Sonication of sludge by high-power ultrasound technology -

Practical Experiences

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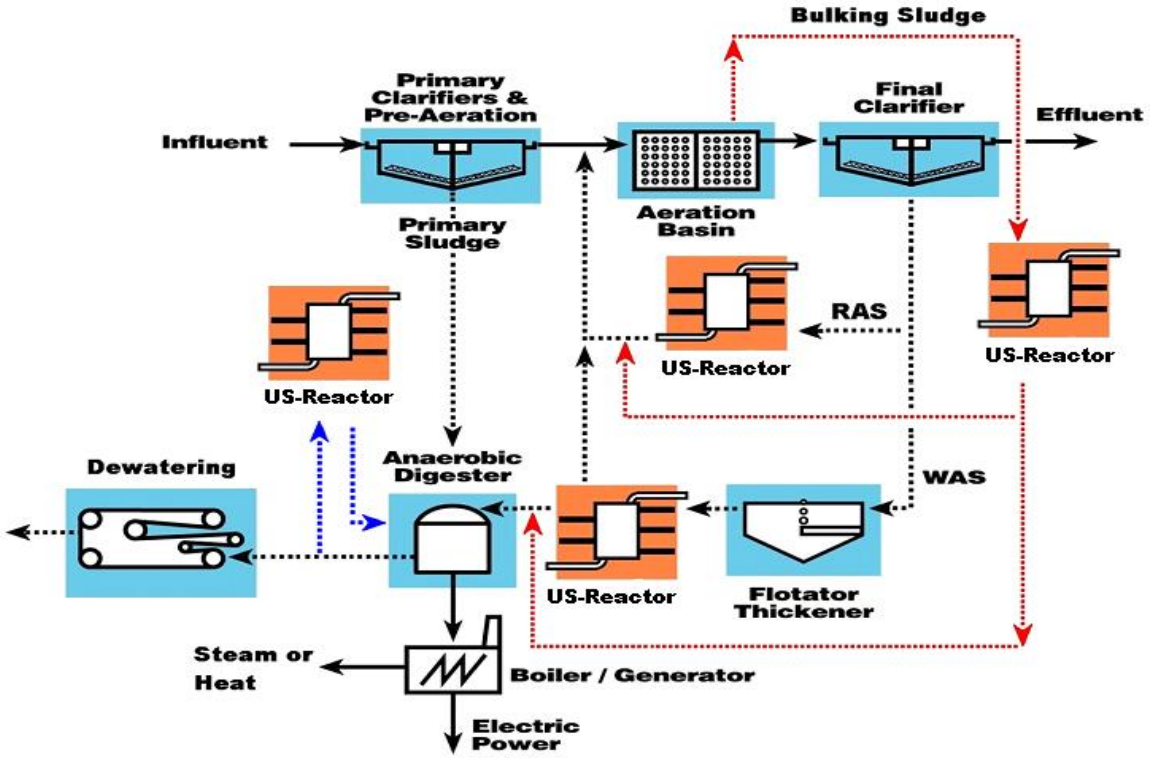
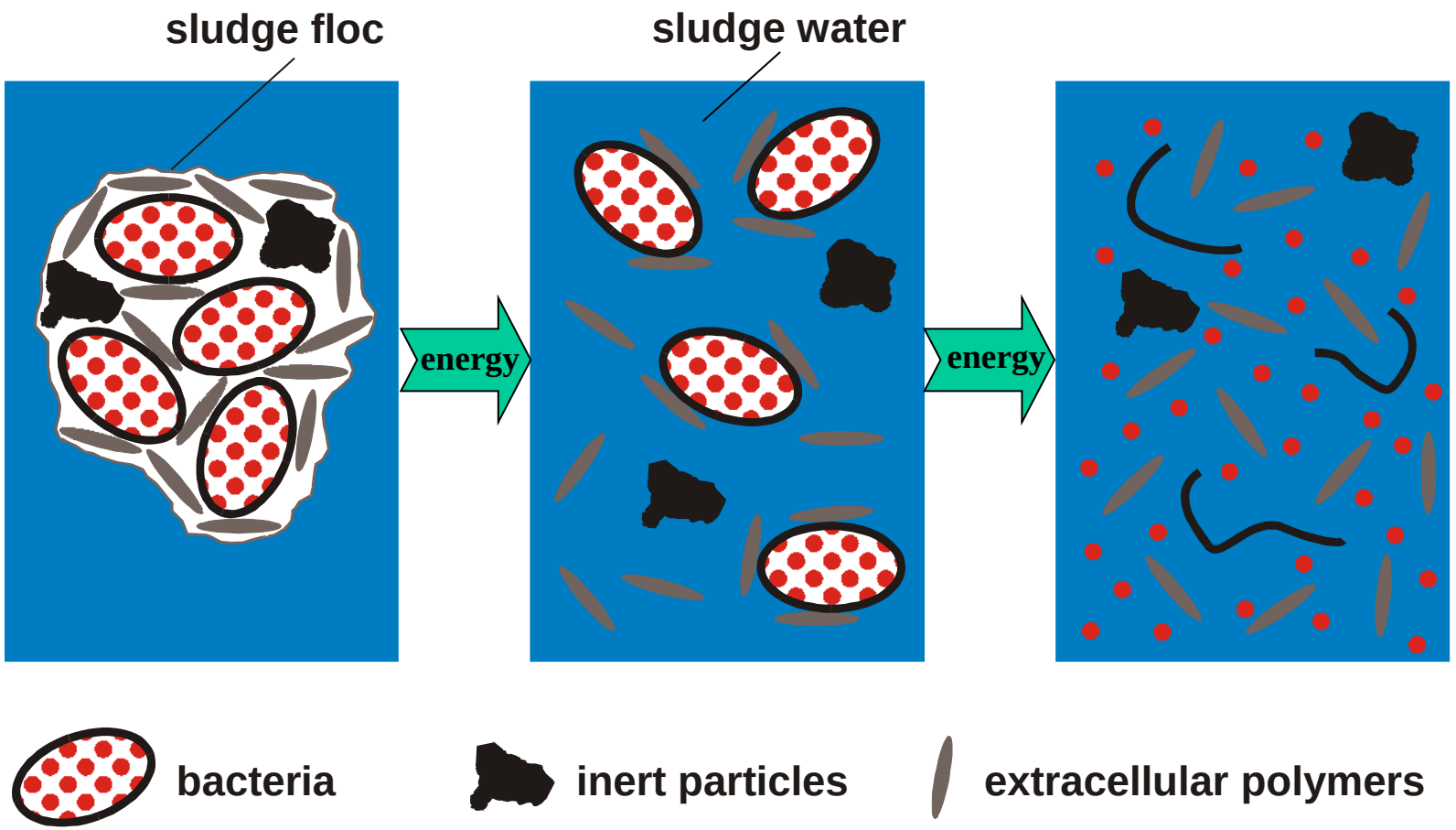
1. Ultrasonic Disintegration of Biomass on WWTP

