AQA Chemistry A-level

3.3.5: Alcohols

Detailed Notes

3.3.5.1 - Production of Alcohols

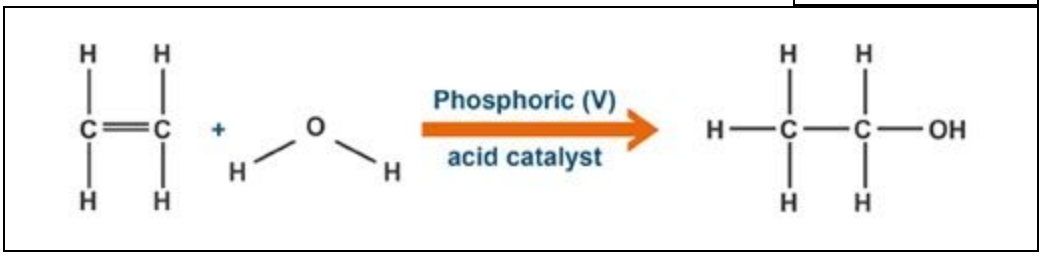
Alcohols contain an **-OH group** and follow the general formula **$C_nH_{2n+1}OH$**. They can be produced via two main methods.

Hydration

This method produces **alcohols from alkenes** in the presence of an **acid catalyst.** Phosphoric acid is commonly used as the catalyst under **aqueous conditions at 300°C** and high pressures.

Example:

Image courtesy of bbc.co.uk



This process has a **very high percentage yield** as ethanol is the only product. Therefore the hydration method is favoured as an industrial process.

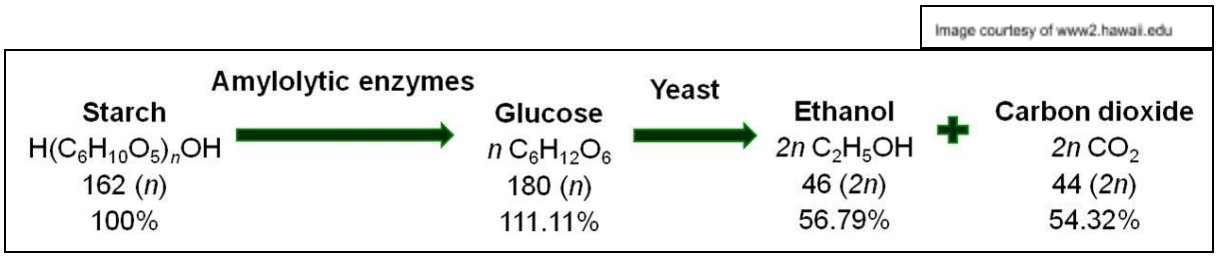
Fermentation

In this process, enzymes break down starch from crops into **sugars** which can then be **fermented to form alcohol**. This method is **cheaper** than hydration as it can be carried out at a lower temperature. However it has to be fermented in **batches**, meaning it is a much slower process with a **lower percentage yield**.

Ethanol is a common **biofuel** produced in this way. It is said to be **carbon neutral** as the carbon given out when it is burned is equal to the carbon taken in by the crops during the growing process.

Example:

Image courtesy of www2.hawaii.edu

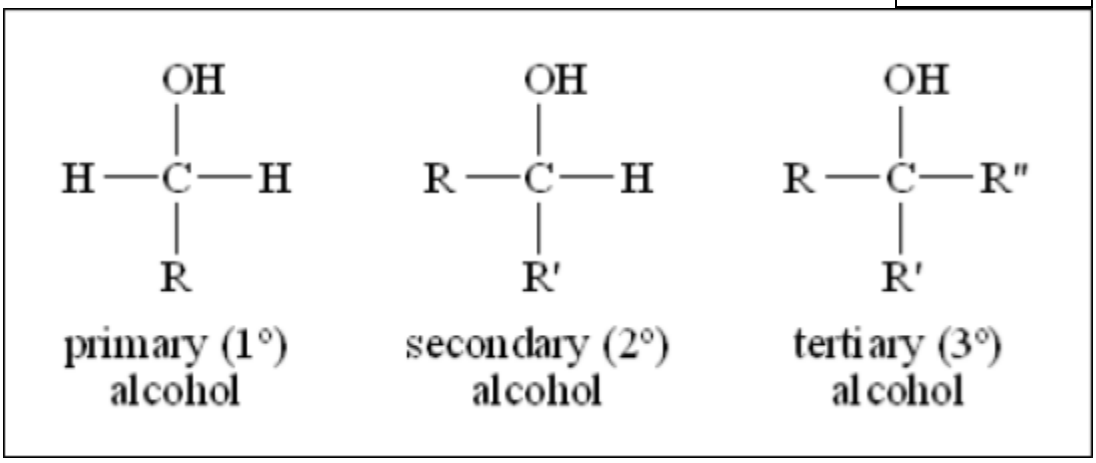


3.3.5.2 - Oxidation of Alcohols

Alcohols can be primary (1°), secondary (2°) or tertiary (3°). **1° and 2°** alcohols can be **oxidised** to produce various products but **3°** alcohols are **not easily oxidised**.

