THERMAX

BIODIESEL NOTES

Frequently Asked Questions

Are there any temperature restrictions?

TULSION ™ T-45 BD / T-45 BD MACRO™ have a performance range from ambient temperature up to temperatures around 120°C (248°F).

Should I remove the methanol from the biodiesel before or after purifying with TULSION ™ T-45 BD / T-45 BD MACRO™?

Low concentrations of methanol in the raw biodiesel will enhance the effectiveness of TULSION ™ T-45 BD / T-45 BD MACRO™ to remove soap, glycerin, trace metals from catalyst and other naturally occurring metals found in most feedstock oils. We recommend drying the biodiesel after it has been purified by TULSION ™ T-45 BD / T-45 BD MACRO™. Visit www.thermaxindia.com website for more information on Biodiesel applications specifically the brochure on "Metals, Methanol & Monoglycerides". Alternatively, clip and paste the following address to your search engine and scroll down the page for the Biodiesel icon (http://thermaxindia.com/v2/ProductPage.asp?levelno=2&objectid=95&pageno=1&divid=3).

What filtering accessories are required?

The column towers contain a permanent sieving Johnson screen plate. One can think of the columns of TULSION ™ T-45 BD / T-45 BD MACRO™ resin as self-contained filtering units. Contact your local Thermax representative to determine the correct sieve openings required.

How often must the resin be changed?

Typically, 1 lb (kg) of TULSION ™ T-45 BD / T-45 BD MACRO™ resin will treat 1,200 to 1,800 lbs (kgs) of biodiesel. The lifetime of the resin thus depends on three main factors: (1) the impurity levels in the incoming contaminated biodiesel stream, (2) the flow rate, and (3) the amount of TULSION ™ T-45 BD / T-45 BD MACRO™ in the column. Either resin may need regeneration after 300 – 600 BV's of raw biodiesel has been processed through the column. Three (3) to five (5) BV's of methanol would be passed down-flow through the bed in order to remove the "soap-glycerin sheet" that often forms on the top of the resin bed and increases pressure drop though the bed while inhibiting product flow. Either resin may be regenerated in this fashion 5-10 times before the resins are ionically "spent" and must be evacuated from the service vessel and replaced with virgin media. Visit www.thermaxindia.com website for more information on Biodiesel applications specifically the brochures on "Methanol Regeneration" and "Operating Notes". Alternatively, clip and paste the following address to your search engine and scroll down the page for the Biodiesel icon (http://thermaxindia.com/v2/ProductPage.asp?levelno=2&objectid=95&pageno=1&divid=3).

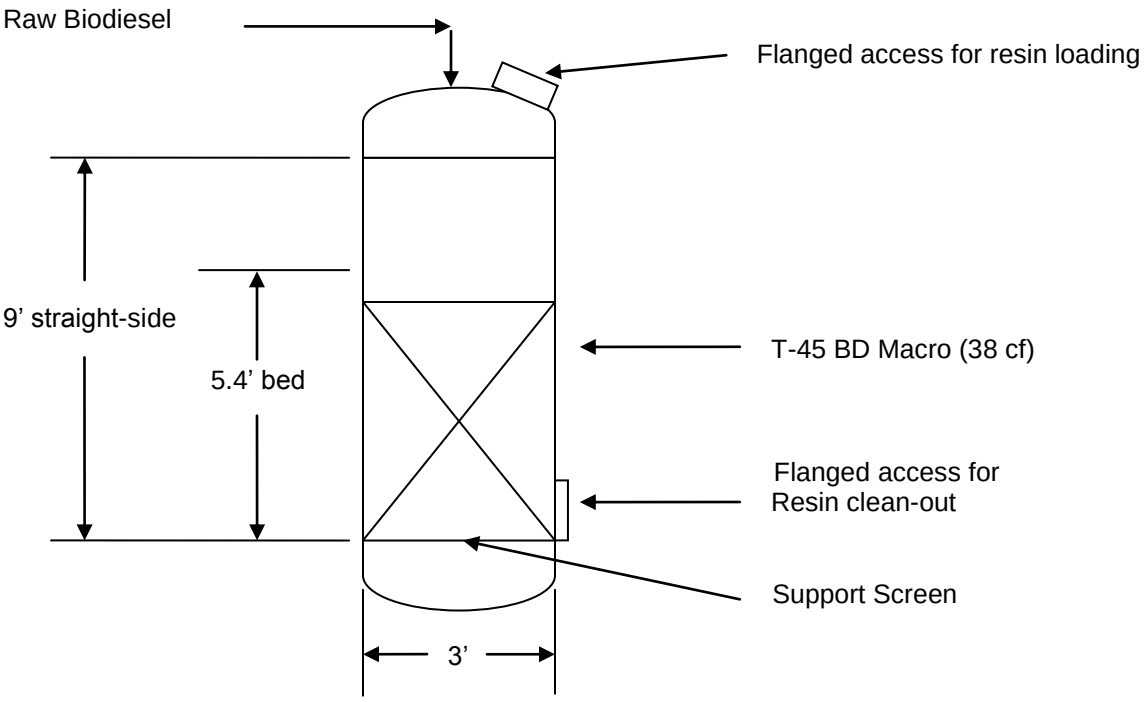
How do I know when the TULSION T-45 BD / T-45 BD MACRO media needs to be changed?

