Effect of Material Type, Temperature, and Layer Thickness on PLA and PETG from 3D Printer Products by Tensile Test

Etik Puspitasari, Syamsul Hadi and Moh. Hartono
State Polytechnic of Malang, Soekarno Hatta Street no 9, Malang City, Indonesia

Keywords: 3D Design, 3D Printer, Factorial Design, PETG, PLA, Plastic Specimen, Tensile Test.

Abstract: Many plastic products are produced from 3D printers. The problem to know the strength of the right materials, researchers try to test the results of plastic specimens from 3D printers with the tensile test. Product size according to ASTM D638 standard using PLA (Polylactic Acid), and Polyethylene terephthalate glycol (PETG) filaments. The purpose is to determine the effect of material type, temperature, and thickness of PLA and PETG filament layers from 3D printer results with tensile tests. The method used is factorial design. The results of the maximum tensile strength on PLA material while the lowest on PETG. At the highest temperature, the maximum tensile strength is reached at 260 °C, and the lowest is 220°C. That the higher the temperature, the greater the effect on the tensile strength. And the highest layer thickness for maximum tensile strength is 0.3 mm, the lowest layer is 0.1 mm and has a maximum tensile strength of 3.651 N/mm2. The thicker the layers, the greater the effect on the tensile strength. There is an interaction effect between 3 variables. 3D designs and product prototypes for an additional hanger for a motorcycle by 3D printers have been made.

1 INTRODUCTION

3D printers are one of the current and future technologies that must be studied. Where the science of reverse engineering is developing. Reverse engineering is the process of analyzing an existing product as a reference for designing similar products by minimizing and increasing product advantages (Daywin et al., 2019). Prototype product design with the 3D printer is required. Rapid prototyping process with emphasis on application(Davim, J. P., Kumar, K., Zindani, 2020). Currently, many plastic products are produced from 3D printers. 3D printers are very practical in product development to print three-dimensional objects such as parts for prototypes, machine parts, robotics parts, electronic circuit parts, and other plastic products, etc. Which are drawn from 3D software which is then transferred to 3D printer software files and then printed on the machine 3D printers. Preliminary design for 3D printing and proper technique ensures the success of 3D printing (Micallef J, 2015).

Digital manufacturing has become an intrinsic part of the modeling profession, so the practitioner or product designer must be skilled in traditional hand-made techniques and digital technologies(Lansdown H, 2019). Designer in designing a product, one of which must take into account what material is right for the product in terms of material strength or cost. This has been done in previous studies related to the strength of the PLA material on plastic specimens produced by 3D printers with a layer thickness of 0.1-0.5 mm. Indicating that the test results show are not linear or the thicker the strength is not always Greater, and the specimen increases. The strongest is in the layer thickness of 0.35 mm.(Puspitasari et al., 2021). The visual results of plastic test specimens with a 3D printer are the smaller the layer used, the smoother and more aesthetically pleasing(Puspitasari, 2020).

The types of materials or filaments in 3D printers are Polylactic Acid (PLA), Acrylonitrile Butadiene Styrene (ABS), Polyethylene terephthalate glycol (PETG), Nylon (PA), Thermoplastic Elastomers (TPE), and Polycarbonate (PC). Some filaments have unique motifs such as wood, namely Wood filaments, a combination of PLA and metal, and Polyvinyl Alcohol (PVA).

PLA and PETG were chosen because researchers wanted to prove which material had the best material strength. Based on research that printing two types of filaments, namely polylactic acid (PLA), and polyethylene terephthalate glycol (PETG). the main

Puspitasari, E., Hadi, S. and Hartono, M.
Effect of Material Type, Temperature, and Layer Thickness on PLA and PETG from 3D Printer Products by Tensile Test.
DOI: 10.5220/0010949300003260
In *Proceedings of the 4th International Conference on Applied Science and Technology on Engineering Science (iCAST-ES 2021)*, pages 572-580
ISBN: 978-989-758-615-6; ISSN: 2975-8246

objective of the study was to find, through simulation and mechanical compression tests, the maximum prototype deformation of the adapter and to identify the best material regarding mechanical resistance. The result shows that the maximum deformation for PETG is 0.5976 mm and PLA is 0.3103 mm. From the research results, PLA has shown a lower deformation value, but PETG was chosen as the impression material because no cracks or fractures were found during the research trials (Silva & Guilhon, 2019).

