

Composite Materials - III

(Making of Composite)

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Elon Musk created a history today!



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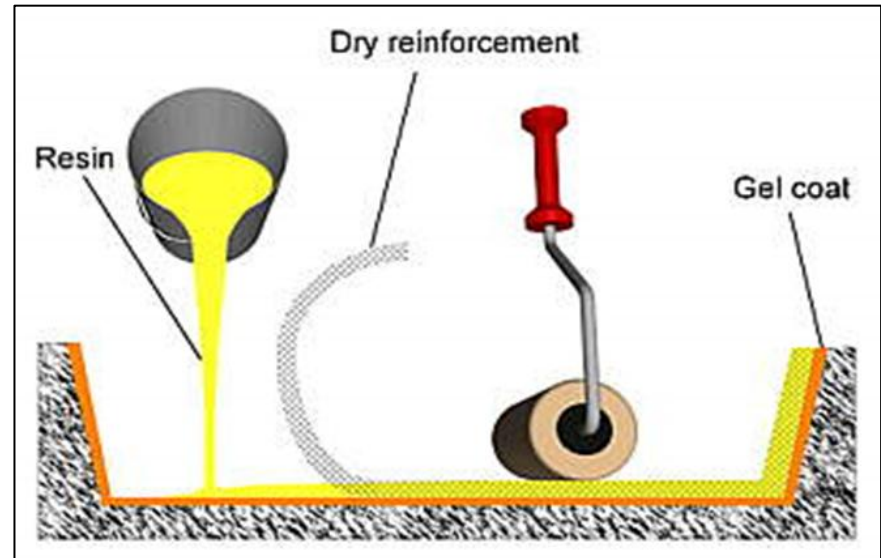
Contents

- ✓ Hand lay up Technique
- ✓ Spray lay up Technique
- ✓ Pultrusion
- ✓ Prepreg
- ✓ Resin – transfer Moulding
- ✓ Pressure bag and Vacuum bag Techniques



Hand lay up process

- ✓ Gel coat is applied to open mold - to avoid the sticking of polymer to the surface.
- ✓ Reinforcement is placed in the mold.
- ✓ Base resin mixed with a catalyst (hardener) is applied by pouring and brushing.
- ✓ Layup is made by building layer upon layer to obtain the desired thickness.



- For epoxy based system, normal curing time at room temperature is 24-48 hours.
- This method is mainly suitable for thermosetting polymer based composites.



❑ Advantages:

- Low cost tools
- Versatile

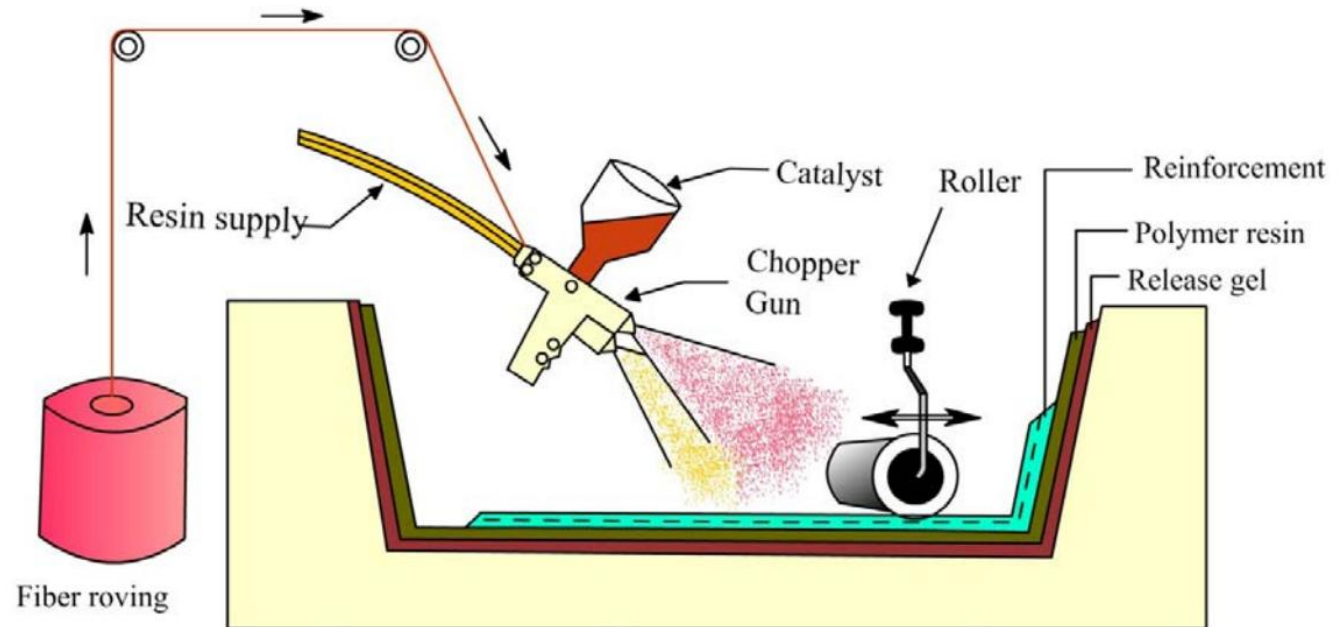
❑ Disadvantages:

- Time consuming
- Easy formation of air bubbles and disorientation of fibers
- Inconsistency



Spray lay-up

- Extension of the hand lay-up method.
- A spray gun is used to spray pressurized resin and reinforcement which is in the form of chopped fibers
- Matrix material and reinforcement may be sprayed simultaneously or separately.



❑ Advantages:

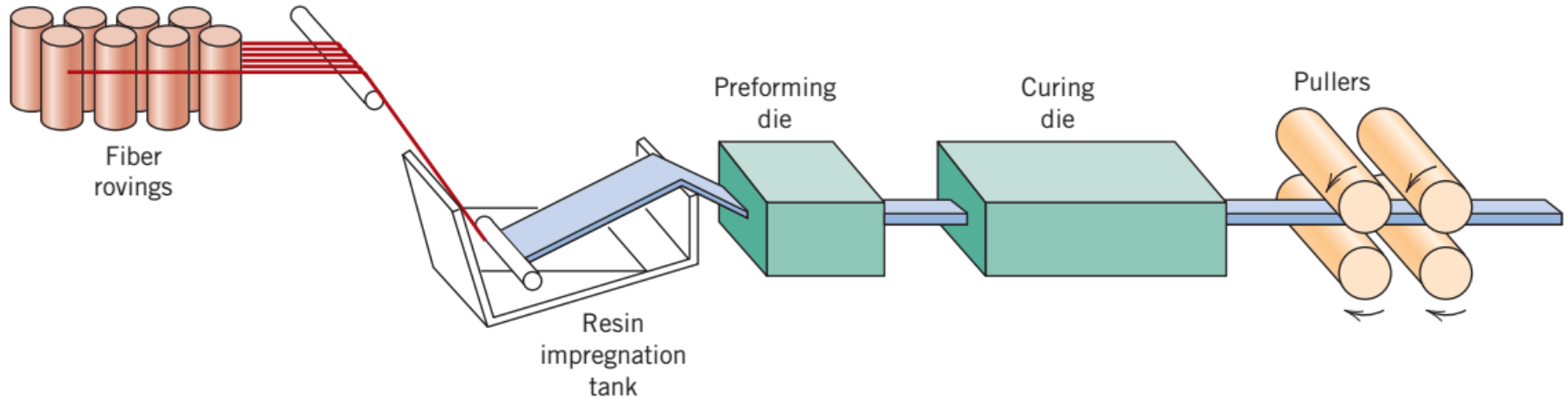
- Continuous and faster process
- Any material can be used as mold.
- Error can be corrected by re-spraying.

