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# Design and Analysis of Ceiling Fan Regulator Knob

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**Abstract:-** *Injection moulds are divided into two types based on runner design (i.e.) Cold runner moulds and Runner less moulds (i.e.) hot runner moulds. In cold runner moulds, for multi-cavity and multi-point injection moulds, there is wreckage of material in runner area. Sometimes wreckage of material is more than component weight. For avoiding the above problem, the technique used is hot Runner moulds. Hot runner mould is the advanced manufacturing methods for multi-cavity type moulds. These types of moulds are widely used for large production rate. While producing plastic components using normal/standard multi-cavity mould, we are facing the problems like partial filling, cavities in components, less product quality, injection pressure and temperature drop age and warpage etc. Thus we are redesigning the Ceiling Fan Regulator Knob by doing some modification in and this will be beneficial for our using purpose. We are making design of the component, mould flow analysis using software Solidworks.*

**KEYWORDS: *- mould, core-cavity, warpage, etc.***

## 1. INTRODUCTION

Plastic industry is one of the world's fastest growing industries, ranked as one among few billion dollar industries. Most of the product which we used in daily life involves the usage of plastic and most of these products can be produced by plastic injection molding method. Plastic injection molding process is well known manufacturing process to create products with various complex shapes and geometry at low cost .The plastic injection molding process is a cyclic process with four significant stages. These stages are filling, packing, cooling and ejection

## 2. OBJECTIVES

The prime objective is to design the Injection Mould tool to produce good quality Component and economically and also:-

- Design and analysis of Ceiling Fan Regulator Knob.
- To improve the aesthetic view and reduce material wastage.
- Provide strength to the Knob.
- Provide grip to the knob.
- Applying a shrinkage to the part material, geometry and moulding conditions.

## 3. MODEL STUDY AND MODELLING OF COMPONENT

Model study includes identifying the problems in Component, following are the problems involved in component

- Proper ejection method required to eject the component.
- Bosses at the sides needs for proper placement of screw inserts.

Component is modeled using the software SOLIDWORK Component has a circular in structure with following dimensions:

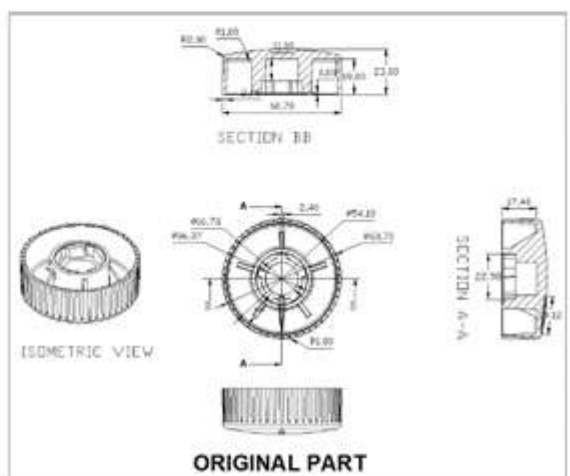


Figure No.1 Dimension of Knob.

Other details of model are given below:-

Component name: circular knob

Component material: PP (polypropylene)

Shrinkage: 1.5

Moulding type: Eight Cavity injection mould tool

Figure No.2 3D model of Knob.

## 4. DESIGN OF MOULD

This section describes the design aspects and other Considerations involved in designing the mould to Produce plastic box.

Three design concepts is considered in designing of the mould including:

i. Three-plate mould (Concept 1) has two parting line with single cavity.
ii. Two-plate mould (Concept 2) has one parting line with many cavities with gating and ejection system.
iii. Two-plate mould (Concept 3) has one parting line with single cavity without gating system.

### Design calculation

Numeric calculation to be carried out to predict the weight of the component, Shot Capacity, Plasticizing Capacity ,Clamping Capacity, on which machine mold to be loaded, plasticizing and shot capacity of the machine, and cooling parameters like inlet and outlet temperature effect, quantity of water to be circulate. These results are tally with the simulation results during moulding.

Data from CAD model

Material = Polypropylene

Mass = 10 grams

$Q_B$ = 546 KJ/Kg

Density = 1 kg/$dm^3$

Moulding Temp = 250 $^0$C

**Calculation of Number Cavities Based on:-**

1. **Shot Capacity**

$Ns=\frac{0.85\times W}{M}$

Where,

Ns: Number of cavities based on shot capacity

M: - Mass of component.

W: - shot capacity for polymer

$W = Sv \times \rho \times C$

Sv: - Swept Volume
C: - Constant
ρ :- Density of material.
Sv= 100 $cm^2$
W= 70 ×1×0.95
W = 66.5 gm.

$$Ns = \frac{0.85 \times W}{M}$$

$$Ns = \frac{0.85 \times 66.5}{10}$$

Ns =5.65
≈5

2. **Plasticizing Capacity**

$$Np = \frac{0.85 \times P \times Tc}{3600 \times M}$$

Where,
Np:- Number of Cavities Based on Plasticizing Capacity.
Tc = cycle time
$Tc= \frac{M\times 3600}{Ps}$
M = Mass = 10 gram.
Ps :- Plasticizing Capacity of Machine

= 6.1 kg/hr

$Tc=\frac{10\times 3600}{6.1\times 3600}$

Tc = 5.9 second.
$Q_A$- Total Heat Content of Polystyrene.
$Q_B$- Total Heat Content of Material.
$P=\frac{Ps\times QA}{QB}$
$P=\frac{6.1\times 239.4}{546}$
P = 6.1 Kg/hr.

$$Np = \frac{0.85 \times P \times Tc}{3600 \times M}$$

$$Np = \frac{0.85 \times 6.1 \times 5.9 \times 1000}{3600 \times 10}$$

$$Np = 8.4 \approx 8$$

**Determination of number of cavity**

From the above calculation of component and its shape and size 8 cavity moulds is preferred.

