Composite Processes

PL ET 370

Open Mold Processes
- Hand Lay-up
- Spray-up
- Filament Winding

Closed Mold Processes
- Pultrusion
- RTM

Open Mold Composite Processes
- Gel Coat
  - Thin layer of resin
  - Female Mold
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Composite Processes

- Materials
  - Polyesters
  - Vinyl Ester
  - Epoxies
  - Urethanes
  - Phenolics

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Composite Processes

- Fibers
  - Glass
  - Carbon/Graphite
  - Aramid/Kevlar

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Fillers and Reinforcements

- Glass Fibers
  - Most Common
  - Lower Cost
  - Dimensional Stability
  - Heat Resistance
  - High Strength
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Fillers and Reinforcements
- Carbon Fiber
  - Very High Cost
  - Low Weight
  - Some Lubricity
  - High Strength

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Fillers and Reinforcements
- Kevlar Fiber
  - Very High Cost
  - Low Weight
  - Some Lubricity
  - High Strength
  - High Wear Resistance

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Hand Layup
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Hand Layup

- Process
  - Gel Coat
  - Fiber Mat Laid into Place
  - Resin Rolled/Painted
  - Can do for several layers

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Hand Lay-up

- Advantages
  - Good for Low Part Counts
    - Inexpensive Tooling
  - Little or No Mechanical Equipment

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Hand Lay-up

- Disadvantages
  - Precision Needed for Hand Work
  - Skilled Labor
  - High Labor Cost
  - Long Cure Time/Slow Cycle
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Hand Lay-up

- Prepregs
- Fibermat with Orientation

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Spray-up

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Spray-up

- Similar to Hand Lay-up
  - Gel Coat
  - Resin & Fiber Spray
    - Fiber on Spool
    - Chopped in Spray Head
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Filament Winding

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Filament Winding

- Process
  - Mold on Spinning Mandel
  - Pay-off - Moving Head
  - Resin Bath
  - Fiber on Spools

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Filament Winding

- Advantages
  - High Fiber Content
  - Minimum Fiber Damage
  - Orient Fibers
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Filament Winding

- Disadvantages
  - Extra Time in Cycle to Wind
  - Development/Debug Time to Determine Filament Path
  - Fast Speed doesn't Coat Fibers

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Pultrusion

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Pultrusion

- Process - Like Extrusion
Resin Transfer Molding
RTM

- Process
  - 2 Reactants
  - Mixing Head
  - Preform

Advantages
- Low Mold Pressures
- Low Mold Cost
- Large Parts
- Good for Prototyping
- Gel Coats
RTM

- Disadvantages
  - Preform Development Lengthy
  - Problems Predicting Resin Flow