UNIVERSITI TEKNIKAL MALAYSIA MELAKA

INFLUENCE OF CUTTING CONDITION ON PRODUCT QUALITY WHEN CUTTING ALUMINUM ALLOYS

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Process) (Hons.)

by

MOHD FAHAME BIN CHE DAUD

B050910265

880503 - 11 - 5511

FACULTY OF MANUFACTURING ENGINEERING

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DECLARATION

I hereby, declared this report entitled "Influence of Cutting Condition on Product Quality When Cutting Aluminum Alloys" is the results of my own research except as cited in references.

Signature :

Author's Name : Mohd Fahame Bin Che Daud

Date : 03rd JUNE 2013

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Process Engineering) (Hons.). The member of the supervisory is as follow:

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(TN.HJ AB RAHMAN BIN MAHMOOD)

ABSTRAK

Sasaran Projek Tahun Akhir ini adalah untuk mengenalpasti pengaruh terhadap kondisi pemotongan kepada kualiti produk apabila memotong aluminium aloi menggunakan parameter yang berbeza seperti kelajuan pemotongan (70 m/min, 90 m/min, dan 110 m/min), kadar suapan (0.1 mm/rev, 0.45 mm/rev, dan 0.8 mm/rev) , dan juga panjang alat pemotong (95 mm,105 mm, dan 115 mm). Projek ini juga bertujuan untuk mengumpul maklum balas data dari operasi penggerudian dengan menggunakan penguji kekasaran permukaan untuk mengenalpasti kekasaran permukaan bahan kerja aluminium aloi. Alat pemotong jenis keluli berkelajuan tinggi adalah alat utama yang digunakan sehingga akhir eksperimen ini. Perkiraan analisis ini dijalankan apabila analisis regresi telah digunakan untuk menganalisa kesan parameter penggerudian terhadap kualiti lubang produk yang digerudi pada aluminium aloi. Setiap inci keputusan eksperimen ini boleh diambil kira tanpa sebarang sisa data dan ia akan dikumpulkan dan dianalisis menggunakan pakej perisian komersial MINITAB 16. Sebagai pengesahan, model regresi telah dibangunkan untuk mendapatkan keputusan yang lebih tepat dalam projek ini. Formula yang dijalankan ini adalah berkait rapat dengan apa yang telah dikaji oleh objektif dan mewujudkan korelasi biasa parameter yang dipilih untuk mempengaruhi kondisi pemotongan pada kualiti produk semasa menjawab persoalan terhadap kekasaran permukaan. Data perkembangan ini telah dibandingkan dengan data yang disahkan dan akan membuahkan hasil yang tepat. Kemudian, parameter yang berbeza pada setiap data yang diambil telah dibenarkan dengan syarat dianalisis dengan ujian berpasangan (T-Test) di mana menyedari hipotesis yang diperolehi daripada ujian yang dilakukan.

ABSTRACT

The aim of this Final Year Project was to influence of cutting condition on product quality when cutting aluminum alloys using different parameter such as cutting speed (70 m/min, 90 m/min, and 110 m/min), feed rate (0.1 mm/rev, 0.45 mm/rev, and 0.8 mm/rev), and also tool length (95 mm, 105 mm, and 115 mm). The project purposed also want to collect data response from CNC Machining Center operation by using surface roughness tester to utilize the surface roughness of the aluminum alloys work piece. High Speed Steel cutting tool was the major tool that used of up to finish the experiment. An arrangement of this analysis were conducted when regression analysis had been employed to analyze the effect of drilling parameters on the product quality of drilled holes on aluminum alloy. Every inch of the results of this experiment could be taken into account without any residual data and it would be collected and analyzed using the commercial software package MINITAB 16. As comfirmation, a regression model was developed to get the desired accuracy results in this project. This formula was closely related on what were researched by the objective of created a common correlation selected parameter to influence cutting condition on product quality with current responding in surface roughness. The development data was compared with the validated data would yield accurate results. Then, each data taken has allowed provided different parameters were analyzed by the unpaired test (T-Test) in which they realize hypothesis obtained from tests done.

DEDICATION

To my father; Che Daud Bin Mat Ali, my mother; Che Junaidah Bt Che Daud, my siblings and my friends. Your love is my driving force.

To my supervisor, Mr.Ab Rahman Bin Mahmood that mostly guide me with patient.

To FKP technician that mostly guide me in this project

Thank you for all your supports, guidance, helps and co-operation, directly or in directly.

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ANOVA	-	Average value of the dependent variable
UTeM	-	Universiti Teknikal Malaysia Melaka
MRR	-	Material Removal Rate
TiN	-	Titanium Nitride
HSS	-	High-Speed Steel
NC	-	Numerical Control
TIR	-	Total Indicator Run out
vibDAQ	-	Vibration Data Acquisition
FFT	-	Fast Fourier Transform
USB PC	-	Universal Serial Bus
JPEG	-	Joint Photographic Experts Group
CAD/CAM	-	Computer Aided Design / Computer Aided Manufacturing
RA	-	Surface Roughness
R - Sq	-	R- Square

CHAPTER 1
INTRODUCTION

This project entitled “Influence of cutting condition on product quality when cutting aluminum alloys.” This chapter has covered on the general view of manufacturing, objectives, scopes and limitations which have involved in this project.

