

TIREPower ANAEROBIC DIGESTER



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Typical Scrape Manure



Typical Flush Manure



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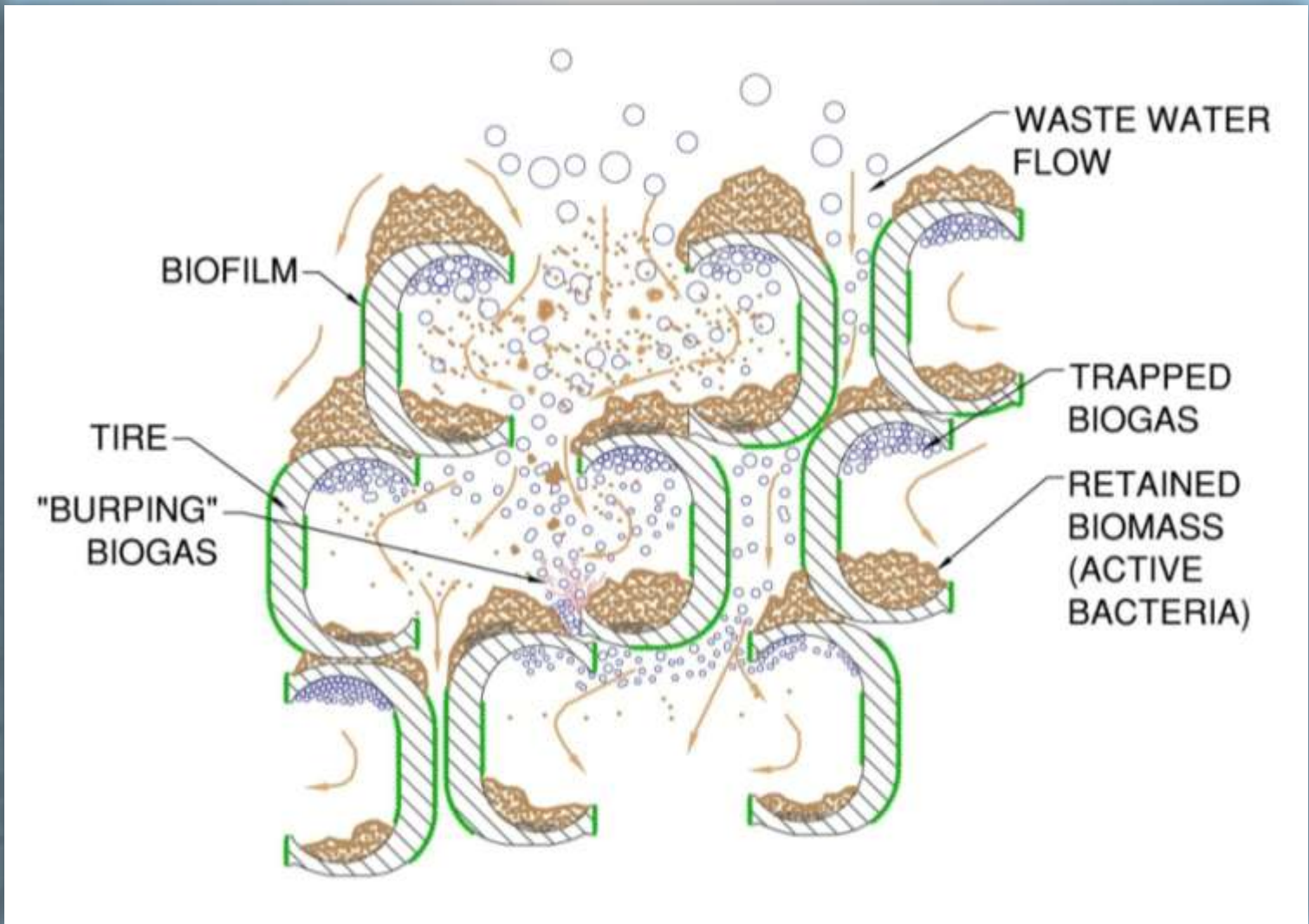


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TIREPower AD Development Goals

- AD Solution for Dilute Flow Streams Especially Flush Dairy Operations
- Shorten Hydraulic Retention Time
- Media Capable of Treating Manures without Plugging
- **More Affordable AD System**



