Evaluation of kinetic data

The molecular mass of the repeat unit is usually designated M_R and is simply the sum of the atomic masses A_i of the component atoms (i) of the repeat unit:

$$M_R = \sum_i A_i$$

The number of repeat units in a chain is specified by the degree of polymerization, n , but a much more commonly used measure is the chain molecular mass M

$$M = nM_R$$

When just one hydrogen atom is substituted in the ethylene molecule, so-called **vinyl** polymers are created.

Thus poly(vinyl fluoride) has the repeat unit $[CH_2—CHF]_n$

When *both* hydrogen atoms on one of the two carbon atoms in the repeat unit are substituted, **vinylidene** polymers are formed.

TYPES OF POLYMERS

During the development of polymer science, two types of classifications have come into use. One classification is based on polymer structure and divides polymers into condensation and addition polymers. The other classification is based on polymerization mechanism and divides polymerizations into step and chain polymerizations.

To the arrangement of repeating units, and the different arrangements of molecular segment.

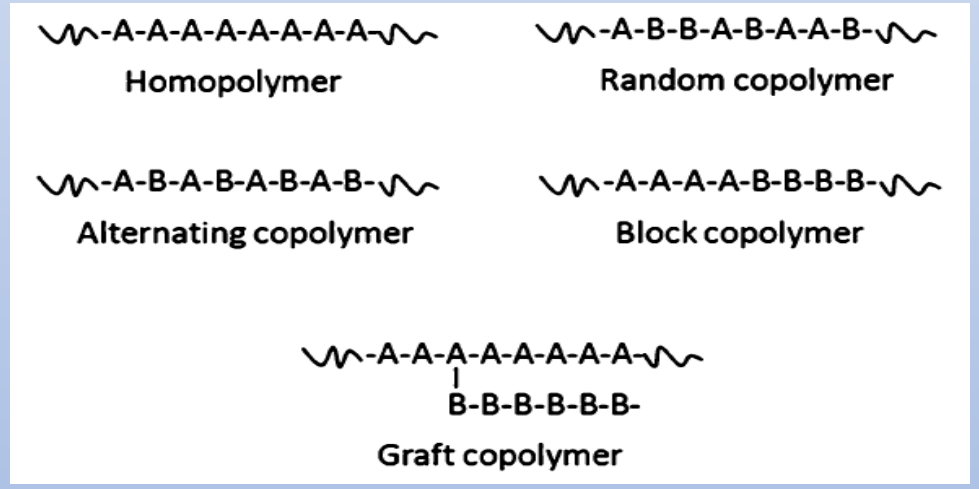
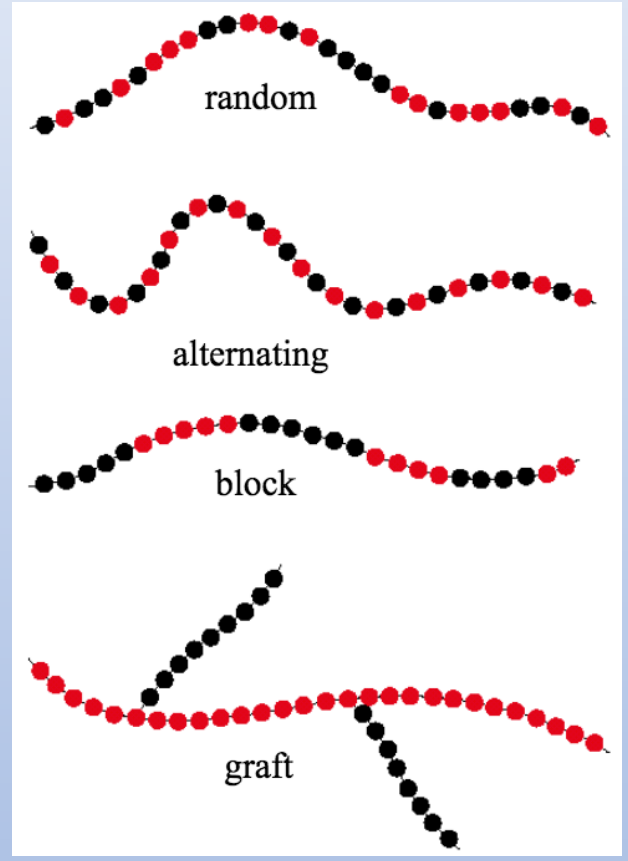


Fig. 1.2 Possible arrangements of repeating units to form different type polymers



These homopolymer and copolymers also can be prepared into polymers with different arrangement of molecular segment, such as star polymer, comb polymer, ladder polymer, dendrimer, and so on.