A tensile test is carried out by gripping the test object with a known cross-sectional area on the jaws of the testing machine and so that the test object experiences a gradually increasing tensile force (Higgins, 2006).

With the above background, the researcher will design and make a tensile test plastic specimen pattern using a 3D printer which will later be tested with a tensile test. The purpose of this research is to analyze the effect of material type, temperature, and layer thickness on the tensile strength of 3D printer products with PLA and PETG materials. Analyzing the effect of interaction between material type, temperature, and layers thickness on the tensile strength of 3D printer products with PLA and PETG materials. And able to make 3D designs and prototypes of 3D printer products from the research results that have been obtained.

2 RESEARCH METHODOLOGY

This research was carried out at the Department of Mechanical Engineering, State Polytechnic of Malang which has tensile test equipment. The variable data that will be used are as follows :

1. Independent variables:
   a. Layer thickness 0.1mm, 0.2mm, 0.3mm
   b. Temperature 220°C, 240°C, 260C
   c. Material Type PLA and PETG
2. Dependent Variable Tensile Test Results
3. Controlled Variables:
   a. Printing speed: 70mm/s
   b. Infill pattern: lines
   c. Fulfill density: 100%
   d. Bed Temperature: 60°C

Specimens made must be based on the ASTM D638 Type 1 standard with the following dimensions: 165 mm long, 19 mm wide, and 5 mm thick. Based on (Materials et al., 2006) on the ASTM D638 Type 1 standard for the standard test method for tensile testing of plastic specimens, the thickness of the specimen is up to 7 mm and can be less than 7 mm. Plastic specimens to be made with a 3D printer can be seen in Figure 1 below.

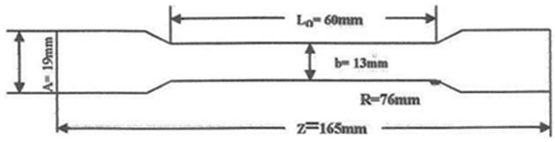

Figure 1: Product Design of 3D printed plastic specimens for Tensile Test testing.

From the variable data above, it can be seen in Figure 2 the following research block diagram:

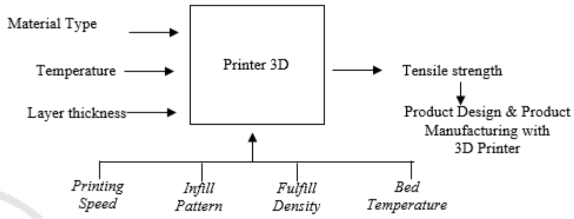

Figure 2: Research block diagram.

The research hypothesis is an assumption that is not necessarily true in research, so to find the truth of this research, the research hypothesis can be seen as follows:

1. Research hypothesis is "There is an effect between material type, temperature, and layer thickness on the tensile strength of 3D printer products made of PLA and PETG materials"
2. Hypothesis Nul (H0) is as follows:
   a. There is no effect of material type on the tensile strength of 3D printer products made of PLA and PETG materials.
   b. There is no effect of temperature on the tensile strength of 3D printer products made of PLA and PETG materials.
   c. There is no effect of layer thickness on the tensile strength of 3D printer products made of PLA and PETG materials.
   d. There is no interaction effect between material type, temperature, and layer thickness on the tensile strength of PLA and PETG 3D printer products
3. Alternative hypothesis (H1) is as follows:
   a. There is an effect of material type on the tensile strength of 3D printer products made of PLA and PETG materials.

b. There is an effect of temperature on the tensile strength of 3D printer products made of PLA and PETG materials.
c. There is an effect of layer thickness on the tensile strength of 3D printer products made of PLA and PETG materials.
d. There is an interaction effect between material type, temperature, and layer thickness on the tensile strength of 3D printer products made from PLA and PETG materials.

