Request for Information (RFI) DE-FOA-0001615: Cellulosic Sugar and Lignin Production Capabilities, Published July 20, 2016

Category 1: Lignocellulosic Sugars

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Disclaimer and Important Notes: American Process Inc. reserves right to withhold deliveries based on merit of the project after assessing the safety, environmental, availability and economic factors. There is no guarantee that the performance or specification of particular product will be achieved as represented herein.

Any information obtained as a result of this RFI is intended to be used by the Government on a non-attribution basis for planning and strategy development; this Response does not constitute a formal proposals or abstract.

Description: Alpena Biorefinery is a fully integrated process designed for 24/7/345 continuous operation producing wood molasses and capability of fermenting it to fuel grade ethanol and potentially other fermentation products or purified to xylose The plant is collocated in Decorative Panels Inc. hardboard manufacturing site, which provides liquid hardwood hemicellulosic feedstock.

The Alpena Biorefinery is owned and operated by American Process Inc. of Atlanta. The facility has experienced staffing, infrastructure, data collection, laboratory facilities and a waste water treatment plant.

Purpose: The facility was built in part with grants from the U.S. Department of Energy (DOE) and Michigan Economic Development Center (MEDC) to demonstrate production of cellulosic ethanol. The facility has completed the demonstration requirements producing cellulosic ethanol, which was sold to fuel blending and qualified for cellulosic ethanol RINs. This was the first ever commercial production of cellulosic ethanol form hardwood and was the first step in API's scale up of the GreenPower technologies suite.

The facility currently produces continuously wood molasses, which is being concentrated to about 50% total solids content. This product is made available for testing by industry, academia, national laboratories and other biofuels and bioproducts stakeholders for process development in converting to biofuels, bioproducts or intermediates, subject to customary intellectual property agreements

Safety: American Process Inc. has highly functioning safety programs and procedures. Established safety culture has been complimented by implementation of **SafeStart** Safety Awareness and Personal Safety Skills Development Program to all of its plants. Alpena staff has been trained with all core training units. SafeStart is an international training process for developing personal, 24/7 safety skills—proven to reduce injuries 30%–70% by more than 3,000 clients in 60+ countries.

The employees of Alpena Biorefinery have exceeded 100,000 safe work hours without a recordable injury as of February 22, 2016. The last injury was on May 26, 2014.

Environment: API complies with all applicable laws and regulations; promotes waste reduction, resource and property conservation, environmental protection; and train employees to be knowledgeable about all environmental matters relevant to their work.

Proprietary Information: Because information received in response to this RFI may become publicly available, this document does NOT include any information that might be considered business sensitive, proprietary, or otherwise confidential.

Process Description

Alpena biorefinery can convert liquid extract from adjacent steam explosion process all the way to fuel ethanol. Feedstock is mixed northern hardwood (primarily maple and aspen). The wood molasses can be further hydrolyzed to monomeric wood sugars. This step includes the clarification of acid insoluble lignin.

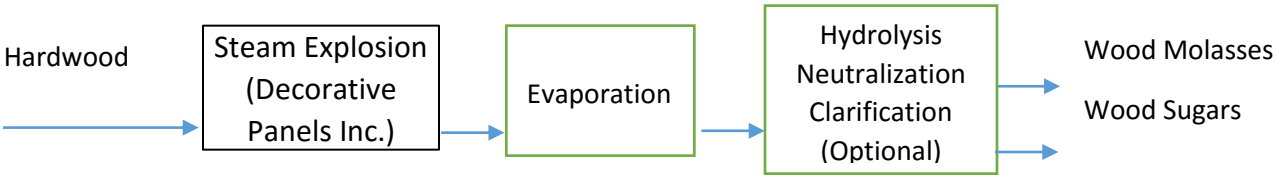

Figure 1. Alpena Biorefinery block flow diagram

The sugar products are available in two forms as listed in the table 1 and described below.

The Alpena Wood Molasses contain hot water soluble molecules from hardwood in an aqueous form. The main constituents are hemicelluloses and soluble lignin. The wood molasses are suitable for biofuel or further refining to fuel, feed and nutrients (xylitol).

The Alpena sugar solution contains soluble natural impurities from the fractionation step, including acetic acid.

The Wood Sugars contain monomerized hemicellulosic sugar in an aqueous form. This sugar solution contains also some soluble impurities from the hydrolysis. The wood sugars are suitable for biofuel or biochemical fermentation, where xylose (and arabinose) can be utilized.

Certificate of Analysis

Each sample will be accompanied with certificate of analysis to list monomer sugar content, total saccharides, formic acid, acetic acid, levulinic acid, furfural, 5-hydroxymethyl furfural and lignin content, ash content, total insolubles and total solids. Sulfur content and selected metal ion analysis are performed upon request.

Product Specifications

Table 1. Sugar product features and target specifications

Category 1: Lignocellulosic Sugars		
Product Name:	**Alpena Wood Molasses**	**Alpena Wood Sugars**
Grade:	**Hemicellulose**	**Hydrolysate**
1: Availability	Commercial	R&D
2: Quantity	9000 Gal/day	1 kg
3: Moisture	50%wt	20-50%Wt
4: Physical Form	Brown Unclear Liquid	Brown Clear Liquid
5: Packaging	truck, tote (1000 L)	Plastic Container
6: Raw biomass type	Mixed hardwood	Mixed hardwood
7: Production Process	GreenPower+	GreenPower+
8: Productivity	100-150 BD g/kg BD biomass	80-150 BD g/kg BD biomass
9: Glucose/Xylose Content of D.S.	10% Glucose BD / 30% BD Xylose Oligomers	20% Glucose BD/ 50% BD Xylose
10: Variance	+/-5%	+/- 10%
11: Non-sugar Content of D.S	50%	30% (Lignin, Ash, organic acids)
12: Purification Method	none	Clarification
13: Concentration	600-650 g/L	300-400 g/L
14: Storage (shelf-life)	Ambient (6 month)	+4 C (1 month)
15: Additional information		
16: Typical Use	Animal Feed Binder Fuels (through hydrolysis)	Fuels (fermentation) and Xylitol