Polyoxymethylene (POM), Acetal

Introduction to Polymer Presentation

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11/21/05

Presentation Outline:

- **Introduction:**

  * What is polyoxymethyene?

- **Formation:**

  *How it is formed?

- **Properties and applications**.

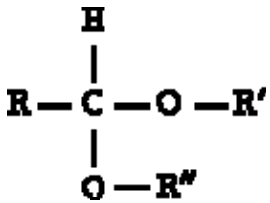
  *Acetal Homopolymer (properties and applications)

  *Acetal Copolymer (properties and applications)

- **How are they processed?**

Introduction:

- Polyoxymethylene is a functional group or molecule containing the functional group of a carbon bonded to two -OR groups. It can be also refer to "Acetal".



- Introduced to industry in 1956 as a potential replacement for die-cast metals.
- Polymer Type (Thermoplastic)
- It is a colorless liquid with a strong odor.
- Used as in solvent in perfumes and as synthetic flavoring ingredient.
- It is a flammable liquid and dangerous fire hazard.

Introduction Continuation:

- *Advantages*

  -Highly crystalline

  - More creep resistant than Nylon.

  - Good resistance to solvents (except phenols).

  - Low smoke emission.

  -High gloss surfaces.

- *Disadvantages*

  -Poor resistance to acids/alkalies.

  -Burns easily, (not available with flame retardants).

  -Limited processing temperature range.

  -High mould shrinkage.

- **Key Properties**

  -Resistance to chemicals

  -Dimensional stability

  -High strength and stiffness

  -Machinability

- **Acetal Fabrication**

  -Highly machinable

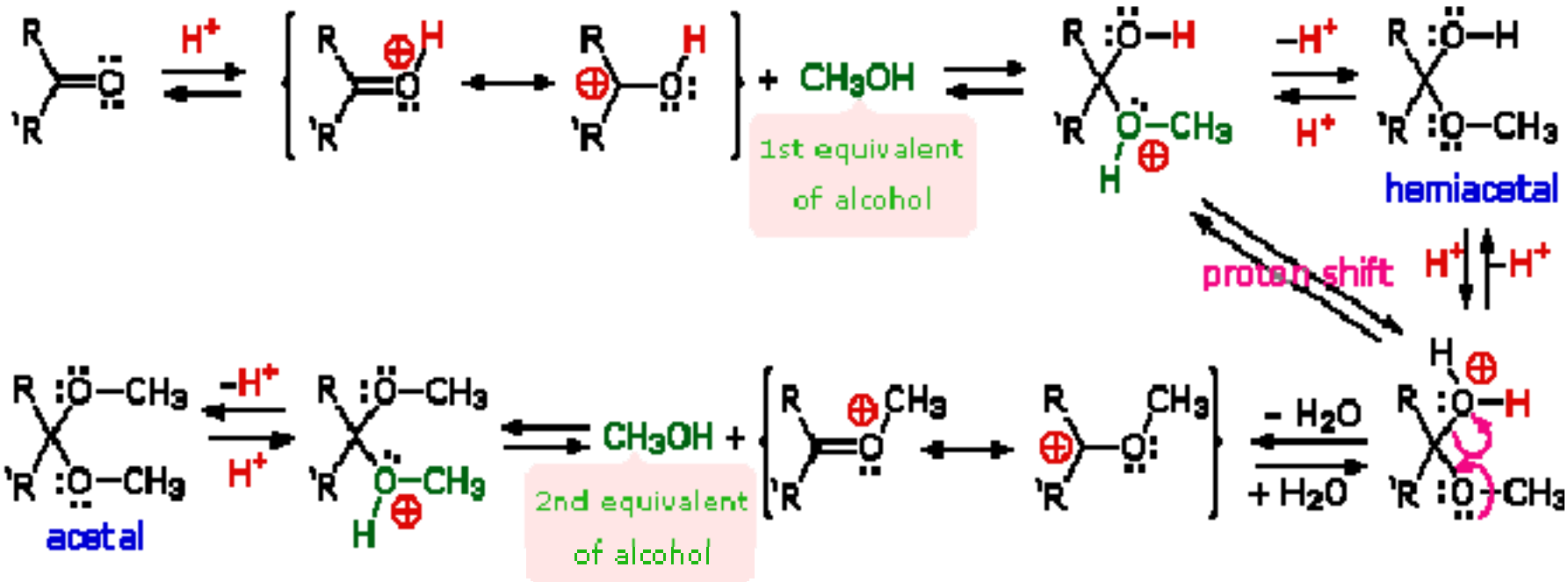
  -Excellent for mechanical parts or electrical insulators

