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: AVAPCO LLC and American Process Inc. reserve right to select the customers 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: Thomaston Biorefinery is located in Upson county on eight acre gated lot hosting a 34,000 ft^2 enclosed manufacturing building, offices, process control room and laboratory. The process is a fully integrated demonstration biorefinery designed for 24/5 campaigns with processing woody and agricultural feedstocks. The main products are sugars, lignin, ethanol and nanocellulose. The facility has experienced staffing, infrastructure, data collection and laboratory facilities, feedstock receiving and waste hauling.

The AVAPCO plant was designed and constructed by American Process Inc in 2010 with private investment and it is operated by AVAPCO LLC, an affiliate of API. The facility has completed over 13,000 hours of demonstration run time for various private clients. The nanocellulose production line was added in 2015. API of Atlanta, a biorefinery company, provides technology development and EPC engineering services worldwide.

Purpose: AVAPCO facility is a biorefinery demonstration of AVAP process. The process outputs are made available for testing or further converting by industry, academia, national laboratories and other biofuels and bioproducts stakeholders, subject to customary intellectual property provisions. AVAPCO uses the plant to perform process verifications at industrially relevant scale for purpose of licensing the technology. The facility can also be used for further biomass conversion testing to produce biofuels, bioproducts or intermediates.

Safety: American Process Inc. has implemented **SafeStart** Safety Awareness and Personal Safety Skills Development Program to all of its plants. Thomaston 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 Thomaston Biorefinery have exceeded 100,000 safe work hours without a recordable injury as of April, 2016.

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

The AVAP process converts solid biomass into sugar and lignin intermediates. Feedstocks include softwood (Southern Pine) or mixed hardwood chips, which both are available locally. Other feedstocks including several agricultural residues have been also run.

The process design uses sulfur dioxide and ethanol to fractionate the biomass, and separate, cellulose, hemicelluloses and lignin. Both cellulose and hemicelluloses are then hydrolyzed separately to sugars and lignin is separated .

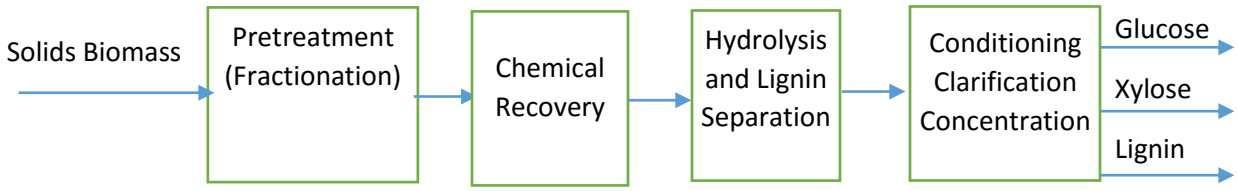

Figure 1. Simple block flow diagram of the AVAP process

Sugar is available in several forms as listed in the table 1 and described below.

AVAP C6 Crystal™ is dry D-Glucose powder. This sugar has undergone crystallization to produce purest sugar, rendering it a potential replacement of Dextrose The crystal form is suitable for chemical synthesis or fermentation with intolerance to any impurities.

AVAP C6 Molasses™ contains cellulosic glucose in an aqueous form. This sugar solution contains soluble impurities from the fractionation step as well as additives for the saccharification step. The C6 molasses is suitable for biofuel and biochemical fermentation, where some impurities can be tolerated and has already been used in several downstream conversions to chemical and biofuels.

AVAP C5 Molasses™ contains hemicellulosic sugars in an aqueous form. This sugar solution contains some soluble impurities from the fractionation. The C5 molasses are suitable for biofuel and biochemical fermentation, where xylose (and arabinose) can be utilized. The sugar composition is dictated by the original biomass used.

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 the 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:	**AVAP C6 Crystals**	**AVAP C6 Sugars**	**AVAP C5 Sugars**
Grade:	**Technical**	**Technical**	**Technical**
1: Availability	R&D	R&D	R&D
2: Quantity†	100 g – 1 ton	100 ml – 10 tons	100 ml – 1 tons
3: Moisture	5%wt	30%wt	50%wt
4: Physical Form	White Solid	Yellow Liquid	Brown Liquid
5: Packaging	plastic lined drum	bottle, canister, tote	bottle, canister
6: Raw biomass type	HWD,SWD	HWD,SWD	HWD,SWD
7: Production Process	AVAP	AVAP	AVAP
8: Productivity	200-300 g/kg BD biomass	300-400 g/kg BD biomass	150-300 g/kg BD biomass
9: Glucose/Xylose Content (typical)	99% Glucose (DE99)	85% Glucose, 5% other sugars	75% Xylose/Galactose/ Arabinose/Mannose / Glucose
10. Variability	+1/-2.5%	+/- 5%	+/- 15%
11: Non-sugar Content	<0.2%%* Acids 0.02% Inorganics	5-10%* (Lignin, Ash. organic acids)	10-30%* (Lignin, Ash, Organic Acids)
12: Purification Method	Crystallization	Filtration	Ultrafiltration
13: Concentration	Solid	800 g/L	300 g/L
14: Storage (shelf-life)	Dry ambient (1 year)	Ambient (3 months)	+4 C (3 months)
15: Additional information	Corn Stover and other feedstocks available upon request	Corn Stover and other feedstocks available upon request	Corn Stover and other feedstocks available upon request
16: Typical Use	Chemicals (catalysis or fermentation), Nutrition	Fuels and chemicals (fermentation or catalysis)	Fuels and chemicals (fermentation), Xylitol
17: Other			

†As shipped

* Dry Basis

Picture 1. Thomaston Analytical Lab