

**International Journal of Innovative Research in Science,
Engineering and Technology**

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

New Study on the Injection Velocity Variation in Small Hand Lever Operated Injection Moulding Machine

¹Shrikant R.Kulkarni,² Dr. P.R.Kulkarni

Department of Mechanical Engineering, W.I.T, Solapur University, Solapur, India¹

Head, Department of Mechanical Engineering, W.I.T., Solapur University, Solapur, India²

ABSTRACT: Small Hand injection moulding machine is a manual injection type of machine. Manual injection is carried out by using lever. When relative angle between lever and operating arm changes, there was variations into the parameters like injection velocity, torque, injection pressure. Due to variation into parameters, defects arise into the final product. In this paper, simple method of velocity diagram is considered for calculating variations into the angular velocity of pinion which results in variation of injection velocity.

KEYWORDS: Manual injection, Defects in injection moulding, injection speed, variation in injection velocity.

I. INTRODUCTION

Injection moulding is a major processing technique for converting thermoplastic material into a useful end product. Whereas domestic low value and low performance commercial items are generally being moulded with conventional and commodity plastics. These small products are manufactured on a manually operated injection moulding machine. As the plunger (Rack and pinion) is manually operated due to which there is a variation into parameters like torque, injection velocity and injection pressure in cycle of operation. This variation into parameters results into rising the defects into the final product. Anand Industries was established by Mr. S.L. Yemul. Anand Industries manufactures products like cap, churner, top pin, Plastic Bobbin which are made up of thermoplastic. In company, technical guidance is provided by Prof. Jayant Yemul.

In case of small injection moulding machine, as the relative angle between lever and operating arm goes on varying due to which the applied force goes on varying in one revolution of lever which results in varying parameters like torque, injection pressure and injection velocity. These variations result in defective product. Following parameters are investigated in details for eliminating defects in hand injection moulding machine.

II. CONVENTIONAL INJECTION MOULDING MACHINE

Process of hand moulding machine consists of following steps, inserting the raw material into the hopper up to a desired level. By operating the plunger using hand lever operated rack and pinion mechanism, plastic material enters into the injection cylinder. Heater sheets are provided on surface of injection cylinder which converts solid plastic into molten plastic. This molten plastic is injected into the mould. By operating plunger with sufficient injection pressure so as to produce good surface finish.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

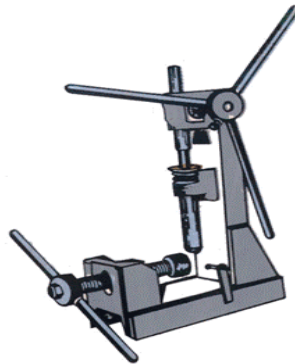


Fig.Hand Injection Moulding Machine

Products which are manufactured on injection moulding machine are made up of different plastic materials like

Thermoplastics:-Thermoplastics are the material which do not undergo chemical change in their composition when heated and can be moulded again and again. Examples include polypropylene, polyethylene and polyvinyl chloride.

Machine Parameters:-following are the machine parameters, relative angle , Injection Velocity.

From above parameters molten plastic temperature and material viscosity are remain constant while injection pressure and injection velocity goes on varying hence we have to consider it.

III.LITERATURE REVIEW

- **D. Mathivanan**
The research paper mainly focused on identifying causes of sink mark defect on final product.
- **Y.P.Tidke**
The research paper mainly focused on study and analysis of various defects related with injection moulding process by using Taguchi approach.
- **E. Bociaga**
The main objective of paper is to analyze the flow of molten liquid inside the cavity. The variation related with speed of molten liquid inside the cavity results in various defects.
- **JagannathaRao**
This paper analyzes the molten flow of liquid inside the cavity so as to identify the impact of variation in injection velocity at various sections of cavity.

IV.TYPES OF DEFECTS

Following are different types of defects which are commonly observe into the plastic material product

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

(1) Short Shut :-



(2) Excess Shut :-



(3) Sink Mark :-



(4) Cold Shut :-



International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

Causes of Defects:-

- (1) Insufficient Injection velocity
- (2) Intermittent Flow in the cavity
- (3) Insufficient Pressure
- (4) Insufficient Feed

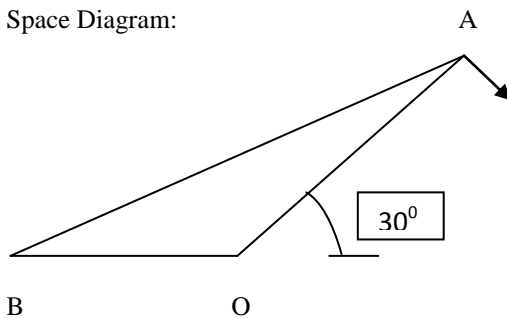
Objectives:-

- (1) To find out variation in injection velocity.
- (2) To find out impact of variation in relative angle on injection velocity.

Variation in Injection Velocity

As the injection moulding machine is a hand operated which means for the cycle of operation operator needs to apply the pressure on a hand lever. But it is observed that every time the pressure applied by operator goes on varying due to which the travelling speed of plunger goes on varying.

