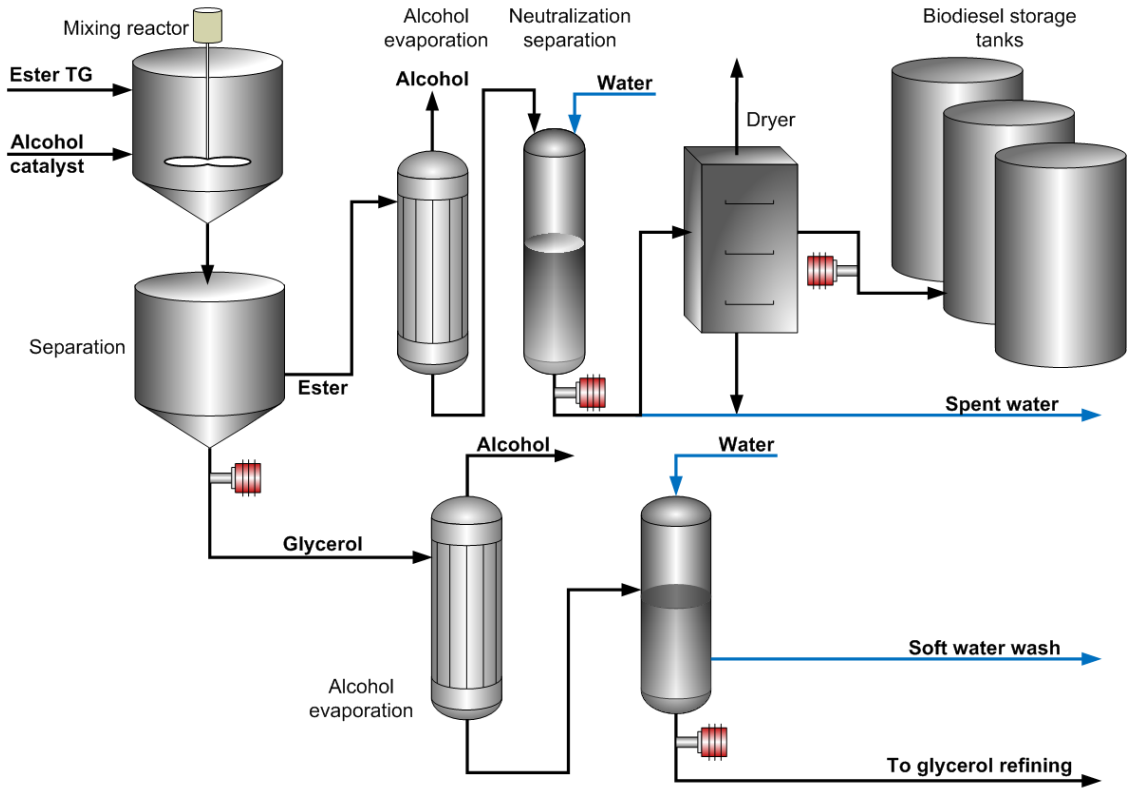
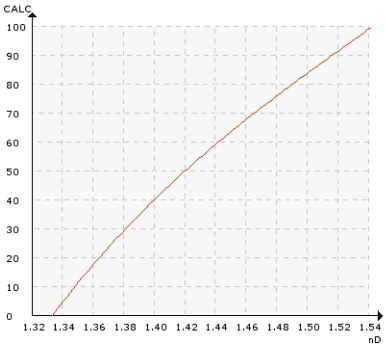


BIODIESEL, MONO-ALKYL ESTER

Typical end products

Biodiesel to be used on its own or as a blend with petrodiesel

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



Introduction

Biodiesel refers to a vegetable oil, or animal fat based diesel fuel, consisting of long-chain alkyl (methyl, propyl or ethyl) esters.

There are three basic routes to ester production from oils and fats:

1. Base catalyzed oil transesterification with alcohol.
2. Direct acid catalyzed oil esterification with methanol.
3. Conversion of the oil to fatty acids, then to Alkyl esters with acid catalysis.

