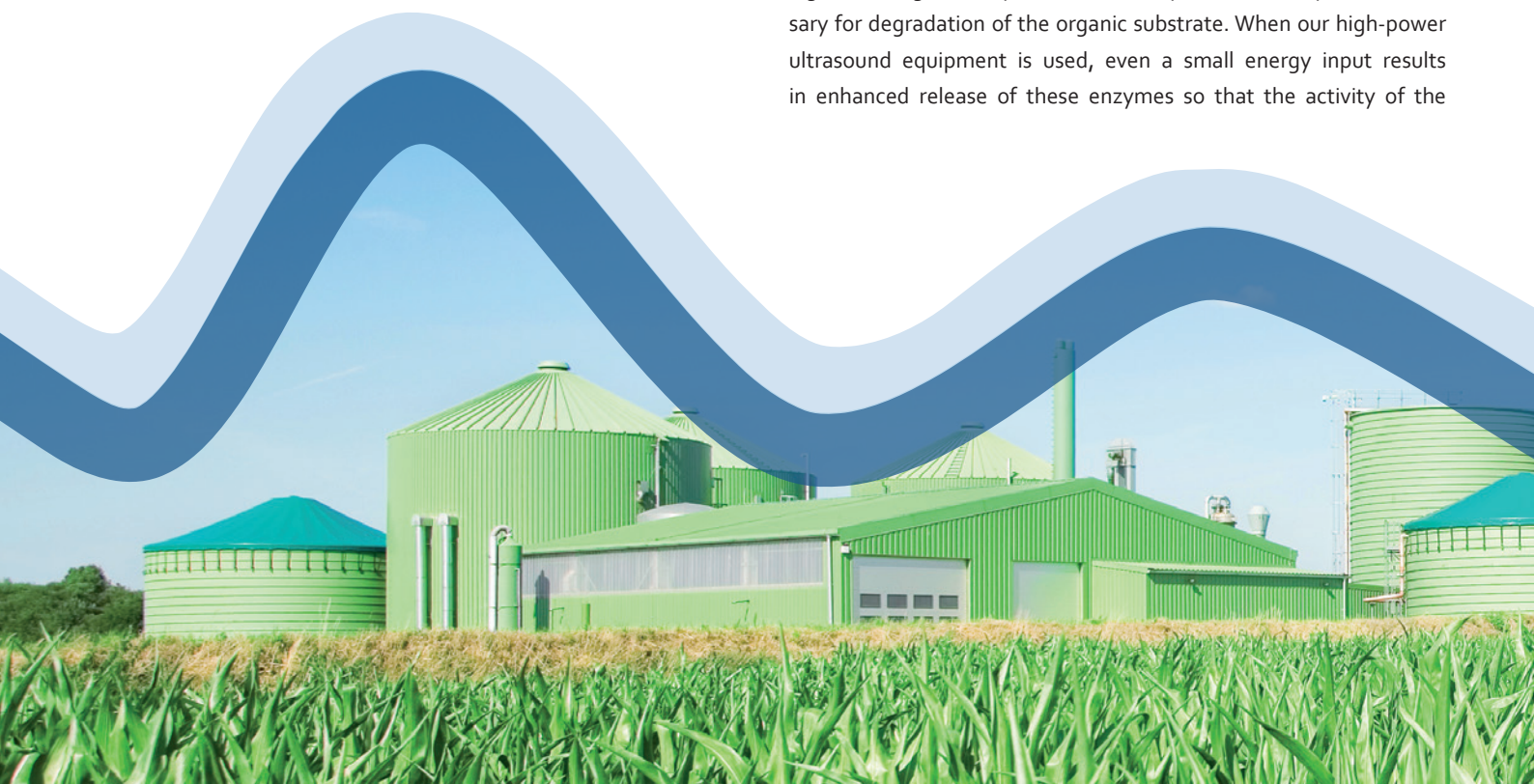
### “High-power ultrasound for disintegration of biomass.”

However, the biological anaerobic degradation process takes place very slowly, as the solid biomass is difficult for the bacteria to break down. The first step in the degradation chain is the so-called hydrolysis, which causes reduction of the particle or molecular size and therefore determines the speed of the entire degradation process.