Data Processing and Analysis method

After drawing the tensile test specimen design according to the ASTM D638 standard with drawing software and saved in STL format, the data is entered into CURA for data processing according to variables and then converted into a GCODE file. Then print it using a 3D printer. The results of the tensile test specimens were carried out by tensile testing on PLA and PETG specimens where specimen there were 27 specimens multiplied by 3, so the total specimen tested was 54 specimens, in this study, there were only 45 data because PETG at 220 C temperature could not be printed and temperature too low. After that, the data obtained will be recorded. Then the data from the tensile test results will be processed by factorial design using Minitab software. Then make product designs and manufacture products with a 3D printer.

3 RESULT AND DISCUSSION

The following are the results of the 3D design of the tensile test specimen according to the ASTM D638 standard. Save the drawing design with the STL file format. can be seen in the following Figure 3

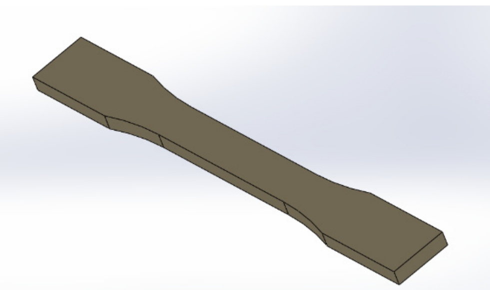

Figure 3: Specimen Design 3D Tensile test standard ASTM D638.

Open the specimen drawing design file to the CURA software for setting the independent variable and dependent variable. can be seen in the following Figure 4:

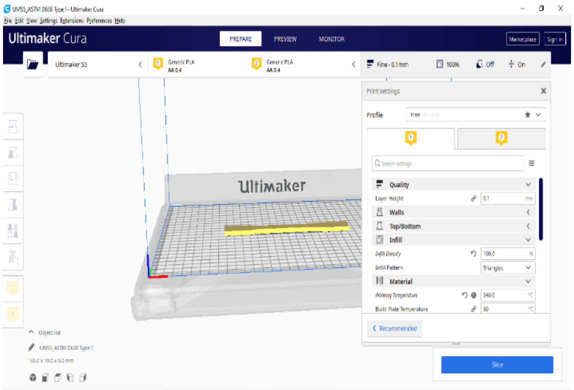

Figure 4: Setting specimen parameters with CURA.

After that the process of making tensile test specimens with a 3D printer is carried out, it can be seen in Figure 5:

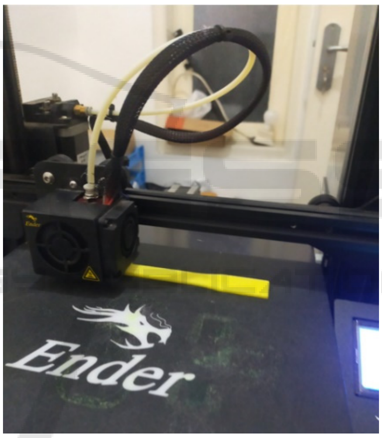

Figure 5: 3D Printer Process.

The following are the results of tensile test specimens from PLA and PETG from 3D printers, which can be seen in the following Figures 6 and 7

Figure 6: Results of tensile test specimens from PLA from 3D printers.

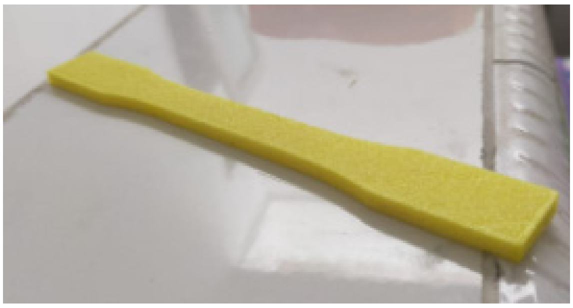

Figure 7: Results of tensile test specimens PETG from 3D printers.

The time needed to make one tensile test specimen is as follows.

1. On a 0.1 mm thick layer with a temperature of 220 C, 240 C, 260 C, it takes an average of 3 hours 57 minutes 10 seconds per 1 specimen.
2. At 0.2 mm thick layer with a temperature of 220 C, 240 C, 260 C takes an average of 2 hours 4 minutes 40 seconds per 1 specimen.
3. Layer thickness of 0.3 mm with temperatures of 220 C, 240 C, 260 C takes an average of 1 hour 26 minutes 57 seconds per 1 specimen.