Media Bed Cross-Section



Retained Solids From Pilot

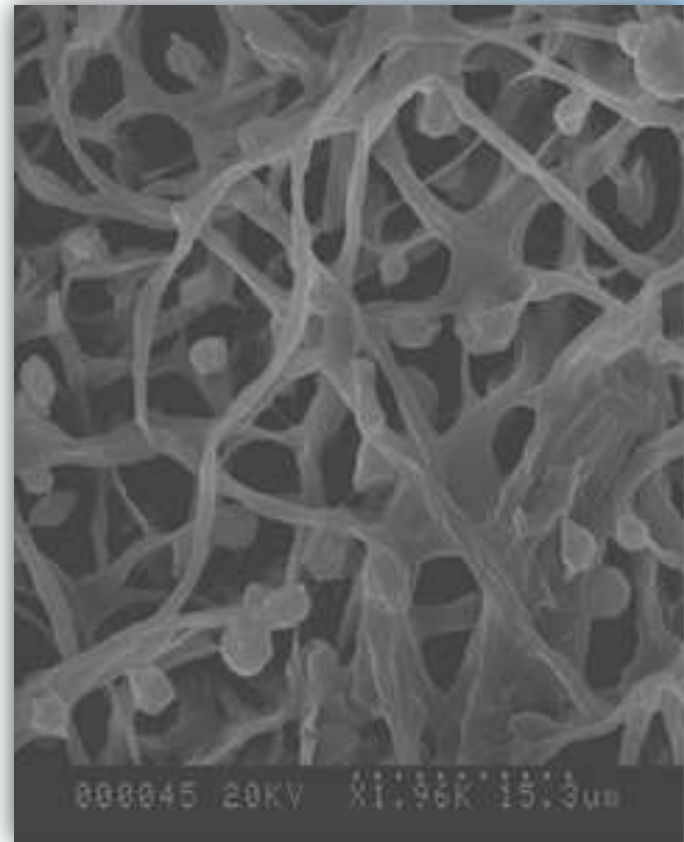
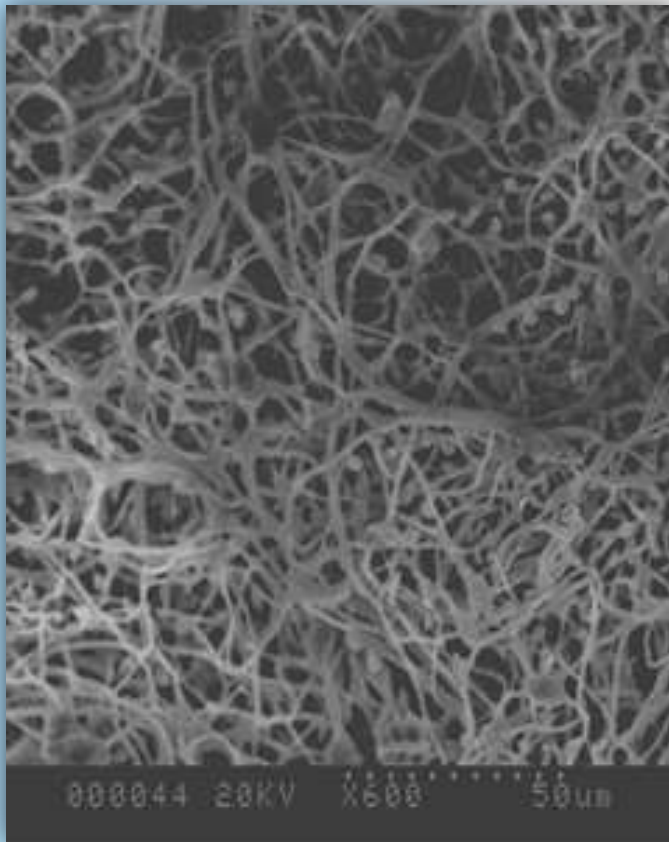


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Fixed Film Image From Pilot



Media Profile From Pilot



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Pilot Summary

- Operated 1 Year - Sept 2005 to Sept 2006
- Total Volatile Solids and COD Removals Between 30% and 45% at 7 Days HRT
- No Indications of Media Plugging with Sand Laden Dairy Manure
- Advanced Model Developed
- Study Warranted Full Scale Prototype to Optimize Design and Demonstrate Capabilities



