IMPACTS OF THERMOCHEMICAL HYDROLYSIS ON VISCOSITY, BIOGAS & DEWATERABILITY

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MWEA 2018 Biosolids Conference
PRESENTATION FROM 20,000 FEET

- About Centrisys/CNP
- What is Thermo-Chemical Hydrolysis (TCHP) ?
- Why hydrolyze your sludge?
- How does Pondus TCHP work ?
- Pros and Cons versus conventional hydrolysis techniques
- Kenosha, WI Case Study
- Assessing new projects – how to know what to expect
- Conclusions
CENTRISYS AND CNP
WHAT IS THERMO-CHEMICAL HYDROLYSIS?

Hydrolysis = Chemical decomposition of compounds by reacting with water

Thermal Hydrolysis = Accelerated chemical decomposition of compounds via added heat

- Bust open sludge cells via high temp and pressure
- 300 to 320°F under pressure for 30 min

Thermal Chemical Hydrolysis = Accelerated chemical decomposition of compounds via added heat and chemical

- Bust open sludge cells via moderate heat and elevated pH
- 150 °F for 2 hours with NaOH addition
SO WHY HYDROLYZE ?

TWAS

40X

400X

1000X

PONDUS LTWAS

40X

400X

1000X
SO WHY HYDROLYZE?

1. Decrease Sludge Viscosity
   - Lower energy pumping and mixing
   - May enable higher solids loading to digester

2. Improve VS destruction rate and extent in Anaerobic Digester
   - Generate more biogas
   - or Increase VS loading rate of digester(s)

3. Improve Sludge Dewaterability
   - Increase Cake %TS
   - Decrease Polymer Required
HOW DOES PONDUS TCHP WORK?

Chemical: 1.5 to 2.0 liters of caustic soda (50% concentration) is injected per 1 m³ of sludge

Initial pH 11+ but hydrolysis process breaks down the cell walls and releases internal organic acids which brings the pH of the flow stream back to 6.8-7.0

Detention time through the reactor and heat exchanger for 2 to 2.5 hours.
HOW DOES PONDUS TCHP WORK?
HOW DOES PONDUS TCHP WORK?
## PROS & CONS VERSUS CONVENTIONAL SLUDGE HYDROLYSIS

<table>
<thead>
<tr>
<th></th>
<th>Thermal Hydrolysis</th>
<th>CNP Pondus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>300-320°F</td>
<td>150°F</td>
</tr>
<tr>
<td>High Pressure</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Chemical</td>
<td>No</td>
<td>Yes (50% NaOH)</td>
</tr>
<tr>
<td>%TS Process Feed</td>
<td>&gt; 10% TS</td>
<td>4-8% TS</td>
</tr>
<tr>
<td>Cell Degradation</td>
<td>More complete destruction</td>
<td>Cell walls become porous, EPS is destroyed, soluble COD release, most cell wall structure stays intact</td>
</tr>
<tr>
<td>Viscosity Reduction</td>
<td>Similar for Both</td>
<td></td>
</tr>
<tr>
<td>Gas Production</td>
<td>Upto 50% increase in gas production</td>
<td>20 to 30% increase typical</td>
</tr>
<tr>
<td>Sludge Dewaterability</td>
<td>Increased Cake %DS, possible increase in polymer use</td>
<td>Increased Cake %DS, decrease in polymer required</td>
</tr>
<tr>
<td>Cost</td>
<td>Relatively higher</td>
<td>Relatively lower</td>
</tr>
<tr>
<td>Foot Print</td>
<td>Relatively higher</td>
<td>Relatively lower</td>
</tr>
<tr>
<td>Supernatant color</td>
<td>Due to complete breakdown, denaturized proteins, supernatant from dewatering tends to have yellow color</td>
<td>Supernatant resembles normal digester supernatant</td>
</tr>
</tbody>
</table>
### PONDUS INSTALLATIONS WORLD-WIDE

