



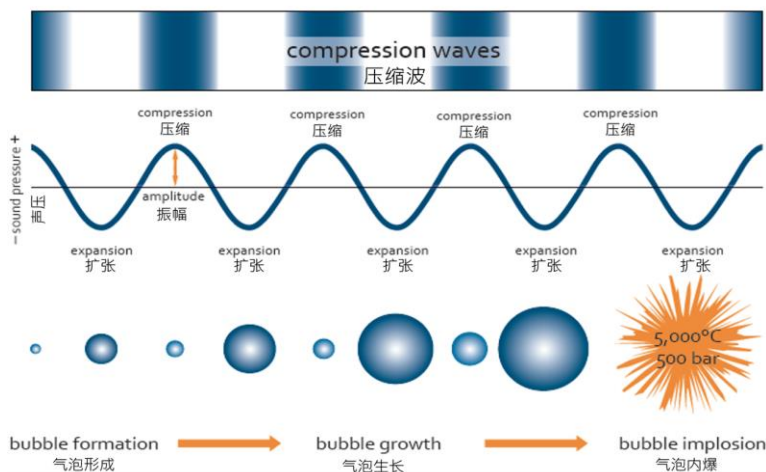
ATAL High Power Ultra-Sonic
高强度超声波系统
(AHPUS)

Introduction 简介

ATAL High Power Ultra-Sonic (AHPUS) 高强度超声波系统

ATAL High Power Ultra-Sonic (AHPUS) is provided by ATAL Engineering Limited. The frequency is greater than the upper limit of human hearing, which is higher than 2 kHz with instant penetration, high energy density characteristics. In the aqueous medium, ultrasonic wave causes periodic compression and stretching of the aqueous phase. High intensity ultrasound makes the water molecules in the liquid form tiny bubbles and make them collapse. In an instant, local high pressure of 500 bar and high temperature of 5,000°C are formed, resulting in cavitation and strong mechanical shear force. These ultrasonic forces are powerful enough to destroy many solid surfaces. The extreme environmental conditions produced by ultrasonic can cause the lysis of microbial cell wall, resulting in the release of intracellular organic matter and intracellular enzyme to the liquid phase, thus promoting the dissolution of cell wall in sludge. The anaerobic digestion efficiency of sludge is improved with promoting hydrolysis and digestion.

高强度超声波系统 (AHPUS) 是由安樂工程有限公司提供。超声波频率大于人的听觉上限，是一种频率高于2千赫的声波，具有瞬间穿透力强、能量密度高的特点。在水介质中，超声波形成水相周期性的压缩与拉伸。高强度超声使液体中的水分子形成微小的气泡，并使其坍塌，在瞬间局部形成了500 bar 高压与5,000°C 高温，产生空化作用，同时形成极强的机械剪切力。这些由超声波所引起的力量足以摧毁许多坚固的表面。超声波产生的极端环境条件，可使微生物细胞壁产生裂解，导致胞内有机物和胞内酶释放至液相中，从而促进污泥中细胞壁的溶解，促进水解和消化的进行，污泥厌氧消化效能也因此提高。



Schematic diagram of AHPUS
高强度超声波预处理工艺示意图

High intensity ultrasound breaks down the microorganisms. AHPUS ultrasonic reactors are used to produce cavitation in water at lower frequency ranges and at higher intensities (20 and 35 kHz). The AHPUS ultrasound system first breaks down the microbiome with a very low energy input (the processing time is short), then breaks down the cell wall of the organism to allow the cytoplasm inside the cell to flow out and dissolve.

