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Analysis Impact Test and Hardness Test on Construction Steel with Quenching Oil SAE 40 Cooling Media at Heat Treatment Temperature Variation 700, 800 and 900 ºC

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Abstract-Research on the market construction steel was heat treatment with oil quenching has been done.The purpose of this experiment to increase the strength of the steel construction.The method was started from the construction steel, heated at a temperature of 700, 800, 900 °C with a holding time of 60 minutes and then cooled rapidly using SAE 40 oil medium at room temperature.Results achieved higher heating temperature the increase the hardness, but the toughness decrease.This shows that the quenching treatment with oil medium will increase the hardness and create brittle.

Abstrak-Penelitian tentang baja kontruksi pasaran yang di perlakukan dengan quenching telah dilakukan. Tujuan dari percobaan ini untuk meningkatkan kekuatan dari baja kontruksi yang ada di pasaran. Metode yang dilakukan adalah memanaskan baja konstruksi pada suhu 700, 800, 900 ^{o}C dengan waktu penahanan 60 menit kemudian di dinginkan cepat menggunakan media oli SAE 40 pada suhu kamar. Hasil yang dicapai semakin tinggi suhu pemanasan semakin tinggi kekerasannya tetapi ketangguhannya turun. Hal ini menunjukkan bahwa perlakuan quenching akan meningkatkan kekerasan dan membuat rapuh

Keywords: Heat treatment, Hardening, Holding Time, Quenching.

1. Introduction

In the industrial world often required hard materials, wear-resistant, but hard steel obtained by hardening translucent (Thought hardening) will decrease the ductility and toughness properties.In many ways, often ductility or toughness was also required in addition to the wear resistant properties.These were necessary for the surface hardening, which was one way to obtain a hard surface, resistant to wear and on the inside (core) which was ductile and tough. Hardness in the hardening process were influenced by the composition of the carbon content, coolant type and material used in the hardening process.Construction steel was widely used in the mechanical engineering framework of cheap and abundant in the market.This steel can only be used for the framework, if it will be used as the tool it is necessary to treat again.The treatment was done so that this construction steel becomes harder and the strong.Many steel markets in Semarang, Indonesia, which were sold but does not know the carbon content and type. For that we need more research, that the results can be used as a benchmark in the treatments of the construction steel. To know the carbon content it is necessary for the composition test.Levels of carbon were necessary because according Surdia (1983) steel which can be changed character using heat treatment are medium carbon steel.Medium carbon steel before it was used to make tools, agricultural tools, automotive components first given heat treatment, the types of heat treatment are quenching, annealing, normalizing, and tempering, so that the properties of the material to be changed in accordance with terms of design needs. Materials resistant to impact or pressure and friction of other metals, e.g. gears, shafts and other components that move. One was hardening heat treatment, heating the steel in the austenite phase or above the critical temperature followed by rapid cooling (quench) (Beumer, 1985 and Surdia, 1983).Quenching process was a heat treatment with cooling in shock that will produce a harder steel properties. In this test used a cooling medium oil. After quenching hardness of steel processed will change, to determine the

level of hardness, then tested by the impact and hardness test. Impact test equipment used to measure the material ductility or brittleness of the material to sudden load (Suherman, 1998).

The purpose of this study was to find the influence of quenching with SAE 40 oil cooling on toughness and hardness of construction steel.

2. Experimental Methods

Starting from the construction steel from the market was being made Impact test specimen with a size of 10 × 10 x 55 mm^3 with a depth of 2 mm notch in accordance with ASTM E23 standard (Suryanarayana, 1979) depicted in Figure 1. From the test results of the composition of this steel has more carbon content of 0.36%. The hardness test specimen size was 10 × 10 × 10 mm^3.

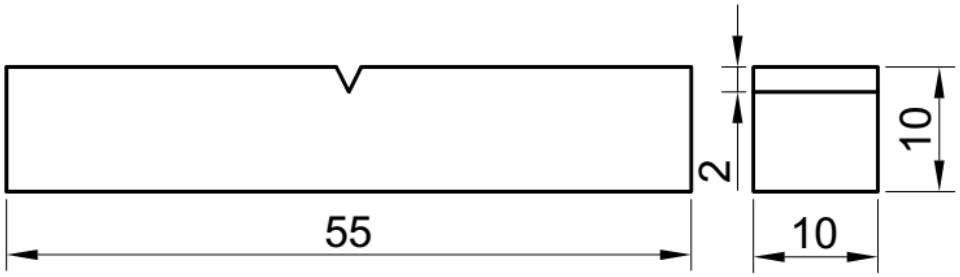


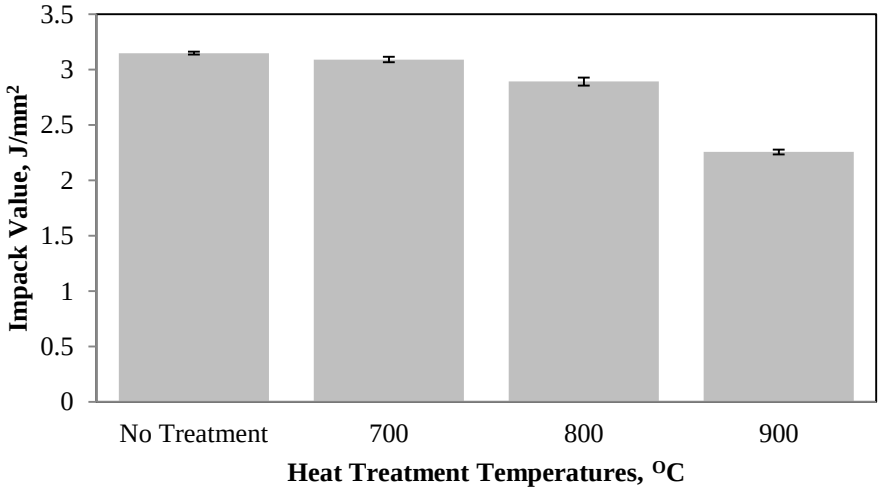
Figure 1. Dimension of impacttest specimen