<table>
<thead>
<tr>
<th>Waste Water Treatment Plant</th>
<th>Year Built</th>
<th>Capacity WWTP [MGD]</th>
<th>Sludge Throughput per Reactor [gpm]</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gifhorn, German</td>
<td>2005</td>
<td>10</td>
<td>9.7</td>
<td>24h- activity</td>
</tr>
<tr>
<td>Ratekau, German</td>
<td>2007</td>
<td>5</td>
<td>11</td>
<td>12h-activity, night standby operation</td>
</tr>
<tr>
<td>Uelzen, German</td>
<td>2014</td>
<td>11</td>
<td>11.9</td>
<td>24h- activity</td>
</tr>
<tr>
<td>Nordhorn, German</td>
<td>2014</td>
<td>20</td>
<td>7.9</td>
<td>24h activity, sometimes as pasteurization in batch</td>
</tr>
<tr>
<td>Kenosha, USA</td>
<td>2016</td>
<td>28</td>
<td>23</td>
<td>24h- activity</td>
</tr>
<tr>
<td>Wolfsburg, German</td>
<td>2016</td>
<td>20</td>
<td>26</td>
<td>24hr- activity</td>
</tr>
<tr>
<td>Göppingen, Germany</td>
<td>2018</td>
<td></td>
<td>In Design/Construction</td>
<td></td>
</tr>
<tr>
<td>Löhne, Germany</td>
<td>2018</td>
<td></td>
<td>In Design/Construction</td>
<td></td>
</tr>
</tbody>
</table>
KENOSHA, WI CASE STUDY

Digested Sludge HRT From 30+ Days to < 20 Days
KENOSHA, WI CASE STUDY
KENOSHA, WI CASE STUDY
- REDUCED TWAS VISCOSITY

![Graph showing the viscosity of TWAS, NaOH dosing alone, and PONDUS TCHP Treatment vs stir RPM.](image)

**TWAS**

**NaOH dosing alone**

**PONDUS TCHP Treatment**

**Hydrolyzed TWAS (LTWAS)**
KENOSHA, WI CASE STUDY - BIOGAS PRODUCTION

Biogas Production of Primary ADs (cf/d)

- 2017
- 2016
- 2012
KENOSHA, WI CASE STUDY
- DIGESTED SLUDGE DEWATERABILITY

Cake Solids (% TS) vs Polymer Dosage (lb/dry ton)

- PONDUS Treatment
- Prior PONDUS Treatment

Cake Dryness Improvement
Polymer Reduction
A RECAP – WHY HYDROLYZE WITH

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   - Increase Cake %TS
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4. Improve Sludge Dewaterability
   - VFA Production
### VOLATILE FATTY ACID PRODUCTION / RELEASE

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>VFA ppm</th>
<th>Ammonia ppm</th>
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</thead>
<tbody>
<tr>
<td>Rock River WRRF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock River TWAS</td>
<td>7.0</td>
<td>484</td>
<td>50</td>
</tr>
<tr>
<td>Rock River LTWAS (Lab)</td>
<td>6.7</td>
<td>4,159</td>
<td>638</td>
</tr>
<tr>
<td>Kenosha WRRF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kenosha TWAS</td>
<td>6.7</td>
<td>-</td>
<td>60</td>
</tr>
<tr>
<td>Kenosha LTWAS</td>
<td>7.1</td>
<td>5,517</td>
<td>813</td>
</tr>
<tr>
<td>Kenosha LTWAS(Lab)</td>
<td>6.9</td>
<td>5,017</td>
<td>640</td>
</tr>
</tbody>
</table>

> NEARLY 10 FOLD INCREASE IN VFA
ASSESSING NEW PROJECTS – HOW TO KNOW WHAT TO EXPECT

- CNP can offer experience-based performance guarantee in many cases
- Sometimes testing done upfront
  - Lab-simulated Pondus

  + Soluble COD and VFA Testing
    - Provide estimates for SCOD and VFA Production
    - 1 month from start to finish
    - $100 to $1,000

  + Biological Methane Potential (BMP) Test
    - Provides estimated additional gas production
    - 2-3 months from start to conclusion
    - $2000 - $4000

  or BMP with daily GC Testing
    - Can be used to generate kinetic rate constants for biomass degradation specific to source
    - $10,000 - $15,000
    - 4-6 months from start to conclusion
CONCLUSIONS

- At 6% DS into process - PONDUS TCHP can provide estimated 65% VSD at 17 Days HRT
- Holding digester capacity constant, biogas generation should be expected to increase by >25%
- 2 to 3% point increase in digested sludge dewaterability
- 20 to 30% reduction in sludge dewatering polymer requirement
- Decreased sludge viscosity makes higher solids digestion more practical
  - Reduce pumping and mixing energy, wear, and tear
- Lab testing can be completed as necessary to evaluate potential benefit
Dr. Dünnebeil – Pondus GmbH
Kenosha Water Utility
Dr. Zhongtian “John” Li – CNP
Dr. Hiroko “Yoshi” Yoshida – Centrisys/CNP
Dr. Kopp – Kläranlagen Beratung Kopp
THANK YOU FOR YOUR QUESTIONS AND INTEREST

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Thank you for your attention and interest!

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