Example:

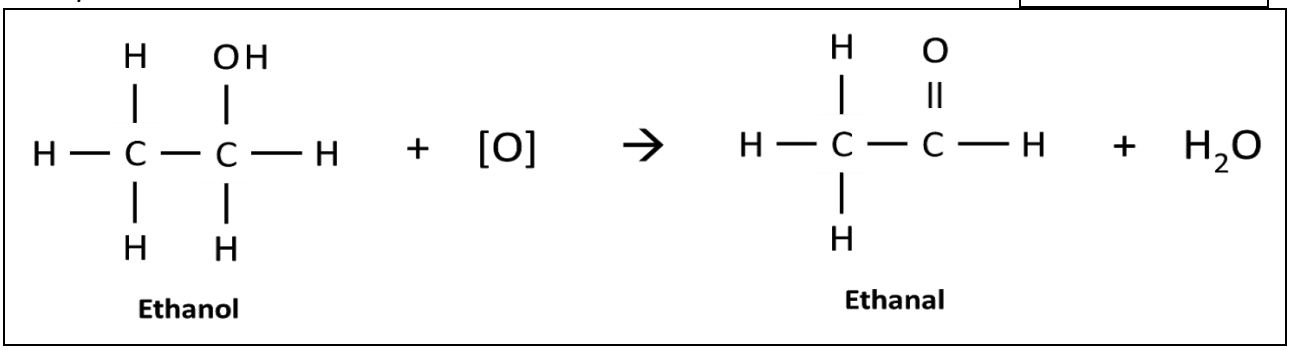
Image courtesy of Quora



1° alcohols can be heated in the presence of **acidified potassium dichromate** and distilled to produce **aldehydes**.

Example:

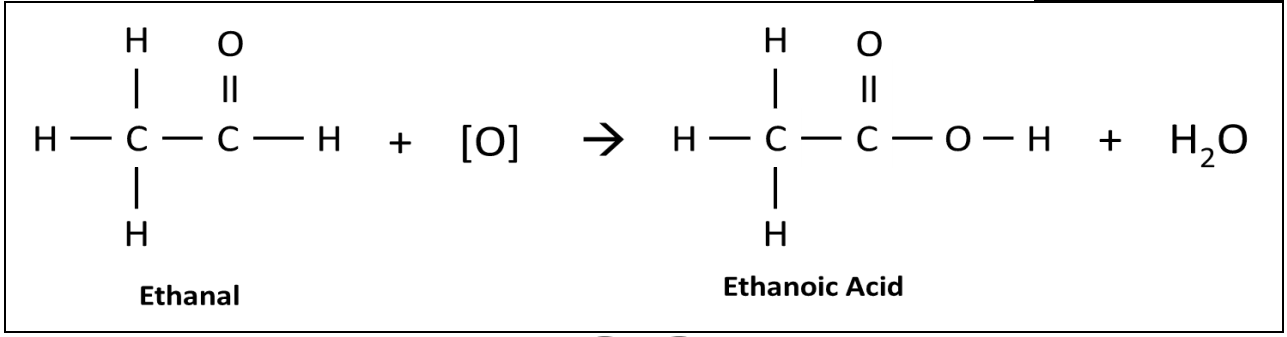
Image courtesy of anhourofchemaday



When heated further under **reflux** conditions, 1° alcohols **oxidise further** to produce **carboxylic acids**.

Example:

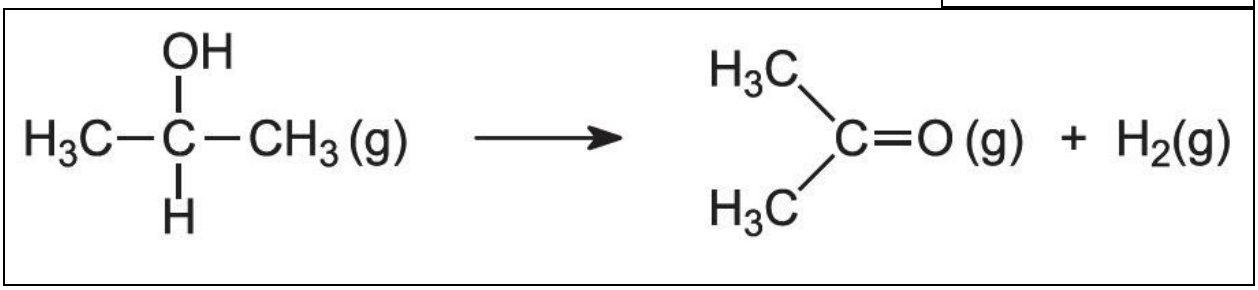
Image courtesy of anhourofchemaday



2° alcohols can be oxidised when heated in the presence of **acidified potassium dichromate** to produce **ketones**.

