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Gongcheng Kexue Yu Jishu/Advanced Engineering Science Journal ID : AES-03-10-2022-343

Title : Design Dynamometer 3-Axial Cutting Force on Turning Process for Brittle Material

Abstract : The purpose of this research is to develop a dynamometer to measure the cutting force in the lathe process of brittle rock material. The dynamometer will measure the cutting force, feed force and axial force using a strain gauge sensor. The process design steps include: manufacture of dynamometers, manufacture of electronic circuits, process calibration and testing on brittle materials of rock. The calibration of the dynamometer is carried out with a universal testing bending machine and a universal dividing head clamping device to adjust the dynamometer in horizontal and vertical positions with the load increasing from 0 to 20 kg. The dimensions of the dynamometer are 190 mm x 40 mm x 40 mm and can measure cutting force, feeding force and axial force simultaneously. From the results of the dynamometer calibration, R2 is obtained for the cutting force of 98.7%, R2 for the axial force of 85.1% and R2 for the feeding force of 82.6% while in the cutting force of the rock material it is obtained: the maximum cutting force of 80.6 N, the maximum axial force of 5.1 N and maximum feeding force of 11.9 N..

Full article

Gongcheng Kexue Yu Jishu/Advanced Engineering Science Journal ID : AES-02-10-2022-342

Title : Fabrication of Polypropylene Filament Using a Single Extruder and Measurement of Its Dimensional Accuracy

Abstract : Additive Manufacturing (AM) has been a frontier topic in the industrial revolution 4.0. Out of several AM techniques, fused deposition modeling (FDM) is the most widely used technique. FDM uses filament as input feeding. The dimensional accuracy of the filament is an essential factor for success in this method. This research is an attempt to fabricate a filament made of polypropylene using a plastic extrusion machine. According to the typical FDM type 3D printer, the target is a filament with a diameter of 1.75 mm. The three main parameters that affect the dimensional accuracy of the filament are varied, namely the heating band temperature band (150-170 oC, 155-175 oC, and 160-180 oC), winding speed (13 mm/s, 16 mm/s, and 19 mm/s), the distance between the roll and the nozzle (200 mm, 500 mm and 700 mm). The experiment was designed according to the Taguchi L9. Minitab 19 was used to determine the S/N ratio and analyze the variance (ANOVA). It proved that temperature and distance significantly affect the diameter of the extruded filament while rolling speed does not significantly affect the filament diameter. Applying a combination of temperature (160-180 oC), nozzle to a winding distance of 700 mm), and rolling speed of 13 mm/s would achieve the best accuracy of filament diameter of 1.73 mm with a deviation of 0.03 mm..

Full article

Gongcheng Kexue Yu Jishu/Advanced Engineering Science Journal ID : AES-28-09-2022-333

Title : AUTOMATED DATA SECURITY MODEL USING CRYPTOGRAPHY TECHNIQUES IN CLOUD ENVIRONMENT

Abstract : Cloud computing is one of today's most hotly debated research areas because of its capacity to cut computing costs while simultaneously boosting computing service scalability and flexibility. A major advantage of cloud computing is that users can access shared resources such as software and information whenever and wherever they need it. Cloud computing is now being used in a wide variety of settings, including the military, hospitals, industry, and educational institutions, to store massive amounts of data. The data or information can be retrieved from the cloud at the request of the client. Information can be classed as private, public, or sensitive and all cloud-based information is stored elsewhere. For confidential and personal data, third-party cloud providers are always difficult to trust. Even the cloud industry's biggest players agree that security is a shared duty between the enterprise and the customer. As a result, from the perspective of the client, information stored in the cloud should be encrypted thoroughly to ensure that it cannot be read by any other user. So many difficulties arise when data is stored in the cloud, including the security of that data. Many algorithms have been devised to address these problems. The use of cryptographic techniques in this study helps to alleviate security concerns. For data security, cryptography techniques are becoming more prevalent. Asymmetric Key Cryptography with Related Key Set (AKC-RKS) technique is used in this paper to give novel safety mechanisms. The proposed model is compared with the traditional encryption techniques and the results show that the data security levels of the proposed model is high..

