BIODIESEL
ULTRA LOW IN PRECIPITATES
Air Liquide Group

The world leader in gases, technologies and services for Industry and Health

Air Liquide is present in 80 countries with approximately 65,000 employees and serves more than 3 million customers and patients. Oxygen, nitrogen and hydrogen are essential small molecules for life, matter and energy. They embody Air Liquide’s scientific territory and have been at the core of the company’s activities since its creation in 1902.

Air Liquide’s ambition is to lead its industry, deliver long term performance and contribute to sustainability.

Air Liquide Engineering & Construction

A technology partner of choice

Air Liquide Engineering & Construction builds the Group’s production units (mainly air gas separation and hydrogen production units) and provides external customers with efficient, sustainable, customized technology and process solutions.

Our full suite of technologies

- Liquefied Natural Gas
- Cryogenics
- Hydrogen
- Syngas
- Petrochemicals
- Natural Gas Treatment
- Sulfur
- Standard Plants
- Oleochemicals

15 Engineering centers and front end offices
3 Manufacturing centers
60 Proprietary technologies
1,600 Patents

Air Liquide Engineering & Construction builds the Group’s production units (mainly air gas separation and hydrogen production units) and provides external customers with efficient, sustainable, customized technology and process solutions. Our core expertise in industrial gas, energy conversion and gas purification, enables customers to optimize natural resources.

We cover the entire project life-cycle: license engineering services / proprietary equipment, high-end engineering & design capabilities, project management & execution services. In addition we also offer efficient customer services through our worldwide set-up.

As a technology partner, customers benefit from our research and development to achieve energy transition goals.
Innovative design
and expert execution

Premium plants and equipment, on time, every time

We began building and designing biodiesel plants over 25 years ago and have been fine tuning our processes ever since. Coupled with the expertise of our engineers, we are able to deliver an operational solution to meet your objectives within a 12-month time-frame.

Our biodiesel technology is the outgrowth of decades of experience in advanced Lurgi oils, fats and oleochemical processing. The process plants cover the entire technology route from the oil seeds via the refining of oils to the generation of value added final products. Automated processing steps allow the convenient and safe operation of the plants, which also applies to the biodiesel technologies of transesterification and refinement of biodiesel and glycerin products.

Low Costs, Maximum Yield

- High efficiency: one kilogram of feedstock yields one kilogram of biodiesel
- Robust, reliable equipment reduces maintenance costs resulting in low OPEX

Environmentally Responsible

- Transesterification at low temperatures and atmospheric pressure reduces energy consumption
- Wash-water recycling minimizes effluent and waste water discharge

Combined with the efficient use of raw materials, our plants are low in OPEX while improving your environmental footprint.

The biodiesel produced by our sophisticated plants meets or presents even better characteristics than all international quality standards including EN 14214 and ASTM D6751. The end product is ready for diesel-powered cars and engines and can be used as intermediate in surfactant and personal care applications after components have been separated by fractionation or distillation.

Our plants range in capacity from 50,000 to 400,000 tons per year in a single processing route. We established the current industry norm of 200,000 tons per year still recognized across the industry today.
Our leading edge biodiesel technology offers a complete oleochemical production chain with processes for seed crushing and oil extraction to oil refining as up-stream processes. Diverse renewable oil-bearing feedstocks can be used for edible oils, personal care products and pharmaceuticals, biodiesel fuels and other oleochemicals.

**Seeds and oil fruits**

- Soybean
- Sunflower
- Rapeseed
- Palm kernel
- Peanut
- Cottonseed
- Palm oil
- Palm kernel oil
- Coconut oil

**Pressing**

**Extraction**

**Crude oils**

**Oil refining**

**Refined oils**

**Refined products**

- **Food uses**
  - Edible oil (food, food additives)

- **Technical uses**
  - Biodiesel (fuel)
  - Personal care and pharma applications (soap, cosmetics, glycerin distillates)
  - Fatty acid, fatty alcohol (surfactants, detergents, lubricants, additives)
Reliable performance and consistent product quality

Our biodiesel technology features oil pretreatment to remove raw material impurities. Free fatty acids removed during oil pretreatment can be processed by re-esterification (glycerolysis) to a biodiesel feedstock again in order to boost the overall yield and to ascertain a long-term profitability. Sediments appearing during the transesterification itself are removed by a unique patented process step.
Biodiesel production

Tailored for your needs

We offer a range of oil pretreatment plants designed for the particular type of crude oil you use and have extensive experience in both chemical and physical refining processes. Our expert project teams will assist you in choosing the right solution.

Biodiesel: better than standard

- High methyl ester content confirming high degree of conversion of feedstock
- Low mono-/di-/tri-glycerides and low moisture content ensuring good product stability and low inclination of product to sedimentation
- Consistently low acid value demonstrates the highly efficient biodiesel washing step
- Low methanol content demonstrates effective prevention of loss of hazardous reactants
- Low glycerin content demonstrates the highly efficient biodiesel washing step
- Low or no detectable content of sediments constituting content of total solids far below specified benchmark assuring problem-free use of biodiesel
Biodiesel technology

**Oil transesterification**
- Reactor 1
- Reactor 2
- Patented glycerin cross-flow
- Used wash water

**Biodiesel washing and sediment removal**
- Wash column
- Sediment removal
- Sediment

**Biodiesel drying**
- Vacuum
- Vacuum
- Dried biodiesel

**Crude oil**
- Methanol catalyst

**Methanol recovery**

**Glycerin water evaporation**

**Closed wash water loop**

**Crude glycerin**

**Methanol recovery**

**Glycerin water evaporation**
Oil transesterification

Over 75 biodiesel plants around the world use our two-stage mixer settler design. The process combines refined oils with methanol and a catalyst under atmospheric pressure and temperatures around 60° Celsius in multi-stage reactors to produce biodiesel (methyl esters) and glycerin. Our patented Glycerin cross-flow reduces catalyst consumption.

