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Comparison and Selection of Suitable 3D Printing Technology to Replicate Plastic Material Properties for Rapid Prototyping

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Abstract: In R&D there is need of rapid prototyping to validate new concepts. 3D printing is widely used now a days For rapid prototyping of new concepts. As there are numerous 3D printing technologies are available now in market so it is always difficult to select correct 3D printing technology to replicate plastic material as per requirement in prototyping. Engineers in industry initially struggle or spend time to select best suited 3D printing technology for rapid prototyping of their concept or part. In this study we will be reviewing different available 3D printing technologies and its capabilities in terms of adding properties in printed parts. We will be selecting most common plastic which are being used in industry. For selected materials best suited 3D printing technologies will be compared on the basis of required material properties

Keywords: 3D printing, Plastics, RPT, Comparison, Product

I. INTRODUCTION

In early stage of new product development, selected concepts need to be validated before moving to manufacturing. In development stages manufacturing of parts directly in plastic is not feasible. But there is need to use Rapid prototyping method to validate concept which is best alternative for actual manufacturing process.. 3D printing is one of the well know rapid prototyping technique. It is recent trend in manufacturing sector. It has its unique advantages over conventional methods. 3D printing technology is widely used in R&D sectors of manufacturing industry such as automobile, medical, aerospace etc. But as different 3d printing technologies are available in market so there is always question on quick selection of right technology. In this paper we will be comparing different 3d printing technologies for replicating plastic material . we will list different cases as per requirement in product and we will list best suitable 3d printing technology for each case. This comparison will help user to select 3d printing technology which will be suitable for requirement in their product.

II. METHODOLOGY

Recent trend in 3D printing technology will studied. Most common 3d printing technology with their material which can replace plastic will be selected and compared. On the basis of industrial application most commonly used plastic materials will be selected for study. 3D printing technologies will be compared to replicate selected plastic materials

III. AVAILABLE 3D PRINTING TECHNOLOGIES FOR INDUSTRIAL APPLICATIONS

Following are the 3D printing technologies available in market for plastic

- 1) Stereolithography (SLA)
- 2) Selective Laser Sintering (SLS)
- 3) Fused Deposition Modeling (FDM)
- 4) Digital Light Process (DLP)
- 5) Multi Jet Fusion (MJF)
- 6) PolyJet

Following are the 3D printing technologies available in market for metals

- a) Direct Metal Laser Sintering (DMLS)
- b) Electron Beam Melting (EBM)

IV. TABLE SHOWS COMPARISON OF 3D PRINTING TECHNOLOGIES ON THE BASIS OF PROPERTIES

| Properties | 3D printing technology | | | |
|---|------------------------|-----------|------|---------|
| | SLA | SLS | FDM | Polyjet |
| Dimensional Accuracy | Good | Less | Poor | Good |
| Surface finish | Good | Poor | Poor | Good |
| Stiffness | Good | Poor | Good | Good |
| Elongation properties | Poor | Excellent | Good | Poor |
| Overmold compatibility or silicon / rubber material | No | No | No | Yes |
| Range of material | Wide | Limited | Wide | Limited |

Scale : Excellt/ Good/ Poor

Yes/No

Wide /Limited

V. PLASTIC MATERIALS AND THERE EXPECTED PROPERTIES FROM 3D PRINTING

There are variety of plastic materials are being used for different applications.