❑ Disadvantages:

- Resin rich Laminate
- Inconsistency.
- Short Fibres: inferior mechanical strength
- No control of fiber orientation.
- Not Environment friendly.



Pultrusion (Pull + Extrusion)



- Automated Process for **continuous** manufacturing of **constant cross-section** profiles.
- Profiles have **high strength** in the longitudinal direction.
- **Principal reinforcements** : Glass, Carbon, and Aramid fibers (40-70% volume).
- **Matrix materials** : polyesters, vinyl esters, and epoxy resins.



❑ Advantages:

- Automated processes.
- High speed.
- Versatile cross-sectional shape.
- Continuous reinforcement.

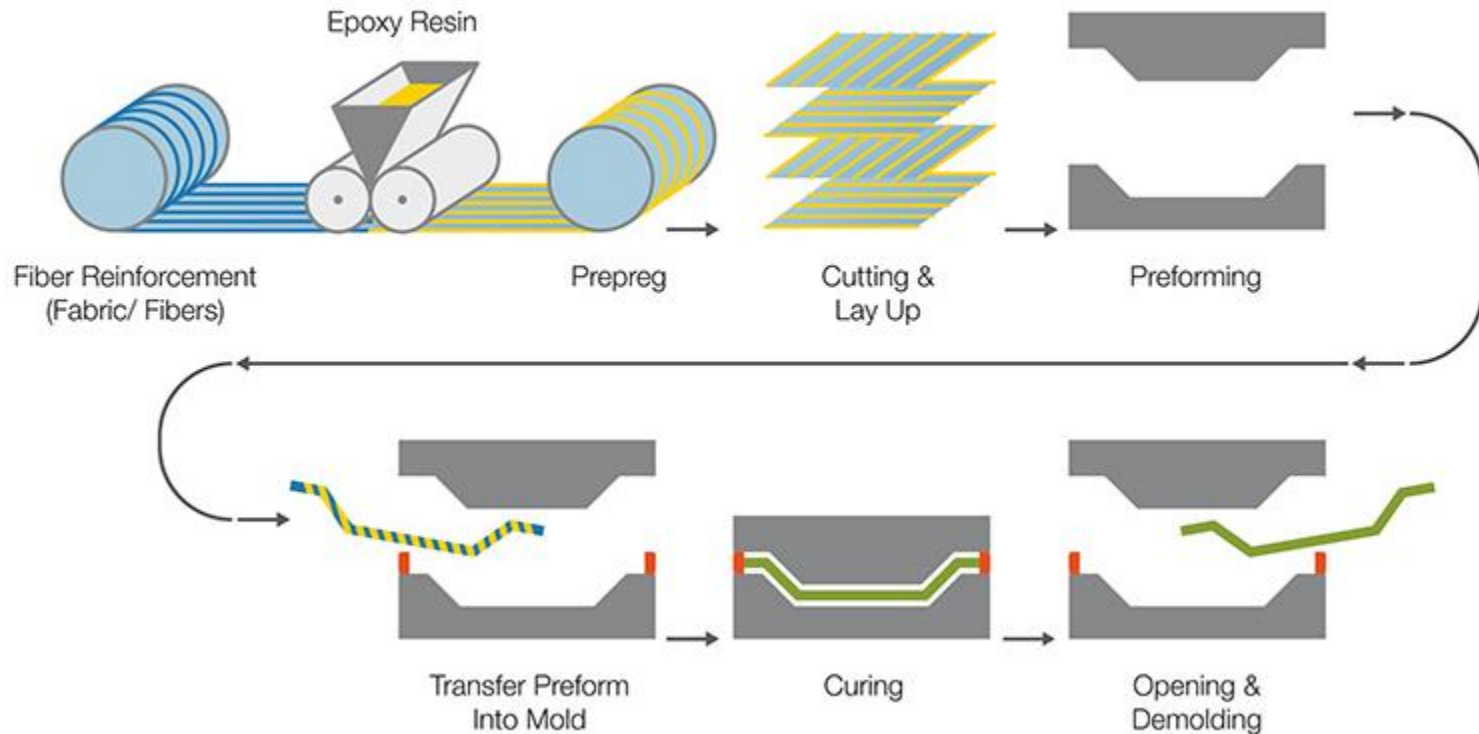
❑ Disadvantages:

- Die can be easily messed up.
- Expensive die.
- Mainly thermoset matrix.



