UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ANALYSIS THE PERFORMANCE EVALUATION BETWEEN OIL BASED COOLANT AND ENVIRONMENTALLY BASED COOLANT ON CUTTING SURFACE IN TURNING OPERATION

Thesis submitted in accordance with the partial requirements of the Universiti Teknikal Malaysia Melaka for the Bachelor of Manufacturing Engineering (Design)

By

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This thesis submitted to the senate of UTeM and has been accepted as partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering (Design). The members of the supervisory committee are as follow:

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Main Supervisor

(Mr. Mohd Irman bin Ramli)

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Co-Supervisor

(Mr. Saifudin Hafiz bin Yahaya)

DECLARATION

I hereby, declare this thesis entitled "Analysis the performance evaluation between oil based coolant and environmentally based coolant on cutting surface in turning operation" is the result of my own research
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ABSTRACT

Experiment done in the project is to investigate the performance of coolant effect at cutting surface. The objective is to identify the type of coolant that most suitable to use in faculty of manufacturing engineering (FKP) machine shop laboratory.

Machine used in the experiment is conventional lathe machine with different types of coolant for every machining operation. The two types of coolant used in the experiment: 1. Bacteriostatic Emulsifiable and 2. Soluble oil. Workpiece material used is mild steel rounded bar. High Speed Steel (HSS) type was selected as cutting tool during the turning process.

Surface roughness values were measured from machined surface using surface roughness tester machine and scanning metallurgy microscope also used to check surface integrity.

DEDICATION

Specially dedicated for my boloved father, Baharudin bin Hj Md. Jali and my mother, Siti Hasnah binti Hj Jailani and who are very concerns, understanding patient and supporting. Thank you for everything to my supervisor, Mr. Mohd Irman bin Ramli, Soleha binti Rossdy, my sister, brothers and all my friends. The work and success will never be achieved without all of you.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Machining or metal cutting operation is an operation that removes metal into chip. One of the machining operations is turning process. Turning is the operation that removes the metal sheet whilst the metal twist and the cutting tool touch the material to remove the unwanted metal. Turning produces solids of revolutions which has tight tolerance because of the specialize nature of the operations. Turning is performed on a machine called lathe in which the tool is stationary and the part is rotated.

There are many parameters and variables that influence the turning operations. The parameters that were used in turning operations influenced by the value and the result of the surface roughness. The parameters which influenced surface roughness are cutting speed, feed rate, depth of cut and machining time. Besides, another factor that influences the surface roughness value is cutting fluids.

Cutting fluids have been used extensively in metal cutting operations for the last 200 years. The use of coolants for machining was first reported by Taylor in 1907 (Ezugwu, 2007).In machining cutting fluid may be considered an accessory which is frequently applied in order to increase production rate, improve surface quality, reduce costs and consequently increase profit (Vieiraa and Machado, 2001). In the beginning, cutting fluids consisted of simple oils applied with brushes to lubricate and cool the machine tool. Occasionally, lard, animal fat or whale oil was added to improve the oils lubricity. As cutting operations became more severe, cutting fluid formulations became more complex. Today cutting fluids are special

blends of chemical additives, lubricants and water formulated to meet the performance demands of the metalworking industry. The cooling lubricants are used in machining operations in order to (i) reduce friction at the tool–chip and tool–workpiece interfaces, (ii) cool both chip and tool, and (iii) remove chip (Dhar and Kamruzzaman, 2007).

In some machining situations, variations in coolant concentration can affect surface finish, part-to-part consistency and even the useful life of the coolant and cutting tools. Until recently there was no practical way to constantly maintain proper coolant concentration.

There are now several types of cutting fluids in the market, the most common of which can be broadly categorized as cutting oils or water-miscible fluids. Water-miscible fluids, including soluble oils, synthetics and semisynthetics, are now used in approximately 80 to 90 percent of all applications. Although straight cutting oils are less popular than they were in the past, they are still the fluid of choice for certain metalworking applications.

The purpose of the project is to analyze and evaluate the cutting fluids performance in turning operation. The evaluations are defined from the experiment's outcomes.

The coolants that were used as the cutting fluids in this experiment are soluble oil and bacteriostatic emulsifiable coolant. These two type coolant being studied because they are used widely and can produce better surface finish.

1.2 PROBLEM STATEMENT

Based on the research before, few main problems occurred in handling oil based coolant as listed below:

a. Cutting surface or surface roughness development from present coolant in Utem, Manufacturing Faculty machine shop has unclear result. It is still in unknown condition whether acceptable or not.
b. Factor affecting high speed steel (HSS) cutting tool life-span still could not be expected systematically. The present tool life has unclear status whether coolant play important rule in expanding tool life.
c. Coolants are becoming more expensive and the cost of disposal keeps increasing.
d. FKP's Machine Shop only used soluble oil coolant in lathe machine. A study is conducted to propose other better coolant be applied in the shop.

1.3 OBJECTIVES

The objectives in this research are:

1. To study the relationship between the surface roughness value and cutting fluids
2. To analyze the surface texture of the material after machining operation
3. To investigate type of cutting fluids between soluble oil and bacteriostatic emulsifiable that can produce better surface finish
4. To clarify the most suitable coolant utilization and low management cost in FKP machine shop.

