



## High Free Fatty Acids Pretreatment and Conversion

Free Fatty Acids (FFA) pretreatment is absolutely necessary for any Biodiesel Plant wishing to incorporate palm acid oils, palm oil mill effluents, crude degummed oils, waste vegetable oils or used cooking oils (WVO/UCO), jatropha, beef tallow, choice white grease, poultry fat, and various other inferior oils. Normally, these oils containing some 3% - 50% FFA and will consume large amounts of methylate and methanol which produce water and soaps that contaminate, centrifuges, piping, pumps, and vessels on any future batches.

## What is “Pretreatment” and why is it needed?

- Pretreatment describes any and all steps required to prepare feedstock for transesterification. This most commonly involves water removal and converting FFA into useable oil;
- Any water left in oil causes soap production during transesterification process;
- Soaps could clog lines, impede optimal reactions, and result in equipment downtime. FFA are fats that exist in a variety of new and used oil sources are:
  - *WVO/UCO FFA are created when fatty foods are fried;*
  - *New Oils: Palm Acid Oils, Palm Oil Mill Effluents, Corn Oil, Rapeseed, Jatropha and many other agricultural feedstocks make excellent oils for biodiesel, but all have FFA levels too high for transesterification.*

### Some Examples of High FFA Oils



Palm Oil

Jatropha

Algae



## What are the options for Pretreatment?

Three methods exist for removing FFA from feedstock:

- **Caustic Stripping.** Caustic is used to “strip” FFA from oils. Caustic reacts with FFA to create soaps, which result in significant yield loss and creates disposal issues with soaps that are produced.
- **Acid Esterification.** Methanol and sulfuric acid are mixed with oils, and FFA is converted into methyl esters of 99.8% yield. This process results in no yield loss and no soap production at lowest cost.
- **Enzyme Esterification.** Large scale fermentation using both fed-batch or continuous process could reach 99.5% yield of Biodiesel. The process results in no yield loss and no soap production, however the current enzyme cost is still high.

## The HiFFA-GWR Series System™:

The FFA shall be pretreated. Pretreatment options include (Acid Esterification or Caustic Stripping). GWR has designed an exclusive system (**GWR-CFAES™** - Series/Continuous Flow Acid Esterification System) which utilises the proven method of using methanol and acid to convert FFA into usable oils as opposed to simply caustic washing them out leaving a considerable yield loss. GWR further adds to this process a proprietary process of utilising a modified waste additive to remove excess water from the oil prior to a transesterification process to further prevent the development of soap production.



Through the use of proprietary technology, (The GWR **GWR-CFAES™** - Series Unit) it is now possible to convert feedstocks containing up to **95% FFA** into usable fuel, eliminating soap production, and provide a **100% yield** even with the most inferior oils.

## Advantages of a Pretreatment System (GWR-CFAES-Series System) :

- Removes water content
- 100% FFA conversion
- Prevents soap creation
- Up to 95% FFA Feedstocks
- Energy Efficient
- Fast return on investment
- Cost savings:
  - *Post treatment*
  - *Dry wash*
  - *Ion-exchange treatment*
  - *Methanol Recovery/Purification*



## How does the GWR-CFAES™ system implement work?

- The GWR-CFAES™ system is a continuous flow acid esterification system.
- The GWR-CFAES™ system precisely meters methanol and sulfuric acid into feedstock, converting FFA into saleable oil prior to transesterification.

## What technologies does GWR employ to be able to guarantee the performance of the GWR-CFAES™?

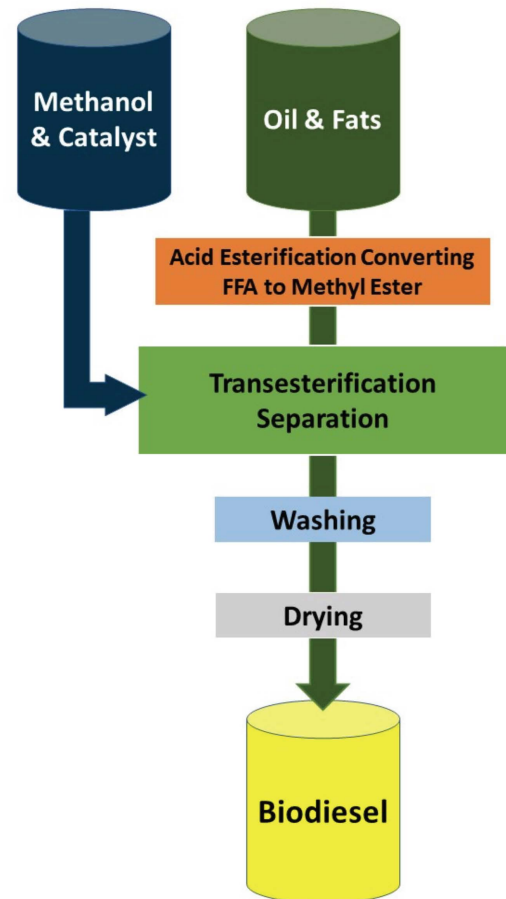
While the specifics are proprietary, GWR has engineered the GWR-CFAES™ to use heat, pressure, static mixing, and special dosing methodologies to obtain optimal conversion rates at flow rates from **1.5 million to 500 million litres per year**.

GWR's proprietary pretreatment unit is less expensive than other units that are designed to remove the FFA saving you lost volume and money and allowing you to render the FFA to profitable oils. This increases end-product yield and bottom line profit. Without the pre-treatment/esterification process, a Biodiesel Plant will operate with little to no profit margin.

The **GWR-CFAES-Series** unit represents a complete package capable of handling all of your Biodiesel Engineering needs at a competitive price. The GWR-CFAES™ is currently being integrated into numerous existing operational and un-operational Biodiesel plants throughout Malaysia and are an essential component of an **GWR BioDiesel "Turnkey" Plant**.

### Why Choose GWR-CFAES™ Series?

- Scalable** - From 1,500,000 litres to 500,000,000 litres or 1,290 Metric Tons to 430,000 Metric Tons (Biodiesel density at 860 kg/m<sup>3</sup>) per year
- Capable** - Only product line offering ability to handle up to 95% or higher FFA
- Agile** - Enables biodiesel plant operators to be multi-feedstock capable
- Reliable** - Continuous flow, automated, with remote monitoring capability
- Safe** - Intrinsically safe wiring, nitrogen purged panels, integrated safety features
- Proven** - Over 25 years of process technology experience built into every system



**GWR-CFAES™**  
Process flow



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