Review on Design of Bi-Axial Toggle Driven Roto-Casting Machine

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***Abstract*—Utilising a biaxial toggle drive, hollow objects can be manufactured to provide inexpensive, incredibly resilient, stress-free components with a range of surface finishes. Fibre reinforced polymer, or FRP, can be utilised to create any type of component, with no limitations on size or design, as it can be used to create the mould for the component. Hollow things can be made very well with the rotational casting method, also referred to as roto casting. Unlike the majority of casting processes, this one does not require pressure. The moulds used in this method are fairly priced and may be produced in relatively small batches at a very low cost because they do not need to bear pressure.**

1. INTRODUCTION

The project's only goal is to comprehend the construction and workings of the biaxial toggle drive as well as the rotational casting, or roto casting, casting method, which is great for making hollow objects. Unlike the majority of casting processes, this one does not require pressure. The process's moulds are reasonably 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 offers the product designer a tremendous level of creative freedom because nearly any shape can be created. Mouldings can be used for countless applications, and there are hardly any size limitations.

This is a cheap method of creating transparent plaster or resin parts. The mould is filled with resin or plaster and rotated both horizontally and vertically by carefully turning it. By rotating simultaneously, the resin on the mold's internal surfaces is dispersed, fused, and hardened by the catalyst's reaction. The plastic casting process called "rotational casting," or "roto casting," yields large hollow, seamless, and double-walled parts. The three-stage technique consists of a heating chamber, a cooling chamber, and a mould on a rotating frame. Because of its unique design, roto casting moulds can produce objects with single or double walls. When the process of roto casting begins, one of the polyethylene resins is poured into the mould as the main raw material. The mould can be rotated around its axis of rotation using the frame of the mould. As the mould spins, the resin is equally dispersed throughout its interior, giving the finished object a consistent thickness all the way around. After a set period of time, the mould moves to the cooling chamber, where the melted, liquified resin is given time to cool before the product is removed from the mould. Rotational casting produces products of the highest quality that are known for their durability and toughness. The tooling for the moulds is less expensive since rotational casting does not entail pressure because the moulds are not put under strain. 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. The finished product consists of seamless pieces with consistent wall thicknesses and extra material in the corners to cushion shocks and strains where they happen most often.

2.STAGES OF ROTO-MOULDING MACHINE

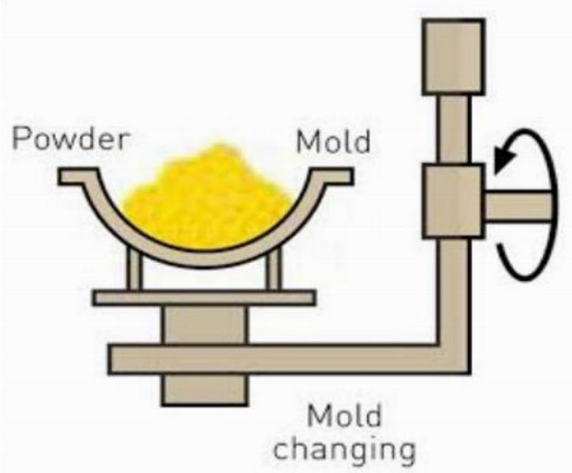
Various stages of rotomoulding machine are as follows [5]:

1. Charging the mould
2. Cooling the mould
3. Demoulding

A. CHARGING THE MOULD

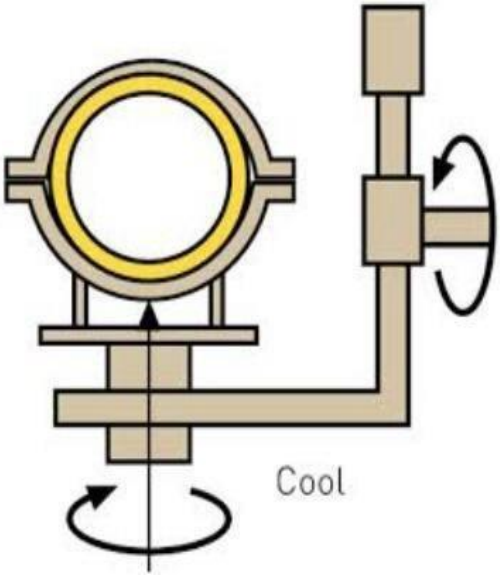
In Step 1, a specified amount of liquid or powdered plastic, equal to the necessary component weight, is

charged into a hollow metal mould that is kept at room temperature. The dimensions of the charge can be estimated by considering the mold's surface area, the necessary thickness of the final moulding, and the plastic's density. Rotational moulding has the significant benefit of not wasting any material because the entire amount of plastic inserted into the mould is used to create the product.



