International Journal of Advance Research in Science and Engineering
Vol. No.5, Special Issue No. (02), March 2016
www.ijarse.com
IJARSE
ISSN 2319 - 8354

# STUDY OF MANDREL EXTRACTOR

**AkshayMahajan[1], FahadFarooqui[2], SwapnilMokal[3], Gaurav Patel[4], KetanPatel[5], Chandrashekhar K. Patil[6]**

*[1,2,3,4] BVCOE&RI Nashik B.E.Mechanical, Pune University (India)*

*[5]Assistant Professor Mechanical Dept. BVCOE& RI Nashik (India)*

*[6]Principal BVCOE& RI Nashik (India)*

## ABSTRACT

*The study shows that it is the process of manufacturing the components using the filaments of the product with mixture of resin. In this the filaments of the components which is to be manufactured is placed on the rotating mandrel. The mixture of resin and glass is mixed in the proportion of the 30 % glass and 70 % resin. The Main application of this method is for the fabrication of open and closed type of cylinderThe process is done in three different parts, filament winding, curing and extraction in the previous section the extraction part done by using the pneumatic cylinder. The origin of our study is difficulties ours during the production processes by use of the different methods such as pneumatic cylinder, Rope Drive, Belt Drive. The problems arising while extraction of the mandrel by using the pneumatic cylinder the material gets damaged at the beginning where the pneumatic cylinder is attached. The major drawback of this system is that the pneumatic cylinder is directly attached to the work piece which damages the work piece as well as the increase in operationalnoise level. Due to use of compresses air in the system, the system becomes bulky and noise level also increases. To avoid all these drawbacks we have chance to improve the working methodology by changing the extraction process.*

## I. INTRODUCTION

Filament winding is a fabrication technique mainly used for manufacturing open (cylinders) or closed end structures (pressure vessels or tanks). The process involves winding filaments under tension over a rotating mandrel. The mandrel rotates around the spindle (Axis 1 or X: Spindle) while a delivery eye on a carriage (Axis 2 or Y: Horizontal) traverses horizontally in line with the axis of the rotating mandrel, laying down fibers in the desired pattern or angle. The most common filaments are glass or carbon and are impregnated in a bath with resin as they are wound onto the mandrel. Once the mandrel is completely covered to the desired thickness, the resin is cured. Depending on the resin system and its cure characteristics, often the rotating mandrel is placed in an oven or placed under radiant heaters until the part is cured. Once the resin has cured, the mandrel is removed or extracted, leaving the hollow final product. For some products such as gas bottles the 'mandrel' is a permanent part of the finished product forming a liner to prevent gas leakage or as a barrier to protect the composite from the fluid to be stored.Filament winding is well suited to automation, and there are many applications, such as pipe and small pressure vessel that are wound and cured without any human intervention. The controlled variables for winding are fiber type, resin content, wind angle, tow or bandwidth and thickness of the fiber bundle. The angle at which the fiber has an effect on the properties of the final product. A high angle "hoop" will provide circumferential strength, while lower angle patterns (polar or helical) will provide greater longitudinal / axial tensile strength.Products currently being produced using this technique range from pipes,

golf clubs, Reverse Osmosis Membrane Housings, oars, bicycle forks, bicycle rims, power and transmission poles, pressure vessels to missile casings, aircraft fuselages and lamp posts and yacht masts

## II. FILAMENT WINDING

In filament winding method, fiber strands are unwind and passed continuously to the resintank. In resin tank, fiber strand are impregnated completely with the resin. Now, these resinimpregnated strands are passed onto a rotating mandrel. These strands are wound around themandrel in a controlled manner and in a specific fiber orientation. The schematic of filamentwinding is shown in figure 1. Fiber tension is critical in filament winding becausecompaction is achieved through the fiber tension. The fiber tension affects the percentage offiber reinforcement and porosity content in the composite which in turn affects the propertiesof the processed composite product. The fiber tension depends upon the type of fiber, itsgeometry and the winding pattern required on the rotating mandrel. The fiber tension shouldbe at optimal level because too high fiber tension may break the fiber completely or initiatefiber fracture at the surface. Curing of the composite is done with heat, generally in an ovenand final composite product is taken out of the mandrel. To remove the metallic mandrelfrom the composite part, hydraulic rams may be used. For complex geometry of compositepart, the mandrel used may be of soluble plaster which can be washed out after processing orit may be a collapsible rubber and materials having low melting point. The profile of themandrel is exactly the same as that of the final product is required. In some cases, mandrelbecomes the integral part of the assembly. A carriage is used to keep the roving in place andto direct them to the mandrel. A high fiber volume fraction can be achieved in the compositewith this processing technique. Cores may be used in this method but normally, product is in single skin. [1]

