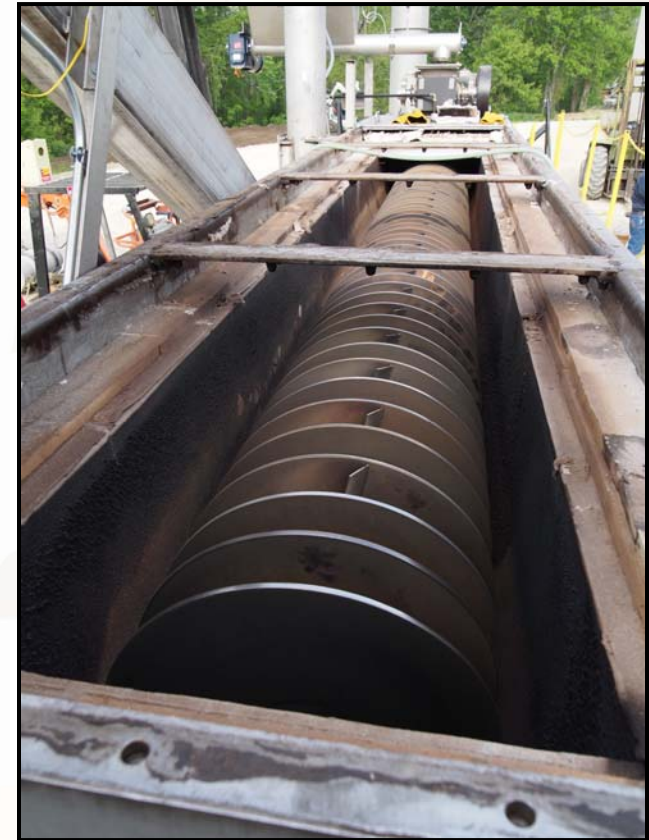


Design and Test Plan for Scaled-Up Torrefaction Unit

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June 29, 2016



Torrefier Specifications

- » Model: Norris Thermal Technologies, Biogreen CM600
- » Feedrate: 440 – 900 lb/hr
- » Feedstock Specifications: Approximately < 1” particles



Design Improvements

- » Increased throughput
- » Reduced air infiltration in reactor
- » Increase capacity of air locks
- » Improved gas scrubbing and product cooling systems



