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Effect of Austenitizing Temperature, Soaking Time and Grain Size on Charpy Impact Toughness of Quenched and Tempered Steel

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Abstract : Low alloy quenched and tempered steels are typically used in cast railway components such as knuckles, yokes, and couplers. Since these components experience extensive impact loading during their service life, adequate impact toughness of these grades need to be ensured to avoid catastrophic failure of parts in service. Because of the general availability of Charpy V Test equipment, Charpy test is the most common and economical means to evaluate the impact toughness of materials and is generally used in quality control applications. With this backdrop, an experiment was designed to evaluate the effect of austenitizing temperature, soaking time and resultant grain size on the Charpy impact toughness and the related fracture mechanisms in a quenched and tempered low alloy steel, with the aim of optimizing the heat treatment parameters (i.e. austenitizing temperature and soaking time) with respect to impact toughness. In the first phase, samples were austenitized at different temperatures viz. 760, 800, 840, 880, 920 and 960°C, followed by quenching and tempering at 600°C for 4 hours. In the next phase, samples were subjected to different soaking times (0, 2, 4 and 6 hours) at a fixed austenitizing temperature (980°C), followed by quenching and tempering at 600°C for 4 hours. The samples corresponding to different test conditions were then subjected to instrumented Charpy tests at -40°C and energy absorbed were recorded. Subsequently, microstructure and fracture surface of samples corresponding to different test conditions were observed under scanning electron microscope, and the corresponding grain sizes were measured. In the final stage, austenitizing temperature, soaking time and measured grain sizes were correlated with impact toughness and the fracture morphology and mechanism.

Keywords : heat treatment, grain size, microstructure, retained austenite and impact toughness
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