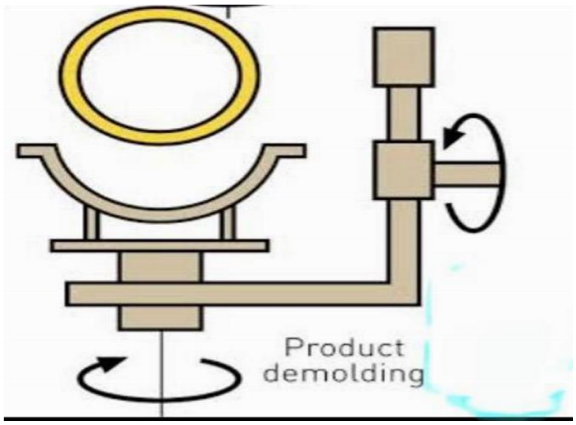
B. COOLING THE MOULD

This stage involves removing the mould from the and starting the cooling process. The mould in the cooling bay is depicted in Figure 3. During this phase, the mould keeps rotating while cooling is aided by high-velocity air and, occasionally, a fine water spray to speed up the process once the plastic has set.



C. DEMOULDING

In this stage, the finished part is removed from the cooled mould and the process can be repeated.



WORKING PRINCIPLE:

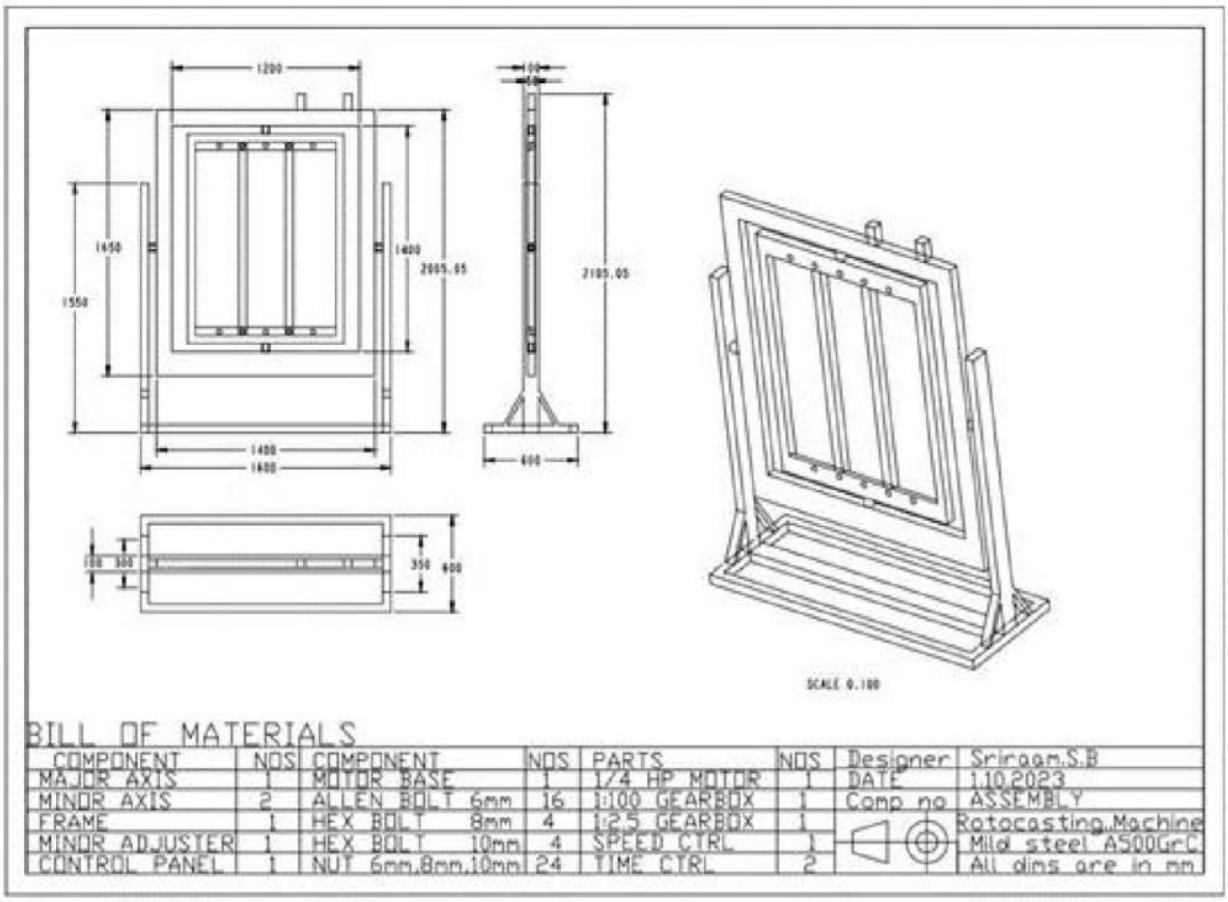
This mechanism is basically used to run the rotocasting machine with the help of a chain sprocket drive, shaft and a HELICAL GEARBOX. The main drive from the motor is transmitted to the major axis via shaft that is locked in position with Bush and cotter pin. The drive from the motor to the shaft is 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 1ratio 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 1:4 that is the standard speed reduction that is universal and according the reference of science directory and Wikipedia.

