



IMPACTS OF THERMOCHEMICAL HYDROLYSIS ON VISCOSITY, BIOGAS & DEWATERABILITY

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

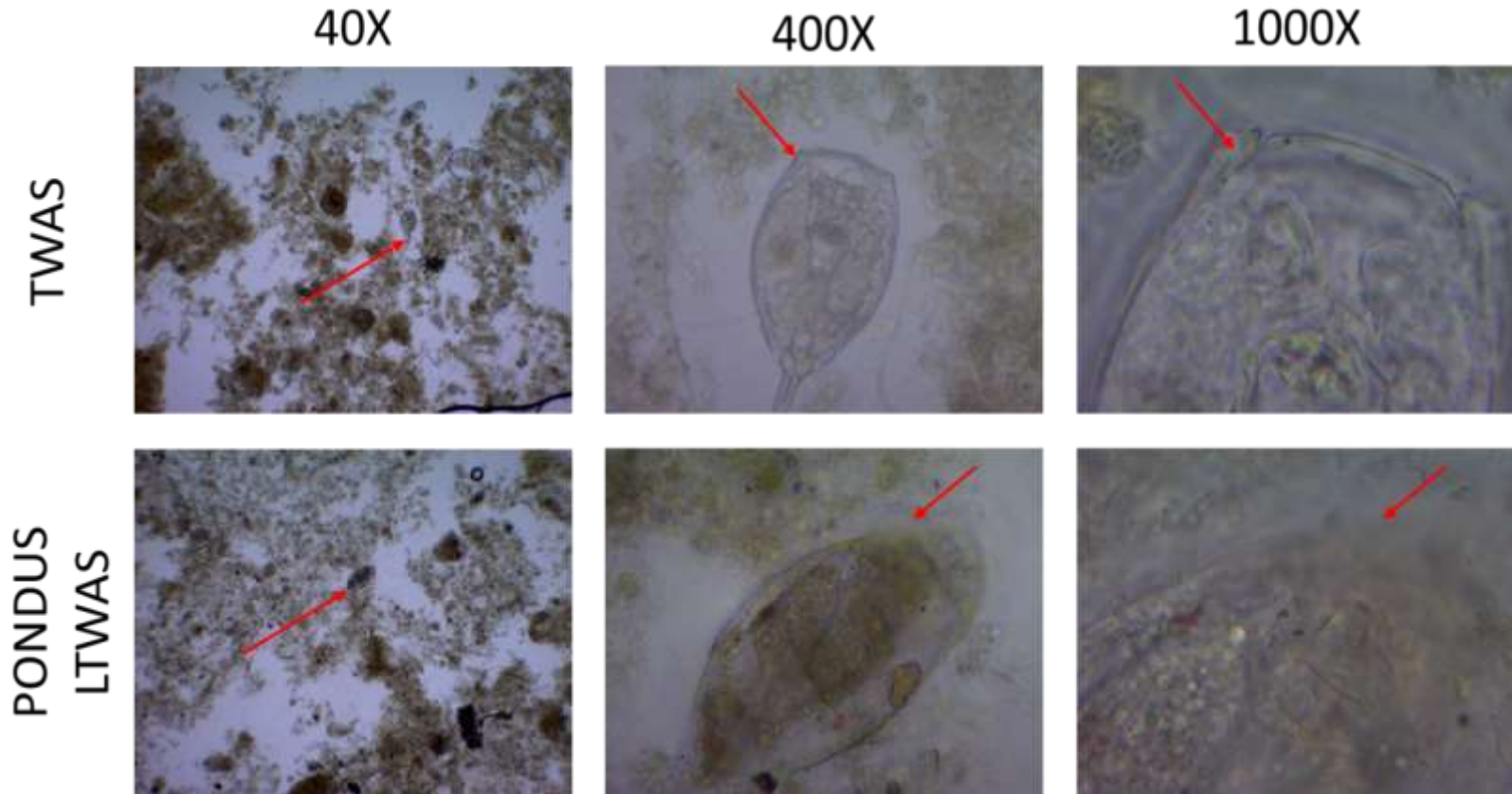
Thermal Hydrolysis = Accelerated chemical decomposition of compounds via added heat

- 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 ?



