DOE Informational Questionnaire

Sweetwater Energy, Inc.
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Category 2: Lignin

Question 1: To which types of research entities are you willing and able to sell or otherwise provide your lignin? (e.g., university researchers, national laboratories, industry/private sector)? Are there any types of research entities to whom you are not willing and able to sell your lignin?

- *Sweetwater will sell lignin to any research institution looking to create value-added products.*

Question 2: What are the maximum and minimum quantities of lignin that you are willing and able to sell (kg)?

- *Sweetwater can sell as little as a 1 kg or as much as a 50 kg of lignin. Arrangements for larger volumes are possible.*

Question 3: In what units do you sell your lignin and is it packaged (e.g., super sacks), or sold in bulk?

- *Sweetwater sells lignin by the kilogram. Lignin is packaged in sealed containers sized dependent on amount shipped.*

Question 4: How do you ship lignin?

- *For small samples Sweetwater uses common carriers, such as UPS. For larger amounts we use over-the-road freight companies.*

Question 5: What is the lignin concentration in your product?

- *Sweetwater's lignin cake is more than 80% pure lignin.*

Question 6: What type(s) of biomass do you use in your process?

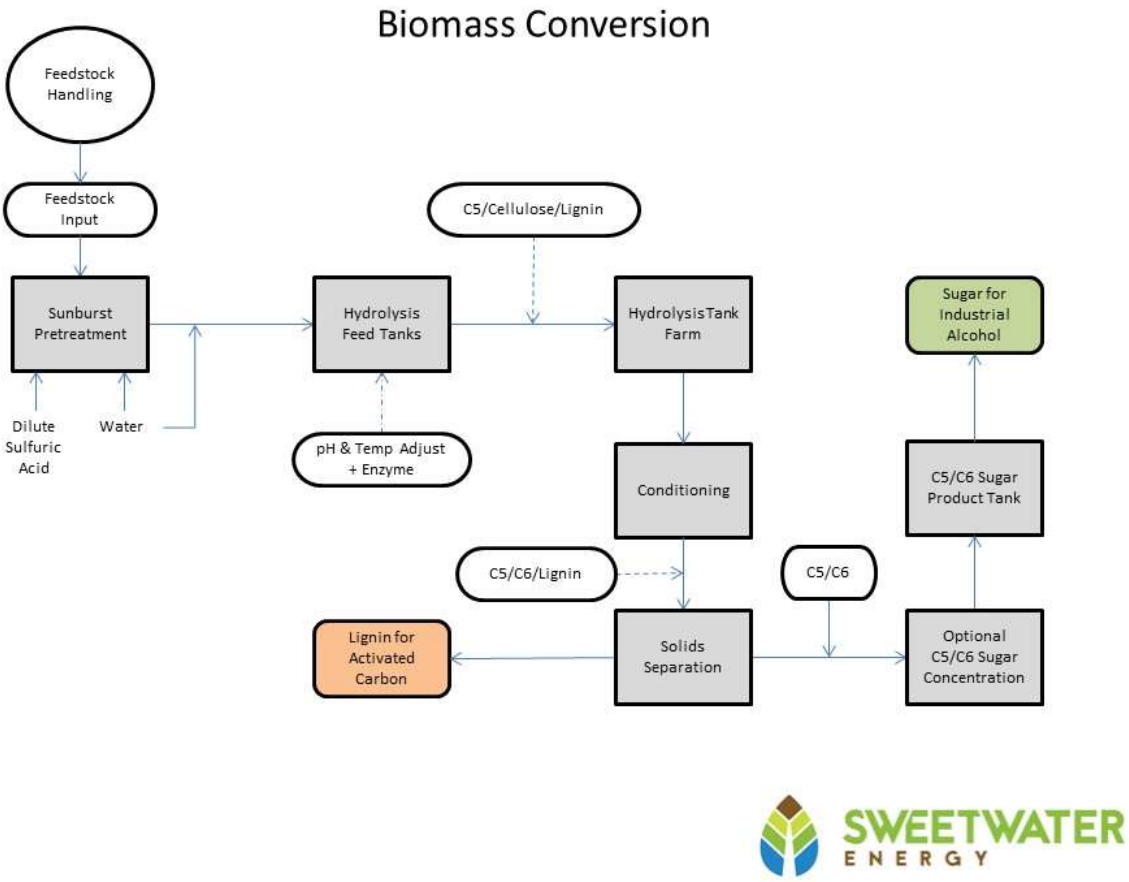
- *Sweetwater has successfully processed dozens of feedstocks. We have processed several types of hardwoods, softwoods, grasses – including miscanthus and sorghum, and various wastes, such as palm fronds and banana peels.*

Question 7: What process do you use that produces lignin (dilute acid, ammonium fiber expansion (AFEX), hot water, organosolv, etc.)?

- *Sweetwater uses a proprietary thermomechanical enzymatic hydrolysis to separate sugar and lignin. The process produces very few inhibitors, so the sugar and lignin are of very high quality.*

Question 8: What details of the scale of your process are you willing to share (e.g. batch and/or continuous or volumetric productivity)?

- *Basic block flow diagram:*



Question 9: Do you measure the typical composition of your lignin? If so, what method do you use? How consistent is the composition of your lignin?

- *Sweetwater's process itself is very controlled and consistent. Ergo the only variability in the lignin comes from the feedstock itself. Below is the typical ultimate and proximate analysis of our lignin (performed by Twin Ports Laboratory) in addition to the compositional analysis of our lignin, achieved via the NREL process for Determination of Structural Carbohydrates and Lignin in Biomass.*

<u>Dry Weight %</u>	
Pure Lignin	86.1
Ash	1.7
Unconverted Hemicellulose	2.0
Unconverted Cellulose	5.8

Monomeric Sugars	4.0
Extractives	0.2
Sulfur	0.2

Compositional Analysis (moisture free)

Ash (wt. %)	1.68
Volatile Matter (wt. %)	62.50
Sulfur (wt. %)	0.174
Net Cal. Value at Constant Pressure (J/g)	23012
Carbon (wt. %)	59.43
Hydrogen (wt. %)	5.63
Nitrogen (wt. %)	0.53
Oxygen (wt. %)	32.56
Chlorine (mg/kg)	36
Fluorine (mg/kg)	9
Mercury (mg/kg)	0.001

Question 10: Do you routinely test your lignin for consistency within and between lots?

- *Yes, Sweetwater tests its sugars and lignin with every batch and every production run.*

Question 11: What impurities are present in your lignin and what testing do you perform to determine the presence of impurities?

- *Due to Sweetwater's rapid and low severity pretreatment, the lignin produced is homogenous and very low in impurities such as ash and sulfur. As a result, our unique clean lignin can be used for high-value applications, beyond the traditional uses other pretreatment technologies allow for as an energy source, in advanced materials and packaging applications.*

Question 12: Does your process include a purification or filtration step?

- *Sweetwater's process separates biomass' lignin and sugar extremely efficiently, producing very few chemical byproducts, resulting in extremely high-quality lignin.*

Question 13: What is the typical concentration in g/L you can provide?

- *Sweetwater's lignin cake is dry and powdered.*

Question 14: Have you examined the impacts of transport and storage on lignin? If so, can you please provide any relevant (non-proprietary) details of these impacts?

- *The impacts of shipping on Sweetwater's lignin is negligible, since the lignin cake is less than 25% moisture and ships as a dry powder.*

Question 15: What additional information are you willing and able to provide to the research community about the lignin? Please provide any non-proprietary cost

information you are willing to share.

- *Sweetwater is happy to provide a cost estimate to any research institution. Cost is based on specification requirements and feedstock utilized.*