CITRIC ACID (C$_6$H$_8$O$_7$)

**Typical end products**
- Pharmaceutical, food, industrial applications, beverages, jams, laundry detergents, cosmetics, etc.

**Chemical curve:** Citric acid per Conc. % b.w. at Ref. Temp. of 20˚C

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**Introduction**

Citric acid is a naturally occurring fruit acid. Citric acid is produced commercially through the carbohydrates fermentation (e.g. glucose) which are often found in starches and sugars. Citric acid is primarily used as an organic acidulant and pH-control agent for food, beverages, pharmaceuticals and technical applications.

Citric acid is available as a colorless crystal, white crystalline powder or as a liquid solution.

**Application**

Fermentation is the most economical and widely used method for the production of citric acid. In fermentation, the sugar or molasses is converted to citric acid by microbial activity with the addition of nutrients.

After fermentation, the citric acid needs to be recovered and purified from the broth. Lime is added in a neutralization tank and the resultant calcium citrate is filtered off and acidified with sulfuric acid. The decomposition of calcium citrate with sulfuric acid results in soluble citric acid and insoluble calcium sulfate.

The aqueous citric acid is separated by filtration and concentrated using evaporators before crystallization. The product citric acid is filtered from the mother liquor and dried for a crystalline or powder product. Citric acid can be also supplied as a 50 % liquid solution.

**Instrumentation and installation**

The K-Patents Process Refractometer PR-43 is used for accurate and reliable concentration measurements at various stages of the citric acid production process. The refractometer is installed in-line for real-time and continuous information on the process and quality of the product.
The K-Patents refractometer is used at the feed to the fermenter to ensure that the sugar or molasses Brix concentration is within the desired limit, usually between 17 to 22 Brix. This maximizes the use of molasses and minimizes the quantity of unfermented sugar in the broth.

The refractometer also measures the concentration of citric acid in the evaporator feed and outlet to ensure the target concentration is achieved. The refractometer provides Ethernet and 4-20 mA signals that can be used for real-time control of the steam flow for optimizing the energy consumption.

Another refractometer monitors the crystallization process for a high-quality crystal product. K-Patents' unique digital refractive index technology is not influenced by bubbles or particles, thus making the refractometer ideal for monitoring liquid-solid operations. A typical measurement range for the crystallizer is 60-95 % and the process temperature is between 40 and 60 °C (104-140 °F).

If the citric acid is dissolved for a final liquid product, the K-Patents refractometer can be used for automated and reliable dilution of the acid, thus enhancing productivity and guaranteeing the product is within specifications. The end-product ranges from 45 to 65 % and temperature varies from 20 to 40 °C (68-104 °F).

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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 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, l-clamp or Varinline® connection.</td>
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<tr>
<td>K-Patents Sanitary Probe Refractometer PR-43-AP 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, l-clamp, APV Tank bottom flange or Varinline® 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. |
| Measurement range | Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 Brix. |