Design and Fabrication of Injection Moulding Die

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Abstract— Injection moulding is one of the most widely used production processes for mass production of plastic parts. The main objective of this project is to study, design and manufacture component using Plastic injection moulding technique. PTC CREO 3.0 is used to design the die and component. The die is made of OHNS material while the component manufactured is of NYLON-6 material. This paper shows complete study of Plastic injection Moulding for Nylon Bush along with Die design study and simulation.
Key words: OHNS Material, Injection Moulding Die

I. INTRODUCTION

Injection moulding process is used to produce many household appliances, automotive and industrial parts. The injection moulding process is capable of producing a large variety of part designs containing many details such as threads, springs and hinges, in a single moulding operation. In this process, molten polymer is injected under very high velocity into the mould, where it is solidified and cooled to get desired shape component. Study of different materials to be used for manufacturing of Component is carried out. Utilization of material with optimum characteristics such as Strength, toughness, density, mould ability melting point. Nylon is the first commercially used Synthetic Thermoplastic polymer. The most popular polymer bushing materials are PTFE (Polytetrafluoroethylene), PEEK (Polyether ether ketone), Ryton® PPS (Polyphenylene sulfide), Nylon, UHMWPE (Ultra-high-molecular-weight polyethylene).The Nylon bushes are widely used in gears, pulleys, sprockets, shafts, fan blades, rollers etc. The component is manufactured using various grades of plastic categorized on basis of physical and chemical properties. The design of injection mould is highly interactive and manual process involving substantial knowledge of multiple areas, such as mould design features, mould making processes, moulding equipment and part design, all of which are coupled to each other. The screw type clamping system is used for clamping purpose. The clamping system's function is to keep the plastic from leaking out or "flashing" at the mould's parting line. The main challenge is to design and produce a die that is straightforward to manufacture, while providing uniform filling and cooling of plastic parts.

II. LITERATURE SURVEY

In paper [1], the cycle time of the injection moulding process has five main stages. The first one, designated as pasting, involves the heating and melting of the plastic in the plasticiser. The second stage, injection, injection of melt into the mould. The third stage packing, to prevent back flow and compensates for the decrease in volume of melt during solidification. The forth the cooling stage, involves the moulded part cooling in the mould until it is sufficiently rigid to be ejected. Finally the last stage release allows removal of the part by hydraulically opening and closing the mould to start the next cycle time. In paper [2], In Polypropylene material, identified some of the satisfactory properties for production or moulding. In this density, percentage elongation at break, shrinkage percentage there are the considering properties to take for the production. After loading the tool into injection moulding machine the material pellets are melted and injected into the mould. Under the pressure, the molten material is forced in to mould through sprue. The mould is held under pressure until the material cools and hardens. Once the material hardens, the mould is opened and the part is removed. And the process can be repeated. The standard injection cycle time is 25 to 44 sec, this time will vary depends on part design.

III. PROCESS FLOWCHART

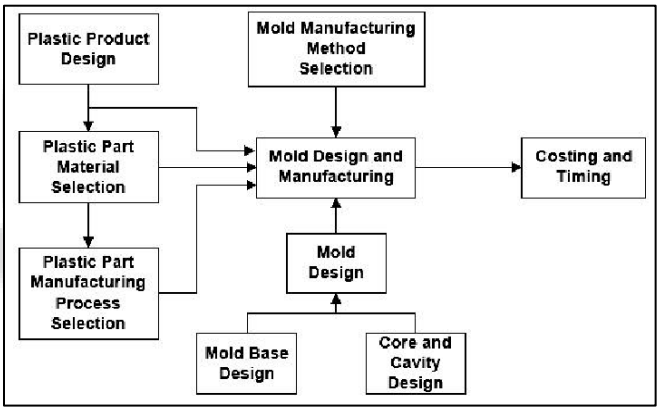

Fig. 1: Process Flowchart

IV. COMPONENT DESIGN

A. *Dimensions of Bush*

- Outer Diameter: 40mm
- Inner Diameter: 30mm
- Wall thickness: 2mm
- Height: 10mm
- Shank diameter: 30mm
- Wall thickness: 3mm