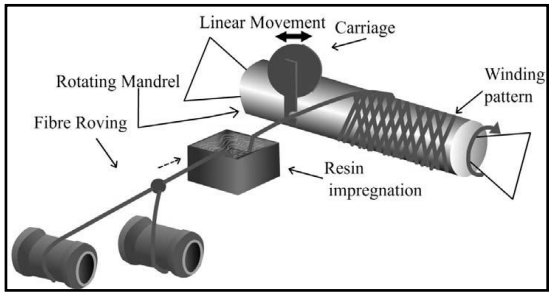


**Figure 1**

- **Advantages**
  - Easily prone to automation and thus amenable to high production volumes.
  - High strength products are produced due to fine and continual control of fiber angle.
  - Various sizes can be produced using this method.
  - Directional control of modulus and strength is feasible.
- **Limitations**
  - Winding at angles when fiber is almost parallel to axis of symmetry is difficult.
  - Reverse curvature parts cannot be produced easily.
  - Complex shapes, particularly parts with two-directional curvatures are difficult to produce.
  - External surface finish is not always high.

## III. MANDREL

- An object used to shape machined, or electroformed, work.
- A tool component that grips or clamps materials to be machined.
- A tool component that can be used to grip other moving tool components.
- It's a non-rotating element of the machine
- It's cylindrical in shape
- It's a spindle on which work piece is supported during the machining operation
- Mandrel is the arbor on which the machining tool is mounted
- The driving spindle in the headstock of lathe

**Figure 2**

## IV. HISTORY

Mandrels are not recent inventions. Metal machining utilizing the spinning process has been recorded as far back as ancient Egyptian times. In metal spinning, a wood or metal spinning mandrel is used, the form of which corresponds with the internal contour of the part to be produced. This method securely clamps the raw material and allows for accurate machining into the desired final form. Since the material is clamped internally, there is no interference to the operator from the lathe/mandrel assembly during production.Also, the traversing mandrel was introducedaround 1700, and instantiated the design of a lathe mandrel able to slide axially in its bearings under the control of the operator, so that components having short lengths of threadcould be produced, such as screws. The traversing mandrel was primarily employed by clockmakers and ornamental turners during this era. Eventually the device was superseded by a mandrel-driven device called a leadscrew, which uses a train of gears that can be altered as required for the turning application.[2]

### Problem Statement

- Initially the conceptualize that use of pneumatic cylinder is used for the removal of the mandrel from the work piece
- How could you do the same operation without pneumatic cylinder?
- Improve Production Rate

### Objective

- To choose appropriate mechanism for mandrel extractor designing to perform loading and unloading operation
- To design mandrel extraction system performing the activity.

- To choose appropriate material for fabrication of mandrel system and C-clamp.
- The objective of the project is to introduce the new technique of mandrel removal from the body

## V. TYPES OF SOLUTIONS

Rope Drives

Use of Pneumatic Cylinder

**Rope Drive :-**Wirerope is a type of cable which consists of several strands of metal wire laid (twisted) into a helix. The term cable is often used interchangeably with wire rope. However, in general, "wire rope" refers to diameters larger than 3/8 inch (9.52 mm). Sizes smaller than this are designated cable or cords. Initially wrought iron wires were used, but today steel is the main material used for wire ropes.Historically wire rope evolved from steel chains, which had a record of mechanical failure. While flaws in chain links or solid steel bars can lead to catastrophic failure, flaws in the wires making up a steel cable are less critical as the other wires easily take up the load. Friction between the individual wires and strands, as a consequence of their twist, further compensates for any flaws.Wire ropes were developed starting with mining hoist applications in the 1830s. Wire ropes are used dynamically for lifting and hoisting in cranes and elevators, and for transmission of mechanical power. Wire rope is also used to transmit force in mechanisms, such as a Bowden cable or the control surfaces of an airplane connected to levers and pedals in the cockpit. Static wire ropes are used to support structures such as suspension bridges or as guy wires to support towers. An aerial tramway relies on wire rope to support and move cargo overhead.

