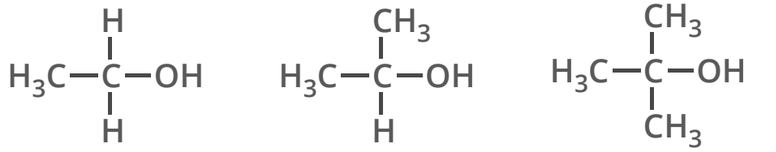
A GUIDE TO OXIDATION REACTIONS OF ALCOHOLS

Compounds containing the alcohol functional group (–OH) can be oxidised to produce carbonyl compounds. Here's how it happens.

THE REAGENTS



PRIMARY (1°) ALCOHOL

Carbon attached to –OH has one other carbon directly attached.

SECONDARY (2°) ALCOHOL

Carbon attached to –OH has two other carbons directly attached.

TERTIARY (3°) ALCOHOL

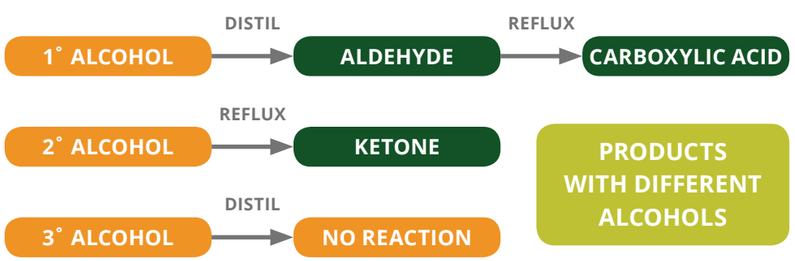
Carbon attached to –OH has three other carbons directly attached.

Alcohols can be oxidised to carbonyl compounds (containing a C=O bond) using an oxidising agent. Acidified dichromate (VI) salts can be used, though due to their toxicity alternative reagents can also be utilised, such as pyridinium chlorochromate (PCC).

$Na_2Cr_2O_7$ — **SODIUM DICHROMATE**

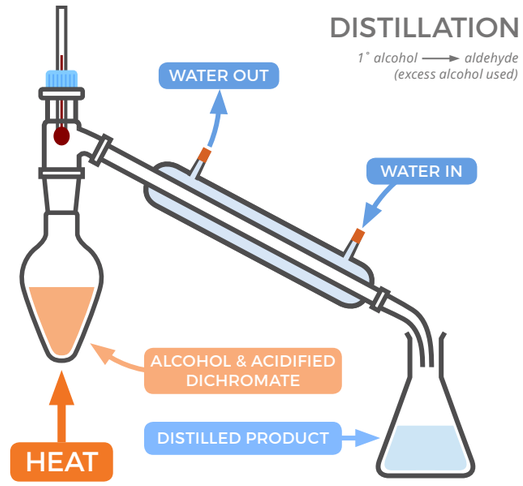
$K_2Cr_2O_7$ — **POTASSIUM DICHROMATE**

The type of compound obtained from the reaction depends on the starting alcohol (shown below). When an oxidation reaction is carried out with a dichromate salt, the dichromate ion ($Cr_2O_7^{2-}$) is reduced to the Cr^{3+} ion, giving a colour change from orange to dark green.

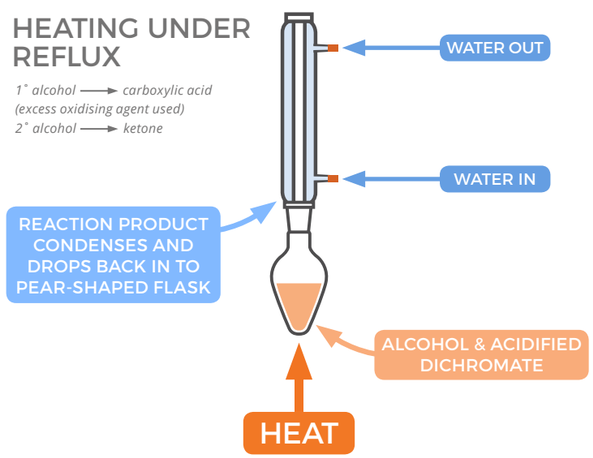


PRODUCTS WITH DIFFERENT ALCOHOLS

THE APPARATUS

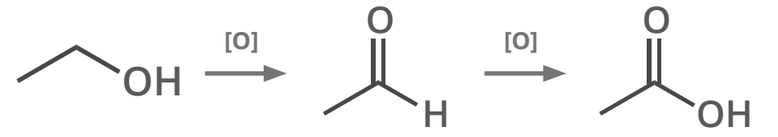


An aldehyde can be obtained from primary alcohols using distillation (above). Otherwise, heating under reflux (below) is used to make sure the alcohol is fully oxidised before distilling off the product.



TESTING FOR REACTION PRODUCTS

Oxidising agents can be represented simply in chemical equations as [O]. An example reaction is shown below.



Note: In step 1, water (H_2O) is lost as a side product of the reaction

$$3\ C_2H_5OH + 2\ Cr_2O_7^{2-} + 16\ H^+ \rightarrow 3\ CH_3COOH + 4\ Cr^{3+} + 11\ H_2O$$

DICHROMATE (ORANGE) — **CHROMIUM ION (GREEN)**

There are two different chemical reactions that can be used to identify the products of oxidation reactions.

FEHLING'S SOLUTION

Contains complexed Cu^{2+} ions. Aldehydes reduce these ions to red copper (I) oxide. Ketones don't react with Fehling's solution.

TOLLEN'S REAGENT

Contains the diamine silver ion, $[Ag(NH_3)_2]^+$. Aldehydes reduce this to metallic silver, forming a silver mirror on the glass surface.