The effect of our ultrasound aims at overcoming this limiting hydrolysis step. The ultrasound oscillations not only affect the structure of the substrates (breakdown of the cells) but also the active micro-organisms (stimulation through fluctuating sound pressure and cavitation, prevention of agglomerate formation, release of enzymes). Biological hydrolysis is therefore supported or entirely substituted by use of our ultrasound system, so that accelerated and enhanced degradation takes place.

### Intensification of the fermentation through ultrasound

Ultrasound intensifies fermentation on biogas plants. The fermenting micro-organisms produce the enzymes (exo-enzymes) necessary for degradation of the organic substrate. When our high-power ultrasound equipment is used, even a small energy input results in enhanced release of these enzymes so that the activity of the



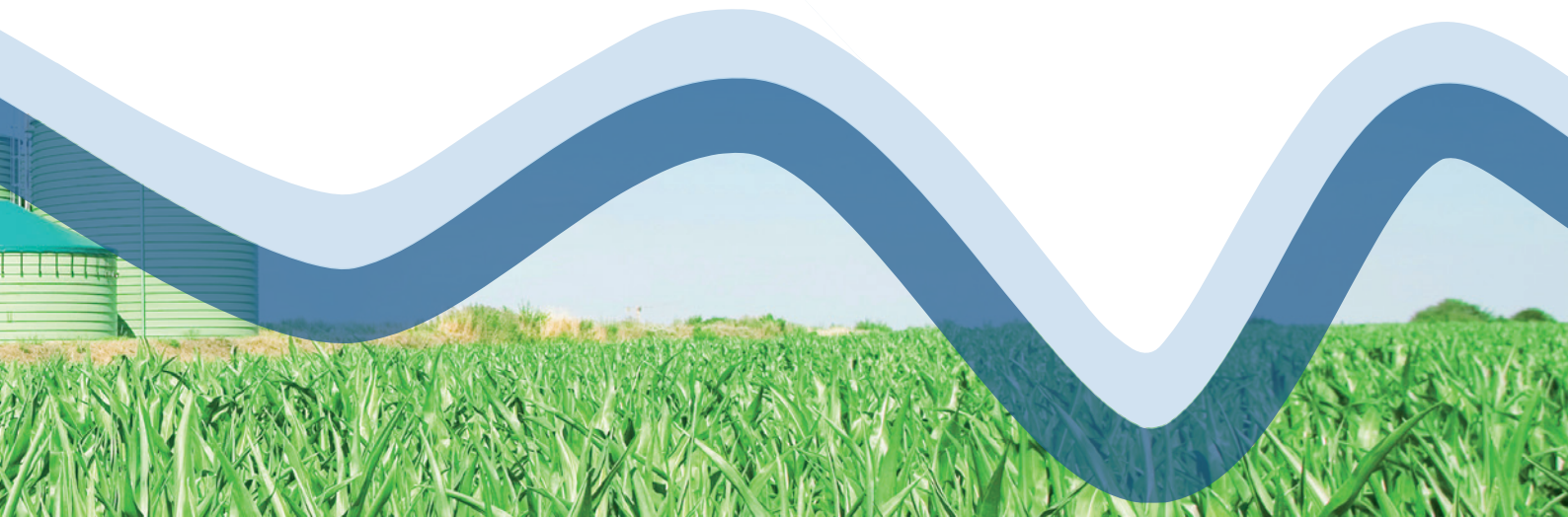
micro-organisms is stimulated. Sonication also causes an increase in the interface between the liquid and solid phase (particles and flocs disintegrate), which facilitates enzymatic attack. Further energy supply also destroys the walls of plant and bacterial cells and therefore results in the release of the dissolved organic cell contents, which are in turn very readily degraded by fermentation. The end effect is an intensified digestion process with further degradation of the organic substrates and increased biogas production. Therefore, by using ultrasound, on the one hand more biogas can be produced from the same biomass feed; on the other hand, it is also possible to reduce the feed quantity with unchanged biogas production. In addition, the quality of the biogas is improved by an increase in its methane content. Due

### “Ultrasound technology – intensification of anaerobic degradation.”

to the difficult to degrade agricultural biomasses used, the methane fraction produced by conventional biogas plants is sometimes less than 50%. In addition, sonication of the volumetric flow added reduces the viscosity of the fermenter content and therefore makes it more fluid. This reduces the power consumption of the agitators and pumps.