DESIGN



Design prototype

ACTUAL PROTOTYPE:

The fact that the mould rotates at a comparatively sluggish pace—typically up to 12 rev/min— should be noted. Therefore, the procedure should not be confused with centrifugal casting, in which the plastic is flung against the mould wall as the mould rotates rapidly. While it may seem appealing to spin the mould quickly in order to boost output, the intricate design and dimensions of moulds prevent this from happening. Rotational moulding involves placing the plastic at the bottom of the mould, and when the heated mould turns, every point on the mold's surface dips into the powder pool and collects the molten plastic.

By altering the speeds of rotation about the perpendicular axes of rotation it is possible to control the wall thickness of the end product. Areas that need to be thick should enter the powder pool more regularly than other parts of the mould surface.

Depending on the shape of the plastic part, different values can be selected for the ratio of the speeds about the two axes. The speed ratio can be calculated by dividing the major (arm) axis speed by the minor (plate) axis speed. Typically, a 4:1 speed ratio is employed to obtain a part with a consistent wall thickness. To obtain a uniform wall thickness in a moulded object, it is feasible to determine the appropriate speed ratio for a new mould by adding only enough powder to cover the mold's whole surface with a thin layer of powder. To make sure that every

portion of the mould surface is sufficiently coated, various speed ratios can then be examined. When the entire material charge is utilised, a portion with a consistent thickness should result. We'll talk about the significance of choosing the appropriate speed ratio later.

Heating plastic powder or liquid by raising the temperature of the spinning mould is the fundamental step in the rotational moulding process. Plastic begins to stick to the mold's inside surface when its temperature rises to a sufficient level above ambient temperature. Until all of the plastic material has been deposited into the inside surface of the mould, the hollow will repeatedly pass through the pool of plastic material as the mould rotates.

APPLICATION

There are a wide variety of application of roto casting, it has infinite numbers of products that can be innovated, via conversion from typical materials like steel, aluminum ,cast iron etc. .,,some of the products that can be developed and be made in roto moulding process are manhole inspection chambers, rainwater tanks and diesel fuel tanks, children's playhouses, slides, climbing frames, toys and leisure crafts, traffic cones, dinghies, canoes and kayaks, pallets, garden planters, and water butts/

CONCLUSION

Rotation ratio, cooling duration, and cooling rate are important variables in the rotational casting process. The dimensional quality and mechanical characteristics of the products that will be manufactured are determined by these parameters. High thermal stability, easy flow in a molten state, and the presence of antioxidant groups in the molecular structure are all requirements for the polymer resin. Rotational casting has several benefits, including the ability to produce parts with consistent wall thickness, low-cost tooling, production flexibility, fewer downstream processes, and reduced resin waste. Large, double-walled components can be made with ease as well. The drawbacks of rotational moulding include a lengthy cycle time because of extended cooling cycles, a small selection of materials, a short tool life, and challenges moulding specific details.

To the best of our knowledge, the project work discussion has given us a great opportunity and experience. While working on small projects, we learn a lot about designing and planning. We believe that the little project is an excellent way to open doors between household and industrial uses.

The "BIAXIAL TOGGLE DRIVEN ROTO-CASTING MACHINE" is built in a way that meets requirements. We have used the facilities that are available to the best of our abilities and skills. There are many benefits to this, including low cost and easier production with the aid of this machine. Because it requires less upkeep, industries can readily employ it.

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