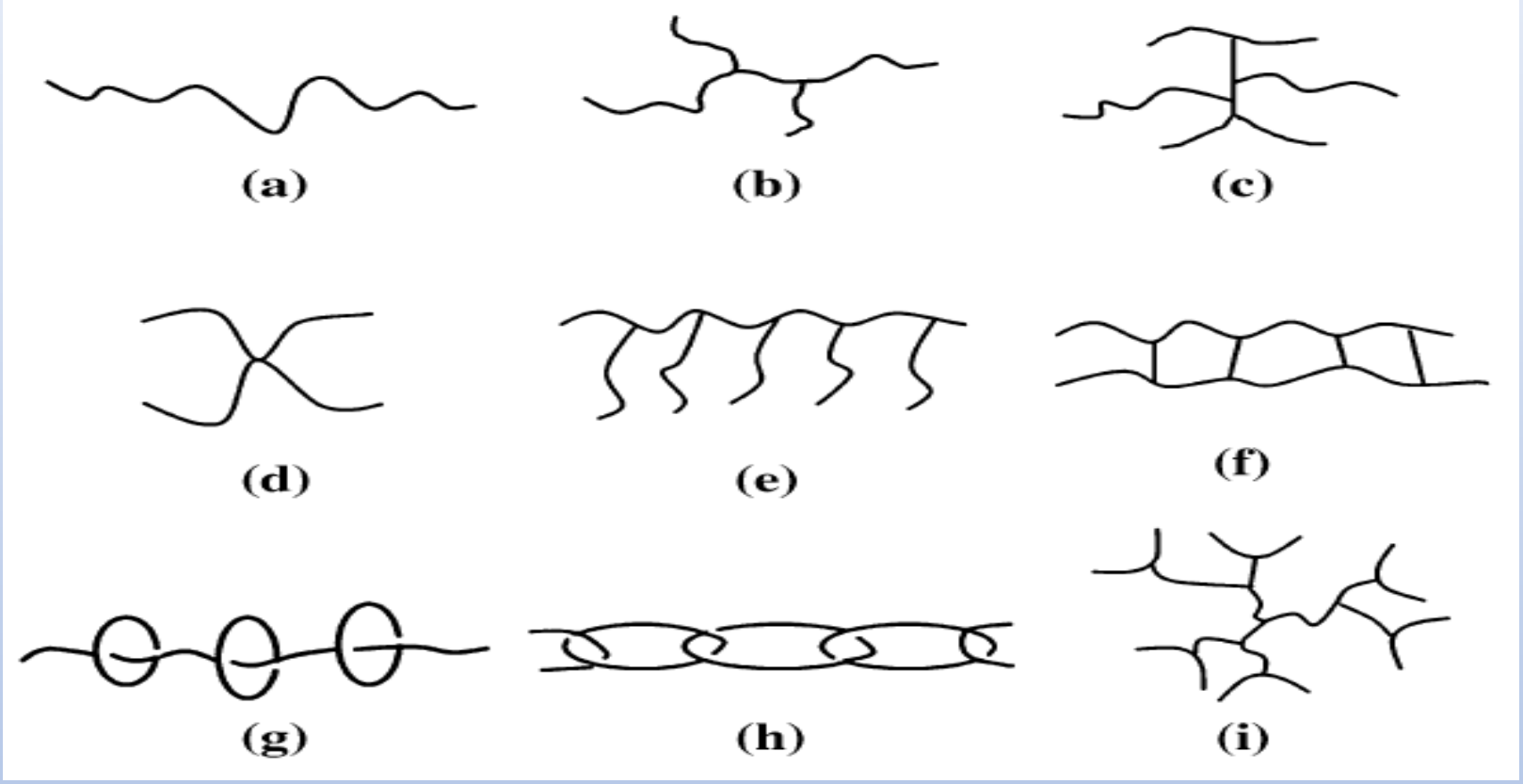
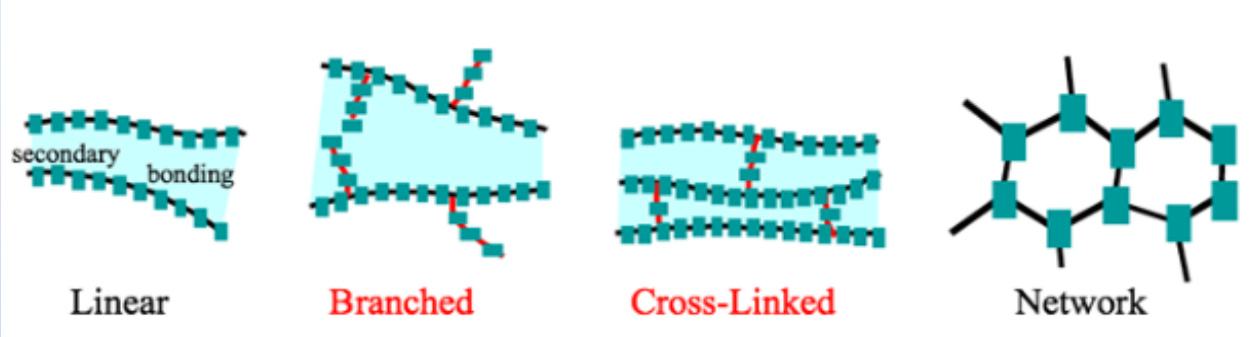