Space Diagram:



According to space diagram,

Let,

OA= Hand Operated Lever (Crank)

OB= Pinion Length

Θ = Angle made by lever with axis

Let us assume that operator holds the lever at ptA . In this position crank makes an angle of 30 with horizontal axis. So operator goes on operating the hand lever, angle made by the lever with horizontal axis goes on varying. So for different angle of crank we have to draw the velocity diagram which will show the variation in velocity of pinion which directly affects the parameter like injection velocity, Injection Pressure exerted by the plunger on molten material. Therefore velocity of Pinion is calculated by using velocity diagram as given below.

Velocity Diagram

Now Calculating velocity of crank

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

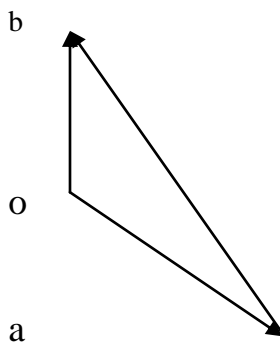
Velocity of Crank= $L_{OA} * \text{Ang. Velocity OA}$

$$V_{OA} = 0.5 * (2 * \pi * 128 / 60)$$

$$V_{OA} = 6.8 \text{ m/sec}$$

Scale:-

$$1 \text{ cm} = 2 \text{ m/sec}$$



From diagram,

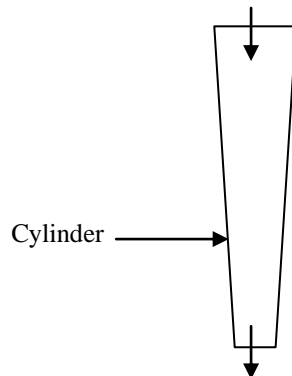
$$V_{OB} = \text{Length of OB} * \text{Scale of vel. Diag.}$$

$$= 2.2 * 2$$

$$V_{OB} = 4.4 \text{ m/sec}$$

By using similar method of velocity diagram for different crank angle.

Now for calculating injection velocity consider the section of cylinder as shown in fig



Plunger is travelling inside the cylinder at certain velocity (nearly equals to pinion velocity) which exerts pressure on molten material to travel through nozzle provided at the bottom of cylinder having diameter of 3mm.

Let,

$$A_1 = \text{Area of Plunger (dia 1.4 cm)}$$

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

V_1 = Velocity Of Plunger

A_2 = Area of Nozzle (dia. 0.3 cm)

V_2 = Velocity Of Injection

Now using the equation,

$$A_1 V_1 = A_2 V_2$$

$$1.539 * 4.4 = 0.071 * V_2$$

$$V_2 = 95.4 \text{ m/sec}$$

Similarly for different crank angles,

Crank Angle	Pinion Velocity (v_1)	Injection Velocity
30	4.4 m/sec	95.4 m/sec
45	3.6 m/sec	78.03 m/sec
60	4 m/sec	86.7 m/sec
90	3.3 m/sec	71.53 m/sec
0	6.8 m/sec	147.4 m/sec

Particularly at zero degree crank angle, lever is completely horizontal in position at which max pressure will be exerted by the operator. Hence injection velocity is max at this crank angle.

Conventional injectionmoulding machine consists of rack and pinion arrangement. Hand lever is directly coupled to pinion. The pressure exerted by the operator on a hand lever goes on varying for every cycle of operation due to which linear velocity of plunger goes on varying which results in variation of injection velocity. The relative angle between hand and operated lever goes on varying during one complete revolution of lever which means at different values of angles crank angle also changes. The variation into injection velocity at every cycle of operation having impact on final product.

The variations in injection velocity of molten plastic will results in improper flow of molten liquid throughout the cavity which causes uneven cooling of molten liquid at various sections of cavity.

V.CONCLUSION

From the result of velocity diagram method it is clear that, as the velocity of pinion changes, injection velocity also changes with every cycle of operation and also relative angle between operators hand and lever changes there is variation into a pinion velocity due to which injection velocity of molten liquid also changes.

For reducing no of defects arises into final product injection velocity of molten liquid should be kept constant.

REFERENCES

1. D.Mathivanan, "Minimization of the sink mark defects in injection molding process using Taguchi approach", International Journal of Engineering, Science and Technology, Vol. 2, No. 2, 2010, pp. 13-22.
2. Y.P.Tidke, "Study and optimization of process parameter in plastic injection moulding", IJRASET, Vol.2 Issue 4, 2014.



ISSN(Online): 2319-8753
ISSN (Print): 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

3. E. Bociąga , “Visualization of melt flow lines in injection moulding”, JAMME, vol. 18, Issue 1-2, oct.2015, pp 1022-48.
4. JagannathaRao, “ Analysis of plastic flow in two plate multicavity injection mould for plastic component”, International Journal of Scientific and Research Publications, Volume 3, Issue 8, August 2013.
5. Kazmer D, “ The foundation of intelligent process control for injection molding”, Journal of Injection Molding Technology, 2010 Vol. 3, No.1, pp. 44–56.
6. Oyetunji A, “Development of small plastic injection moulding machine for small scale industries”, JEST, Vol.5, No. 1 (2010) 17 – 29.
7. M.C. Song, Z. Liu, M.J. Wang, T.M. Yu & D.Y. Zhao “Research on effects of injection process parameters on the moulding process for ultrathin wall plastic parts” in Journal of Materials Processing Technology, 2007, vol 187-188, pp 668-671.