Review on Fabrication of Roto-Moulding Machine

(ROTATIONAL MOULDING MACHINE)

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Abstract— **Rotational moulding is becoming a highly sophisticated manufacturing method for plastic parts. New mould and machine features, and advanced process control technologies, are becoming available at regular intervals. This gives designers, and end users, access to new opportunities to create novel and innovative plastic mouldings. Rotational moulding is a technique for the transformation of plastics in hollow articles such as doll's heads, tanks, containers, gloves, etc. The technique allows obtaining small parts of a few grams as well as containers of more than 20000 liters of capacity. Foamed parts, multi-layer moldings' or soft mouldings without joining lines can also be produced, what gives an idea of the versatility of this technique. Roto-moulding machine works on basic principle of centrifugal force which is generated within mould cylinder. By adding some extra features like the pressure blowing and rotational bearing design changes we can save large amount of time in this procedure. So our goal is to make the cycle stress free and reduce the total making time of the product. Hence the cost and time efficiency will be good as purposed by us**.

Index Term— Rotational, Moulding, Casting, Heating, Cooling, Plastic, Material, Mould, Hollow, Component

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I. Introduction

Rotational moulding, also known as rotocasting or rotomoulding, is a low pressure, high temperature manufacturing method for producing Hollow, one-piece plastic parts. As with most manufacturing methods for plastic parts, rotational moulding evolved from other technologies. The basic principle of forming a coating on the inside surface of a rotating mould dates back for many centuries, but the process did not gain recognition as a moulding method for plastics until the 1940. A British patent issued to Peters in 1855 (before plastics existed) cites a rotational moulding machine containing two-axis rotation through a pair of bevel gears. It refers to the use of a split mould having a vent pipe for gas escape, water for cooling the mould and the use of a fluid or semi-fluid material in the mould to produce a hollow part.

Currently rotational moulding is a very competitive alternative to blow moulding, thermoforming and injection moulding for the manufacture of hollow plastic products. This is because it offers designers the opportunity to achieve the economic production of stress-free articles, with uniform wall thickness and potentially complex shapes.

Rotational Molding involves a heated hollow mold which is filled with a charge or shot weight of material. It is then slowly rotated (usually around two perpendicular axes) causing the softened material to disperse and stick to the walls of the mold. In order to maintain even thickness throughout the part, the mold continues to rotate at all times during the heating phase and to avoid sagging or deformation also during the cooling phase. The process was applied to plastics in the 1940s but in the early years was little used because it was a slow process restricted to a small number of plastics. Over the past two decades, improvements in process control and developments with plastic powders have resulted in a significant increase in usage.

Rotocasting (also known as rotacasting), by comparison, uses self-curing resins in an unheated mould, but shares slow rotational speeds in common with rotational molding. Spin casting should not be confused with either, utilizing self-curing resins or white metal in a high-speed centrifugal casting machine.

II. Stages of Roto-moulding Machine

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

a. Charging the mould
b. Heating the mould
c. Cooling the mould
d. Demoulding

III. Charging the Mould

In Stage 1, a hollow metal mould (at room temperature) is charged with a predetermined quantity of powdered (or liquid) plastic, which is equal to the desired part weight. The size of the charge can be determined on the basis of the surface area of the mould, the required thickness of the final moulding and the density of the plastic. An important advantage of rotational moulding is that there is no material wastage – all the plastic placed in the mould is used to make the part.

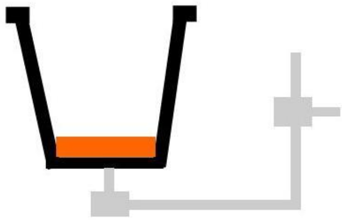

Fig. 1 charging the mould

IV. HEATING THE MOULD

In Stage 2, it can be seen that the other half of the mould has been clamped into position and the mould begins to rotate in a heated environment. This is often a hot air convection oven, but the mould could be heated by a variety of methods that include electricity, infrared, hot oil or open flames.

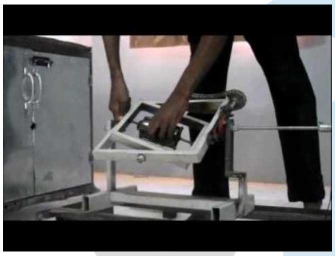

Fig. 2 Heating Cabinet

It is important to note that the mould rotation is relatively slow – typically up to 12 rev/min. Thus the process should not be confused with centrifugal casting in which the mould rotates at high speed and the plastic is thrown out against the mould wall. Although it might be attractive to rotate the mould at high speeds to increase productivity, the complex shape and size of moulds do not permit this. In rotational moulding, the plastic lies in the bottom of the mould and as the heated mould rotates, all points on the surface of the mould dip into the powder pool and pick up 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.

The ratio of the speeds about the two axes can be set to different values, depending on the shape of the plastic part. The speed ratio is the speed of the major (arm) axis divided by the speed of the minor (plate) axis. A speed ratio of 4:1 is commonly used to get a uniform wall thickness part. If it is desired to get a uniform wall thickness moulded part, a good practical way to get the correct speed ratio for a new mould is to put in the mould just enough powder to achieve a thin film coating over the entire surface of the mould. Different speed ratios can then be investigated in order to ensure that all parts of the mould surface are adequately coated. When the full charge of material is used, this should give a uniform thickness part. Alternatively, computer simulation programs such as Roto Sim can be used to determine the correct speed ratio before the mould is set up on the moulding machine. The importance of using the correct speed ratio is discussed later.

