BMM4893: Mechanics of Composite Materials

Chapter 2: Production Methods for Composite Products

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Synopsis

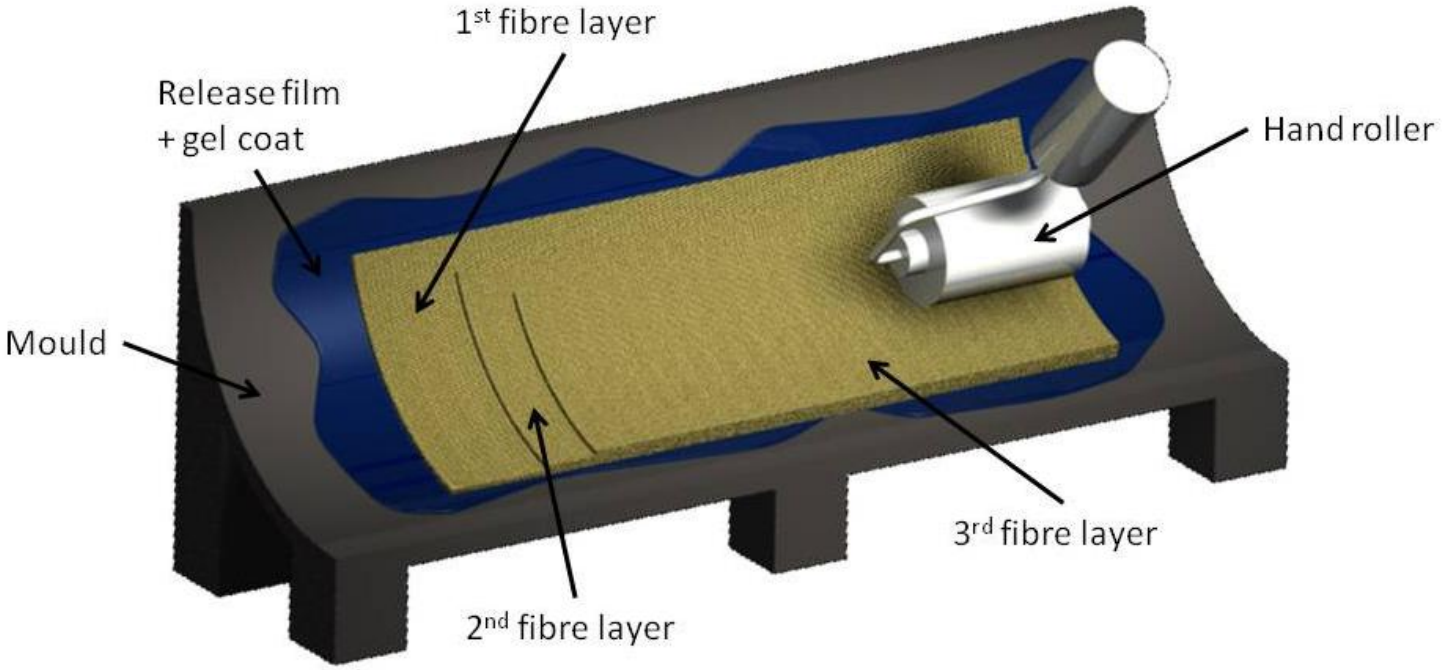
This chapter explains the fabrication processes using open and closed moulds. Later, the quality assurance of the composite products will be discussed.

Learning Outcome

By the end of this topic, student should be able to:

