FFA reduction with AGT

Turn high FFA fats, oils & grease into low FFA, high value biofuel & oleochemicals
From vulnerability to versatility
Alfa Laval has developed a breakthrough solution to one of the most important commercial squeezes encountered by biodiesel producers, in the form of a straightforward, skid-mounted Advanced Glycerol Treatment (AGT) pretreatment process.

The AGT process allows practically any kind of low-cost/low-quality high FFA fats, oils and grease of vegetable or animal origin to be used as feedstock for producing low FFA biodiesel inside an existing transesterification plant. Previously, this required refined virgin oil for a working production set-up.

An AGT system enables operators to tap into the worldwide FOG (fats, oils and grease) spot market, where waste products are available at highly favourable prices – and are sometimes even traded at negative values.

Choose your degree of refinement
On the output side, you can choose to tap off the biorefined oil at different stages of production and upgrading. Installing an AGT system gives you the freedom to select any appropriate output and to sell the oil directly after upgrading in the AGT process. This delivers treated oil as mono-, di- and triglycerides, ready for mixing as heavy fuel oil. This also means it can be traded as an oleochemical, or forwarded to off-site biodiesel producers.

Further, the sales prices of biodiesel products are also often subject to many different legislative, technical and marketing parameters – both local and international. These are usually well beyond the control of any individual producer, and prices are often heavily dependent on combinations of local market situations and politically determined environmental priorities.

Uncertain biofuel market
This built-in commercial uncertainty is increased by similar vulnerability on the output side. The lack of flexibility in the end-product limits the ability to make the most of new market opportunities and/or favourable price constellations.

Maximum flexibility, minimum cost
The Alfa Laval AGT process provides you with a highly versatile, future-proofed approach to processing FOG feedstocks. You can:
- Add significant value to existing waste products
- Move your company into new, high-value product segments available within the field of biorefining e.g. oleochemicals
- Make an easy switch to whichever level of feedstock upgrading and processing is currently most in demand in your particular market
- Use less chemicals in your pretreatment process and reduce operating costs
- Reduce the environmental impact of your operations

Volatile edible feedstock prices for biodiesel producers
The majority of the world’s current biodiesel production is undertaken by conventional transesterification plants. Unfortunately, these often have the dual drawbacks of depending heavily on high-quality feedstocks from the edible oils and fats industry, and of biodiesel being their only viable end-product. When feedstock prices represent the bulk of the expenditure involved in biodiesel production, exposure to the price-volatile spot market for edible oils makes any company’s biodiesel set-up vulnerable on the input side.

Meat by-products and UCO
For meat renderers and companies collecting used cooking oil (UCO) AGT offers a new business opportunity.

Thinking for the future
With the AGT pretreatment process, Alfa Laval offers you a superior technology that will play an essential role in remaining successful in the biodiesel processing market. It provides you with a modular, forward-compatible retrofit option that paves the way for future profitability using a wide range of different feedstocks of varying quality and specifications.
rendered animal fats, trap grease, used cooking oil (UCO), fatty acid seed oils, nut oils, recycled vegetable oils and fatty acid distillates.

Recovery of heat and glycerol

The AGT process takes place in staged batch reactors specifically designed to take advantage of process heat recovery (economizing), along with other operating efficiencies.

Versatile and economical

The AGT process is based on the well-proven chemical reaction known as re-esterification. The chemistry involved follows the general principles of thermodynamics, with heat, the addition of excess glycerol and continuous removal of water converting the free fatty acids into mono-, di- and triglycerides. The initial feedstock can be virtually any kind of fats, oils and grease, including rendered animal fats, trap grease, used cooking oil (UCO), fatty acid seed oils, nut oils, recycled vegetable oils and fatty acid distillates.