Full article

Gongcheng Kexue Yu Jishu/Advanced Engineering Science Journal ID : AES-28-09-2022-331

Title : GREEN SYNTHESIS OF SEVERAL CHALCONE DERIVATIVES USING GRINDING TECHNIQUE

Abstract : Chalcone and its derivatives are known for their biological activities such as antibacterial, anticancer, antioxidant, and anti-inflammatory. This research conducted a synthesis of chalcone derivatives, namely 4-dimethylamino-4-hydroxy chalcone (DMAHC), 4-dimethylamino benzal acetone (DMAB), and 6-fluoro-2-chloro-4-hydroxy chalcone (FCHC) by grinding technique. The grinding technique was successfully carried out with zero solvents to minimize waste production. Claisen-Schmidt condensation reaction with NaOH as a base catalyst was employed in this study to synthesize chalcone compounds. The grinding process was succesfully applied in a very short time, approximately 15 minutes. The derivative products, DMAHC, DMAB, and FCHC, were produced in the form of yellow solids with melting points of 67, 65, and 189°C with yields of 46.32, 33.49, and 26.55%, respectively. FTIR spectrophotometer characterized a sharp absorption in around 1660 cm-1 as a typical absorption of the C=O carbonyl functional group of chalcone derivatives. The analysis results with 1H-NMR showed the appearance of proton absorption in the chemical shift (δ) between 7.6 and 7.8 ppm as the proton absorption of

Title : Identification of Depression through Social Networking Comments and Social Activities: A Systematic Literature Review

Abstract : Preventing suicide before it happens, is one of the most challenging tasks for the police force as well as family members. Observed main reasons behind incidents of suicide cases are daily personal lifestyle, working condition, social life behavior and person's depression condition. According to recent studies, examining the effects of social interactions and context practices on various modes of expression, such as visual, textual, and social activity using social media is possible to be used to predict depression signs. The paper has put forward elements of reviewing initial studies on social media depression detection. Four digital libraries were searched for primary studies: ScienceDirect, SpringerLink, IEEE Xplore Digital Library and Association for Computing Machinery (ACM) Digital Library to broaden the results. The technique of this study is to review each article. Twenty-eight initial studies were examined. In the conclusion of this study, geotagging is the most analyzed social media platform technique to find locations shared by people. Hashtags were the most applied for depression detection. Rule-based sentiment analysis can grasp phrases that contain sarcasm to detect depression. Multimodal features such as users' comments and image posts with machine learning or deep learning acquire the best output results to detect depression..

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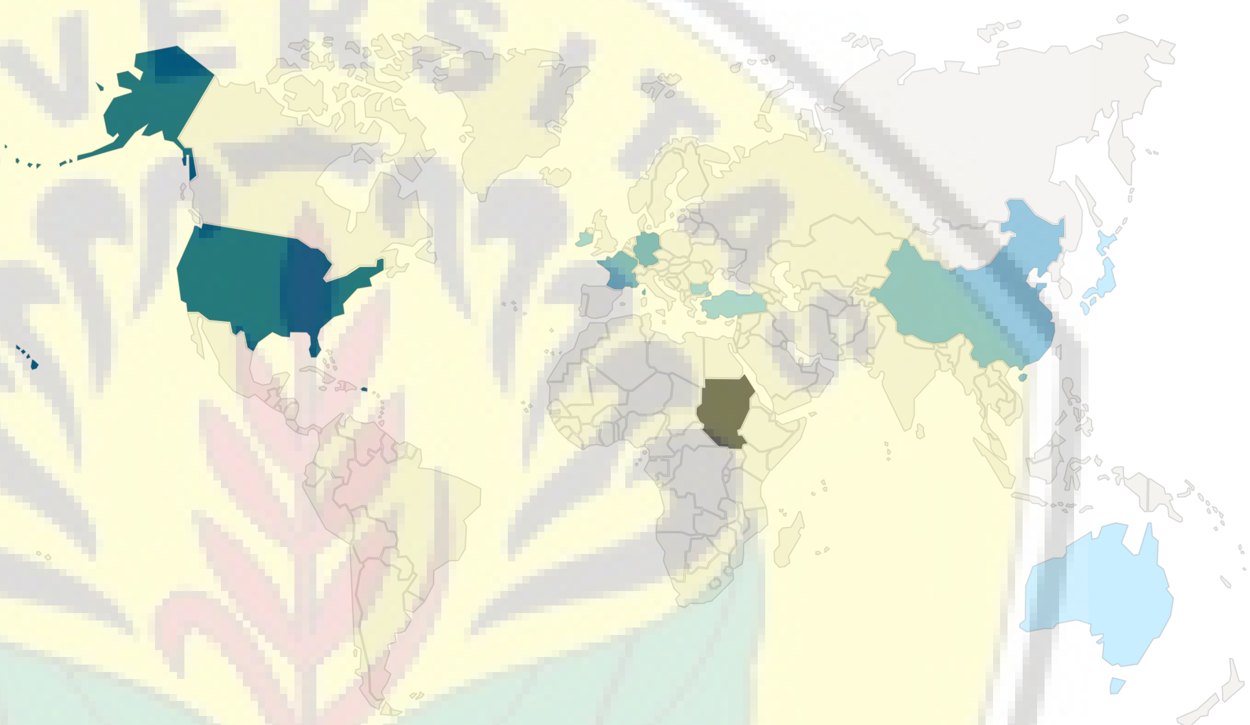

