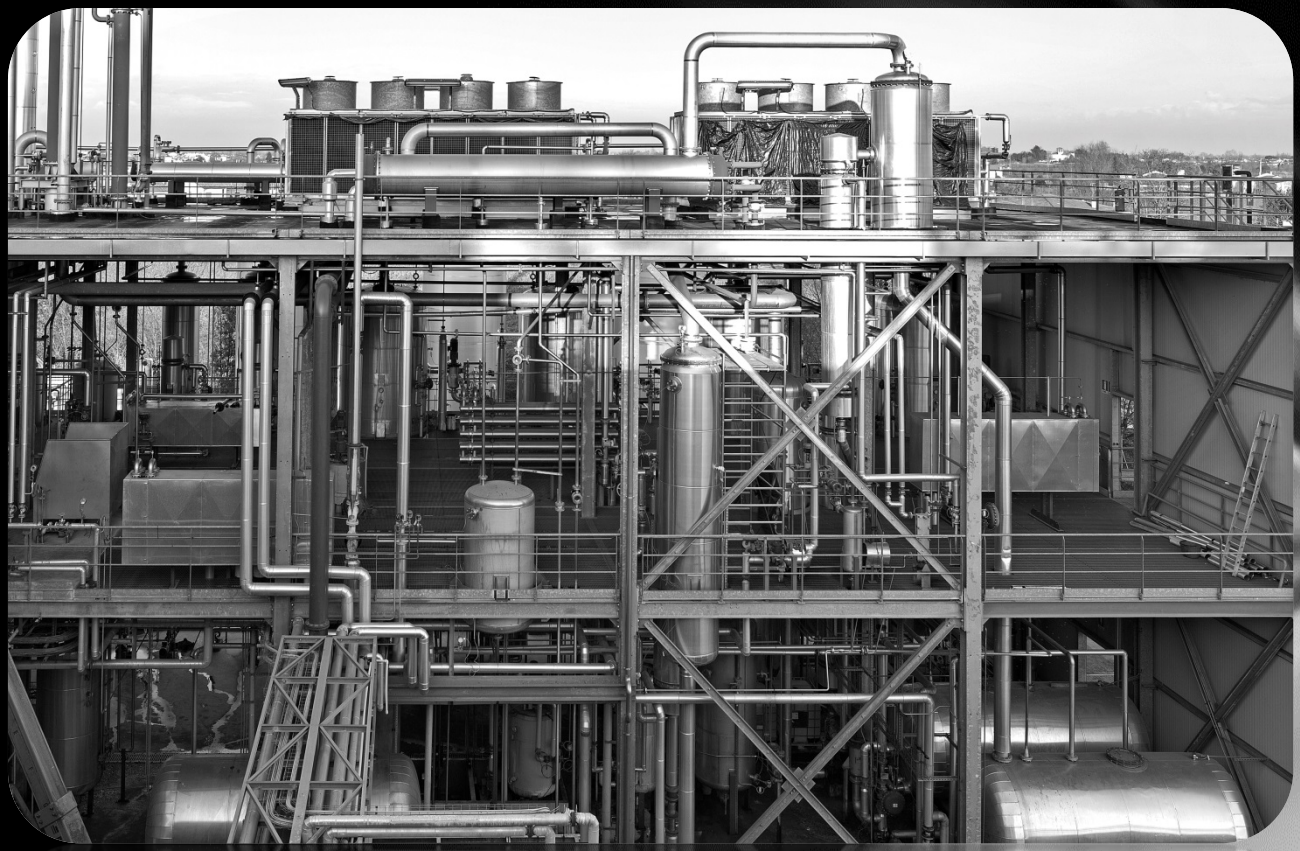

Biodiesel Plants

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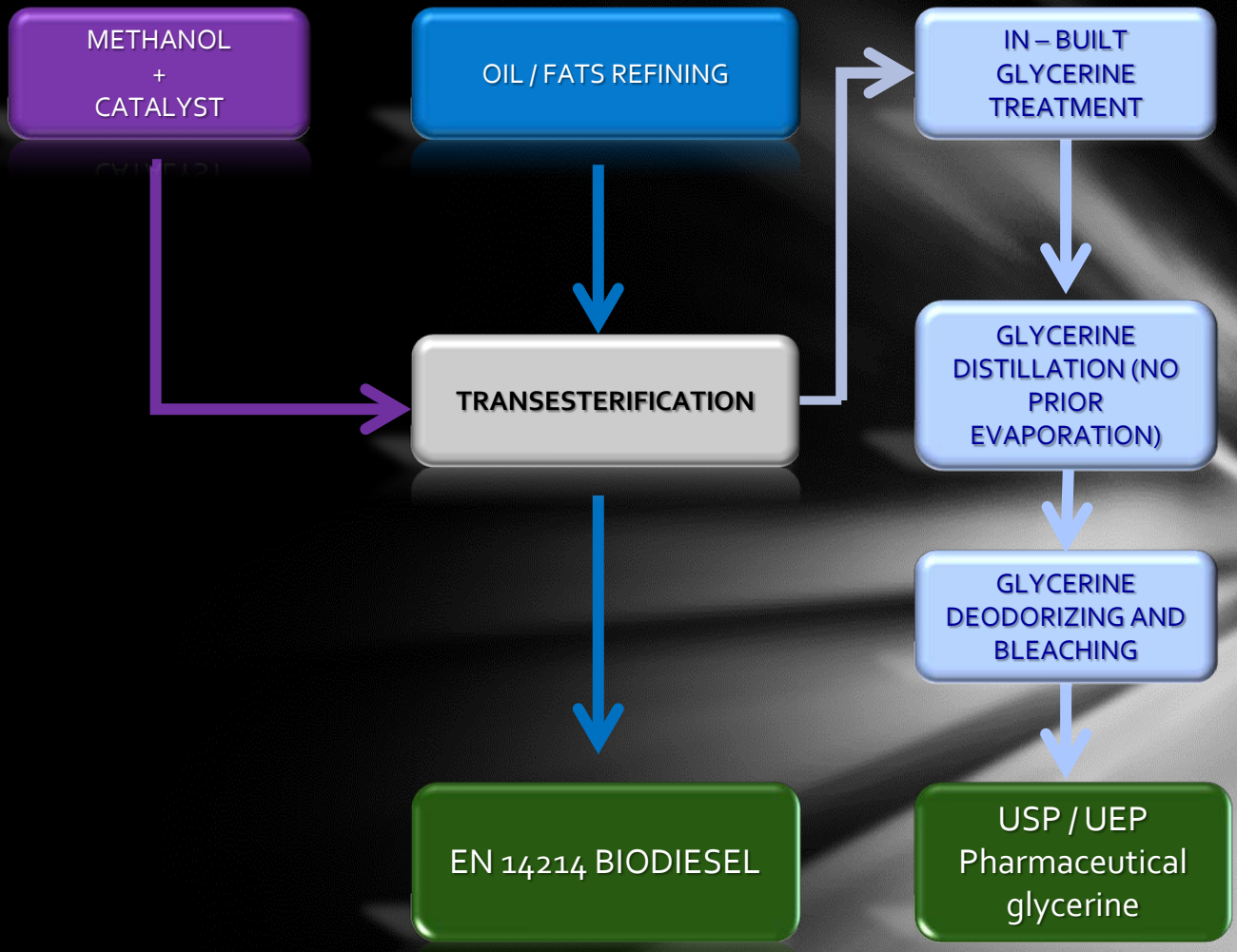
WHAT'S BIODIESEL

Technically, biodiesel is a biofuel produced through a transesterification reaction, a process in which a vegetable oil or animal fat is reacted with excess of methyl alcohol in presence of an alkaline catalyst. The final product is composed of blend of methylester which can be used as a fuel for either automotive or heating purposes, either pure or blended with conventional diesel.

Biodiesel has been demonstrated to have significant environmental benefits in terms of decreased global warming impacts, reduced emissions, greater energy independence and a positive impact on agriculture.
The use of biodiesel results in a significant **reduction in CO2 emission (65%-90% less** than conventional diesel), particulate emission and other harmful emissions. Biodiesel is extremely low in sulphur, and has a high lubricity and fats biodegradability. These are all advantages which have been confirmed by various EC Commission programmes and tests of independent research institutes.
In specific cases, used vegetable oils can be recycled as feedstock for biodiesel production. This can reduce the loss of used oils in the environment and provides a competitive and CO2 advantageous way of transforming a waste into transport energy.
As such, an increased use of biodiesel in Europe represents an important step for the European Union to meet its emission reduction target as agreed under the Kyoto agreement. Additionally reducing pollutant emissions alleviates various human health problems.

WHY BIODIESEL