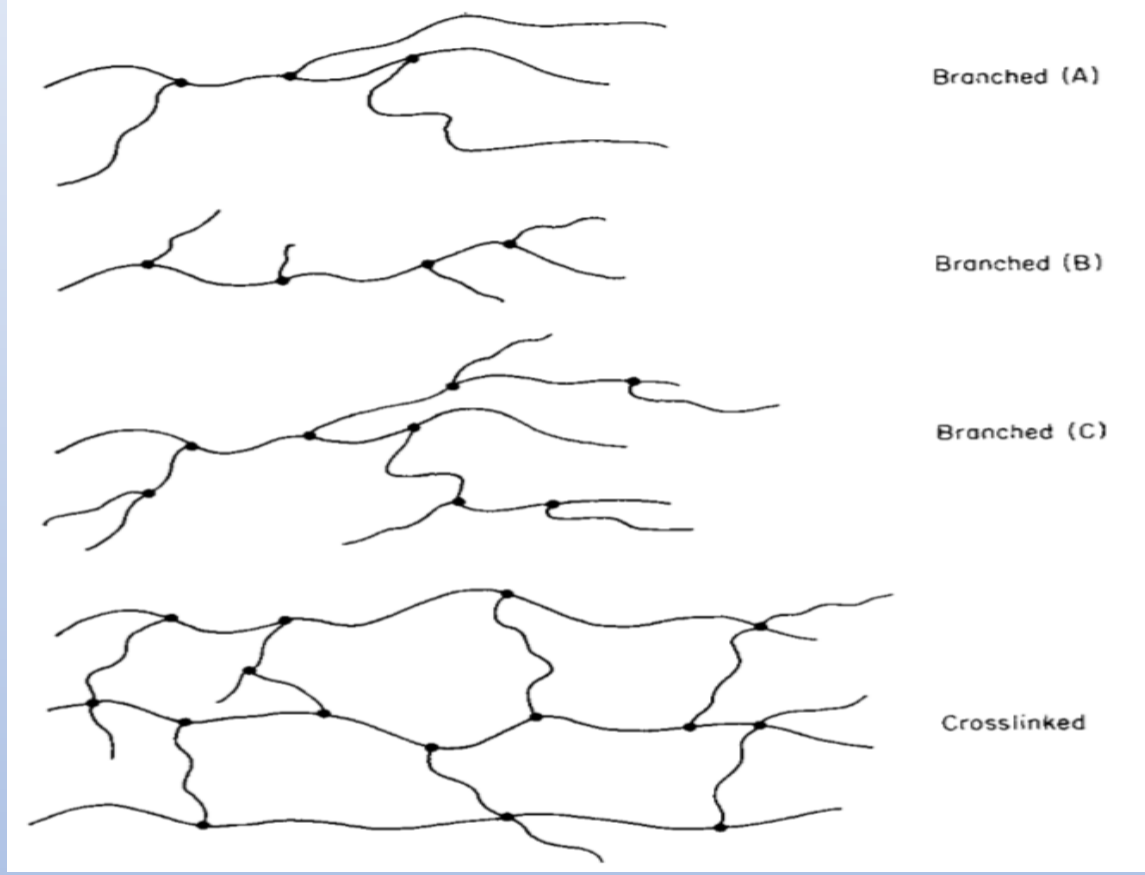


