Pengaruh Kadar Polyalkylene Glycol sebagai Quenchant terhadap Mikrostruktur dan Sifat Mekanik Baja Paduan Rendah sebagai Material Bucket Tooth = The Influence of Polyalkylene Glycol as Quenchant on the Microstructure and Mechanical Properties of Low-Alloyed Steel as Bucket Tooth Material

Talitha Arista Nia, author

Abstrak

Austenite sisa bersifat metastabil dan mudah bertransformasi menjadi fresh martensite jika diberikan tegangan mekanik atau disimpan dalam kurun waktu tertentu. Transformasi austenite sisa menimbulkan tegangan sisa yang menginiasi terjadinya delayed crack. Penelitian ini berfokus pada optimalisasi kecepatan pendinginan saat proses quenching, yang menghasilkan mikrostruktur lebih seragam dan sifat mekanik yang sesuai dengan standar. Penelitian ini mencoba menggunakan media quenching berbasis polimer dengan varian kadar yang berbeda, yaitu sebesar 1%, 5%, 10%, dan 15%. Penambahan PAG pada rentang 1-5% menghasilkan penurunan pada koefisien perpindahan panas di permukaan, dibandingkan quenching air. Namun, peningkatan kadar PAG dari 5% hingga 25% memberikan efek yang berlawanan, dimana koefisien perpindahan panas cenderung meningkat, dengan nilai tertinggi koefisien sebesar 5950 W m-2 K-1 pada kadar 25%. Disimpulkan bahwa penambahan kadar 1-5% PAG ke dalam air dapat menurunkan koefisien perpindahan panas di permukaan baja, sehingga tegangan termal dapat tereduksi dan menghasilkan pendinginan yang lebih terkontrol. Hasil penelitian menunjukkan kadar PAG sebesar 1%, 5%, 10%, hingga 15% memberikan laju pendinginan masing-masing sebesar 52.7/s, 40.1/s, 23.1/s, dan 17,8/s. Terlihat bahwa semakin tinggi kadar PAG dalam air, maka laju pendinginan akan semakin melambat, membuat transformasi mikrostruktur tidak sempurna, sehingga jumlah austenite sisa dalam mikrostruktur semakin banyak, yang memberikan potensi delayed crack lebih tinggi. Laju pendinginan juga memberikan efek signifikan pada sifat mekanik, yaitu penurunan kekerasan. Semakin lambat laju pendinginan, maka waktu difusi karbon akan semakin panjang, sehingga karbon yang terperangkap dalam kisi kristal akan semakin rendah, yang berdampak pada penurunan kekerasan. Nilai kekerasan memilki hubungan yang liniear dengan kekuatan tarik, sehingga penurunan kekerasan juga menyebabkan penurunan kekuatan tarik. Namun, penurunan laju pendinginan dapat menurunkan tegangan termal saat proses quecnhing, sehingga potensi terjadinya quenching crack akan menurun

.....Retained austenite is metastable and easily transforms into fresh martensite, give rise in crystal volume, and generate some residual stresses that might initiate a delayed crack. This research focuses on optimizing the cooling rate during the quenching process, which results in a more uniform microstructure and mechanical properties that comply with the standard. This study tries to give polymer-based quenchant at various percentages, which are 1%, 5%, 10%, dan 15%. Adding a small amount of PAG (ie 1% dan 5%) reduces the heat transfer coefficient at the surface, compared to conventional water quenching. However, an increase in PAG content from 5% to 25% has the opposite effect, where the heat transfer coefficient increases, with the highest coefficient value of 5950 W m-2 K-1 at 25% content. It was concluded that the addition of 1-5% PAG to water can reduce the heat transfer coefficient on the steel surface, so that the thermal stress can be reduced and produce more controlled cooling. The results showed PAG percentage of

1%, 5%, 10%, up to 15% gave a cooling rate of 52.7 / s, 40.1 / s, 23.1 / s, and 17.8 / s, respectively. It appears that the higher the PAG content in water, the slower the cooling rate. A slow cooling rate increases the potential for incomplete transformation, so that the amount of retained austenite in the microstructure increases, Thus the amount received in the microstructure is increasing, giving a higher potential for delayed crack. The cooling rate also has a significant effect on mechanical properties such as hardness. The slower the rate of cooling, the longer the diffusion time of carbon, so that the carbon trapped in the crystal lattice will be lower, which results in a decrease in hardness. The value of hardness has a linear relationship with the tensile strength, so the decrease in violence also causes a decrease in tensile strength. However, a decrease in the cooling rate can reduce thermal stress during the quenching process, so the potential for a quenching crack will decrease.