Key considerations for high FFA process technologies

<table>
<thead>
<tr>
<th>Process conditions:</th>
<th>AGT</th>
<th>Acid Esterification</th>
<th>FFA Stripping</th>
<th>Super Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield</td>
<td>&gt;200°C, vacuum</td>
<td>&gt;70°C, overpressure</td>
<td>Caustic or steam</td>
<td>+250–300°C, 10–25MPa</td>
</tr>
<tr>
<td>Reaction time</td>
<td>High yield even at high FFA</td>
<td>Needs multiple water removal</td>
<td>FFA % equals yield loss</td>
<td>High yield</td>
</tr>
<tr>
<td>Consumptions of chemicals:</td>
<td>Short</td>
<td>Long, multiple batches</td>
<td>Short</td>
<td>Short</td>
</tr>
<tr>
<td>By-products:</td>
<td>None</td>
<td>Large qty of CH3OH &amp; catalyst</td>
<td>NaOH/steam</td>
<td>Large qty of CH3OH used</td>
</tr>
<tr>
<td></td>
<td>Water vapor</td>
<td>Glycerol</td>
<td>Soap/FFA</td>
<td>Spent CH3OH</td>
</tr>
</tbody>
</table>

Convert high FFA to low FFA

The AGT set-up is specifically designed to process FFA levels of 10–100%, while the 1–10% band is dealt with by Alfa Laval acid esterification process systems. The raw oil and new plus recovered glycerol are mixed and pre-heated using heat recovered from the previous batch in robust, efficient Alfa Laval plate heat exchanger circuits. The fluid is then heated to peak reaction

... and end-product versatility
temperature by a thermal system. The reactors are equipped with a vacuum system that enables powerful FFA conversion as a result of its capacity to extract the water present in the feedstock or produced in the chemical reaction. The absence of air also prevents unwanted side reactions, such as oxidation of the raw oil, dimerization of glycerol and decomposition of glycerol to acrolein.

Once the reaction is complete, the glycerol and processed oil have to be separated, and the temperature reduced. During discharge, the batch is cooled using thermal energy drawn from the incoming fluid, by circulating through the heat exchanger circuit. The chilled fluid is then separated, so that treated oil is transferred to storage or to an existing downstream biodiesel manufacturing process, while the glycerol phase is recovered for the next batch.

**When FFA reduction is the key**

If you want to upgrade an existing biodiesel plant for feedstock flexibility or to find new business opportunities e.g. for a meat rendering facility, let Alfa Laval calculate how much profitability you can gain from a versatile AGT system for low FFA biofuel and oleochemicals. Capacity ranges from 15 hl/day (400 gl/day) to 1,500 hl/day (40,000 gl/day). It will soon pay off.

**Processing advantages add up**

- An easy upgrade/extension path to cope with changing needs
- Maximum processing versatility
- Chemical consumption kept at a minimum
- High yield
- Beneficial recycling of heat and expelled glycerol
- By-products: water vapor and small quantity of solid waste
- Fast Return On Investment – Maximized ROI

**Wider processing perspective**

The unique AGT process is only one among the comprehensive Alfa Laval portfolio of oil refining technologies for:

- Vegetable oil refining
- Chemical pretreatment
- Physical pretreatment
- Enzymatic degumming
- Flash deacidification
- Transesterification
- Multi-feedstock esterification
- Fish and meat by-product rendering solutions
Many companies that process biofuels are looking into ways of replacing edible high-cost raw materials with alternative low-cost feedstocks. Others, e.g. meat renderers, face the challenge what to do with their by-products of high FFA content.

Using a new energy and cost-effective pretreatment process from Alfa Laval, it is now also possible to convert inedible high free fatty acid (FFA) feedstock into low FFA profitable biofuels and oleochemicals.

The new advanced glycerol treatment (AGT) process enables you to retrofit and revitalize virtually any FFA process, making it easy to tackle both changing customer requirements and patterns of demand, as well as fluctuating conditions in the overall market.

Efficient FFA reduction

<table>
<thead>
<tr>
<th>FFA Reduction</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 - 100% FFA</td>
<td>low value</td>
</tr>
<tr>
<td>0.8 - 8.0% FFA</td>
<td>higher profit</td>
</tr>
</tbody>
</table>
Alfa Laval in brief

Alfa Laval is a leading global provider of specialized products and engineered solutions.

Our equipment, systems and services are dedicated to helping customers to optimize the performance of their processes. Time and time again.

We help our customers to heat, cool, separate and transport products such as oil, water, chemicals, beverages, foodstuffs, starch and pharmaceuticals.

Our worldwide organization works closely with customers in almost 100 countries to help them stay ahead.

How to contact Alfa Laval

Up-to-date Alfa Laval contact details for all countries are always available on our website at www.alfalaval.com