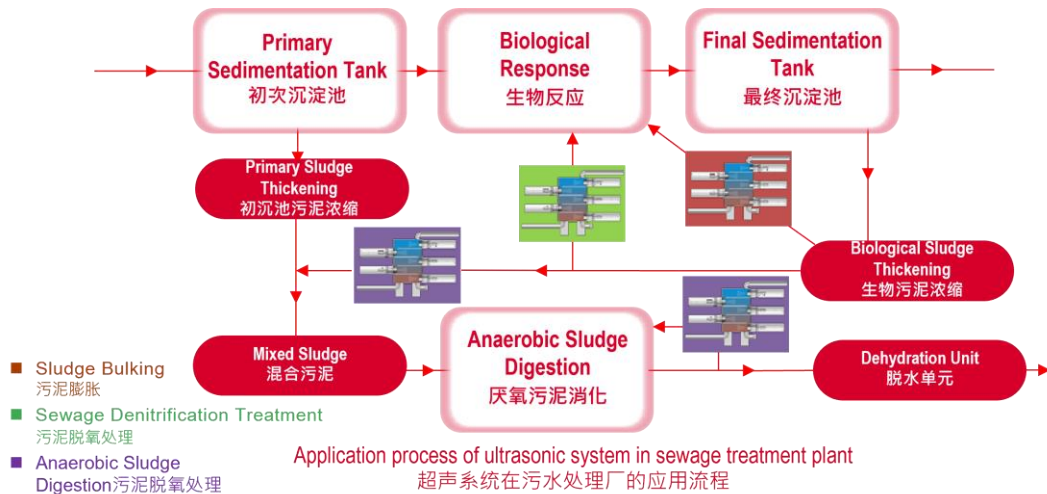
高强度超声波能够分解微生物。AHPUS超声波反应器应用在（20和35千赫）的较低的频率范围内和较高强度下在水中产生空化作用。AHPUS超声系统在相当低的能量输入的情况下首先分解微生物群（处理时间短），其次击破生物细胞壁使细胞内的细胞质流出并溶解。

Major Features 主要特点

Anaerobic Sludge Digestion 厌氧污泥消化

Sludge hydrolysis is an important rate-limiting step in anaerobic digestion due to the existence of cell wall. The remaining activated sludge treated by high intensity ultrasonic wave is easier to obtain biological enzymes for the subsequent sewage treatment process, which achieves the purpose of reducing the amount of remaining sludge and increasing the amount of biogas.

由于细胞壁的存在，污泥水解是厌氧消化的重要限速步骤。高强度超声波处理的剩余活性污泥更容易获得生物酶来进行后续的污水处理工艺，达到了减少剩余污泥量，并增加沼气量的目的。



Sewage Denitrification Treatment 污水脱氮处理

In biological nitrogen removal process, providing additional carbon source for denitrification is an indispensable step. Purchasing methanol or other chemicals as a carbon source for the denitrification process is a common approach. The ultrasonic system can decompose bacteria and microorganisms from the residual sludge, which can be added to the denitrification process as a new carbon source, while reducing the amount of sludge disposal.

在生物脱氮中，为反硝化阶段提供外加碳源是不可缺少的步骤。购买甲醇或其他化学品来作为反硝化过程的碳源是一般的方法。超声波系统能从剩余污泥中分解细菌微生物，其分解物可以作为新增碳源来添加到反硝化过程中，污泥的弃置量同时也能减少。

Sludge Bulking 污泥膨胀

Sludge bulking and foam in sewage treatment plant is a common problem due to the large number of filamentous microorganisms. The digester is often foam increasing phenomenon, seriously affecting the operation of sewage treatment plant. Continuous treatment of a small portion of the refluxed sludge with an ultrasonic system can maintain the role of ultrasound in the activated sludge pool for a long time. The pressure difference and cavitation produced by ultrasound can permanently destroy filamentous bacteria. Therefore, high-intensity ultrasonic waves can effectively prevent sludge expansion and foam generation.

由于丝状微生物大量生成，出现在污水处理厂中的污泥膨胀和泡沫是一个普遍存在的难题。消化池也经常发生泡沫增多的现象，严重地影响污水处理厂的运作。持续地用超声波系统处理一小部分回流污泥，能够长效保持超声波在活性污泥池中的作用。超声波所产生的压力差及空化作用能够永久破坏丝状细菌。因此，高强度超声波能够有效防止污泥膨胀和泡沫的产生。

Disinfection 消毒

Standard chlorine disinfection and ultraviolet disinfection cannot achieve disinfection in very turbid and high concentration of liquid, such as process water and wastewater. But ultrasound can also be used in these media. Viruses or bacteria that attach to suspended particles cannot be easily eliminated by the ultraviolet light. However, as the ultrasonic wave can shatter the suspended particles and flocs, the bacteria can be separated and resuspended, realizing the effectiveness of the traditional method.

