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Effects Machining Parameter of Surface Roughness Composite Glass Fibre Reinforced Polyester

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ABSTRACT

This paper presents the ability of the milling machining Glass Fibre Reinforced Polyester composites by using conventional milling machines. In this study, the cost per unit of Computer Numerical Control (CNC) is high to do the milling of the polymer composites. Here, it describes the general methods of polymer composites machining and results of laboratory tests performed on surface roughness test. In the experiment, the polymer composite used is glass fibre reinforced polyester and conventional milling machines used for machining of polymer composites. Fibreglass material is solid and strong and lighter than other metals. After machining, composite materials will be tested in any physical changes. From the results of the analysis for the cutting speed of 1000rpm, it shows the polymer composite has low value of surface roughness. For the cutting speed of 500rpm, the polymer composite indicates high value of surface roughness. Selection of high speed cutting for machining is suitable for milling glass fibre reinforced polyester composites. It provides good physical properties of polymer composite materials.
KEYWORDS: Polymer Composite, Milling Machine, Glass Fibre, Surface Roughness, Polyester.

INTRODUCTION

Polymers are long chain molecules and repetitive where the connection is made from several other molecules called monomers. Monomers may be similar, or may also have one or more chemical groups substituted. These differences can affect the properties of the polymer such as solubility, the ability to be bent or strength. The combination of two or more different base materials will produce a substance known as composite. Result of the merger will be seen where the composite material has the same constituents as the base material. Production is to improve the mechanical properties, thermal characteristics and etc. Composite is the result of a combination of two or more macroscopically different components. It has interfaces between them in order to obtain the properties of certain physical and mechanical properties which better than their constituent components [4].

In this study, a conventional milling machine was used to carry out the process of mill up glass fibre reinforced polyester. The objective of this study was to investigate the effect of process parameters on surface roughness machining of glass fibre reinforced polyester by using a conventional milling.

LITERATURE REVIEW

Machining is the process of making the most important and most of the world's manufacturing infrastructure at present. It can be used for a variety of jobs to cut materials and can produce complex shapes with precision tolerances and has good finishing. Milling is a basic machining process and is mostly metal removal operations in the manufacturing industry. Quality of ground work is an important role to improve the fatigue strength, corrosion resistance and creep life of a substance [3].

Polyester is commonly used as a matrix material, often with a glass fibre reinforced. Polyester is the material economy with high chemical resistance as well as resistance to environmental effects. It has high dimensional stability and low moisture absorption. Low volume fractions with different colours are used for a long time. Technology for the production of glass and composite thermoset polyester is easier and cheaper than other glass resin material [2].

The importance of this study is to reduce the cost of producing polymer-based composites for experimental polymer composite milling machining by using conventional milling machine.

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METHODOLOGY

Machining Procedures

Milling machining process performed on the work piece fibre glass reinforced polyester. During the process of machining, the machining parameters were recorded tool wear, machining speed, feed rate machining and the resulting shape of tartar.

Step 1

Prepare all of the equipments that will be used during the machining done. Make sure all equipments are in good condition before starting the experiment.

Figure 1: Equipment used

Step 2

Measuring work piece size set and marks it to facilitate machining processes carried out.

Figure 2: Measuring the work piece

Step 3

Assemble the vise on the milling machine, install the tool in the chuck and install the work piece in a vise.

Figure 3: Tighten the vise

Step 4

Milling the first surface on the work piece to the first surface of flat. Leave 10mm above the surface as a reference to make comparison of surface roughness after machining.

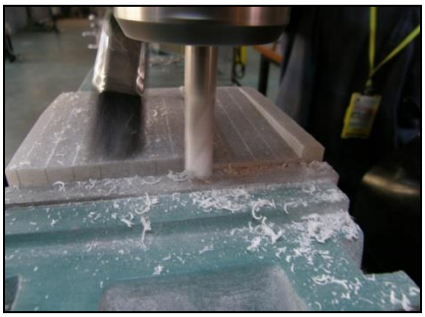

Figure 4: The milling process

Step 5

Set the milling machine on the 0.0 as a starting point machining. Do the milling on the work piece by 2mm on each level. Each level is 10mm wide. Make milling machining on the work piece in the shape of level in the first 10 level. Each level has a different height difference of 2mm.