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TIREPower AD – Threemile

- Commercial Scale Digester Facility
- Partners - Bonneville Environmental Foundation, NW Natural Gas, and Threemile Canyon Farms, LLC
- 12-18 Month Demonstration/Test Phase
- \$1.5 Million Budget:
 - Phase 1 - Digester Construction and Testing
 - Phase 2 - Full Operation with Biogas Put To Beneficial Use

TIREPower Digester Basin



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Digester Full of Tire Media



Completed HDPE Digester Cover



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Pump Station & Effluent Weir



Heat Exchanger and Boiler Container



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Boiler Container



Biogas Blower Building



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Biogas Flaring 10-Days After Startup



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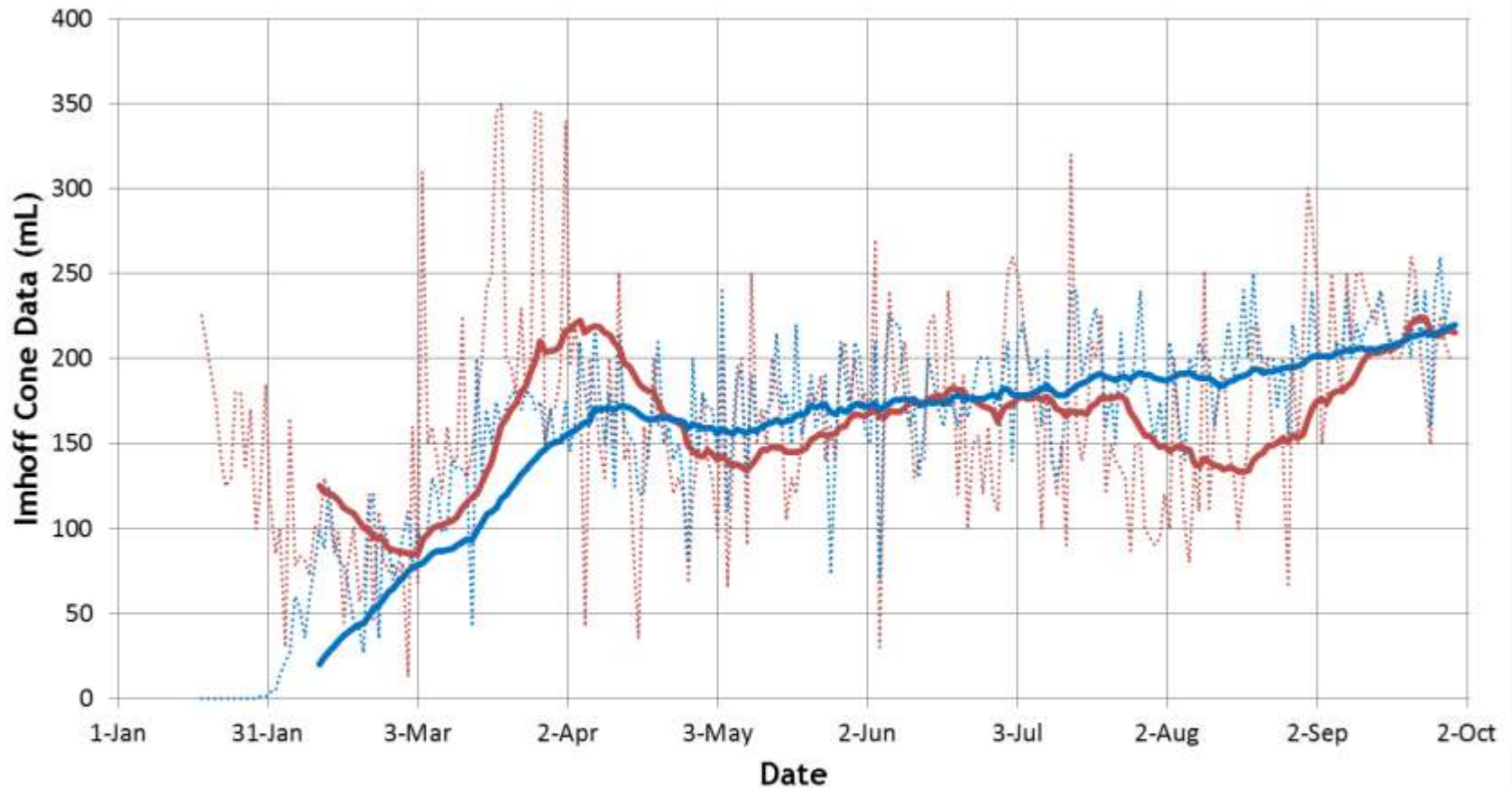
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Threemile Operations Plan

