

# FRP moulding using biaxial toggle driven Roto- Casting machine

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**Abstract-** Manufacturing hollow objects using biaxial toggle drive to produce cost efficient, highly durable, Stress free components with various surface finish. Any kind of component with no size and design. Restrictions can be fabricated using FRP (Fiber reinforced polymer) which is used in making the mould for the component. The casting technique known as rotational casting, or roto casting, is excellent for producing hollow objects. This technique does not use pressure like most other casting process does. Because the process's moulds don't need to withstand pressure, they are reasonably cheap and may be produced in relatively short batches at a very low cost. A wide variety of goods are produced using the roto casting process. Since almost any shape can be made, the method gives the product designer a great deal of creative freedom.

**Key words :** biaxial, fiber reinforced polymer, mould, casting, pressure

## INTRODUCTION

The sole purpose of the project is to understand the design and mechanism of the biaxial toggle drive and the casting technique known as rotational casting, or roto casting, which is excellent for producing hollow objects. This technique does not use pressure like most other casting process does. The process's moulds are affordably priced and can be made in comparatively small quantities for a very low cost because they don't have to bear pressure. The roto casting method is used to make a wide range of products. The process allows for the creation of nearly any shape, which greatly expands the creative possibilities for the product designer. There are literally thousands of uses for mouldings, and there are virtually no size restrictions. This is an economical way to make clear resin or plaster components. By gently rotating the mould it is filled with resin or plaster and rotated both vertically and horizontally. The resin on the interior surfaces of the mould is distributed and fused by the simultaneous rotating and by the reaction with the catalyst it hardens. Large hollow, seamless, and double-walled pieces are produced using the casting technique known as "rotational casting," also known as "roto casting." A mould on a rotating frame, a heating chamber, and a cooling chamber are all components of the three-stage process. Roto casting moulds may create goods with single or double walls to their particular design. polyethylene resins serves as the primary raw material for roto casting. The mould's frame has the ability to rotate the mould around its axis rotation. The

resin is distributed evenly across the inside surface of the mould as it spins, giving the end product a uniform thickness throughout. The mould transitions to the cooling chamber after a certain amount of time, where the liquefied, melted resin is allowed to cool before the product is expelled from the mould. Products made by rotational casting are of the finest caliber and are renowned for their toughness and longevity. The tooling for the moulds is less expensive since rotational casting does not entail pressure because the moulds are not put under pressure. The proportions of the objects that are rotated into shape are essentially limitless because the machines and moulds can create very large, intricate plastic shapes. There are also few restrictions when it comes to part design, allowing the designer to include complex aspects. While rotational moulding also makes use of a rotating mould, roto casting is not the same. Rotational moulding involves heating and filling the mould with material. The material is then slung onto the inner wall of the mould by the rotation of the mould around two or more axes. Producing huge resin pieces at a reasonable cost can be achieved using rotational casting. Producing products with superior stability, consistent wall thicknesses, and high-quality finishes is the main goal of rotational casting. The roto casted product can have inserts and spin weld attachments put straight to it thanks to this production method. The end result is a product seamless sections that have uniform wall thicknesses and additional material in the corners to absorb shocks and stresses where they occur most frequently.

## WORKING PRINCIPLE

The rotational casting process is quite simple, it is driven by a biaxial toggle drive mechanism, which is transferred via the chain sprocket and bevel gears and rotates the major and minor axes of the machine, resulting in 360 degrees of rotation, which aids in the even filling of material during the cooling cycles. Rotational casting has a pretty straightforward principle.

A resin or plaster substance, typically in powder slurry form, is poured into a hollow mould that is constructed out of FRP (Fiber reinforced polymer). The mould is shut and slowly rotated on two axes. The polymer then gradually reacts with the catalyst, hardens and "lays up" on the interior of the revolving mould. After the resin or the plaster slurry hardens and solidify as time passes by. The process is stopped, and the result is removed from the mould, once the material has finally cooled and

solidified sufficiently to pull away from the mould surface. The drive for the major axis is obtained by a chain drive which is connected with sprocket that is driven by a motor; similarly the minor axis is driven by gear box that is connected via shaft, which is a sub drive also known as toggle drive, this mechanism gets the drive from the sprocket that drive the major axis. Its directly connected to the major axis's driven sprocket and rotates the gear box, which in turn rotates the minor axis. These gear box, is used for perpendicular drive, same in this case also drives in right angles. After the mould preparations are done the raw material that is either clear resin or plaster of paris also known as POP is then diluted to a slurry form and then it is, poured into the mould, which then due to the process rotates 360 degrees and acquires the shape of the mould. After the cooling cycle is done, once after the raw material acquires the shape of the mould, after the regulated cooling time, the mould is opened and the final product is removed from the mould.