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Fabrication of Polypropylene Filament Using a Single Extruder and Measurement of Its Dimensional Accuracy

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Keywords:
Polypropylene, Dimensional Accuracy, Taguchi design, Filament, Extruder

ABSTRACT

Additive Manufacturing (AM) has been a frontier topic in the industrial revolution 4.0. Out of several AM techniques, fused deposition modeling (FDM) is the most widely used technique. FDM uses filament as input feeding. The dimensional accuracy of the filament is an essential factor for success in this method. This research is an attempt to fabricate a filament made of polypropylene using a plastic extrusion machine. According to the typical FDM type 3D printer, the target is a filament with a diameter of 1.75 mm. The three main parameters that affect the dimensional accuracy of the filament are varied, namely the heating band temperature band (150-170 ºC, 155-175 ºC, and 160-180 ºC), winding speed (13 mm/s, 16 mm/s, and 19 mm/s), the distance between the roll and the nozzle (200 mm, 500 mm and 700 mm). The experiment was designed according to the Taguchi L9. Minitab 19 was used to determine the S/N ratio and analyze the variance (ANOVA). It proved that temperature and distance significantly affect the diameter of the extruded filament while rolling speed does not significantly affect the filament diameter. Applying a combination of temperature (160-180 ºC), nozzle to a winding distance of 700 mm), and rolling speed of 13 mm/s would achieve the best accuracy of filament diameter of 1.73 mm with a deviation of 0.03 mm.

1. INTRODUCTION

The emergence of 3D Printing technology is very influential in several industrial fields, especially from an economic perspective [1]. With 3D printing technology, companies can make prototypes without issuing raw materials or materials [2], [3]. One of the 3D printing techniques is fused deposition modeling (FDM). It makes 3D printing, especially the FDM technique, has excellent potential in the manufacturing world [4]. A 3D printing machine is capable of printing a workpiece with a size of more than 1 m^2 from the recycled material filament by adding a plastic crusher before the heating nozzle [5]. This trend was followed by manufacturing various types of machines ranging from small to large. The 3D printing machine has been used to create a chocolate cake [6]. The FDM technique has been successfully designed by adding robot arm to control the movement of the print head [7]. Inline, 3D printing raw materials, i.e., the filaments, are also developing [8]. Therefore, research on filaments continues to grow to this day.

[9] researched the effect of extrusion process parameters on the mechanical properties of PLA filaments with parameters of temperature, print speed, and layer height. The results showed that the parameter with the highest tensile strength of the specimen was in setting A, namely, print speed of 80 mm/s, layer height of 0.15 mm, and extruder temperature of 220 °C. [10] conducted a study on the effect of 3D printing process parameters on the tensile strength and response of filament dimension accuracy used by PLA using the Taguchi method and analyzed using ANOVA. This study indicates that infill density and nozzle temperature are the most influential parameters, with 40.78% and 14.17%, respectively. The optimum parameters are shown in the combination of nozzle temperature of 215°C, extrusion width of 0.35 mm, infill density of 75%, and honeycomb pattern, which produces specimens with a tensile strength of 30.52 MPa.

Optimization of workpiece topology mapping resulting from 3D Printing provides impacts such as reducing strain, bending stress, and extending the life of components [11]. In addition, the simulation method using SolidWorks software is an excellent virtual test method to determine fill time, maximum injection pressure and temperature at the end of filling so that the product will avoid air traps, weld lines, and sink marks [12]. One of the 3D printing techniques is fused deposition modeling (FDM).