The purification capacity of TULSION ™ T-45 BD / T-45 BD MACRO™ is exhausted when impurities are no longer captured by the resin. At this "breakthrough" point, one will start to detect low levels of cations in the biodiesel that has passed through the column. Once the resin bed is no longer able to maintain performance after a methanol regeneration, it is time to be replaced. Monitoring glycerin levels in the B100, as per ASTM D-6584 protocol, is often used to assess the performance of the resin.

What size column do I need?

The column size will depend on the production rate you want to achieve in your plant. It should be noted that the size of the column will not impact your overall resin consumption rate or the operating cost. Our customers typically find it convenient to change the resin every 8 to 12 weeks. Thermax can assist in determining the appropriate column size to achieve this change-out interval. An example below for a 10-gallon per minute system (10 gpm or 37.8 liters per minute equates to 5 million gallons per year or 18.9 million liters per year).

Design Criteria:	5 M gallons / year or 10 gpm flow 2.0 BV/hr service flow rate Bed L/D: 1.5 min.
Resin Loading:	1,145 lbs / vessel T45 BD Macro (38 cf or 1,080 litres) to fill vessel 60% 1,600 lbs / vessel T45 BD (32 cf or 905 liters) to fill vessel 50%
Column Dimensions:	3' diameter x 9' straight side 1 ½' high dome on top and bottom of vessel Carbon steel
Change out Frequency:	350 – 400 gallons / lb of media* 400,000 – 460,000 gallons B 100



* Operating capacity dependent on SOP and influent feed quality (FFA, glycerin level, soaps, metals, etc.)

How do I remove the spent TULSION ™ T-45 BD / T-45 BD MACRO™ from the column?

The columns should have a port at the bottom for unloading spent resin. Most of the resin will flow out on its own. To facilitate unloading, it may be convenient to incline the screen plate at the bottom of the column. Residual resin can be vacuumed, blown, or transferred out in a slurry.

How much TULSION ™ T-45 BD / T-45 BD MACRO™ should I load in the column?

For T45 BD Macro the column should only be loaded about 50 to 60% full; for T45 BD gellular resin the column should be loaded 40-50% full. This will allow ample room for both resins to swell as the resin absorbs methanol and any residual water that may be present. The macroporous resin swells about half as much as the gel counterpart. Be sure to maintain sufficient headspace, at least 50 cm, above the resin in its fully swollen state. Thermax suggests using a swelling of 100% for the gel resin (T45 BD) and 50-60% for the T45 BD Macro.

How do I load fresh TULSION ™ T-45 BD / T-45 BD MACRO™ into column?

1. Open the top of the vessel. Examine the vessel to make sure that the old resin and biodiesel have been removed.

2. Lift the drums to the top of the vessel and load the resin by dumping from the drums into the empty vessel. Make sure that the vessel is not loaded more than 1/3 full with TULSION ™ T-45 BD / T-45 BD MACRO™ resin.