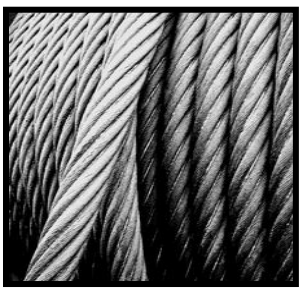

**Figure 3**

**Use of pneumatic Cylinder**

- Pneumatic system is a power transmission system in which, transmission of power takes place through compressed air.

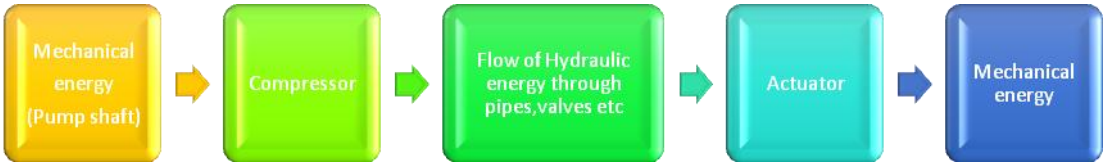


**Fig 4. Block Diagram of Pneumatic System**

- Mechanical energy is given to compressor is the shaft of compressor is rotated by means any prime mover. Compressor draws air from atmosphere and the compressed air flow to actuator through pipes and valves. Actuator produces back the mechanical energy (either liner motion of cylinder or rotary motion of air motor shaft)

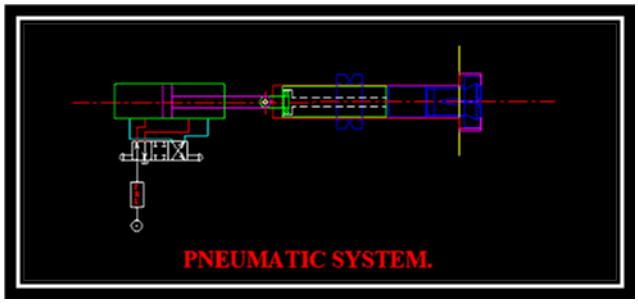


**Figure 5**

## Advantages

- Pneumatics system is very fast in operation. This is because of very low viscosity of compressed air.
- Pneumatics System works better even in hot surrounding. The pneumatic system are cool on duty even in very hot surrounding of about 398 K
- Pneumatics System are very clean, absolutely dust free surrounding.
- Automatic and safety circuits are possible.
- If overload, the system stalls. System will start working once the load is reduction in efficiency
- Pneumatics System is better in mines. Because they do not generate any spark and hence no change of explosion and fire hazard.

**Disadvantages**

- Air is freely available in nature, but not the compressed air.
- Force developed by Pneumatics System is very less compared to hydraulic
- Working time is more
- As work piece is 3m long and the cylinder length is maximum 1m then it's very costly to for unloading of work piece

**MajorComponents of Machines**

- Mandrel
- Trolley
- Winder
- Rope
- Gear box

## VI. TROLLEY

- These are the rotating elements of body
- Trolleys are placed for the providing the guideways to the work piece
- There is horizontal guideways to the trolleys
- For height arrangements there are slots are provided, so the the it will be adjusted for the work piece
- There is horizontal alignment is also provided for the vary diameter of the work piece

**Figure 6**

## VII. WINDERS

- One winder is fitted on the machine to wind the rope which is used to extract the mandrel
- One end of the rope is attached to the mandrel and anther end of the rope is fitted to the winder
- It rotates in clockwise direction
- When we give the pull to the one end of the rope and winder starts rotating n it pulls out the mandrel and we gets the required final product

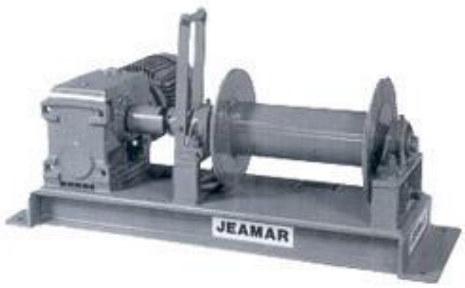


**Figure 7**

## VIII. GEAR BOX

- Gear box is used to mainly for the speed reduction
- 3 stage gear box is used

## IX. MOTOR

- Motor is used for driving the gear box
- 1500 rpm motor is used
- Power of the motor is the 5 Hp
- 3.7 kW capacity

