Condensation Polymers

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Condensation Polymers

In condensation polymerisation there are usually two different monomers that add together and a small molecule is usually given off as a side product eg H_2O or HCl

The monomers usually have the same functional group on both ends of the molecule , di-amine, di carboxylic acid, diol

condensation polymers may be formed by reactions between dibasic acids and diols, between dicarboxylic acids and diamines and between amino acids.

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Polyesters

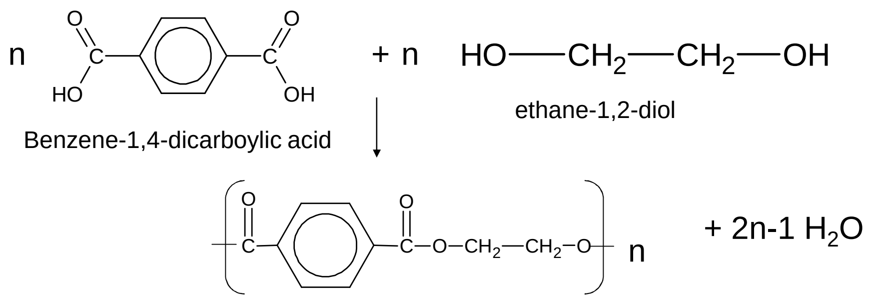
<u>Generally formed by</u>

Dicarboxylic acid + diol → polyester + water

or

Di acyl chloride + diol → polyester + HCl

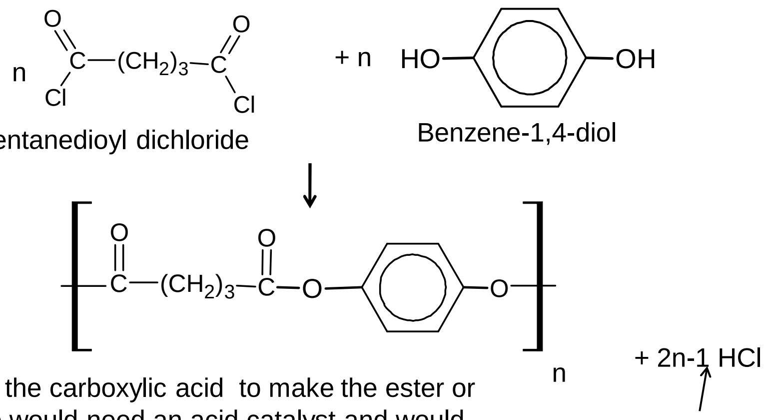
Terylene



Terylene fabric is used in clothing, tire cords

key

Polyester



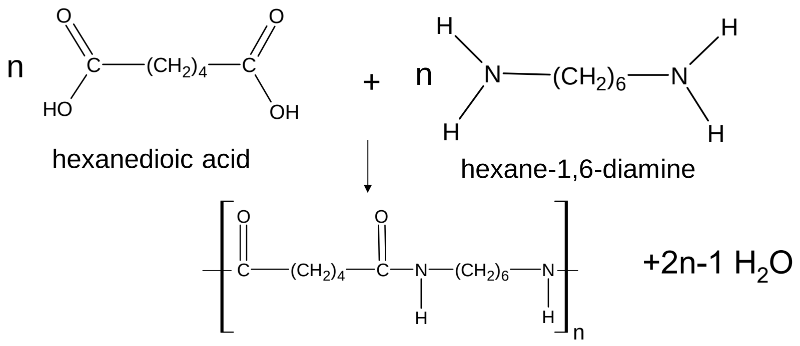
Using the carboxylic acid to make the ester or amide would need an acid catalyst and would only give an equilibrium mixture. The more reactive acyl chloride goes to completion and does not need a catalyst but does produce hazardous HCl fumes

The -1 here is because at each end of the chain the H and OH are still present

Polyamides

diamine + dicarboxylic acid → polyamide + water
diamine + di acyl chloride → polyamide + HCl

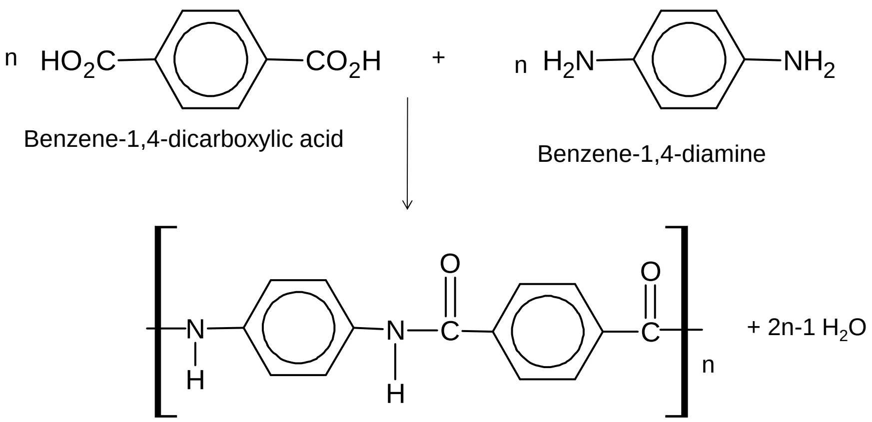
Nylon 66



The 6,6 stands for 6 carbons in each of the monomers. Different length Carbon chains produce different polyamides

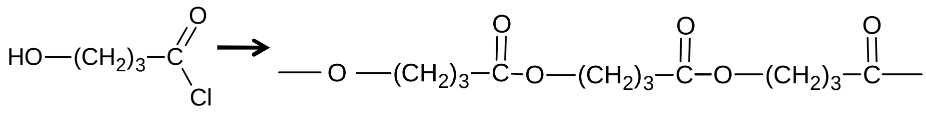
key

Kevlar

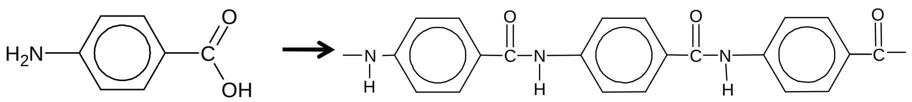


This polyamide can form sheet like structures where the polymer chains are held in place by hydrogen bonds. It is strong

It is also possible for polyamides and polyesters to form from **one** monomer, if that monomer contains both the functional groups needed to react



3 repeating units



3 repeating units

Hydrolysis of esters + poly(amides)

polyesters and polyamides can be broken down by hydrolysis and are, therefore, biodegradable

The reactivity can be explained by the presence of **polar bonds** which can attract attacking species such as nucleophiles and acids

•Polyesters can be hydrolysed by acid and alkali
•With HCl a polyester will be hydrolysed and split up in to the original di carboxylic acid and diol
•With NaOH an polyester will be hydrolysed and split up into the diol and dicarboxylic acid salt.

Polyamides can be hydrolysed by aqueous acids or alkalis.

- With HCl an polyamide will be hydrolysed and split up in to the original dicarboxylic acid and diamine salt
- With NaOH an polyamide will be hydrolysed and split up into the diamine and dicarboxylic acid salt.

key

Intermolecular bonding between condensation polymers chains

Polyesters have permanent dipole bonding between the $C^{\delta+}=O^{\delta-}$ groups in the different chains in addition to the van der waals forces between the chains.

Polyamides (and proteins) have hydrogen bonding between the oxygen in $C^{\delta+}=O^{\delta-}$ groups and the H in the $N^{\delta-}-H^{\delta+}$ groups in the different chains in addition to the van der waals forces.
Polyamides will therefore have higher melting points than polyesters.