The above and other reasons have led the European Community to issue directives to the member states in order to increase the replacement stake of biofuel over synthetic fuels for transport to **10% by 2020.**



BRIEF PROCESS HIGHLIGHTS

Typically, the process for EN14214 Biodiesel production is obtained through the following technological steps:

- Oil drying section
- Reaction section
- Settling & evaporation section
- Biodiesel washing and drying section
- Glycerine treatment section

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Transesterification occurs continuously in peculiarly designed reactors, in the first section of which the actual reaction takes place, while in the subsequent settling glycerine is removed as soon as it forms, so as to speed up reaction itself and shift the equilibrium to the biodiesel phase.
Biodiesel is subsequently washed in a centrifugal separator specially designed for this purpose and subsequently dried, showing at this point a quality meeting EN 14214 standard.
Glycerine is sent to a treatment step with hydrocloridric acid, which produces a crude with an approx glycerol content of 85% which can be sent to distillation without any further treatment, making therefore away with the need of any dilution and re-evaporation step.
The excess methanol is recovered in our system mostly in anhydrous form, which allows our system to be equipped with a reduced methanol rectification section (just for the methanol coming from the glycerine final treatment section), therefore with quite lower steam consumptions.
The plant can be completed with a very peculiar esterification section, where either fatty acids from physical refining or acid oils from chemical refining can be converted into a suitable feedstock for the transesterification by using part of the glycerine produced by the plant.