#### Design and easy integration

Due to the difficult structure of the raw biomass fed we prefer to sonicate a partial flow of the fermented biomass from the main or secondary fermenter. The sonicated sludge in a loop is then returned to the main fermenter. This volumetric flow usually equals 30 to 50% of the substrate quantity added daily. The standard Ultrawaves ultrasound system (connected load 5 kW) is very compact with a footprint of 1.45 m x 0.25 m and therefore requires little space. On-site, it is only necessary to provide inlet and outlet connections as well as an electrical and water connection. The ultrasound systems themselves usually operate 24 hours a day.



# Practical results

## Case study: Bordesholmerland biogas plant

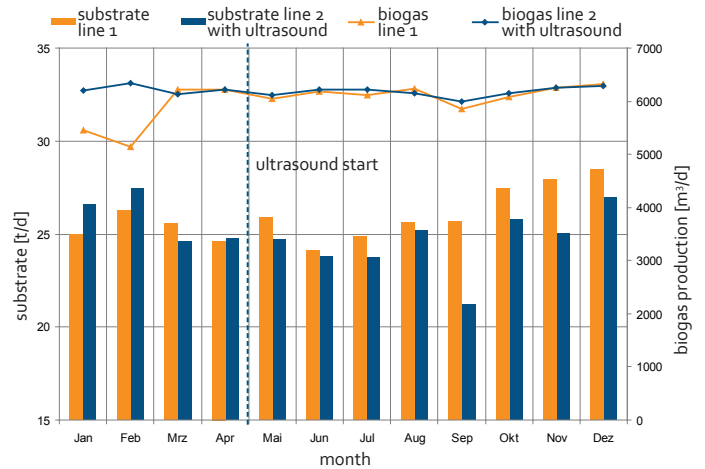
In December 2007, the first biogas plant in Germany was operated with Ultrawaves ultrasound technology. Today we have successfully equipped many more biogas plants with our ultrasound technology.

Bordesholmerland biogas plant, a maize mono-fermentation plant, is presented here as a practical example and reference. Two parallel lines are operated, one of which (line 2) has been equipped with our standard ultrasound reactor. The test started in May 2011 with the objective of using less substrate while maintaining the same biogas production (6,150 m<sup>3</sup> per day per line). 36 m<sup>3</sup> per day of the secondary fermenter content are sonicated in line 2 and are returned to the fermenter. Since the ultrasound system is in operation the daily substrate supply has reduced by 4 t/d (17%) compared to line 1, while biogas production remained unchanged. At the same time, the methane content of the biogas increased by two percent to 53%. The sonication also caused a reduction of the viscosity of the fermenter

**“Less substrate  
with the same biogas production.”**

content, which reduced the power consumption of the agitators and pumps. In total, the net economic benefit of the line equipped with the Ultrawaves ultrasound system increased significantly.

Further and more detailed descriptions of case studies and our reference list are given on our website.



The quantity of substrate added daily and biogas production in lines 1 and 2 of Bordesholmerland biogas plant. The ultrasound system is installed in line 2.

### The advantages in summary

- Intensification of fermentation
- Increase in biogas production
- Increase in methane content
- Substrate savings
- Viscosity reduction
- Lowering the power consumption for agitators and pumps

### About ULTRAWAVES

Ultrawaves GmbH develops and markets innovative high-power ultrasound systems for water and environmental engineering. Apart from the application on biomass in wastewater treatment and biogas plants, our systems are also used in industrial applications. The company was founded in 2001 as spin-off company from Hamburg Technical University (TUHH) and since then has worked closely with research facilities and industrial partners. Through our extensive sales and partner network we are represented internationally and offer a worldwide service.



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