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Effect of surface condition on high-cycle fatigue behavior of PM-HIPed high-nitrogen martensitic tool steel

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This study focuses on a high-nitrogen martensitic tool steel, known for its excellent corrosion resistance, very high wear resistance, high compressive strength, and good hardening properties. Due to the presence of high nitrogen and other alloying elements, producing this alloy using conventional processes is challenging. As a result, it is manufactured using powder metallurgy (PM) and hot isostatic pressing (HIP). In the last step of PM-HIP process, the powder container must be removed, typically by pickling in an acid-leaching bath. However, this pickling process can lead to increase surface roughness and alter the outermost surface layer. The aim of this study is to investigate the impact of the pickling process on the high-cycle fatigue properties of the high-nitrogen tool steel. Two surface conditions, as-pickled and machined, were evaluated. Fatigue performance under high-cycle regimes was assessed using a four-point bending test. The fracture surfaces of failed samples were analyzed to identify fatigue failure defects. The influence of parameters such as surface roughness and residual stress was also discussed.

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