SWEETENERS: GLUCOSE (DEXTROSE), FRUCTOSE, GLUCOSE SYRUP, SORBITOL

Typical end products
Sweeteners for beverages, beer brewing, jams, preserves, sweets, confectionery, ice cream, liqueurs, pharmaceuticals, etc.

Chemical curve: R.I. per BRIX at Ref. Temp. of 20˚C

Introduction
The starch molecule consists of a large number of dextrose (glucose) units. The starch can be processed to break down these molecules by acid hydrolysis for example, and produce sweeteners that are not only used for sweetening mixture, but also for texture, color stability and flavor in various final products.

Application
Dextrose
In the production process of dextrose, the starch slurry is taken to a reactor where alpha amylase enzymes are added to start a hydrolysis reaction. The enzymes break down the polymer and form a hydrolysate with a Dextrose Equivalent (DE) of 10-20. The DE value is an important parameter as it is a measure of the hydrolyzation degree.

This stream is often further processed to obtain a dextrose syrup. The pH is adjusted, and further enzyme addition occurs before it is pumped to saccharification tanks to complete the hydrolysis reaction. Reaction can take 24-90 hours and the resulting syrup has a DE of about 94 %.

The liquor is filtered to remove any residual proteins and fats before being passed through activated carbon beds. Following carbon purification, the hydrolysate is demineralized by ion exchange prior to isomerization.

Dextrose syrup can be sold as bulk or can be further concentrated and crystallized into a final crystalline product.
Fructose

After demineralization through anion and cation exchange resins, the dextrose syrup can be further isomerized to High Fructose Syrup (HFS). The conversion step happens in a reactor containing immobilized enzymes. Once the conversion is complete the liquor is pumped through beds of activated carbon and then evaporated to the proper solids level about 71-80 % dissolved solids (DS).

The resulting 42 % HFS is used for many applications as a replacement liquid for sucrose. However, for some other applications a higher level of fructose is necessary.

After demineralization to remove trace components from isomerization, further purification of the fructose is done by separation at 36-60 % DS usually by adsorption. The relative difference in affinity of the resin for fructose and dextrose allows separation into two enriched streams. Typical purity of dextrose and fructose is 85 % and 90 %, respectively. The dextrose fraction is returned for re-isomerization. The fructose fraction at 90 % is blended with a 42 % fructose stream to produce 55 % HFS. The enhanced fructose fraction at 90 % is blended with a 42 % fructose fraction is returned for re-isomerization. The fructose content of 70 %.

Sorbitol

Similar to fructose, sorbitol is produced from high DE dextrose syrup. The clear dextrose solution is hydrogenated in the presence of a catalyst in stirred reactors to convert it to sorbitol.

The hydrogenated solution is decanted and subsequently subjected to carbon treatment and ion exchange. The catalyst is recycled and reused. The sorbitol is refined and evaporated to dry substance content of 70 %. The syrup may be spray dried or crystallized to obtain a powder.

Instrumentation and installation

Vaisala K-PATENTS® Process Refractometer PR-43 is designed to meet the demanding requirements of starch sweetener production. The refractometer provides an accurate and continuous dissolved solids measurement that helps to comply to the tight final product specifications.

The refractometer is used to control in real-time the evaporation and blending operations, as well as for quality control to ensure the final syrup concentration meets the requirements. The measurement by the refractometer is not affected by suspended particles or bubbles and is ideal for the control of liquid-solid mass transfer operations. The quality of crystalline products can be improved by tighter and automated control of crystallization.

All our refractometer sensor models are easy to install directly in the pipeline without the need for expensive sampling lines or by-pass arrangements. The sensors and flow adapters can also be mounted on vessels, tanks and small or large process pipes. Moreover, the operation costs can be minimized as our refractometers are maintenance-free and do not require recalibration.

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<tr>
<th>Instrumentation</th>
<th>Description</th>
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<tr>
<td>Sanitary Compact Refractometer PR-43-AC</td>
<td>For hygienic installations in small pipe line sizes of 2.5 inch and smaller. The PR-43-AC refractometer is installed in the pipe bend. It is angle mounted on the outer corner of the pipe bend directly, or by a flow cell using a 3A Sanitary clamp, I-clamp or Varlin® connection.</td>
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<tr>
<td>Sanitary Probe Refractometer PR-43-AP</td>
<td>For hygienic installations in large pipes, tanks, cookers, crystallizers and kettles and for higher temperatures up to 150°C (300 °F). The PR-43-AP refractometer is installed in the pipe line or vessel through a 2.5 inch or 4 inch Sanitary clamp, I-clamp, APV Tank bottom flange or Varlin® connection.</td>
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<tr>
<td>Process Refractometer PR-43-GP</td>
<td>A general industrial refractometer for pipes and vessel installations. The PR-43-GP can be installed with 2, 3 and 4 inch flange and 3 inch Sandvik L coupling process connections and a variety of flow cells for pipe sizes of 1 inch and larger.</td>
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<td>User Interface</td>
<td>Selectable multichannel MI, compact CI or a web-based WI user interface options allow the user to select the most preferred way to access and use the refractometer measurement and diagnostics data.</td>
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<td>Measurement range</td>
<td>Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 Brix.</td>
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