M.Sc. Sem I, CC-2, Physical Chemistry

Condensation Polymerization

In condensation polymerization, the formation of the polymer occurs when there is a loss of some small molecules as byproducts through the reaction, where molecules are joined together. The byproducts formed may be water or hydrogen chloride. Polyamide and proteins are examples of condensation polymers.

Some of the different types of condensation polymerization are given below.

Polyamides:

They are synthetic fibres and are called nylons. These polymers have an amide linkage between them. Condensation polymerization of di-amines with di-carboxylic acid and also of amino acids and their lactams will create a polyamide.

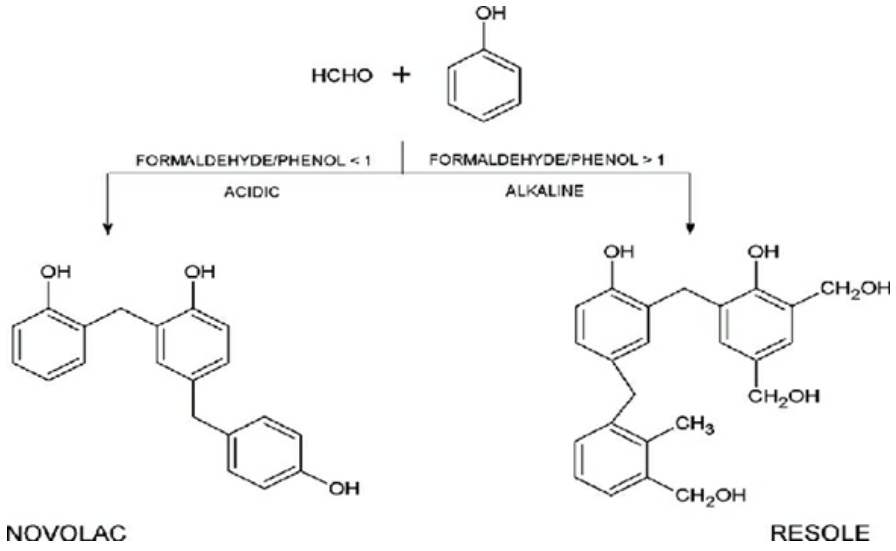
- Nylon 66: This polymer is prepared under the condition of high pressure and temperature by the condensation polymerization of hexamethylenediamine with adipic acid.
- Nylon 6: It is prepared by heating caprolactam with water under high temperatures. It is used for tyre cords, fabrics and ropes.

Polyesters:

When dicarboxylic acids and diols undergo polycondensation, polyesters are formed. They are prepared by heating a mixture of terephthalic acid and ethylene glycol at 460 k by using zinc acetate antimony trioxide as a catalyst. Dacron or terylene are the best-known examples of polyesters. And also, they are used for glass reinforcing materials in safety helmets.

Phenol-Formaldehyde Polymer:

These are the old synthetic polymers obtained by condensation polymerization of phenol with formaldehyde in the presence of either an acid or base as a catalyst.



Novolac, on heating with formaldehyde, undergoes crosslinking and forms an infusible sold mass named as Bakelite. They are used for combs, electric switches and phonograph records.

Melamine-Formaldehyde Polymer:

It is formed by the condensation polymerization of melamine and formaldehyde in certain conditions. They are used for the manufacture of unbreakable crockery.

Characteristics of Condensation Polymerization:

Some main characteristics of this type of polymerization are;

- The molecules should have one or two functional groups (like alcohol, amine, or carboxylic acid groups).
- The reaction occurs between two similar or different functional groups or monomers. It can take place between a dimer and oligomer, one monomer and one dimer or between a chain and another chain of polymers.
- Smaller molecules usually combine to form larger molecules.
- Mixed properties of both the molecules or functional groups are taken into consideration.
- A linear polymer is obtained as the condensation product when both functional groups are difunctional.
- When one of the functional groups is tri- or tetra-functional, the polymer formed will be a cross-linked polymer having a three-dimensional network.
- The average molecular weight decreases when monomers are added with one reactive group. Therefore, the functionality of each monomer determines the average molecular weight and cross-link density.