BRIEF PROCESS HIGHLIGHTS

The plant has been designed with a particular attention to its environmental impact and gives therefore gaseous effluents in an amount remarkably lower than what allowed by even the strictest standard and liquid effluents in very limited amount (about 10kg of liquid effluents per ton of product) and with very low COD values.
Moreover, final monoglyceride content is as low as 0,6 % (vs 0,8% as indicated by EN 14214) in standard plant configuration. The addition of special dedicated section brings this value further down to 0,3%.

MULTI-FEEDSTOCK

The plant is a multi-feedstock one , i.e it can accept any kind of previously degummed and deacidified vegetable oils or animal fats (it must be considered that some feedstock parameters, like for example I.V. and CFPP, are not modified by process, so the achievement of the EN 14214 standard is obviously also depending on the characteristics of feedstock itself, meant as pure product or blend). Typically required feedstock parameters are:

FFA %	0,1 max
Phosphatides	10 ppm max
Moisture	0,5% max
Unsaponifiable	1,0% max
Impurities	0,01% max

ANDREOTTI IMPIANTI'S BIODIESEL EXPERIENCE

Taking advantage of a five-decade experience in the field of oils and fats processing, Andreotti Impianti supplied its first biodiesel production complex in Germany in 1998.
Many other such plants have been sold over the years, allowing our Company to be among the major actors in this professionally highly demanding and competitive sector. For specific references, please contact us.

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CONSUMPTION VALUES

Some specific consumption values depend on the characteristic (MW etc.) of the inlet feedstock.
Typically, if one considers degummed and deacidified rapeseed oil, consumptions per ton of feedstock are:

Steam at 10 Barg	250 kg
Cooling water (in rcirculation on the cooling tower)	25 m³
Power	10 Kw
Methanol *	100 kg
Sodium Methylate **	3 – 4 kg
Catalyst destroyer	0,5 – 1 kg
Compressed air	1 Nm³
Hydrocloric acid	1,0 kg
Caustic soda	0,3 kg

PRODUCTS AND YIELDS

Typically 1 kg of fat or oil will result in 1 kg of biodiesel. Transesterification will also produce about 12% of crude glycerine to BS/USP/EUPH standards at an average glycerol content of 85%, which can be sent to distillation without any further treatment (see the specific brochure “Glycerine Plants”).

*(incl. methanol present in Sodium methylate solution)
** (as 100% methylate)

- Multi-feedstock plant, fully continuous
- Production of EN 14214 biodiesel without need of any further distillation
- Ease of operation thanks to completely automated control
- Mild temperature and pressure operating conditions
- Single stage washing
- Low steam consumption due to high recovery rate of anhydrous methanol not needing rectification
- Highest environment compatibility thanks to extremely reduced effluent emissions
- Lower catalyst consumption
- Low installation and operational costs
- Possibility of reconverting free fatty acids from physical refining or acid oils from chemical refining into transesterification feedstock
- High grade crude glycerine production for further distillation
- Final monoglyceride content far lower than prescribed by standard

ANDREOTTI IMPIANTI'S BIODIESEL TECHNOLOGY HIGHLIGHTS

Characteristics	Unit	Values		Test method
		Min	Max	
Esters content	% (m/m)	96.5		EN 14103
Density at 15°C	kg/m³	860	900	EN ISO 3675 / 12185
Viscosity at 40°C	mm²/s	3.50	5.00	EN ISO 3104
Flash point (based on Soy, Rapeseed)	°C	≥101		prEN ISO 3679
Sulphur	mg/kg		10.0	prEN ISO 20846 / 20884
Carbon residue	% (m/m)		0.30	EN ISO 10370
Cetane number		51.0		EN ISO 5165
Ash content (sulfate ash)	% (m/m)		0.02	ISO 3987
Water content	mg/kg		500	EN ISO 12937
Total contamination	mg/kg		24	EN 12662
Corrosion on copper	Class 1 (3 hours ar 50° C)			EN ISO 2160
Oxydation stability, 110 °C	hours	6.0		EN 14112
Acid Value	mg KOH/g		0.5	EN 14104
Iodine Value	gr I2/100 gr		120	EN 14111
Linolenic acid methylester	% (m/m)		12.0	EN 14103
Poliunsaturate fatty acids methylesters	% (m/m)		1	
Methanol	% (m/m)		0.20	EN 14110
Monoglycerides	% (m/m)		0.80	EN 14105
Diglycerides	% (m/m)		0.20	EN 14105
Triglycerides	% (m/m)		0.20	EN 14105
Free glycerol	% (m/m)		0.02	EN 14105 / EN 14106
Total glycerol	% (m/m)		0.25	EN 14105
Group I metals (Na+K)	mg/kg		5.0	EN 14108 / EN 14109
Group II metals (Ca+Mg)	mg/kg		5.0	EN 14538
Phosphorous content	mg/kg		4.0	EN 14107

EN 14214 STANDARDS AND TEST METHODS FOR AUTOMOTIVE BIODIESEL

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