Figure 5: Work finish

Surface Roughness Testers Portable SurfTtest ST-301

Portable surface roughness tester is able to operate independently which can make measurement on any part of the work piece. It has size of 5.7 colour liquid-crystal display (LCD) with touch screen functionality to enhance operations and provide high visibility. Besides, it also can show the mean, standard deviation, max, min, graduation rates and histograms. Stored data can be displayed and printed on the built-in printer or stored in memory.

Figure 6: Surface roughness testers portable SurfTtest ST-301

RESULTS AND DISCUSSION

Work Piece Machining

The results of the experiment that shown in Table 1 are based on the parameters specified in the table work piece machining using milling machines. Parameters set is to obtain a decision tool wear, machining speed, feed rate and machining resulting shape of tartar.

Table 1: Table of milling machining

Machining Parameters	Depth of cut = 2mm											
	1	2	3	4	5	6	7	8	9	10	11	12
Tool Wear (mm)	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Machining Speed (rpm)	1000	1000	1000	800	800	800	600	600	600	500	500	500
Machining Feed Rate (mm/rev)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Shape of Tartar	Very Fine	Very Fine	Very Fine	Fine	Fine	Fine	Rough	Rough	Rough	Very Rough	Very Rough	Very Rough

Surface Roughness

The results of the experimental testing of surface roughness based on testing done by using a portable surface roughness tester SurfTtest ST-301 is shown in Table 2. It indicates the results of which were taken from the test surface roughness by using portable surface roughness testers. Of the decisions taken, it was found that each different cutting speed give different values on each surface roughness.

Table 2: Surface roughness test results

Milling Speed Reading Category	0 rpm (µm)	1000 rpm (µm)	800 rpm (µm)	600 rpm (µm)	500 rpm (µm)
Arithmetic Average Rough, Ra					
Reading No: 1	3.18	1.26	1.45	2.01	2.56
2	3.45	1.40	1.40	2.42	2.72
3	3.71	1.45	1.74	2.73	2.74
4	3.66	1.22	1.52	2.58	2.69
5	3.66	1.19	1.67	2.54	2.91
Average	±3.53	±1.30	±1.56	±2.46	±2.72
Maximum Height Rough, Ry					
Reading No: 1	19.02	8.57	10.95	12.06	15.85
2	19.18	8.20	8.51	13.47	13.84
3	18.7	9.60	13.03	18.05	16.24
4	20.60	8.23	8.48	17.08	17.02
5	20.94	7.27	10.4	15.73	17.17
Average	±19.69	±8.37	±10.27	±15.28	±16.00

Based on Table 2, the results of 1000ppm cutting speed shows the average surface roughness of Ra = lowest of 1:30 (m) and Ry = 8:37 (m), while cutting speed of 500ppm shows the average surface roughness of Ra = highest 2.72 (m) and Ry = 16:00 (m). Surface roughness plays an important role for the quality of the product, and the most important parameter in the assessment for precision machining [1].

From the analysis of the results, it shows a good surface roughness for the machining of glass fibre reinforced polyester by using high speed cutting machining milling processes. For Figures 7 and 8 show a straight line graph of reading on the surface roughness of Ra and Ry. It indicates the highest surface roughness (after the milling process) is at the cutting speed of 500rpm, while the roughness of the lowest value of cutting speed is 1000rpm. Selection of parameters in high speed machining of composite polymers will offer better final surface finish [5].

