This page gives you the facts and a simple, uncluttered mechanism for the nucleophilic addition / elimination reaction between acyl chlorides (acid chlorides) and amines.

- Ethanoyl chloride is taken as a typical acyl chloride. Any other acyl chloride will behave in the same way. Simply replace the CH$_3$ group in what follows by anything else you want.
- Similarly, ethylamine is taken as a typical amine. Any other amine will behave in the same way. Replacing the CH$_3$CH$_2$ group by any other hydrocarbon group won't affect the mechanism in any way.

### The reaction between ethanoyl chloride and ethylamine

Ethanoyl chloride reacts violently with a cold concentrated solution of ethylamine. A white solid product is formed which is a mixture of N-ethylethanamide (an N-substituted amide) and ethylammonium chloride.

\[
\text{CH}_3\text{C}\text{OCl} + \text{CH}_3\text{CH}_2\text{NH}_2 \rightarrow \text{CH}_3\text{C}\text{OCH}_2\text{CH}_3 + \text{CH}_3\text{CH}_2\text{NH}_3\text{Cl}
\]

Notice that, unlike the reactions between ethanoyl chloride and water or ethanol, hydrogen chloride isn't produced - at least, not in any quantity. Any hydrogen chloride formed would immediately react with excess ethylamine to give ethylammonium chloride.

\[
\text{CH}_3\text{CH}_2\text{NH}_2 + \text{HCl} \rightarrow \text{CH}_3\text{CH}_2\text{NH}_3\text{Cl}
\]

### The mechanism

The first stage (the addition stage of the reaction) involves a nucleophilic attack on the fairly positive carbon atom by the lone pair on the nitrogen atom in the ethylamine.

The second stage (the elimination stage) happens in two steps. In the first, the carbon-oxygen double bond reforms and a chloride ion is pushed off.

That is followed by removal of a hydrogen ion from the nitrogen. This might happen in one of two ways:

It might be removed by a chloride ion, producing HCl (which would immediately react with excess ethylamine to give ethylammonium
chloride as above) . . .

and

\[ \text{CH}_3\text{CH}_2\text{NH}_2 + \text{HCl} \rightarrow \text{CH}_3\text{CH}_2\text{NH}_3\text{Cl} \]

. . . or it might be removed directly by an ethylamine molecule.

The ethylammonium ion, together with the chloride ion already there, makes up the ethylammonium chloride formed in the reaction.

Contributors

Jim Clark (Chemguide.co.uk)