The modern design of machine components, tools and dies is critically dependent on the ability to tailor bulk and surface properties that optimise the component and the overall system performance. Surface engineering is just that, the design of surface and substrate together, as a system, to give enhanced and cost-effective engineering performance of which neither is capable on its own. The purpose is to minimise corrosion, reduce frictional losses, reduce wear, improve load-carrying capacity and fatigue resistance, etc. or simply to improve the aesthetic appearance. Nowadays, machine components and tools are exposed to very demanding loading conditions as well as to environmental restrictions. Thus materials need to fulfil many requirements, which are not always mutually compatible. However, by using different heat-treatment and surface-engineering processes, the microstructure and surfaces can be altered and thus properties optimised for a selected application.

Many of the most significant developments and findings that have occurred in the technology and science in recent years had an impact and introduced new challenges also in the field of heat-treatment and surface engineering. On the other hand, introducing and using an ever-growing portfolio of heat-treatment and surface-engineering technologies also requires improved understanding of these processes. Especially, in-depth knowledge of the correlations between the microstructure and the related properties is essential. This enables proper selection and optimisation of the heat-treatment and surface-engineering processes, enhancement of the performance and significant extension in the lifetime of the tools and parts while reducing the manufacturing costs.

The 3rd Mediterranean Conference on Heat Treatment and Surface Engineering (MCHTSE 2016), organised by Slovenia Society for Heat Treatment in cooperation with Croatian Society for Heat Treatment and Surface Engineering, Associazione Italiana di Metallurgia, and International Federation for Heat Treatment and Surface Engineering in Portorož, Slovenia in September 2016 as well as *10th International Conference on Industrial Tools and Advanced Processing Technologies (ICIT&APT 2017)* organised by Slovenian Tool and Die Development Centre (TECOS) in Ljubljana, Slovenia in April 2017 provided forums within which engineers, scientists, researchers and production managers reviewed and discussed new challenges, recent progress and emerging topics in the fields of industrial tools, advanced heat-treatment and surface-engineering technologies. They also offered an opportunity to examine the present state and perspectives in theory and practice of heat-treatment and surface-engineering of tools and dies.

The second part of this special issue is on Heat Treatment and Surface Engineering and includes eight extended papers presented at the *3rd Mediterranean Conference on Heat Treatment and Surface Engineering*, and *10th International Conference on Industrial Tools and Advanced Processing Technologies*, focusing mostly on the processes, characterisation and correlations between microstructure and properties.

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Effectiveness of deep cryogenic treatment in improving mechanical and wear properties of cold work tool steels

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Abstract: In recent years, deep cryogenic treatment (DCT) is getting increased attention in many tooling applications as a mean to improve tool performance. However, contradictory results are reported indicating improved as well as deteriorated wear resistance. The goal of this work was to investigate effect of DCT on wear properties of tool steel and how they change depending on the tool steel type, and hardness and fracture toughness obtained. Results show that steel composition considerably affects the way how cryogenic treatment changes steel properties. For low carbon tool steel toughness properties can be improved for up to 70% at only minor hardness drop, but are quite limited in the case of high-speed steel, while at high carbon content both hardness and toughness are deteriorated. In general, DCT was found to result in reduced abrasive wear resistance except for cases of combined hardness and fracture toughness improvement.

Keywords: deep cryogenic treatment; DCT; wear resistance; fracture toughness; hardness; tool steel.

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