Fig. 1.3 Possible arrangements of molecular segment to form different type polymers: (a) linear polymer, (b) branched polymer, (c) crosslinked polymer, (d) star polymer, (e) comb polymer, (f) ladder polymer, (g) polyrotaxane, (h) polycatenane, (i) dendrimer

Polymers can be classified as linear, branched, or crosslinked polymers depending on their structure.

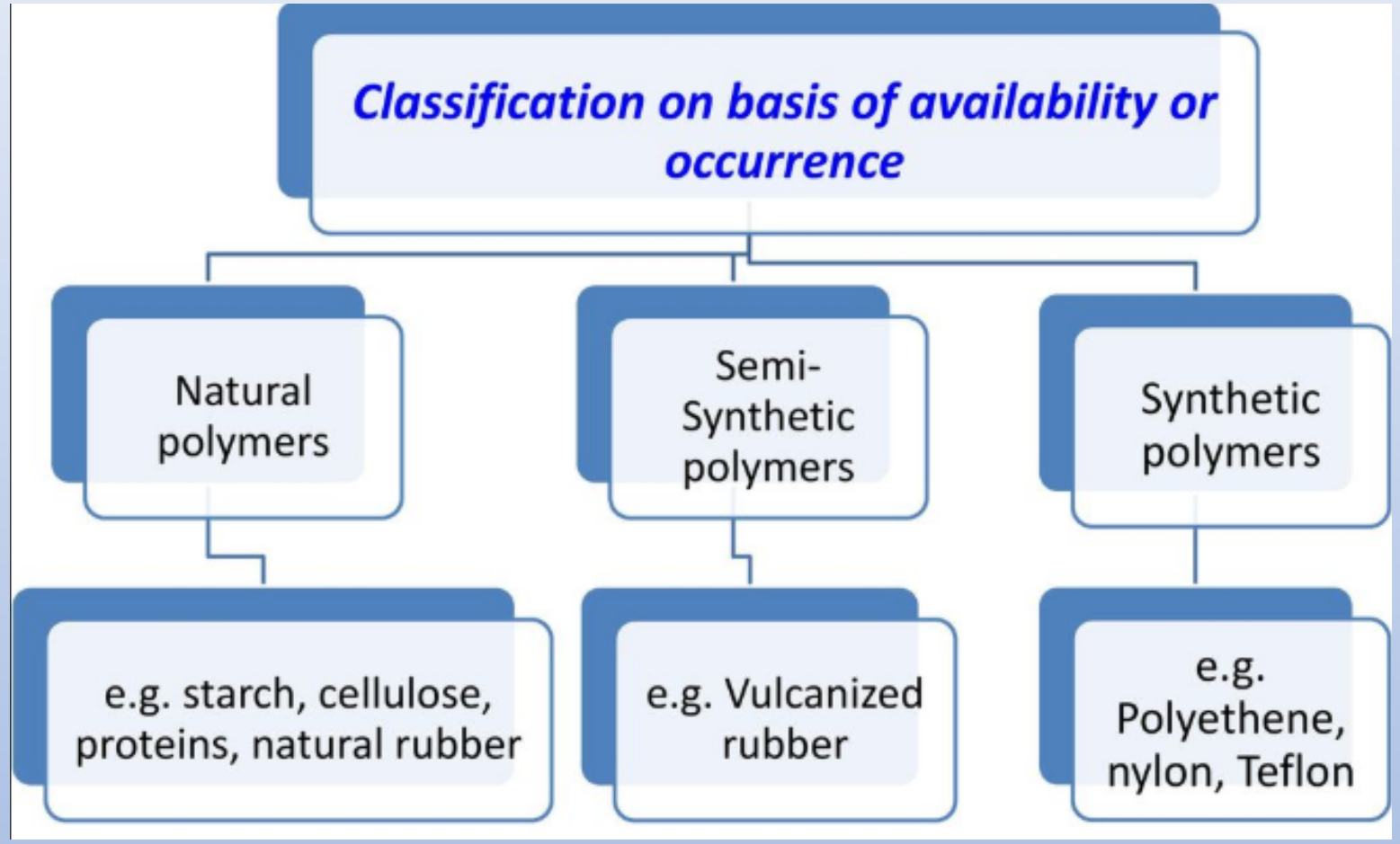




One important classification of plastics is by the permanence or impermanence of their form, or whether they are: thermoplastics or thermosetting polymers.

