***Classification of Polymerization According To Preparation Methods:*** Preparation methods for polymers may be roughly divided into two categories – (A). Condensation Polymerization Methods. (B). Addition Polymerization Methods.

**(A). Condensation Polymerization Methods :** These methods are usually employed for low molecular weight functional group reactions, where the stoichiometric proportions of the reactions are fixed for the desired final products. During processing, solvent addition may or may not be important. These reactants are usually mixed in a batch reactor with controlled temperature and addition of catalysts. Vacuum processing or Azeotropic Distillation may be employed to remove condensation products such as H2O to obtain a higher degree of polymerization.

**(B). Addition Polymerization Methods:** These methods are carried out with controlled thermal and catalyst conditions. They may be further classified as –

**i .Bulk Polymerization** : This mode of polymerization may be employed to obtain the purest form of polymer, and the greatest yield of polymer per unit volume may be obtained using this method. This method involves only the monomer molecule, an initiator and a chain transfer agent ( if necessary). In a large scale batch form, the process is to be run slowly or in continuous mode with large heat transfer area. Casting of objects of various shapes may be accomplished using the Batch Bulk Polymerization. Using continuous bulk polymerization processes, polystyrene and other thermoplastic compounds may be moulded.

**ii .Solution Polymerization** : An inert solvent is added to the reacting components in the reaction vessel in this process. The solvent enhances the heat capacity, thereby reducing the viscosity and facilitating heat transfer. Some of the solvent may be refluxed to remove heat from the reaction vessel. But , much of the reactor space is taken up by the solvent. As such , compared to Bulk Polymerization, Solution Polymerization reduces both the reaction rate and the molecular weight of the compounds. Additional batch and continuous processes are used to separate the final polymer product and to recover and store the solvent used.

 **iii .Suspension Polymerization** : In order to control the enormous amount of heat release in Bulk Polymerization, Suspension Polymerization method was developed. The reaction mass is dispersed as minute droplets of size 0.01 – 1 mm in diameter in a continuous aqueous phase. Each of these droplets act as tiny bulk reactors. Heat transfer occurs from the droplets to the water having large heat capacity and low viscosity. Cooling jackets are used to facilitate heat removal. Agitators are used along with suspending agents in the aqueous phase inorder to maintain a specific droplet size and dispersion.

The Suspension Polymerization process cannot be run in a continuous mode, since, such a system has stagnant corners where polymer accumulation may occur. On a commercial scale, Suspension Polymerization is carried out in jacketed, stainless steel or glass – lined stirred tanks, which may have a capacity of 20,000 gal or 75.5 m3. Suspension Polymerization produces small, uniform polymer spheres. These are used directly, or may be extruded and chopped to form larger, moulded pellets.

**iv .Emulsion Polymerization** : This is the most widely used method of polymerization. This process overcomes the difficulty of heat control and low degree of polymerization. The organic reaction mass is emulsified with soap in a continuous aqueous phase. The dispersed particles are smaller in size than in Suspension Polymerization ( ≤ 0.1 μm) . In addition, due to stabilizing action of soap, the emulsion obtained is stable and agitation may not be necessary. In some methods, a water – soluble initiator may be used. The main product of Emulsion Polymerization is latex, which forms the basis of the popular latex paints. By coagulating the latex with ionic salts and acids, solid rubber may also be obtained.

**v .Homogeneous Polymerization**: In case of homogeneous bulk polymerization, the feed is a gas , liquid or solid monomer. No initiators or additives are used. For homogeneous Solution polymerization, the monomer is completely dissolved in a solvent.

 **vi .Heterogeneous Polymerization**: In heterogeneous Emulsion polymerization, the monomer molecules are emulsified in aqueous media in the form of micelles. For heterogeneous Suspension polymerization, the monomer is suspended in an aqueous or other type of media as large droplets