Options for Biosolids Disintegration

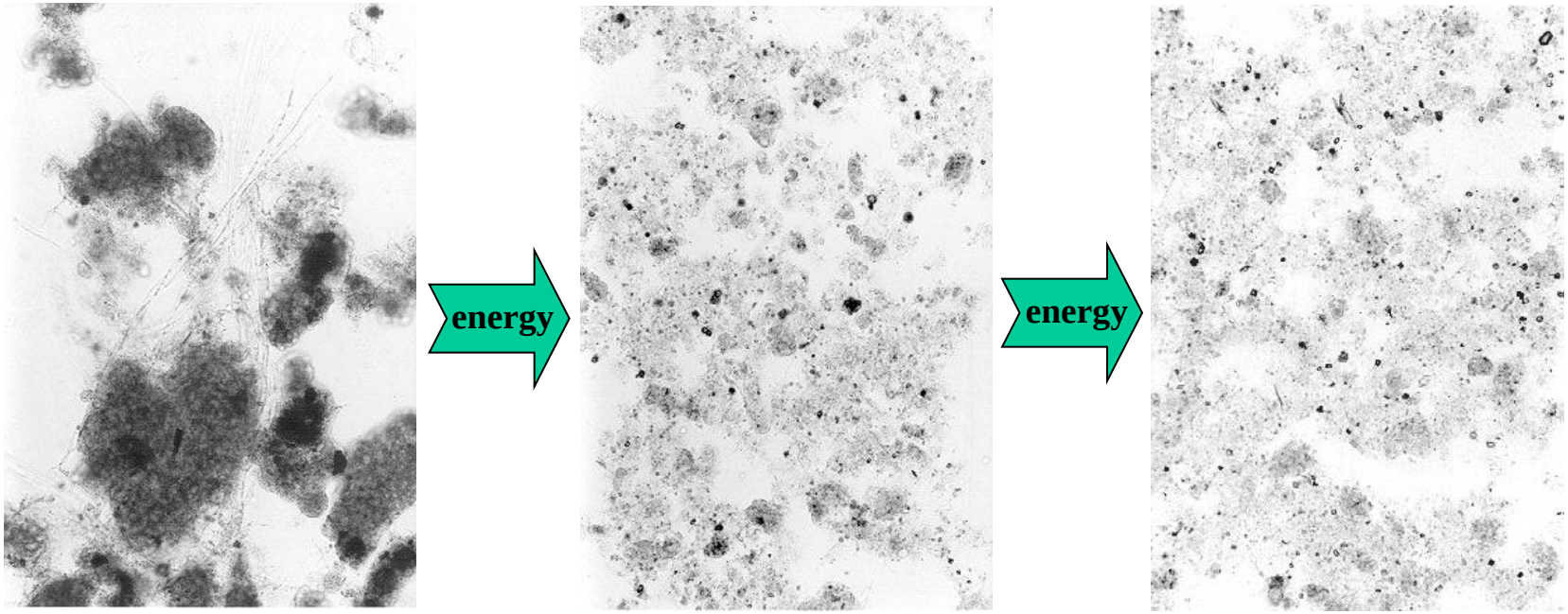


- Intensification of anaerobic biosolids digestion
- Intensification of aerobic biosolids digestion
- Combating bulking and foaming sludge