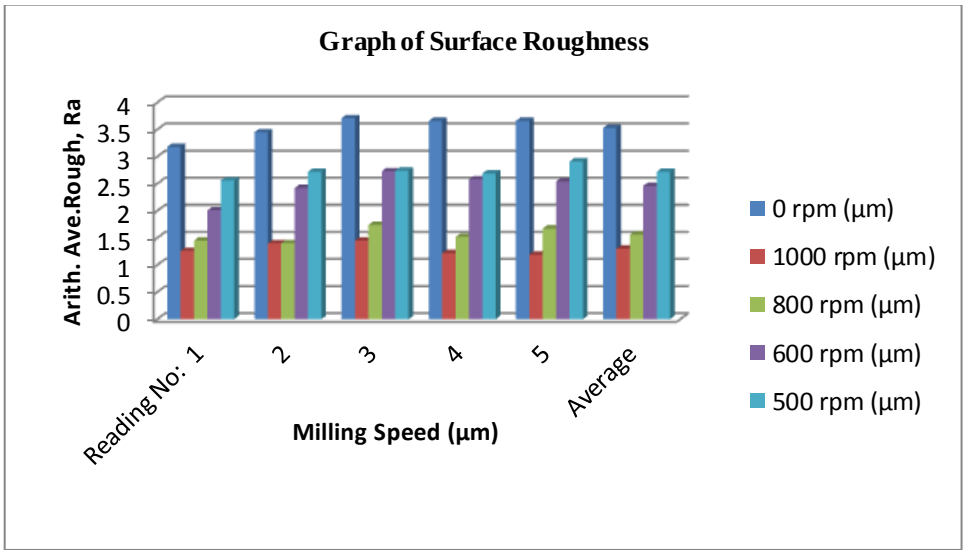

Figure 7: Graph of arithmetic average rough (Ra) versus cutting speed (rpm)

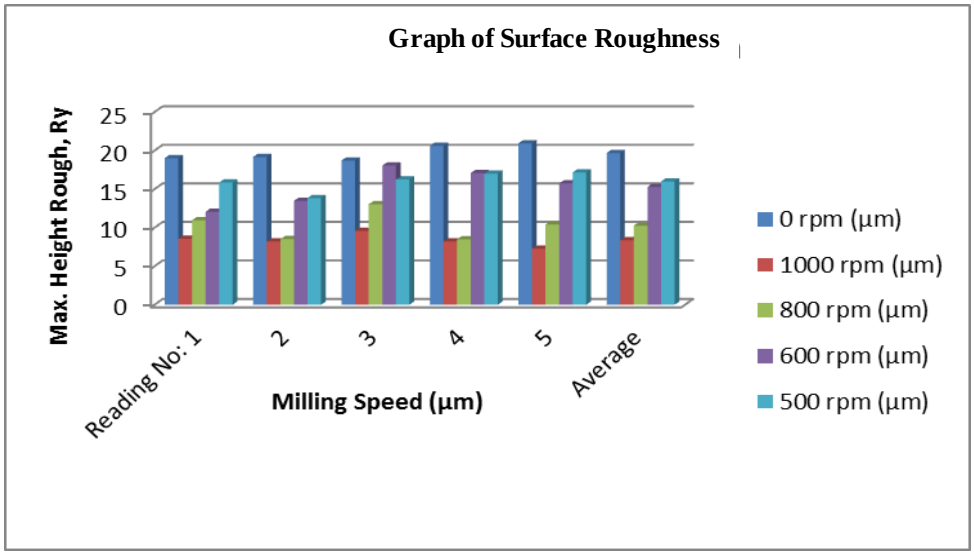

Figure 8: Graph of maximum rough height (Ry) versus cutting speed (rpm)

CONCLUSION AND RECOMMENDATIONS

In conclusion, the results indicate significant findings from the machining of glass fibre reinforced polyester by using high speed steel tool at different cuts of parameters. It shows machining capabilities in terms of surface roughness of polyester reinforced fibre glass by using a milling machine conventional. The best process of cutting is at 1000rpm speed, feed rate of 0:03min/rev with lowest of average surface roughness of Ra = 1.30µm and Ry = 8.37µm. The results and analysis shown that conventional machining milling process has capability to perform the machining of glass fibre reinforced polyester.

Some recommendations are suggested to be carried out in the future. Further research will focus on other variables such as by using Taguchi design method in milling operation. It is to investigate the cutting characteristics of fibre reinforced composite material by using high speed and carbide tool.

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