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Analysis Of Co2 Sensor Enclosure Prototype Using 3d Print Resin Prusa Sl1 With Standard Resin Materials

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Abstract – 3D Printing is a technological development in the world of manufacturing. 3D Printing is a printer capable of printing three-dimensional objects, the advantage of 3D Printing is that it is very possible to create various complex patterns. Related to this definition, 3D printing can have an important function in the world of manufacturing. In making a product on a 3D printing resin type machine, the main ingredients used are standard resins and other types of resins. This research discusses how the CO2 sensor enclosure uses 3D printed resin to become a product. The final results of this study are to show the results of the product from the Prusa SL1 3D Print Resin machine with the materials used as standard resin, but the resulting product is defective because the components of the 3D printed resin machine have a working time of 500 hours, if it exceeds 500 hours it will experience defects on the product. In addition, standard resin type materials are not suitable for use with compressive or tensile forces because these materials have the characteristic of being very brittle when given a large enough pressure.

Keywords – 3D print resin PRUSA SL1, 3D Printing, enclosure, resin standard.

I. INTRODUCTION

3D Printing is a new evolution in the world of manufacturing technology, which is capable of producing and producing and designing three-dimensional object structures in one unit. 3D Printing is a Fused Deposition Modeling (FDM) fabrication process, namely Additive Manufacturing (AM) technology whose working system is the formation of objects by adding material layer by layer. In recent years, 3D printing technology has experienced a significant increase in its contribution to print quality and print costs in rapid prototyping procedures. Rapid prototyping such as 3D printers is an effective tool in product development.

In the industrial world, 3D printing is very popular because prototyping which usually takes a long time can be made in a shorter time. This greatly affects the costs incurred in producing a quality product. Before the product is mass produced, a product prototype is first made to determine its shape, dimensions, and ergonomics so that it can be evaluated. Apart from engineering, 3D printing is also used in the medical field. One example of application in the medical world is the manufacture of artificial organs such as ears, hands, feet, and others

The Rapid Prototyping process begins with creating a 3D CAD model design using software such as Solidworks, Autocad, Sketchup, and so on. The valid model is then oriented to the manufacturing space (part orientation). The concept of rapid prototyping is to divide objects with a thickness that matches the cross-section of the object. Furthermore, the 3D Printer machine makes three-dimensional products by adding materials or materials layer by layer according to the division of the object's cross-section. The quality of the surface of the object depends on the thickness of the layer of the 3D printer.

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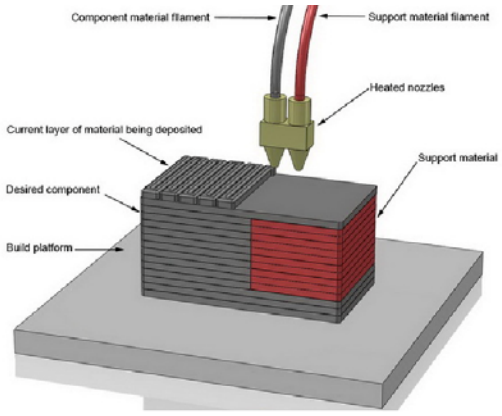
II. METHOD

2.1. 3D PRINT

The theory of a 3D printer machine is a printing machine that prints three-dimensional objects that can be seen, held and has volume. A 3D model is built layer by layer which is the process of creating a three-dimensional solid object from a digital file. The creation of 3D objects is printed using an additive process in which an object is created by placing successive layers of material until the entire object is made. 3D Printing, also known as Additive Manufacturing (AM), refers to the process used to create three-dimensional objects in which layers of material are formed under computer control to create objects. Objects can be almost the same shape or geometry and are usually produced using digital model data from 3D models or other electronic data sources such as Additive Manufacturing Files (AMF) and STL files (Attaran Mohsen, 2017). Thus, unlike materials removed from stock in conventional machining processes, 3D printing or AM constructing three-dimensional objects from a CAD model is assisted by adding successive layers upon layers of 3D printing terms. Creating a 3D model can take several hours to several days, depending on the method used and the size and complexity of the model. Additive systems can usually reduce this time to a few hours, although it varies depending on the type of machine used and the size and number of models produced simultaneously (Edward, 2015).

2.2. Rapid Prototyping

Rapid prototyping is a technology that directly converts three-dimensional CAD data into physical prototypes. Rapid prototyping allows automation for the construction of physical models and has been used to significantly reduce product development cycle times and improve the quality of product designs. In the rapid prototyping process, thin horizontal cross sections are used to turn materials into physical prototypes. Fused Deposition modeling (FDM) is an addictive manufacturing technology commonly used for modeling, prototyping, and production (Attaran Mohsen, 2017). This technology is one of the techniques used for 3D printers. Because a plastic filament is inserted into the extrusion nozzle. The nozzle is heated to melt the plastic and has a mechanism which allows the flow of melted plastic. The nozzle is mounted to a mechanical stage which can be moved from both vertical and horizontal directions. Then the nozzle will run up to the table according to the cut geometry, then the plastic is extruded thinly to form each layer. After that, the plastic will harden quickly after being removed from the nozzle (Edward, 2015).