Disintegration of Biosolids



Light-microscopical Analysis

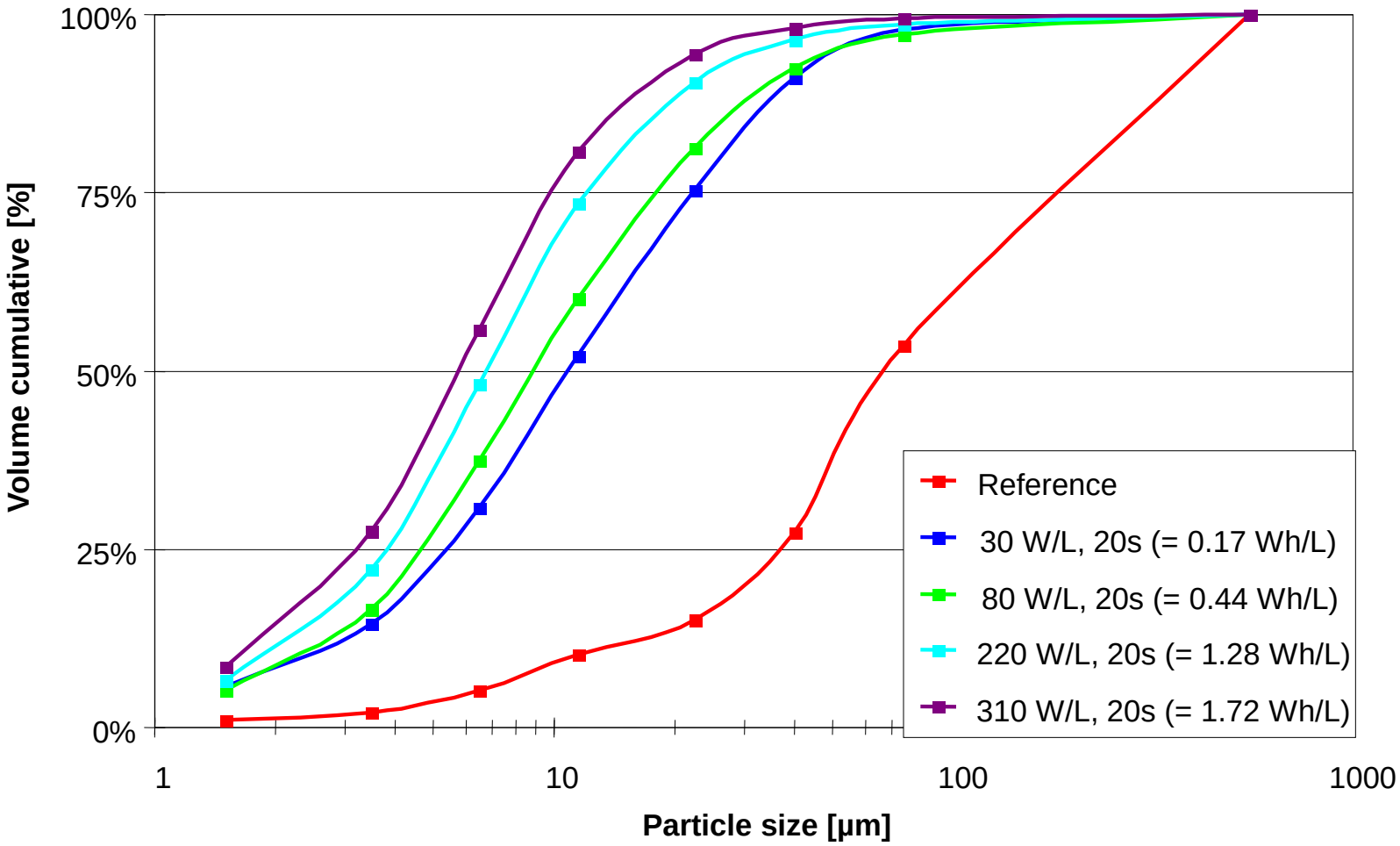


untreated WAS

30s sonicated

90s sonicated

Effect of sonication on particle size distribution



2. Enhancing Aerobic Biomass Digestion

Bünde WWTP, Germany
Case Study

Bünde WWTP, Germany

Initial Conditions:

- Design capacity: 40,000 PE
- Actual Load: 54,000 PE
- Alternating nitrification and denitrification @ 22 d sludge age
- Floating sludge due to excessive growth of filamentous micro-organisms