B. *PTC CREO Model*

As per dimensions,

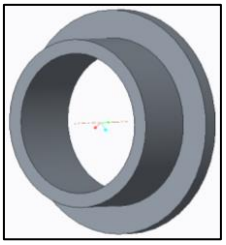

Fig. 1: Isometric view of Bush

1) Input Parameters

– Material: Nylon6
– Density: 1140 kg/m^3
– Young's Modulus: 23GPa
– Poisson's ratio: 0.39
– Yield Strength: 50000KPa

2) Ansys Result

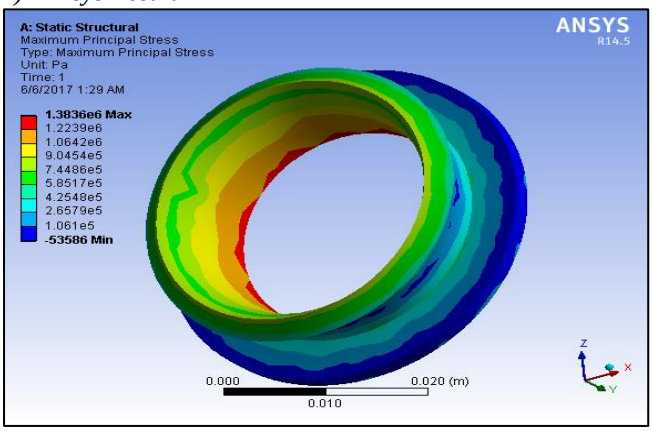

Fig. 2: Stress Distribution at 222.4 N force

3) Mould Design

– Plate dimension: 86*64mm
– Plate thickness: 15mm
– Guide pin length: 40mm
– Guide pin diameter: 10mm
– Core diameter: 27mm
– Outer diameter of Cavity: 40mm
– Inner diameter of Cavity: 30mm
– Gate diameter: 5mm
– Gate length: 10mm

C. PTC CREO Model

As per dimensions,

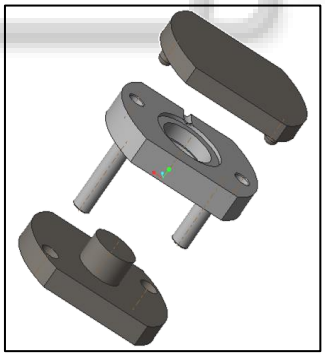

Fig. 3: Exploded View of Mould

1) Input Parameters

– Material: OHNS
– Density: 8670 kg/m3
– Young's Modulus: 200GPa
– Poisson's Ratio: 0.30
– Clamping Force: 17 KN
– Nozzle Pressure: 2500 Pa

2) Ansys Result

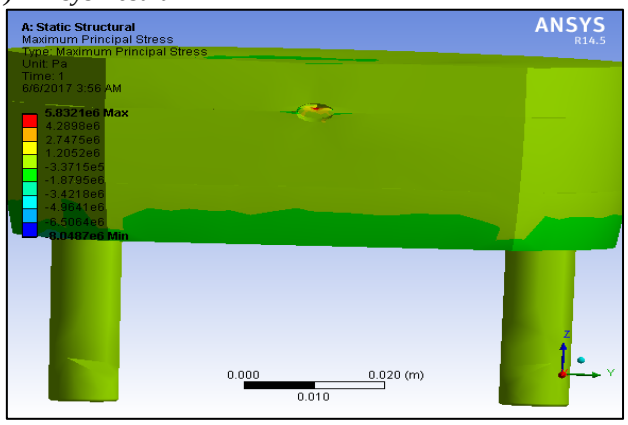

Fig. 4: Stress Distribution on Mould

V. CONCLUSION

On the basis of the above parameters, it can be concluded that the whole procedure to finally get defect free component confirming specification with built in tool quality has been achieved in most economical way. The tool is manufactured in – house, the trial proofing of the tool and inspection of the component has been done.

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