

## Foaming of Polymer

A polymer foam is basically a polymer-gas mixture, which gives the material a microcellular structure. i.e. means polymer foams are made up of a solid and gas phase mixed together to form a foam.

Types → polymer foams can be two types →

- |                              |          |                                    |
|------------------------------|----------|------------------------------------|
| (i) <del>Thermoplastic</del> | Rigid    | — closed-cell foams {based on geo} |
| (ii) <del>Thermoset</del>    | Flexible | — open-cell foams { " }            |

polymer foams are found virtually everywhere in our modern world and used in a wide variety of applications such as disposable packing of fast-food, the cushioning of furniture and insulation material.

Blowing agent → The gas used in the foam is termed as blowing agent, & can be either chemical or physical.

Chemical blowing agents are chemical, takes part in reaction or decompose, giving off chemicals in process. Physical blowing agents are gases, do not reacts chemically in foaming process i.e inert

Methods — poly. foams are produced through diff. methods such as slab-stock by pouring, extrusion & diff forms of molding.

polymer foams can divided into either thermo plastic or thermoset, which are further



divide into rigid or flexible foams.

thermo plastic  $\rightarrow$  broken down & recycled.

Thermoset  $\rightarrow$  harder to recycle due to crosslinking.

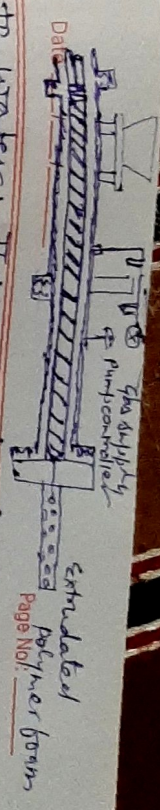
History  $\rightarrow$  Polymers foams were first made in 1930s and '40s with foamed polystyrene being the first polymer foam in 1931. Polyurethane was invented by Dr. Otto Bayer at the start of the 2nd world war. It was first used as a replacement for rubber and also used as coating to protect metal, wood & common materials at the time.

After tens years of war, flexible polyurethane foam was invented & first then it being used for cushioning furniture & automotive industries.

### Types of polymer foams-

(i) Polyurethane - It has urethane linkage, is  $-NH-CO-O-$ . It can exist both foam - flexible & rigid. Mostly there are thermosets, means hard to melt & reprocess.

(ii) Biodegradable foams - These are water soluble and sensitive to humidity, while traditional petroleum-based foams are more inert.



to water. These are also limited in making foam, have microcellular str, means they will hard to make into thin sheets.

(iii) Starch - It is an alternative material to traditional polystyrene. It was made already in 1989 as biodegradable packaging. It is a polyacetalide made up of glucose unit linked by glycoside linkage & length is generally 500-2000 repeat units.

It is made up of amylose & amylopectin. Amylose is more linear & gives to foam flexibility. Amylopectin is highly branched to produce hardness of product.

Blowing agents - water, CEC's, HEFC's, CO<sub>2</sub>, HFC's are used as blowing agent.

- CFE - Chloro Fluoro Carbon
- HCFC - Hydro Chloro Fluoro Carbon
- HFC - Hydro Fluoro Carbon

Applications - (1) used in refrigerators, freezers for

- (2) thermal insulation, padding & transport
- (3) padding for furniture, padding & transport
- (4) used for food container & disposable dishes & egg cartons.