All of the results of the ASTM D638 standard tensile test specimen can be seen in Figures 8 and 9 as follows:

Figure 8: Tensile test specimen results with PLA filament from a 3D printer.

Figure 9: Tensile test specimen results with PETG filament from a 3D printer.

Before calculating the stress and strain, it is necessary to calculate the cross-sectional area (A) first because it greatly affects the tensile stress. The cross-sectional area of each specimen is measured and recorded to obtain the results of the tensile stress. To find the cross-sectional area (A) that is Wc or the width of the inside of the specimen multiplied by the thickness (t).

The cross-sectional area of the design according to the ASTM D638 standard is Wc = 13 mm and t = 5 mm, then A = 65 mm (drawing dimensions). can be seen in the formula below:

$$A = Wc \times t \tag{1}$$

Where :
A = Specimen cross-sectional area
Wc = Width Gauge Area
t = Specimen thickness

The process of measuring tensile test objects from PLA and PETG that have been printed with a 3D printer using a caliper with an accuracy of 0.02 mm to calculate the actual dimensions with the above formula (1) so that it can calculate the actual cross-sectional area. can be seen in Figure 10 below:

Figure 10: The process of measuring the PETG tensile test specimen from a 3D printer.

The following is the tensile test process which can be seen in Figure 11 below:

Figure 11: Tensile test process of 3D printer specimen.

The results of the calculation of the cross-sectional area (A) are used to calculate the tensile stress (σ). So that the best tensile stress is obtained in the material, temperature, and layer thickness which will be tested by Factorial Design.

The tensile test is then carried out. The results of the tensile test of 3D printer specimens from PLA in Figure 12 are below:

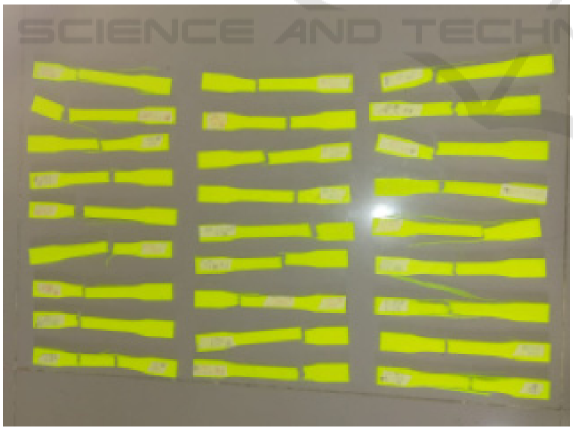

Figure 12: Tensile test results of PLA specimens from 3D printer.

The tensile test is carried out with a tensile testing machine. The standard used in the tensile test is the ASTM D638 standard. (Budiono, 2015).

To find the value of the tensile stress that occurs is determined by the following formula (ASTM D 638 Standard). Based on (Hadi Syamsul, 2016) the tensile stress formula can be seen from formula 2 below

$$\sigma = F/A \tag{2}$$

Where :

σ: Tensile Stress (N/mm2)
F: Tensile Load (N)
A: Specimen cross-sectional (mm^2)

The following are the results of the tensile stress testing of the 3D printer tensile test specimen from the PLA filament. The data will be processed by factorial design. which can be seen in Table 1 below:

Table 1: Tensile Stress Test Results of PLA.

Variasi Suhu	Variasi Layer (N/mm²)		
	0,1 mm	0,2 mm	0,3 mm
220°C	4,949	2,654	3,151
	4,780	3,084	4,742
	4,056	3,387	4,465
Rata-rata (N/mm²)	4,595	3,042	4,119
240°C	3,459	3,810	4,345
	1,800	2,659	4,911
	2,200	3,213	4,570
Rata-rata (N/mm²)	2,487	3,227	4,608
260°C	2,747	3,606	3,250
	2,737	4,223	4,454
	2,715	3,550	3,250
Rata-rata (N/mm²)	2,733	3,793	3,651

The tensile test is then carried out. The results of the tensile test of the 3D printer specimen from PETG in Figure 13 are below:

Figure 13: Tensile Test Results of PETG Specimens from 3D printers.