Prepreg Process

- Fiber reinforcements are impregnated with a specific amount of epoxy resin system in a separate step before the lay-up.
- In this so-called prepregging step, fibers are wetted uniformly and a prepreg of high quality is formed.



❑ Advantages:

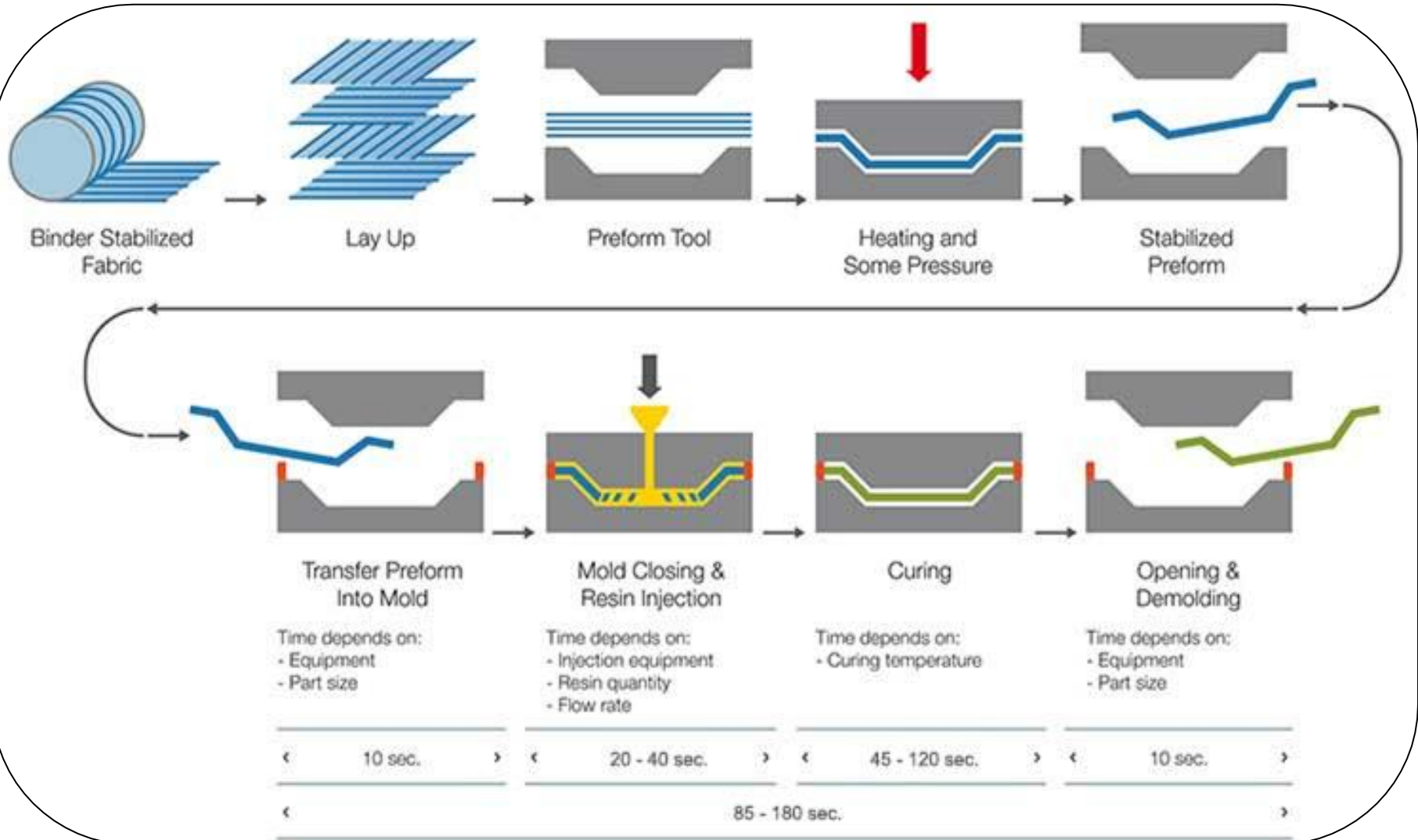
- Orientation of fibers can be changed
- Consistent
- High productivity

