SOYBEAN OIL, VEGETABLE OIL

**Typical end products**
- Soybean oil for food and biodiesel.

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

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**Introduction**

Soybean seed contains about 19 % oil. Soybean oils, both liquid and partially hydrogenated, are sold as *vegetable oil* or are used in a wide variety of processed foods.

Soybean oil is also used as a feedstock for biodiesel production.

**Application**

**Solvent extraction**

To extract soybean oil from the seeds, the soybeans are cracked and commercial hexane is used for solvent extraction. Hexane dissolves the oil out of the seeds. Oilseeds are usually flaked to increase the exposure to hexane. This type of extractor drips the hexane down onto the flaked soybeans to dissolve the oil in a manner similar to a coffee percolator.

Ninety percent of the solvent remaining in the extracted oil simply evaporates and as it does, it is collected for reuse. The rest is separated with a stripping column. The oil is boiled with steam, the lighter hexane floats upward and the resultant condensate is collected.

The bottom product of the column is the crude oil, which is refined and blended for different applications, e.g. by hydrogenation.

**Refining**

The refining stage is designed to remove the phospholipids and free fatty acids from the crude oil.

Refining can be done in two stages. The first is degumming.

The second stage of refining is neutralization or caustic refining. This process removes the free fatty acids present in the crude oil. An alkali solution, usually sodium hydroxide, is added and it reacts with the free fatty acids to produce soap. This soap is insoluble in the oil, and is easily separated by washing with water. The alkali solution also neutralizes any acid remaining from the degumming stage.

The alkali will also react with the triglycerides in the oil, so the neutralization parameters (type of alkali, solution strength, temperature, agitation and time) must be optimized to minimize the yield loss. There may be additional losses from emulsification and oil droplets suspension in the soap solution.
A by-product of the caustic refining is a mixture of soap, water and oil known as **soapstock**. This has been considered as a low-cost feedstock for biodiesel but its high water content and conversion of the soaps to methyl esters are significant obstacles for cost-effective utilization.

**Instrumentation and installation**

The K-Patents Sanitary Process Refractometer PR-43-A is used to monitor and optimize the extraction process. The refractometer measures continuously the amount of extracted oil in hexane, providing real-time information on extraction efficiency. Typically, the concentration of the mixture after extraction is 30 % oil and 70 % hexane. The process temperature is 60°C (140° F).

After the extraction, the solvent is recovered in the separation column. The refractive index value of the oil after solvent removal can be monitored for quality control purpose. In-line measurement by the K-Patents refractometer allows for effective control of the extraction process and optimized extraction efficiency.

The concentration of caustic soda is also monitored using a K-Patents refractometer so that the neutralization process proceeds efficiently.

Appropriate equipment hazardous and intrinsic safety approvals are available for hazardous area installations.

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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, I-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, I-clamp, APV Tank bottom flange or Varinline® connection.</td>
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<td>K-Patents Process Refractometer PR-43-GP is 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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| 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. |