SWEETENED CONDENSED MILK

Typical end products
Sweetened condensed milk.

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

Introduction
Sweetened condensed milk is a product obtained simply by evaporating milk to decrease the water content and adding a sweetener. The sweetener can be sucrose, dextrose or any other natural sugar.

This product was invented as a way to preserve milk. The sugar content in the sweetened condensed milk increases the osmotic pressure to a level where most of the microorganisms are destroyed.

Sweetened condensed milk is typically used in the making of many sweets and desserts.

Application
Sweetened condensed milk can be produced from whole or skim milk. The first step in this process is the standardization of fat and solids-not-fat to a level that meets legal standards.

The following preheating step stabilizes the milk and destroys microorganisms. The preheated milk is pumped to the evaporator where the solids content is increased by the removal of water.

A multiple-effect evaporator that operates under vacuum conditions is typically used to raise the solids concentration to 30-40 % (see also application note Milk Evaporation and Drying).

Sugar is added as a dry solid either before evaporation or as a syrup during the process. It is important to accurately monitor the quantity of sugar added as the shelf life of the milk depends on the osmotic pressure being sufficiently high. The sugar in the milk is generally between 62.5-64.5 %.

The amount of sugar required can be predicted from the total dissolved solids content in the fresh and the evaporated milk.

After evaporation, some manufacturers homogenize the milk to regulate the viscosity of the end product. The sweetened condensed milk then moves on to
cooling and crystallization. After this, the milk is ready for canning or packing.

**Instrumentation and installation**

The K-Patents Sanitary Process Refractometer PR-43-A accurately controls the Total Dissolved Solids (TDS) content of the milk in real-time to obtain a high quality product with a long shelf life.

The refractometer is used for standardization after the holding tank to achieve the precise solids content required to meet legal standards. Accurate TDS measurement in the fresh milk also helps to determine the exact amount of sugar required for addition before or during the evaporation step.

A refractometer after the evaporation step monitors the performance of the evaporators and helps to achieve the desired concentration of the milk.

If the manufacturing process involves a homogenization step, a third refractometer can be installed after that stage. The K-Patents refractometer detects fat globules as long as they are smaller than 6 μm. This globule size can be achieved by adjusting the pressure of the homogenizer. The recommended homogenizer’s primary pressure is \( P_1 = 26 \text{ MPa} \) (260 bar).

The refractometer can be calibrated to read the factory’s preferred scale, either Brix or Total Dissolved Solids. Moreover, the K-Patents refractometer provides Ethernet and 4-20 mA output signals that can be used for real-time process control.

Usually a prism wash system is not required except when the dry solids content exceeds 40% or the flow velocity is below 1.5 m/s. For these conditions, the K-Patents Sanitary Probe Refractometer PR-43-AP-L42 with steam prism wash, aseptic steam valve ASV, and side flow cell is recommended.

The K-Patents Process Sanitary Refractometer PR-43-A complies with the standards required for safe food processing and for achieving a high-quality product. The refractometer is available with 3-A Sanitary and EHEDG certifications, and it withstands both CIP cleaning and high process temperatures.

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<tr>
<th>Instrumentation</th>
<th>Description</th>
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<tr>
<td>K-Patents 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 Varininline® connection.</td>
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<tr>
<td>K-Patents Sanitary Probe Refractometer PR-43-AP</td>
<td>For hygienic installations in large pipes, tanks, cookers, crystalizers 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 Varininline® connection.</td>
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| User Interface | 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. |

| Automatic prism wash | Prism wash is required in applications where flow velocity is below 1.5 m/s (5 ft/s) or where dry solids exceed 40%. The wash media is aseptic steam. The components of a steam wash system are refractometer PR-43-AP-L42 with insertion length of 42 mm, Side flow cell SFC-HHSS-H10/15/20/25, Aseptic steam valve ASV-H/ESS-H05, and Multichannel user interface MI for automatic prism wash diagnostics and control. |

| Measurement range | Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 Brix. |