TULSION®

THERMAX

BIODIESEL PRODUCTION: APPLICATION NOTES

T-45 BD Macro

What is Biodiesel ?

Biodiesel is an alternative fuel for diesel engines. It is gaining attention worldwide after gaining considerable success and acceptance in Europe. The primary advantage of biodiesel fuel is that it is non-toxic and biodegradable and most importantly, a renewable energy source. Biodiesel can be used as B100 (neat) or in a blend with petroleum diesel. A blend of 20% Biodiesel with 80% petroleum diesel, by volume, is termed as B20 and a blend of 10% Biodiesel with 90% petroleum diesel, by volume, is termed as B10, the most common blend used in the Americas and in Europe.

Process of Production:

The first step in biodiesel production involves esterification of fatty acids and trans-esterification of triglycerides, commonly found in raw oil feedstocks. Therefore by reacting (virgin or used) oils and (rendering plant) fats with alcohols (e.g. methanol or ethyanol) in the presence of an alkali catalyst (such as potassium or sodium hydroxide, KOH and NaOH respectively) is called trans-esterification. After the trans-esterification reaction the product is allowed to settle in order to form two (2) layers.

The “fatty-acid-methyl-ester” or “biodiesel” component is present in the hydrophobic or top layer and the glycerin component settles into the hydrophillic phase (bottom layer).

Therefore, the top layer contains the alkyl esters (also referred to as raw biodiesel fuel) and the lower layer is predominantly composed of a reaction by-product called glycerin. The top layer of crude biodiesel is carefully removed and is then “polished” either using a water-wash or non-water wash methods.

It is important to note that the raw biodiesel at this stage contains a number of trace contaminants ranging from residual metals often imparted by the potassium or sodium hydroxide (KOH or NaOH) used in conjunction with methanol (or ethanol) to catalyze the trans-esterifcation reaction.

Trace contaminants will include 200 to 1,000 mg/l (also referred to a “parts per million” or “ppm”) levels of free glycerin; 500 to 2,000 ppm of water, 200 – 1,000 ppm of monogylcerides and in systems employing the water-wash protocol, free water may be present in the 500 – 2,000 ppm range.

(Note: Biodiesel fuel readily absorbs moisture from the atmosphere once it has been processed and depending on the time between manufacture and use may contain 1,200 – 1,500 ppm of miscible water. Removing excess water that may cause the finished biodiesel fuel to exceed the 500 ppm BD 100 specifications can be accomplished via use of a centrifuge or synthetic desiccants, also available from Thermax.

Purification process:

The crude / raw biodiesel cannot be used directly since it contains glycerin and soap in concentrations that exceed the specified limits. Glycerin and soap are the byproducts of the trans-esterification reaction.

To use this Biodiesel as an alternative fuel, these byproducts must be removed from the raw biodiesel in order that they comply with national as well as international standards.

One method commonly used to purify the raw biodiesel is called “water washing”. Typically, 2-3 BV’s of demineralized water is required in 6 – 8 separate washings in order to transfers the water soluble impurities such as soap and glycerin to be removed from the fuel and into the water phase. This method can purify the biodiesel to acceptable contaminant levels but results in an enormous volume of water that must be demineralized for the washing process and after use, the same volume of water must be post-treated to remove the contaminants prior to discharge. Therefore, to product 1 gallon of purified biodiesel fuel requires 6–8 gallons of demineralized water and 6-8 gallons of liquid wastewater to be treated.

Why Tulsion resins?

To avoid generating a huge liquid waste stream because of 6-8 water washes during the purification step, an alternative method gaining worldwide acceptance the purification of biodiesel via synthetic solid acid catalysts such as Tulsion T-45 BD or T-45 BD Macro. These ion exchange resins are installed into a vertical columns where the raw fuel is introduced at 30^0C – 40^0C at the rate of 2 – 6 bed volumes / hour(BV/hr.)

Both of these resins can readily removes the glycerin, soap, trace metals and monogylcerides which would all adversely affect the efficiency of today’s high performance diesel engines. These resins have proven to be effective at lowering free glycerin from 500 - 1000 ppm to < 10 ppm and the soap from 1,000 to 5,000 ppm to < 5 ppm. Metals and monoglycerides are nearly non-existant and are covered in more detail in a subsequent technical bulletin.

Advantages of using of ion exchange resins for Purification:

Tulsion T-45 BD is a premium grade, solid acid catalyst based on a cross-linked polystyrene matrix containing sulfonic acid groups.

Tulsion T-45 BD Macro is manufactured using controlled particle size synthesis and is used for many process applications exhibiting high conversions with excellent physical, chemical stability and operating characterstics.

Both products can be used in a wide range of temperature and pH conditions.

1. Reduction of contaminated wastewater.
2. No liquid / liquid phase separation
3. Less free water in biodiesel to be removed in drying step.
4. Higher purity of end product.

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