3. Close the top of the vessel. Introduce biodiesel (use purified biodiesel if available) from the bottom of the vessel until the resin is covered. Allow a minimum of one hour for the resin to swell in the biodiesel prior to starting the flow.

4. Start the flow of biodiesel from the top of the vessel at the specified flow rate (approximately 2 BV/h).

For more information, visit www.thermaxindia.com website for more information on Biodiesel applications specifically the brochure on “Column Loading Procedure”. Alternatively, clip and paste the following address to your search engine and scroll down the page for the Biodiesel icon (http://thermaxindia.com/v2/ProductPage.asp?levelno=2&objectid=95&pageno=1&divid=3).

SAFETY NOTE: *If the relative humidity is less than 60%, an explosion risk does exist due to a potential static discharge when loading fresh TULSION ™ T-45 BD / T-45 BD MACRO™ resin into a vessel that previously contained biodiesel. To minimize any explosion risk it is recommended to rinse the vessel with biodiesel containing less than 2.5 weight % methanol prior to loading fresh TULSION ™ T-45 BD / T-45 BD MACRO™ resin.*

If the methanol concentration in the biodiesel is unknown, another possible approach is to use a portable flammable gas detector to determine that a flammable environment is not present in the vessel prior to loading the fresh TULSION ™ T-45 BD / T-45 BD MACRO™ resin.

How do I unload the TULSION ™ T-45 BD / T-45 BD MACRO™ Resin?

1. Open the valve at the bottom of the vessel and allow the biodiesel to drain out of the bed of TULSION ™ T-45 BD / T-45 BD MACRO™ resin.

2. If available, purge the resin bed with nitrogen or compressed air for one hour to remove additional biodiesel that may be in the resin bed.

3. Open the evacuation port at the bottom of the vessel to empty the used TULSION ™ T-45 BD / T-45 BD MACRO™ resin into containers. If the resin will be disposed of these containers should be suitable for transporting.

What flow rate should be used?

The flow rate should be chosen by the biodiesel producer as a function of the target production capacity but in general, Thermax recommends a service flow rate of 2-4 BV/hour. As a general rule, the flowrate should be around 3 liters per hour per kilogram of installed TULSION ™ T-45 BD / T-45 BD MACRO™ (or 0.36 gallons/hour per lb). Thus, if the column contains 1000 kg (2205 lb) of TULSION ™ T-45 BD / T-45 BD MACRO™, the biodiesel flowrate should be around 3000 liters per hour (794 gal/hour).

Do I need a pump or is gravitational force sufficient for the biodiesel to flow through the columns?

For small scale (e.g. laboratory) or batch treatment operations, it may be possible to use gravity flow although careful thought should be given to how flowrate is controlled. It is highly recommended, however, that large scale commercial installations should use a pump to control the flow through the column.

How do I know when I need to regenerate the glycerol purification columns and what is the process?

Glycerol breakthrough can be measured using the ASTM test method D-6584. The TULSION ™ T-45 BD / T-45 BD MACRO™ purchased for these columns will not impact your overall resin consumption because when the glycerol removal columns are initially installed they will remove not only glycerol but also catalyst and soap. The resin in the glycerol columns can be replaced from time to time by the spent resin in the downstream purification columns. In practice the glycerol purification resin is replaced every 5 to 10 desorption cycles.

