

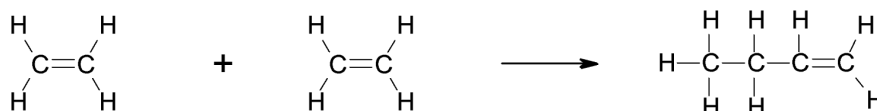
## POLYMERS AND POLYMERIZATION

**Polymers** are large molecules composed of a repeating sequence of **monomers**. A monomer is usually a small molecule or compound. A common monomer is ethene (ethylene),  $C_2H_4$ . Polymers are typically produced using two types of reactions; **addition polymerization** and **condensation polymerization** reactions.

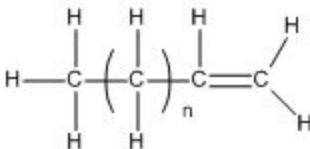
### Addition Polymerization Reactions:

Addition polymerization involves the bonding of monomers without the elimination of atoms. Bonding is accomplished by opening unsaturated bonds between carbon atoms in the molecules.

*Example of an Addition Polymerization Reaction using Ethene:*





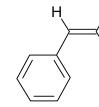
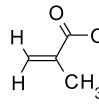

As polymerization continues, more ethene units are incorporated into the structure to form the polymer polyethylene. The final product may contain thousands of monomers, defined by the number  $n$ .



polyethylene

One or more of the hydrogen atoms in ethene can be replaced by groups such as  $-F$ ,  $-Cl$ ,  $-CH_3$ , and  $-COOCH_3$ . By substituting the hydrogen atoms synthetic polymers with trade names such as Teflon, Saran, and Lucite, or Plexiglas result. By varying the additional components of the molecule it is possible to create compounds with customized properties.

*Table 1: Examples of Common Monomers used in Addition Polymerization*

| Monomer Structure   | Monomer Name        | Polymer                  | Uses  |
|---|---------------------|--------------------------|---|
|  | ethylene            | polyethylene             | films, coating for milk cartons, wire insulation, plastic bags, bottles, toys   |
|  | vinyl chloride      | polyvinyl chloride (PVC) | raincoats, pipes, credit cards, bags, floor tiles, shower curtains, garden hoses, wire insulation, gutters, down spouts |
|  | styrene             | polystyrene              | electrical insulation, packing material, combs  |
|  | methyl methacrylate | Plexiglas, Lucite        | glass substitutes, paints   |
|  | tetrafluoroethylene | Teflon                   | gaskets, bearings, insulation, non-stick pan coatings, chemical resistant films   |

