



What is biodiesel?

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Biodiesel is a renewable fuel produced from vegetable oils or animal fats. It is a non-petroleum based diesel fuel, made up of methyl or ethyl esters of fatty acids found in vegetable oils. Biodiesel has become a standardised term referring exclusively to mono alkyl esters. There are other diesel-grade fuels of biological origin, but they are biofuels and not included in the term biodiesel¹.

The diesel engine

The diesel engine was first made by Dr Rudolph Diesel². He was trying to make an engine that was more efficient than the coal-burning steam-engines that were used at the time. He filed a patent in 1892, which was granted in 1893 in Germany (patent no. 677207). His first prototype, built in 1893, exploded. In 1897 his third effort was successful, and in 1900 the Otto Company of France demonstrated a Rudolph Diesel engine running on peanut oil at the World Fair in Paris. The engine was theoretically 65% more efficient than coal engines of the time, but in reality probably between 30–50% more efficient. By 1898 Dr Rudolph Diesel was a millionaire from franchise fees.

In the 1920s diesel engine manufacturers altered their engines to use the lower viscosity of petro-diesel (a fossil fuel) rather than vegetable oil (a biomass fuel)³. Petro-diesel is cheaper to produce than biofuels, so the biofuel industry waned. Side effects of burning fossil fuels are now recognised as an environmental concern, as is the realisation that fossil fuels are a finite commodity.

Properties of biodiesel

Biodiesel varies in colour from golden to dark brown. It has a high boiling point and low vapour pressure. The flash point of biodiesel is 130 °C, which is significantly higher than that of petro-diesel (64 °C) or gasoline (-45 °C). A higher flash point means that more energy is needed to make it burn. Biodiesel gels at low temperatures.

Key advantages of biodiesel

- Biodiesel can be used in normal diesel engines without modification, although new diesel engines incorporate design modifications to maximise performance with biodiesel.
- Biodiesel is actively used as a supplement to petro-diesel to improve its lubricating properties which are affected by removal of sulfur. Just a 2% addition of biodiesel to petro-diesel increases lubricity up to 50%.
- Biodiesel has been approved for up to 20% mix with petro-diesel as a world standard. However, any percentage mix up to 100% can be used, particularly with new, modified engines.
- Biodiesel has virtually no sulfur, reduces hydrocarbon emissions, carbon monoxide, NO_x and ozone formation.
- Biodiesel reduces particulate discharge from engines at any concentration. Particulates from petro-diesel cause lung problems such as asthma.
- Biodiesel is a renewable fuel that can be derived from any source of fatty acids, including animal fats, using a refining and production process. The final fuel produced must meet the American society of testing materials standards to be called biodiesel.
- Biodiesel can be made from domestically produced, renewable oilseed crops such as soybeans, canola, cotton seed, mustard seed and palm.
- Some waste products, such as chicken fat, can be recycled and processed into biodiesel.
- When added as a mixture to petro-diesel, biodiesel can help to dissolve engine sediments.
- It's sometimes claimed that biodiesel smells like popcorn or French fries when burnt.
- As petro-fuel prices rise, large-scale production of biodiesel becomes more economically viable.

Key disadvantages of biodiesel

- The calorific value of biodiesel is 33 MJ/L, which is 9% lower than petro-diesel.
- Biodiesel softens and degrades rubber and elastomers with time, affecting the fuel hose and fuel pump. Engines therefore need to be modified.
- Biodiesel can dissolve some paints with time.
- Biodiesel has poor cold-flow properties. This means that a diesel engine may require some modification to warm the fuel prior to starting, or that a dual-fuel car is produced, where petro-diesel is used initially to warm biodiesel.

Key disadvantages of biodiesel (continued)

- With higher blends of biodiesel, it is possible for fuel to get into engine oil causing sludge formation.
- Biodiesel has a shelf life of about six months. Some biological growth can occur.
- Unfeasibly large areas of land are required to produce sufficient biodiesel to replace fossil fuels. With current yields, an area twice the size of the United States would be required for soybean to replace America's fossil fuel usage.
- Biodiesel production requires fossil fuels at the moment.
- A switch to production of crops for biodiesel instead of food has several consequences. It pushes the price of food crops up⁴. Biodiesel farming practices have not been assessed for environmental impact. The UN Special Report on the right to food called for a five year moratorium on biofuels labeling it a 'crime against humanity' to convert food to fuel.⁵
- Summarising ten years work as UN Special Rapporteur on the right to food, Olivier De Schutter recommended:
'The international community should reach a consensus on agrofuels, based not only on the need to avoid the negative impact of the development of agrofuels on the international price of staple food commodities, but also on the need to ensure that the production of agrofuels respects the full range of human rights'.⁶
- Large tracts of South East Asian rainforests, particularly in Sumatra and Kalimantan, have been destroyed to make way for biofuel crops.

