

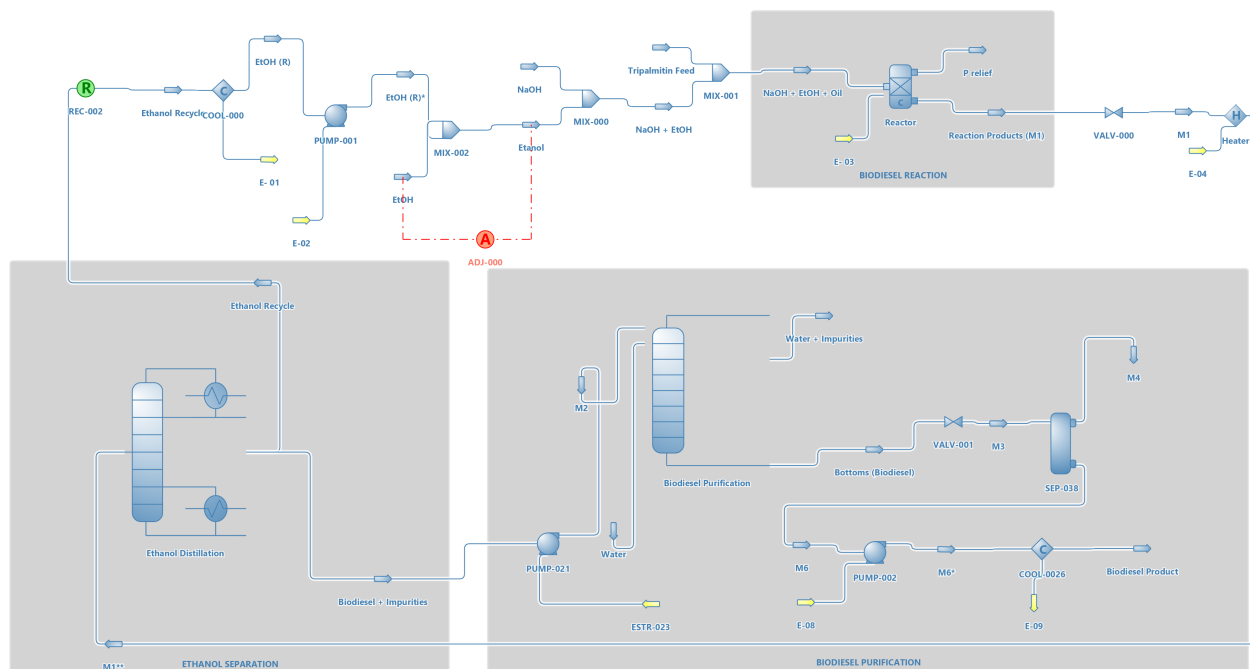
# Production of Biodiesel

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## Background & Description:

Biodiesel was introduced in South Africa before World War II to power heavy-duty vehicles. Recent environmental and domestic economic concerns have prompted a resurgence in the use of biodiesel throughout the world. Biodiesel can be produced through "transesterification"; a process that combines vegetable oils, animal fats, and/or microalgae oils with alcohol in the presence of a catalyst to form fatty esters. Products are separated into phases which provide easy removal of glycerol, a valuable industrial by-product, in the first phase. The remaining alcohol/ester mixture is then separated and the excess alcohol is recycled. Then the esters are sent to the clean-up or purification processes, which consist of water washing, vacuum drying, and filtration.

In this flowsheet, production of ethyl palmitate ( $C_{18}H_{36}O_2$ ) from tripalmitin ( $C_{51}H_{98}O_6$ ) has been demonstrated. Ethyl palmitate is a colourless solid with a wax-like odour. Chemically, ethyl palmitate is the ethyl ester of palmitic acid. Ethyl palmitate is used as a hair- and skin-conditioning agent. Tripalmitin feed along with ethanol is sent to a conversion reactor where reaction takes place between tripalmitin and ethanol to form ethyl palmitate and glycerol. The reactor is considered to have 95% conversion of tripalmitin. The product stream is first sent to a distillation column for ethanol separation. Ethanol recovered from top is recycled back to the mix with the feed stream. The bottom stream containing biodiesel along with other impurities are sent to an absorption column. Water is sent to the bottom of the column to absorb the other impurities from biodiesel while pure Ethyl Palmitate is obtained from the bottom.



## Results:

Object	NaOH + EtOH	NaOH + EtOH + Oil	Reaction Products (M1)	M1**	
Temperature	25.06392	51.07824	51.20892	44.67	C
Pressure	1	1	1	0.296077	atm
Mass Flow	79.030073	303.2891	303.2891	303.2891	g/s
Molar Flow	1.722756	2.000534	2.000539	2.000539	mol/s
Mass Fraction (Mixture) / Ethanol_BD	0.971569	0.253168	0.132914	0.132914	
Mass Fraction (Mixture) / EtP	0.000031	0.000008	0.742583	0.742583	
Mass Fraction (Mixture) / PPP	0	0.739423	0.036971	0.036971	
Mass Fraction (Mixture) / NaOH_BD	0.028369	0.007392	0.007392	0.007392	
Mass Fraction (Mixture) / Glycerol_BD	0.000031	0.000008	0.080139	0.080139	

Object	M1**	Biodiesel + Impurities	Bottoms (Biodiesel)	Water + Impurities	Biodiesel Product	
Temperature	44.67	214.6771	60.00389	147.0185	25	C
Pressure	0.296077	0.296077	1	1	1	atm
Mass Flow	303.289073	263.5016	224.3065	305.2663	224.3065	g/s
Molar Flow	2.000539	1.136907	0.781696	15.12477	0.781696	mol/s
Mass Fraction (Mixture) / Ethanol_BD	0.132914	0.001988	0.000519	0.001334	0.000519	
Mass Fraction (Mixture) / Water_BD	0	0.09224	0	0.871618	0	
Mass Fraction (Mixture) / Glycerol_BD	0.080139	0.85471	0	0.079613	0	
Mass Fraction (Mixture) / EtP	0.742583	0.008509	0.982058	0.016165	0.982058	
Mass Fraction (Mixture) / NaOH_BD	0.007392	0.042554	0	0.007343	0	
Mass Fraction (Mixture) / PPP	0.036971	0.042554	0.017423	0.023926	0.017423	

Table 1: Streamwise Results for Biodiesel Production