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DESIGN AND MANUFACTURING OF WHEEL MOULD

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Abstract - *In the present study, design, manufacturing and testing results of a wheel mould prepared for a solar panel cleaning trolley are reported. Method used for mould preparation is Injection moulding and material used for mould is mild steel. 3 D modelling of mould is done in Creo 3.0. Techno-commercial analysis of the method is done and payback period is calculated. Also the performance of the method is compared with the conventional alternatives.*

Key Words: Design, Payback period, Injection moulding tool, Modelling, Techno-commercial analysis.

1. INTRODUCTION

In industries, various processes are used to manufacture plastic products. Though it depends on many factors such as type of plastics, desired properties of product, cost etc., still injection moulding is beneficial technically as well as commercially over manufacturing processes for mass production. This method is reported by many researchers in literature.

J.C Vasco [1] described about suitable steel selection for mould material which depends on polymer type and additives of components / product and desired mould life. An adequate steel selection will provide the desired surface finishing, suitable machinability and therefore reducing manufacturing delivery time. Processing of vinylic and fluoride polymers causes generation of gases, requiring chemical resistant typically stainless steels are selected. Tempered steels show higher hardness and excellent compressive strength making them suitable for high wear demands and damage resistance. Naveen Karki [2] based on his experience of project on plastic injection mould cavity for Base cover, suggested that during design of mould feed system, runner size, cooling circuit designs plays an important role in increasing the quality of mould. Also it assures the improvements in productivity avoiding defects like a short mould, blocking of gate, burn mark, air bubbles, etc. He further mentioned to give equal importance to different consideration like injection pressure, plastic material, cycle time, volume of mould, thermal conductivity of mould materials, etc where needed. 3D modeling and flow analysis helps to visualize actual manufacturing process. Parth K. Vagholkar [3] described in his research paper about nylon, its properties and uses. Nylons are basically included in the class of polyamides which also contains Kelvar. Nylons are generally formed by condensation polymerization between de-carboxylic acids and diamines. Crystallinity and water absorption are two important properties of nylon related for making plastic product by using moulding process. Increase in crystallinity increases stiffness, density, tensile and yield stress, chemical resistance while decreases elongation, impact resistance, thermal expansion. Increase in water absorption property not helpful in moulding process as it causes loss in stiffness and tensile strength, unwanted growth in dimensions (elongations). So a nylon mechanical property greatly depends on crystallinity and water absorption. P.V.Parihar [4] described increasing importance of mould flow analysis in injection moulding. Mould flow

analysis useful to study various parameters such as gate location analysis, shrinkage analysis, warpage analysis, etc. Prashant Dhutekar [5] described the development of plastic and also how injection moulding machine changes scenario. He had visited the plastic moulding industry and speculated the survey related to injection moulding machine and its working process. He elaborated the injection moulding process sequentially.

In this study, an organization required to produce number of wheel of moderate size for solar panel cleaning trolley in masses. After studying different manufacturing alternatives for preparation of this wheel, injection moulding method is selected as it was cost effective easy for manufacturing. Hence design and development of mould is proposed to produce components in mass production in minimum cost and minimum cycle time.

2. MOULD PREPARATION

2.1. Mould Design

Considering the wheel design, a 3D modeling of mould is done using Creo 3.0. The details of wheel design and mould design are shown in fig. 1 and fig. 2 respectively. Standard procedures are followed for designing of wheel mould with different consideration of feeding system, injector system, cooling circuit, air vent systems for its successful working.