The following are the results of the tensile stress testing of the 3D printer tensile test specimen from the PETG filament. The data will be processed by factorial design, which can be seen in Table 1 below:

Table 2: Tensile Stress Test Results of PETG.

Variasi Suhu	Variasi Layer (N/mm²)		
	0,1 mm	0,2 mm	0,3 mm
220°C	0,000	0,000	0,000
	0,000	0,000	0,000
	0,000	0,000	0,000
Rata-rata (N/mm²)	0,000	0,000	0,000
240°C	3,295	3,522	3,123
	3,266	4,490	3,217
	3,282	3,537	3,135
Rata-rata (N/mm²)	3,281	3,850	3,158
260°C	4,230	3,726	4,529
	4,213	3,727	3,833
	4,249	3,740	3,327
Rata-rata (N/mm²)	4,231	3,731	3,896

Table 2 shows that the temperature of 220 C is zero because the temperature is too low for the PETG filament so that a tensile test specimen cannot be made.

Analysis of Tensile Test Results with Factorial Design

After testing the tensile test on the PLA and PETG specimens and getting the results of the tensile stress and strain values as above. Then the data was analyzed using Factorial Design with Minitab. Because researchers wanted to see whether or not there was an influence or not from 3 independent variables, namely the type of material, namely PLA and PETG, the temperature is 220 °C, 240 °C, 260 °C, and the layer thickness is 0.1 mm; 0.2mm; 0.3mm. The following results of the tensile stress analysis on the tensile test specimen test with a 3D printer in Figure 14 below:

```
Factor           Type   Levels  Values
MATERIAL TYPE    fixed       2  1; 2
TEMPERATURE      fixed       3  220; 240; 260
LAYER THICKNESS  fixed       3  0,1; 0,2; 0,3


Analysis of Variance for TENSILE STRENGTH , using Adjusted SS for Tests

Source                          DF    Seq SS    Adj SS    Adj MS       F      P
MATERIAL TYPE                    1   17,0279   17,0279   17,0279   86,51  0,000
TEMPERATURE                      2   31,0197   31,0197   15,5098   78,80  0,000
LAYER THICKNESS                  2    1,2909    1,2909    0,6454    3,28  0,049
MATERIAL TYPE*TEMPERATURE        2   53,4841   53,4841   26,7420  135,87  0,000
MATERIAL TYPE*LAYER THICKNESS    2    2,8722    2,8722    1,4361    7,30  0,002
TEMPERATURE*LAYER THICKNESS      4    4,0301    4,0301    1,0075    5,12  0,002
MATERIAL TYPE*TEMPERATURE*       4    5,7566    5,7566    1,4391    7,31  0,000
  LAYER THICKNESS
Error                           36    7,0856    7,0856    0,1968
Total                           53  122,5671


S = 0,443647   R-Sq = 94,22%   R-Sq(adj) = 91,49%
```

Figure 14: Factorial Design Result of Tensile Strength .

From the results of the Factorial Design in Figure 4.15, the first variable, namely the type of PLA and PETG material, has a p-value of 0.000, and the value is less than = 0.05. can be concluded that the hypothesis (H0a) is rejected, and the alternative hypothesis (H1a) is accepted, namely "There is an effect of material type on the tensile strength of 3D printer products made of PLA and PETG materials". For the second variable, temperature with a p-value of 0.000, the value is less than = 0.05. can be concluded that the hypothesis (H0b) is rejected, and the alternative hypothesis (H1b) of the study is accepted, namely "There is an effect of temperature on the tensile strength of the 3D printer product, PLA and PETG materials." The third variable is layer thickness with a p-value of 0.049, the value is less than = 0.05. It can be concluded that the hypothesis (H0c) is rejected and the alternative hypothesis (H1c) of the study is accepted, namely "There is an effect of layer thickness on the tensile strength of 3D printer products made of PLA and PETG materials"

In the summary model, the values are the reference data and part of the Factorial Design analysis. The standard deviation value (S) is the average deviation of the data points with the average data. can be seen in Figure 14 that the value of S in the data processing results is 0.443647 which means that the deviation value of the data point with the average data is 0.443647. The coefficient of determination (R-sq) is the percentage contribution of the influence given by the independent variable to the dependent variable. In Figure 14 the coefficient of determination has a value of 94.22% which means that the influence of the independent variables, namely the type of material, temperature, and layer thickness, affects 94.22% of the dependent variable, namely tensile strength. makes the remaining 5.78% an error in the form of other independent variables outside the material type, temperature, and layer thickness as well as errors in testing or other things that affect tensile strength.

