HaPTec

Further qualification of machine hammer peening technology for industrial use

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Abstract

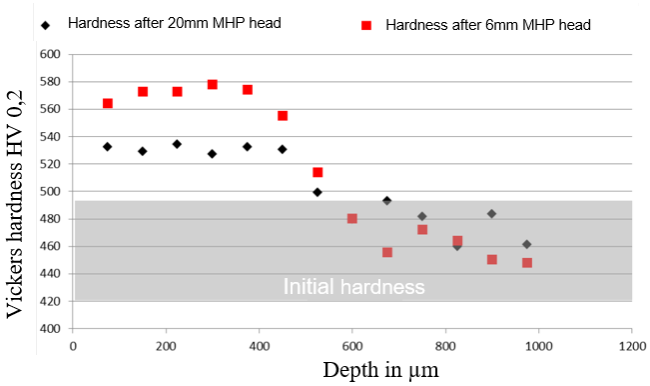
As part of the CORNET project „HaPTec“, a contribution was made to expanding the field of application of machine hammer peening (MHP) in the industrial environment. After defining application guidelines for the MHP processes, a benchmark was carried out which, by comparing the various MHP systems with the established processes of shot peening, deep rolling, and smoothing, shows the potentials to be raised as well possible unique selling points of mechanical surface peening.

Project description

The technology of machine hammer peening enables parameter-controlled machining of functional surfaces in tool and mold-making of sheet metal and solid forming as well as for targeted influencing of the edge layer of components that are exposed to special tribological loads. By means of CNC-controlled manipulators, a hammer system is deterministically guided over the surface to be treated, which allows the technology to be distinguished from shot peening, for example. The aim of surface treatment by MHP is usually to smooth the surface to polish quality, to increase the hardness of the surface layer by work hardening, and to introduce residual compressive stresses. However, the hardness of the material to be machined limits the application potential of MHP technology. Within the scope of this project, the application limits are to be explored and extended.

Results

After defining application guidelines for the MHP processes, a benchmark was carried out which, by comparing the various MHP systems with the established processes of shot peening, deep rolling, and diamond smoothing, shows the potentials to be raised as well as possible unique selling points of mechanical surface hammering. Furthermore, an experimental benchmark was carried out in which all participating processes were compared with regard to the adjustability of relevant surface characteristics (roughness, hardness, residual stresses) (cf. Fig. 1). By developing a finite element (FE) simulation environment as well as a tool based on similarity mechanics, a contribution was made to the possibility of predicting surface layer conditions after mechanical surface hammering. The possibilities as well as the limits of the prediction were shown. Furthermore, measures were developed to be able to process areas that are difficult to access with modified kinematics, for which a new hammering tool was developed and optimized. Furthermore, the boundary conditions for the successful integration of the MHP processes into machining systems were defined and solutions were developed. This concerns in particular the integration into robot systems with low payloads. Based on machining results of different, industry-relevant materials (Zamak, Al2024, 42CrMo4, WC-Co) with hardnesses between 120 and 960 HV using different hammerhead materials and geometries, a material catalog will be created and finally, an application guideline will be developed, which should enable a precise execution of the MHP processes and thus can serve as a guideline for potential users.



[1] Hardness over depth after mhp treatment

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