1.4 SCOPE PROJECT

Scope of this project is conducting a machining operation using conventional lathe machine with two different types of coolant as cutting fluids. Coolant uses in this experiment are soluble oil and bacteriostatic emulsifiable coolant. During the machining operation, cutting tool used is high speed steel (HSS) while workpiece material used is mild steel. Parameters such as feed rate, cutting speed and spindle speed are set followed to the design of experiment (DOE). Result obtained is to define and valuate the two types of coolant performance at the cutting surface on workpieces during turning operation.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION CUTTING FLUID

Cutting fluids are widely utilized to optimize the process of machining operations such as turning, drilling, boring, grinding, and milling. Historically, cutting fluids have been used extensively for the last 200 years. The main purpose of using cutting fluid in machining processes is to reduce cutting zone temperatures in order to increase tool life (Anselmo, 2007).

The most common metalworking fluids used today belong to one of two categories:

a. Oil-based fluids including straight oils and soluble oils
b. Chemical fluids including synthetics and semisynthetics.

Cutting fluids play a significant role in machining operations and impact shop productivity, tool life and quality of work. The primary function of cutting fluid is temperature control through cooling and lubrication. A fluids cooling and lubrication properties are critical in decreasing tool wear and extending tool life. Cooling and lubrication are also important in achieving the desired size, finish and shape of the workpiece. A secondary function of cutting fluid is to flush away chips and metal fines from the tool and workpiece interface to prevent a finished surface from becoming marred and also to reduce the occurrence of built-up edge (BUE).

2.1.1 Coolant

A coolant is an agent (usually in liquid form) whose sole function is to absorb heat from the work and the cutting tool. Water has the highest cooling effect of any cutting fluid. It may be used on materials that are tough or abrasive, but have a great frictional effect and generate much heat in cutting. Typical materials of this nature are rubber tires and celluloid refers to Miller & Mark (2004).

2.1.2 Lubricant

A cutting fluid with the additional property that enables it to act as a lubricant is called a cooling lubricant. These materials usually consist of both cooling and lubricating agents, such as soluble oil or glycerin mixed in proper proportions. Cooling lubricants are used where cutting materials generate excessive heat and are, to a limited degree, tough and abrasive refer to Miller & Mark (2004).

2.2 CUTTING FLUID PROPERTIES

In addition to provide a good machining environment, a cutting fluid should also function safely and effectively during machining operations.

2.2.1 Corrosion Protection

Cutting fluids must offer some degree of corrosion protection. Freshly cut ferrous metals tend to rust rapidly since any protective coatings have been removed by the machining operation. A good metalworking fluid will inhibit rust formation to avoid damage to machine parts and the workpiece. It will also impart a protective film on cutting chips to prevent their corrosion and the formation of difficult-to-manage chunks or clinkers.

To inhibit corrosion, a fluid must prevent metal, moisture and oxygen from coming together. Chemical metalworking fluids now contain additives which prevent corrosion through formation of invisible, nonporous films. Two types of invisible, nonporous films are produced by metalworking fluids to prevent corrosion from occurring. These include polar and passivating films. Polar films consist of organic compounds (such as amines and fatty acids) which form a protective coating on a metals surface, blocking chemical reactions. Passivating films are formed by inorganic compounds containing oxygen (such as borates, phosphates and silicates). These compounds react with the metal surface, producing a coating that inhibits corrosion

2.2.2 Stability/rancidity control

In the early days of the industrial revolution, lard oil was used as a cutting fluid. After a few days, lard oil would start to spoil and give off an offensive odor. This rancidity was caused by bacteria and other microscopic organisms that grew and multiplied within the oil. Modern metalworking fluids are susceptible to the same problem.

No matter how good the engineering qualities of a coolant, if it develops an offensive odor, it can cause problems for management. The toxicity of a fluid may also increase dramatically if it becomes rancid due to chemical decomposition, possibly causing the fluid to become a hazardous waste. Fluid rancidity shortens fluid life and may lead to increased costs and regulatory burdens associated with fluid disposal. A good cutting fluid resists decomposition during its storage and use. Most cutting fluids are now formulated with bactericides and other additives to control microbial growth, enhance fluid performance and improve fluid stability.

2.2.3 Transparency and Viscosity

In some operations, fluid transparency or clarity may be a desired characteristic for a cutting fluid. Transparent fluids allow operators to see the workpiece more clearly during machining operations. Viscosity is an important property with respect to fluid performance and maintenance. Lower viscosity fluids allow grit and dirt to settle out of suspension. Removal of these contaminants improves the quality of the fluid recirculation through the machining system. This can impact product quality, fluid life and machine shop productivity.

2.2.4 Health and Safety Considerations

Workers in machining operations are continually exposed to cutting fluid. A fluid must be relatively non-toxic, non-flammable and non-misting to minimize health and safety risks.

a. Toxicity

   Most metalworking fluids are not highly toxic. Toxicity problems associated with metalworking fluids are usually caused by the fluid becoming rancid, super concentrated or contaminated. The main routes of exposure for metalworking fluid include inhalation (via vapor, smoke or mist), ingestion and skin absorption. Dermatitis and respiratory problems are the most frequent health problems of machine shop personnel.

b. Flammability

   Machining operations typically generate a significant amount of heat which can cause cutting fluids to smoke and/or ignite. A fluid should have a high flashpoint to avoid problems associated with heat damage, the production of smoke, or fluid ignition.