Fabrication of 3D Silicone Head Extruder & Investigating the Best Suitable Material for 3D Printing

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Abstract— 3D Printer Silicone Head Extruder is one of the most recent developments in additive manufacturing. The emergence of a new technology that enables the use of silicone as a 3D printing material. It serves so many markets: medical, automotive, consumer products. We can safely say that it is one of those breakthroughs that will truly impact our technological future. It is difficult to solidify the silicone during printing, a 3D printer is created with silicone head extruder with a suitable silicone material, which will get cure in least time in comparison to other silicone rubber, a suitable curing process will also going to attached with the printer for the curing of silicone during printing layer by layer. It will be helpful in creating many medical equipment. It will be helpful to nature. 3D Printer are nowadays new technology coming in market of manufacturing for giving shape to new imaginations. In many fields of the economy, however, development without 3D printing is almost unimaginable. 3D printing is an innovation which fuels more innovation.

Keywords: 3D Silicone Printer, Curing Agent, Liquid Silicone Rubber, UV Lamp, Stepper Motor

I. INTRODUCTION

The new technology was particularly popular in industrial production. Silicone is a relatively new material in 3D printing, because its mechanical properties are ideal for countless applications. The technology took some time to develop because silicone has a very high viscosity. Silicone is an elastomer, and unlike thermoplastics it cannot return to a liquid state after it's been solidified. An elastomer is a polymer with viscoelasticity (viscosity and elasticity); it's the technical name for rubber. Rubber can be stretched and will return to its original shape when released. Silicone 3D printing is also very popular in the automotive, consumer and medical industries. Before the development, parts made of silicone could only be produced by injection moulding and compression moulding. Some materials scientists succeeded in printing 3D objects from silicone materials without the application of heat. The technology used for this is a variation of the "material jetting process", which in turn is based on the so-called "drop-on-demand" principle. To create a 3D print out of silicone, the print head basically has to deposit individual silicone voxels on the corresponding building.

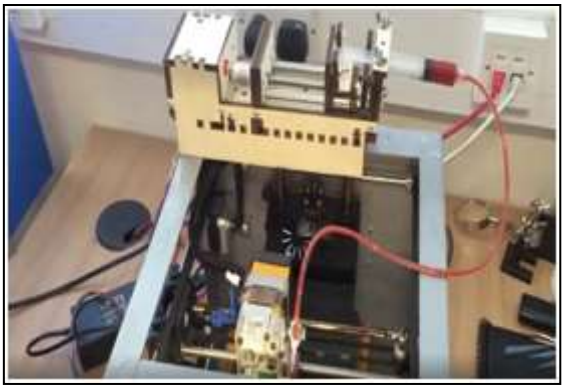


Fig. 1: Injection moulding process used for 3D Silicone Printer

II. LITERATURE SURVEY

Liravi, F. and Toyserkani, E.[1] Additive Manufacturing of Silicone Structures: Printing silicone at high speed. That combines the material injecting and material extrusion (2018).

Carlota V. [2] 3DStartup: Spectroplast and Silicone 3D Printing. Silicone products are made without using moulds, thereby cutting costs and time.

Jayven yeo, Junqiang justin Koh [3] 3D printing silicone materials. Describes the formulation and composition, printing technique, and startegies.(Feb 2020).

Ruben Perz Mananes, Jose Rojo Manaute,[4] 3D surgical printing and pre contoured plates for acetabular fractures (2016).

III. OBJECTIVES

1) To fabricate the 3D printer's silicone head extruder.
2) Investigation for best suitable material of silicone which is having least curing time.
3) Estimatimating the best curing process/agent for the printer.
4) To report best optimization variables.
5) To carryout cost analysis.

IV. MATERIALS AND METHODOLOGY

A. Materials Used

1) Liquid Silicone Rubber:

A Liquid Silicone Rubber material is a two-part platinum-cured elastomeric that can be injected into a mold cavity to manufacture a part. Silicone rubber is an inorganic polymer formed by silicon (Si), oxygen (O), carbon (C) and hydrogen (H). The main chemical chain, called the backbone, is formed by silicon and oxygen, which is why it is called siloxane. The operating temperature range for LSR can be between -65°C to150°C, which short peaks to 260°C. The feasibility of the process be taken into account, but also the curing time should be considered, which is directly related to the thickness of the

product. In fact, it is known that the curing time increases almost exponentially with each additional millimetre of thickness.

Fig. 2: Liquid Silicone Rubber

2) UV Curing

The silicone rubber structure used in this curing process has slight modifications in the backbone to facilitate bond breakage and a photosensitive catalyst is used. The UV area is between 320 and 400 nm and it is generated through gas discharge lamps. The variation of the final properties of the silicone rubber within 5% in comparison to the conventional curing silicone rubbers. The curing time can be as short as 0.5 seconds, although this time depends on the speed of the line, the process temperature, and the UV intensity. The advantage of this technique is that the curing speed is independent of the thickness.

