Investigation of Influence of Quenching and Annealing on the Plane Fracture Toughness and Brittle to Ductile Transition Temperature of the Zinc Coated Structural Steel Materials

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ABSTRACT

This article discusses that the variation in fracture toughness is exclusively due to the influence of coating on the surface of the material, depending upon the time interval that the specimen is immersed in the coating tub under a specific temperature. Parameters during the process of coating have shown their own influence on heat treatment, which has shown its own significance of the fracture toughness of coated and uncoated materials. Hence, to estimate this effect, EN 18 and AISI 1020 steels have been tested under different heat treatment processes, like annealing, oil-quenching and water-quenching. The results obtained under these conditions have clearly shown that the influence of heat treatment is significant on the fracture toughness of the materials. Compared to untreated materials, the annealed and quenched materials have shown much variation in fracture toughness.

KEYWORDS

Annealing, BDTT, Coating, Fracture Toughness, Heat Treatment, Quenching

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INTRODUCTION

Rassizadehghani et al., 2008, have mentioned that various mechanical properties like hardness, toughness, strength, etc. of medium carbon steels can be enhanced by quenching them in a particular medium which depends on the parameters such as the type of heat treatment, composition of the steel, the size and profiles of the components. Mithlesh Sharma et al., 2013, defined the heat treatment as a means of heating and cooling the material which enables it to achieve the desired mechanical properties of steel or alloys, through which the variation of temperature with respect to time is considered to be an important factor in modifying the mechanical properties of the materials. Murugan et al. (2013) were of the opinion that the heat treatment process helps in improving various mechanical properties like strength, ductility, hardness, toughness, corrosion resistance, etc. Nadim Ibrahim Nasir (2015) concluded that the heat treatment is a process which is done for different metals by heating them at a constant temperature and holding for a specific duration of time to enhance the mechanical properties and changes in microstructure of the metals. Senthil Kumar et al., 2012, have conducted tensile tests on medium carbon steels which were heat treated with various processes like normalizing, annealing, tempering, hardening, during which the yield strength is found to be higher for the tempered specimen due to its grain re-arrangement when compared with the annealed, normalized and hardened specimens. Qamar et al. (2009) have conducted the experiment on the steel material and found that the toughness was gradually increased with the corresponding increment between the temperatures of range from 250°C up to 550°C. Murugan et al. (2012) have investigated from their experimental studies that the surface hardness is improved by various heat treatment processes for 20Ni55Cr50Mo20 alloy steel. Adnan Calik (2012) has studied the influence of level of preservation on the mechanical properties and microstructure of AISI 1020/1040/1060 steels by heating the specimens at 1250°C for 4 hours and consequently cooling them by different methods and shown that the microstructure of these steels was altered remarkably upon varying the cooling rate. Odusote, Ajiboye, and Rabiu (2010) have examined the medium carbon steels by heating them between the range of 900°C - 980°C and soaked them in a muffle furnace for about 45 minutes before quenching them in water and palm oil separately. The quenched samples were observed under scanning electron microscope and concluded that the properties of samples which are quenched in palm oil have enhanced than that of water-quenched samples. The influence of the heat treatment on the mechanical properties of rolled medium carbon steel were studied by Daramola et al. (2010) by heating the material to the austenitic temperature of 830°C followed by rapid quenching in water and by tempering at 480°C. The results revealed that the steel has got combined properties like ductility, tensile and impact strength which is really needed for structural application. Guzman et al. (2000), have studied the effect of a commercial electro less Ni-P (EN) deposit of 10 μm on the fatigue properties of a quenched and tempered SAE 4340 steel, for both as-deposited & deposited and post-heat treated for a duration of 1 hour at 723 K, during which the deposited steel shown maximum hardness and reduction in fatigue from 12% and 23% based on the coating condition. Zhang et al. (1996) have studied the effect of electro less nickel coating on the fracture properties and fatigue life and concluded that the fracture and fatigue properties of the material can be improved by short peening before the coating.
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