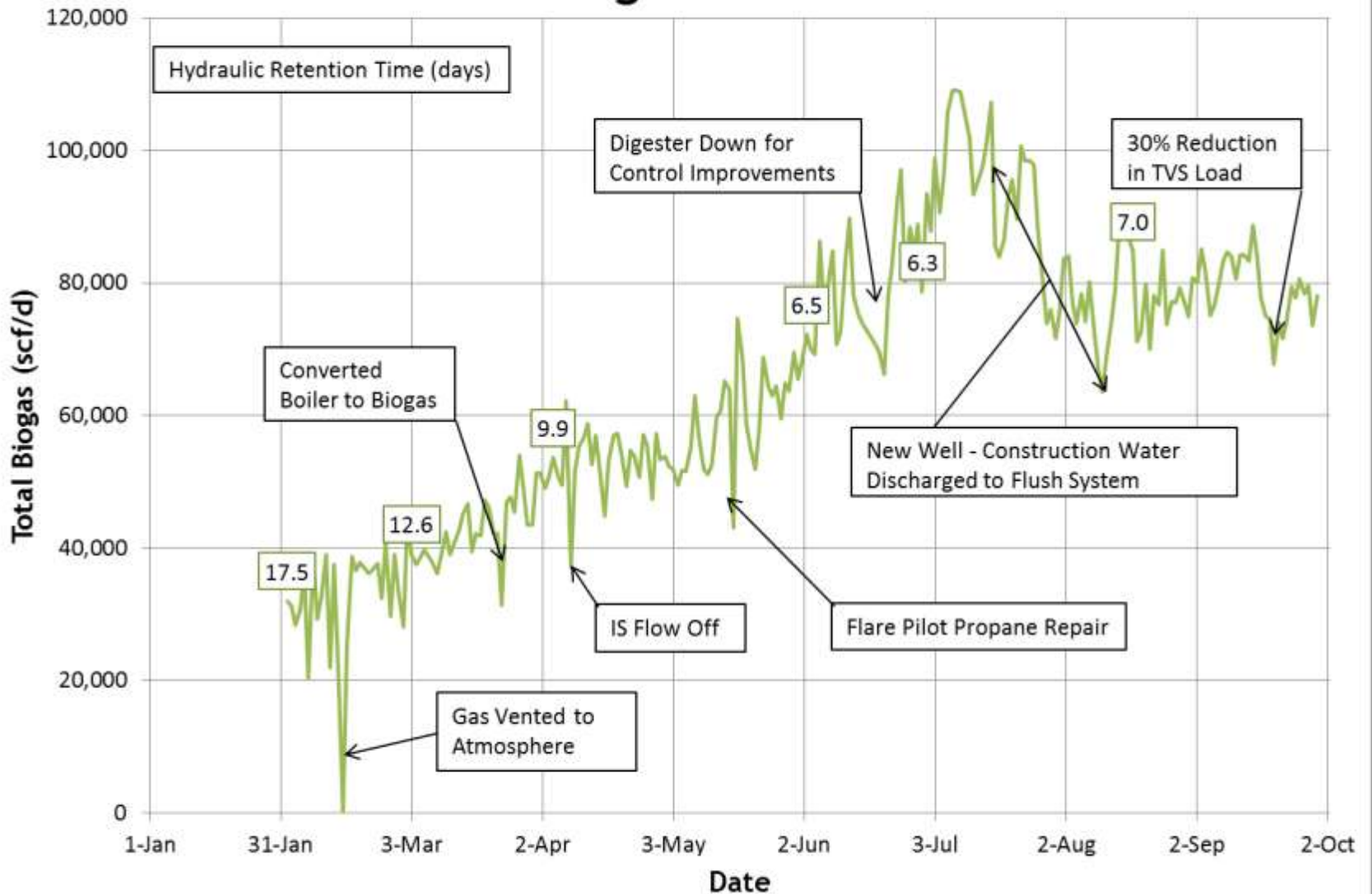
- Start-Up Phase Began January 18, 2010
 - Burnable Biogas within 10 Days
 - 60% Methane Content within 20 Days
 - Converted Boiler to Burn Biogas March 24, 2010
- HRT Optimization Phase Completed September 2010 (6.5 to 7.5 Day HRT)
- **6 Month Performance Evaluation Phase Currently Underway**
- Process Optimization Phase - Spring 2011