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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

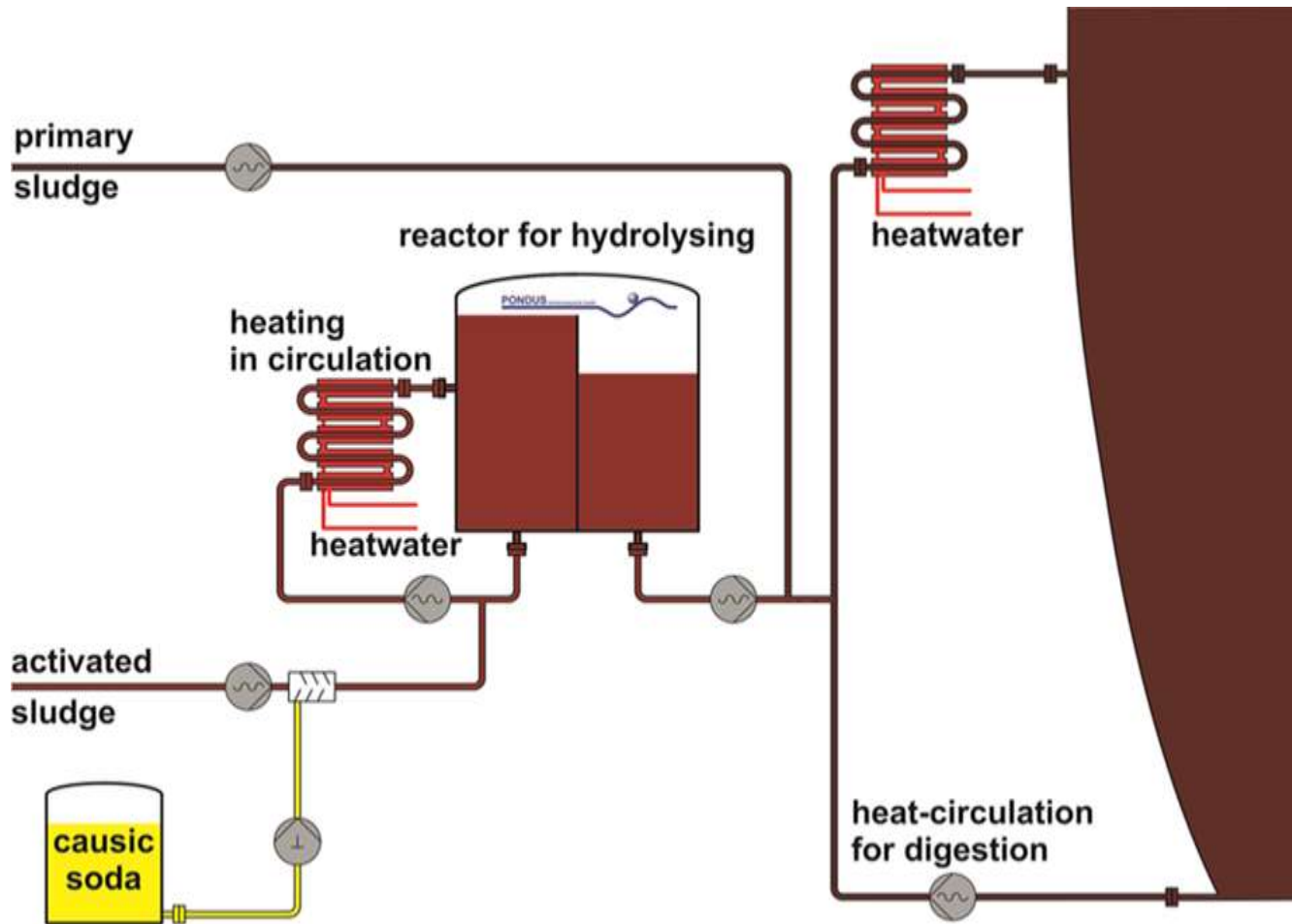
Detention time through the reactor and heat exchanger for 2 to 2.5 hours.



HOW DOES PONDUS TCHP WORK?



