CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Most conventional cutting-tools are made from tool steel with high carbon content and are shaped to the required geometries by machining. The objective of through hardening is to harden parts throughout their cross section. This is to ensure that not only is the surface resistant to wear, but the entire part is more able to resist bending or twisting without failure. Steel producers increase the steel's carbon content to enhance hardening ability. For example, low carbon steel such as AISI 1018, with 0.18% carbon, does not harden when quenches from its critical temperature. Medium carbon steel such as AISI 1045, with 0.45% carbon, will achieve a hardness of, say, 35 on the Rockwell C scale. Carbon content near 1% or beyond will provide a very hard part beyond HRC 60 in many cases. [1] Unfortunately as hardness goes up, the ability of the part to withstand shock and bending forces decreases.

Normally carbon steel is not enough hard to be used as a cutting tool. Therefore heat treatment process is important to improve the mechanical properties of the carbon steel. The common forms of heat treatment for steels are hardening, tempering, annealing, normalizing, and case hardening. The hardness value of the medium carbon steel ranged from 229 to 447 HB (20.3 HRC to 47.5 HRC).[2] Because of their higher carbon content, these steels are usually used in the hardened and tempered condition Properties of medium carbon steel shows continuous changes from water-hardening to oil-hardening types. With different type of quenching medium and tempering temperature a wide range of mechanical properties can be produced. In this project, medium carbon steel (AISI 1045 0.45% C) will undergo quenching process in three different types of medium; to compare which medium gives the best internal structure and hardness value after heat treatment.

1.2 PROBLEM STATEMENT

1.2.1 Current System

Carbon steel (0.90% to 1.70% C) are used in the manufacture of chisels, tools parts where high hardness is required to maintain a sharp cutting edge.[3] However, the most common problem we are encountered is the short life of the tool. Usage properties, as well improper heat treatment processes contributes to this problem. Furthermore, the selection of the medium for quenching process will also affects the hardness and the properties of the carbon steel.

1.2.2 Solution

In this project, medium carbon steel AISI 1045 (diameter = 1.6cm, height = 2cm) has selected as the material for quenching process. The optimum internal structure must have the hardness value around 321 HB or around 35 HRC after quenching process. [2] The hardness of the carbon steel can be analyzed through Rockwell tester and the internal structure can be analyzed by using microscope image analyzer.

Figure 1.1: An illustration of a carbon steel AISI 1045 work piece

1.3 OBJECTIVE

The objectives of research are as follow:

1) To analyze the internal structure of carbon steel after oil quenching, water quenching, and oil-based coolant quenching.
2) To identify the hardness of the carbon steel through Rockwell hardness test.
3) To recommend the suitable medium for quenching process.
4) To make comparison between quenching process; in an hour and one day.

1.4 SCOPE OF PROJECT

1.4.1 To Study the Machines and Materials

Relevant information and knowledge of the machines, materials, and equipments are obtained from books, journals and internet. This study is focused on the quenching process. The scope of study assists the medium selection for quenching process, procedure for setting up and running lab oven, grinding machine, hardness tester and microscope image analyzer. Meanwhile, type of carbon steel to be used in this project has been identified, i.e. medium carbon steel AISI 1045 with 0.45% C. Furthermore, selected mediums are oil, water and oil-based coolant (coolant for lathe machine).

1.4.2 Design the Experiment

The selected carbon steel, medium carbon steel AISI 1045 is cut to the size (height = 2cm) as shown in Figure 1 by using band saw. After the work piece has been formed, it goes through heating process. Finally, the specimen is tested through hardness tester and analysed by microscope image analyser.