Influent and Effluent Imhoff Cone Data

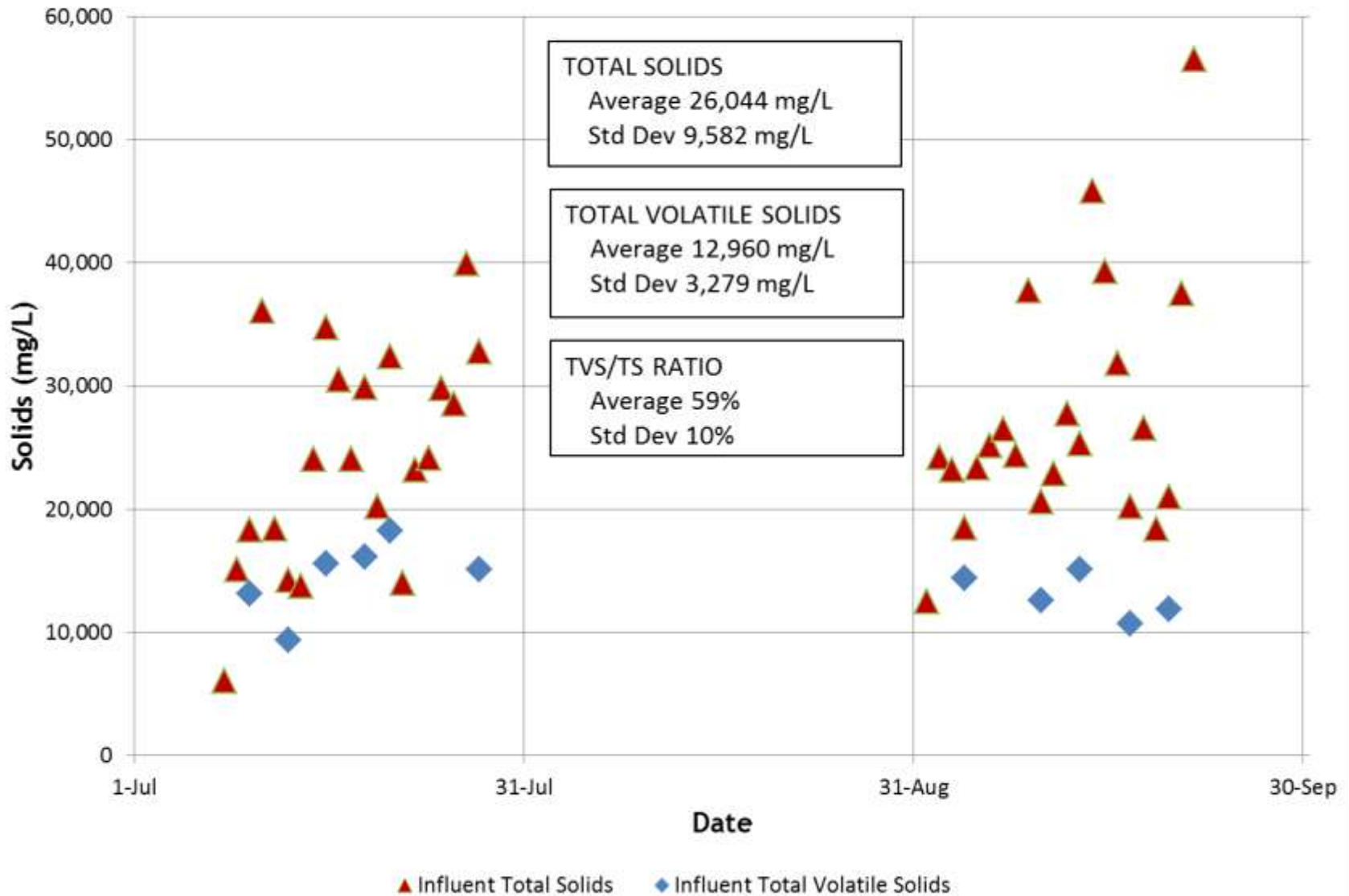


- Influent Imhoff Cone
- Effluent Imhoff Cone Data
- 25 per. Mov. Avg. (Influent Imhoff Cone)
- 25 per. Mov. Avg. (Effluent Imhoff Cone Data)

