Preparation of Benzamide

Scheme:

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\begin{align*}
\text{Benzoyl Chloride} & \quad \text{(MW 140.57)} \\
& \quad \text{d 1.212 g/mL} \\
\text{NH}_3 & \quad \text{(from 30% NH}_4\text{OH)} \\
\text{Benzamide} & \quad \text{(MW 121.14)} \\
& \quad \text{lit mp 128-130 } ^\circ\text{C}
\end{align*}
\]

In carbonyl group, an oxygen atom is doubly bonded to a carbon atom. Since oxygen is more electronegative than carbon, it draws electron density towards itself. This results in the formation of a dipole with oxygen developing a partial negative charge and leaving carbon with a partial positive charge. As a result, the carbon atom in a carbonyl group is prone to attack by nucleophiles.

Chlorine is more electronegative than carbon as well and also withdraws electron density to itself. This additional dipole intensifies the partial positive charge on carbon making it even more prone to attack by nucleophiles, even weak ones (e.g., H\textsubscript{2}S).

Mechanism:

Step 1: Nucleophilic attack by NH\textsubscript{3} on carbonyl carbon affording tetrahedral intermediate (TI)

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\begin{align*}
\text{C-N bond forms} & \quad \text{C=O bond distorted} \\
\text{C=O bond reforms} & \quad \text{C-Cl bond broken}
\end{align*}
\]

Step 2: Regeneration of C=O, expulsion of Cl
Step 3: Proton Transfer to NH₃

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\text{procedure:}
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1. To 2 mL 30% NH₄OH and 1 mL benzoyl chloride
2. Mix and allow to stand 2 min
3. Add 4 mL H₂O and recrystallize
4. Take a melting point, determine percent yield on the basis of benzoyl chloride and take an IR scan; look for peaks due to N-H doublet bond stretching.
   a) ~ 3350 cm⁻¹ due to asymmetric bond stretching
   b) ~ 3170 cm⁻¹ due to symmetric bond stretching