Pictures



Reactor



Cooling System

Pictures

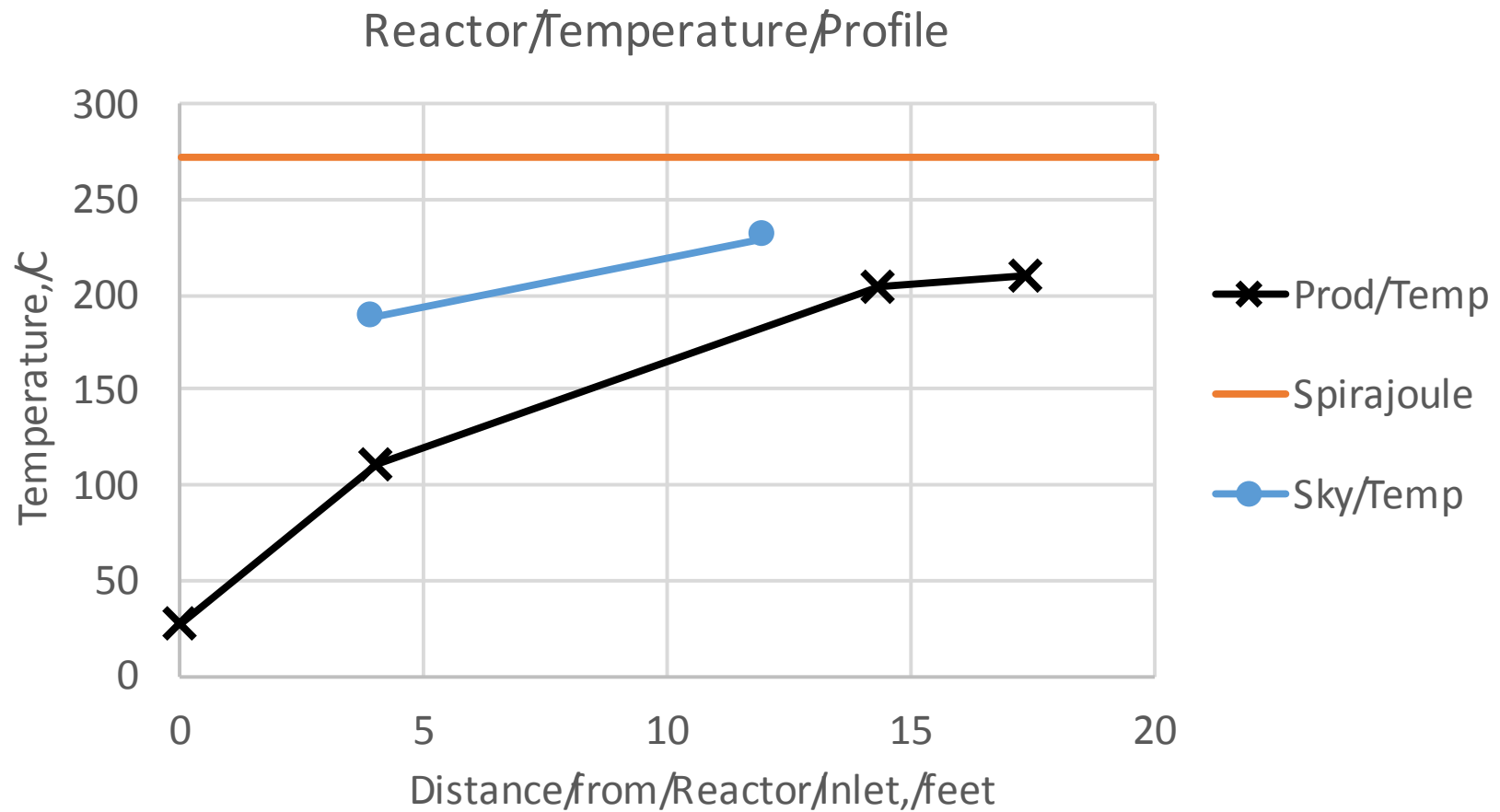


Syngas Scrubber

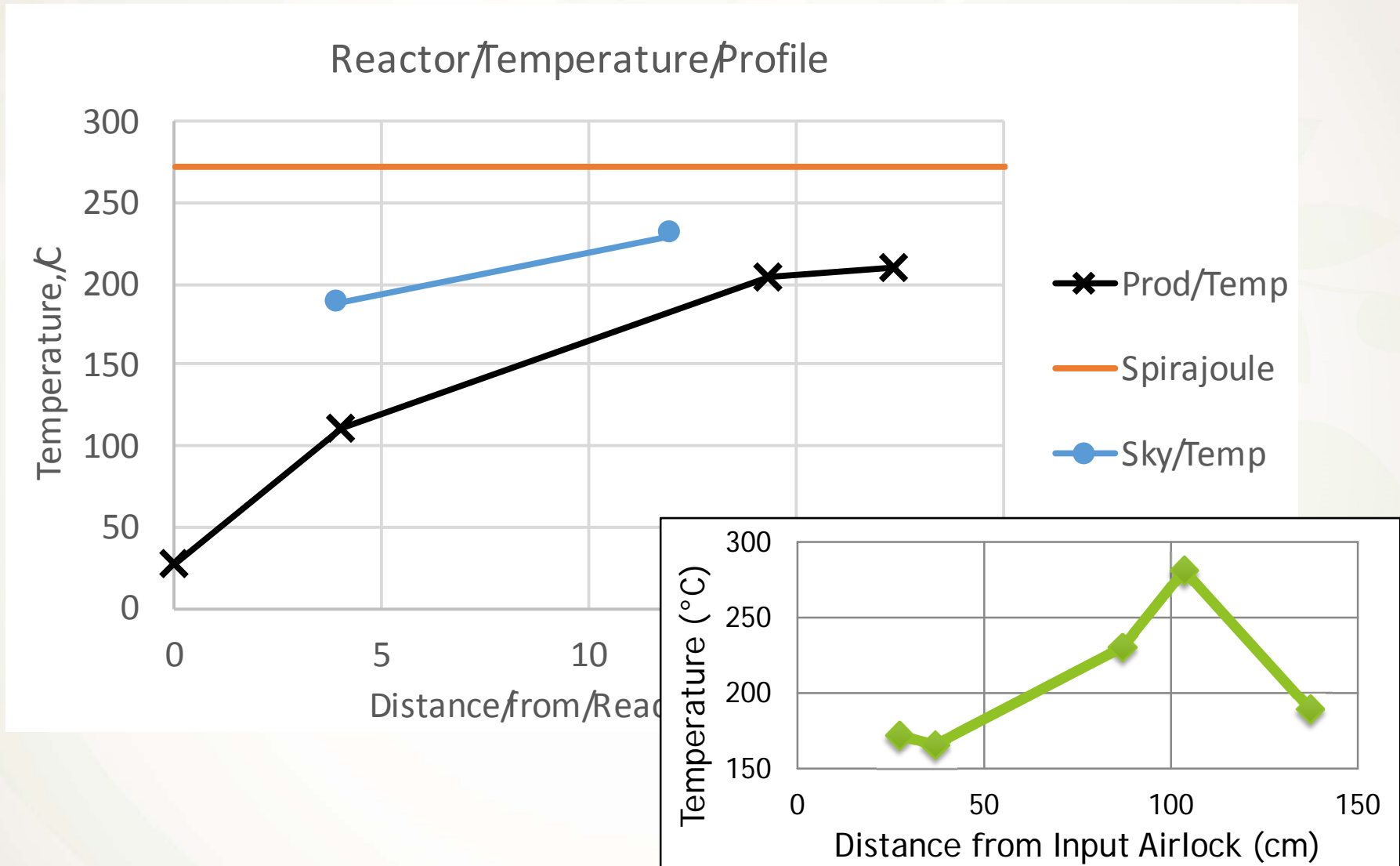


Syngas Flare

Reactor Temperature Profile



Reactor Temperature Profile

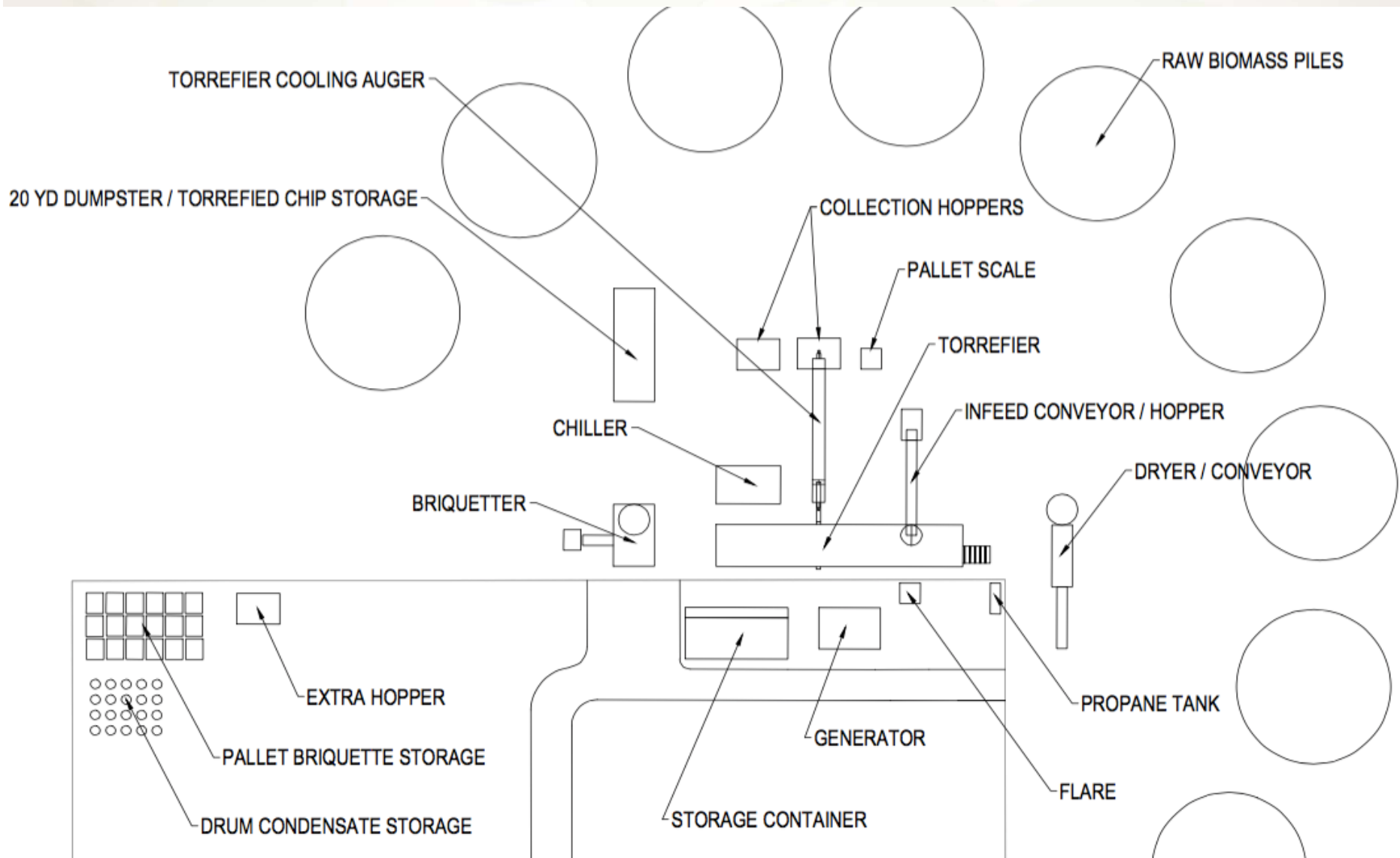


Test Plan Overview

- » Field site in Samoa, CA
- » Torrefier on site for three weeks
- » Produce briquettes from torrefied biomass
- » Operate with one feedstock at multiple operating points



Site Plan



Test Objectives

- » Understand reactor temperature profile in larger machine
- » Explore relationship between feedstock moisture content and level of torrefaction
- » Build upon data set to include syngas and emissions data
- » Observe how torrefier setpoints influence briquette quality