In Figure 14, it is found that the interaction between the variables of material type and temperature is mutually influential, this is evidenced by the p-value of 0.000, the value is less than = 0.05. The second interaction found that the interaction between the material type variable and layer thickness also had an effect, this was evidenced by the p-value of 0.002, the value was less than = 0.05. In the third interaction, temperature and layer thickness variables have an effect, this is evidenced by the p-value of 0.002, the value is less than = 0.05. The fourth interaction of the three variables. Namely, the type of material, temperature, and layer thickness interact and influence each other, this is evidenced by the p-value of 0.000, the value is less than = 0.05.

Next is the normality graph is shown in Figure 15 below:

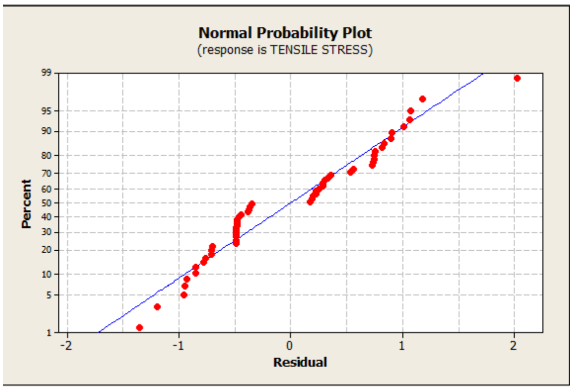

Figure 15: Normality Probability Plot.

The normality probability plot in Figure 15 above shows that the data is on the Normal line and approaching the diagonal line, so it is stated that the data is Normal.

Main effect plot for maximum tensile strength where tensile strength is sometimes called ultimate strength. which is the maximum stress that can be received by a material before breaking. The results of data processing can be seen in Figure 16 below:

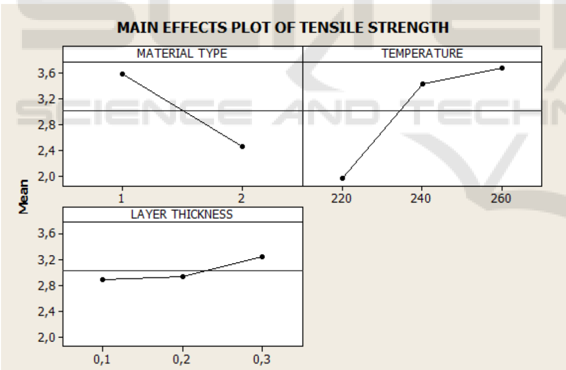

Figure 16: Main Effect Plot of tensile strength for PLA and PETG.

In Figure 16 above, the maximum tensile strength for this type of material is at No. 1, namely PLA, while the lowest is at No. 2, namely PETG. The highest maximum tensile strength temperature is achieved at a temperature of 260 °C, and the lowest is at a temperature of 220 °C. It can be seen that the higher the temperature, the greater the effect on tensile strength. And the highest layer thickness for maximum tensile strength is at layer 0.3 mm, and the lowest is at layer 0.1 mm. It can be seen that the thicker the layer, the greater the effect on tensile strength.

The analysis of the interactions plot of the tensile strength analyzes the effect of the interaction between the type of material, temperature, and layer thickness. And the results are obtained as shown in Figure 17 below:

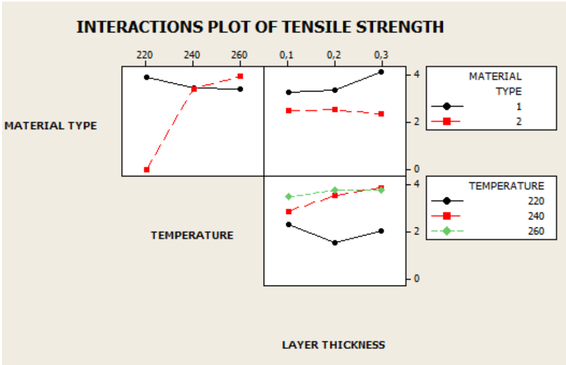

Figure 17: Interactions Plot of Tensile Strength.