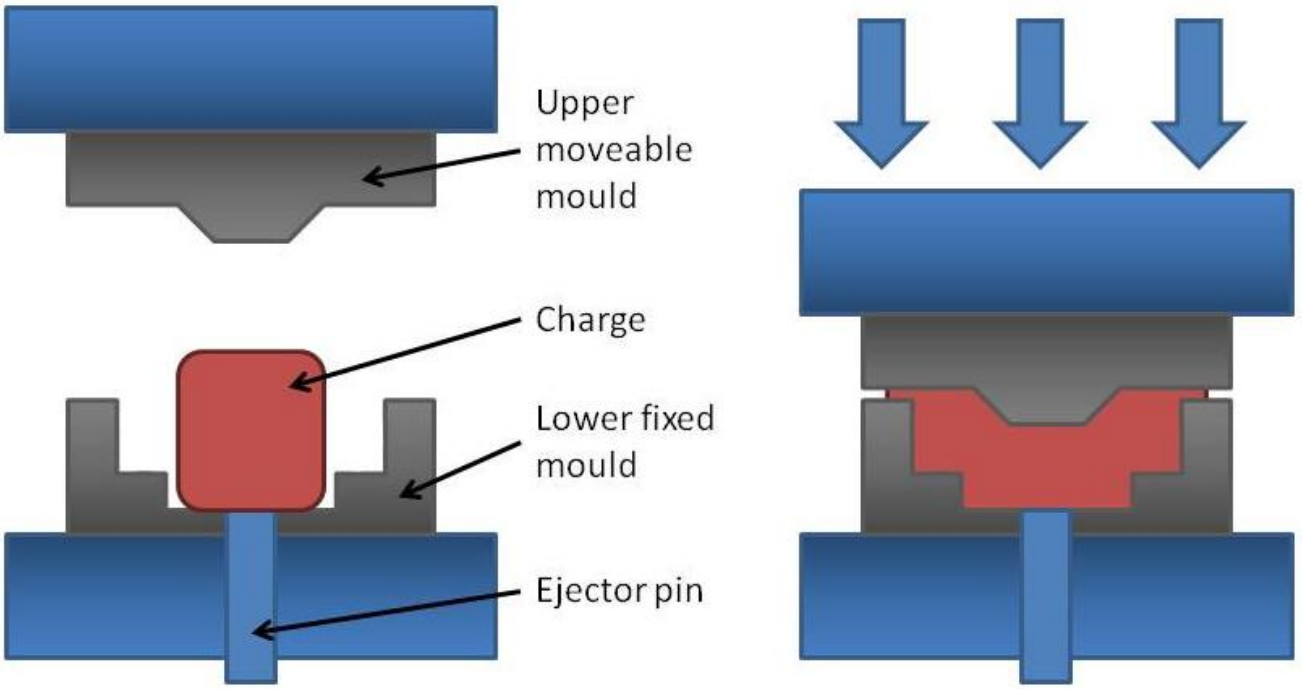
- Explain the fabrication processes using open moulds
- Explain the fabrication processes using closed moulds
- Discuss the quality assurance of the composite products

Hand lay up



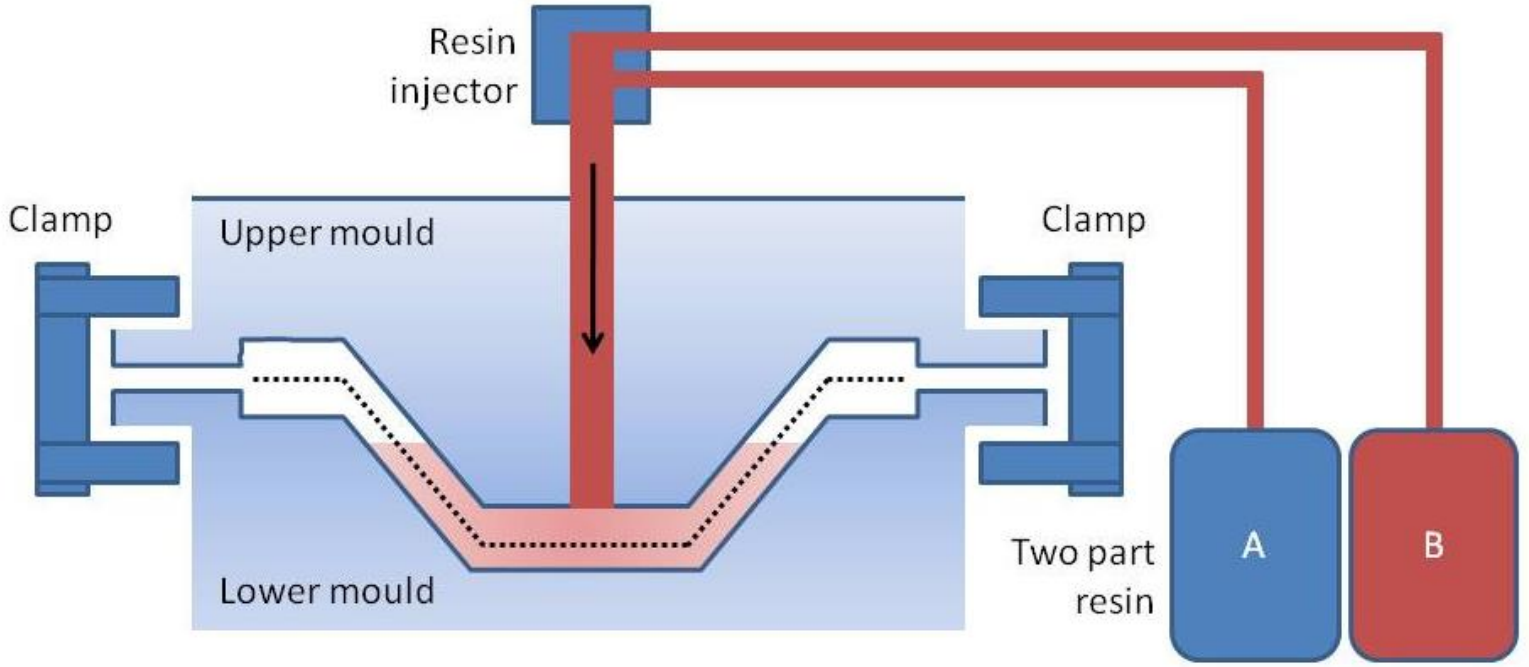
A gel coat and release film are applied to the inside surface of the mould. A layer of woven fibre is then laid down, with care taken to ensure the correct fibre orientation, and a controlled quantity of liquid resin is poured on. A hand roller is used to remove voids and spread the resin evenly throughout the fibres. This process is repeated until the required number of layers is built up. The resin is then cured, either by heat, exposure to UV light or exposure to normal atmospheric conditions.