This technology is seamlessly integrated in the downstream processing route of biodiesel washing, sediment removal and glycerin production.
Washing to maximize efficiency

Acids are added in a controlled manner to split potential traces of soaps contained in the biodiesel in order to facilitate effective removal in the biodiesel washing step. The washing water similarly removes free glycerin, methanol and other soluble polar components. At the same time the water washing step represents an important stage for the ultimate removal of sterol glucosides as sediments.

The Lurgi biodiesel washing technology uses a counter-flow extraction column in a multi-stage process for maximum efficiency. The result is biodiesel of the highest purity. The wash water is recovered in the glycerin water evaporation process and reused in a closed, zero discharge wash-water loop.

Wash column

![Wash column diagram](image)

Multi-stage washing effective removal of impurities

![Multi-stage washing diagram](image)
Sediment removal

During biodiesel production our integrated and patented process step effectively agglomerates and removes sediment-forming compounds. With our patented technology, the end product is a biodiesel that is clear, precipitate-free and highly stable over extended time periods with concentrations of sterol glycosides and mono-glycerides far below the set industrial standards. This, along with removal of polar compounds, is particularly important for higher blending ratios with ultra-low sulphur petro diesel.

Glycerin production

Glycerin is a byproduct of biodiesel production. The use of sodium and chloride during synthesis of biodiesel leads to superior glycerin quality which can be processed with minimum losses and avoids fouling and other problems during downstream processing of glycerin. Our technologies allow for further refining and production of pharmaceutical-grade products. This also includes use of salt removal centrifuge or wiped-film evaporation systems to obtain a nearly dry pitch and the residue is easily collected and disposed.
Efficiency

Our biodiesel plant technology consumes little energy and a minimum of utilities, chemicals and catalyst compared to that of a prime biodiesel product. Per one (1) metric ton of biodiesel produced, the following specific consumption are required:

- Steam: 300 kg (approximately)
- Cooling water: 25 m³ (approximately)
- Catalyst (as 100% Na-methylate): 5 kg
- Electricity: 12 kWh
- Methanol: 96 kg (depending on feedstock)

Yields

One (1) metric ton of dried, degummed and de-acidified oil feedstock yields:

- Biodiesel: 1 metric ton
- Crude glycerin: 125 kg (approximately) as crude glycerin (80-85%) as by-product. Alternatively crude glycerin can be processed further to pharma grade glycerin distillate.
Evolving with you

Continually stepping up our game

Air Liquide Engineering & Construction, through its innovative biodiesel technology, provides customers with a range of plant options designed to maximize efficiency, improve the quality of the product and help to minimize operating costs.

All of the components of our plants are manufactured to the highest standards and are backed by the reliability of a firm with over a century of experience behind it.

Research and development

We invest significantly in R&D, which means we are at the forefront of our industry, proactively shaping the biodiesel sector. Our highly skilled employees, located around the world, contribute a wealth of knowledge to each project, ensuring you benefit from the right technology choices, experience and expertise, seamless project implementation.

You help make us smarter

Since acquiring Lurgi technologies in 2007, Air Liquide Engineering & Construction continues to build on the knowledge we gain from our customers. We rely on the operational experience of our customers to guide us in our innovation. They help us find solutions through the research and development that we and the entire Air Liquide Group undertake.

The great strides we made in over a quarter century of Biodiesel technology, notably in our counter-flow extraction processes, arose from our customers’ needs for high purity and greater efficiency.
Execution capabilities

Thanks to our network of engineering and manufacturing centers, Air Liquide Engineering & Construction is able to offer effective project management, procurement and execution close to customers and vendors.

One of our key engineering centers specializing in Biodiesel is headquartered in Kuala Lumpur, Malaysia. JJ-Lurgi Engineering is a joint venture between Air Liquide Engineering & Construction and Jebsen & Jessen. JJ-Lurgi boasts over 25 years in designing, engineering and constructing biodiesel plants for customers worldwide and serving a rapidly growing Asia/Pacific market.

More than 75 biodiesel plants have been delivered, ranging from smaller plants to most modern and largest recent delivery. Customers turn to us because they know that they can rely on our multidisciplinary project teams, all of whom have direct knowledge of the markets they serve. We deliver competitive biodiesel solutions that are reliable, safe and extremely efficient.
Air Liquide Engineering & Construction, through its portfolio of technologies, offers the most comprehensive state-of-the-art biodiesel production technology. Our plants are reliable, easy to operate and produce superior biodiesel fuels.
Vitry
Champigny
Frankfurt
Krakow
Kiev
Moscow
Singapor
Kuala Lumpur
Beijing
Hangzhou
Shanghai
Kobe
Seoul
Calgary
Montreal
Houston
Johannesburg
Ras Al Khaimah
Abu Dhabi
Dubai
New Delhi
Engineering Centers and front-end offices
Manufacturing centers
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