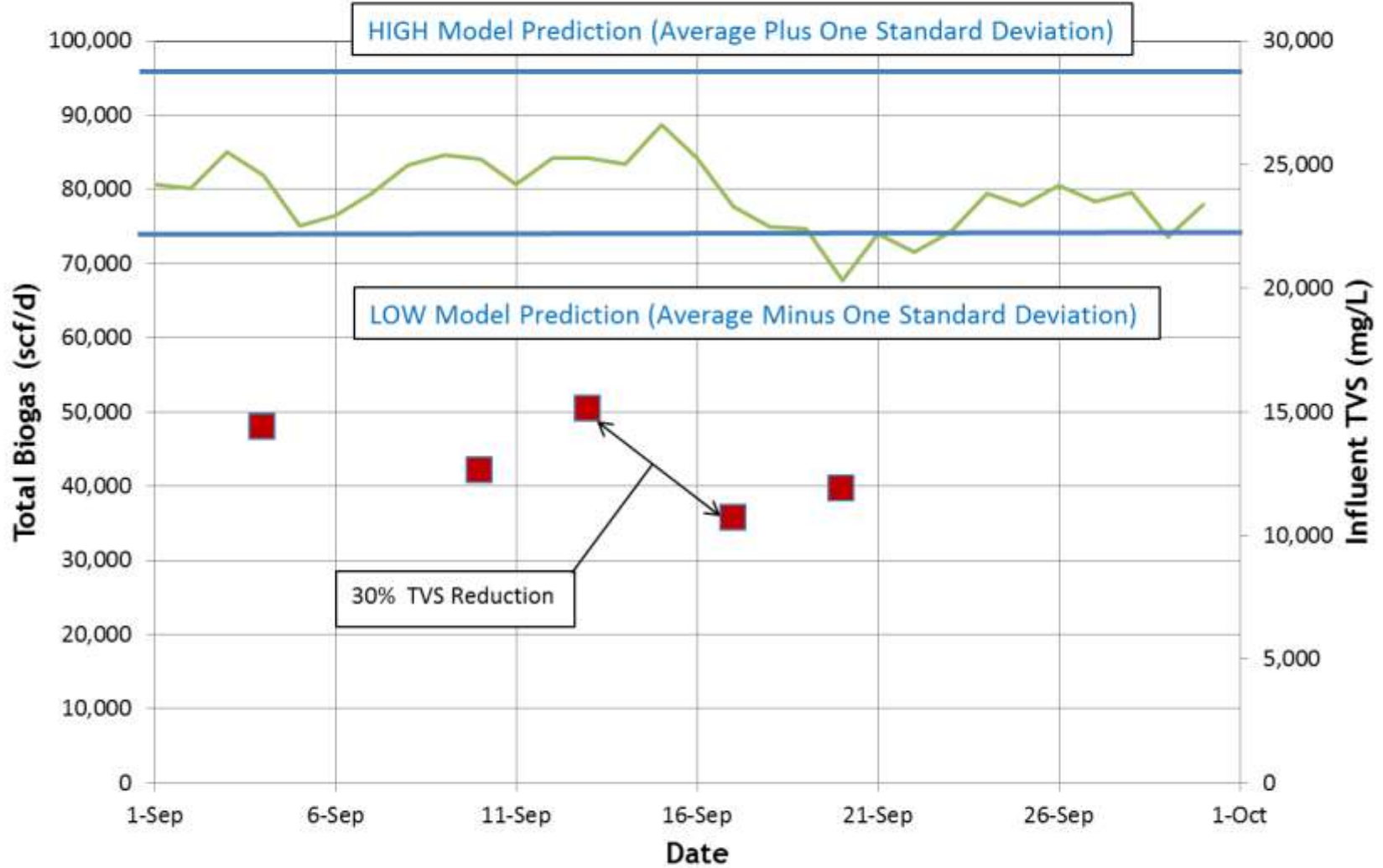
Total Biogas Produced



Influent Total and Volatile Solids



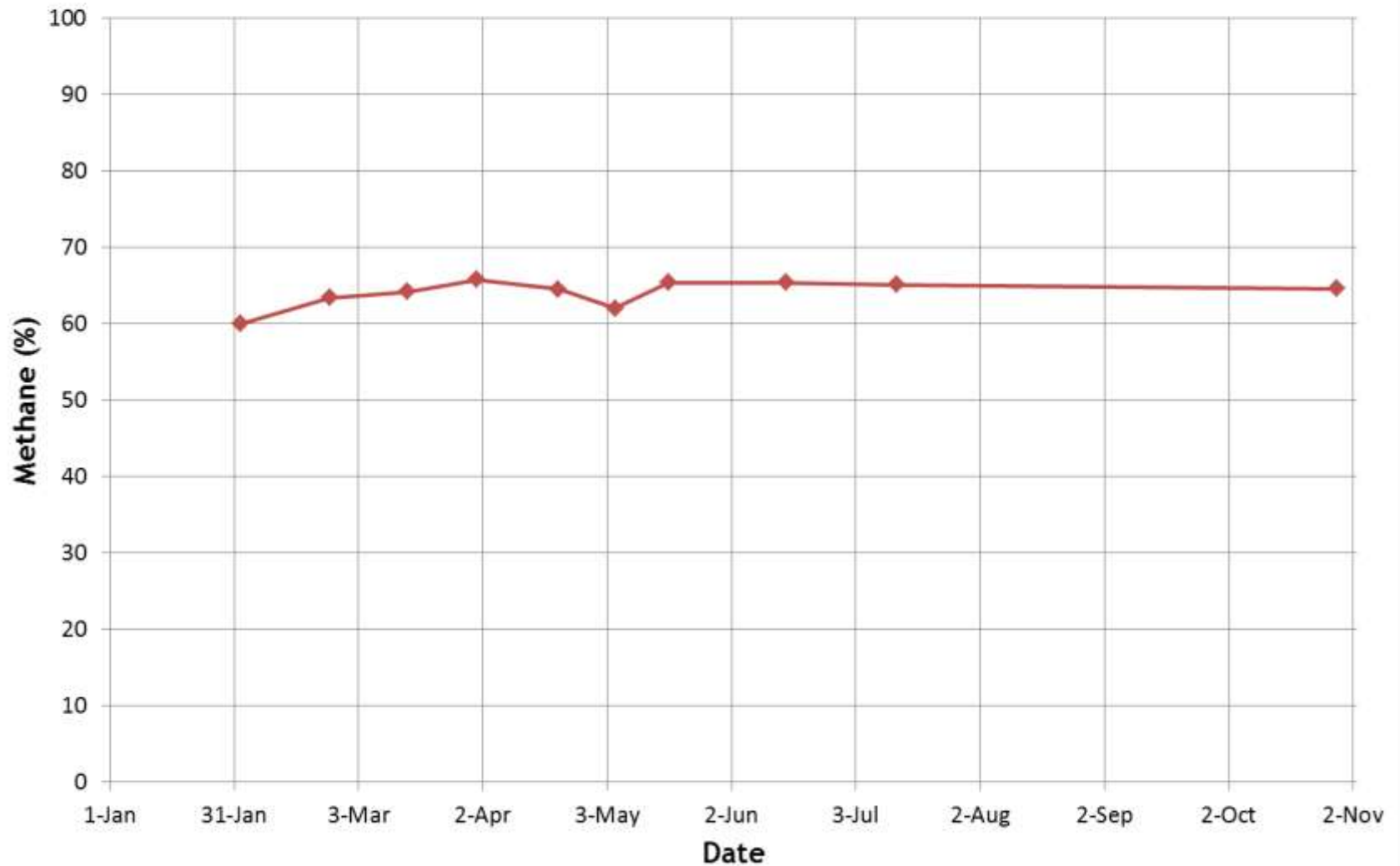
Total Biogas Produced at 7 Day HRT



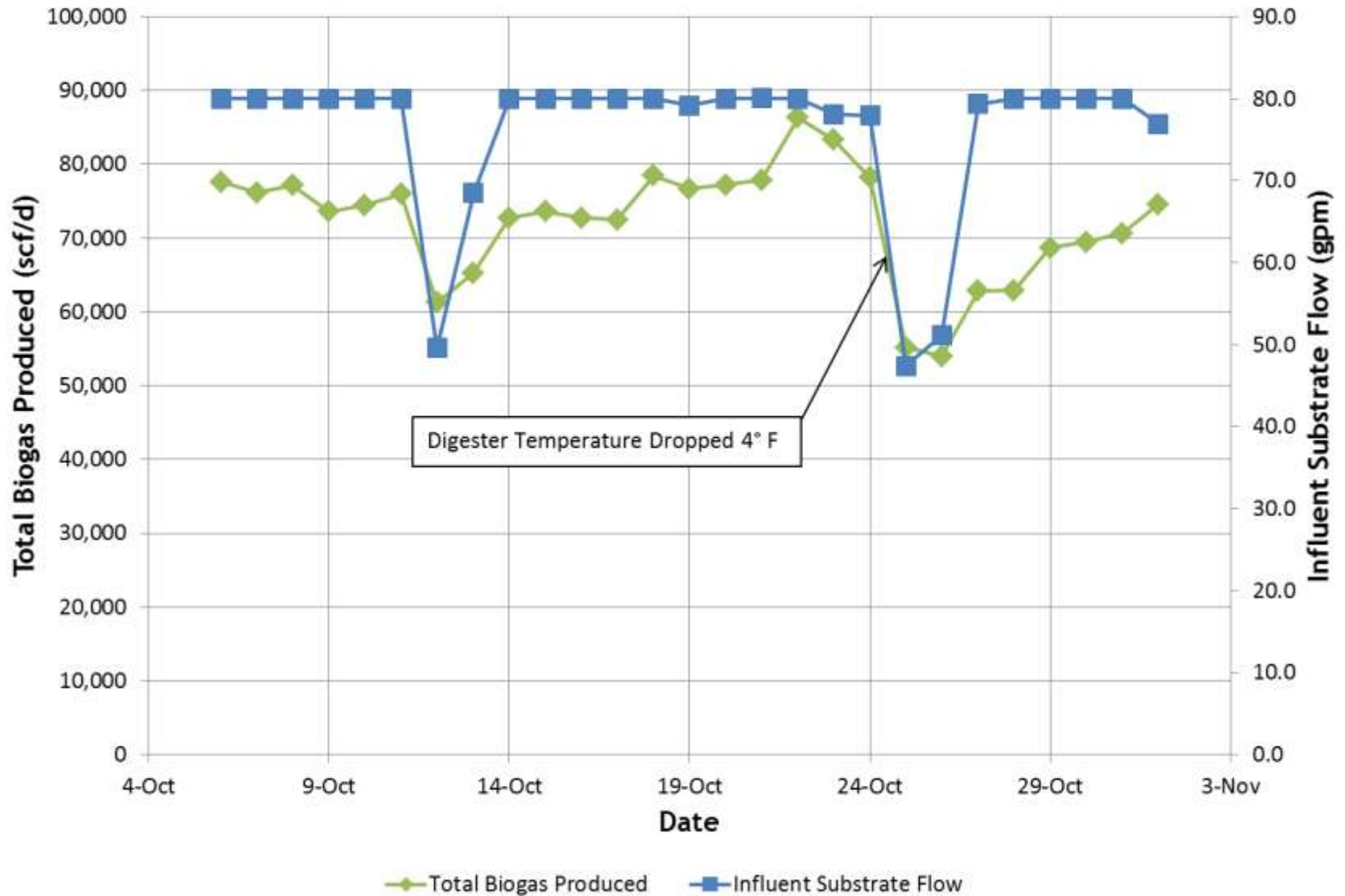
— Total Biogas Produced ■ Influent TVS

Model results shown assume 40% TVS destruction.

Biogas Quality (% Methane)



Robust Recovery of Digester Performance



TIREPower Advantages

- Feasible for Dilute Flow Streams
- Applicable to Scrape Dairy Operations or Thicker Organic Flow Streams
- Short Hydraulic Retention Time – Means Smaller Digester Vessel
- Media Capable of Retaining Biomass for Enhanced Treatment without Plugging
- Reproducible / Modular
- **Retained Biomass/Bacteria Resist Upsets**
- **More Affordable AD System**



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Thanks to Our Partners

- Bonneville Environmental Foundation
- Northwest Natural Gas
- Threemile Canyon Farms, LLC
- WSU Biological Systems Engineering Department
- Miller Mechanical Specialties, Inc. – Biogas Handling
- Brown and Caldwell – Engineering & Technical Support
- HiLine Engineering and Fabrication, Inc. – Pump Station/Controls
- Apollo, Inc. – General Contractor
- Phase 2 Electric – Electrical Installation
- Cole Industrial, Inc. – Boiler System
- Les Schwab Tire Centers – Tire Supplier
- Vaughan Company, Inc. - Chopper Pumps
- Komax Systems, Inc. – Heat Exchangers



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