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PROS & CONS VERSUS CONVENTIONAL SLUDGE HYDROLYSIS

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

PONDUS INSTALLATIONS WORLD-WIDE

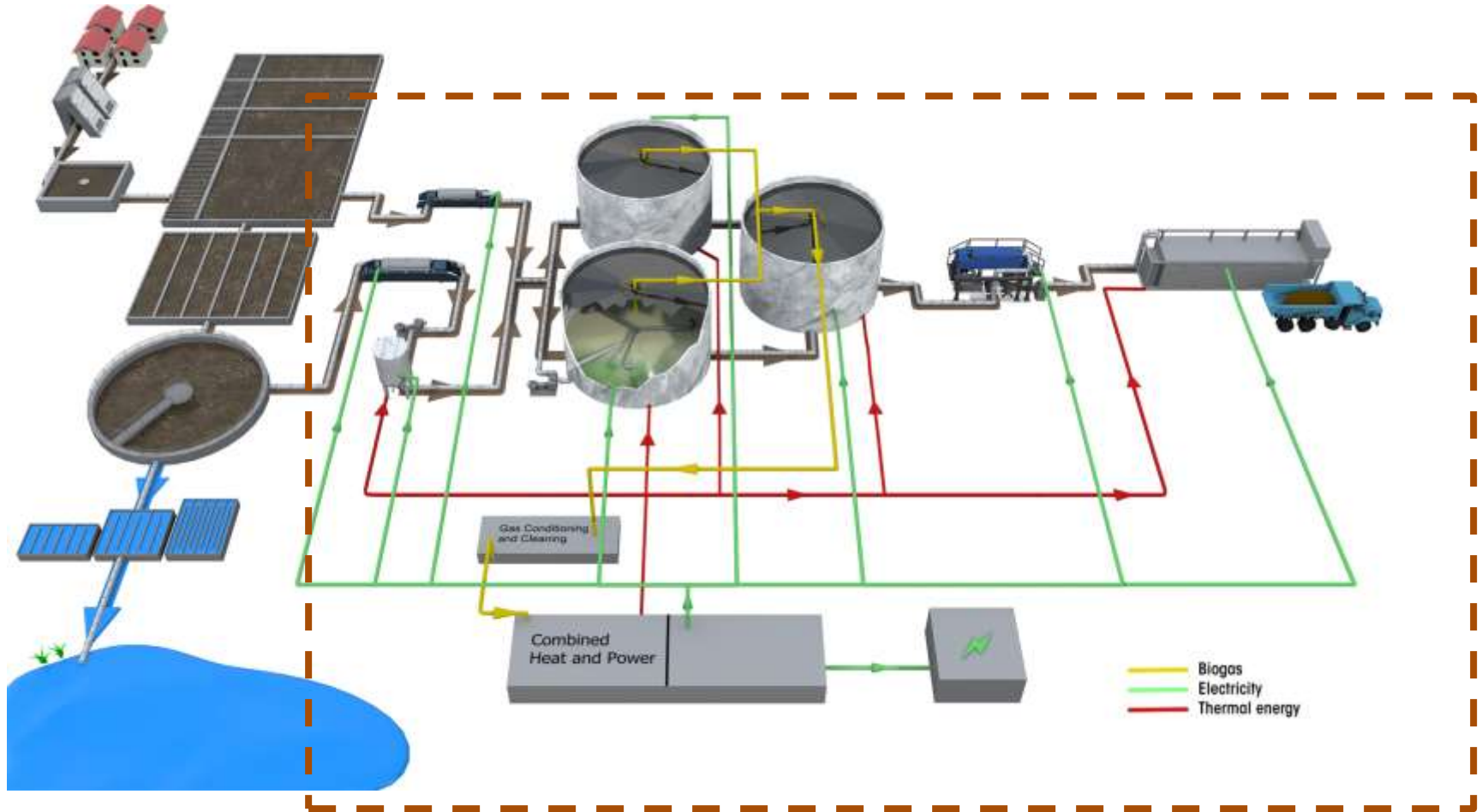
Waste Water Treatment Plant	Year Built	Capacity WWTP [MGD]	Sludge Throughput per Reactor [gpm]	Notes
Gifhorn, German	2005	10	9.7	24h- activity
Ratekau, German	2007	5	11	12h-activity, night standby operation
Uelzen, German	2014	11	11.9	24h- activity
Nordhorn, German	2014	20	7.9	24h activity, sometimes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

