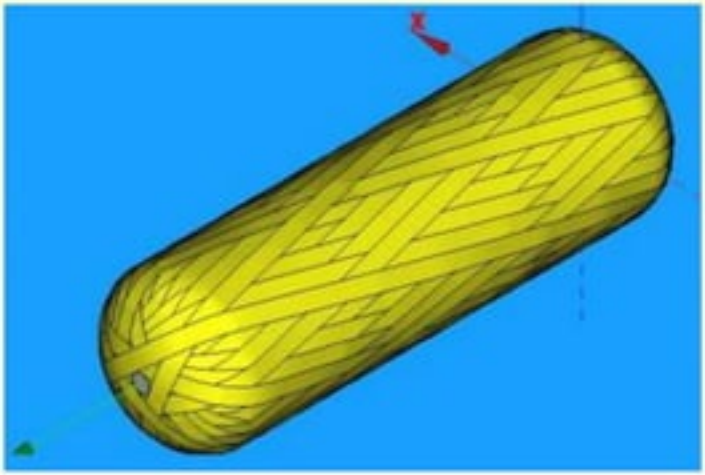
FILAMENT WINDING



Neslihan Yağmur

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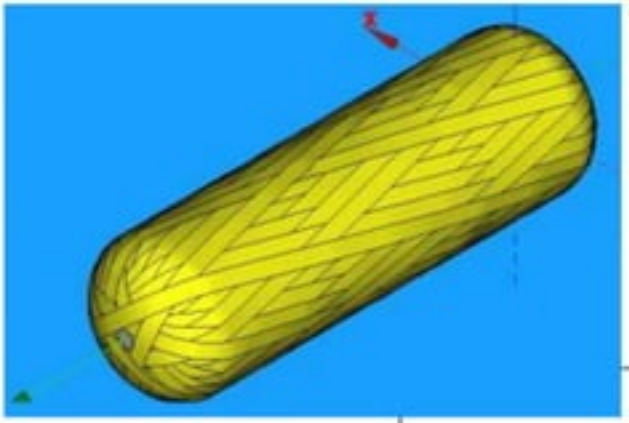
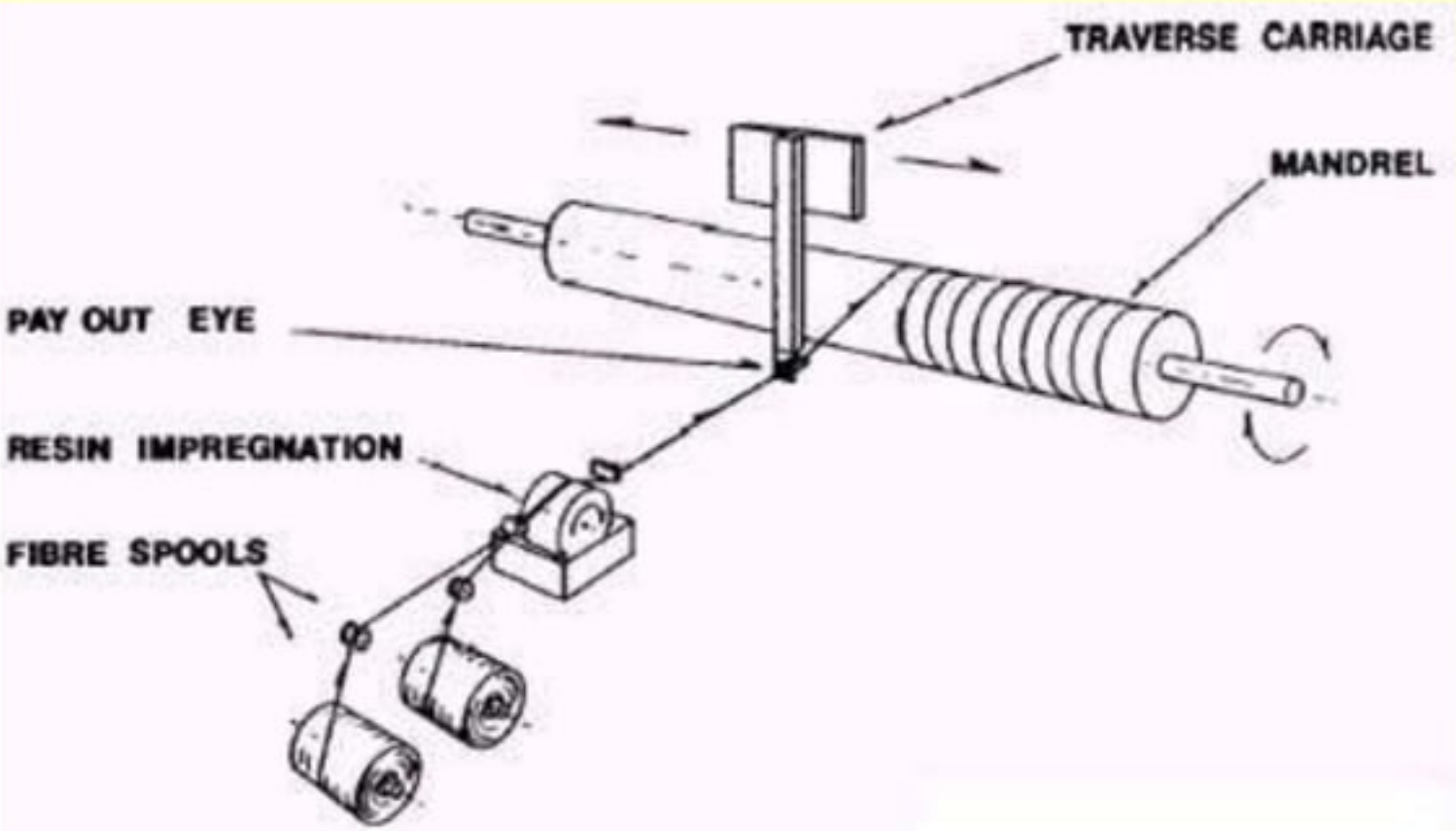
What is Filament Winding?