Today, the majority of the alkyl esters are produced with a base catalyzed reaction.

Fat or oil is reacted with alcohol, like methanol, in the presence of a catalyst to produce glycerin and the methyl esters for biodiesel. Excess methanol is charged to assist in quick conversion and then it is recovered for reuse. The catalyst is usually sodium or potassium hydroxide, which is premixed with the methanol.

Typical final product methylesters are:

- RME (rape methyl ester, from rapeseed)
- PME (palm methyl ester, from palmoil)
- SME (soy methylesters, from soybean)
- FAME (fatty acid methyl ester, from a mix of vegetable and animal products)

These also have different Refractive Indexes.

Application

Base catalyzed production of biodiesel is generally carried out through the following stages:

Mixing of Alcohol and Catalyst. Sodium hydroxide (caustic soda) or potassium hydroxide (potash) are typical catalysts. These are dissolved in alcohol using standard agitator or mixer.

Reaction. The alcohol/catalyst mix is then charged into a closed reaction vessel, which oil or fat is introduced to. This is a totally closed system to prevent alcohol loss into the atmosphere. The reaction mix is kept just above the alcohol boiling point (around 71°C or 160 °F) to speed up the reaction. Recommended reaction time varies from 1 to 8 hours and in some systems the reaction is at ambient temperature. Excess of alcohol is normally present to ensure the conversion of the entire feedstock to esters.

Care must be taken when monitoring the amount of water and free fatty acids present in the oil or fat feedstock. If the free fatty acid level or water level is excessive, it may cause problems with soap formation and glycerin by-product separation downstream.

Separation. Once the reaction is complete, two major products exist: glycerin and biodiesel. Each contains a substantial amount of excess methanol left over from the reaction. The reacted mixture, if required, is neutralized at this stage. The glycerin is much denser than the biodiesel and the two can be gravity separated by simply drawing off the glycerin from the bottom of the settling vessel. A centrifuge is sometimes used to accelerate the separation.

Alcohol Removal. Once the glycerin and biodiesel have been separated, the excess alcohol in each is removed by a flash evaporation process or through distillation. In some systems, the alcohol is removed and the mixture neutralized before the glycerin and esters have been separated.

In both cases, the alcohol is recovered and is re-used. Care must be taken to ensure no water accumulates in the recovered alcohol stream.

Glycerin Neutralization. The glycerin by-product contains unused catalyst and soaps, which when neutralized with an acid, leave crude glycerin. In some cases, the salt formed during this process is recovered to be used as fertilizer. Though in most cases, the salt is left in the glycerin. Water and alcohol are removed to produce a crude glycerin of 80-88% purity. In more sophisticated operations, the glycerin is distilled to a purity of 99% or higher, which is suitable to be used in cosmetics and pharmaceuticals.

Methyl Ester Wash. Once separated from the glycerin, the biodiesel may be purified by application of a warm water wash, which removes the residual catalyst and soaps. Once dried, it is stored and ready for distribution. In some processes this step is unnecessary. This is normally the end of the production process, resulting in a clear amber-yellow liquid with a viscosity similar to petrodiesel. In some systems, the biodiesel goes through an additional distillation to remove small amounts of color bodies in order to produce colorless biodiesel.

Product Quality and Registration. Prior to distribution as a commercial fuel, the finished biodiesel must be analyzed using sophisticated analytical equipment to ensure that it meets ASTM specifications.

Installation

The K-Patents Process Refractometer PR-23-GP is used in-line to monitor the flow of ester and glycerin, ensuring they flow into the correct tanks.

The refractometer is also used for interface detection and quality monitoring of the different esters (RME, SME, FAME, PME). These have different R.I. values.

The washed glycerin concentration is also monitored.

Instrumentation	Description
	K-Patents Process Refractometer PR-23-GP is an industrial refractometer for large pipe sizes and tanks, cookers, crystallizers and kettles. Installation through a flange or clamp connection.
Measurement range:	Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 % by weight.