From Figure 17 above, the interaction between material type, temperature, and layer thickness shows that the highest interaction between material type and layer thickness is in type 1, namely PLA with a layer thickness of 0.3 mm, the highest temperature interaction is at a temperature of 260°C.

Furthermore, the contour plot for tensile strength can be seen in Figure 18 below:

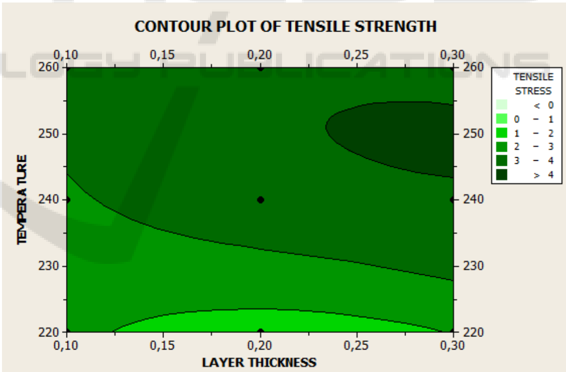

Figure 18: Contour Plot of tensile strength.

In Figure 18 above, it can be seen that the area that has large tensile strength and > 4 N/mm2 is at a layer thickness of 0.25-0.30 mm and a temperature between 240-255 °C. Furthermore, the area that has the smallest tensile stress of 1-2 N/mm2 is at a layer thickness of 0.125-0.30 mm with a temperature between 220 °C.

Designs and Prototypes of 3D Printers for an additional hanger for a motorcycle

From the research obtained above, the best tensile strength for PLA material with a layer thickness of 0.3 mm and a temperature of 260°C is 3.651 N/mm2, from these results the researcher makes an additional hanger for a motorcycle design and will then make a prototype printed on a 3D printer. The background for making this design is the application of the research results obtained where the product to be made contains elements of tensile strength because the function of the product is as a hanger of goods where it accepts loads and tensile forces. In addition, the background of this design was made because the researcher got the idea when buying a lot of items with a lot of plastic bags that had to be hung on a motorcycle hanger, it was not enough because there was only one hanger so the researcher wanted to make a hanger that had 3 branches so that when this product placed on the original motorcycle hanger can load more goods. This product can be used in all brands of motorcycles because it has been pre-measured. The following 2D and 3D designs for the additional hanger for a motorcycle can be seen in Figures 19 and 20 below:

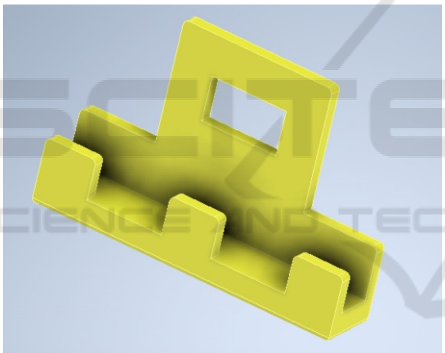

Figure 19: 3D design of additional hanger for a motorcycle..

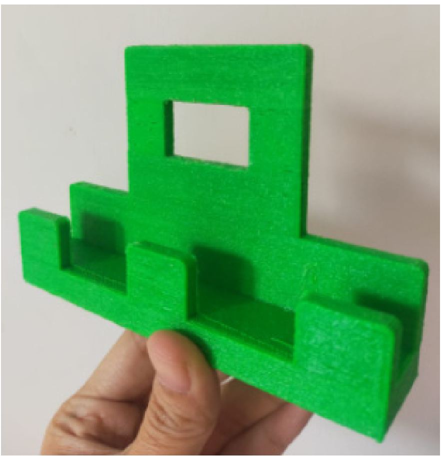

Figure 20: Printer 3D result of additional hanger for a motorcycle.

Figure 21: Application of additional hanger for a motorcycle.

Based on Figure 21 the addition of these tools can increase the capacity to carry goods on a motorcycle.

