



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**Study on Contribution and Effect Analysis of Coolant on Roundness
in Cylindrical Grinding**

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

by

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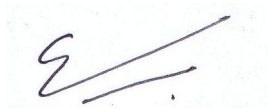
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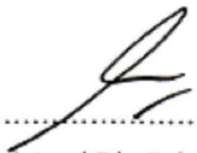
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APPROVAL

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ABSTRACT

The purpose of this research is to study the contribution and effect of coolant to machined surface integrity in term of roundness. The process of grinding was done by Universal Cylindrical Grinder Model OD 820 S with variable speed table and full CNC wheel head indeed manufactured by SHARP Precision Machine Tools. The parameters involved in this analysis include depth of cut, work head speed and traverse speed which are set as followed to previous parameter analysis based on the design of experiment (DOE). All other parameters are constant such as coolant which is Pretech Cool Syn 3000 Green with three difference brix concentration and abrasive wheel speed which is 1960 rpm. The roundness test will be performing using the CNC roundness at the Metrology Lab and method that used to determine the roundness of each sample is Least Square Circle Method. The result analysis was done based on roundness value from CNC roundness tester.

ABSTRAK

Tujuan utama kajian ini adalah untuk mengkaji sumbangan dan kesan penyejuk ke atas bahan kerja berbentuk silinder ini dari aspek kebulatan. Mesin yang digunakan dalam kajian ini adalah mesin pencanai untuk bahan kerja berbentuk silinder universal yang dikeluarkan oleh SHARP Precision Machine Tools. Parameter yang terlibat dalam kajian ini termasuklah kedalaman pemotongan, kelajuan spindal dan kelajuan traverse. Parameter ini di ambil dari kajian pelajar lepas berdasarkan rekabentuk eksperimen (DOE). Semua parameter lain adalah diseragamkan seperti penyejuk jenis Pretech Cool Syn 3000 Green dengan tiga perbezaan brix tumpuan dan kelajuan roda pelepas pada kelajuan 1960 rpm. Penguji kebulatan CNC akan menentukan kebulatan pada sampel yang dikaji dan kaedah Least Square Circle akan digunakan. Keputusan yang dikeluarkan daripada penguji kebulatan CNC akan selesai berdasarkan nilai kebulatan sampel yang dikaji.

DEDICATION

*For my beloved parent, my best friend and all friends, and to those who's with me all
this time*

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

ANOVA	-	Analysis of Variance
CMM	-	Coordinate measuring machine
CNC	-	Computer numerical control
Cr	-	Chromium
DOE	-	Design of experiment
Fe	-	Ferum
FKP	-	Fakulti Kejuruteraan Pembuatan
ID	-	Internal diameter
LSC	-	Least Square Circles
MCC	-	Minimum Radius Circumscribing Circles
MIC	-	Maximum Radius Inscribing Circle
Mn	-	Manganese
MZC	-	Minimum Radial Zone Circles
Ni	-	Nickel
OD	-	Outside Diameter
P	-	Phosphorous
PSM	-	Projek Sarjana Muda
R	-	Radius
RPM	-	Revolution per Minute
S	-	Sulphur
Si	-	Silicon
Syn	-	Synthetic
UTeM	-	Universiti Teknikal Malaysia Melaka
In	-	Inch
In/min	-	Inch per Minute
Mm	-	Millimeter
μm	-	Micron Meter

μ - micro
% - percent

CHAPTER 1

INTRODUCTION

1.1 Background of Project

The cylindrical grinder is used to grind work such as round shafts. Although many of the construction features of the cylindrical grinder are similar to those of the surface grinder, there is a considerable difference in the functions of the components. Cylindrical grinders have no cross traverse table. As in the surface grinder, the base of this machine contains a hydraulic power unit and a coolant system. Longitudinal ways support the sliding table. Horizontal ways (at right angles to the longitudinal ways) permit the wheel head to move toward or away from the work piece. The machine will use this horizontal movement to feed the grinding wheel into the work for a depth of cut (Choi and Lee, 1998).

Most grinding machines are equipped with coolant systems. The coolant is directed over the point of contact between the grinding wheel and the work. This prevents distortion of the work piece due to uneven temperatures caused by the cutting action. In addition, coolant keeps the chips washed away from the grinding wheel and point of contact, thus permitting free cutting. Clear water may be used as a coolant, but various compounds containing alkali are usually added to improve its lubricating quality and prevent rusting of the machine and work piece. An expensive coolant often used for all metals, except aluminum, consists of a solution of approximately 1/4 pound of sodium carbonate (sal soda) dissolved in 1 gallon of water. Another good coolant is made by dissolving soluble cutting oil in water. For grinding aluminum and its alloys, a clear water coolant will produce fairly good results (Knapp, 1998).

There are many factors that effect on roundness to cylindrical grinding such as type of coolant used, cutting parameter, vibrations, machining tool (cutting tool and fixture) and material of work piece. Hence, this project is mainly purpose to cover the study of performance of new coolant with different viscosity by using cylindrical grinding in FKP Machine Shop laboratory. This study also determine the 3 sets of viscosity of a new coolant in term of producing high accuracy and precision dimension and highly smooth surface finish that can influence the roundness of the finish product.

1.2 Problem Statement

Cylindrical grinding machine is a new machine in FKP laboratory. Thereby, not many students have the experience of handling the machine. The previous research only test the performance of the machine effect upon different material, meanwhile the contribution and effect of coolant is not considered. Furthermore contribution of coolant to roundness is not taking into consideration even though it is one of the important variable parameters in cylindrical grinding (Catai and Bianchi, 2008).Therefore, this study will look into the effect of the coolant with difference brix concentration to machine surface integrity in term of roundness.