Drills typically have high length-to-diameter ratios. Hence, they were capable of produced relatively deep holes. However, drills were somewhat flexible and should be used with care in order to drill holes accurately and to prevent breakage. Among traditional machining processes, drills was the most important metal cutting operations, comprising 33% of all metal cutting operations (Chen W C et.al, 1999). Furthermore, the chip that were produced within the hole moved in a opposite direction to the forward movement of the drill. Thus, chip disposal and ensuring cutting-fluid effectiveness can present significant difficulties in drilling. So, in industrial environment, we need to know the feed rate of drill which was forced into the workpiece material and can be expressed as in./rev (mm/rev). Cutting speed was the velocity at which a point on the circumference of the drill passes the wall of the hole being drilled and can be expressed as surface ft/min (m/min). Besides that, feed rate and tool length also can be adjusted with every different step or process to get the different results on surface roughness of drilling process.

As gone too far with influence of cutting condition on product quality when cutting aluminum alloys, more characteristic would be known about the facts and problems with drill uses. As a facts, drilling operation was evaluated based on the performance characteristics such as surface roughness, material removal rate (MRR), tool wear, tool life, cutting force, hole diameter error, power consumption and are strongly

correlated with the cutting parameters such as cutting speed, feed, depth of cut, and tool geometry (Chryssolouris G et.al, 1990, Chua MS et.al, 1993, Yang H et.al,1998, Paulo davim.J et.al,2003). Therefore, the cutting efficiency of a drill was determined by the characteristic and condition of the point of the drill. Most new drills were provided with a general-purpose point (118° point angle and an 8° to 12° lip clearence). Besides, excessive feed rate caused the abnormal trust on drill bit which can lead to breakdown of chiesel point and cutting lips. Failure induced by this abnormality caused a broken or split drill. The result of cutting condition when cutting aluminum alloy was insufficient clearenced between drill and workpiece exist, that would caused the drill to rub behind the cutting edge. It could be made the drill work hard, generate heat, and increase end thrust. This results in poor holes quality and drill breakage also reflected on cutting condition.

As contained in the sequence of experimental equipment, a lot of measurement such as the usage of accelerometer devices was used for vibration measurement on the work piece during the drilling process. In line with the main focus of this experiment, the greatest surface roughness data should be studied as a response by using the method procedures of MINITAB software. In addition, the mathematical models based on linear regression and neutral network (normal) techniques had been constructed to establish validated model with data development.

Other than that, in influence of cutting condition, drilling process should be not too blunt that cannot be cut. Over blunt of any metal-cutting tool generally shown in poor production rates, inaccurate work, and the shortening of the tool life. Premature blunt of a drill caused by any one of a number of factors such as; the drill speed may be too high for the hardness of the material being cut, the feed may be too heavy and overload the cutting lips, and also the feed may be too light and cause the lips to scrape rather than cut. Thus, this project might be intelligent solution when to know the response of product quality based on multiple parameter used. So, referred to the guideline of this experiment, it must be carried out with successful procedure in drilling investigation for industrial environment.

1.1 Problem Statement

Usually certain industry when running the drilling process will refer to their pass experience, in other word it is by trial and error method of machining process. From this method we cannot classify it as a standard characteristic of industrial principle. Other than that, commonly workers do not have specific instruction or guide line about how to drill holes with different parameters likes when there is an existence of tool wear while doing machining. Based on past inference of statistical analysis there exist influence of cutting condition i.e. cutting speed, feed rate, and tool length on product quality. This quantitative research will be carried out to investigate and infer this statement especially when drilling aluminum alloys. The result of this research was by knowing the response and parameters influencing toward that response hopefully it will help machinist in reducing development cost.

1.2 Objectives

The main objectives of this project are:

1. To study the effect of cutting condition on surface roughness product in flood drilling process of aluminum alloy based on multiple parameter used.
2. To investigate and analyze the response as a result of introducing different drilling parameters.
3. To establish and validate the empirical model for influence of cutting condition on product quality (surface roughness) when cutting aluminum alloys using statistical data analysis.

1.3 Scope of Project

In this project, CNC machining centre will be used to perform process of drilling holes on aluminum alloys specimen. From this machining process, different parameters such as cutting speed, feed rate, and varies tool length will be incorporated to complete this research. Therefore, the response which was a product quality as a result of surface roughness and influence of different cutting parameters will be analyzed. This model was important as a guide line for machining quality analysis and selection of optimum cutting parameters. At the end of the project a full analysis and inference about the influence of cutting tool parameters and surface roughness on product quality when cutting aluminum alloys will then be carried out using an established Linear Regression Model.

