

Fuelled by coffee

Biofuels: A novel form of biodiesel is derived from an unusual feedstock that is more commonly used to fuel mental activities: coffee.



Illustration by Pelle Mellor

Running a diesel engine on a plant-based fuel is hardly a new idea. One of the early demonstrations carried out by Rudolph Diesel, the German engineer who invented the engines at the end of the 19th century, operated on pure peanut oil. Diesel fuel made from crude oil eventually won the day because it was easier to use and cheaper to produce. But new forms of biodiesel are now starting to change the picture again. One of them is derived from the remains of a drink enjoyed the world over: coffee.

Biodiesels are becoming increasingly popular. In America, Minnesota has decreed that all diesel sold in the state must contain 2% biodiesel (much of it from the crops grown by the state's soya farmers). Biodiesel can also be found blended into the fuel used by public and commercial vehicles and by trains in a number of countries. Aircraft-engine makers are testing biofuel blends. As with other biofuels, the idea is that making fuel from plants, which absorb carbon dioxide as they grow, will produce fewer emissions than burning fossil fuels.

In the case of coffee, the biodiesel is made from the leftover grounds, which would otherwise be thrown away or used as compost. Narasimharao Kondamudi, Susanta Mohapatra and Manoranjan Misra of the University of Nevada at Reno have found that coffee grounds can yield 10-15% of biodiesel by weight relatively easily. And when burned in an engine the fuel does not have an offensive smell—just a whiff of coffee. (Some biodiesels made from used cooking-oil produce exhaust that smells like a fast-food joint.) And after the diesel has been extracted, the coffee grounds can still be used for compost.

The researchers' work began two years ago when Dr Misra, a heavy coffee drinker, left a cup unfinished and noticed the next day that the coffee was covered by a film of oil. Since he was investigating biofuels, he enlisted his colleagues to look at coffee's potential. The nearby Starbucks was happy to oblige by supplying grounds. The researchers found that coffee biodiesel is comparable to the best biodiesels on the market. But unlike biodiesels based on soya or other plants, it does not divert crops or land from food production into fuel production.

A further advantage is that unmodified oils from plants, like the peanut oil used by Diesel in the 19th century, have high viscosity and require engine alterations. Diesel derived from coffee is less thick and can usually be burned in an engine with little or no tinkering.

The diesel-extraction method for coffee grounds is similar to that used for other vegetable oils. It employs a process called transesterification, in which the grounds react with an alcohol in the presence of a catalyst. The coffee grounds are dried overnight and common chemical solvents, such as hexane, ether and dichloromethane, are added to dissolve the oils. The grounds are then filtered out and the solvents separated (to be reused with the next batch of coffee grounds). The remaining oil is treated with an alkali to remove free fatty acids (which form a soap). Then the crude biodiesel is heated to about 100°C to remove any water, and treated with methanol and a catalyst, so that transesterification takes place. When cooled to room temperature and left to stand, the biodiesel floats up, leaving a layer of glycerine at the bottom. These layers are separated and the biodiesel is cleaned to remove any residues.

Although some people make their own diesel at home from leftovers and recycled cooking oil, coffee-based biodiesel seems better suited to larger-scale processes. Dr Misra says that a litre of biodiesel requires 5-7kg of coffee grounds, depending on the oil content of the coffee in question. In their laboratory his team has set up a one-gallon-a-day production facility, which uses between 19kg and 26kg of coffee grounds. The biofuel should cost about \$1 per gallon to make in a medium-sized installation, the researchers estimate.

Commercial production could be carried out by a company that collected coffee grounds from big coffee-chains and cafeterias. There is plenty available: according to a report by the United States Department of Agriculture, more than 7m tonnes of coffee are consumed every year, which the researchers estimate could produce some 340m gallons of biodiesel. Time, perhaps, to pour another cup before refilling the car.

The Economist, New York, 5 mar. 2009, Technology Quarterly, online. Disponível em <www.economist.com>. Acesso em: 12 mar. 2009.