标准的氯消毒和紫外线消毒的方式无法于极混浊和高浓度的液体里，如工艺水和废水，达到消毒目的。但超声波也能应用于这些介质里。依附于悬浮颗粒上的病毒或细菌不容易被紫外线消除。但由于超声波可以震碎悬浮颗粒和絮体群，使细菌分离并而重新悬浮，使得传统的方法再次发挥其有效性。

Job Reference 案例

Bamberg Sewage Treatment Plant, Germany 德国班堡污水厂*



Bamberg Sewage Treatment Plant in Germany
德国班堡污水厂

Sludge Capacity 处理污泥量

400 m³/d (150 m³/d primary sludge 初沉污泥 + 250 m³/d residual activated sludge 剩余活性污泥)

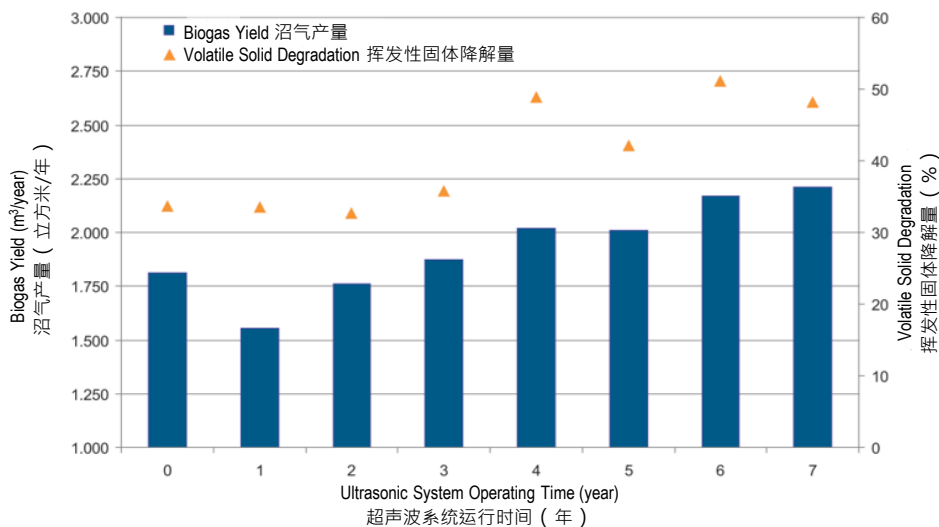
Result 成效

Germany's Bamberg Sewage Treatment Plant has two ultrasonic sludge reactors (5 kW each). At the initial stage of treatment, they operated eight hours per day to handle 30% of the sludge from the secondary settling tank, while the sludge concentration process operated automatically throughout the day. Nowadays, the sludge treatment has reached 80%. The ultrasonic treatment is very effective:

- ✓ Saved €25,000 investment cost of building a new sludge tank
- ✓ The degradation rate of volatile solids increased from 34% to 58%, thus reducing sludge yield
- ✓ 29% increase in biogas production

德国班堡污水厂安装了两台超声波污泥反应器（每台5千瓦）。在初始阶段，每日8小时之内处理浓缩二沉池污泥的30%，同时全自动运行污泥浓缩过程。至今污泥处理量已达80%。超声波处理的成效非常理想：

- ✓ 节省建造一个新的污泥罐所花费的2.5万欧元的投资成本
- ✓ 挥发性固体降解率由34%提升达58%，因此减少了污泥产量
- ✓ 沼气产量显著增加29%



Development of Biogas Production and Volatile Solid Degradation in Bamberg Sewage Treatment Plant, Germany
德国班堡污水厂沼气产量及挥发性固体降解量的发展

* Job reference used ultrasonic sludge reactors
该业绩使用了超声波污泥反应器

Headquarters 总部

13/F, Island Place Tower, 510 King's Road, North Point, Hong Kong ☎ (852) 2561 8278
香港北角英皇道 510 号港运大厦 13 楼

@ info.env@atal.com

www.atal.com

Other Offices 其他办事处

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