  -Wear resistant surfaces

  -Excellent rigidity

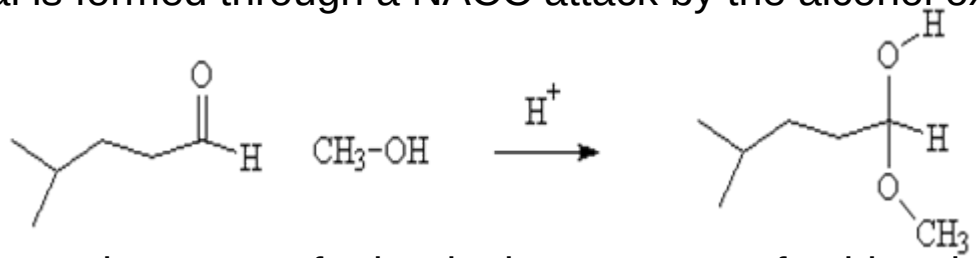
Formation:

- An acetal is the product of the acid catalyzed reaction between an alcohol and a ketone or aldehyde.In order to achieve effective acetal formation two additional features must be implemented.
  -acid catalyst must be used
  -the water produced with the acetal must be removed from the reaction.

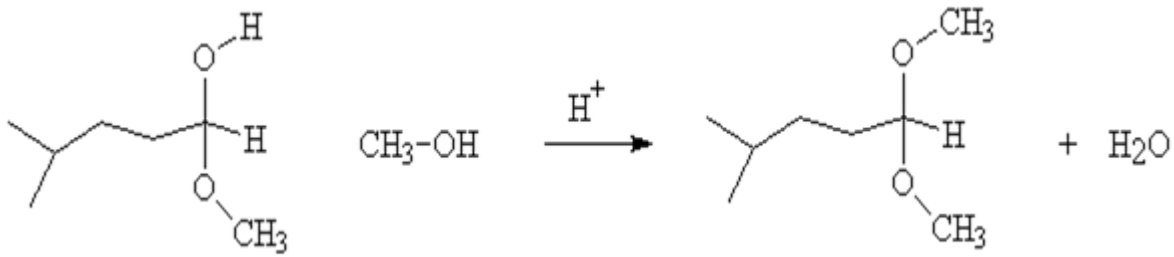


Formation:

-Hemiacetal is formed through a NACC attack by the alcohol oxygen.



-The hemiacetal can react further in the presence of acid and more alcohol to generate an acetal.



-Acetal resins are produced by the polymerization of purified formaldehyde [CH2O] into both homopolymer and copolymer types with slightly different advantages for each .

Acetal Homopolymer

Properties:

- Available in several viscosity ranges
  -higher viscosity materials are generally used for extrusions and for molded parts requiring maximum toughness;
  -lower viscosity grades are used for injection molding

- It resins have high tensile strength, stiffness, resilience, fatigue endurance, and moderate toughness under repeated impact .

- Have high resistance to organic solvents, excellent dimensional stability, a low coefficient of friction, and outstanding abrasion resistance among thermoplastics.

- Resistance to creep is excellent.

Acetal Homopolymer

Applications:

- Automotive applications

  - include fuel-system and seat-belt components, steering columns, window-support brackets, and handles.

- Plumbing applications

  - shower heads, ballcocks, faucet cartridges, and various fittings.

- Consumer items

  -quality toys, garden sprayers, stereo cassette parts, butane lighter bodies, zippers, and telephone components

- Industrial applications

  -couplings, pump impellers, conveyor plates, gears, sprockets, and springs.

Acetal Copolymer

Properties:

- High tensile and flexural strength, fatigue resistance, and hardness. Lubricity is excellent.
- Moisture absorption is low.
  - permitting molded parts to serve reliably in environments involving humidity changes.
- Good electrical properties, combined with high mechanical strength.
  - qualify these materials for electrical applications requiring long-term stability.
- Excellent resistance to chemicals and solvents and resistance to strong alkalies is exceptionally good .

Acetal Copolymer

Applications:

- Industrial and automotive

  -copolymer include gears, cams, bushings, clips, lugs, door handles, window, cranks, housings, and seat-belt components.

- Plumbing applications

  -valves, valve stems, pumps, faucets, and impellers

- Applications for the FDA-approved grades

  -include milk pumps, coffee spigots, filter housings, and food conveyors.

How are they Processed?

- Acetals may be processed by

  -extrusion techniques.

  -conventional injection molding

- Polymer extrusion

-Extrusion is the most used, and perhaps the most important method of plastic fabrication today.

-It is the conversion of a raw material into a finished product or part by forcing it through an opening.

How are they Processed?

- **Injection Molding**

-It is the most widely used polymeric fabrication process.

-Polymer melts have a high viscosity and can not simply be poured into a mold.