KENOSHA, WI CASE STUDY

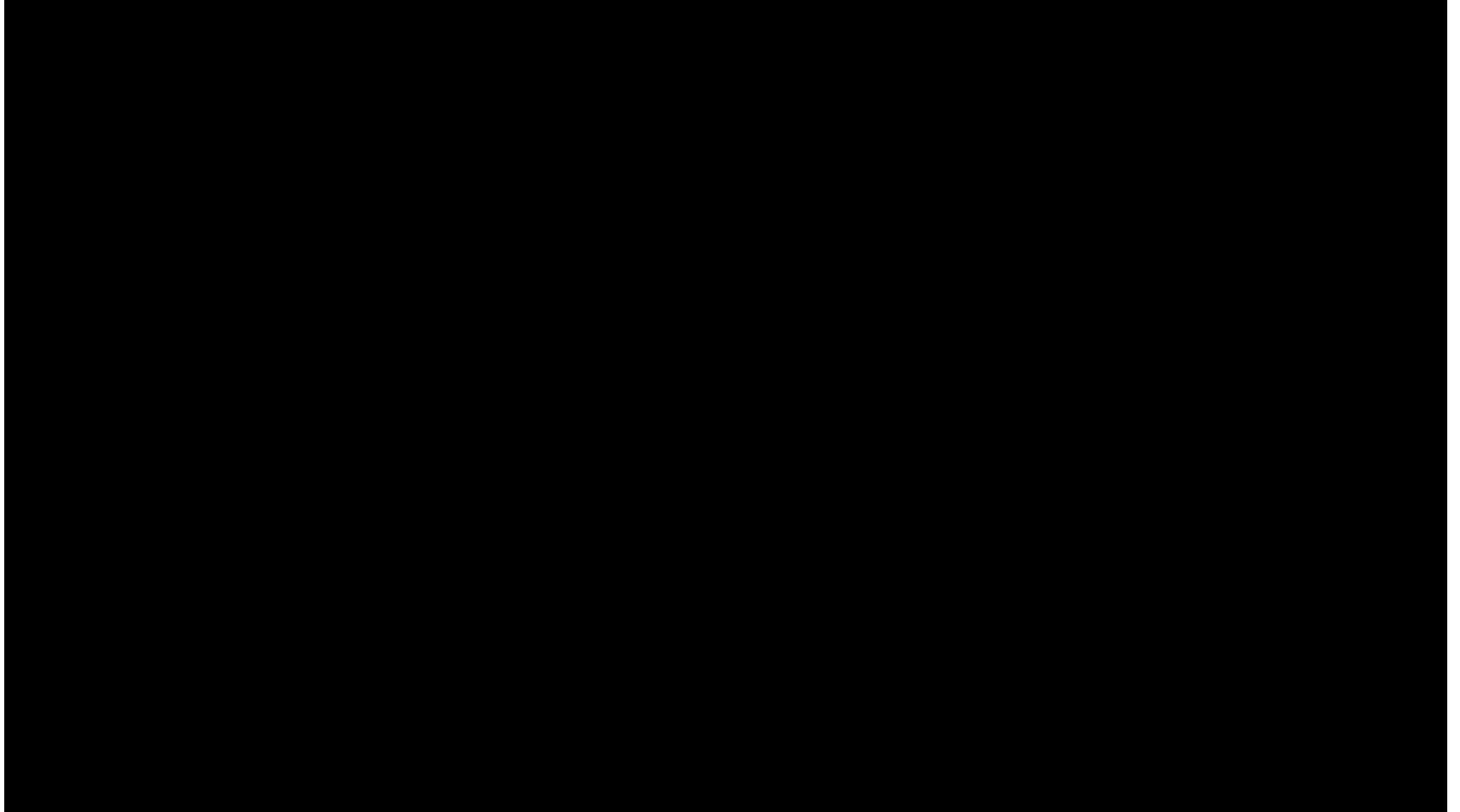


Digested Sludge HRT From 30+ Days to < 20 Days

KENOSHA, WI CASE STUDY

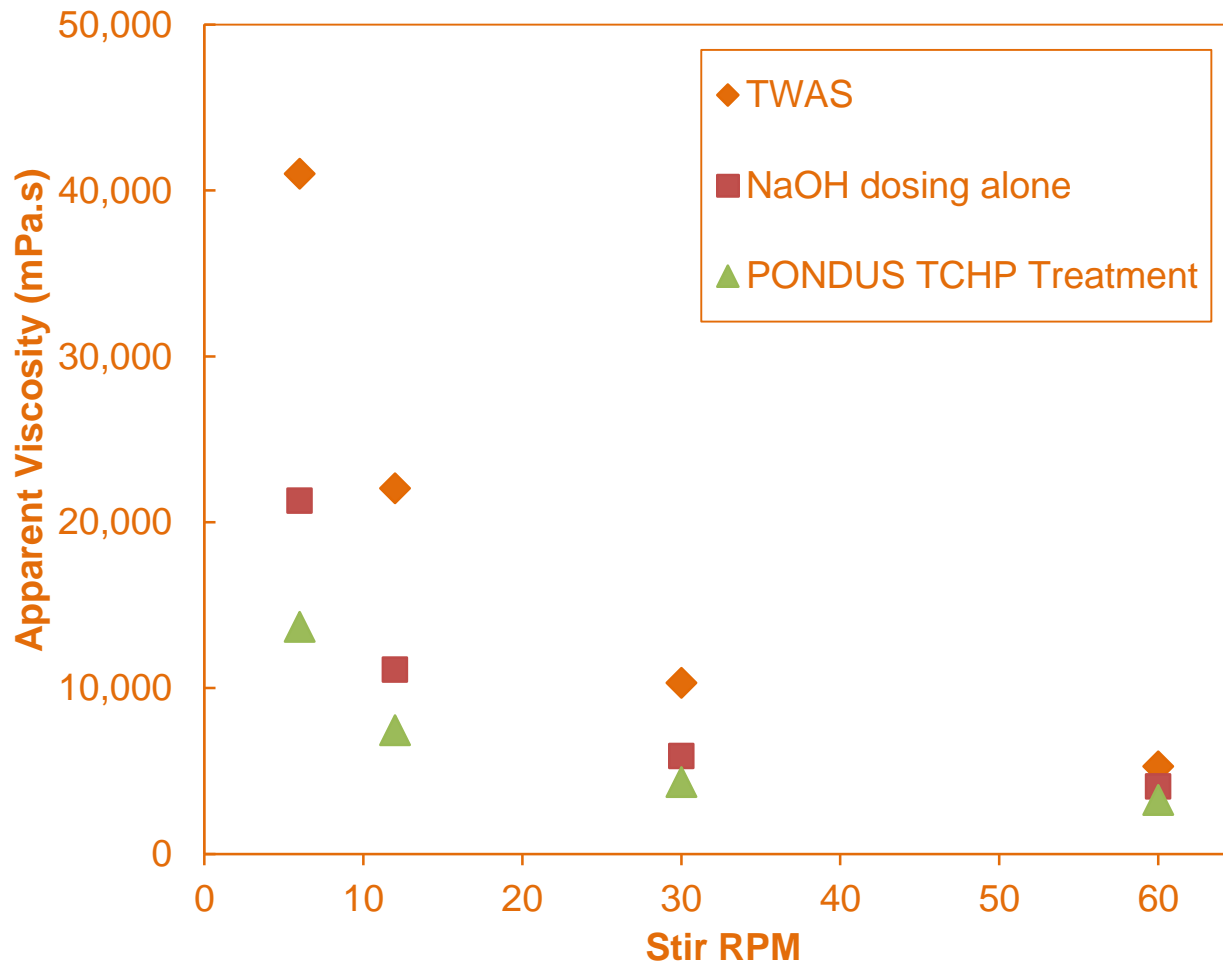


KENOSHA, WI CASE STUDY



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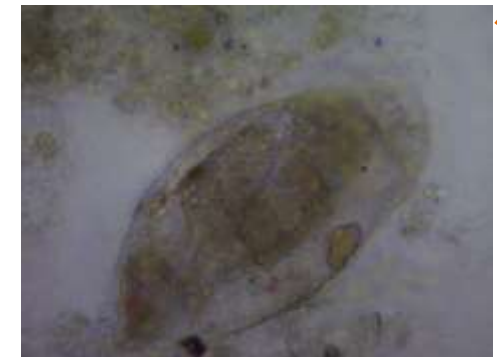
- REDUCED TWAS VISCOSITY



