

Polymerization

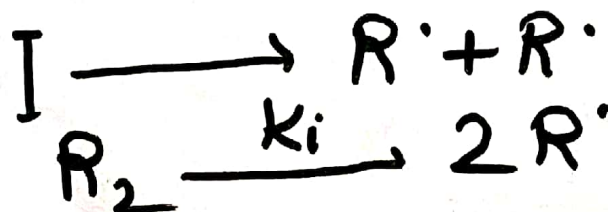
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Polymerization is a process where lower masses of molecules combine under setting of pressure, heat and light to form large molecular mass of product. The product is known as Polymer and the units are known as monomer.

Kinetics of Polymer
3+ steps three categories
such as:

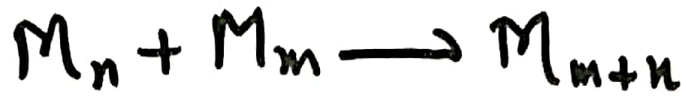
1. Initiation
2. Propagation
3. Termination

Mechanism



Termination Step.

In this step,



$$\text{Rate } v_3 = k_t [M_n] [M_m]$$

For equal masses of monomers

$$v_3 = k_t [M\cdot]^2$$

The rate of change of radical concentration

$$\frac{d}{dt} [M\cdot] = -2k_t [M\cdot]^2$$

Now net rate of formation can be changed

$$\frac{d}{dt} [M\cdot] = 2\phi k_i [I] - 2k_t [M\cdot]^2$$

Again in steady state

$$\frac{d}{dt} [M\cdot] = 0$$

$$2\phi k_i [I] = 2k_t [M\cdot]^2$$

$$[M\cdot] = \left(\frac{\phi k_i}{k_t} \right)^{1/2} [I]^{1/2}$$

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Initiation,



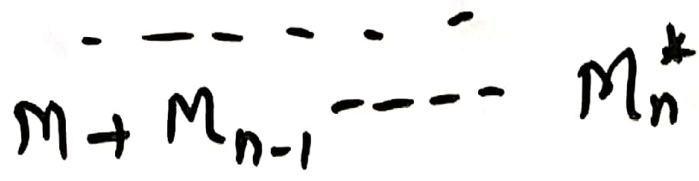
$$\text{Rate} - v_1 = 2 k_i [M] [R \cdot]$$

$$v_1 = 2 k_i [I]$$

(1)

propagation step:





$$\text{Rate} \rightarrow v_2 = k_p [M] [M^*]$$

(2)

But total concentration of radicals

$$\frac{d}{dt} [M] = 2 \phi k_i [I] \quad (3)$$

where $\phi \rightarrow$ the yield of the initial step

That means the process of polymerization as in concentration is proportional to square root of initiator's concentration

$$\underline{[M] \propto [I]^{1/2}}$$

Degree of polymerization (D.P)

$$D.P = \frac{\text{Total mass of monomers}}{\text{Mass of product.}}$$

problems:

104600 wt of monomers produce Styrene.
Calculate DP?

$$D.P = \frac{\text{Total mass of monomers}}{\text{Mass of product.}}$$

$$= \frac{104600}{95}$$