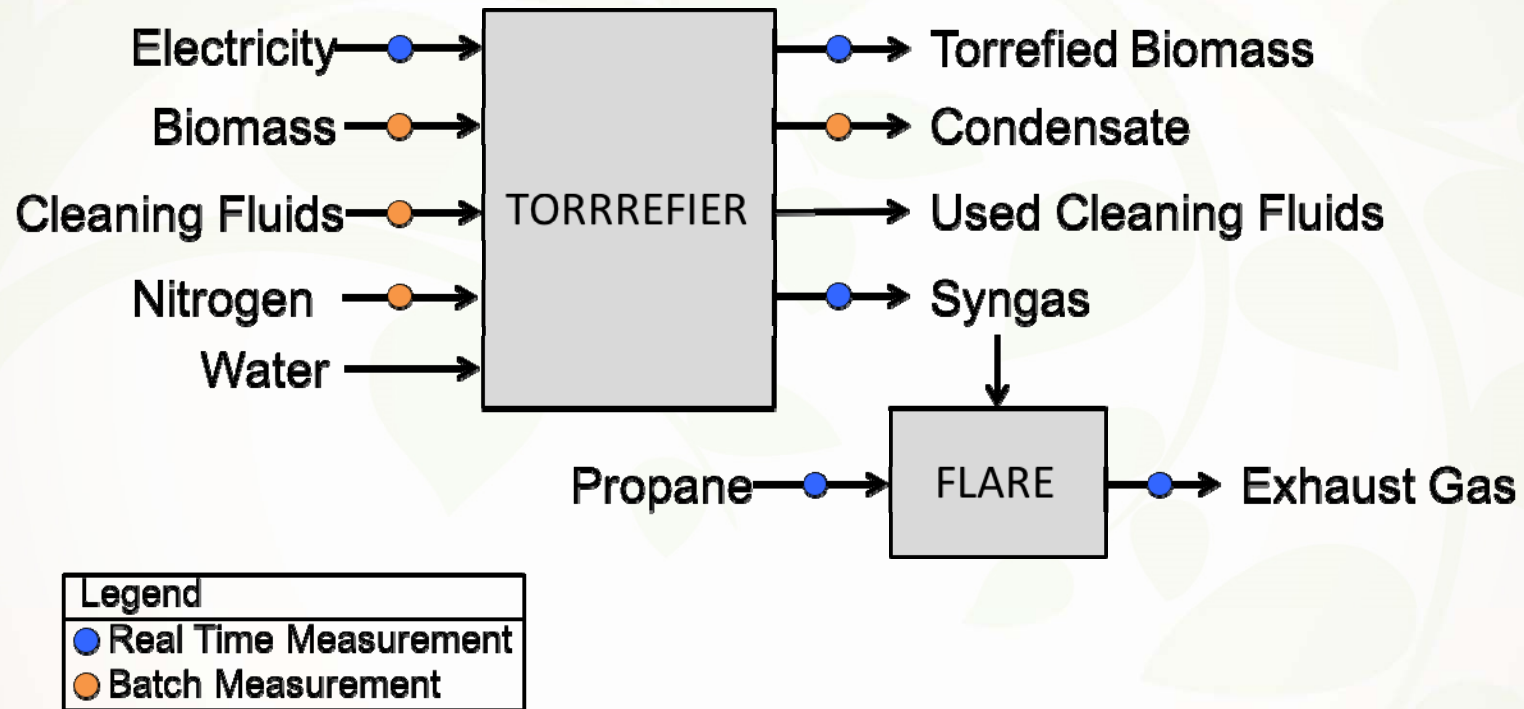
Test Plan for July 2016 in Samoa, CA

<i>Dates</i>	<i>Monday</i>	<i>Tuesday</i>	<i>Wednesday</i>	<i>Thursday</i>	<i>Friday</i>
7/11 - 7/15	Receive	Instrumentation		Preliminary Tests	
7/18 – 7/22	275°C 10 min/20 min 15% MC	300°C 10 min/20 min 15% MC	325°C 10 min/20 min 15% MC	300°C 10 min/20 min 15% MC+ash	275°C 10 min/20 min 5% MC
7/25 – 7/29	300°C 10 min/20 min 5% MC	325°C 10 min/20 min 5% MC	300°C 10 min/20 min 5% MC+ash	Public Demo	Ship Out

» Produce briquettes from torrefied material on following day.



Measurement Plan



List of Measurements

<i>Real Time</i>	<i>Feedstock Analysis</i>	<i>Torrefied Biomass Analysis</i>	<i>Briquette Analysis</i>
<ul style="list-style-type: none"> • Throughput rate • Bio-oil production rate • Reactor temperature profile • System pressures • Syngas composition and flow • Emissions composition and flow • Propane consumption • Nitrogen consumption • Electricity demand • Labor requirements 	<ul style="list-style-type: none"> • Bulk density • Moisture content • Proximate analysis • Calorific Value • Particle size distribution • Grindability • Water Absorption • Transportation Simulation • Durability (Briquettes) 		

Acknowledgements

- » Aaron Norris, Norris Thermal Technologies
- » Chuck Norris, Norris Thermal Technologies
- » Charles Chamberlin, Ph.D., Schatz Energy Research Center
- » Arne Jacobson, Ph.D., Schatz Energy Research Center