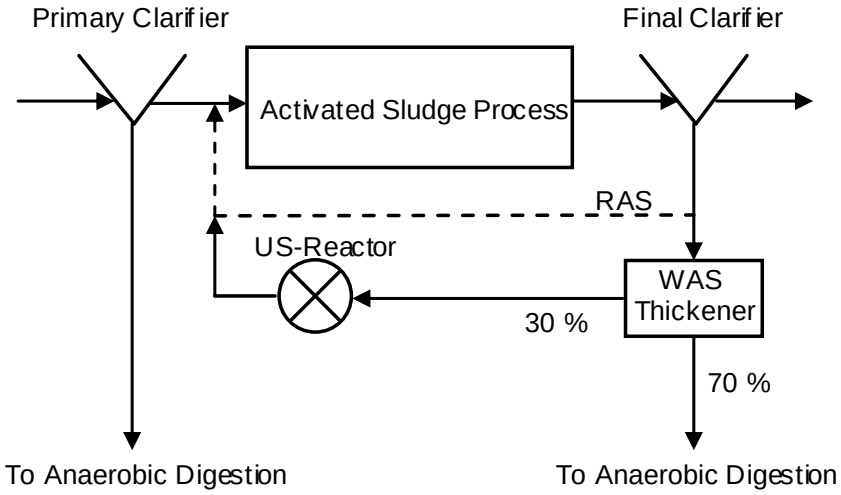
Desired Goal: Reduction of process fluctuations

- Minimization of waste activated sludge production
- Sustainable reduction of N-conc. in the effluent
- Combating filamentous organisms

Bünde WWTP, Germany

Ultrasound Installation in 2006:

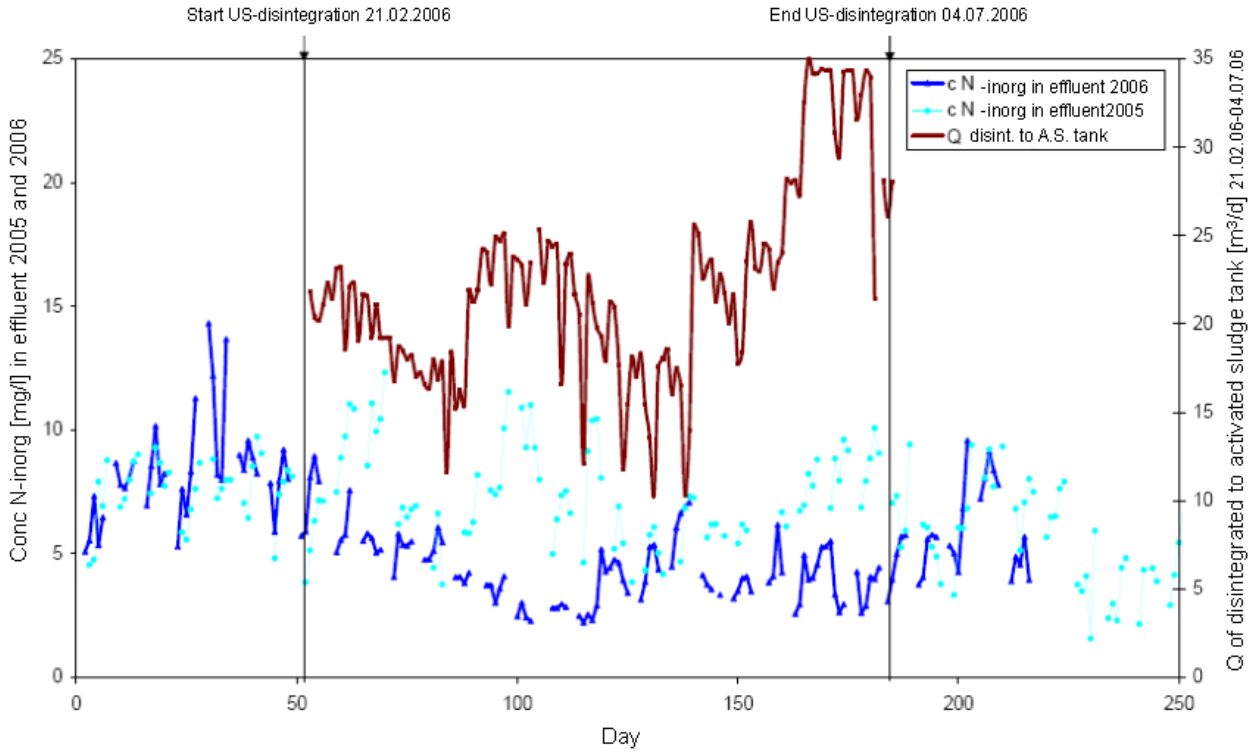
Sonication of 30% of the TWAS (~ 30 m³/d) @ 4.0 kWh/m³



Bünde WWTP, Germany

Results of US Installation:

- No foaming or bulking sludge in the activated sludge tank
- 25% reduction of waste activated sludge mass
- Reduction of the nitrogen concentration in effluent (N < 5 mg/l)



3. Enhancing Anaerobic Biomass Digestion

Bamberg WWTP, Germany
Case Study

Bamberg WWTP, Germany

Initial Conditions:

- Design capacity: 220,000 PE
- Actual Load: 330,000 PE
- 150 m^3/d primary sludge, 250 m^3/d TWAS
- (3) Egg-shaped digesters with 18 d HRT
- 35% average VS degradation

