

Request for Information (RFI) DE-FOA-0001615: Cellulosic Sugar and Lignin Production Capabilities

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Category 1: Lignocellulosic sugars

Question 1: To which types of research entities are you willing and able to sell your lignocellulosic sugar (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 lignocellulosic sugar?

We primarily samples industry/private sector. Requests from academic sector are evaluated on a case by case basis, but normally turned down. All sampling is done under NDA/MTA.

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

Samples are available in all sizes up to 100 kg and more. As of now samples are provided free of charge.

Question 3: What is the sugar concentration in your product?

Directly out of the process the total sugar concentration is in the range 100-200 g/L. In order to increase storage stability (i.e. prevent microbial growth) we concentrate hydrolysates to >50% dry matter content.

Question 4: What physical form do you sell your sugars (e.g., solid or liquid)?

Hydrolysates are provided as liquids.

Question 5: How do you package your lignocellulosic sugars for shipping? Do you ship in bulk?

Depending on sample size, the hydrolysates are shipped in bottles, plastic containers, drums or in IBC containers.

Question 6: What type(s) of biomass do you use to produce lignocellulosic sugar?

Over the years a range of feedstocks including softwood, hardwood and annual crops have been subjected to the BALI™ process. For the time being hydrolysates are produced from softwood.

Question 7: What process do you use to produce lignocellulosic sugar?

Lignocellulosic sugar is produced with Borregaard's proprietary BALI™ biorefinery process which includes a sulfite based pretreatment followed by enzymatic hydrolysis.

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

In the BALI™ demonstration plant hydrolysis is run both in batch and continuous mode.

Question 9: What is the typical composition of your sugar stream (e.g., glucose, galactose, mannose, xylose, arabinose) and what is the purity?

For softwood, an average sugar composition is given below:

Monosaccharide	% distribution *)
Glucose	87 %
Xylose	5 %
Mannose	5 %
Cellobiose	2 %
Galactose	1 %

*) These figures are averages for spruce and pine. Exact figures will vary with feedstock, pretreatment and process conditions.

Question 10: Do you routinely test your cellulosic sugar for consistency within and between lots and between feedstocks (if applicable)?

Yes

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

See answer to question 12.

Question 12: Does your process include a purification step?

The purity of the lignocellulosic sugars may be tailored, depending on the requirements in the downstream process. A unique feature of the BALI™ pretreatment is that lignin is made water soluble, allowing it to be washed out of the fiber prior to the enzymatic hydrolysis. The clean starting material in the hydrolysis allows for very pure hydrolysates with an excellent fermentability. Based on feedback from partners who have tested the hydrolysates, the hydrolysate is now branded as **BALI™ drop-in sugar** since it can replace dextrose syrups in any ratio.

Question 13: What is the highest concentration in grams/Liter you can provide?

Se question 3.

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

Yes. Directly out of the process the hydrolysates are non-sterile. To avoid growth of contaminating microorganisms one or more of the following is done (depending on the type of downstream processing): lowering of pH, concentration to >50%, cooling/freezing, addition of antimicrobials such as sodium azide.

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

Given the complexity involved in the production of lignocellulosic sugar we do not expect these to be available at a price below that of starch based sugar. And even if the production cost should come down significantly it is unlikely that lignocellulosic sugars (which are “value added” from an environmental perspective) will be sold with a rebate compared to starch based glucose syrup.

Question 16: Into what markets do you typically sell your lignocellulosic sugar? What is a typical application for your lignocellulosic sugar?

As of today the lignocellulosic sugar is not a commercial product. It is produced in the 1 MT/day BALI™ demonstration plant.