Example:

Image courtesy of essentialchemicalindustry.org

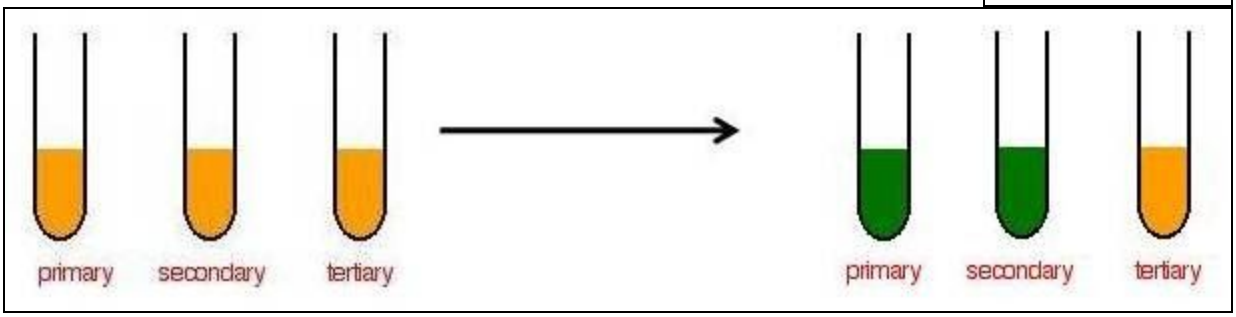


Potassium Dichromate ($K_2Cr_2O_7$)

This is used in the oxidation of alcohols as the **oxidising agent**. It is reduced as the alcohol is oxidised. This can be observed as a colour change from **orange to green** when the alcohol is oxidised.

Example:

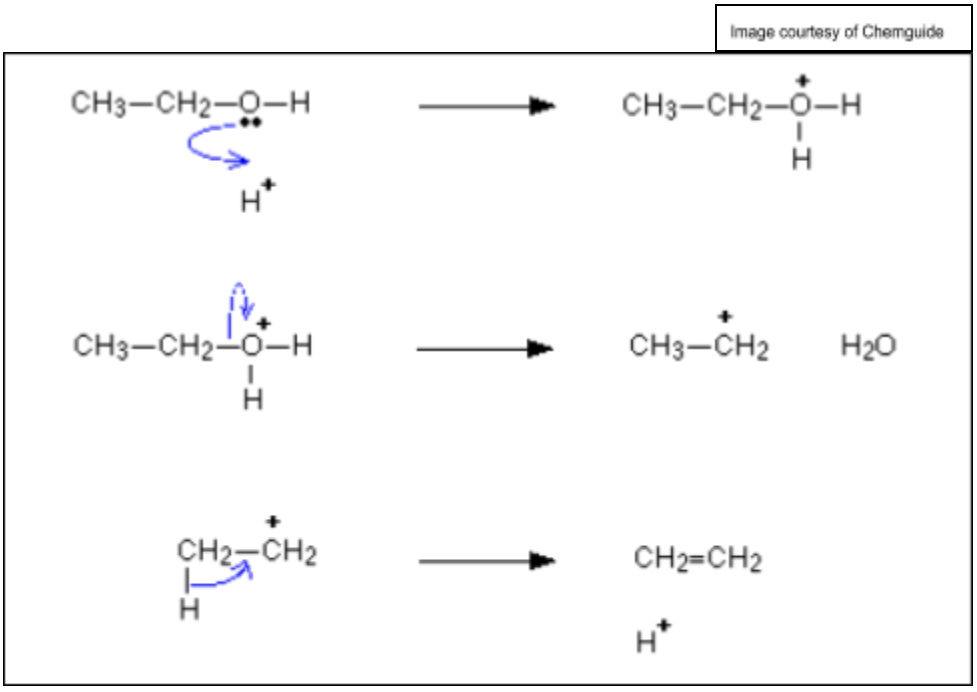
Image courtesy of chemhume.co.uk



3.3.5.3 - Elimination Reactions

Alkenes can be formed from the **dehydration of alcohols**, where a molecule of **water is removed** from the molecule. In order to do this **excess of hot sulfuric acid** is added and **aluminium oxide** is used as a catalyst.

Mechanism



The H^+ acidic ions are reformed in the reaction showing how they act as a catalyst.

This reaction means that **addition polymers can be produced from fermentation** without the need for crude oil, a **nonrenewable** resource. Fermentation produces the primary alcohol which is then dehydrated to produce an alkene used in the production of addition polymers.