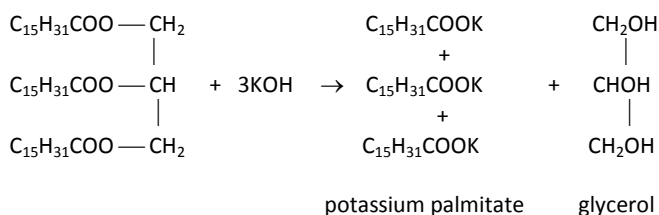


Preparation of soap

Theory

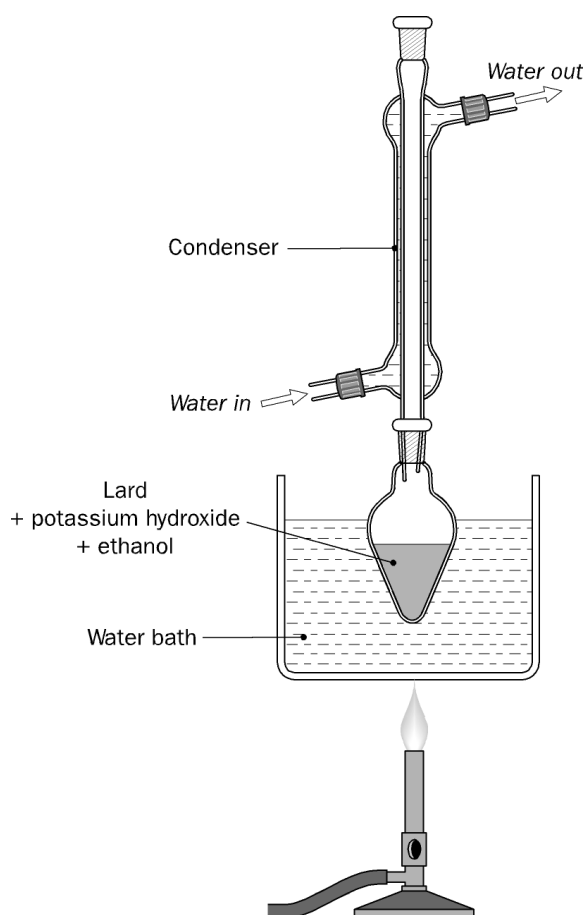
Animal fats and vegetable oils are esters of long-chain carboxylic acids and the alcohol propane-1,2,3-triol (glycerol). Hydrolysis of these substances under alkaline conditions produces glycerol, and the salt of the acid present, i.e. soap. For example, if the animal fat contains esters of palmitic acid, the reaction is as follows:



Potassium palmitate is the soap formed in this particular case. The fact that soap is a long-chain hydrocarbon with an ionic group at the end means that soap has both polar and non-polar properties, which gives it its cleansing action.

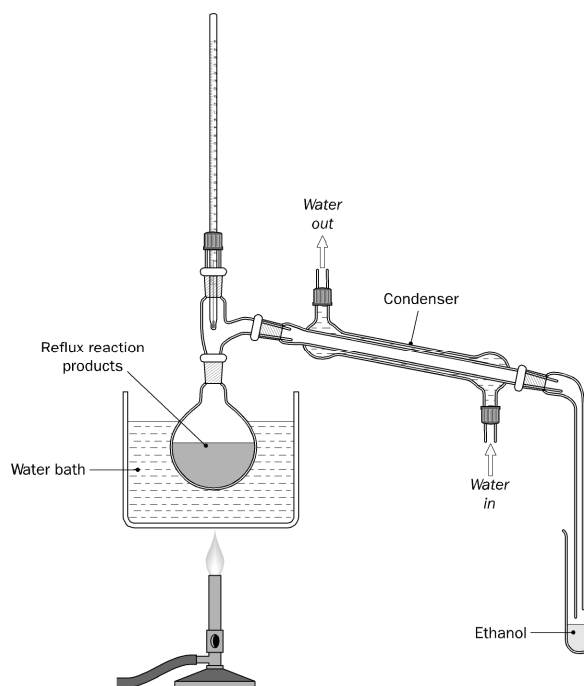
Procedure

NB: Wear your safety glasses.



Add 2.5 g of lard, 2.5 g of potassium hydroxide and 20 cm³ ethanol, along with a few anti-bumping granules, to the flask. Swirl to allow proper mixing. Set up the reflux apparatus, making sure to grease all joints. Reflux the mixture for 20 minutes, using a water bath.

Remove the ethanol by distillation. Dissolve the residue in a minimum of hot water (approximately 15 cm³). Add this solution to the brine. The soap should precipitate out. Filter the soap. Test the soap for its lathering qualities by shaking a small sample of it with water. It is important to wash your hands afterwards to remove any potassium hydroxide still present.



Suggested Solutions to student questions

How do you explain the cleansing action of soap?

The ionic part of the soap molecule is water-soluble while the non-polar hydrocarbon part is soluble in oil and grease. Soap therefore allows otherwise insoluble substances such as oil or grease to become soluble in water.

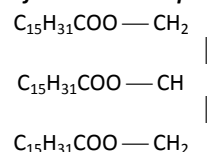
Why is a reflux apparatus used in this experiment?

To ensure that the hydrolysis of the fat is as complete as possible. If the mixture was boiled in an open vessel the ethanol would be lost from the mixture.

Name the compound CH₂(OH)CH(OH)CH₂(OH).

Propane-1,2,3-triol (Glycerol).

Draw the structure of a fat from which soap can be made.



Glycerol is a by-product of the reaction in which soap is made. This does not distil over with the ethanol after the reaction is complete, and remains dissolved in the hot water when added to brine to precipitate the soap. Explain why.

Glycerol (CH₂(OH)CH(OH)CH₂(OH)) has a much higher boiling point than either ethanol or water. With three hydroxyl groups per molecule, there is considerable hydrogen bonding between its molecules. There is also considerable hydrogen bonding between glycerol molecules and water molecules when glycerol is dissolved in water, and this accounts for glycerol remaining in solution when added to brine.