

FAME

Lab Scale

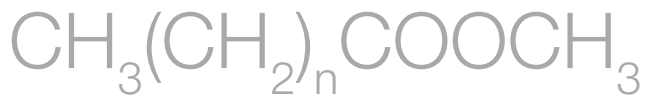
Bench Scale

Pilot Plant

Demonstration

Production

FAME, Fatty Acid Methyl Esters



Fatty acid methyl ester, FAME, is a nontoxic, biodegradable biodiesel that can be produced from a wide array of vegetable oils and fats. It is used both as a blending component in fossil diesel and as a pure fuel. It is then called B100 (see separate fact sheet). FAME, together with Bioethanol, is the leading renewable liquid fuels on a global basis. In Sweden, FAME is the second largest renewable liquid fuel on the market. All FAME on the Swedish market is based on rapeseed methyl ester (RME) to comply with climate related requirements.

Primary area of use

Fatty acid methyl ester, FAME, generally goes under the name biodiesel and is used as fuel in diesel engine vehicles. It is normally used as a blend-in component in fossil diesel to increase the renewable content of the fuel. The current European diesel standard allows up to 7% v/v of FAME in diesel fuel without any modifications in vehicles or the distribution system. FAME is fully miscible with fossil diesel and apart from increasing the renewable content,

it improves the lubricating properties. However, FAME is sensitive to cold climate and different grades are therefore sold depending on the climate zone of the distribution area. In Sweden, most grades allow operation down to -20°C.

FAME can also be used as a pure fuel, called B100 (see separate fact sheet). Pure FAME is nontoxic and biodegradable if spilled into nature. However, the biodegradable properties have a negative impact on the storage time, and pure FAME should therefore be consumed within six months to avoid problems with oxidation and polymerization. Vehicles that run on pure FAME must be approved for this by the vehicle manufacturer to ensure compatibility of materials and engine settings. Today, several trucks, busses and light transportation vehicles have been approved for the use of pure FAME. In Sweden the market for B100 has grown rapidly during the last years, but knowledge about the fuel has now quite spread to the rest of Europe.

Distribution system

FAME is a liquid fuel and does not require any modification to the distribution systems when blended into fossil diesel. Nearly all diesel distributed today at filling stations in Sweden contains roughly 5-7 % v/v FAME, depending to some extent on seasonal and geographical conditions.

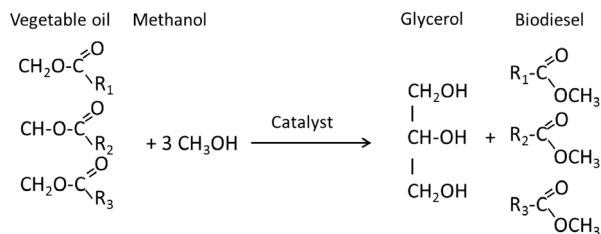
Properties

Chemical formula:	$\text{CH}_3(\text{CH}_2)_n\text{COOCH}_3$ (General formula of methyl esters)
Molecular mass:	RME: 296g/mol (Oleic acid C18:1)
Density at 15°C 1,013 bar:	860-900 kg/m ³
Heating value:	RME: 38 MJ/kg
Cetane number	> 51

Feedstock and production

FAME can be produced from a wide array of oils and fats. The most common feedstock in Europe is rapeseed and sunflower oil. In the US soybean, corn or rapeseed oil are most common, while palm oil is used in Asia. Generally, FAME can be produced from any fatty acid source, meaning that algae, jatropha, animal fats and other waste oils can be used. However, the fatty acid composition of the feedstock determines the properties of the final product. Generally, unsaturated and polyunsaturated fatty acids have low melting points. On the other hand, too much polyunsaturated fatty acids increase the oxidation tendency and hence shortens the storage time of the fuel. Therefore, climate zone, required filterability, etc. must be considered in the choice of feedstock or feedstock mix.

FAME is produced through transesterification of fatty acids and methanol. Oil and fat consist of triglycerides that separate to form FAME and glycerin in a transesterification process by replacing the glycerol-backbone in the triglyceride with an alcohol, typically methanol, under the action of a catalyst (i.e. sodium hydroxide). The triglycerides and methanol then form straight-chain methyl esters that are separated and purified in several steps to meet the fuel specification. The methanol used in the production is typically of fossil origin, but it can also be produced from renewable raw materials. Glycerol is a byproduct from the biodiesel process and depending on its purity, it is sold in different market segments.



The transesterification reaction for producing FAME from vegetable oil.

Current production and use as fuel

The consumed FAME in Sweden during 2015 was 425 000 m³, representing to 31% of the liquid renewable fuels on the market (HVO, FAME and bioethanol). Out of this, 247 000 m³ was sold as low blends and 178 000 m³ was sold as pure FAME, B100. To fulfil the demand of the Swedish market, about 70% of the FAME was imported, mainly from Europe.

The European Union, EU (28), is the largest producer of FAME globally with a production of roughly 12 700 000 m³ in 2014. Germany, France, The Netherlands and Spain are the main producers. EU is followed by US, which had a production of 8 000 000 m³ in 2015. South America produced about 6 900 000 m³ and Asia Pacific (APAC) roughly 5 400 000 m³ in 2014.

In Sweden there are two main production sites of RME, the basis for FAME; Perstorp in Stenungsund, producing roughly 150 000 m³ RME per year and Ecobrånslé in Karlshamn with a production capacity of almost 40 000 m³ RME per year. There are also many small Swedish production sites, for example Tolefors Gård in Östergötland that produces roughly 400 m³ RME per year from used cooking oil.

FAME/biodiesel projects

Unclear political steering systems, land usage discussions and removal of tax incentives in Sweden have raised many concerns for the FAME industry the past years. Nonetheless, the global development of biodiesel continues, and new production plants are being built. Despite the uncertain political situation in EU, several European countries want to increase biodiesel use even more and in August 2015 a new European Standard, EN 16709, was approved, allowing B20 and B30 blends in fossil diesel (14-20 % v/v or 24-30 % v/v FAME in diesel fuel) for designated vehicles. However, this is not applicable in Sweden today; as the Swedish law for transportation fuels (Drivmedelslag 2011:319) does not allow marketing of diesel fuels containing more than 7 % v/v of FAME.