Starch - Saccharification

Application Sheet

Content:

Enhanced dextrose syrup production

Production of dextrose syrups is a well-established process. The enzyme application is rather complex with final syrup requirements determining the optimum saccharification parameters. This also includes the choice of enzyme. Novozymes offers a range of saccharification products designed to cover the entire application spectrum.

Benefits

Novozymes' saccharification product range provides the following:

- Higher dextrose yield – due to lower reversion rate
- Low risk of syrup infections – by running at up to 64˚C
- Stable process – allowing for variations in temperature

Products

Table 1 provides an overview of process conditions and Novozymes' product range characteristics in application.

Characteristics	Dextrozyme® GA and GA 1.5X	Dextrozyme DX and DX 1.5X
Main raw material	corn	corn
Dextrose yield target	<= 96%	> 96%
Low reversion rate	+++	++++
Smooth wheat syrup filtration	++	+
High-temperature saccharification	Up to 64°C Up to 147°F	Up to 64°C Up to 147°F

+++++ = best performance and most recommended.

Table 1.Provides an overview of process conditions and characteristics in application

Dextrozyme DX 1.5X gives 1.5 times the performance of Dextrozyme DX. The dose can therefore be reduced.

Likewise, Dextrozyme GA 1.5X gives 1.5 times the performance of Dextrozyme GA.

For saccharification of wheat starch, a combination of Finizym W and Dextrozyme DX or Dextrozyme DX 1.5X is recommended. See section on smooth wheat syrup filtration.

There is more information about the above-mentioned products available at the Customer Centre.

Performance

Higher dextrose yield and lower reversion rate

Figure 1 shows the dextrose development of Dextrozyme DX and Dextrozyme GA under standard saccharification conditions and at different doses.

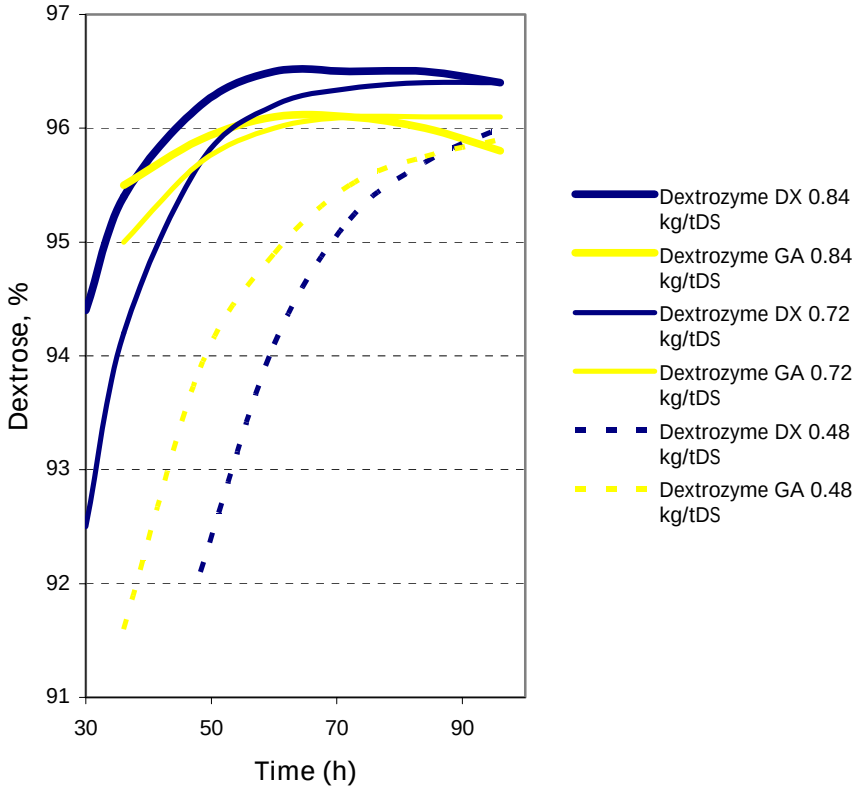

Figure 1. Dextrose formation for Dextrozyme GA and Dextrozyme DX.
Dry solids: 31% (initial), pH 4.3, 61°C (142°F), starting DE 10-12 (liquefied with Liquozyme X).

As seen in Figure 1, dextrose maxima are achieved very quickly and are very stable before isomaltose is produced and dextrose levels are reduced. This is due to the high performance of the acid alpha-amylase (for Dextrozyme GA and Dextrozyme GA 1.5X) and pullulanase/acid alpha-amylase (for Dextrozyme DX and Dextrozyme DX 1.5X), which means that lower levels of glucoamylase activities can be used to obtain high saccharification performance.

Because of these lower levels of glucoamylase, the reversion of glucose into isomaltose is reduced to the absolute minimum. Peak levels can therefore be maintained for much longer and production variations can be tolerated.

On average, it is possible to achieve dextrose levels that are up to 0.5% higher using Dextrozyme DX or Dextrozyme DX 1.5X rather than Dextrozyme GA or Dextrozyme GA 1.5X.

The influence of dry substance on the maximum dextrose peak is given in Figure 2. Here we see that there is a negative effect of high dry substances on the maximum dextrose levels. This effect is the same for Dextrozyme DX products and Dextrozyme GA products. For every 1% increase in dry substance (initial), there is a decrease in final dextrose level of about 0.15%.