There are many types of filaments used to form 3D models. Plastic types and their derivatives dominate this type of filament for 3D printing [13]. One of the filament materials used is polypropylene. Polypropylene (PP) is a thermoplastic polymer made by the chemical industry and used in various applications, including packaging, textiles, stationery, laboratory equipment, loudspeakers, automotive components, and polymer banknotes [14].

Research on PP was carried out by [15], who discussed the mechanical properties and fracture surfaces of polypropylene (PP) which has heat-resistant properties. The thermal testing with Differential Scanning Calorimetry (DSC) showed that recycling did not cause a significant change in melting point (stayed in the 160 163L). The results of the tensile and hardness test showed that there was no significant change between pure PP and recycled PP. On the other hand, the tensile test results of recycled PP showed that the tensile strength was 22.1% lower than pure PP, Young's modulus decreased by 8.1%, and the strain-at-break was drastically reduced by 65.7%. It concluded that recycled PP has the same mechanical properties as pure PP, so polypropylene is appropriate as filament material.

Several studies above show the importance of filament in influencing the output of 3D printing. Therefore, in this study, research will be carried out on (i) modifying an extrusion machine to be able to cast filament of 1.75 mm for FDM type 3D printer, (ii) optimizing the parameters for fabrication of PP filaments and analyzing their accuracy. The variables used are temperature, rolling speed, and the distance of the rolling.

2. MATERIALS AND METHODS

2.1 Establishment of Predictive Process

The research framework used in this study is an experiment using the Taguchi method, which consists of several stages. Figure 1 shows the research framework to modify the extrusion machine in the Packaging Laboratory of the Faculty of Engineering for adaptation purposes printing 3D printer filament from PLA or

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PP material. The injected filaments were then dimensionally measured with a micrometer. Taguchi design was employed for designing the parameter variation. The research by [16] states that when setting the temperature parameter between 230-250 ^{o}C the extrusion machine is not optimal, so it is recommended to lower it to increase the efficiency of the extruder machine. The control system uses PI (Proportional Integral), which has proven effective and pragmatic in meeting the parameter setting point [17]. This study uses the primary tool in the form of an electric motor extrusion machine 1/4 hp (1350 rpm) with a screw rotation speed of 23.2 rpm, 220 volts, and a temperature of 150-180 °C on two band heaters—the rolling up filaments using an Arduino mega 2560 machine. A thermo control to measure the temperature required from the band heater. A micrometer screw is needed to measure the filament's roundness.

The second step is an experimental design by determining the independent and response variables and calculating degrees of freedom (DOF). The independent variables in this study were temperature, winding speed, and distance of the winding rollers, while the response variable was the dimensional accuracy of the filament. It is necessary to determine the minimum number of experiments [18]. Determining the orthogonal array (OA) used depends on the number of factors observed. If all factors are at the same level, select the type of OA according to the level. Modify OA by merging the column method if there is a mixture of two, three, or four-factor levels. Assignment of factors, signal and disturbance (or noise) factors, and their interactions to the selected orthogonal array by observing linear graphs and triangular tables. Both of these are factor assignment tools designed by Taguchi. Graph of the various columns to which the factors are. The triangular table contains all the possible interactions between the factors (columns) in an OA.

The third step is an experiment consisting of two: applying the number of replications and randomizing the experiment. The injected filaments should be close to the target design, i.e., the diameter of 1.75 mm. Otherwise, the research process will be repeated in the second stage by redefining the experiment's parameters.

The fourth step is analyzing the accuracy using the ANOVA method. The final step is to withdraw the conclusion.

2.2 Variable Settings

Variable settings limit research conducted based on variables that affect the process. Determining the variables used in this study is shown in Table 1. For the sake of simplicity those three variables (barrel & nozzle temperature, rolling speed, and distance between roll and nozzle) will be shorten as (i) temperature, (ii) speed, and (iii) distance, respectively.

Table 1. Variable and level used in the experiments

Level	Variable		
	Barrel & Nozzle Temperature (^{o}C)	Rolling Speed (mm/s)	Distance between Roll and Nozzle (mm)
1	150/170	13	200
2	155/175	16	500
3	160/180	19	700

2.2.1 Orthogonal Value Determines

The orthogonal matrix determines the parameters and levels of each control parameter. The orthogonal matrix must have degrees of freedom greater than or equal to the specified degrees of freedom parameter. The degrees of freedom of the control parameters are calculated using the equation in the following Table 2.

