

STATE LINE BIOFUELS

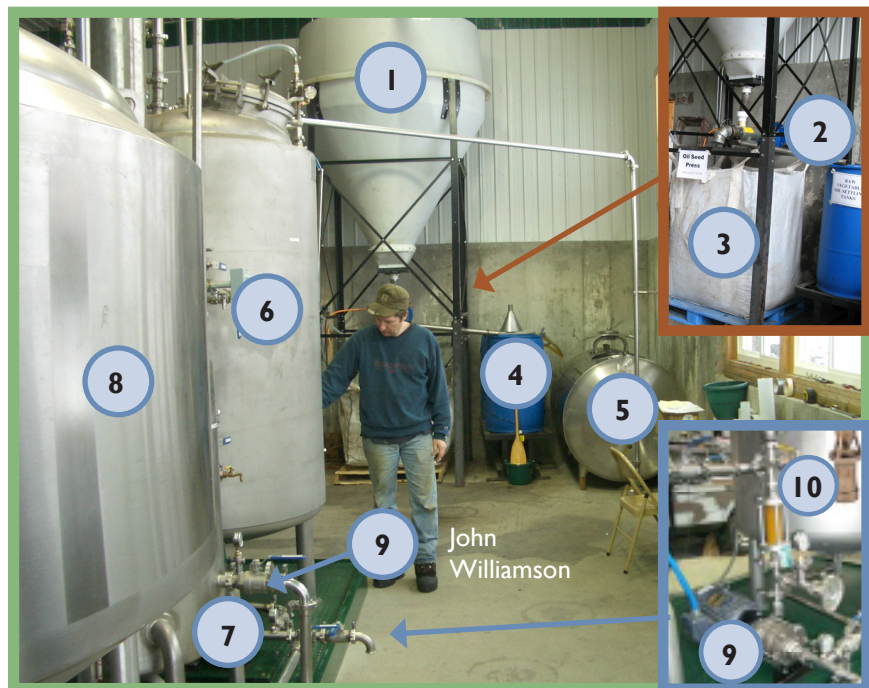
System Overview

The biodiesel process at State Line Biofuels begins with a harvested crop of oilseed which is first dried and then stored in the 100 bushel grain hopper (1). From the hopper it is fed by gravity to the oil mill (2) directly below which presses up approximately 3 gallons of oil from the seed each hour. The mill also separates the remainder of the seed as meal. The meal is dropped into a bag (3) and the oil is diverted to a set of two 55 gallon primary settling drums (4). This settling process occurs by gravity and separates some of the sediment and remaining particles from the vegetable oil. The settled oil moves by gravity into a 300 gallon milk tank converted for use as a raw oil storage tank (5). This portion of the system provides the raw oil used in the production of biodiesel. Filtered waste vegetable oil can also be added into the storage tank.

Conversion of vegetable oil to biodiesel occurs in the 400 gallon reaction tank (6). This tank is “jacketed” meaning it has a double wall with a heat transfer surface between the walls. Hot water can be circulated through this jacket to heat the oil in the tank to a reaction temperature of 120-130°F. A similar process can be used to reclaim alcohol after the reaction has been completed. The oil is moved to this tank by drawing a small vacuum on the tank using a vacuum pump (not shown). Oil is then drawn into the reaction tank (6) from the storage tank (5) by opening a hand valve.

Alcohol and hydroxide are combined in a separate 115 gallon mix tank (7) which has also been drawn to a vacuum. This allows the transfer of alcohol into the tank without using a transfer pump. Hydroxide is presently added manually through a hatch on the top of the mix tank. The operator needs to be very careful when doing this as these ingredients are hazardous. Proper personal protective equipment (PPE) and careful handling are critical for safety reasons. The solid hydroxide is dissolved into the alcohol by mixing vigorously in a closed loop. This is done using a specially designed pump (9) and an eductor nozzle (10) which is attached to the return line of the loop inside the mix tank. A sight tube located directly above the pump allows for the operator to visually check the progress of the mixing.

Once sufficiently mixed, the alcohol / hydroxide mixture is transferred to the reaction tank and mixed with the vegetable oil. This is the start of the biodiesel reaction (*transesterification*). The pump is used to circulate the vegetable oil, alcohol and hydroxide until the reaction is complete. The progress of the reaction can be visually monitored using the sight tube above the pump. When the reaction is complete, the same pump is used to transfer the biodiesel and glycerin to a 500 gallon, conical bottom settling tank (8) which allows the two to separate with gravity. The glycerin is removed off the bottom of the tank. The remaining fuel can then be tested for quality, passed through a final filter and used to power the farm’s machinery.



System Components

Number	Component	Model / Size	Approximate Cost*
1	Grain Hopper	100 bushel, Polypropylene	\$900
2	Täby Oil Mill	Model 70	\$8,000
3	Meal Bags	N/A	N/A
4	Primary Settling drums	(2) 55 gallon PVC drums	N/A
5	Oil Storage Tank	Milk Tank 300 gallon, jacketed	\$400
6	Reaction Tank	400 gallon jacketed	\$6,000
7	Mix Tank	115 gallon, flush bottom valve with Parylene coating on valve seal	\$4,250
8	Settling Tank	500 gallon, conical bottom	\$2,000
9	Pump	Eastern Centrichem, ECH3 w/ explosion proof motor and variable speed drive.	\$3,500
10	Mixing Nozzle	BETE Fog Nozzle Turbomix Eductor mixing nozzle, TMI50.	\$200
N/A	Hand Valves	Various, 30 valves @ \$100 each	\$3,000
N/A	Plumbing	Milk Line and Fittings, 300 feet & 30 fittings	\$500
N/A	Gas Sensors	(2) Industrial Test Equipment HC-822 Combustible Gas Sensors @ \$200 each	\$400
N/A	Pallet	Spill containment skid pallet, custom made	\$2,000
Total			\$31,150*

System Features

- ▶ **Efficiency**
 - Single pump design with variable speed control
 - Passive nozzle enhances catalyst mixing, shorter batch times
 - Design features allow for planned alcohol recovery
- ▶ **Safety**
 - Standard operating procedures
 - Spill prevention and containment (skid and trough)
 - Vacuum fill system (no machines operate when moving alcohol)
 - Combustibility sensors
 - Separation of wiring from hazardous locations
 - Emergency shut down button
 - Personal protective equipment
 - Manual operation, always attended
- ▶ **Flexibility**
 - Most tanks have more than one use
 - Manual operation of valves allows for highly flexible use

Disclaimer - This information sheet is intended to provide general background about this specific system for those interested in considering on-farm biodiesel production. The processor at State Line Biofuels is a work in progress and this description is not complete. The reader is encouraged to carefully consider all technical aspects of their own processor as unique and take care when applying specific features from one design to another.

* Costs indicated are for this particular system. Many of the components were purchased used and labor has not been included.

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