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THE NUMERICAL INVESTIGATION OF THERMAL CYCLE OF LASER SURFACE HARDENING

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Subassemblies of machines and devices must be characterized by appropriate exploitation features, especially in relation to the surface layer of cooperating surfaces. Structure and properties of these layers ensure appropriate resistance to abrasive, corrosive and fatigue wear and determine the operating life and failure-free cooperation of these components. Specific antiwear characteristics of surface layers can be obtained using many different manufacturing techniques. The current techniques include treatment with a concentrated energy beam, e.g. laser beam. The essence of the laser beam surface hardening process is the introduction of a sufficient amount of heat into the workpiece material as a result of the absorption of the laser radiation and the cooling of the surface as a result of heat conduction deep into the material (usually no additional cooling media are used for cooling). A necessary condition is an adequate heat capacity of the workpiece.

The hardening process with concentrated energy beams does not require heating of the entire workpiece. The workpieces are only heated in the surface layer. A precisely defined and locally limited heat affected zone means that the amount of heat introduced into the material is very limited.

Solving technical problems of surface hardening is often aided by numerical methods, among which the finite element method (FEM) is the most commonly used.

In this study, FEM numerical models of the laser hardening process were developed. It was determined the heat capacity of the workpieces sufficient to achieve the required thermal cycle at the workpiece specific locations. It was also determined the influence of the heating path sequence and the time delay between them on the thermal cycles.

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