Table 2. Total degrees of freedom in the control parameter

	Barrel & Nozzle Temperature	Rolling Speed	Distance between Roll and Nozzle	Total
Number of Levels	3	3	3	
df = k-1	2	2	2	6

Table 2 shows that the control parameter's total zero degrees of freedom are 6, therefore the orthogonal matrix suitable for this experiment has 6 degrees of freedom L9(3^3). The L9 orthogonal matrix Table 3 is as follows:

Table 3. Matrix orthogonal L9(3^3)

Experiment	Control Parameter		
	A	B	C
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	2
5	2	2	3
6	2	3	1
7	3	1	3
8	3	2	1
9	3	3	2

2.3 Process Analysis

Analysis of variance (ANOVA) was used to determine the process variables that significantly contributed to the response variable. The S/N ratio is a representative response of the overall response. The calculation of ANOVA is carried out using the formula:

1. Calculating the total number of squares (sum of squares): $SST = \sum_{i=1}^{n}(y_i - \bar{y})^2$
2. Calculate the sum of squares of each process variable (sum of square):
   $SSA = nA\sum_{i=1}^{n}(A_i - \bar{y})^2$
3. Calculate the mean of the square
   $MSA = \frac{SSA}{Df_A}$

3. RESULTS AND DISCUSSIONS

The modified extrusion machine is shown in Figure 1. The central part consists of an extrusion system with are screw, barrel, and nozzle. The plastic pellets are placed on the hopper and then fed to the barrel by rotating the screw, which is driven by an electric motor. To melt the plastic pellets required heating and controlled temperature. A double band heater controls the heat. One band heater B near the hopper and band heater A near the nozzle. Heat regulation by thermocouple with buttons assembled in the box on the engine frame. The outgoing filament is then rolled up on a roller. The speed of the rolling up process should be controlled to avoid overstretched or broken filament.

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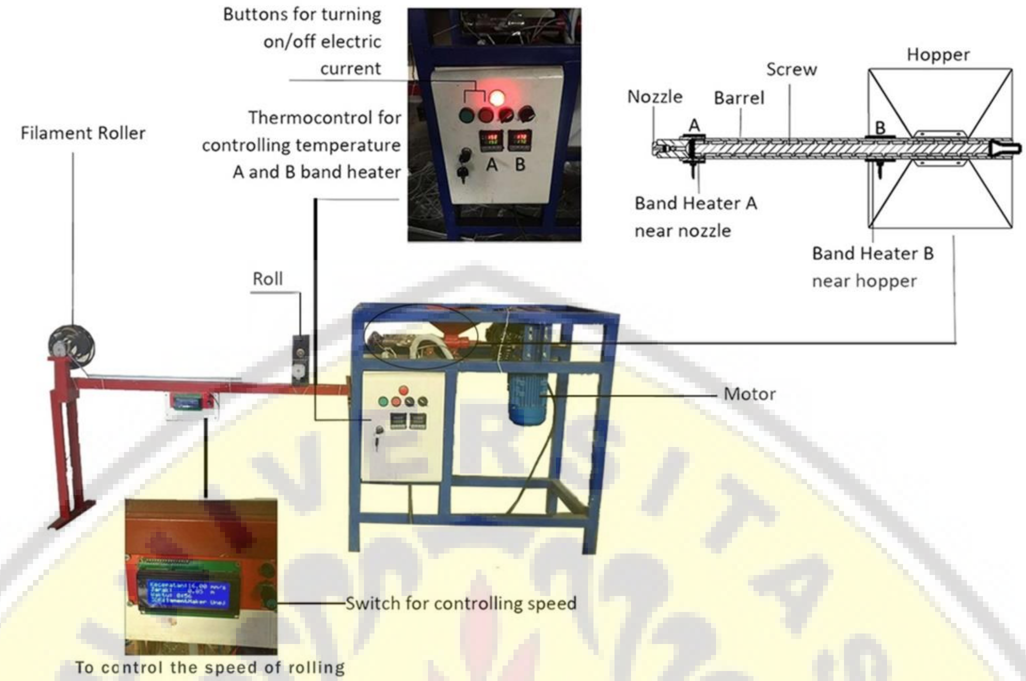

Figure 1. The modified extrusion machine and its part

3.1 Data of Filament Diameter

The extruder has succeeded produced a filament. The produced filament is depicted at Figure 2(a). Then, it followed by measurement [Figure 2(b) & 2(c)]. Measurement was carried out several times at length of 5 mm. The average of diameter of each filament was presented at Table 4 column 5-8. The average diameter of the same combination, then, presented in column 8 Table 4.