	Plastic	Comments
PMMA	acrylic, poly(methyl methacrylate)	Thermoplastic. A transparent rigid polymer.
ABS	acrylonitrile-butadiene-styrene	Based on SAN resin modified with polybutadiene rubber.
EP	epoxy	Thermoset. Resins used for encapsulation, adhesives, surface coatings and high-strength fibre-reinforced composites.
HDPE	high density polyethylene	Thermoplastic. Linear polyolefin widely used in blow moulding.
MF	melamine formaldehyde	Thermoset. Used in domestic ware, switches, plugs, etc.
PA	nylon, polyamide	Thermoplastic. Used in bearings, gears, mouldings, wall plugs, (Rulmanlarda, dişlilerde, pervazlarda, dübellerde kullanılır)
PF	phenolic, phenol formaldehyde	Thermoset. Moulding material and laminating resin. Sometimes known as Bakelite.
PAN	polyacrylonitrile	A fibre-forming thermoplastic polymer. One of the base polymers used to make carbon fibre.

Thermoplastics are the plastics that, when heated, do not undergo chemical change in their composition and so can be molded again and again. **Thermosets**, or **thermosetting polymers**, can not melt and take shape only once: after they have solidified, they stay solid.



Classification dependent on the sources such as natural or synthetic

Types of Polymerization

The types of polymerizations are generally classified into chain polymerization and step polymerization according to chemical reactions in the polymerization [4].

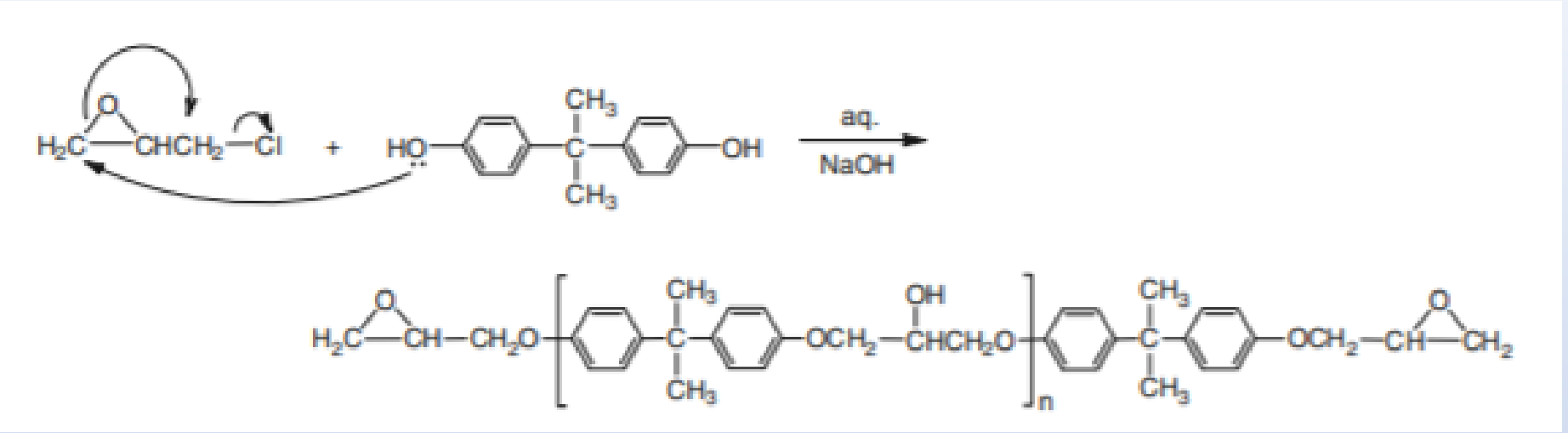
The molecular weight of polymers can be built either gradually by step reactions, this type of polymerization is also called polycondensation polymerization, or simultaneously by chain reaction depending on the chemical structure of the monomer.

