53).

2. **Synthetic Polymers.** The polymers which are prepared artificially by chemical methods are called *synthetic polymers*. The examples are polythene, PVC, polystyrene, nylon, dacron, teflon etc.

(*i*) *Polyethylene.* The monomer is ethylene

$$n\,C_2H_4 \longrightarrow [-CH_2 - CH_2-]_n$$

Ethylene(Monomer) — Polyethylene(polymer)

The material so formed is called *polythene plastic*.

End-use. Polythene is used in packing, housewares such as buckets and dustbins, carpet backing, cable insulation and flexible bottles.

(*ii*) *Polyvinyl chloride (PVC).* It is obtained by polymerizing vinyl chloride. It is done in suspension at 52°C and 9 atm pressure.

$$n CH_2 = CH - Cl \longrightarrow [-CH_2 - \underset{\displaystyle Cl}{\underset{|}{CH}}-]_n$$

Vinyl Chloride (Monomer) — Poly vinyl Chloride (Polymer)

Repeat unit $= - CH_2 - CH -$

Material name = PVC plastic

End-use. It is widely used in imitation leathers, corrugated roofing material and gramophone records. With the addition of plasticizer, the polymer has a rubber like texture. This is used in squeeze bottles, pipes, etc.

(*iii*) *Orlon (acrilan).* This is prepared by polymerization of vinyl cyanide as follows :

$$n\underset{\text{Vinyl Cyanide (Monomer)}}{CH_2 = CH - CN} \xrightarrow[H_2O_2]{FeSO_4} \underset{\text{Polyvinyl Cyanide (polymer)}}{[-CH_2 - \underset{\displaystyle CN}{\underset{|}{CH}}-]}$$

Repeat unit $= - CH_2 - \underset{\displaystyle CN}{\underset{|}{CH}} -$

Material name = Orlon or acrilan

End-use. This polymer is used as synthetic textile fibre in clothing and carpeting.

(*iv*) *Teflon (Flucon).* It is prepared as follows :

$$n\underset{\text{Tetrafluoroethylene (Monomer)}}{CF_2 = CF_2} \xrightarrow[FeSO_4, H_2O_2]{\text{Aq. suspension}} \underset{\text{Polytetrafluoroethylene (Polymer)}}{[-CF_2 - CF_2-]_n}$$

Repeat unit $= - CF_2 - CF_2 -$

Material name = P.T.F.E. or Teflon

End-use. It is used as nonstick coating for utensils. Teflon has low chemical reactivity, high toughness, excellent electrical and heat resistance. It is, therefore, used as insulation for electrical goods.

(*v*) *Polystyrene.* It is prepared by the polymerization of styrene, when heated along with or without catalyst.

$$n\underset{\text{Styrene (Monomer)}}{C_6H_5 - CH = CH_2} \longrightarrow \underset{\text{Polystyrene}}{[-\underset{\displaystyle C_6H_5}{\underset{|}{CH}} - CH_2-]_n}$$

Repeat unit $= - \underset{\displaystyle C_6H_5}{\underset{|}{CH}} - CH_2 -$

Material name = Plastic

End-use. It is used in the manu-

Material name = Plastic

End-use. It is used in the manufacture of television cabinets, food containers, cosm bottles, plastic cups and toys.

(*vi*) *Polyesters.* These are condensation polymers, *e.g.*, Terylene (also called dacron) prepared as follows :

$$HO - CH_2 - CH_2 - OH + CH_3OOC - C_6H_4 - COOCH_3$$

Ethylene glycol (Monomer) — Dimethyl terephthalate (Monomer)

$$\downarrow \ 200^{\circ}C \text{ and base catalyst}$$

$$HO - CH_2 - CH_2 - OOC - C_6H_4 - COOCH_3 + CH_3OH$$

$$\downarrow \text{ Further reaction at each end}$$

$$[- CH_2 - CH_2 - OOC - C_6H_4 - COO-]_n$$

Terylene (polymer)

Repeat unit $= - CH_2 - CH_2 - OOC - C_6H_4 - COO -$

Material name = Terylene (Dacron)

End-use. The molten polymer can be spun into fibres and can be combined with co

fibres. The combination of terylene and cotton produces a fabric (*e.g.*, 60/40, 80/20, 67/2 dries quickly and retains the coolness and comfort of 100% cotton.

