Investigating the Relationship Between Carburising Time and Case Depth in Steel Case Hardened by Pack Carburising, Gas Carbonitriding and Cyaniding Techniques

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Case hardening heat treatment processes are used extensively in industry to improve wear-resistance and toughness of steel components, by producing a hardened layer on the outer surface of the component. Confirmation into the significance of the relationship between carburising time and case depth for various case hardening methods is severely lacking in modern research. The following investigation tests the significance of the relationship between carburising time and case depth in steel for pack carburising, gas carbonitriding and cyaniding case hardening techniques. The significance of the difference in case depth produced by each case hardening technique for typical carburising times is established. Through first-hand experimentation, primary quantitative data was collected by carburising steel samples for 1hr, 2hr, 3hr, 4hr and 5hr by each case hardening technique. Case depth was measured for each sample metallographically. Data analysis revealed strong significance in the relationship between carburising time and case depth for each case hardening technique, where the difference in mean case depths between subsequent carburising times yielded p-values <0.05 for all tested case hardening techniques. Statistical analysis revealed significance in the difference in case depth across each case hardening technique investigated. Findings of the investigation were used to refute null hypotheses, concluding that the relationship between carburising time and case depth is significant, and that the difference in case depth produced between each investigated case hardening process is significant. These conclusions hold strong importance in the metallurgy fraternity, as the statistical significance between carburising time and case depth was previously unknown.

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