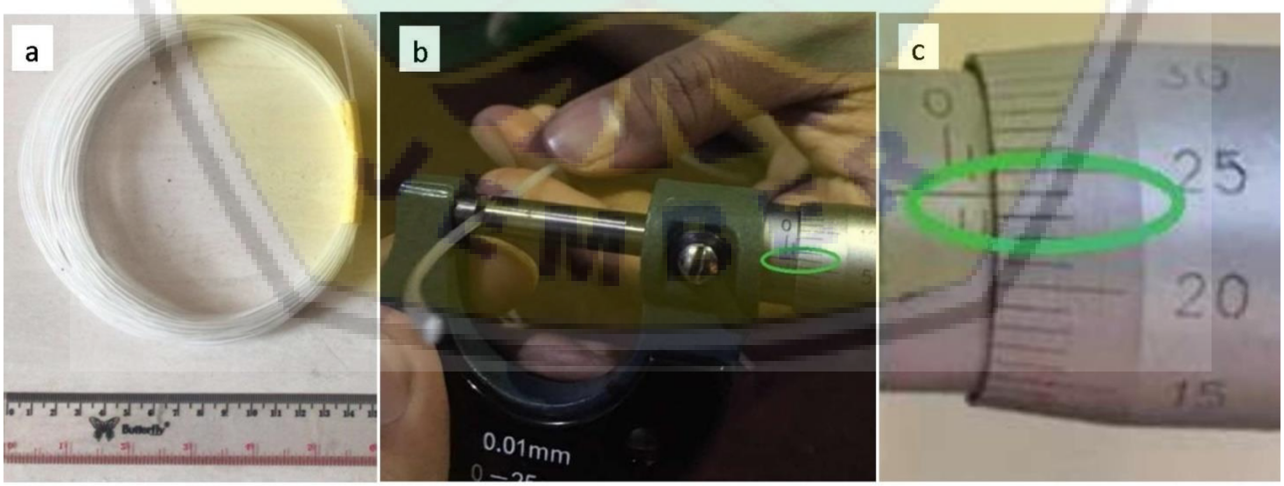

Figure 2. The produced filament (a), its measurement (b), and the appearance of dimension at the micrometer

Table 4. The design of experiment and the data of filament's diameter

Control Factor	Diameter (mm)

No	Speed (mm/s)	Temperature (°C)	Distance (mm)	Replication			Average	S/N Ratio
				I	II	III		
1	2	3	4	5	6	7	8	9
1	13	150-170	200	1.76	1.78	1.69	1.74	24.36125
2	13	155-175	500	1.69	1.54	1.75	1.66	16.82973
3	13	160-180	700	1.72	1.72	1.76	1.73	30.42780
4	16	150-170	500	1.57	1.64	1.46	1.56	17.72965
5	16	155-175	700	1.48	1.36	1.38	1.41	19.65800
6	16	160-180	200	1.71	1.70	1.66	1.69	29.10212
7	19	150-170	700	1.27	1.29	1.26	1.27	31.58180
8	19	155-175	200	1.58	1.48	1.57	1.54	22.01312
9	19	160-180	500	1.21	1.17	1.18	1.19	28.04003

Based on the filament data in Table 4 (the last column), the highest S/N ratio is 30.42780. In Taguchi design, the higher S/N ratio means that the signal (controlled variable) is more dominant that of the noise (uncontrolled variable). Therefore, the best diameter results are obtained with a combination of speed parameters (13 mm/s), temperature (160-180 °C), and distance (700 mm) with an average diameter of 1.73 mm.

3.1.1 Calculation of S/N Ratio Data

Based on the calculation of the S/N ratio using the Minitab 19 application (of free trial version), the data on the S/N calculation is obtained in Table 4, the last column, and the average response of the S/N Ratio value for each level parameter is shown in Table 5.

