

Analyzing the Effect and Correlation of Initial Cooling and Aging Processes on The Mechanical and Microstructural Properties of Extruded Aluminum 6063 Alloy

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This study explores the impact of initial cooling conditions and aging processes on the hardness properties of extruded Aluminum 6063 alloy, a widely used material in various industrial applications. The study aims to provide insights into optimizing the mechanical properties of the alloy for enhanced performance. The research investigates the origin of customer complaints regarding the mechanical properties of aluminum 6063 alloy products, focusing on initial cooling rate and aging process. The experimental methodology involves subjecting Aluminum 6063 alloy specimens to different initial cooling rates during the extrusion process. Subsequently, aging treatments are applied to assess the impact of time and temperature on the alloy's hardness. Vickers hardness tests are conducted to quantify the material's resistance to plastic deformation under varying conditions. The results reveal a significant correlation between the initial cooling conditions and the hardness of the extruded alloy. The microstructural analysis indicates that rapid cooling rates lead to refined grain structures, contributing to improved hardness. Furthermore, the aging process is observed to influence the hardness properties, with optimal conditions identified for achieving desired mechanical characteristics. The results show that aging at 180°C - 4h can achieve desired tensile strength and surface hardness values, and there is no significant relationship between initial cooling temperature and mechanical properties. As a conclusion, instead of 180°C - 6h aging for water quenched profiles, 180°C -4h aging saves time, effort and money for the company. This research contributes to the understanding of the thermal and mechanical behavior of Aluminum 6063 alloy, offering valuable insights for the optimization of manufacturing processes in industries relying on this material. The findings have implications for engineering applications where hardness plays a critical role in determining the structural integrity and performance of components made from extruded Aluminum 6063 alloy.

Keywords: *Aluminum 6063 Alloy, Extrusion, Initial cooling conditions, Aging process, Hardness properties, Mechanical behavior, Microstructural analysis*