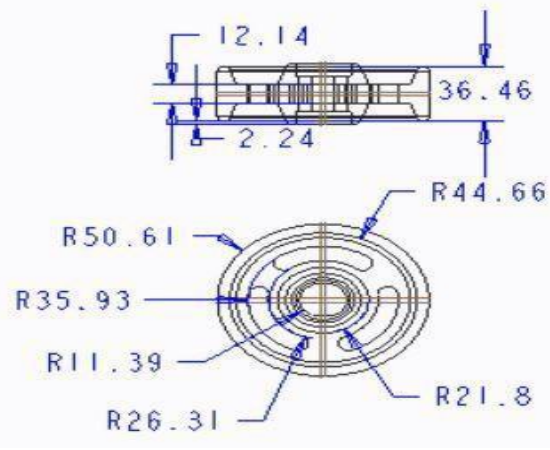

Fig -1: Design of wheel

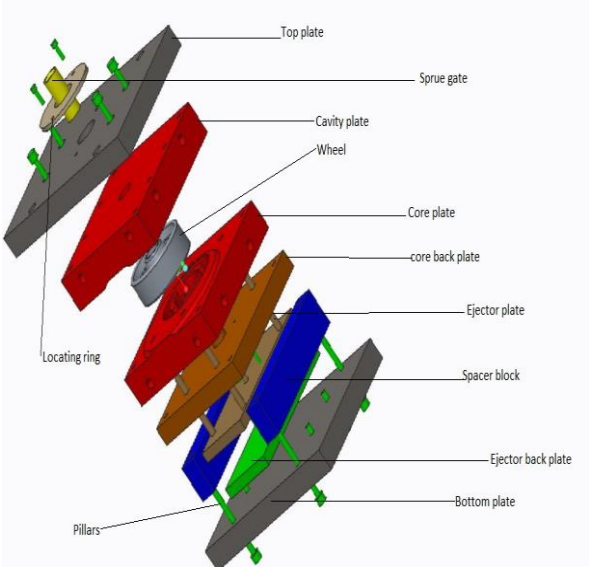

Fig -2: Design of Mould

2.2. Manufacturing of Mould

For manufacturing of mould, based on generated production drawings, mould is manufactured. Most of the parts of mould are manufactured by conventional process. For complex profiles like core and cavity, VMC is used. Once the assembly is done, mould setting and trials on injection moulding machines were taken. Wheel mould and actual wheel are shown in fig. 3 and fig. 4 respectively.

Fig -3: Wheel mould

Fig -4: Actual wheel

3. TECHNO-COMMERCIAL ANALYSIS

3.1. Mould Costing

Material of mould = Mild Steel

1. Raw material cost = Total weight of the mould (Kg) x Raw material cost/kg

= 128 x 110

=14080 Rs

2. VMC operation diamond polishing =12400 Rs
3. Transportation cost = 2400 Rs
4. The machining operation days = 9

Cost per day =1850 Rs

Machining operation cost= 1850 x 9 =16650 Rs

5. Minor work = 950 Rs

Total cost=950+16650+2400+12400+14080= 46480 Rs

Total cost=46480 Rs

3.2. Production rate

Machining time for manufacturing of one piece contain stroke, cooling time and removal time of the finished wheel.

Machining time = 80 sec for one piece

No. of pieces manufacture per hrs can be calculated as

3600/80 = **45 pieces/hrs**

3.3. Cost of Wheel

3.3.1. Raw material cost

Our wheel material is nylon which has market price of 170/kg

Raw material cost 170 Rs./kg

The weight of the wheel is 0.135 kg

Therefore cost of raw material for one wheel is 22.95

As we can produce 45 piece/hrs

Therefore,

Raw material cost per hr = 22.95 x 45 =1032.75 Rs.

3.3.2. Labour cost

Due to unavailability injection moulding machine, this work is done through external agency whose charges were 200 Rs/hr per batch.

Production labour cost= 200 Rs/hr

Hence the total cost of production per hr =

Raw material + labour cost=1232.75

As we can manufacture 45 piece/hr

Therefore, price per piece=1232.75/ **=27.39 i.e 27.50 Rs**

3.4. Payback Period

Raw material cost=110 x 128=14080 Rs

Mould cost= 46480 Rs

Wheel cost = 28 Rs

No of wheels per hr = 45

Market price =110 - 45= 65 Rs profit per wheel

Therefore,

65 x 45 = 2925 Rs/hr

23400 Rs profit/shift (8hrs)

Mould cost/market price = 46480/2925

=15.89= **16 hrs**

3.5. RESULTS

Table -1: Final Result

Cost of Mould	46480 Rs
Production Rate	45 pieces/hr
Wheel Cost	27.5 Rs
Payback Period	16 Hrs

4. CONCLUSIONS

It is seen that the injection moulding reduced the cycle time of production of wheels. Also it reduced the cost per piece of wheel. Hence it resulted in as an optimum solution for the concern problem.

References

[1]. J.C.Vasco, Material Selection for High Performance Mould, Research Gate, Nov 2007

[2]. Naveen R Karki, Design and Manufacture Of Plastic Injection Mould Cavity For "Base Cover Of Bus Ticketing Machine", IJAIEM, Volume 5, June 2016

[3]. Parth K Vagholkar, Nylon (Chemistry,Propertiesand Uses), IJSR, Volume 5, Sept 2016

[4]. Prashant K. Dhutekar, Plastic: Historical Development And An Industrial Survey, IJRAT, April 2018

[5]. P.V.Parihar, Design and Analysis of Mould (Plastic) Component Using Mould Flow Software- A Review, IJRAT, April 2016