Table 5. Average response value of S/N ratio at each parameter level

Level	Parameter		
	Speed	Temperature	Distance
1	23.8729	24.4830	25.1588
2	22.1633	19.5003	20.8665
3	**27.1371**	**29.1900**	**27.1480**
Delta (max-min)	3.2642	9.6897	6.2815
Rank	3	1	2
Average	24.3911		

From the data in Table 4 and Table 5, the S/N Ratio Plot in Figure 3 is obtained below:

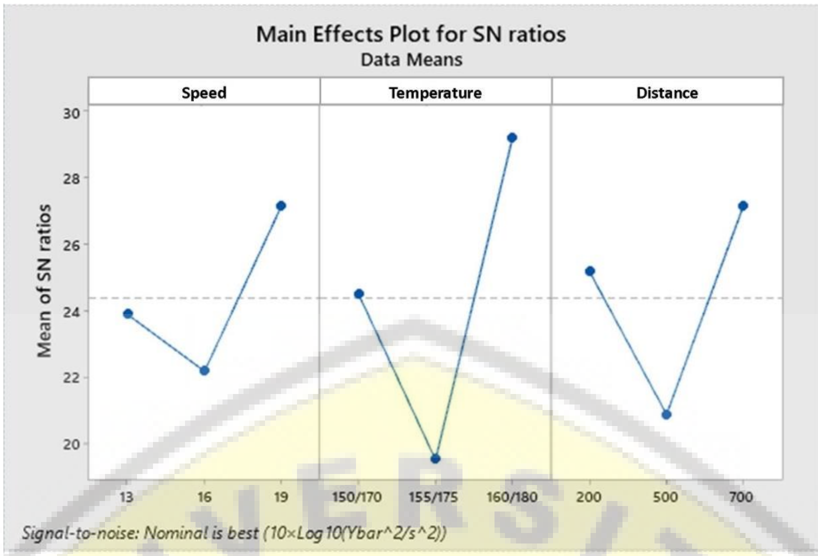

Figure 3. Plot for S/N ratio (Minitab 19)

Based on the calculation of the S/N Ratio and Plot for the S/N ratio, it is found that the parameter that most influences the dimensions and diameter of the filament made is the temperature.

3.1.2 Calculation of ANOVA

Analysis of variance (ANOVA) aims to determine the contribution of each parameter to the response under study. Below is an example of calculating ANOVA with the value of the S/N ratio:

a. Calculate the total number of squares (sum of squares)

$$SST = \sum_{i=1}^{n} (y_i - \bar{y})^2$$

SST = $(24.3612 - 24.3911)^2 + (16.8297 - 24.3911)^2 + (30.4278 - 24.3911)^2 + (17.7296 - 24.3911)^2 + (19.6580 - 24.3911)^2 + (29.1021 - 24.3911)^2 + (31.3582 - 24.3911)^2 + (22.0131 - 24.3911)^2 + (28.0400 - 24.3911)^2$

SST = 250.0976

b. The sum of the squares of each parameter

$$SSA = nA \sum_{i=1}^{n} (A_i - \bar{y})^2$$

SSA = 3 x $[(23.8729 - 24.3911)^2 + (22.1633 - 24.3911)^2 + (27.1371 - 24.3911)^2]$

SSA = 38.3171

c. Means of square

$$MSA = \frac{SSA}{Df_A}$$

MSA = 38.3171/2

MSA = 19.1585

The next step is calculation of the percentage contribution to determine how much influence each parameter has on the total variation of the existing response. If the error value is less than 15%, it means the parameter affects this study. Otherwise, some parameters were neglected in the study. Following is the calculation of the contribution proportion from the ANOVA results:

$SS'_A = SSA - df_A \, . \, MS_{Res}$

$SS'_A = 38.3171 - 2 \times 4.5341$
$SS'_A = 29.2478$

In the ANOVA, we got the percentage contribution of each parameter. Then, it was converted to the S/N ratio, as depicted in Table 6.

Table 6. ANOVA Results and Parameter Contribution with S/N Ratio Calculation

	Parameter				
	Speed	Temperature	Distance	Residual	Total
DoF	2	2	2	2	8
SS	38.3171	140.8735	61.8387	9.0683	250.0976
MS	19.1585	70.4367	30.9194	4.5341	
F-value	4.2254	15.5347	6.8192		
Percentage	12%	53%	21%	14%	100%

From Table 6, we compare the F-value with F-table. Statistically, a variable has a significant to the dimension of the filament as the output if F-value bigger than F-table. The F-table of F(0.05;2;6) = 5.14. Therefore, temperature and distance both significantly influence the dimension of the extruded filament, while, speed of rolling does not affect it. The residual error of the ANOVA analysis is 14%, which is a bit better than that of [19], who achieved error of 15%.