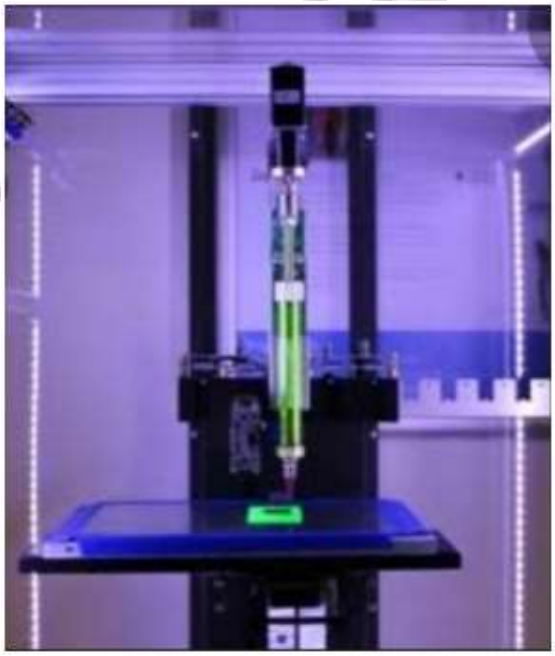


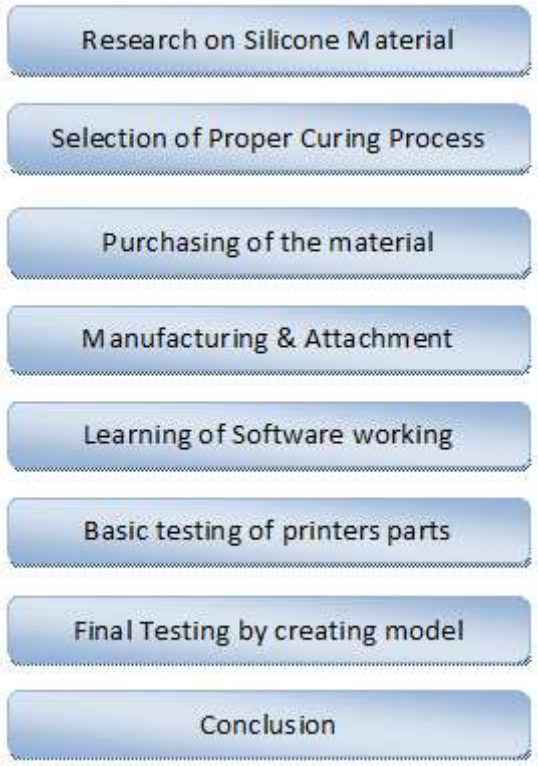
Fig. 3: UV light in 3D Printer

3) Stepper Motors

A stepper motor (or step motor) is a brushless DC electric motor that partitions a full pivot into a numerical of equivalent advances. The motor's position would then be able to be instructed to move and hold at one of these means with no criticism sensor, as long as the engine as deliberately measured to the application. Stepper motor moves a known break for each beat of vitality. This beat of vitality is given by a stepper driver and is suggested as a stage. As every movement moves the motor a known partition it makes them helpful gadgets for repeatable arranging. We will utilize stepper motor to move the bed carriage and different gatherings in their individually X - Axis, Y - Axis, Z-Axis.

Fig. 4: Stepper motor

B. Methodology Followed



V. Results and Discussions

A. Fabricated Silicone Head Extruder

The extruder is fabricated according to the dimensions which maintain the pressure of the fluid when the fluid is dropping for the printing.

Extrusion Die	Diameter	Thickness
	32mm	2.4mm

Table 1: Head Extruder Dimensions

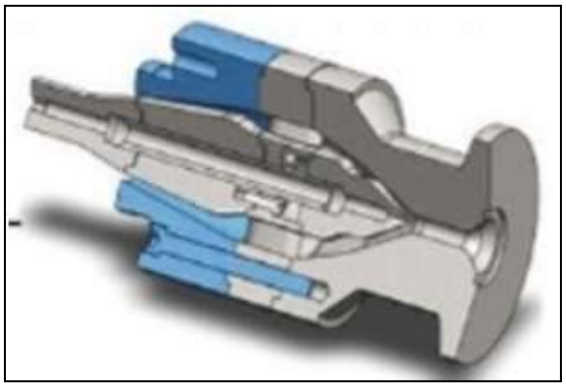


Fig. 5: Cross-Section of Extrusion die

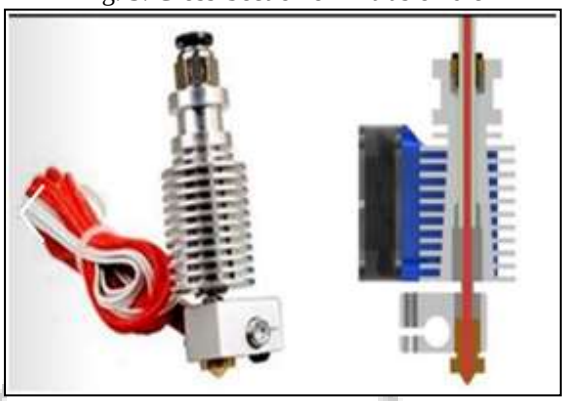


Fig. 6: Silicone Head Extruder

B. UV Curing Process

To solidify the liqiuid silicone rubber, uv curing process is used. Uv light cures the LQR at the fastest rate.

Time of Curing	0.5 s
Curing depends on	Speed of line, Process temperature

Table 2: UV Curing Process

1) Cad models

3d model design of ear which is used for 3d Printing

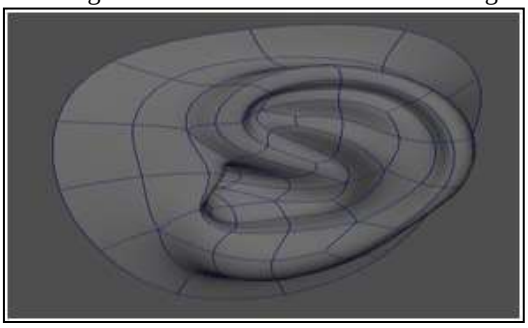


Fig. 7: Front view of the ear

Fig. 8: Side view of the ear

Fig. 9: 3d model of the ear after printing

VI. CONCLUSION

For 3d printing the silicone material has been used and identified the suitable best material of silicone i.e liquid silicone rubber which is cured at room temperature with in a time of 0.5 seconds with the help of ultra violet curing process. Time will be varied of solidifying LQR according to the thickness.

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