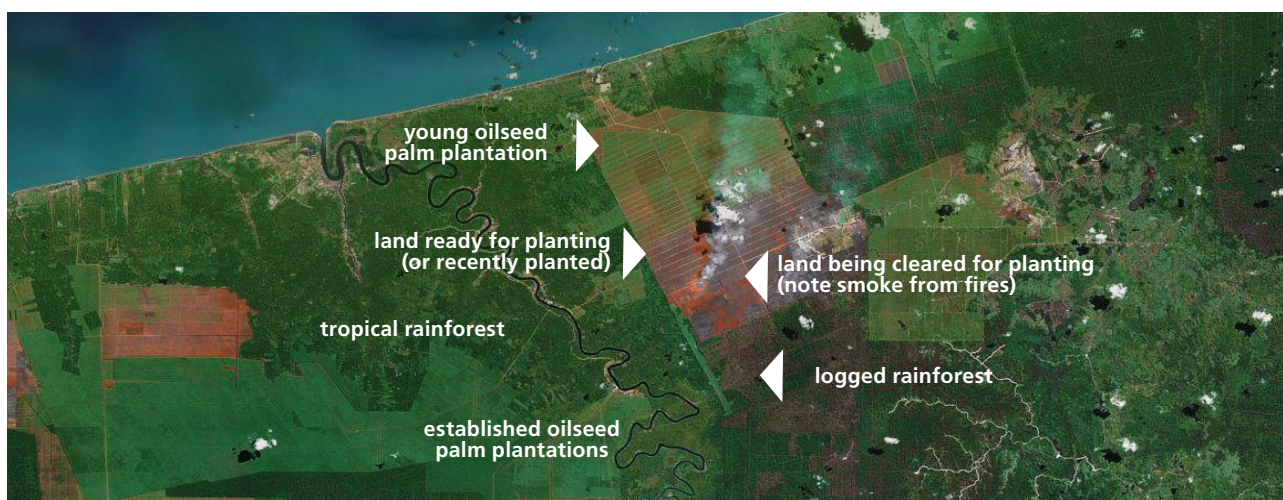


Image from Central Washington Biodiesel, used with permission.

This aerial image shows an area in Malaysia where tropical rainforest is being converted to palm oil plantations. The rainforest is the dark green area in the upper left. Established palm oil plantations are lighter green. New plantations are brown. Note the fires that are turning rainforest debris into carbon dioxide.

Where Australia goes from here

As at 1 December 2013, there were 7 biodiesel plants with a combined total installed capacity of about 360 ML. However only four of these plants are operating, producing about 115 ML of biodiesel from tallow and used cooking oil.⁷

References

- 1) National Biodiesel Board. (2008). *What is biodiesel?* Retrieved from <http://biodiesel.org/what-is-biodiesel/biodiesel-basics>
- 2) National Inventors Hall of Fame Foundation, Inc. (2002). *Rudolf Diesel*. Retrieved from <http://invent.org/inductee-detail/?IID=42>
- 3) Knothe, G. (2001). Historical perspectives on vegetable oil-based diesel fuels. *Inform*, 12, 1103–1107. Retrieved from <http://lipidlibrary.aocs.org/history/Diesel/file.pdf>
- 4) OECD. (2007). *Biofuels for Transport: Policies and Possibilities (OECD Policy Brief)*. Retrieved from <http://www.oecd.org/publications/technology-roadmap-biofuels-for-transport-9789264118461-en.htm>
- 5) Ziegler, J. (2007). *Interim report of the Special Rapporteur on the right to food (UN Special Report to the General Assembly A/62/289)*. Retrieved from <http://www.righttofood.org/wp-content/uploads/2012/09/A62289.pdf>
- 6) De Schutter, O. (2014). *The transformative potential of the right to food*. Final report to the United Nations General Assembly. Retrieved from http://www.srfood.org/images/stories/pdf/officialreports/20140310_finalreport_en.pdf
- 7) Biodiesel production facilities in Australia. (2013). Retrieved from <http://www.biofuelsassociation.com.au/biodiesel-production-facilities-in-australia>