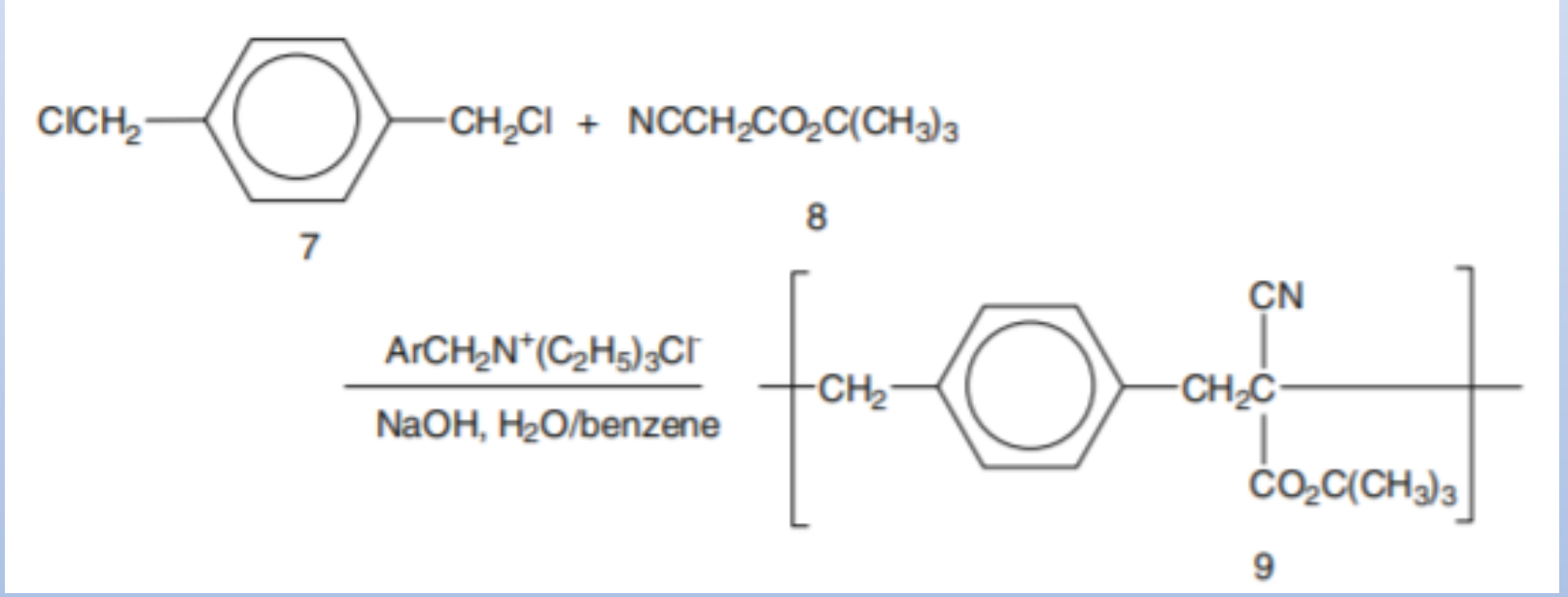
Depending on the type of initiation, the chain polymerization can be classified into free radical chain polymerization, ionic chain polymerization, and coordinating chain polymerization. Their principles will be addressed in the subsequent chapters.

Ring opening polymerization has been extensively used in synthesis of polyether, polyamide, polysiloxane, and the curing of the epoxy resin. The reaction mechanism of ring opening polymerization is unique in its own way which shows a combination behavior of step polymerization and chain polymerization. The detailed reaction mechanism will be present later.

The type of products formed in step polymerization is determined by the functionality of the monomers, i.e., by the average number of reactive functional groups per monomer molecule. Monofunctional monomers give only low molecular weight products. Bifunctional monomers give linear polymers. Polyfunctional monomers, with more than two functional groups per molecule, give branched or crosslinked polymers. The properties of the linear and the crosslinked polymers differ widely.

This reaction mechanism is used in the synthesis of epoxy resin as shown in the following:





Radical Chain Polymerization

The polymerization of unsaturated monomers typically involves a chain reaction. In a chain polymerization, one act of initiation may lead to the polymerization of thousands of monomer molecules. The chain polymerization starts with an active center responsible for the growth of the chain which is associated with a single polymer molecule through the addition of many monomer units. Thus polymeric molecules are formed from the beginning, and almost no intermediate species between monomer and high molecular weight polymer are found.