

COVENANT UNIVERSITY  
NIGERIA

*TUTORIAL KIT*  
*OMEGA SEMESTER*

PROGRAMME: CHEMISTRY

COURSE: CHM 423

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6. In a tabular form, give 5 examples of elastomers, their compositions and properties.
7. With the aid of a systematic diagram, illustrate the compounding and processing operations in rubber technology.
8. Give five (5) examples of fibre forming polymers.
9. What are the processes involved in fibre forming processes for the manufacturing of glass fibre.

## SOLUTION

(1a)

**Tensile Yield Strength:** Tensile yield strength is the maximum engineering stress in psi (or Pa) at which a permanent non-elastic deformation of the thermoplastic material begins.

**Yield Point:** Yield point is the first point where the specimen yields, where the specimen's cross-sectional area begins to contract significantly, or where the strain can increase without increase in the stress.

**Ultimate Tensile Strength:** Ultimate tensile strength is the maximum stress the thermoplastic material can withstand before failing, whichever occurs at the higher stress level.

**Tensile Modulus:** Tensile modulus or **Young's Modulus** is the ratio of stress to strain within the elastic region of the stress-strain curve before the yield point.

**The Glass Transition Temperature ( $T_g$ ):** The  $T_g$  is the temperature, or range of temperatures, over which the polymer exhibits a marked change in several physical properties, most notably specific volume, thermal coefficient of expansion, specific heat capacity, and refractive index.

**Thermosoftening plastic:** is a **polymer** that turns to a liquid when heated and freezes to a very glassy state when cooled sufficiently.

(12 Mks)

(c) There are many aspects and properties to consider when choosing a thermoplastic resin for a product formation:

Impact Strength

Flexibility

Transparent vs. Opaque

Can it be easily bonded?

Chemical Resistance

Fatigue Resistance

Cost

Any six of the seven listed (6 Mks)

2 (a)

- (i) It can often be lowered by adding a low-molecular-weight plasticizer to the melt before forming (Plastics extrusion; molding) and cooling.
- (ii) Adding non-reactive side chains to the monomers before polymerization.
- (iii) Incorporate the original plastic into a copolymer, as with graft copolymers of polystyrene, or into a composite material.

(6 Mks)