3.2 Roundness Data

Roundness measurement can be done using a measuring instrument with two sensors opposite each other (180º), for example, a screw micrometer. In measuring the roundness of the filament, it was cut randomly along 5 cm to make it easier to determine the diagonal to be measured. The data for measuring filament roundness are shown in Table 7 and Table 8.

Table 7. Data of the best filament roundness

Specimen Number	Diameter of Specimen (mm)		
	Replication		Delta
	1	2	
1	1.77	1.74	0.03
2	1.78	1.74	0.04
3	1.76	1.75	0.01
4	1.77	1.72	0.05
5	1.78	1.74	0.04
6	1.76	1.72	0.04
7	1.78	1.75	0.03
8	1.77	1.76	0.01
9	1.78	1.74	0.04
10	1.77	1.75	0.02
Average	1.77	1.74	0.03

Table 8. Data of roundness measurement with the widest deviation

Specimen Number	Diameter of Specimen (mm)		
	Replication		Delta
	1	2	
1	1.74	1.50	0.24
2	1.72	1.50	0.22
3	1.74	1.51	0.23
4	1.73	1.56	0.17
5	1.75	1.52	0.23
6	1.74	1.51	0.23
7	1.73	1.52	0.21
8	1.75	1.50	0.25
9	1.74	1.51	0.23
10	1.74	1.52	0.22
Average	1.74	1.51	0.22

The slightest deviation is 0.03 mm, and the worst is 0.22 mm. Therefore, we can conclude that the machine can produce filaments with good roundness tolerance.

3.3 Discussion of Parameter Effect

From the results of the research conducted, the influence of each parameter used is as follows:

3.3.1 Temperature

The temperature parameter significantly influences the data retrieval, with the most significant contribution percentage of 53% and the F-value of 15.5347. It relates to the distribution of the filament coming out of the nozzle when the temperature in the barrel is too small and not evenly distributed. Therefore, the plastic granules contained in it will not melt evenly. Consequently, the distribution of the released filament was not stable. When the filament is rolled, the resulting filament is not uniform because the volume that comes out is unstable. Therefore, setting the temperature on the barrel is very important. It requires the right temperature with a band heater temperature of 160^{o}C at the closest distance (50 mm) to the nozzle and 180 ^{o}C at the closest distance (35 mm). The temperature at the hopper with a range of 180-200^{o}C produces a consistent distribution of filaments with a polypropylene base. Another researchers found that for recycled LDPE, the best temperature range 165°C- 190°C [20].

3.3.2 Distance

Data processing revealed that the distance parameter contributed to the filament precision at 21% and an F-value of 6.8192. Roll distance significantly affects the diameter of the filament because there is no external cooling on the extrusion machine. The extruded filament is in a melted condition. If it is hurriedly rolled-up just after extruding, it may flatten. Therefore, a distance between the nozzle and roller is necessary to ensure the filament change. The best distance is 700 mm from the nozzle. Previously some researchers have designed a similar machine but there was no roller as a filament equipment post extrusion [21].

3.3.3 Rolling Speed

Based on data processing using the Taguchi method with the help of the Minitab19 application, the F-value is smaller than F-table. It confirms that roller speed has an insignificant effect on the diameter of the filament. This finding is different from the one obtained by [22]. Difference this may be affected by the difference the material used. This research uses new PP raw material in granular form, while [22] using recycled PP material.

4. CONCLUSION

Based on the data analysis and processing results using the Taguchi method with the help of the Minitab19 application, authors come to some conclusions. First, parameters that significantly influence the results of the dimensions and diameter of the filament are temperature and roll distance with an F-value of 15.5347 and 6.8192, respectively. In comparison, the parameters that have no significant effect on the dimensional results and the diameter of the filament is the roller speed with an F-value of 4.2254. Secondly, the accuracy of the dimensions and diameter of the filaments produced with roller speed, temperature, and distance of the nozzle with the roll capable of producing suitable dimensions and diameter of the filament. Thirdly, the best diameter was at the average of 1.73 mm at the target of 1.75 mm, and a reasonable roundness deviation of 0.03 mm in each measurement. Finally, an average of the best filament dimension accuracy was achieved when using a combination of parameters of variable temperature 160-180 ^{0}C, nozzle distance with the roll is 700 mm, and roller speed of 13 mm/s.

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