

Investigating the Saponification of Fats and Oils

Background

Fats and oils are esters of triglycerols and fatty acids. Hydrolysis can break down a fat or oil and release the triglycerol and fatty acids. If the hydrolysis is carried out under alkaline conditions a soap can be made. The reaction is known as saponification. A saponification value can be found for individual fats and oils and it can be used to compare their relative molecular masses. It can also be used to compare the relative chain length of the fatty acids that make up the fat or oil.

Practical Techniques

You will need to find out about volumetric analysis (titrations) and how to make up accurate solutions. You also need to find out about reflux.

Where to start

The saponification value of the fat or oil is defined as the number of milligrams of potassium hydroxide that react with 1 gram of the oil or fat.

The oil or fat should be refluxed with potassium hydroxide. The unreacted potassium hydroxide should then be titrated against hydrochloric acid to determine the amount of unused potassium hydroxide. Therefore the amount of potassium hydroxide that has reacted with the fat or oil can be determined.

Possible Investigations

- Investigate the saponification of different fats and oils.
- Investigate the saponification value of milk fat – you need to find a way of isolating the fat from the milk
- Investigate the accuracy of this technique – how critical is the reflux time?
- Will the technique work with other alkalis?

Sources of Information

- Thorpe A., Making a standard solution, *Chemistry Review*, November 2002

- Selinger B., (1998), *Chemistry in the Marketplace*, Harcourt, Brace, Jovanovich, London
- Faust C.B., Jassal S.S., (1993) Lipids – a consumer's guide, *Education in Chemistry*, Vol 30,1
- Shipton M., *Fats and Oils*, Unilever Educational Booklet: Advanced Series,
- The Chemistry Video Consortium and The Royal Society of Chemistry (2000) *Practical Chemistry for Schools and Colleges* CD ROM
- Ferguson M., Volumetric Analysis. *Chemistry Review*, September 1996
- Lindsey D., Reflux and Distillation, *Chemistry Review*, November 1999
- Battye P., Titrations, *Chemistry Review*, February 2003
- Thorpe A., Assessing the risks in practical work, *Chemistry Review*, September 2000
- Thorpe A., Experimental error and error analysis: just how good are those results, *Chemistry Review*, November 2001

Teachers' Notes

General

The Unilever Fats and Oils Booklet is an excellent source for this investigation and has **full experimental details** for this experiment. Each experiment can take up to 1 hour.

Chemical Principles

Fats and oils, alkenes, esters, hydrolysis, quantitative chemistry

Essential Equipment

Burettes, pipettes, quickfit apparatus

Essential Chemicals

Potassium hydroxide, hydrochloric acid, phenolphthalein indicator

Safety

No risk assessment has been given. It is essential that students prepare a detailed risk assessment before they start. Teachers must be satisfied that this is suitable for the proposed investigation.

Experiment Starter Sheet – Investigating the saponification of fats and oils

A basic procedure is given below.

Prepare the following solutions

- 0.5 mol dm⁻³ potassium hydroxide (in ethanol)
- 0.5 mol dm⁻³ hydrochloric acid solution

You will need to think about how much of each solution to prepare. This will depend on how much of the solution is used in each experiment and how many experiments you do (including any repeats).

Weigh out about 2 grams of the fat or oil in a dry container. Add 25cm³, using a pipette, of the potassium hydroxide solution and a few anti-bumping granules. Then reflux the solution for about 30 minutes. Allow to cool. Titrate the contents with the hydrochloric acid solution using phenolphthalein indicator to determine the end point.

You can also carry out a blank titration (without the fat or oil). This will enable you to obtain an accurate figure for the amount of potassium hydroxide added to the fat or oil.