## X. MECHANICAL CHARACTERISTICS

- Type – Horizontal Bed
- No of spindles- 1
- Sizes

  Max component diameter 40mm to 1600mm

- Max weight of the mandrel and components is 9000kg
- No of controlled axes is four (simultaneously)
- Speed of All axes
- Rotation X- 0 to 10 rpm
- Carriage travelling- -Y: 0 to 60 m/sec
- Cross feed travel- Z: 0 to 40 m/sec
- Fiber delivery speed 60m/sec
- No od spools for creel stand 12
- Machine noise level 65dB

## XI. CONSTRUCTION

- The foundation frame is fabricated, stress relived weldment fully reinforced and the gear box, motor, spindle assembly etc. are mounted on the frame
- Necessary component holding arrangements are mounted on the frame
- The cross axis is mounted on the carriage and moves on the guideways provided for particular
- Maximum 3 meters of cylindrical work piece is manufactured by the machine
- Mandrel holding arrangement id done by the 3 jaw chuck
- Automatic and adequate lubrication of all the sliding and rotating part except motors and pumps and gear box
- All the motors and cables and drives, control panel should fully sealed and fitted with panel air conditioner
- The machine is provided with the adequate safety of latest approved type
- Various types of vibration isolator are used to reduce the vibration of the machine components.

## XII. METHODOLOGY

- In filament winding method, fiber strands are unwinding and passed continuously to the resin tank
- In resin tank, fiber strand is impregnated completely with the resin.
- these resin impregnated strands are passed onto a rotating mandrel
- These strands are wound around the mandrel in a controlled manner and in a specific fiber orientation.
- Fiber tension is critical in filament winding because compaction is achieved through the fiber tension.
- The fiber tension affects the percentage of fiber reinforcement and porosity content in the composite which in turn affects the properties of the processed composite product.
- After the winding is done the mandrel kept in oven for curing the of the product
- By curing the material, it got solidifies and got uniform shape
- After the curing of material is done the mandrel is taken out of the oven
- Then mandrel is fixed on the machine
- By fixing the mandrel on the chuck and attaching the wire rope to the one end of the mandrel other end is attached to the winder through a pulley provided on the machine

**Advantages**

- High strength to weight ratio is possible to achieve with this process.
- High degree of uniformity in fiber distribution, orientation and placement.
- Labor involvement is minimal as it is an automated process.
- Filament winding method is suitable to process composite parts requiring precisetolerances.
- Fiber orientation in a specific direction is possible in this process.
- Cost of the composite part processed through filament winding method is substantially

**Disadvantages**

- Capital investment is relatively high.
- Very precise control over the mechanism is required for uniform distribution andorientation of fiber.
- Composite product configuration be such that it should facilitate in mandrel extraction.
- It is not possible to produce the reverse curvature (female feature).
- For some applications, mandrel may be expensive and surface of the composite part may not be satisfactory
- Fiber direction cannot be changed within one layer of winding

**Application**

- Composite products like storage tanks, pipelines, vessels, gas cylinders, fishing rods, missile cases, rocket motor cases, ducting, cement mixture, sail boat mast, aircraft fuselages and golf club shafts are very common to be developed with this method.
- Now, the application spectrum of filament winding has expanded to complex engineered non-spherical and non-cylindrical composite products with the use of sophisticated machinery and software.

## XII. CONCLUSION

- Rope drive is selected as the solution for increase the precision an accuracy of the loading and unloading of the object.
- Mandrel extractor is fabricated by using machining processes.
- All the machine components are made in-house in the company and device is tightening by the bolts and welding
- Using 3 times of factor of safety the selection of rope drive is done to sustain the required force to remove the mandrel from the work piece and to increase the life of system.

## REFERENCES

[1]. https://en.wikipedia.org/wiki/Filament_winding#Materials
[2]. https://en.wikipedia.org/wiki/Mandrel
[3]. http://www.oxforddictionaries.com/definition/english/mandrel
[4]. Mechanics of Composite Materials, Jones, R. M., Mc-Graw Hill.
[5]. Analysis and Performance of Fiber Composites, Agarwal, B.D. and Broutman, L. J., John Wiley & Sons.