The basic rotational moulding process involves heating of plastic powder, or liquid, through the increase in temperature of the rotating mould . When the temperature of the inside surface of the mould becomes high enough, the plastic starts to adhere to it. As the mould continues to rotate, the cavity will pass through the pool of plastic material again and again, until all of the plastic material has been deposited onto the inside surface of the mould.

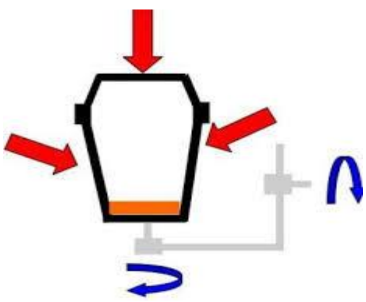

Fig. 3 Heating the mould

V. Cooling The Mould

In Stage 3, the hot mould is removed from the oven and the cooling cycle begins. Figure 3 shows the mould in the cooling bay. The mould continues to rotate during this stage and cooling is usually assisted by high velocity air and sometimes a fine water spray is used to increase the cooling rate after the plastic has solidified. If water cooling is used too early then the moulded part may become warped or distorted.

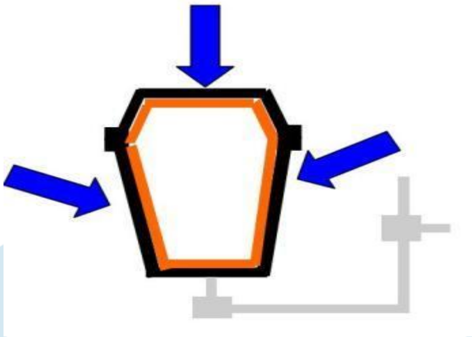

Fig. 4 Cooling the mould

VI. DEMOULDING

In Stage 4, the finished part is removed from the cooled mould and the process can be repeated.

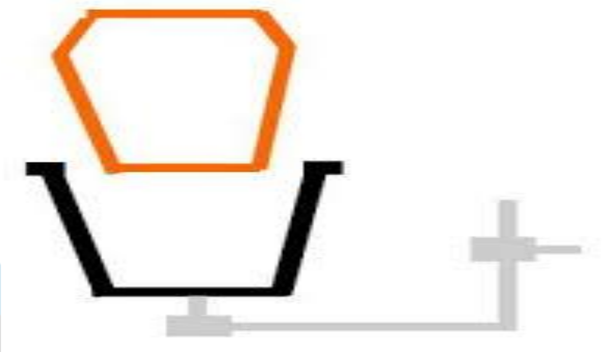

Fig. 5 De-moulding

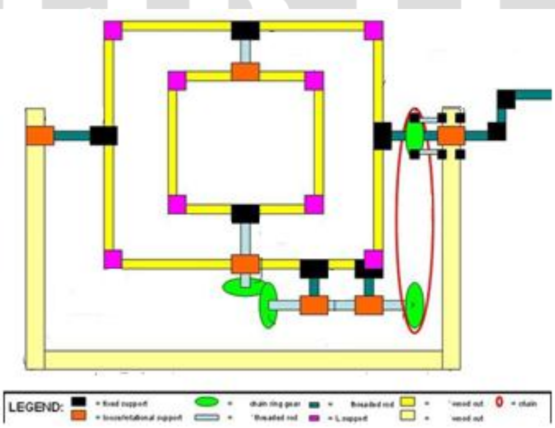

Fig. 6 Prototype

Fig. 7 Actual Prototype

VII. APPLICATIONS

1. Material Handling Product

Examples: Tanks (agricultural, chemical, fuel, septic), chemical drums, shipping containers, wheeled bins, hoppers, coal bunkers

2. Industrial Product

Examples: Pump housings, pipefitting's, effluent ducts, air ducts, sewer linings, safety helmets, stretchers, light fittings

3. Leisure Product

Examples: Canoes, kayaks, windsurfing boards, boats, trailers, Toys, playground furniture, mannequins

4. Marine Products

Examples: Floats, buoys, life belts

5. Road Signage

Examples: Road barriers, road cones, road signs

Fig. 8 Tanks

Fig. 9 Safety Helmets

Fig. 10 Toys

VIII. CONCLUSION

This paper is review on the basis of fabrication of rotational moulding process. Rotational moulding presents a method for producing definitive lightweight, low cost, corrosion and fatigue resistant thermoplastic shank sections for prostheses. An advantage of the technique is the simplicity and low cost of associated moulding equipment and moulds. This enables shank design to be quickly and readily modified at the prototype stage if required to suit highly stressed areas of the prosthesis. Moulding wall thickness can be varied by adjusting the amount of starting material to match patient weight and activity level.

The moulded nylon shank sections are attached to other limb components such as socket and foot unit by a single bolt fixing onto moulded-in metallic inserts at distal and proximal ends of each shank. Laboratory fatigue testing and limited patient trials have highlighted the reliability and durability of nylon rotationally moulded shanks which recommend them as a potential alternative to those produced from aluminum alloy and carbon fiber reinforced resin.

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