The time of making an additional hanger for a motorcycle product takes 6 hours 28 minutes for 1 product. This proves that 3D printers are suitable for making prototypes or making small quantities of products. Not suitable for mass production. Based on research Rapid Prototyping Techniques are for custom-made products and not for mass manufacture (Davim, J. P., Kumar, K., Zindani, 2020). For mass production, it is recommended to use injection molding but must make a mold. The advantage of 3D printers is that there is no need to make molds or prints and complex designs can be made on a 3D printer. based on research (Davim, J. P., Kumar, K., Zindani, 2020), Rapid Prototyping Techniques are for custom made products and not for mass manufacture.

4 CONCLUSION

1. There is an effect of material type, temperature, and thickness on the tensile strength of 3D printer products with PLA and PETG material. The hypothesis (H1) is accepted. Supported by the factorial design method where the P-value of the three variables is less than the value of = 0.05. The maximum stress is on the type of PLA material while the lowest is on the PETG. The highest maximum tensile stress temperature is achieved at a temperature of 260 °C and the lowest is at a temperature of 220 °C. It can be seen that the higher the temperature, the greater the effect on

tensile strength. And the highest layer thickness for maximum tensile strength is at layer 0.3 mm and the lowest layer is 0.1 mm and has a maximum tensile strength of 3.651 N/mm2. It can be seen that the thicker the layer, the greater the effect on tensile strength.
2. There is an interaction effect between material type, temperature, and layer thickness on the tensile strength of 3D printer products with PLA and PETG materials. Supported by the factorial design method where the interaction value of the three variables above the P-value is less than the value of = 0.05.
3. 3D designs and product prototypes for an additional hanger for a motorcycle by 3D printers have been made according to the results of the research.

ACKNOWLEDGMENT

The research team from Mechanical Engineering of the State Polytechnic of Malang has carried out research, to all parties who have helped this activity and P2M of the State Polytechnic of Malang.

REFERENCES

Budiono. (2015). *Pengujian kuat tarik terhadap produk hasil 3d printing dengan variasi ketebalan layer 0,2 mm dan 0,3 mm yang menggunakanan bahan abs (acrylonitrile butadiene styrene)*.

Davim, J. P., Kumar, K., Zindani, D. (2020). (2020). *Rapid Prototyping, Rapid Tooling and Reverse Engineering: From Biological Models to 3D Bioprinters*. Germany: De Gruyter.

Daywin, F. J., Utama, D. W., Kosasih, W., & Wiliam, K. (2019). Perancangan Mesin 3d Printer Dengan Metode Reverse Engineering (Studi Kasus di Laboratorium Mekatronika dan Robotics Universitas Tarumanagara). *Jurnal Ilmiah Teknik Industri*, *7*(2), 79–89. https://doi.org/10.24912/jitiuntar.v7i2.5929

Hadi Syamsul. (2016). *Teknologi Bahan*. Penerbit Andi, Yogyakarta.

Higgins, R.. (2006). *Materials for Engineers and Technicians. 4th ed*. UK: Newnes.

Lansdown H. (2019). *Digital Modelmaking: Laser Cutting, 3D Printing and Reverse Engineering*. The Crowood Press.

Materials, P., Materials, E. I., Matrix, P., Materials, C., & Specimens, P. (2006). *Standard Test Method for Tensile Properties of Plastics 1*. *January 2004*, 1–15. https://doi.org/10.1520/D0638-14

Micallef J. (2015). *Beginning Design for 3D Printing*. Apress.

Puspitasari, E. (2020). Analisa Pola Spesimen Plastik Uji Pukul Charpy Dengan Menggunakan Printer 3D. *Jurnal Teknik Ilmu Dan Aplikasi*, *9*. https://doi.org/10.33795/jtia.v9i2.33

Puspitasari, E., Wirawan, W., & Hadi, S. (2021). Analisis Lapisan Cetak Printer 3d Spesimen Plastik Pla Kelipatan 0,05 mm TERHADAP ENERGI PUKUL. *Info-Teknik*, *21*(2), 139. https://doi.org/10.20527/infotek.v21i2.10049

Silva, A., & Guilhon, D. (2019). Comparative analysis of ankle prosthesis connector adapters in 3D printed using PLA and PETG. *IFMBE Proceedings*, *70*(1), 155–161. https://doi.org/10.1007/978-981-13-2119-1_24