TWAS

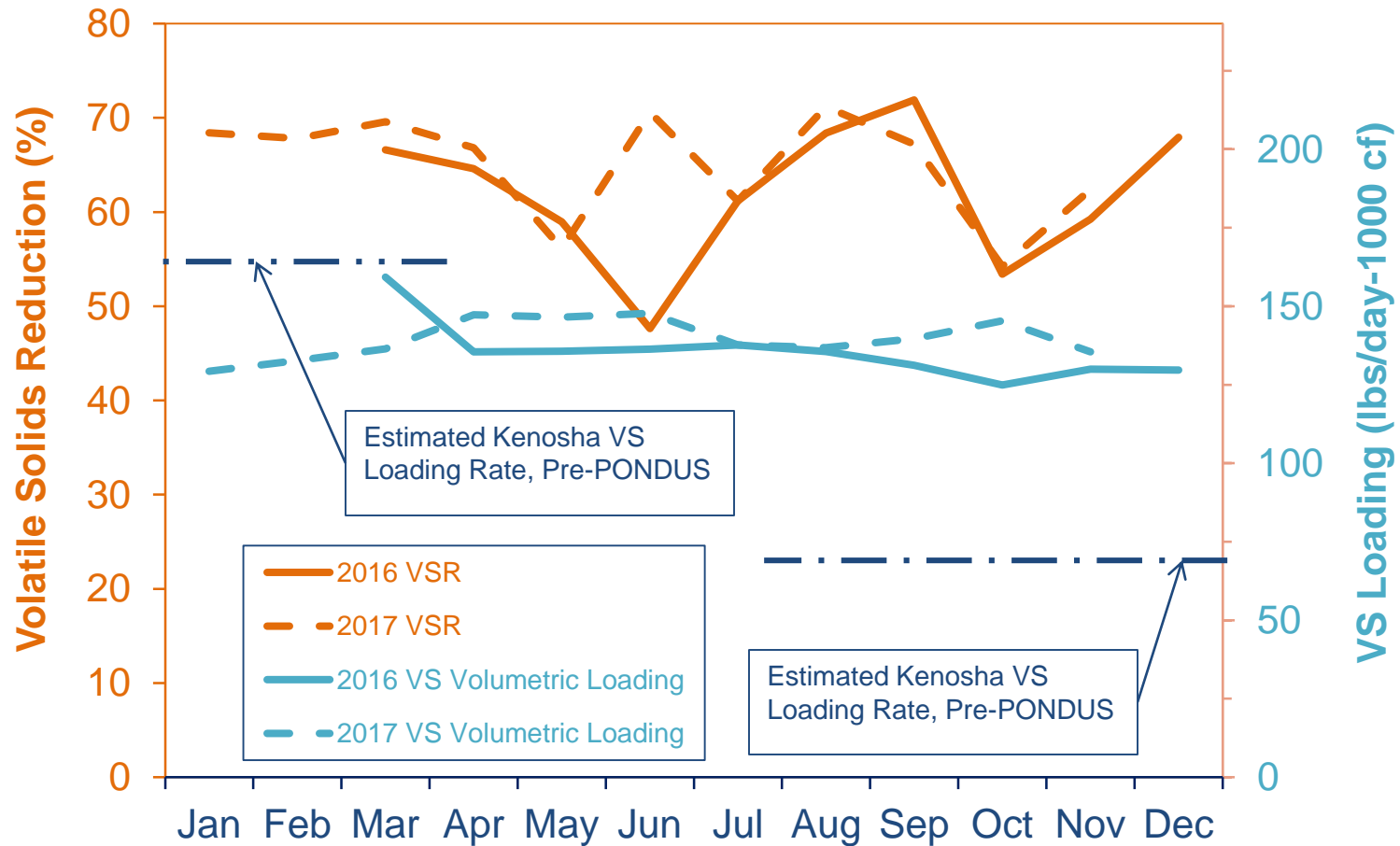


Hydrolyzed TWAS (LTWAS)



