Chapter 5 Homework: Polymer and Polymer Composite Processing

Due: 10/24/24

Available Points: 50

## 1. What is the definition of a composite material? List and explain the <u>two classifications</u> of a composite. Give an example of each classification. (5 points)

A composite is a heterogeneous substance consisting of two or more consolodated meternils that does not lose the characteristics of each component. The two classifications are reinforced polynous. Composites made with fibrous meterials; and filled polynous. A polynomer composite made with perturbet fillers. An example of a reinforced polynom is fibroliss reinforced polynomer. An example of a filled polynomer composite is classified polyetylene.

2. Name 7 advantages of composite materials. (7 points)

1) Reinforcement of the rean resulting in increased track flexural compression, and impact strongth, rigidits, and combinitions of these

- Z) Increased size stability
- 3) Improved fire retarding
- 4) Corrosion protection
- S) Improved electrical properties, reduction of dichective constant
- 6) Coloning
- 7) Improved process chity; controlled viscosities good mining, and controlled orientation of fibrs.

# 3. Is the following material a composite? Yes or No? (9 points) a. Rigid-rod polymers molecularly dispersed in PMMA (25)

- a. Rigid fod polymers morecularly dispersed i
- b. Blend of two miscible polymers No
- c. Phase-separated diblock copolymer No
- d. Tire made of carbon black and polybutadiene 🚾
- e. Cotton fiber consolidated by phenol resin  $\frac{1}{2}$
- f. Sugar/Water mixture No
- g. Mica and polyethylene powder mixture N.
- h. Bullet proof jacket made of liquid crystal molecule, Kevlar
- i. Consolidated two immiscible polymers  $\sqrt{\ }$

#### 4. True or False? Correct the false statements. (4 points)

- a. A roving is a type of filler that is used to reduce the amount of plastic required and provides almost no reinforcement effect.

  | List | L
- b. Nanofillers that achieve effective dispersion are more efficient than traditional fillers at improving polymer properties. The small and recent as significant property improvement
- c. The hierarchy of reinforcing fibers from thinnest to thickest is filament < strand < roving. True

  d. A polymer is considered an engineering plastic if its mechanical properties are maintained
- d. A polymer is considered an engineering plastic if its mechanical properties are maintained around 200°C. Forley thesis chart super engineering plastic, engineering plastics are would 150°C.
- 5. Give one example of a naturally occurring composite, mineral filler, and synthetic fiber. Explain the usefulness of mineral fillers and synthetic fibers for composite preparation. (4 points)

Naturally occurring composite. Tendon, bone, bam boo, wood

Mineral fillers. Silica, mica, calcium cerbonate

Synthetic fibers. Gliss fibers and cerbon fibers

Mineral fillers are useful as the help reduce cost, commpose process ability, the

Con impose mechanical and thoral proporties, and conveduce alone to.

Synthetic fibers are useful for imposing stepth/stiffing durability, and the creation

of strong but lightneight composition.

The following list contains all the processes that could be answers to the following questions

- Injection Molding
- Transfer Molding
- Vacuum Assisted Transfer Molding
- Extrusion
- Pultrusion
- Filament Winding
- Hand Lay-Up
- Spray-Up
- Compression Molding
- Resin Transfer Molding
- Reaction Injection Molding

#### 6. What process does each description characterize? (7 points)

- a. Laying down fabrics made of reinforcement fibers and then painting the matrix resin layer by layer Lay-Up
- b. Uses a hydraulic press to form the composite into shape Compression mel ding
- c. The closed mold composite processing method that allows manufacturing of a very large object 

  Case Transfer Molding VARTM
- d. Fiber/resin mixture is fed into the hopper and transferred into a heated barrel, screws rotate to apply a high shear process and molten resin is pushed forward and injected with a high pressure into the mold cavity through the runner and gate
- e. A bundle of fiber rovings are passed through a wet resin bath, squeezed into a desired shape, passed through a heated die, and cured into a final composite
- f. The processing technique that offers the shortest cycle time | Zeaction Injection Molding
- g. Resin-wet rovings are wound around a mandrel, and the mandrel is cured to a solid composite Filamet winding

#### 7. Which of these processes are highly automated? Circle 3. (3 points)

- a. Hand Lay-up
- b. Transfer Molding
- c. Pultrusion
- d. Filament Winding
- e. RIM
- f. Extrusion

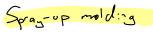
8.	W	Which of these processes can be used for nanocomposite processing? Circle 3. (3 points)	
	a.	Spray-Up	
	b.	Compression Molding	
	c.	Injection Molding	
	d.	Transfer Molding	

e. Extrusion

f. Pultrusion

## 9. You are asked to manufacture the following products. Choose one technique to use. (5 points)

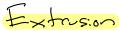
a. A life size statue of yourself.



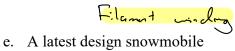
b. An arrow used for archery.

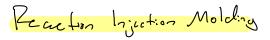


c. HDPE pipe (5 cm diameter, 250 m long)



d. A high-pressure railway tank car





Multiple Choice. Select a processing method based on each of the desired properties (3 points)

### 10. The composite processing technique suitable for the highest strength composites

- a. Compression Molding
- b. Filament Winding
- c. Pultrusion
- d. Injection Molding

## 11. The processing method for the most versatile design flexibility of the mold shape using continuous fiber reinforcement

- a. Hand-Lay Up
- b. Pultrusion
- c. Thermoforming
- d. Extrusion

### 12. Best method for processing a very intricate shaped object with a thermoplastic polymer.

- a. Compression Molding
- b. Spray-Up Molding
- c. Pultrusion
- d. Injection Molding