- Filament winding is the process of winding fiber material and resin around a shape, known as a mandrel, to create composite product. The process of filament winding is typically used to create circular composite products with a hollow core.



Filament Winding Process



Process

- Precision high-speed positioning of continuous fiber in a pre-determined pattern is the basis of the filament winding process .
- There is a mandrel that the fiber and resin wound upon, is cured in room temp or in oven. After cure mandrel is removed leaving a hallow composite structure.

Tension

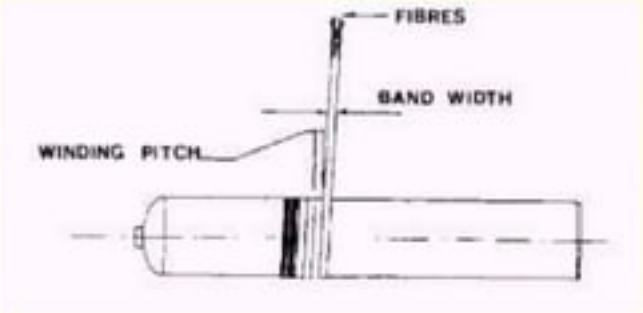
- fibre tension is critical to the operation of a filament winding machine,
- tension required depends on
  - type of fibre
  - part diameter
  - winding pattern

Tension

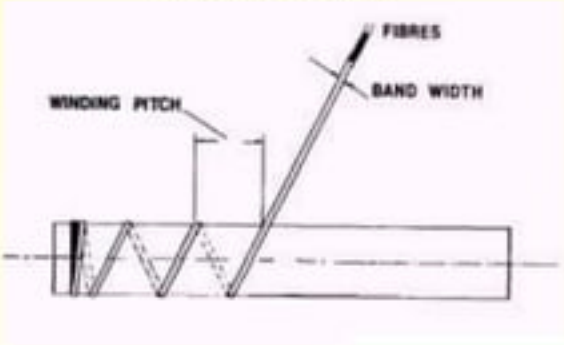
- fibre tension directly affects:
  - fibre volume fraction,
  - void content,
  - strength and stiffness of the composite part.

Winding Patterns

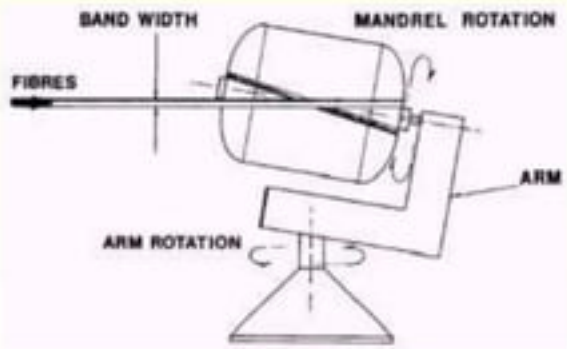
Circumferential:



helical:



polar:



Materials

fiber (in roving form):

- E-glass, S-glass,
- Carbon / Graphite,
- Aramid,
- Borons.

Materials

Resins:

- Epoxy,
- Vinyl ester,
- Polyester,
- Polyurethane,
- Phenolics,
- Furans,
- Polyimides.

Factors Affecting Properties

- Fabrication variables
- Processing variables
- Winding variables
- Material's variables
- Environmental variables

Advantages of Filament Winding

- highly reproducible nature of the process
- continuous fiber over the entire part
- high fiber volume is obtainable
- ability to orient fibers in the load direction (10° minimum winding angle)
- fiber and resin used in lowest cost form
- size of component not restricted by oven or autoclave size
- process automation (particularly with high volume) results in cost savings

Disadvantages of Filament Winding

- part configuration must facilitate mandrel extraction
- mandrel could be complex and expensive
- inability to wind reverse curvature
- inability to easily change fiber path within one layer
- wound external surface may not be satisfactory for some applications

Application

- Storage tank
- Railway tank car
- Pipe

Application

- Aerospace Parts
- Sporting Goods
- Gas Tanks

References

- Filament Winding Compositions for Fiber/Resin Composites, P. Klemarczyk, 1996
- Thermoplastic Filament Winding, *Composites Manufacturing*, J. Romagna,*1995*