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OPTIMIZATION OF SQUARE SHAPE PORTABLE VACUUM CLAMPING (SQUARE) BASED ON MACHINING PARAMETER

N. Ab Wahab, Shiradzi Bin Basharudin, Hambali Bin Boejang, E. Ruslan, D. A. Hadi and N. Syuhada Nasir
Faculty of Mechanical and Manufacturing Engineering Technology, Universiti Teknikal Malaysia Melaka,
Hang Tuah Jaya, Durian Tunggal, Melaka, Malaysia
E-Mail: norfariza@utem.edu.my

ABSTRACT

Clamping is a fastening device function to hold or secure the object to prevent movement during process or when applied pressure. There are many types of clamping device available for many purposes. This project purpose is to optimize the vacuum clamping based on the machining parameter. From the previous research that develop the vacuum clamping, the product is continue to use to determine the machining performance of vacuum clamping. However, at that time the target was only to develop a functional prototype and only some testing were done. Therefore, in order to optimize the vacuum clamping surface roughness testing was done using this new clamping device to compare with existing clamping device. The expected result show that vacuum clamping is better. As a conclusion, vacuum clamping can be improved for better use in the future and apply to the manufacturing field.

Keywords: Surface roughness testing, vacuum clamp, roughness depth.

1. INTRODUCTION

Clamp is a device usually some rigid material used to hold object securely or support the object to prevent the movement through application of pressure. Clamping will be the important factor that will give the best result of the product being machined. Milling process is one of the machining processes that requires the clamping of the workpiece during machining [1]. Therefore, the product must be hold secure and tightly to achieve accurate machining result. The main function of the clamp is to hold the object securely and prevent the movement of the workpiece when pressure is applied. Some principles need to be considered when do the clamping which is the positioning of the workpiece, strength or force of the clamping that not damage the workpiece, and productivity of the clamping that being used.

Previous study had developed the fixable rotation clamping method which allows the workpiece to be rotated up to 90 degree to both sides. Means, all surface can be machine using one single clamp without need to remove the workpiece from clamping to adjust the position of the workpiece to the desire surface that need to machine [2]. Beside milling process, lathe process also requires clamping to hold the workpiece. Magnetic clamping had been developed to clamp the thin and small workpiece. The study found that magnetic clamping can contribute to better surface roughness for thin workpiece after machining [3].

Before, limitations on current clamping were identify and from there vacuum clamping were produce. There are several aspects that need to take care within the vacuum clamping. Besides that, there are also the parts of the clamp, where it will affect the finishing product need to improvise in order to get the good result of machining when using it. However, only certain tests have been done to test the vacuum clamping to study the machining performance of the clamping because at that time the target was to develop only functional prototypes.

The objectives of this project are:

- To study the effect of different cutting parameter based on machining performance.
- To optimize the vacuum clamping based on the cutting parameter selected.
- To analyze the machine performance and result using vacuum clamping based of the selected condition.

The scope of this project was limit for laboratory and teaching purpose. And also, optimizations of vacuum clamp only apply to milling machine.

2. METHODOLOGY

The experiment will be carried out in the Jabatan Teknologi Kejuruteraan Pembuatan (JTKP) laboratory at Universiti Teknikal Malaysia Melaka (UTeM). The tools for measurement process also provide by JTKP laboratory. Furthermore, all the data and result will be gathered to perform the analysis and analyse the outcome. Figure 2.1 below show the flow of this project run.

2.1 To study the effect of a different cutting parameter on machining performance

The objective of this experiment is to determine whether this vacuum clamping can hold workpiece better and produce smooth surface roughness of machining. All the experiment will be conduct at JTKP laboratory using milling machine. End mill cutter will be used to perform the experiment. Each experiment will be used the same end mill cutter which is the 10mm diameter. Three machining parameters involved in this experiment is the depth of cut, spindle speed and feed rate. With constant value of the depth of cut which is 0.5mm and feed rate 1, 2, and 3 at 40 mm/min. The workpiece used is mild steel with a dimension of 100mmx100mmx1.5mm.