1.3 Objectives

The objectives of this study are:

- (a) To study the contribution and effect of coolant on machine surface integrity in terms of roundness by using cylindrical grinding machine in FKP Machine Shop Laboratory.
- (b) To analyzed the contribution and effect of coolant to the roundness of finish product by using CNC Roundness tester at Metrology laboratory.

- (c) To obtain the comparison of 3 sets concentration of new coolant using Pretech coolant type Cool Syn 3000 Green on its effect to roundness of the finish product.

1.4 Scope of Project

The scope of this project includes conducting a machining operation using the cylindrical grinding machine in order to study the contribution and effect of three difference sets concentration of new coolant in terms of roundness. The machine will be used is Universal Cylindrical Grinder Model OD 820 S with variable speed table and full CNC wheel head indeed manufactured by SHARP Precision Machine Tools. The material used for machining is stainless steel SUS 304. The machining parameters that involve in this analysis is depth of cut, work head speed, traverse speed. All other parameters are constant such as coolant which is Pretech Cool Syn 3000 Green with three difference brix concentration and abrasive wheel speed which is 1960 rpm. The roundness test will be performing using the CNC roundness at the Metrology Lab and method that used to determine the roundness of each sample is Least Square Circle Method. The result analysis will be achieved base on roundness value from CNC roundness tester.

CHAPTER 2

LITERATURE REVIEW

2.1 Cylindrical Grinding Machine

Cylindrical grinding machines are used extensively in engineering workshop to finish pre-machined and heat-treated components for example to grind work such as round shaft. Although many of the construction features of the cylindrical grinder are similar to those of the surface grinder, there is a considerable difference in the functions of the components (Togo, 1999). In cylindrical grinding, the work piece rotates about a fixed axis and the surfaces machined are concentric to that axis of rotation. Cylindrical grinding produces an external surface that may be straight, tapered, or contoured. The basic components of a cylindrical grinder include a wheel head, which incorporate the spindle and drive motor; a cross-slide that moves the wheel head to and from the work piece; a headstock, which locates, holds, and drives the work piece; and a tailstock, which holds the other end of the work. (Refer Figure 2.2)

Internal diameter or "I.D." grinders finish the inside of a previously drilled, reamed, or bored hole, using small grinding wheels at high RPM. The principle elements of an internal grinding machine are the work head, which holds the work and has its own drive; and the wheel head, which is the internal grinding spindle. In addition to the rotary motions of work and wheel, an internal grinder has a traverse movement to bring the wheel to and from the work zone, and a reciprocating spindle movement for both the wheel's approach to the work surface and for the feed movement of the wheel during grinding. An OD grinder grinds the outer diameter (OD) of the work piece, held on one

or both ends. Usually, the work piece is held between centers or chucked and rotated against a faster spinning grinding wheel.

In center less grinding, the work piece rotates between a grinding wheel and a regulating drive wheel. The work is supported from below by a fixed work-rest blade. The two basic modes of center less grinding are thru feed and in feed or plunge mode. In the thru-feed mode, the work proceeds in the axial direction through the slowly narrowing gap between the grinding wheel and the regulating wheel. Work is advanced by the axial force exerted on it by the rotating surface of the regulating wheel. This is a highly productive form of grinding in that a number of work pieces can be ground simultaneously and in a continuous stream. The in feed mode is used for work with projecting heads that would prohibit thru feeding, the work is placed on the work-rest blade while one wheel is retracted and fed to an end stop. The wheel is then brought back, reducing the gap between the wheels, grinding the work (Todd *et al.*, 2000)

The machine that is used in Machine Shop Laboratory is Universal Cylindrical Grinder Model S OD 820H with variable speed table and full CNC wheel head in feed manufactured by SHARP Precision Machine Tools (Refer Figure 2.0) The machine has the capability to machine both of internal and external cylindrical grinding.

Cylindrical grinding is capable to rough out and finish the work to fine tolerances. The surface finish and great accuracy can be obtained more economically on grinders than on other machines.



Figure 2.0: Universal Cylindrical Grinder Model S OD 820H

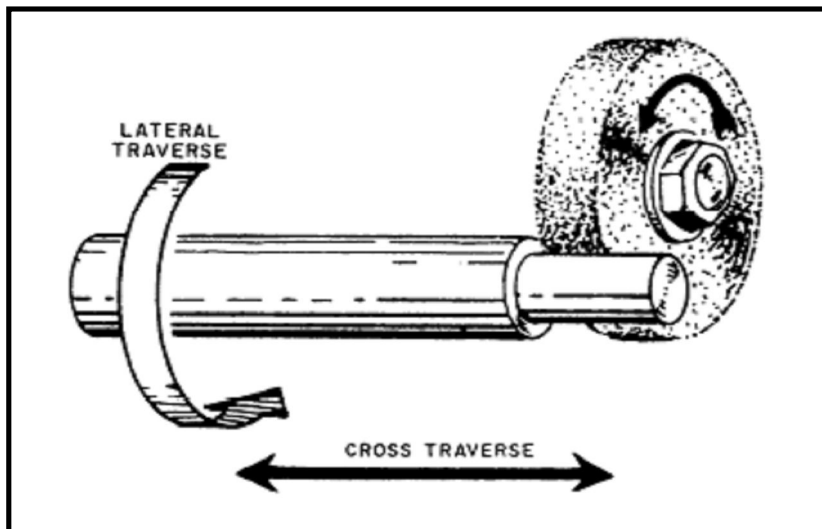


Figure 2.1: Outside Diameter (OD) grinding for cylindrical work piece.