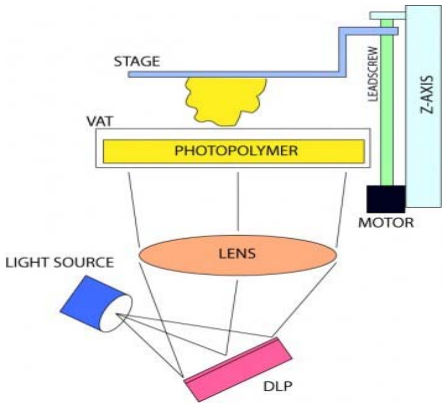
Picture 1. Rapid prototyping

Sourcer : (Barrie, 2014)

2.3. Digital Light Processing (DLP)

Digital Light Processing 3D printer is one method that is increasingly being used today. Moreover, the DLP method is considered an interesting technology because it is able to print objects in a fairly fast time because the printing method is done per layer. However, the lack of standardization in the world of 3D printing and also this knowledge gap makes research on process optimization of 3D printing machines very important to do. Moreover, the success of a 3-dimensional printing process is highly dependent on selecting the right and appropriate parameters. Determining the optimal process parameters is a very challenging job because the differences in the specifications of one printing press will certainly affect the optimal combination of parameters.

Several previous studies have indeed optimized several process parameters in slicer software in order to get the best print results. However, every machine also has different optimum settings so that an optimal parameter in one machine may not necessarily match another machine. Due to these problems, there is a need for research to find process parameter settings on 3D printers to produce objects with maximum quality. In this study, the machine used was the Wanhao Duplicator 7 3D printer. The material used for the Monocure Rapid White 3D resin is white. There are two types of research factors analyzed, each of which has three levels. The two factors are slice thickness and exposure time. The specimen design used was the 8th generation Gamastent brand stent with a height of 15.24 mm, a diameter of 8.99 mm and a thickness of 0.76 mm. Research will print objects with various combinations of process parameters and then researchers will categorize each object by looking at the type of disability in 8 different types of categories. The research objective is to find the optimal combination of parameters to produce objects with the lowest type of disability. Each of the 8 types of defects has a different weight (Excell, Jon, 2013).

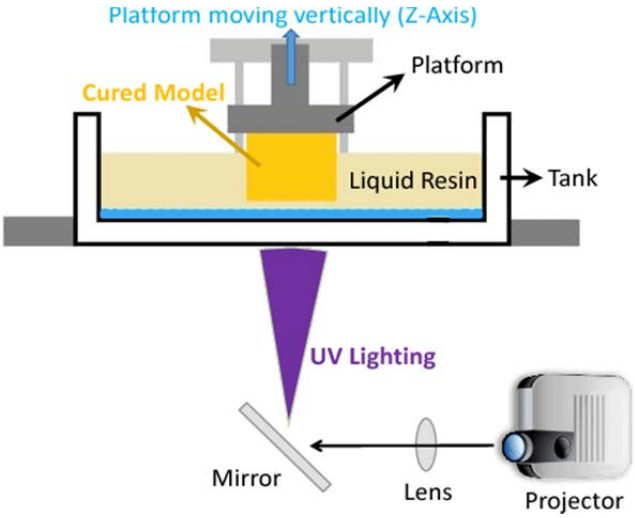


Picture 2. Digital Light Processing

Source : (Attaran Mohsen, 2017)

2.4. Stereolithography (SLA)

Stereolithography is an early and widely used 3D printing technology. 3D printing was created with the intention of enabling engineers to prototype their own designs in a much longer time and effectively. This technology first appeared in the early 1970s. Dr. Hideo Kodama Japanese researcher first devised a modern layered approach to stereolithography by using UV light to cure photosensitive polymers. In July 1984, before Chuck Hull filed his own patent and Alain Le Mehaute filed a patent for the stereolithography process. The patent application of the French inventor was ignored by the French General Electric Company and by CILAS (The Laser Consortium). Le Mehaute believes that this neglect reflects problems with innovation in France. Stereolithography is a form of 3D printing technology used to create models, prototypes, patterns in a layer-by-layer fashion using photo polymerization, a process in which light causes chains of molecules to link together, forming polymers. The polymers then form a three-dimensional solid object. Research in the area had been carried out during the 1970s, but the term was coined by Charles W. Hull in 1986 when he patented the process. He later founded 3D Systems Inc. *to commercialize the patent.*



Picture 3. Stereolithography
Source : (Excell, Jon, 2013)