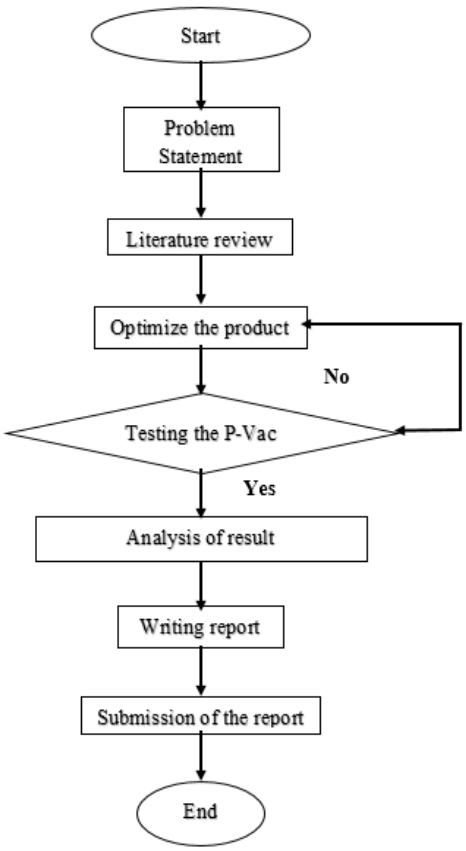

Figure-2.1. Flow chart.

2.2 Setup experiment

a) The experiment was conduct at FTK laboratory using vertical milling machine.
b) Vacuum clamping will be attached to the milling machine.

Figure-2.2. vacuum clamping at milling machine.

c) The material used mild steel with dimension 100mmx100mmx1.5mm.

Figure-2.3. Specimen use for machining.

d) The specimen will be testing using vacuum clamp.

Figure-2.4. Specimen testing.

2.3 Method

After the specimen testing using milling machine, the output from the experiment will be analysed of surface roughness using portable surface roughness tester, SJ-410 at the laboratory.

Figure-2.5. Surface roughness tester, SJ-410.

The surface roughness tester machine will show the measured roughness depth (Rz) and mean roughness value (Ra) in micron (µm). Each experiment will be conducting ten reading of measurement of the data. The setting of the machine is 10mm travel length and 0.5mm/s travel speed. All the data obtained from the surface roughness machine tester will be recorded.

Figure-2.6. Surface roughness testing.

3. RESULT AND DISCUSSIONS

3.1 Surface roughness result

The main parameter that effect the surface roughness are spindle speed, feed rate and depth of cut. In order to get the arithmetic mean value of this experiment, surface roughness tester was required.

Table-3.1. average of each testing.

Spindle speed, v	Feed rate, f			Average Arithmetic mean value, Ra
500	1	2	3	1.056
750	1	2	3	1.048

From the data, the graph will use to evaluate the result.

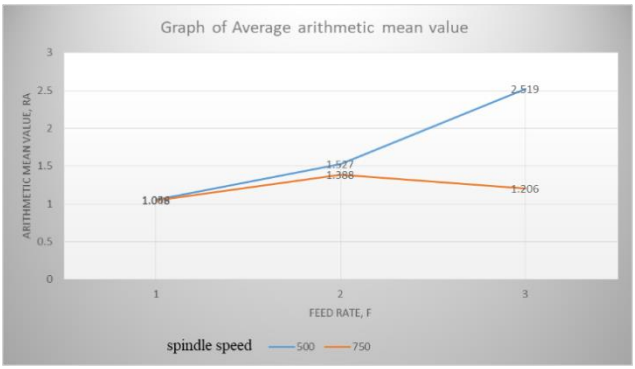

Figure-3.1. Average of arithmetic mean value of testing.

4. CONCLUSIONS

This project was set up solely to optimize the square shape portable vacuum clamping based on the machining parameter using milling machine. The objective was to study the effect of different cutting parameter of the machining performance, optimize and analyse the result of the surface roughness of machining. The process was carried out using vertical conventional milling machine to cut the specimen with end mill diameter 10. Spindle speed and feed rate of machining will be the cutting parameter use to testing. For spindle speed 500 rpm and 750 rpm were used while feed rate is 1, 2 and 3 respectively. Depth of cut during machining were constant for all experiment which is 0.5 mm. 6 slot will be made on the specimen according to the cutting parameter selected. Then, the slot of machining will be testing for surface roughness using portable surface roughness tester, SJ-410 at the laboratory. The result will show which the best result of machining using vacuum clamping.

Based on the result show of this project, the portable square shape vacuum clamping is functional and can be used for one of the clamping devices. A good clamping system will reduce setup time; improve machining performance and precision on the workpiece. With this project can produce good result of the machining and functional properly, there can be more improvement that can be made to make the product better.

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