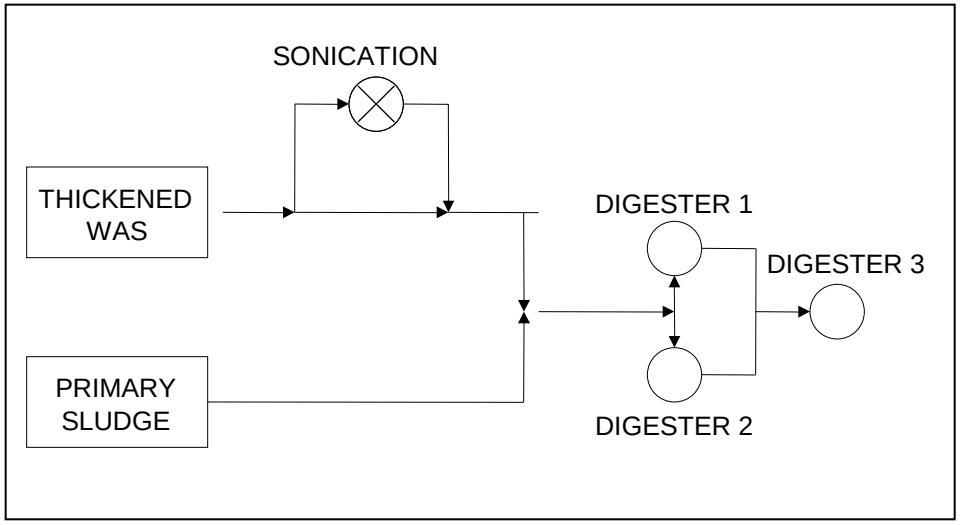
Desired Goal:

- Achieve a minimum of 40% VS degradation
  - Solution 1: Build another 3,000 m^3 egg-shaped digester
  - Solution 2: Use of ultrasound to increase VS destruction

Bamberg WWTP, Germany

Ultrasound installation in 2004:

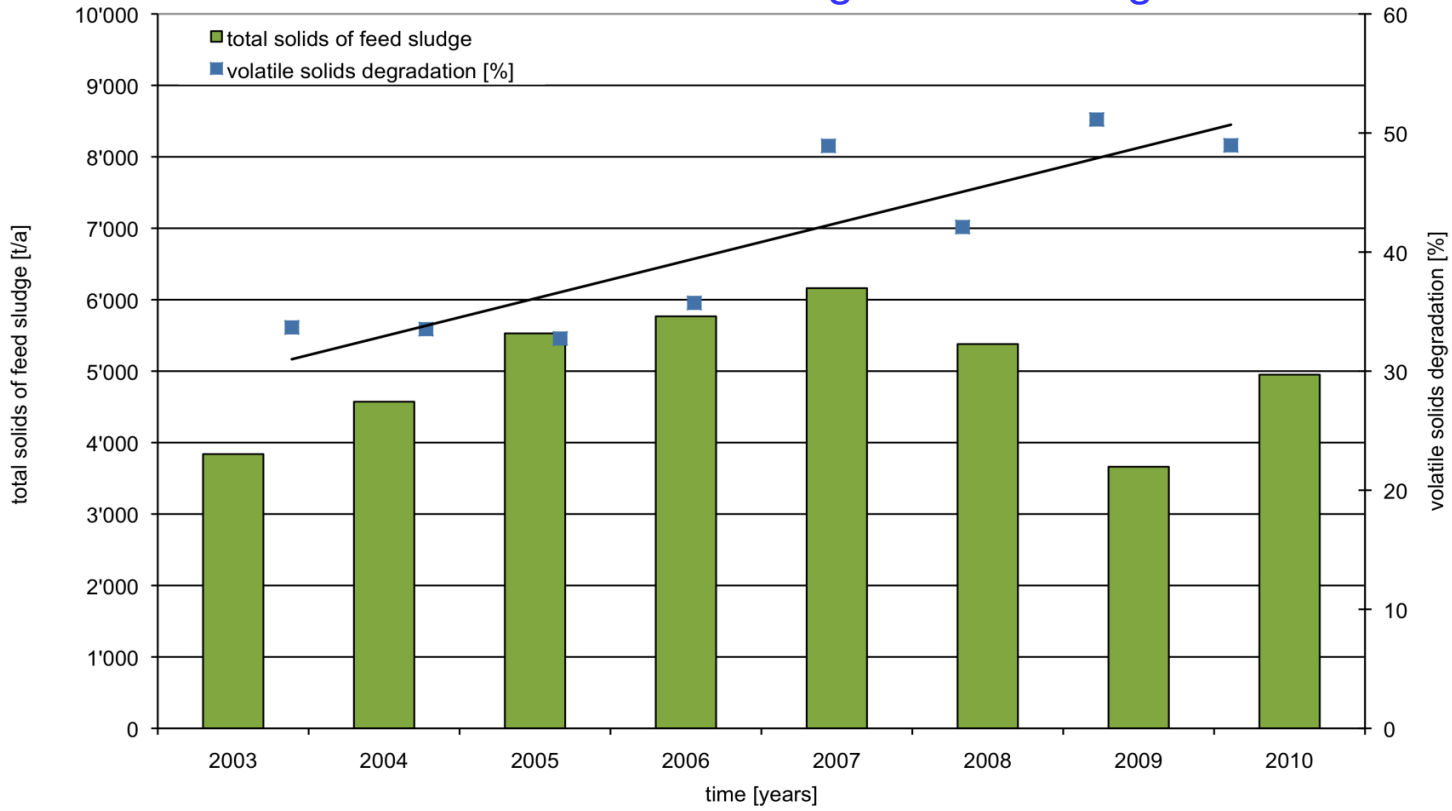
Sonication of 30% (in 2004) - 80% (in 2008) of the WAS (~ 70 – 100 m³/d) @ 2 - 3 kWh/m³