CHAPTER 2
LITERATURE REVIEW

INTRODUCTION

Literature review was one of the key aspects in research to be employed. Detailed search of an interest in the preparation of this research was given emphasis to the second reference to each study. The references of this research were constituted of an internet search, reading from journals, magazines information, understanding of reference books, and so on. In other word, it made an important referenced when all the backgrounds and equipment were used as important factors. In drilling process, more factors had been established in terms of to balance the systematic parameter usage that will lead the product quality affected while machining process on aluminum alloy. Other than that, there was a phenomenon of cutting tool usage during the drilling process when it caused adversely affected the product quality. The various sentiments should be studied with depth especially from parameters usage such as the implementation of the existence of feed rate, cutting speed, and tool length. As engineering principles that was something could be side affected in processing methods and should be carried out very carefully for manufacturing sentiment. Therefore, this projects were very concerned about the response of surface roughness which was activated as a study to determine influence of cutting condition on product quality when cutting al alloys.

2.1 CNC Machining Center

A machining center is an advanced computer-controlled machine tool that is capable of performing a variety of machining operations on different surfaces and different orientations of work piece without having to remove it from its work holding device or fixture. The work piece generally is stationary, and the cutting tools rotate as they do in milling, drilling, honing, tapping, and similar operations. Whereas, in transfer lines or in typical shops and factories, the work piece is brought to the machine, in machining centers it is the machining operation that is brought to the work piece.

In using the word work piece, we should point out that the work piece in a machining center also can consist of all types of tooling. Tooling includes forming and cutting tools, cutters and tool holders, tool shanks for holding tool inserts molds for casting, male and female dies for forming, punches for metalworking and powder metallurgy, rams for extrusion, work-holding devices, and featuring all of which also have to be manufactured. Since the geometries often are quite complicated and a variety of machining operations are necessary, these tools commonly are produced in machining centers. (Kalpakjian, S. and Steven, S., 2010)

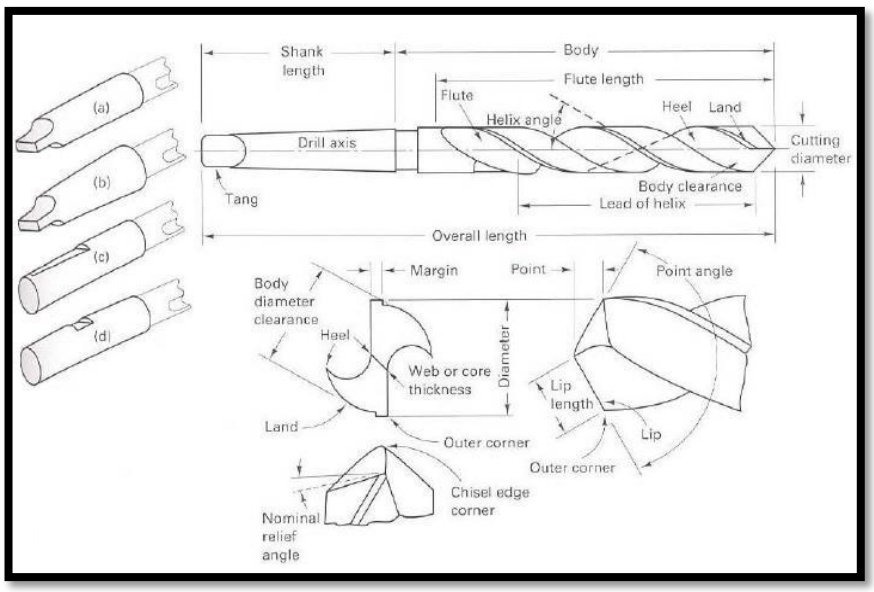
Figures 2.1: CNC Machining Center

2.2 Drilling

In manufacturing it is probable that more holes are produced than any others shape, and a large proportion of these are made by drilling. All of the machining processes performed, drilling makes up about 25%. Consequently, drilling is a very important process. Although drilling appears to be relatively simple process, it is really a complex process. Most drilling is done with a tool having two cutting edges, or lips. This is a twist drill, the most common drill geometry.

The cutting edges are at the end of a relatively flexible tool. Cutting action takes place inside the work piece. The only exit for the chips is the hole that is mostly filled by drill. Friction between the margin and the holes will produces heat that is additional to that due to chip formation. The counter flow of the chips in the flutes makes lubrication and cooling difficult. There are four major actions taking place at the point of drill.

a) A small hole is formed by the web – chips are not cut here in the normal sense.
b) Chips are formed by the rotating lips.



Figures 2.2: Nomenclature and geometry of conventional twist drill.Shank style depends upon the method used to hold the drill. (J.T. Black, Ronald A. Kohser., 2008. *Material & Process In Manufacturing*, 10th edition pg. 628).