#### **MACHINE WORKING PRINCIPLE :**

The above explained mechanism is basically used to run the roto-casting machine with the help of a chain sprocket drive, shaft and a "helical gearbox". The main drive from the motor is transmitted to the major axis via shaft that is locked in position with Bush and cotter pin. The drive from the motor to the shaft is connected via a "love joy coupling". Then the sprocket of the ratio 1: 2.5 transmits the power for the Minor axis via sub drive Or the "toggle drive". The sprocket of 2.5 ratio is mounted on the shaft That is welded to the bearing that is fixed to it but, The shaft that it's mounted rotates freely irrespective to the fixed sprocket. The drive irrelevant to the shaft is transmitted to the 1 ratio sprocket via chain. This then rotates the sprocket and the shaft that the sprocket is mounted on. Due to the pulling force that is created by the rotation of the major axis the chain pulls the 1 ratio sprocket and rotates it and the shaft. This shaft on the other end is connected to a speed reduction gear box of 1:10 ratio, the shaft of long length is supported by bearings. This shaft transmits transverse power to longitudinal power that is "Perpendicular power transmission" is done to give drive to the minor axis via shaft the is connected to the other output end of the gearbox. This makes the perpendicular rotation of the minor axis with respect to the major axis by a total speed reduction of 4:1 that is the standard speed reduction that is universal and according to the reference of science directory.

#### **MANUFACTURING OF ROTO CASTING MACHINE:**

➤ After the finalization of the designs and drawings the raw material and the spare parts are purchased from the market as per requirement of the needed.

➤ The raw materials that are purchased can be classified into two types that is products that is too be manufactured and the product and the parts that is to be purchased for the assembly of the machinery.

➤ Then the components that are to be manufactured for the assembly are the frames, major axis, minor axis, minor axis adjuster.

➤ The components are precisely cut according to the design and drawings and are arc welded for the necessary.

➤ And then after the completion of this process then a coat of primer is applied before painting and a trial run is kept to test the ability of the components.

➤ Then bearing that are purchased is mounted on the frame of the shaft support to handle the major axis and the bearings are mounted on the out end of the shaft.

➤ Due to the increased axial load another pair of bearings are installed on both the ends and support rib structure weld is kept for support.

➤ The deflection of the machine is completely eliminated after the bearings and the support weld.

➤ And the motor stand, motor base and the control panel assembly are mounted on with the help of nuts and bolts and the motor is fixed upon it for the trail run, and it successfully completed with only major axis.

➤ And the minor axis is mounted in between the major axis and is given the biaxial toggle drive, asper the mechanism that is explained in the working principle.

➤ And after successful trials with mechanism the machine is completely lobed, cleaned and painted.

➤ After this work balancing is done so that the work offset or imbalance that creates uneven load for the machine the also causes the motor to over load.

➤ And then the timer is set in a manner that it rotates clockwise for 3 minutes and stops of 10 seconds and the rotates again anticlockwise for 3 minutes to ensure even filling and settling of the material to ensure even wall thickness.

➤ For manufacturing a FRP mould a master pattern is required , so that its shape can be acquired and can be used to take the mould.

➤ Selection of the master pattern is important as the factor of negativity must be considered for the easy replica of the pattern and easy release of the mould.