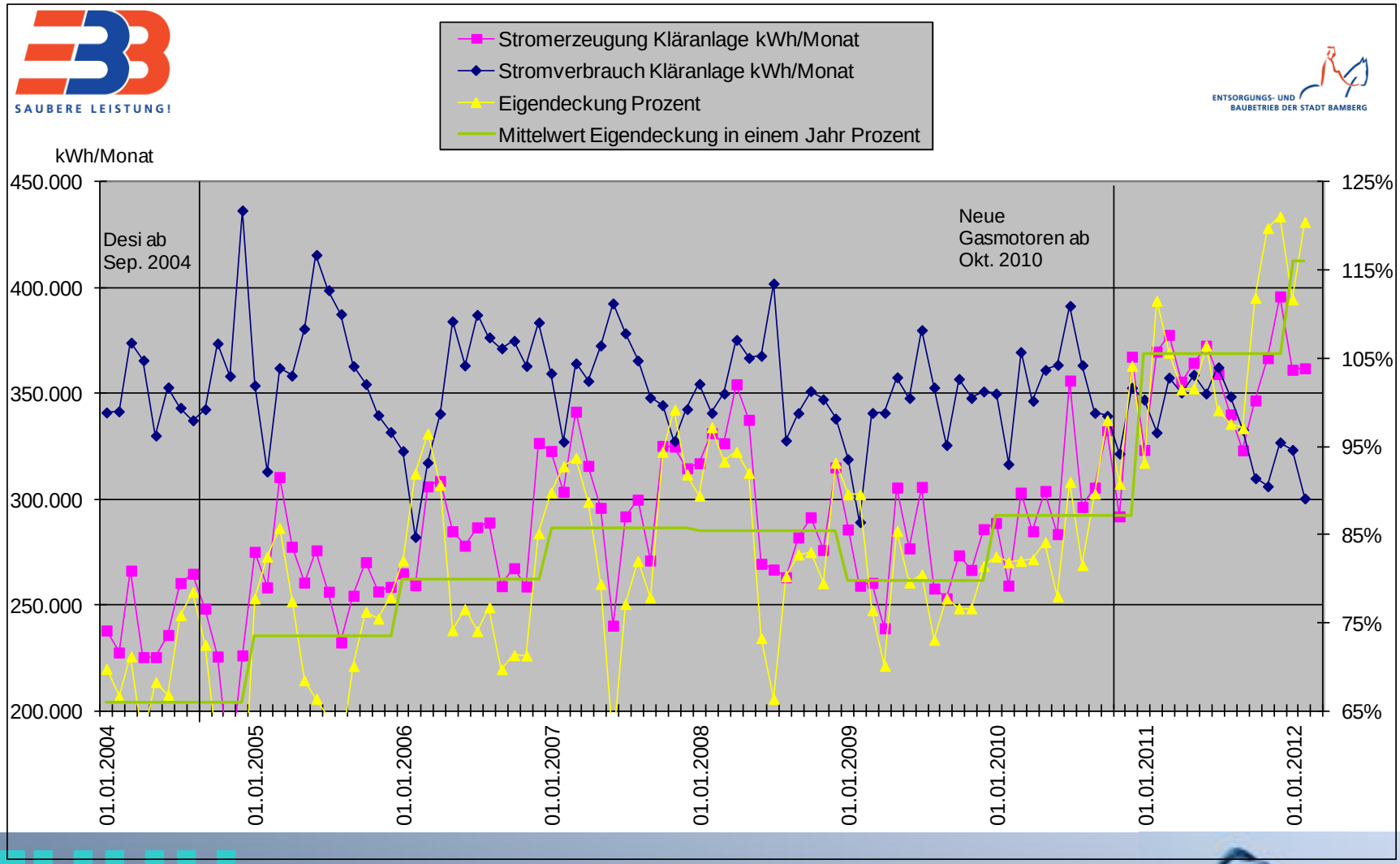
Bamberg WWTP, Germany

Results of US Installation:

- Volatile solids destruction improved from 34 to 50%
- Significantly increased biogas production (+ 45%)
- Avoided construction of a new digester = savings of 1.5 million EUR