## 5. MOULD FLOW ANALYSIS

It is required to do the mould flow analysis for the particular component to know the proper filling and any other defects coming during the filling process of the component. To locate the proper gatting system and melt temperature of the material in which injection process takes place. Following are some images of analysis.

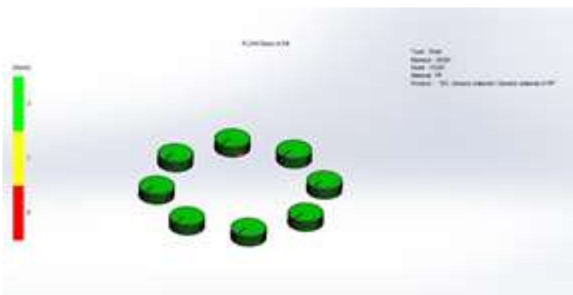

Figure No. 3 Analysis of Ease of fill

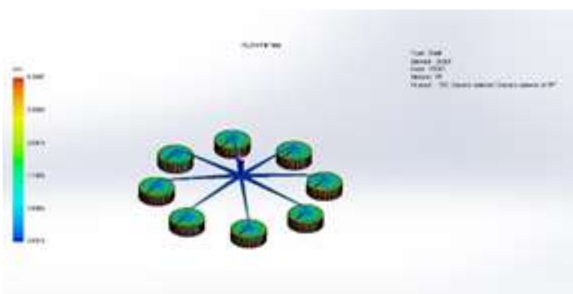

Figure No. 4 Analysis of Flow fill time.

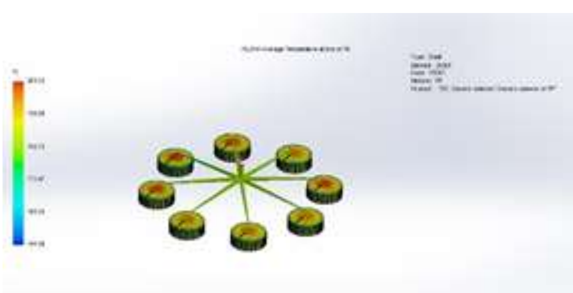

Figure No. 5 Analysis of Temperature at the end of fill

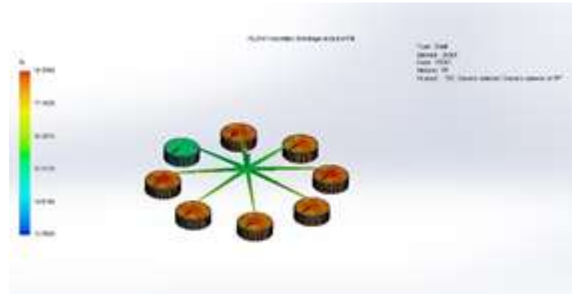

Figure No.6 Analysis of Shrinkage at the end of fill.

Figure No.7 Core Cavity Extraction (Exploded view)

## 6. TOOL ASSEMBLY

Tool assembly is done in modeling software, includes the positioning of extracted core and cavity inserts into the mould base, after assembly 3D models are converted into the 2D drawings for manufacturing process.

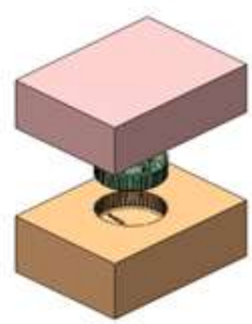

Figure No. 8 Assembly of mould tool

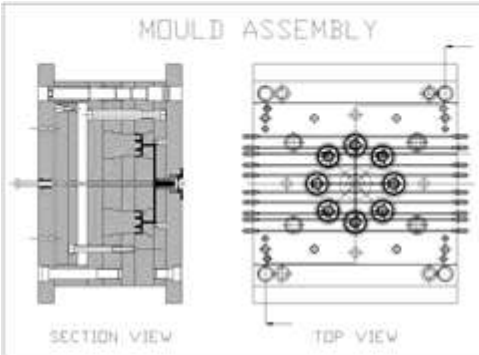


Figure No.9 Drafting of Mould Assembly.

## 7. CONCLUSION

In this project, we carried out the Design and Analysis of Ceiling Fan Regulator Knob. The complete injection mould tool is designed for fabricating regulator knob by using solidwork. The plastic flow analysis is carried out using solidwork. All the results viz. fill time, temperature at the end of fill, weld lines, air traps, Ease of fill prediction are analysed and also we have design the mould tool assembly for knob by considering standard design consideration and it has not shown any error in the mould flow analysis.

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