

## B100 (Biodiesel)

Lab Scale

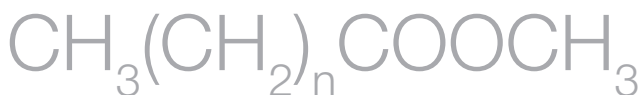
Bench Scale

Pilot Plant

Demonstration

Production

## B100 (Biodiesel)



B100 is a diesel fuel consisting of 100% fatty acid methyl esters (FAME). It is a nontoxic, biodegradable fuel that can be produced from a wide array of vegetable oils and fats. The choice of feedstock has impacts on the fuel quality. Since B100 is used as a pure fuel, it replaces use of fossil diesel with a more sustainable option. In Sweden, FAME – including B100 – is the second largest renewable fuel on the market. All B100 on the Swedish market is based on rapeseed methyl ester (RME) to apply with climate related requirements.

### Primary area of use

B100 is used as fuel in diesel engine vehicles in the transportation sector. Vehicles that run on B100 must be approved for this by the vehicle manufacturer to ensure compatibility of materials and engine settings. Today, several trucks, buses and light transportation vehicles have been approved for this service. In Sweden, the market for B100 has grown rapidly during the last years, but it is still a quite unknown fuel in the rest of Europe.

The European standard for biodiesel, EN 14 214, contains a climate table, regulating the fuels' cold properties. Different grades are therefore sold depending on the climate zone of the distribution area. In Sweden, most grades allow operation down to -20°C.

B100 is a nontoxic fuel that is biodegradable if spilled into nature. However, the biodegradable properties have a negative impact on the storage time. B100 should therefore be consumed within six months from the production date to avoid problems with oxidation and polymerization that could plug engine filters.

### Distribution system

B100 is a liquid fuel and has similar properties to fossil diesel, except that it is nonflammable. This results in fewer demands on the distribution system. Today, the distribution of B100 is primarily limited to direct deliveries to large customers with private filling stations. The number of public filling stations that add pumps for B100 fuel is however continuously increasing.

### Feedstock and production

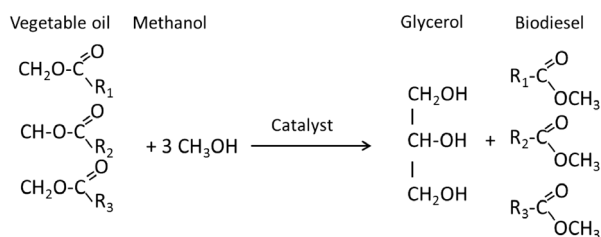
As pure FAME, B100 can be produced from a wide array of oils and fats. Due to the Nordic climate, rapeseed oil is used in Sweden. The balance between mono and polyunsaturated fats

## Properties

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

affects the fuel properties. Generally, unsaturated fatty acids have low melting points. In turn, a larger share of polyunsaturated fatty acids increases the oxidation tendency and hence shortens the storage time of the fuel. Therefore, climate zone and required filterability, etc., need to be considered when the feedstock or mix of feedstocks is chosen.

B100 is produced through transesterification of fatty acids and methanol. Oil and fat consist of triglycerides that are separated 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, which 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 into different market segments.



The transesterification reaction for producing B100 (FAME/Biodiesel) from a vegetable oil.

## Current production and use as fuel

The consumed FAME in Sweden during 2015 was 425 000 m<sup>3</sup>, which represented 31% of the liquid renewable fuels on the market (HVO, FAME and bioethanol). Out of this, 247 000 m<sup>3</sup> was sold as low blends and 178 000 m<sup>3</sup> was sold as B100. To fulfil the demand of the Swedish market, about 70% of the FAME was imported, mainly from Europe.

In Sweden there are two main production sites; Perstorp in Stenungsund, producing roughly 150 000 m<sup>3</sup> RME per year and Ecobrånslé in Karlshamn with a production capacity of almost 40 000 m<sup>3</sup> RME per year. There are also many small Swedish production sites, for example Tolefors Gård in Östergötland, which produces roughly 400 m<sup>3</sup> 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.

## Nomenclature

### Biodiesel

General term for diesel fuels containing bio-based components.

### FAME

(fatty acid methyl esters)

Biodiesel components produced from vegetable oils and fats via reaction with methanol.

### RME (rapeseed methyl ester)

Specific FAME biodiesel produced from rapeseed oil.

### HVO

(hydrogenated vegetable oils)

Biodiesel produced from vegetable oils (basically the same sources as FAME) but through hydrogenation reaction with H<sub>2</sub>. HVO is closer in chemical composition to fossil diesel and can be blended to higher extents without adapting engine configurations.

### B10/B20/B30/B100

Biodiesel containing 10, 20, 30 or 100 volume-% of bio-based diesel, the remaining fraction being fossil.