Energy-self-sufficient operation on Bamberg WWTP



US-Trial on Shek Wu Hui STW, Hong Kong

Shek Wu Hui STW, Hong Kong

Initial Conditions:

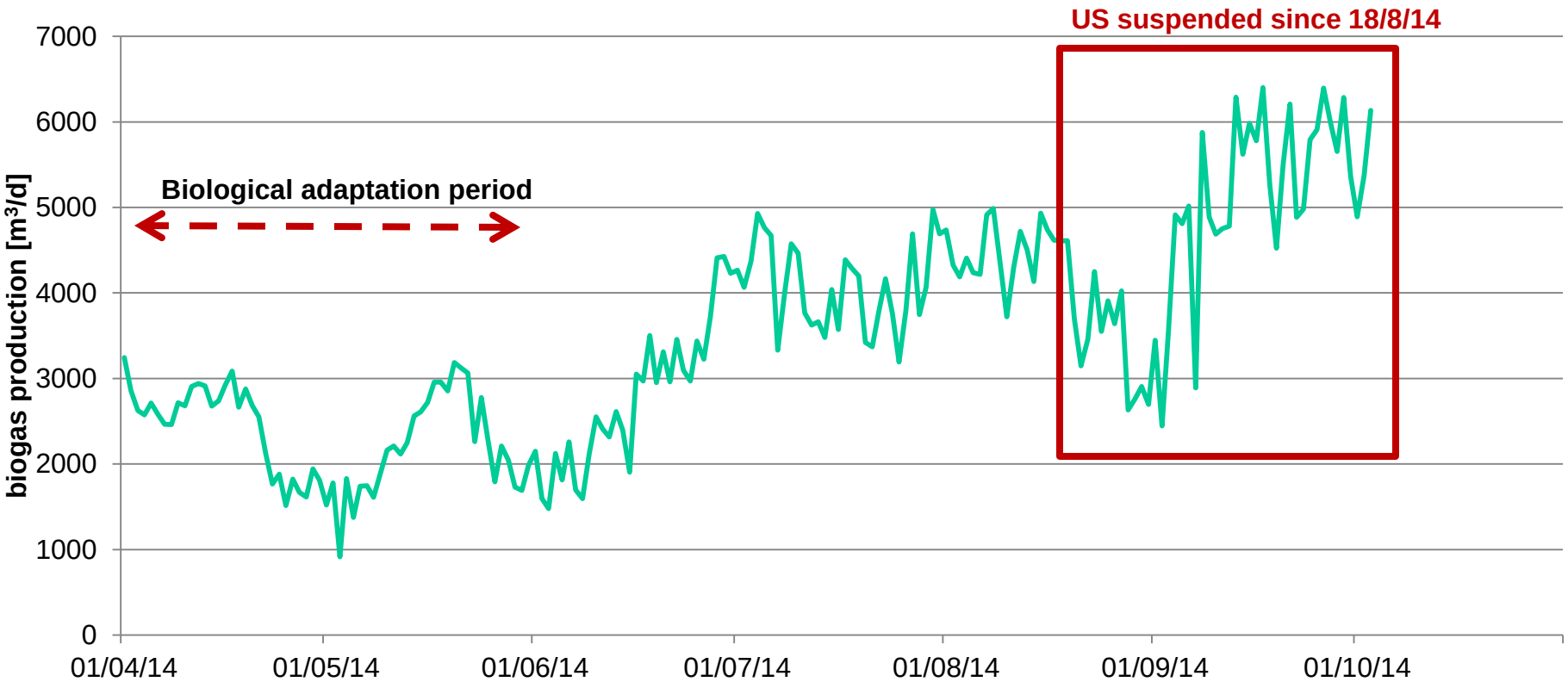
- **Design capacity: 300,000 PE**
- **191 m^3/d primary sludge, 179 m^3/d TSAS**
- **4 Anaerobic digesters with 21 d HRT**
- **Ca. 42% average VS degradation**

US-Trial:

- **Sonication of 15% (ca. 1 m^3/h) of TSAS @ 5 kWh/m^3**

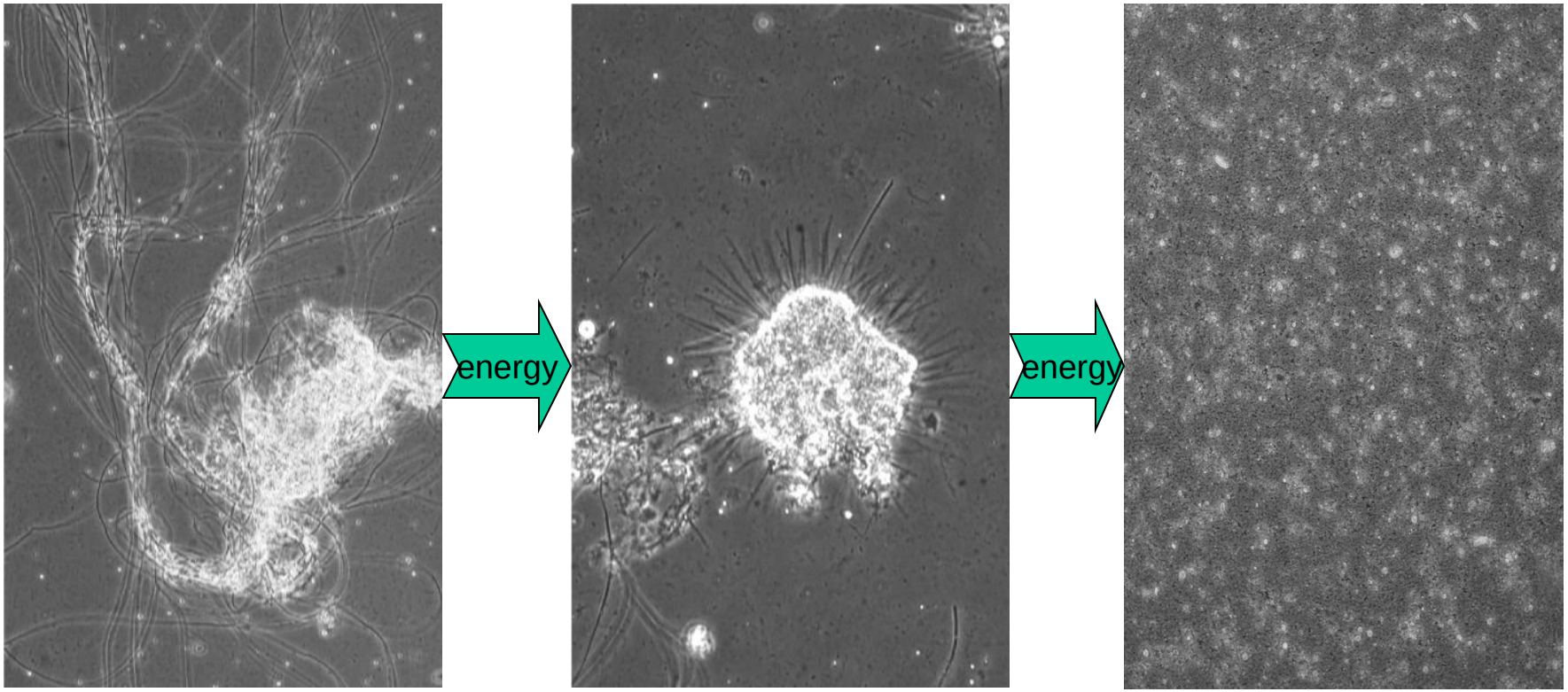
Shek Wu Hui STW, Hong Kong

Biogas production



4. Combating Filamentous/Foaming Sludge

Combating Filamentous Sludge



Original

Short Sonication

Long Sonication

Seevetal WWTP, Germany (165,000 PE)

Sonication of Return Activated Sludge (1% RAS @ 2 kWh/m³)

5. Development of US-reactor

US-reactor for Biosolids Treatment
Requirements

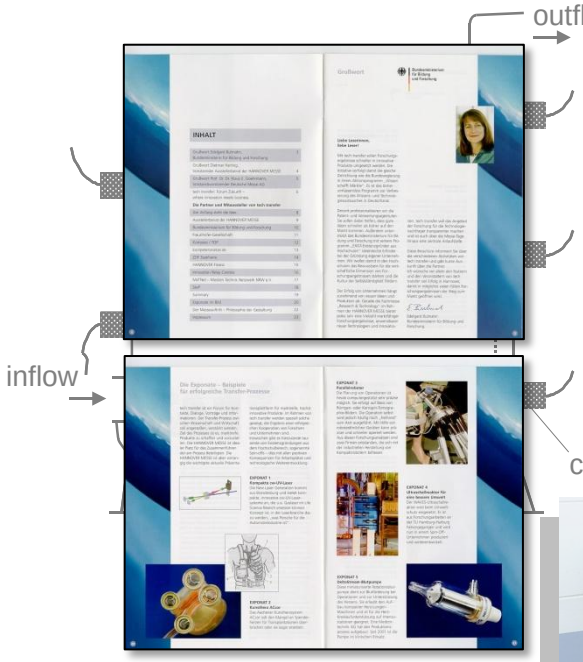
- Treatment of large volumetric sludge streams
- High degree of biosolids cell disintegration
- Continuous operation in spite of varying sludge properties
- Resistant against reactor blockage (sludge impurities)
- Automatic system
- Low maintenance

Full-scale Ultrasound Reactor 2006

Technology Transfer Innovation 2002

Innovation Award German Industry 2006

Innovation Award Baden Württemberg 2007



- Reactor volume: 30 l
- Power [illegible] kW
- Contin[illegible]
- No. of [illegible]
- Freque[illegible]
- Intensi[illegible] m²
- Sonication time: 1 to 3 min
- Sonication dose: 3 to 9 kWh/m³

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Conclusions

- **Biomass treatment with ultrasound is a mature technology**

- **Detailed and specific lab, pilot and full-scale studies have demonstrated the potential of and the practical uses of ultrasound biomass disintegration for biodegradation enhancement.**

Thank you for your attention!