Manufacturing Methods for FRP Composites

Hand Lay-Up

- Simplest most widely used method
- Also called wet lay-up
- Manual placement of the reinforcement in the mold and subsequent application of the resin
- Wet composite is rolled
  - Uniform distribution of resin
  - Remove air pockets
Hand Lay-Up

■ Four basic steps
  ■ Mold preparation: Made from wood, plastics, composites or metals. Application of release agent (wax, silicones, release paper etc) for easy removal of the part.
  ■ Gel coating: Applied after mold preparation to produce a good surface appearance
  ■ Lay-up: Placement of reinforcement and application of resin
  ■ Curing: Usually at room temperature. Part removed from mold

Prepreg Lay-Up

■ Pre-impregnated fiber reinforced material where the resin is partially cured
■ Fibers arranged in unidirectional tape, woven fabric or random chopped strand mat
■ Difference with hand lay-up: impregnation of fiber already done before molding
■ Widely used in aerospace applications
■ Limited shelf life (stored in freezers)
Bag Molding

- Uniform pressure application applied to the laminate after impregnation of the fibers
- Pressure applied with the use of a flexible diaphragm or bag
  - Removal of excess resin
  - Removal of air and volatiles from the matrix
- Vacuum pressure is applied inside the bag and that allows atmospheric pressure to be applied uniformly on the composite part
Resin Transfer Molding (RTM)

- RTM uses a mold with inlets to introduce resin and outlets to allow air to escape
- Fibers are placed dry in the mold and the mold is closed
- Resin is pumped into the mold soaking the fibers (usually using vacuum pressure)
- When all fiber are wet resin supply is closed
- After curing part is removed from the mold
RTM

Pultrusion

- Continuous manufacturing process used to manufacture constant cross-section shapes of any length
- Low cost
- Direct conversion of continues fibers and resin into a finished product
- Fibers continuously impregnated and pulled through a heated die, where they are shaped and cured
Pultrusion

Typical Pultrusion Line

Pultrusion Products