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

Category 2: Lignin

Company name: AVAPCO LLC, Thomaston Biorefinery

Company contact: Vesa Pylkkanen/CTO

Company address: 300 McIntosh Parkway, Thomaston, GA 30286

Phone number: 404-872-8807; E-mail address: Biorefine@americanprocess.com

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 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 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 patented 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 plant converts solid biomass into sugar and lignin intermediates. Feedstocks include softwood (Southern Pine) or mixed hardwood chips, which 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.

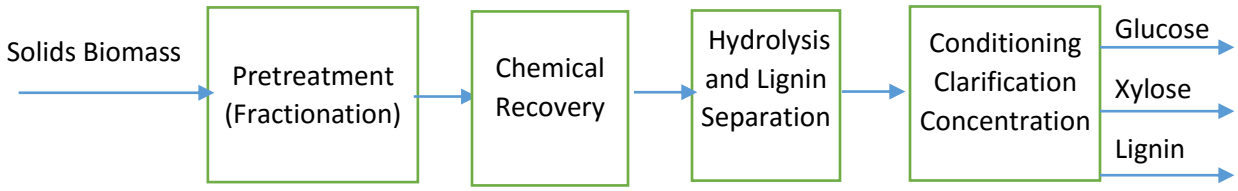

Figure 1. Simple block flow diagram of the AVAP process

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

AVAP lignin™ is a water insoluble, natural lignin. This lignin has undergone minimal condensation reaction, rendering it suitable for chemical synthesis or polymeric blending. API proprietary testing is used to confirm that the reactivity is between 80 and 100%. The lignin has a low sulfur, ash and sugar content. AVAP lignin™ is separated at about 60% moisture. It can also be dried for polymer applications without losing its functionality.

AVAP Lignosulfonate is a water soluble, sulfonated lignin. The lignin has sulfite substitution between 20% and 50%, rendering it suitable for water based applications. The ash content depends on the base used to neutralize it, which can be customized. AVAP lignosulfonate is concentrated and delivered as liquid at 50% total solids.

Certificate of Analysis

Each sample will be accompanied with certificate of analysis to list lignin content, sugar content, ash content, sulfur content and the total solids. Reactivity, individual sugars and selected metal ion analysis are performed upon request.

Product Specifications

Table 1. Lignin product features and target specifications

Category 2: Lignin

Product Name:	AVAP Lignin	AVAP Lignosulfonate
0: Grade	**Technical**	**Technical**
1: Availability	R&D	R&D
2: Quantity	100 g, 5 kg, 50 kg	100 ml, 1L, 30L
3: Packaging	per customer agreement to meet regulations	per customer agreement to meet regulations
4: Shipping Form	Fedex Ground or the best way	Fedex Ground or the best way
5: Moisture	60%wt**	50%wt**
6: Raw biomass type	HWD,SWD, Ag residue	HWD,SWD, Ag residue
7: Production Process	AVAP	AVAP
8: Productivity	100-200 g/kg BD biomass	100-200 g/kg BD biomass
9: Lignin Content	90%*	85%*
10: Variability	+/-5%*	+/-5%*
11: Sulfur Content (as S)	1-2%*	3-6%*
12: Carbohydrate content as % monomer sugars	5%*	10%*
13: Concentration	solid	600 g/L
14: Storage (shelf-life)	+4 C (3 months)	+4 C (3 months)
15: Additional information	Reactivity 80-100%	Available with Ca++, Mg++, NH4+, or Na+, Fe++ base
16: Typical Use	Polymer replacement or filler Chemical synthesis	Dispersant, oil drilling, concrete additive, vanillin
17: Other		

† As shipped

* Dry Basis

** Sample quantities can be dried to 95% d.s.

Picture 1. Thomaston Analytical Lab