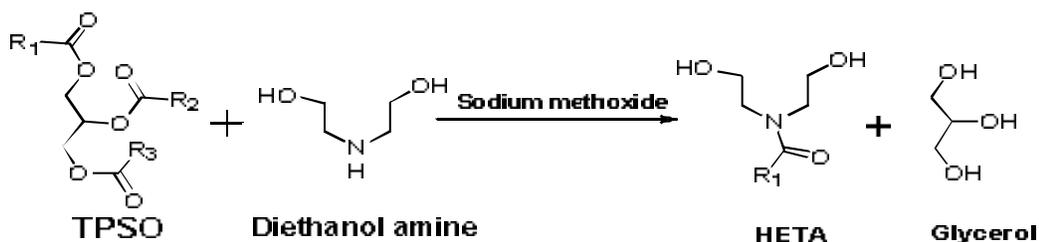
(c) Summary

Extraction of seed oil

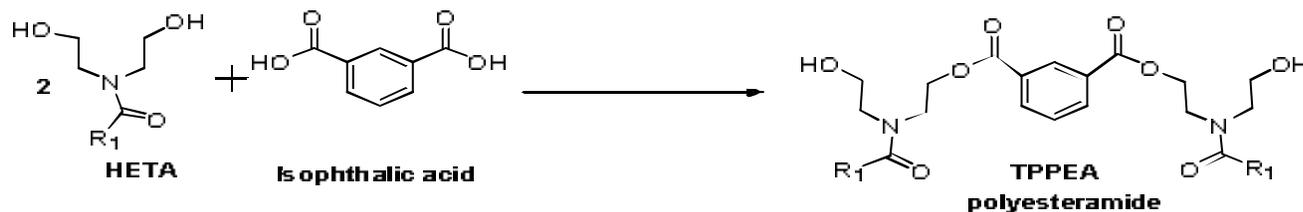


## Reaction Schemes

### STEP-1



### STEP-2



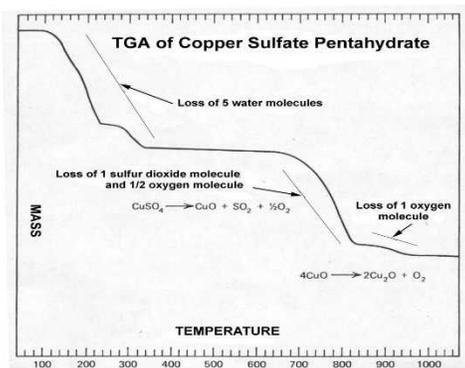
(11 Mks)

3a. (The following points to be marked)

Thermogravimetry (TG) is a lab technique that is used to study the thermal stability of the polymer. Its application is in the area of optimization research of industrial processes.

### Methods

- Sample on a recording microbalance in an oven
- Heated based in a pre-programmed profile
- Temperature changes with the changes in the weight of the pre-programmed
- Reaching the desired weight-change rate.



Example of curve in TG.

(7 marks)

3 a (ii) (The following points to be marked)

Dynamic Mechanical Analysis (DMA) is a lab technique that is used to study the properties of the polymer as it deforms under stress (viscoelastic behavior of polymers)

- Application  
Study the thermal properties (scanning the temperature during experiment)

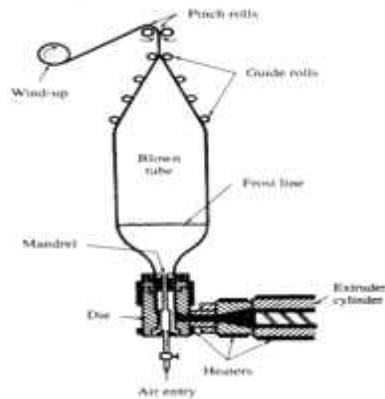
Present more accurate data

- Applied  
Decay of the forced or the free oscillation

Elastic Modulus (E) and the stiffness is calculated from the deformation

Damping property is calculated by measuring the time of the displacement compared to the force. (7 marks)

4a.



Extrusion Forming Technique of Polymers

(7 marks)

4c.

Plastic applications

Fibres

Surface Coatings

Adhesives

Rubber Applications

(2½ mks)

5. Antioxidants, fillers, plasticizers, colouring matters, light Stabilizer

6.

Common names	Composition	Property
Neoprene	Chloroprene	Good weathering resistance, Flame retarding, Moderate resistance to petroleum-based fluids
Buna-N	Nitrile-butadiene	Excellent ozone, chemical, and aging resistance. Poor resistance to petroleum-based fluids
Silicone	Polysiloxane	Excellent high and low temperature properties, Fair physical properties
SBR	Styrene-butadiene	Good physical properties and Abrasion resistance to petroleum-based fluids
Butyl	Isobutene-isoprene	Very good weathering resistance, Excellent dielectric properties,  Very good weathering resistance Excellent dielectric properties, Low permeability to air, Good physical properties, Poor resistance to petroleum-based fluids.
Natural, gum rubber	soprene	Excellent physical properties including abrasion and low temperature resistance, Poor resistance to petroleum- based fluids.
Urethane	Polyethylene- apdate, Poly oxy- 1,4,butylene ether	Good aging and excellent abrasion, tear, and solvent resistance. Poor high temperature properties.
Viton , Fluoro- elastomer	Hexaflouroprop- ylenevinylidene fluoride	Excellent oil and air resistance both at low and high temperatures. Very good chemical resistance
ECH, Hydrin, Herchlor	Ethylene-oxide  chloromethyl- oxirane	Good low temperature properties  Excellent oil and ozone resistance  Fair flameresistance  Low permeability to gases

## 8. Fibre forming polymers

Polymers of unsaturated hydrocarbons

Polymers of hydroxyl compounds.

Polymers of aldehyde, ketones and oxides.

Polymers of unsaturated hydrocarbons

Polyanhydrides polyesters

polyamides

heterocyclic polymers

Nylon, olefin, polyester

acetate, triacetate, acrylic, modacrylic, spandex, and vinyon

polyethylene and aramid fibres.