Investigation & Optimization of Fused Deposition Modelling Process Parameters to Improve the Product Quality of Aerofoil Prototype

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Abstract - *A 3D printing is the process by which any 3D solid object of any shape or geometry can be created from a digital file. This particular research paper is going to study about the 3D printing process and how we can optimise this process parameters to optimise the entire 3D printing process of an aerofoil by applying different setting of these process parameters. There are many 3D printing processes available in industries such as Stereolithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modelling (FDM), Digital*

Light Process (DLP), MultiJet Fusion (MJF) , Polyjet , Direct Metal Laser Sintering (DMLS), Electron Beam Melting (EBM) . and they are used as per the the object to be printed. These processes differ in many circumstances like the material selection, surface finish, durability and manufacturing speed, cost etc. While selecting the perfect 3D printing Process one must understand strength and weaknesses of the process and attributes our products needs to be mapped. As per our product and its requirement we found that the most commonly used process in similar product manufacturing industries is Fused Deposition Modelling (FDM). This process mainly uses two material i.e. PLA (PolyLactic Acid) & ABS (Acrolyene Butadiene Styerlene). While application of this process the parameters decide the overall product quality of object manufactured. This paper aims to explore these parameters & Provide with some improved setting of this process parameters for better quality of the object.

***Key Words*: 3d Printing, FDM, Aerofoil**, etc

1. INTRODUCTION

3D printing Is latest technology of additive manufacturing. it is invented in the year 1984 by Chuck Hull. he invented the first 3D printing process called steoreolithography in which layers are added by curing photopolymers by UV laser. [1]

In 2009 Atom by atom printing were done which allows for Bio3D printing, In 2011. In this year worlds first 3D printed the first 3D printer Robotic Aircraft at the same year the world's first 3D-printed Car and it became commercially available at the next year, at the same year the first gold and silver jewelry were done using 3D printer.in subtractive manufacturing the design object with complicated design are very much difficult to make compared to additive manufacturing. On a 3D printer, complex or simple objects requires the same effort. traditional manufacturing machines still demand a skilled expert to adjust and calibrate them however, a 3D printer gets most of its guidance from a design file. It requires less operator skill than does a traditional subtractive machine hence less money and cost

Manufacturing through 3D printing seems very attractive and cost efficient, but there are many constraints which come in after the product is be manufacture. It has been seen that the products which are manufactured

Using 3D printing process are weak in tensile and flexural strength. The prior statement is only true when the process parameter involved in the 3d printing process are not been properly set at an optimum measurements. This causes the defects in object been manufactured like void been the internal lattice geometry of the product, improper surface finish, improper shape etc.

For eliminating the errors in the product manufactured discuss above, the process parameter should be bought to an optimum setting to get the desirable strength and appearance of the object to be manufactured.

It has ability to build different complex geometrical shapes and structures in least possible time. The mechanical behavior of 3D printed parts depends on the interaction of different process parameters and the raw material properties. Most of this behavior depends on the optimum settings of the process parameters. Today 3D printers are widely used in the context of make prototypes for thorough analysis of the final product to be design by industries.

Due to this requirement of the industries, it is very important to make this 3D printing process a very viable and cost efficient process which can produce very high precision produces. And in future this 3D printing process might change the way our traditional manufacturing industry works and even to fulfill this future requirement this technology, The 3D printing process should get optimized in days to come.

1.1 LITRATURE REVIEW

TUAN DUC NGO states that there are many types of the 3D printing process used in the industries but there 4 main types of the 3D printing process usually used by majority of 3D printing manufacturing industries they are as follows 1. Fused deposition modelling, 2. selective laser sintering 3. selective laser melting 4.stereolithography. Freedom of design, mass-customisation and the ability to print complex structures with minimum waste are the main benefits of 3D printing. He also states that fused deposition modelling (FDM) is one of the most common 3D printing technologies because of low-cost, simplicity and highspeed processing. It is originally used for 3D printing of polymer filaments but has been adapted to many other materials. FDM is mainly used for fast prototyping.[1]

JAGDISH KHATWANI states that two main componenets which really eventually results in the quality of the product manufacture they are 1. Tensile strenght 2. flexural strenght.It has been observed by him that the layer thickness increases, tensile strength decreased whereas flexural strength increased. As the part bed temperature increased, tensile strength and flexural strength also increased. With respect to nozzle diameter, tensile strength increased while flexural strength initially decreased and then increased with increase in nozzle diameter. The failure in tensile testing has been caused because of rupturing due to pulling of fibers.[2]

CHEOL-MIN KIM2 states about influence of the bed temperature change on the deformed shape errors. While doing his research he observed that higher the bed temperature lower is the deformation error taking place. He also states that the shape errors may be decreased by setting the bed at a temperature similar to that of the heat shrinkage of the material used and thus reducing the shrinkage of each edge of the specimen.[6] PRATISH SHUBHAM states about influence of the layer thickness on the product manufactured, While doing his research he found that layer thickness increases, tensile stas the rength reduced by 46%, impact strength reduced by 54.5% and hardness reduced by 40%. After doing further research its was found by him that the layer thickness can be optimized at 10mm.[7]

NOR AIMAN SUKINDAR states about nozzle diameter in FDM process on the product manufactured. While doing his research he found that the product's accuracy and consistency depends on the pressure drop. This pressure drop varies due to the increase or decrease in the nozzle diameter. After further research it was found that the highest pressure drop is contributed by the 0.2 mm and 0.25 mm nozzle diameters, they cannot be taken as the optimum parameter. So the optimum range of the nozzle diameter can be found in between 0.3 to 0.4 mm.[8]

2. CONCLUSIONS

From above literature we have seen that on the basis of different parameters used in different level printing we can change the physical characteristics of any 3d printed product (here it is aerofoil) as per our requirement, by optimizing the process. Optimizing the printing process meant varying parameters of the printing.

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