❑ Disadvantages:

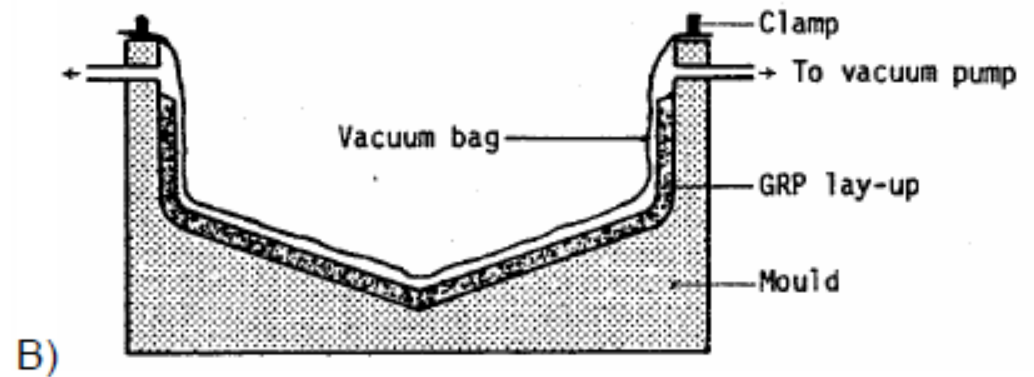
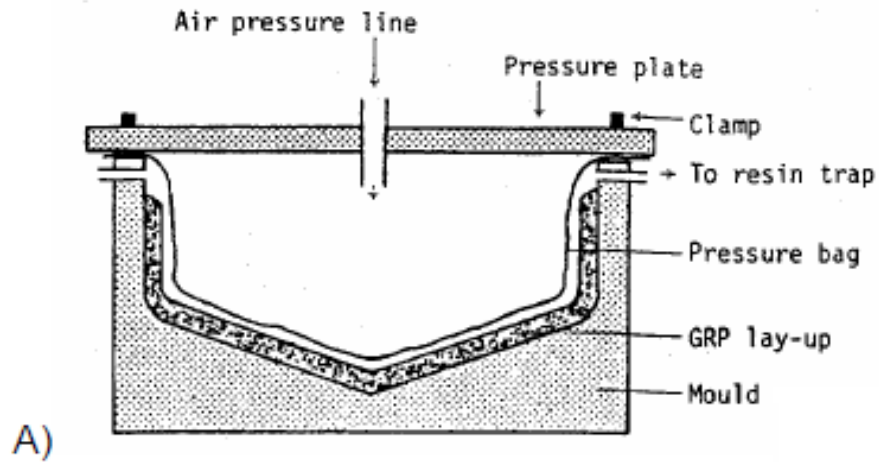
- Continuous process needs more customers
- Limited shelf life
- Delamination



Resin Transfer Moulding



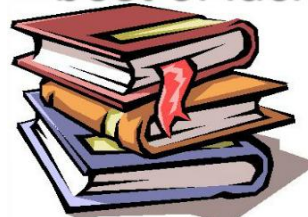
Air Pressure (A) and Vacuum (B) Bag Molding



In the **next lecture**, we will learn about

- ✓ Smart Materials : Overview
- ✓ Types and their need

best of luck



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