

The Effect of Heat Treatment on the Hardness and Impact Properties of Medium Carbon Steel

Nurul Aida Amir Khatif, Mohamad Aliff Kamil Awang Kecik, Mohd Ali Hanafiah Shaharudin, A.K. Prasada Rao, Noor Mazni Ismail¹

Faculty of Manufacturing Engineering, Universiti Malaysia Pahang, 26600 Pekan, Malaysia

E-mail: drmazni@ump.edu.my

Abstract. This paper covers the effect of heat treatment on the mechanical properties of medium carbon steel. The main objective of this project is to investigate the hardness and impact properties of medium carbon steel treated at different heat treatment processes. Three types of heat treatment were performed in this project which are annealing, quenching and tempering. During annealing process, the specimens were heated at 900°C and soaked for 1 hour in the furnace. The specimens were then quenched in a medium of water and open air, respectively. The treatment was followed by tempering processes which were done at 300°C, 450°C, and 600°C with a soaking time of 2 hours for each temperature. After the heat treatment process completed, Rockwell hardness test and Charpy impact test were performed. The results collected from the Rockwell hardness test and Charpy impact test on the samples after quenching and tempering were compared and analysed. The fractured surfaces of the samples were also been examined by using Scanning Electron Microscope. It was observed that different heat treatment processes gave different hardness value and impact property to the steel. The specimen with the highest hardness was found in samples quenched in water. Besides, the microstructure obtained after tempering provided a good combination of mechanical properties due to the process reduce brittleness by increasing ductility and toughness.

1. Introduction

Heat treatment is a process that involves a combination of time-controlled heating and cooling operations of metal without changing the product shape that will produce desired mechanical properties and to observe the microstructure after heat treatment (D.A.Fadare, 2011). Heat treatment is used to improve the mechanical properties of the metal alloys. Basically, the product performance will improve when the strength of material increased (Ashih Bhateja, 2012). It can be divided into three main processes namely annealing, quenching and tempering. In general, the procedure of heat treatment process consists of three stages. First stage is heating the material. Second, hold the temperature for a period of time and third, cool down the metal to room temperature.

The treatment of medium carbon steel with heat can significantly change the mechanical properties, such as ductility, hardness and strength. Heat treatment of steel slightly affects other properties such as its ability to conduct heat and electricity as well. A variety of methods exist for treating steel with heat. The carbon and manganese content in medium carbon steel make quenching and tempering the most common method of heat treatment for this type of steel. This process generally