

## ABSTRAK

### **PENGARUH VARIASI TEMPERATUR DAN *HOLDING TIME* *AUSTEMPERING* BAJA AISI 1045 TERHADAP KEKERASAN, KEKUATAN IMPAK DAN STRUKTUR MIKRO**

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Penelitian ini bertujuan menganalisis pengaruh variasi temperatur dan *holding time* pada proses *austempering* terhadap sifat mekanik, struktur mikro, dan ukuran butir baja AISI 1045. Proses *austempering* dilakukan pada temperatur 400 °C dan 600 °C dengan variasi *holding time* 5 detik, 60 detik, dan 1000 detik. Pengujian yang dilakukan meliputi uji kekerasan Vickers, uji impak Charpy, karakterisasi struktur mikro menggunakan mikroskop optik, serta analisis ukuran butir metode *linear intercept*. Hasil penelitian menunjukkan bahwa seluruh spesimen *austempering* mengalami penurunan kekerasan dibandingkan material awal (*as-received*) menjadi 69,62–79,12 HV akibat berkurangnya densitas dislokasi dan hilangnya efek *strain hardening*. Sebaliknya, nilai impak meningkat dengan nilai tertinggi sebesar 248 J (3,10 J/mm<sup>2</sup>) pada temperatur 400 °C selama 1000 detik, sedangkan nilai terendah sebesar 137 J (1,71 J/mm<sup>2</sup>) terdapat pada material awal. Struktur mikro didominasi ferrit dan perlit tanpa bainit yang teridentifikasi secara jelas, meskipun hasil mekanik menunjukkan kemungkinan terbentuknya bainit dalam jumlah terbatas. Analisis ukuran butir menunjukkan ukuran terkecil sebesar 14,08 µm pada spesimen 400 °C selama 1000 detik dan terbesar 20,83 µm pada material awal. Semakin halus ukuran butir, semakin besar hambatan dislokasi yang memengaruhi sifat mekanik material. Dengan demikian, variasi temperatur dan *holding time austempering* berpengaruh terhadap sifat mekanik, ukuran butir, dan kecenderungan pembentukan struktur mikro baja AISI 1045.

Kata kunci: *Austempering*, Baja AISI 1045, Kekuatan Impak, Struktur Mikro.

## **ABSTRACT**

### ***THE EFFECT OF TEMPERATURE VARIATION AND HOLDING TIME IN THE AUSTEMPERING PROCESS OF AISI 1045 STEEL ON HARDNESS, IMPACT STRENGTH AND MICROSTRUCTURE***

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*This study aims to analyze the effect of variations in austempering temperature and holding time on the mechanical properties, microstructure, and grain size of AISI 1045 steel. The austempering process was conducted at temperatures of 400 °C and 600 °C with holding times of 5 seconds, 60 seconds, and 1000 seconds. The tests performed included Vickers hardness testing, Charpy impact testing, microstructural characterization using an optical microscope, and grain size analysis using the linear intercept method. The results showed that all austempered specimens experienced a decrease in hardness compared to the as-received material, with values ranging from 69.62 to 79.12 HV due to the reduction in dislocation density and the loss of the strain hardening effect. In contrast, the impact value increased significantly, with the highest value of 248 J (3.10 J/mm<sup>2</sup>) obtained at the austempering condition of 400 °C for 1000 seconds, while the lowest value of 137 J (1.71 J/mm<sup>2</sup>) was observed in the as-received material. The microstructure was predominantly composed of ferrite and pearlite phases without clearly identifiable bainite, although the mechanical test results indicated the possible formation of bainite in limited amounts. Grain size analysis showed that the smallest grain size of 14.08 μm was obtained in the specimen austempered at 400 °C for 1000 seconds, while the largest grain size of 20.83 μm was found in the as-received material. Finer grain sizes increase resistance to dislocation movement, thereby affecting the mechanical properties of the material. Therefore, variations in austempering temperature and holding time significantly influence the mechanical properties, grain size, and tendency of microstructural formation in AISI 1045 steel.*

*Keywords: AISI 1045 steel, austempering, impact strength, microstructure.*