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Minimization of the Abrasion Effect of Fiber Reinforced Polymer Matrix on Stainless Steel Injection Nozzle through the Application of Laser Hardening Technique

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Abstract : Currently, laser hardening process is becoming among the most efficient and effective hardening technique due to its significant advantages. The source where heat is generated, the absence of cooling media, self-quenching property, less distortion nature due to localized heat input, environmental friendly behavior and less time to finish the operation are among the main benefits to adopt this technology. This day, a variety of injection machines are used in plastic, textile, electrical and mechanical industries. Due to the fast growing of composite technology, fiber reinforced polymer matrix becoming optional solution to use in these industries. Due, to the abrasion nature of fiber reinforced polymer matrix composite on the injection components, many parts are outdated before the design period. Niko, a company specialized in injection molded products, suffers from the short lifetime of the injection nozzles of the molds, due to the use of fiber reinforced and, therefore, more abrasive polymer matrix. To prolong the lifetime of these molds, hardening the susceptible component like the injecting nozzles was a must. In this paper, the laser hardening process is investigated on Unimax, a type of stainless steel. The investigation to get optimal results for the nozzle-case was performed in three steps. First, the optimal parameters for maximum possible hardenability for the investigated nozzle material is investigated on a flat sample, using experimental testing as well as thermal simulation. Next, the effect of an inclination on the maximum temperature is analyzed both by experimental testing and validation through simulation. Finally, the data combined and applied for the nozzle. This paper describes possible strategies and methods for laser hardening of the nozzle to reach hardness of at least 720 HV for the material investigated. It has been proven, that the nozzle can be laser hardened to over 900 HV with the option of even higher results when more precise positioning of the laser can be assured.

Keywords : absorptivity, fiber reinforced matrix, laser hardening, Nd:YAG laser
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