A STUDY ON THE EFFECT OF MACHINING PARAMETERS, MACHINING CONDITIONS AND MATERIALS ON SURFACE ROUGHNESS IN TURNING PROCESS

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A report submitted
in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this project report entitled "A Study on the Effect of Machining Parameters, Machining Conditions and Materials on Surface Roughness in Turning Process " is the result of my own work except as cited in the references

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APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design and Innovation).

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DEDICATION

To my beloved mother and father

BON LIAN CHIN

LEE BON CHONG

ABSTRACT

Surface roughness is one of the criteria that can be used to decide the quality of products. Products with low surface roughness are more resistive to fatigue failure. Besides that, different materials have different level of machinability. Materials with good machinability can be easily cut and at the same time give good surface finish with low roughness. Hence, this study was carried out to investigate the effect of machining parameters of conventional lathe machine on quality of surface roughness on different materials and determine whether coolant and lubricant are effective to reduce surface roughness. This study started with literature reviews. Next, experiment was conducted under different conditions with different cutting parameters to obtain surfaces on aluminium alloy 6061 and carbon steel AISI 1060. All the obtained surfaces are measured by using surface roughness tester to detect their quality of surface finish in term of arithmetic average surface roughness (Ra). Justifications were made based on the obtained results. From the results obtained, it was found that it cannot be guaranteed to get low surface roughness at the highest spindle speed and the lowest feed rate. Optimization should be carried out in order to find out the most appropriate machining parameters to get low surface roughness. Spindle speed 1100 rpm and feed rate 0.094 mm/rev are suggested to be the candidates for optimization. Besides that, this study found that lubricant is the most effective condition in order to produce surface with low roughness. On top of that, it was discovered that machinability of aluminium alloy 6061 is better than machinability of carbon steel AISI 1060 because obtained surfaces of aluminium alloy 6061 showed lower surface roughness. This study is vital to be conducted as it provides crucial facts and information to help in fabrication industry especially turning process by using conventional lathe machine. The findings from this study are helpful for manufacturers to improve quality of products.

ABSTRAK

Kekasaran permukaan adalah salah satu kriteria yang boleh digunakan untuk menentukan kualiti produk. Produk dengan kekasaran permukaan rendah lebih merintang terhadap kegagalan keletihan. Selain itu, bahan-bahan yang berbeza mempunyai tahap yang berbeza atas kebolehan dimesin. Bahan-bahan yang mempunyai kebolehan dimesin tinggi adalah lebih mudah dipotong dan pada masa yang sama memberi kemasan permukaan yang baik dengan kekasaran rendah. Oleh itu, kajian ini dijalankan untuk mengkaji kesan parameter pemesinan mesin pelarik konvensional kepada kualiti kekasaran permukaan pada bahan yang berbeza dan menentukan sama ada penyejuk dan pelincir berkesan untuk mengurangkan kekasaran permukaan. Kajian ini bermula dengan ulasan kesusasteraan. Seterusnya, eksperimen telah dijalankan di bawah keadaan yang berbeza dengan parameter pemotongan yang berbeza untuk mendapatkan permukaan pada aloi aluminium 6061 dan keluli karbon AISI 1060. Semua permukaan yang diperolehi diukur dengan menggunakan kekasaran permukaan tester untuk mengesan kualiti kemasan permukaan dari segi aritmetik purata kekasaran permukaan (Ra). Justifikasi dibuat berdasarkan keputusan yang diperolehi. Dari keputusan yang diperolehi, didapati bahawa ia tidak boleh dijamin untuk mendapatkan kekasaran permukaan rendah pada kelajuan spindle tertinggi dan kadar suapan yang paling rendah. Pengoptimuman perlu dijalankan untuk mengetahui parameter pemesinan yang paling sesuai untuk mendapatkan kekasaran permukaan rendah. Kelajuan spindle 1100 rpm dan kadar suapan 0,094 mm / rev dicadangkan untuk menjadi calon untuk pengoptimuman. Selain itu, kajian ini mendapati bahawa pelincir adalah keadaan yang paling berkesan untuk menghasilkan permukaan dengan kekasaran rendah. Selain itu, kajian ini mendapati bahawa kebolehan dimesin daripada aloi aluminium 6061 adalah lebih baik daripada kebolehan dimesin keluli karbon AISI 1060 kerana permukaan yang diperolehi daripada aloi aluminium 6061 menunjukkan kekasaran permukaan yang lebih rendah. Kajian ini adalah penting untuk dijalankan kerana ia menyediakan fakta-fakta dan maklumat yang penting untuk membantu dalam industri proses fabrikasi terutamanya proses 'turning' dengan menggunakan mesin pelarik konvensional. Penemuan daripada kajian ini adalah berguna untuk pengeluar bagi meningkatkan kualiti produk.