- Firstly the master pattern is coated with wax polish and dried for 15 min and wiped and another coat of wax polish is applied and dried.
- After the dried wax coating a coat of PVA is applied ,it's a kind of releaser that is used and it similarly applied as wax and 2 coats of PVA(poly vinyl alcohol) is dried
- And then the combination of resin, catalyst, accelerator and pigment is mixed in proportionate ratios as mentioned earlier in the mould manufacturing process and applied on the pva coat and its dried, this turns to be the inner layer of the mould.
- And the fine mat to capture the details of the master pattern of 2 layers is applied with resin composition , And after drying the coarse mat of 6 layer is used for the rigidity of the mould.
- And partion line are made so that the mould can be split while demoulding, The same process mould repeated for the other parts of the mould.

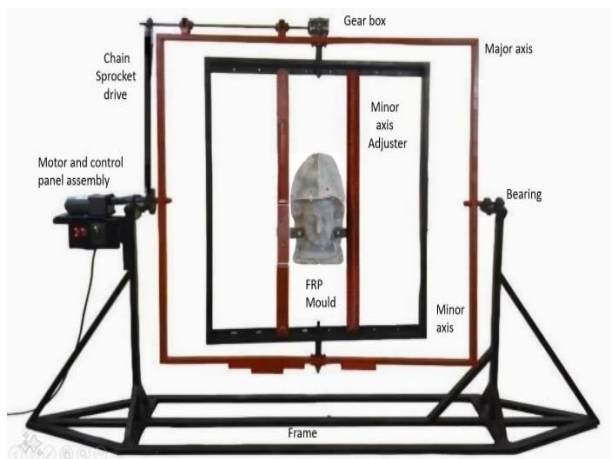


Fig -1: Machine with FRP mould



Fig -2 : casted component

Weight 2.5 kg with 2 layers

**ADVANTAGES:**

Roto casting boasts a number of advantages over comparable moulding methods:

**Low-cost tooling:** low operating pressures allow roto cast tooling to be crafted from low-cost metals such as FRP (Fiber reinforced polymers).

**Consistent wall thickness:** the constant rotation of the mould coats the walls evenly during cooling processes.

**Double-wall construction:** complex double-walled open containers can be produced without secondary processing.

**High durability:** parts are moulded as one solid piece, eliminating the need for joining techniques such as welding and joint fabrication which creates weak spots

**High stability:** the moulding material isn't exposed to external pressure, increasing its stability and reducing the risk of defects in the finished part

**High strength:** roto casting creates thicker corners, reducing the risk of failure in these stress-concentration points

**Appearance:** the soft metal used for the roto cast tooling easily accommodates surface finishes such as fine-detail textures, logos, symbols, and lettering.

**Different Applications**

**A) Cases and Lockers:** Cases and lockers are ideal products for the roto moulding process. Generally large cases, lockers, munitions cases, footlockers, industrial equipment carriers and similar items can be rotationally moulded to varying thicknesses, wall densities and exact dimensions in fairly small quantities. Designing in ribs can provide structural support for larger pieces.

**B) Lawn and Garden Products:** Lawn and garden products like organic composters, rain barrels, water conservation tanks and simulated stone speakers can all be rotationally moulded in plastic to reduce weight and provide leak tight large volume containers. The demand for water conservation solutions is growing and designers are turning to roto moulders to produce colourful, low cost products that can often simulate or blend in with their natural surrounds. Rotational moulding intricate designs like this rain water collection "urn" are achieved as the roto moulds spin in 360 degrees to create seamless, hollow parts. The following are samples of custom roto moulded lawn and garden products:

- Composter
- Tumblers Rain

- Barrels Compost
- Makers Rain
- Collection Urns

**C) Backboards and Spine Boards:** Medical spine boards and backboard are excellent applications for the rotational moulding process. Most spine boards are wide and long yet need to be very strong. Designing a mould for the rotational process allows for the moulding of a long, hollow part with handles and slots for accessories. Typically, rotationally moulded backboards will be injected with poly foam to create an extremely light-weight board with a high level of structural integrity... often rated in excess of 400 pounds. Roto moulded boards also offer customers a wide range of colour selections as well moulded in graphic opportunities that allow for branding and property identification.

## CONCLUSION

The "The FRP mould using biaxial Toggle driven Roto-casting machine" is designed with satisfactory conditions. We have done our ability and skill maximum use of available abilities facilities. This has lot of advantages it is economically cheap, and the production can be done more easily with the help of this machine. It has low maintenance, thus it can use in industry easily.

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