III. Results And Discussion

3.1. Enclosure Manufacturing Process

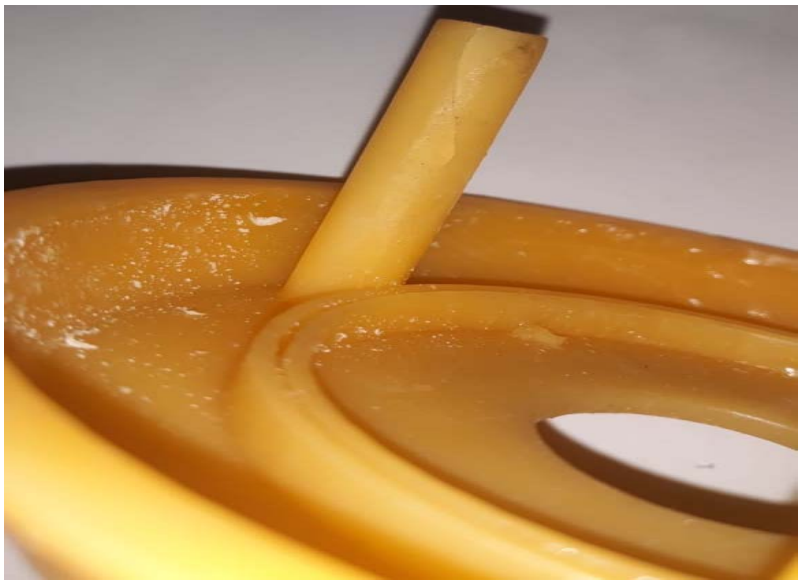
Making an enclosure model using the solidworks application. The process of manual modeling in preparing geometric data and collecting data about the shape and appearance of an object. This object refers to the size of the CO2 sensor.

After the 3D model design is finished, it is then processed by slicer software which converts the 3D model into a series of thin layers and generates a G-code from the STL file which contains instructions for the printer. The slicer software used is Prusa Slicer which is open source. The 3D printer follows Gcode's instructions to lay down successive layers of liquid, powder, or sheet material to build a model from a series of model cross-sections. These layers, which correspond to the virtual cross-section of the CAD model, merge or blend to create the final shape of the model. The main advantage of this technique is its ability to create almost any geometric shape or model. Model construction with existing methods can take anywhere from several hours to days, depending on the method used and the size and complexity of the model. Additive systems can usually reduce this time to very little; varies greatly depending on the type of machine used and the size and number of models produced**.**

3.2. Enclosure Making Results

Picture 5. Failure on the outer surface and the inner surface

Production results that experience failure on the outer surface caused by a print display that exceeds the service life of more than 500 hours which results in voids in certain layers of the product.



Picture 6. Failure on the outer surface and the inner surface

Cracks in the supporting rods of the product are caused by friction and pressure by the bolts when they are combined with other enclosures.

3.3. Discussion

Based on the results of the product that we have obtained from the design that has been made, the product has experienced considerable failure on the outer surface and inner surface as well as cracks and breaks in the supporting rod. From the results of the analysis that we have done by observing each part that has been produced, the failure appears on the inner surface and outer surface caused by the PRUSA SL1 3D Printing Resin Machine on the print display section.

From the sources we have obtained, the cause is the print display component on the PRUSA SL1 3D Printing Resin Machine which has a lifespan of 500 working hours. So if the print display exceeds its service life for more than 500 hours, what will happen is the failure of every product that will be processed by the machine and the designs that have been made will not appear perfectly on the print display. The result is voids in several layers of the finished product. If the print display is not resolved immediately, the production failure will be even greater.

Cracks and fractures in the support rods are caused by the brittle characteristics of the resin material, and when pressure and friction are applied to the surface of the resin with a harder material, the resin material will lose and cause cracks and fractures.

IV. CONCLUSION

From the results of making a CO2 sensor housing model using the PRUSA SL1 3D Print Resin Machine, with several designs that have become a product, several conclusions are obtained, namely:

1. That the manufacture of CO2 sensor enclosures using the PRUSA SL 1 3D Print Resin Machine is less effective when it is produced in large quantities. Due to the type of resin material that is easily brittle to friction and pressure.
2. Use of the PRUSA SL1 3D print resin machine is more suitable for use in making prototype products with dimensions that are not too large and maintenance costs and production costs are relatively expensive compared to 3D printed filament machines.
3. The main cause of production failure which causes vacancies in several layers is caused by the lifetime of the print display that exceeds the working hours limit.
4. The 3D printing resin machine has a high resolution and accuracy of print results, so that each product will have a smooth texture and precise accuracy.

5. If the product is still a prototype and you want to use it according to its use, you should use a type of resin that is suitable for the product, such as heat resistance and stronger tensile strength.

REFERENCES

[1] Attaran Mohsen., 2017, The rise of 3-D printing: The advantages of additive manufacturing over traditional manufacturing. Business Horison, Volume 60, Issue 5. P. 677-688.

[2] Barrie, J., 2014, 3D Printing: Improving Creativity And Digital-To-Physical Relationships In CAD Teaching, International Conference On Engineering And Product Design Education

[3] Edward , 2015 , Raised 3D Printers - Raise the Standard of 3D Printing, Raised3D.

[4] Excell, Jon, 2013, The rise of additive manufacturing. The Engineer.

[5] Horvath, J. C., 2014, Mastering 3D printing, Berkeley, California: Apress.

[6] Robsan, S., Kyle, S., dan Harley, I., 2011 , Close Range Photogrammetry: principles, techniques and applications, Whittles Publishing.