Compression moulding



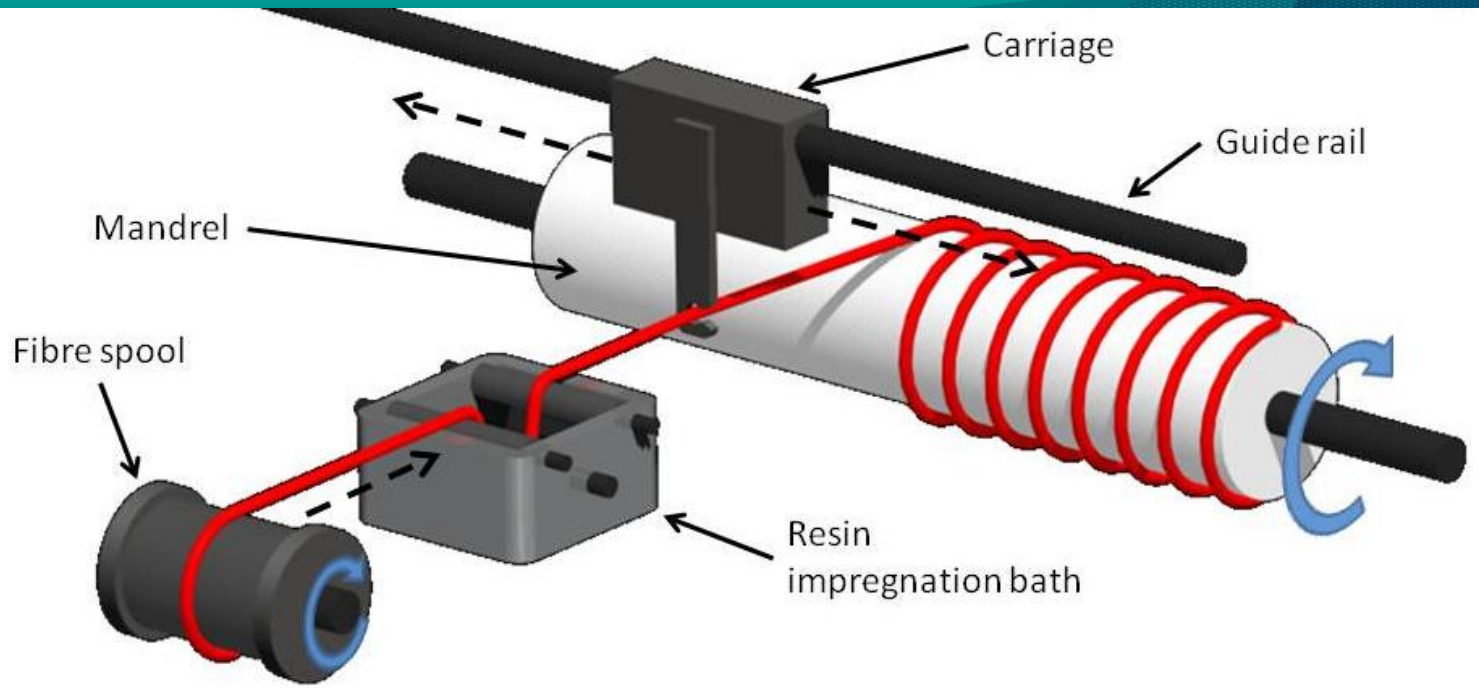
Compression moulding can be used to shape polymer matrix composites. The charge is placed between two steel platens and is heated and cured under pressure. This technique produces components with a high quality surface finish and also has a short cycle time, making it ideal for processes where a high throughput is required. For lower volume production, high machine costs may make this process prohibitively expensive.