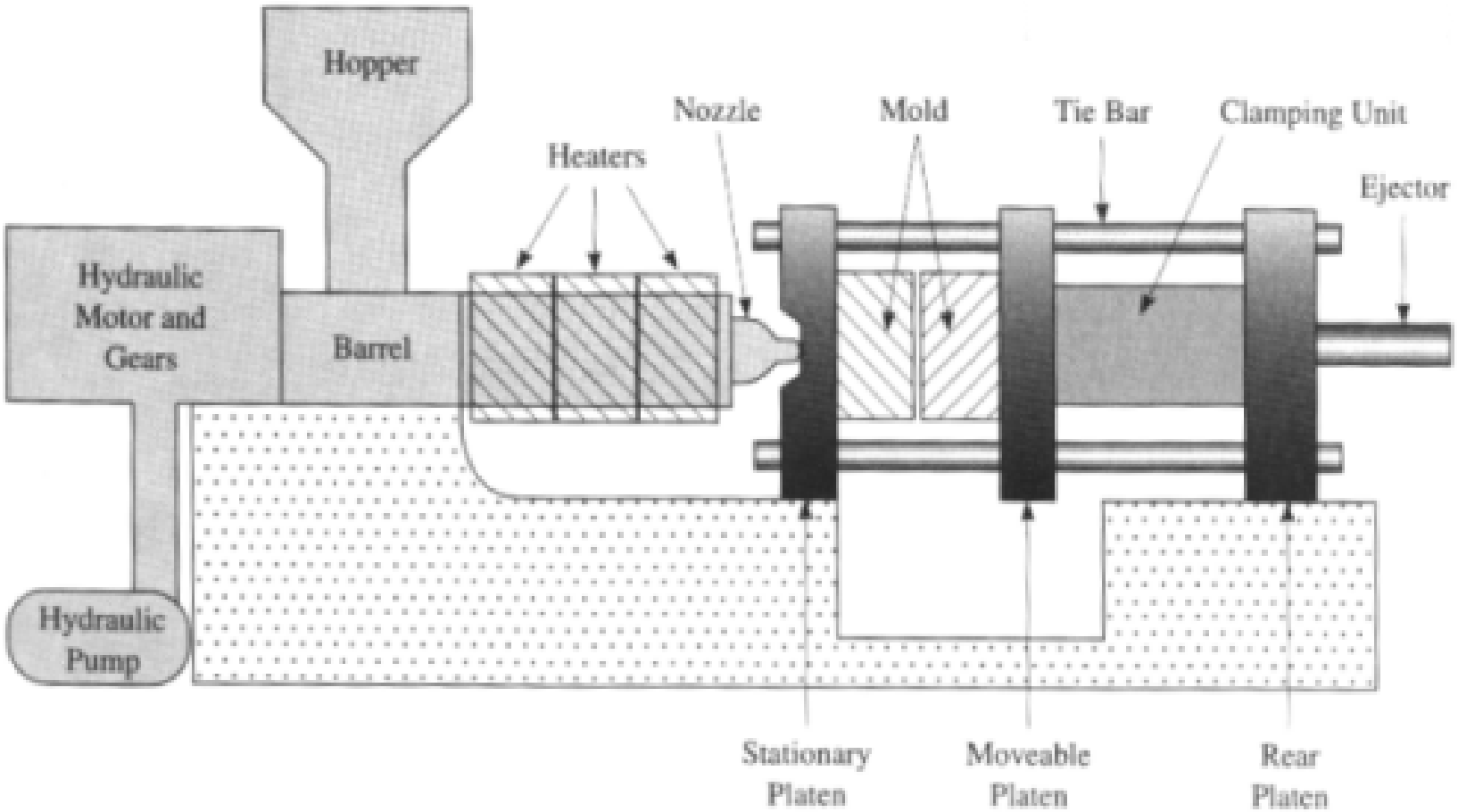
-Large force must be used to inject the polymer into the hollow mold cavity.

-Identical parts are produced through a cyclic process.

How are they processed?

- Injection molding

  -It is accomplished by large machines called injection molding machines.



Conclusion:

- The acetal resins are among the strongest and stiffest of all thermoplastics, so it is used where requirements for good moldability, fatigue resistance and stiffness justify its high price.
- Characterized by good fatigue life, low moisture sensitivity, high resistance to solvents and chemicals, and good electrical properties.
- Because of these properties, acetals often compete with nylons for many of the same applications.
- It can be extruded to produce shapes of constant cross section such as fibers and pipes.
- It must be processed in the temperature range 190 – 230 C and may required drying before forming because it is hygroscopic.
- Without co-polymerization or the addition of blocking groups it degrades easily.