The Impact test specimens were heated in the furnace heater with temperature variations of 700, 800,and 900 °C, holding time are 60 minutes and cooled with SAE 40 oil medium at room temperature. Medium SAE 40 oil was used because it was so viscous that are expected to add to the hardness but ductility was good.

Former Impack test specimens that have been broken cut edges to be used as a hardness test. Each specimen to be made of three pieces in order to get more accurate data.

3. Results and discussion

Impact test results ware at increase temperature of 700, 800 and 900^oC respectively, were 3.09, 2.89, and 2.26 J/mm^2. For comparison steel without treatment Impack value was 3.15 J/mm^2. From these results can be graphed like Figure 2.



Gambar 2. Relationof heat treatment temperatures and impack value.

Figure 2 explains that the specimen without heat treatment when compared to those subjected to heat treatment, then the value of its impact will decrease.It was clear that the construction steel increasingly brittle with heat treatment.From these results, the increase of the heating was carried out on a construction steel and quenching using SAE 40 oil medium, the value of impact will decrease

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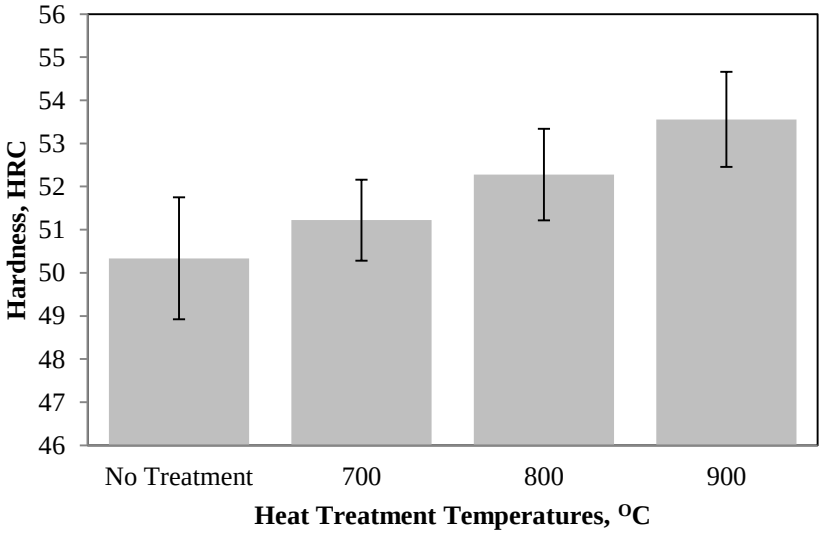
and from it also proves that the reduced material properties of toughness, it was in accordance with the theory of continuous cooling transformation, the process of heating carbon steel temperatures above 700 °C with rapid cooling, the austenitic structure that were soft and ductile would turn into martensite structure that is hard and brittle.

The results of this test showed similarities as did Wisnu (2006) which uses ST 60 steel specimens were heated at a temperature of 830 °C and then cooled with water and conducted media Prayitno (1999) which uses amutit steel specimens were heated at a temperature of 900 ºC with variations holding time 10, 20, 30, and 40 minutes later quenching with oil media.To know that this construction steel toughness was reduced, the need to hardness test, the value hardness can be used to determine the level of hardness on construction steel and prove if increasingly brittle.

Results of hardness testing of construction steel after receiving the heat treatment at temperatures of 700, 800, and 900 °C are respectively 51.22, 52.27, and 53.55 HRC. Whereas without heat treatment was 50.33 HRC. The results can be described as a graph as in Figure 3.



Gambar 3. Relation of heat treatment temperatures and hardness.

The average value of hardness increases at each heating temperature, of value indicates that the hardness value increases with increasing heating temperature of the workpiece. This can be seen in the theory of Continuous Cooling Transformation on carbon steel heating process temperature above 700 ºC (Austenite phase) with rapid cooling, the austenitic structure that was soft and ductile would turn into martensite structure that is hard and brittle.

From the results of this test showed similarities as did Wisnu (2006) which uses ST 60 steel specimens were heated at a temperature of 830 ºC and then cooled with aqueous media and which do Prayitno (1999) which uses amutit steel specimens were heated at a temperature of 900 ºC with variations holding time 10, 20, 30, and 40 minutes later quenching with oil media.

In the end, the effect of the increased the temperature in the heat treatment of construction steel and cooling using SAE 40 oil is increasing the hardness but lowered his toughness.

4. Conclusion

This construction steel after heat treatment will change the characteristic of which is more brittle and louder. Increased temperature heat treatment will increase the toughness, but hardness was getting an increase.

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