Resin transfer moulding



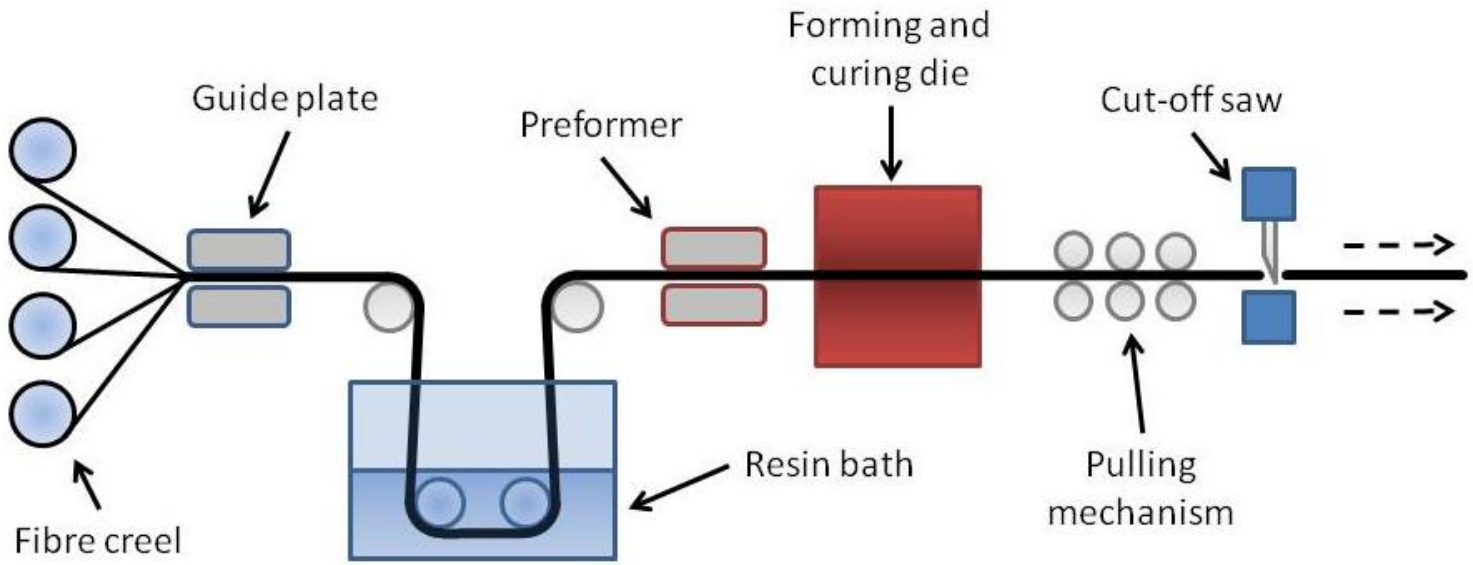
Dry woven roving is laid into the lower mould and the upper mould is fixed in place. Low viscosity resin + catalyst is injected under pressure into the mould cavity, where it permeates the fibres. The composite cures whilst in the mould. This technique is used for low volume production in the manufacture of components such as boat hulls, car parts, etc.