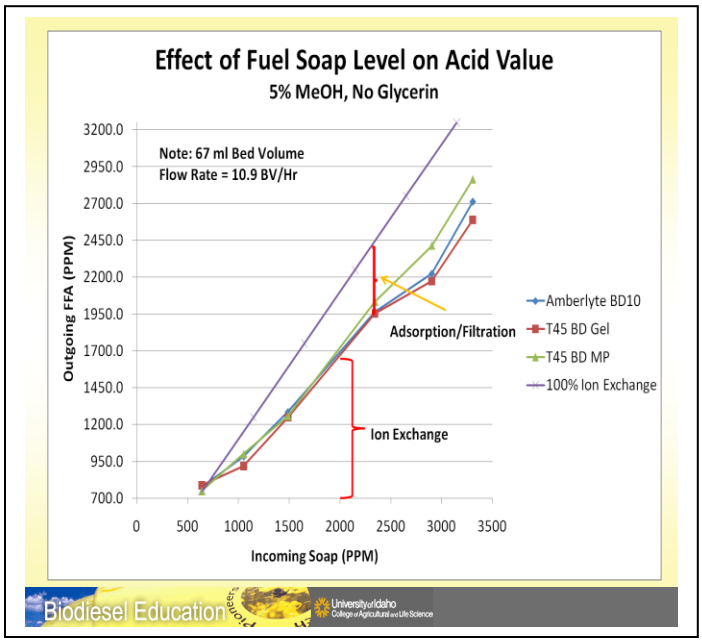
For more information, visit www.thermaxindia.com website for more information on Biodiesel applications specifically the brochure on “"Methanol Regeneration Procedure”. Alternatively, clip and paste the following address to your search engine and scroll down the page for the Biodiesel icon (http://thermaxindia.com/v2/ProductPage.asp?levelno=2&objectid=95&pageno=1&divid=3).

What is the pressure drop across the resin bed and how will this change as the resin swells?

The pressure drop per unit of bed length will depend on the biodiesel linear flow velocity and can be estimated to be 10 – 20 psi through the bed or approximately 1-2 psi per foot of resin bed depth. If the resin is inadequately or insufficiently swollen prior to the introduction of raw biodiesel fuel with 2-4 % methanol, further resin expansion could occur and may lead to pressure drop issues. Contact your local Thermax representative for more information.

How much biodiesel will TULSION T-45 BD / T-45 BD MACRO treat?

The usage rate for TULSION ™ T-45 BD / T-45 BD MACRO™ will depend on the system design including column configuration and operating conditions. In order to maximize the amount of biodiesel treated, a multiple column configuration is strongly recommended where the lead column is overrun to complete ionic exhaustion by soap. Please see the suggested system layout in "BIODIESEL NOTES: INDUSTRIAL USAGE" available at www.thermaxindia.com. The removal of free glycerol and soap by TULSION ™ T-45 BD / T-45 BD MACRO™ occurs via two different mechanisms – adsorption and ion exchange. (See graph below).



For glycerol removal, the resin can be regenerated when it is exhausted and can therefore be used for many glycerol adsorption cycles. The removal of soap therefore effectively determines the operating life of a charge of TULSION T-45 BD / T-45 BD MACRO and this will depend on the concentration of soap in the crude biodiesel. As a rough guideline, 1 kg of TULSION ™ T-45 BD / T-45 BD MACRO™ will treat between 1,200 kg and 1,800 kg of crude biodiesel for soap removal. The estimated usage rate can be inferred from the following figure. The alkali metal (sodium or potassium) concentration can be calculated from the soap concentration. For example, a soap concentration of 1500 ppm as potassium oleate corresponds to a potassium concentration of 183 ppm. Similarly, a soap concentration of 1425 ppm as sodium oleate corresponds to a sodium concentration of 108 ppm.

Can the biodiesel purified with TULSION ™ T-45 BD / T-45 BD MACRO™ meet the specifications for mono- and diglycerides and total glycerin?

Yes. TULSION ™ T-45 BD / T-45 BD MACRO™ users consistently produce biodiesel that exceeds all local specifications. The presence of mono- and diglycerides indicates that the trans-esterification reaction is incomplete. These species often signal a dangerous process inefficiency and must be dealt with at their source where they are easily eliminated by refining process parameters including reaction time, temperature, and catalyst loading. Visit www.thermaxindia.com website for more information on Biodiesel applications specifically the brochure on "Metals, Methanol & Monoglycerides". Alternatively, clip and paste the following address to your search engine and scroll down the page for the Biodiesel icon (http://thermaxindia.com/v2/ProductPage.asp?levelno=2&objectid=95&pageno=1&divid=3).

Do I still need to do a water wash?

No. After trans-esterification, the biodiesel phase is separated by using settlers or centrifuges and then passed directly through TULSION™ T45 BD / T45 BD MACRO™.

Are there any restrictions related to resin disposal?

TULSION ™ T-45 BD / T-45 BD MACRO™ are non-hazardous materials. Please check local regulations regarding disposal. Incineration and land filling are two options that are often adopted.