Most common plastic materials are as follows

Polyethylene Terephthalate (PET), High-Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Low-Density Polyethylene (LDPE) ,Polypropylene (PP),Polystyrene (PS), polyamide (PA), Polycarbonate (PC),ABS

Table –I

Following are properties of plastics are expected from 3D printing technologies

| Properties | Stiffness | Elongation | Surface finish | Dimensional stability |
|------------|-----------|------------|----------------|-----------------------|
| Material | | | | |
| PP | Yes | Yes | Good | Good |
| ABS | Yes | Yes | Good | Good |
| HDPE | Yes | Yes | Good | Good |
| LDE | No | Yes | Good | Good |
| PET | Yes | Yes | Good | Good |
| PS | Yes | No | Good | Good |
| PC | Yes | No | Good | Good |

VI. COMPARISON TO SELECT SUITABLE 3D PRINTING TECHNOLOGY FOR DIFFERENT PLASTIC MATERIALS

Based on requirement of properties in plastic materials, Suitable 3d printing technology can be selected as we know capabilities of selected 3d printing technologies to meet material requirement. Following table will show capabilities of 3d printing technology to simulate properties of plastic

Table-II
Selection of 3d printing technology based on combination of 3d printing parameters

| Different materials which suits to requirements | Different cases of material requirement for prototyping | | | | |
|---|---|--------------------|---------------------------------------|-------------------------|-------------|
| | PP,ABS,LD PE, HDPE, PC, PS like | PP, ABS, LDPE like | PP,ABS,LDP E, HDPE, PS, PC, PTFE Like | PP,ABS, LDPE, HDPE like | TPE like |
| Surface finish | High | High | Low | Low | High or Low |
| Dimensional accuracy | High | High | Low | Low | High or Low |
| Stiffness | High | Low | High | Low | - |
| Elongation | Low | High | Low | High | - |
| Silicon/rubber like /overmoulding | - | - | - | - | Yes |
| Suitable 3D printing technology for given requirement | SLA, Polyjet | SLS | FDM, Polyjet | FDM, SLS | Polyjet |

VII. CONCLUSION

With wide application range of plastic, each every product needs different plastic as per required plastic. But in stage of prototyping we use 3d printing technology to replicate plastic parts. Each 3D printing technology has its own feature make parts. User has to select machine as per requirement in parts. From comparison in this study we come across following findings

- 1) For case of high stiffness, low elongation with good finish and good dimensional accuracy SLA & Polyjet is preferred.
- 2) For case of low stiffness, high elongation with poor finish and good dimensional accuracy SLS is preferred
- 3) For case of high stiffness, OR high elongation with poor finish and dimensional accuracy FDM is preferred

REFERENCES

- [1] Rapid Prototyping and Manufacturing: A Review of Current Technologies Conference Paper · January 2009 DOI: 10.1115/IMECE2009-11750
- [2] A Review paper on 3D-Printing Aspects and Various Processes Used in the 3D-Printing by Vinod G. Gokhare and Dr. D. N. Raut, and Dr. D. K. Shinde, International Journal of Engineering Research & Technology (IJERT) <http://www.ijert.org> ISSN: 2278-0181 IJERTV6IS060409
- [3] 3D Printing Technology, Material Used For Printing and its Applications, Article in International Journal of Scientific and Engineering Research · July 2020 , by Ajay Shinde, Ashutosh dandekar, Rahul Patil, Nandakishor dhavale
- [4] The Impact and Application of 3D Printing Technology Article in International Journal of Science and Research (IJSR) · June 2014 by Cephas Mawere Harare Institute of Technology.
- [5] Bai, W.; Fang, H.; Wang, Y.; Zeng, Q.; Hu, G.; Bao, G.; Wan, Y. Academic Insights and Perspectives in 3D Printing: A Bibliometric Review. Appl. Sci. 2021, 11, 8298. <https://doi.org/10.3390/app11188298>
- [6] 3D Printing of Physical Organ Models: Recent Developments and Challenges Zhongboyu Jin, Yuanrong Li, Kang Yu, Linxiang Liu, Jianzhong Fu, Xinhua Yao, Aiguo Zhang,* and Yong He* Advanced Science published by Wiley-VCH GmbH
- [7] 3D Printed Contact Lenses Article in ACS Biomaterials Science and Engineering · January 2021 by Fahad alam, Mohammed elsherif, Badar Alqattan, Ahmed E salih



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