Practical – Preparation of Biodiesel

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Curriculum links:

AQA	Unit 4, in 3.4.5. Biodiesel is discussed in the context of esters.
Edexcel	Unit 4, in 4.8 there is some discussion the use of transesterification reactions in the preparation of biodieselj.
OCR A	Unit F322, in 2.4.2 there is mention of biofuels replacing fossil fuels. Also in F324, in 4.1.3 on esters.
OCR Salters	Unit F331, in the 'Developing fuels' module. Benefits and risks of biofuels are discussed here. Esters covered in F334 'What's in a medicine?' module, and fats cover in F335 'Colour by design' module.

Suggested use in the classroom:

Like the activity which involves the analysis of waste vegetable oil for its acid content, this activity allows a discussion of the chemistry of esters/carboxylic acid derivatives. It is important to give the students some context for this – there are numerous articles in the press about people making biodiesel from waste chip fat in their garden sheds, and there have been reports of waste oil being stolen because of it's value in the face of rising energy costs.

The activity as it is written involves the preparation of biodiesel from fresh vegetable oil, but it could be combined with the aforementioned analysis of waste vegetable oil as one activity which involves the preparation of biodiesel from waste oil.

The practical is very quick to set up and students can carry out the 10 minutes of shaking while you talk to them about the process or have some sort of class discussion.

There are a number of ways of testing the biodiesel. You could compare its calorific value with regular diesel (use low sulphur diesel) or paraffin. Another method for demonstrating the combustion of biodiesel can be found here:

http://tre.ngfl.gov.uk/uploads/materials/26855/Biodiesel_test.doc

It may also be useful to compare the viscosity of biodiesel with diesel and/or paraffin (as well as the vegetable oil you started from) to discuss ideas about the effects of using different fuels on the pumps and injector systems in the engine. Students could design their own investigation for this.

Notes on materials needed:

Vegetable oil	Rapeseed oil is commonly used for biodiesel preparation and is readily available from supermarkets
Potassium methoxide in methanol	This should be freshly prepared by dissolving 5g of potassium hydroxide in methanol and should be placed in a labelled, capped bottle. It can be dispensed using a pipette in a fume cupboard. Exposure to methanol is minimised as the students will place a bung in their tube.

Note: If your school/college won't allow the use of methanol, you can carry out the procedure using ethanol instead (forming potassium ethoxide), although the reaction is slower.

Safety information:

Students should wear safety glasses and aprons/labcoats. Use standard safety precautions when doing acid/base titrations. **Beware of students with rapeseed oil allergy!**

i. Methanol

Toxic by inhalation, ingestion or skin absorption. May be a reproductive hazard. Ingestion may be fatal. Risk of very serious, irreversible damage if swallowed. Exposure may cause eye, kidney, heart and liver damage. Chronic or substantial acute exposure may cause serious eye damage, including blindness. Irritant. Narcotic.

ii. Potassium methoxide

Stable. Reacts violently with water. Moisture sensitive. Absorbs carbon dioxide from the air. Incompatible with acids, strong oxidizing agents, acid chlorides, acid anhydrides, alkali metals.