The simplest large-scale procedure for reduction of aldehydes and ketones to alcohols is by catalytic hydrogenation:

\[
\begin{align*}
\text{C} &= \text{O} & \text{H}_2, 1000 \text{ psi} \quad \text{Ni, 50°} & \text{C} \quad \text{OH} \\
& 95–100\%
\end{align*}
\]

The advantage over most other kinds of reduction is that usually the product can be obtained simply by filtration from the catalyst, then distillation. The common catalysts are nickel, palladium, copper chromite, or platinum activated with ferrous ion. Hydrogenation of aldehyde and ketone carbonyl groups is much slower than of carbon-carbon double bonds so more strenuous conditions are required. This is not surprising, because hydrogenation of carbonyl groups is calculated to be less exothermic than that of carbon-carbon double bonds:

\[
\begin{align*}
\text{C} &= \text{C} + \text{H}_2 & \text{C} \quad \text{C} & \Delta H^0 = -30 \text{ kcal} \\
\text{C} &= \text{O} + \text{H}_2 & \text{C} \quad \text{OH} & \Delta H^0 = -12 \text{ kcal}
\end{align*}
\]

It follows that it is generally difficult to reduce a carbonyl group in the presence of a carbon-carbon double bond by hydrogenation without also saturating the double bond. Other reducing agents are more selective (Section 16-4E).

Contributors