Filament winding



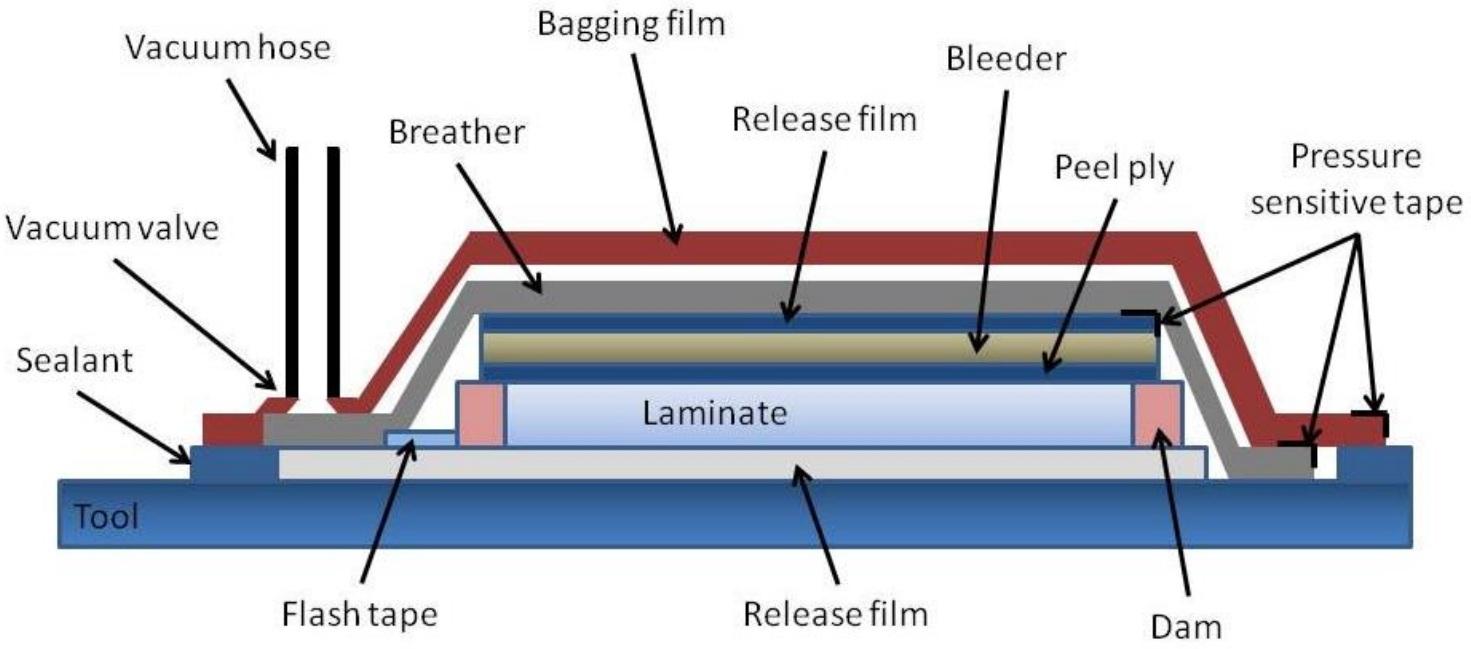
Filament winding is used to produce composite parts with cylindrical geometry. The fibres are taken from the fibre spool and passed through a resin impregnation bath. A carriage and head guide the wet fibre on to a rotating mandrel. Once covered with a sufficient thickness of fibre, the mandrel is removed from the machine while the resin cures. The solid composite is taken off the mandrel in preparation for any surface treatments. In some cases the mandrel may be dissolvable for easy removal. This technique is suitable for the manufacture of pressure vessels as the fibres are orientated circumferentially, providing high hoop strength.

Pultrusion



Fibres are pulled from a set of fibre reels and through a resin bath. They then pass through a preformer, which aligns the fibres into the required cross-sectional shape. The forming and curing dies finalise the shape of the composite, remove any excess resin and cure the composite so that it can be cut into sections of the necessary length by the cut-off saw. This technique is suitable for high volume, continuous production, and is able to produce parts with high fibre density and good resin dispersion.

Vacuum Bagging



The vacuum bagging technique can be used to improve the quality of composites produced by the wet lay-up method. A bagging film is placed around the laid-up composite material and is secured to the tool surface with sealant. Air is evacuated from the bag, leaving the composite under an external pressure of up to 1 atmosphere. This forces resin into any remaining voids and helps to ensure an even distribution. Higher viscosity resins can be used in comparison to the wet lay-up technique.

Quality Assurance

Source of [image](#) from Creative Common

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Thank you

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