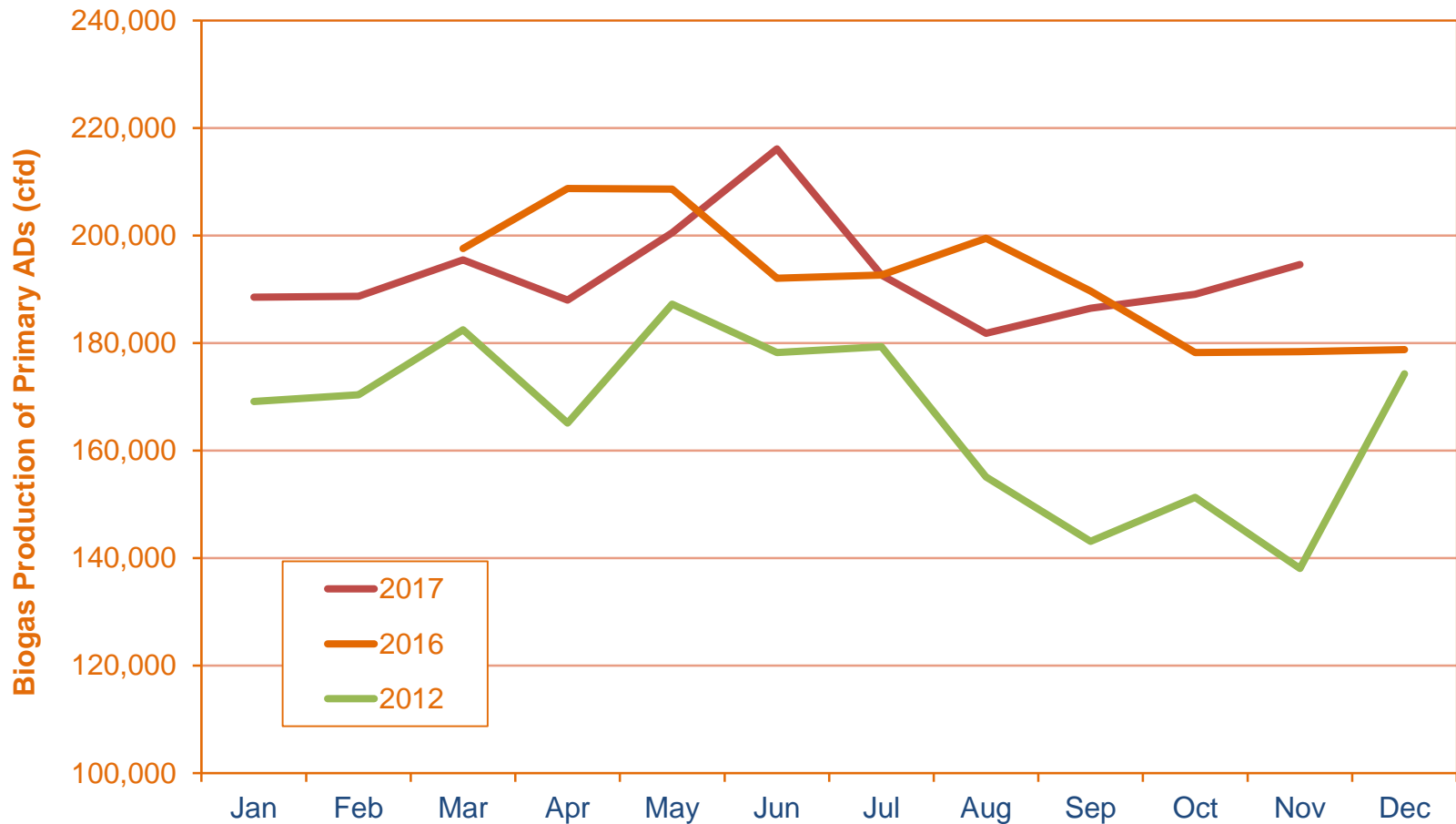
KENOSHA, WI CASE STUDY

- VS LOADING & DESTRUCTION



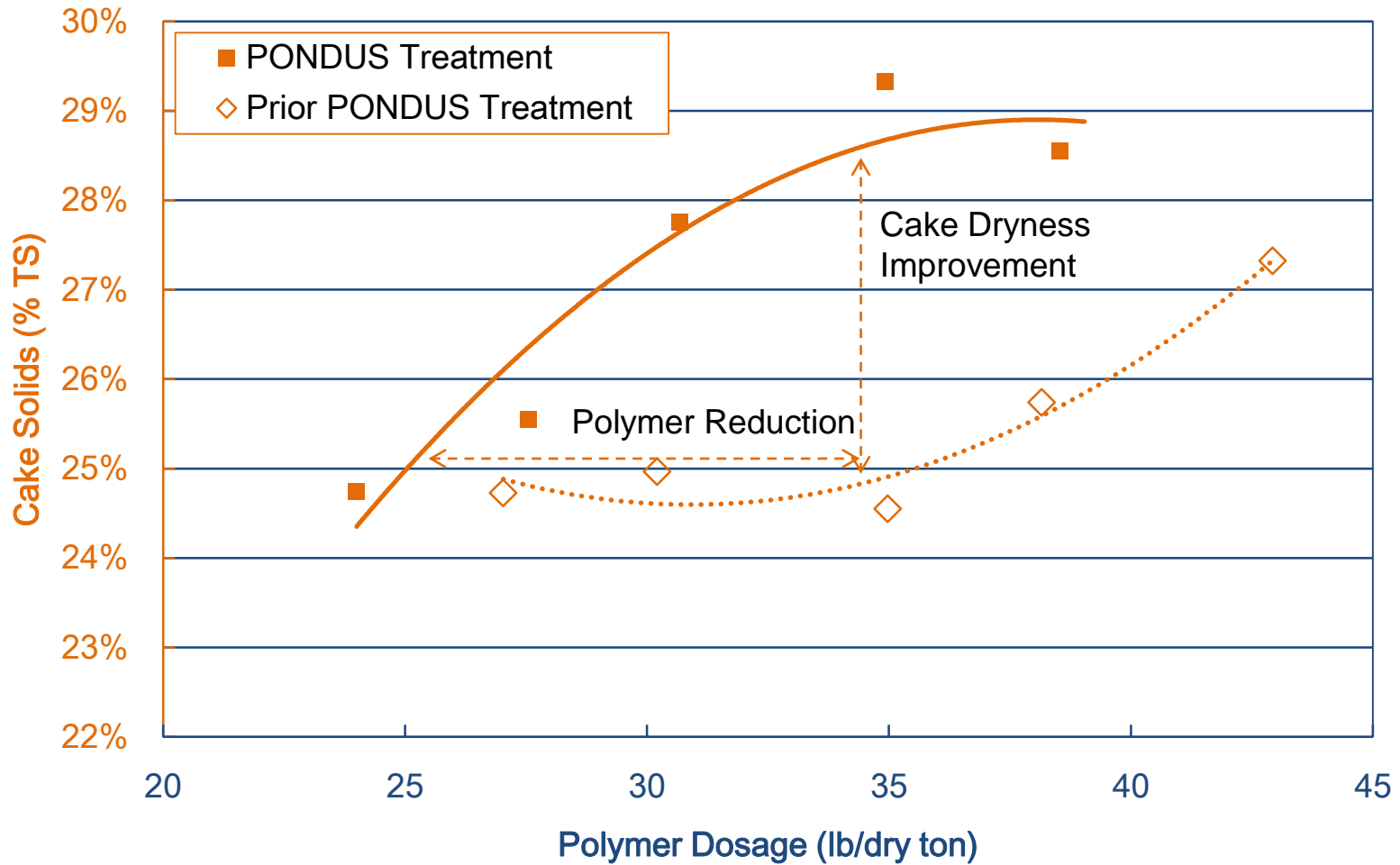
KENOSHA, WI CASE STUDY

- BIOGAS PRODUCTION



KENOSHA, WI CASE STUDY

- DIGESTED SLUDGE DEWATERABILITY



A RECAP – WHY HYDROLYZE WITH

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4. Improve Sludge Dewaterability

- VFA Production

VOLATILE FATTY ACID PRODUCTION / RELEASE

	pH	VFA ppm	Ammonia ppm
Rock River WRRF			
Rock River TWAS	7.0	484	50
Rock River LTWAS (Lab)	6.7	4,159	638
Kenosha WRRF			
Kenosha TWAS	6.7	-	60
Kenosha LTWAS	7.1	5,517	813
Kenosha LTWAS(Lab)	6.9	5,017	640

➤ **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**

GIVE CREDIT WHERE CREDIT IS DUE

- **Dr. Dünnebeil – Pondus GmbH**
- **Kenosha Water Utility**
- **Dr. Zhongtian “John” Li – CNP**
- **Dr. Hiroko “Yoshi” Yoshida – Centrisys/CNP**
- **Dr. Kopp – Kläranlagen Beratung Kopp**

DISCUSSION



THANK YOU FOR YOUR QUESTIONS AND INTEREST



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Thank you for your attention and interest!

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