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LIST OF ABBEREVATIONS

Al 6061	Aluminium alloy 6061
AISI 1060	Carbon steel 1060
CC	Coolant condition
DC	Dry condition
DOC	Depth of Cut
LC	Lubricant condition
SOP	Standard Operating Procedures

LIST OF SYMBOL

Ra	=	Average surface roughness
$\sum$	=	Summation

CHAPTER 1

INTRODUCTION

1.1 Background

It is an actual fact that all the raw materials are exploited from natural resources. In the first place, the raw materials, such as ores, coals and logs, are extracted from the earth. As such, most of the raw materials are either too large or too tiny to be used. As the result, all these materials need to be further processed. Metals which are obtained from mining are normally made into slab, rod, bar as well as plate. Hence, machining process is needed in order to cut the metals into various desired shape.

Generally, machining process refers to the removal of material from a work piece in the form of chips. There are several types of machining process such as drilling, milling, turning, boring, reaming and so on. Most of the machining processes have low set-up cost compared to other manufacturing processes like moulding, forming and casting. The main concerns that need to be emphasised while machining is the machinability and surface finish of products.

Basically, machinability can be defined as the easiness to machine or cut a material. A material with good machinability normally provides good surface finish and at the same time it requires less power to get rid of the unwanted material. It is undeniable that every single of material has its particular compositions. Moreover, different materials have different arrangement of atoms. Consequently, all the materials are distinct in term of physical properties such as hardness, ductility, tensile strength as

well as malleability. All these can influence the machinability of materials. In order to compare the machinability among materials, surface finish can be used as the measure. Surface finish can be observed to distinguish the machinability of materials. Materials which are difficult to be machined will give bad quality of surface finish. In contrast, materials which are easy to be cut or removed will produce good surface finish.

So what is surface finish refers to? Generally, surface finish also can be called as surface texture or surface topography. It refers to the nature of surface. The nature of surface is categorised into three characteristics which are lay, surface roughness and waviness. Firstly, lay can be defined as the direction or general way of the predominant surface pattern. It usually can be identified by production method used. Secondly, surface roughness refers to a measure which is used to determine the finely spaced surface irregularities. Lastly, waviness is the measure of surface irregularities with spacing greater than that of surface roughness. The reasons that lead to waviness are vibrations, deflection as well as warping during machining.

In facts, surface finish is no doubt an important criterion for machining products as rough and uneven surface will lead to friction. Consequently, the products are low resistive to wear and short life spans. In other words, rough surface is undesirable. Conversely, smooth surface ensures good quality of products. Thus, it is vital to find out the way to achieve low surface roughness of machining products.

Conventional lathe machine is the machine that is used in this study. The main function of this machine is to get rid unwanted material from a work piece in order to achieve desired shape. The work piece for the machine is usually in cylindrical shape. The working principle of the machine is that the cutting tool of the machine is fixed and not rotating while the work piece is rotating. In this study, the effect of machining parameters on surface roughness is investigated. This is achieved by using

different values of spindle speed and feed rate to cut the selected materials and then observing the quality of surface in term of roughness. Besides that, the machining process is conducted under three conditions to determine whether coolant and lubricant bring any effect on surface roughness.

1.2 Problem Statement

Nowadays, machining is no doubt playing important role in manufacturing process due to rapid changing of industries. Machining is the process of removing material from work piece in order to achieve a desired shape for a particular use. One of the fundamental and utmost important requirements of machining is surface roughness. Surface roughness is an imperative parameter that needs to be concerned as it manipulates the performance and quality of machined components. The quality of surface can affect the fatigue life, in term of service duration, of the machined components. Machined component with poor surface quality produces fatigue failure easily in short period of time compared to those with good surface quality. Thus, surface finish directly acts as the key to decide the profitability as well as nature of machined parts. It plays a role as a trademark that may impact the execution of mechanical parts and the generation costs. Due to vision limitation of human, the surfaces of products are smooth to the naked eyes. In facts, most of the products are typically rough at the microscopic level. Hence, it is essential to find out the direction on how to get low surface roughness effectively in order to improve the quality of machining products. As such, time and cost can be saved on keep testing different cutting parameters to produce better surface finish.