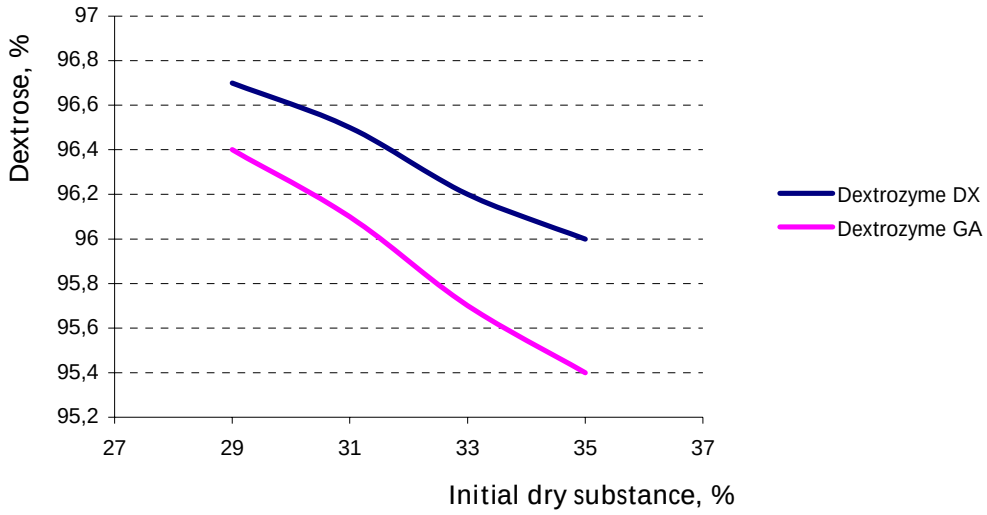

Figure 2. Impact of initial dry substance on dextrose content after 66 hours saccharification. Enzyme dosages: 0.84 kg/t DS, pH 4.3, 61°C (142°F), starting DE 10-12 (liquefied with Liquozyme X).

Smooth wheat syrup filtration

Smooth filtration on a rotary vacuum filter is crucial to wet millers. To obtain this, a combination of Dextrozyme and Finizym W is recommended for wheat starch processing. As Finizym W contains lysophospholipase, it will induce flocculation of the non-starch fat-protein complexes in wheat starch-based syrups. As a result, improved filtration rates are possible with a better clarity of the filtrate. A dramatic reduction in filter aid consumption is also possible. Better filtration improves the performance of the cation resin after filtration.

Corn-based dextrose syrups have filtration speeds up to 700-1200 l/m2/h. Without the use of lysophospholipase side activity, the filtration speed on dextrose syrups based on wheat B-starch would be in the range 50-150 l/m2/h, as well as the bad filtrate quality!

Using the combination of Dextrozyme and Finizym W, the filtration speed can be increased to corn levels.

High-temperature saccharification

Another important issue is the stability of the glucoamylases in relation to temperature. Saccharification is normally carried out at about 60-61° (140-142°F) to ensure microbiological stability. Nevertheless, occasionally infections can occur that decrease the pH of the saccharification and hence the activity of the glucoamylase.

Depending on the saccharification time, saccharifications with Dextrozyme GA or Dextrozyme GA 1.5X can be carried out at higher temperatures.

If the saccharification time is < 40 hours, saccharification temperatures of 64°C can be used. For longer saccharification times, temperatures of 61°C are recommended.

The influence of temperature on dextrose development can be seen in Figure 3.

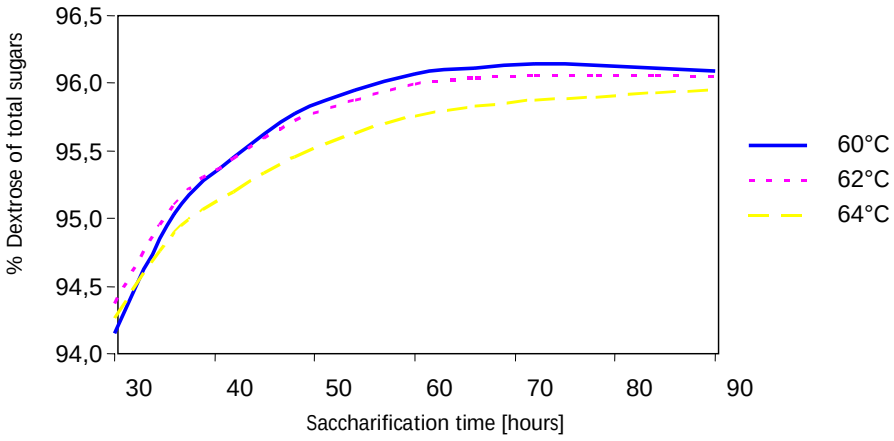

Figure 3. Influence of saccharification temperature on dextrose development for Dextrozyme GA Dry solids 31% (initial), pH 4.3, 61°C (142°F), starting DE 10-12 (liquefied with Liquozyme X), Dosage: 0.66 kg Dextrozyme GA/t DS starch.

Dextrozyme DX products have a similar saccharification temperature dependency to Dextrozyme GA products (not shown in Figure 3).

Usage

Saccharification of liquefied starch with Dextrozyme GA and DX products is best carried out at temperatures of 61-62°C (142°-144°F) at pH 4.3.

A model for DX and GA prediction for saccharification time above 36 hours is available on the Customer Centre at www.novozymes.com.

The primary variables in a saccharification process are initial dry solids (DS), saccharification time, temperature and enzyme dosage.

	Dextrozyme GA and GA 1.5X	Dextrozyme DX and DX 1.5X
Recommended temperature	60-62ºC 140-144ºF	60-62ºC 140-144ºF
Recommended pH	4.2-4.5	4.2-4.5
Recommended DS	29-35%	29-35%

Table 2. Overview of recommended process conditions and application information.

Dosage

Please apply Novozymes' on-line saccharification models for dosage recommendations for a given set of saccharification parameters.

Safety, handling and storage

Safety, handling and storage guidelines are provided with all products.

In addition to the above products, we have a number of other enzyme products available on special request. Please contact us for further details or visit our Customer Centre at www.novozymes.com.

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