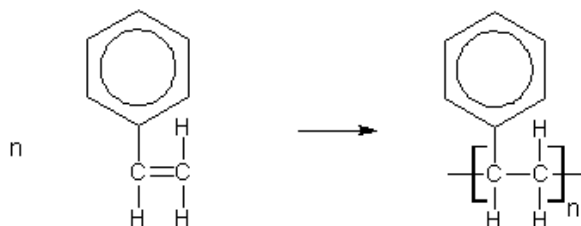


Topic 8 – Polymers Revision Notes

1) Addition polymers

- Monomer = small molecule that can be polymerised
- Polymer = long chain molecule formed by joining many monomers together (many means several thousand)
- The monomer is an alkene which has a π bond
- The π bond breaks and is used to join many monomers into a long chain
- The polymer has single bonds along its backbone
- Addition polymers are not biodegradable because their bonds are **non-polar**

Example – poly(phenylethene), commonly called polystyrene, whose monomer is phenylethene

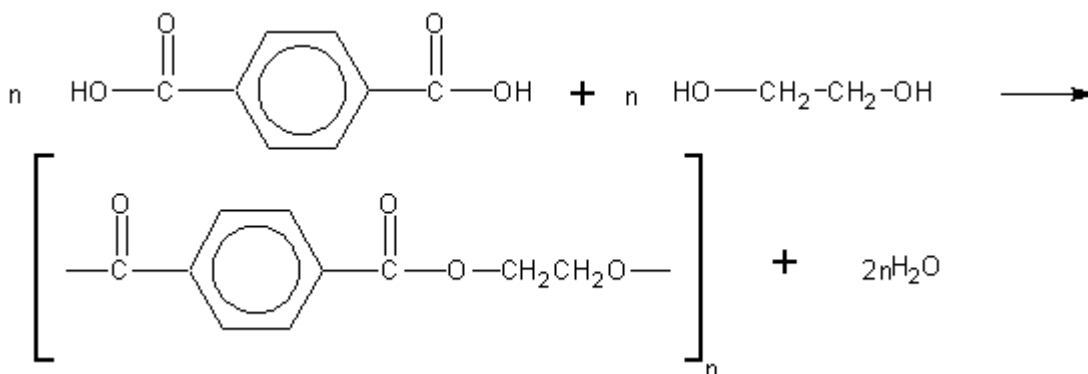


2) Condensation polymers

- The monomer has a functional group at each end
- The functional groups react to form a link; the reaction also produces a small molecule, such as water
- The ester/amide links in condensation polymers can be hydrolysed by heating with dilute acid or alkali. **This works because these links contain polar bonds**
- This means that condensation polymers are biodegradable

a) **Polyesters**

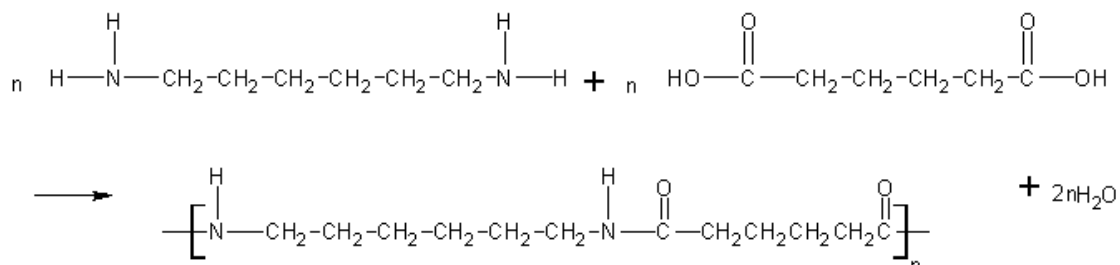
- The monomers are a di-carboxylic acid and a diol
- An ester link is formed between an acid group and an alcohol group with a water molecule eliminated
- **Example: Terylene** whose monomers are benzene-1,4-dicarboxylic acid and ethane-1,2-diol



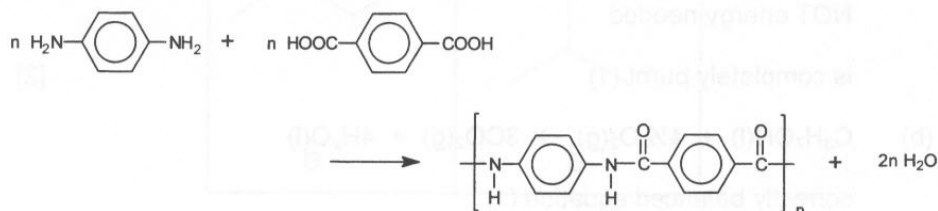
- Polyesters are used as fibres in clothing e.g. poly-cotton shirts

b) Polyamides

- The monomers are a di-carboxylic acid and a diamine
- An amide link is formed between an acid group and an amine group
- **Example 1: Nylon-6,6** whose monomers are hexanedioic acid and hexane-1,6-diamine



- **Example 2: Kevlar** whose monomers are benzene-1,4-dicarboxylic acid and benzene-1,4-diamine



- Polyamides are used as fibres in clothing e.g. Kevlar is used in bullet-proof vests and in extreme sports equipment

3) Going from polymer to monomer

- Identify the type of link. If there is no ester or amide link it's an addition polymer
- For a polyester, put in the -OH's on the acid groups and the H's on the alcohol groups
- For a polyamide, put in the -OH's on the acid groups and the H's on the amine groups
- For an addition polymer, identify the repeating unit and put in the double bond

4) **Recycling and disposal of polymers**

a) **Recycling polymers**

Waste polymers can be melted down and re-used following separation into types (PTFE etc)

Advantages: reduces landfill, saves raw materials, lower cost compared to making polymer from scratch, reduced CO₂ emissions by not being incinerated

Disadvantages: Cost of collection and sorting

b) **Disposal of waste polymers**

- **Combustion for energy production** Waste polymers can be burnt as a fuel but this produces CO₂ which is a greenhouse gas. Some polymers produce toxic gases when burnt
- **Landfill** Polymers can be buried in sites dedicated to waste. However, the amount of land available is limited and suitable sites often fill up rapidly