The carboxylic acid is first converted into an ammonium salt which then produces an amide on heating. The ammonium salt is formed by adding solid ammonium carbonate to an excess of the acid. For example, ammonium ethanoate is made by adding ammonium carbonate to an excess of ethanoic acid.

\[ 2\text{CH}_3\text{COOH} + (\text{NH}_4)_2\text{CO}_3 \rightarrow 2\text{CH}_3\text{COONH}_4 + \text{H}_2\text{O} + \text{CO}_2 \]

When the reaction is complete, the mixture is heated and the ammonium salt dehydrates producing ethanamide.

\[ \text{CH}_3\text{COONH}_4 \rightarrow \text{CH}_3\text{CONH}_2 + \text{H}_2\text{O} \]

The excess of ethanoic acid is there to prevent dissociation of the ammonium salt before it dehydrates. Ammonium salts tend to split into ammonia and the parent acid on heating, recombining on cooling. If dissociation happened in this case, the ammonia would escape from the reaction mixture and be lost. You could not get any recombination. The dissociation is reversible:

\[ \text{CH}_3\text{COONH}_5 \text{(s)} \rightleftharpoons \text{CH}_3\text{COOH} \text{(l)} + \text{NH}_3 \text{(g)} \]

The presence of the excess ethanoic acid helps to prevent this from happening by moving the position of equilibrium to the left.

Some Practical Details

- The ammonium carbonate is added slowly to concentrated ethanoic acid and the reaction is left until all production of carbon dioxide stops.
- It is then heated under reflux for half an hour for the dehydration to take place.
- The mixture is distilled at about 170°C to remove excess ethanoic acid and water - leaving almost pure ethanamide in the flask.

Further purification stages are beyond the scope of this Modules

Activating agent

Carboxylic acid can be converted to amides by using DCC as an activating agent

Direct conversion of a carboxylic acid to an amide by reaction with an amine.
Contributors

- Jim Clark (Chemguide.co.uk)