(vii) Nylon – 6, 6. It is an important polyamide. It is also called *nylon*. It is prepa heating adipic acid with hexamethylene diamine.

$$\underset{\text{Adipic acid (Monomer)}}{HOOC-(CH_2)_4-COOH} + \underset{\text{Hexamethylene diamine (Monomer)}}{H_2N-(CH_2)_6-NH_2} \xrightarrow{\text{Heat}}$$

$$HOO-(CH_2)_4-\overset{O}{\overset{\|}{C}}-\overset{H}{\overset{|}{N}}-(CH_2)_6-NH_2 + H_2O$$

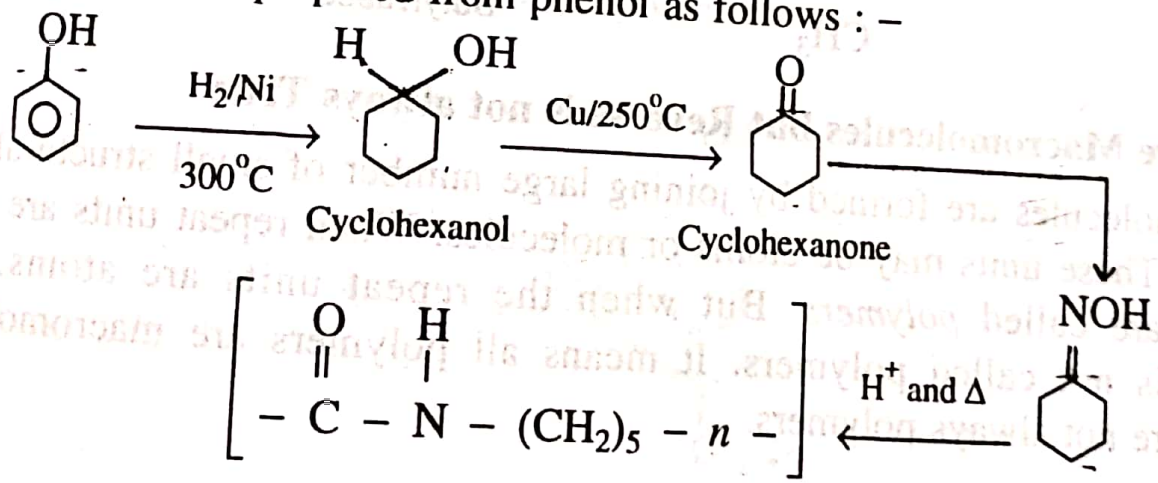
$$\xrightarrow{\text{Further reaction at each end}}$$

$$\left[\overset{O}{\overset{\|}{C}}-(CH_2)_4-\overset{O}{\overset{\|}{C}}-\overset{H}{\overset{|}{N}}-(CH_2)_6-\overset{H}{\overset{|}{N}}-\right]_n$$

Nylone–6, 6

End-use. Molten nylon-6, 6 can be spun to give long threads used in textile and industries.

(viii) Nylon-6. It is prepared from phenol as follows : –



Cyclohexanol — Cyclohexanone

$$\left[-\overset{O}{\overset{\|}{C}}-\overset{H}{\overset{|}{N}}-(CH_2)_5-n-\right]$$

Nylone–6 — Cyclohexanone oxime

End-use

End-use. It is more flexible and has lower melting point than nylon-6, 6. It is mainly used as textile fibre.

(*ix*) *Vinyon.* It is an important industrial polymer. It is prepared as follows :—

$$n\text{CH}_2 = \text{CHCl} + n\text{CH}_2 = \text{CHCOOCH}_3$$

Vinyl Chloride — Vinyl acetate

↓ Polymerization

$$\left[- \text{CH}_2 - \underset{\text{Cl}}{\text{CH}} - \text{CH}_2 - \underset{\text{COOCH}_3}{\text{CH}} - \right]_n$$

Vinyon

(*x*) *Synthetic rubbers.* (*a*) *Neoprene (polychloroprene) Rubber.* It was the first synthetic rubber produced on large scale from chloroprene.

$$n\text{CH}_2 = \underset{\text{Cl}}{\underset{|}{\text{C}}} = \text{CH}_2 \xrightarrow{\text{Polymerisation}} \left[- \text{CH}_2 - \underset{\text{Cl}}{\underset{|}{\text{C}}} = \text{CH} - \text{CH}_2 - \right]_n$$

Chloroprene (Monomer) — Polychloroprene (Neoprene Rubber)

End-use. This rubber is resistant to chemical action. Hence it is used in making containers for corrosive chemicals.

(*b*) *Styrene-Butadiene Rubber.* It is also called *SBR* or *Bunna-S*. It is a copolym from styrene and 1, 3-Butadiene

$$n\underset{\text{Styrene}}{C_6H_5 - CH = CH_2} + n\underset{\text{1, 3 butadiene}}{CH_2 = CH - CH = CH_2} \downarrow$$

$$[- \underset{\underset{C_6H_5}{|}}{CH} - CH_2 - CH_2 - CH = CH_2 - CH_2 -]_n$$

(SBR)

End-use : SBR is mainly used in making tyres, shoe, soles etc.

(*c*) *Butyl Rubber.* It is a copolymer made from isobutylene and isoprene.

$$n\underset{\text{Isobutylene}}{CH_3 - \underset{\underset{CH_3}{|}}{C} = CH_2} + n\underset{\text{Isoprene}}{CH_2 = \underset{\underset{CH_3}{|}}{C} = CH_2} \downarrow$$

$$[- CH_2 - \underset{\underset{CH_3}{|}}{C} - CH_2 - \underset{\underset{CH_3}{|}}{C} = CH - CH_2 -]_n$$

Butyl rubber

III. Polymers are Macromolecules but Re