Editorial

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In a heat-treatment process, correct heating, overheating, and quenching of steels are of great importance. In a heat-treatment cycle and with different thermo-chemical surface treatments the importance of quenching is reflected in the selection of a correct technique and an adequate quenching agent. This will produce high-quality machine parts or tool parts to be built in later in an assembly made up of a larger number of parts, each performing its own function. A machine part quenched under optimum conditions will provide suitable quality with lowest production costs. Since 1990, the American Society for Materials and the International Federation for Heat Treatment and Surface Engineering have organised a number of conferences on heat treatment, special attention being paid to studies of quenching agents, determination of their quenching intensity, and results of machine-part quenching. The results of quenching of machine parts are expressed as their hardness, residual stresses, and volume changes, accompanied by distortion. The journal editors have invited numerous researchers to publish their latest findings in the field of quenching and distortion. Thirty abstracts and later, the same number of papers were selected and reviewed to be published in three special issues of the IJMPT. They will be issued subsequently in 2005.

The first special issue gives a review of investigations conducted in the field of quenching and distortion in terms of quenching agents, quenching issues, and results of quenching such as hardness, residual stresses, volume changes, distortion, and cracking.

The second special issue includes papers on plant oils and their oxidising and quenching capacities and those on various applications of quenching agents, with particular regard to hardening of carbonitrided parts. Studies of metallurgical changes in high-carbon steel in quenching in CMC polymeric water solutions are very important. Virtual quenching permits simulation of a quenching process, estimation of a heat flow at the surface and prediction of the cooling process described by cooling curves, which is often confirmed also by temperature measurements. Such a computer aid makes it possible to predict the variations of hardness and residual stresses, if they occur.

The third issue discusses the following topics:

- understanding of volume changes and distortion of machine parts after quenching
- effects of machining and heat treating on distortion
- simple method for identification transformation plasticity and using its date for determining heat plasticity conditions
- mathematical modelling of temperature and stress during quenching process
- computer aided prediction of hardness after transformation hardening
- numerical simulation and experimental verification of heat transfer at quenching
- materials properties after very intensive cooling process.

The application of high-pressure gas quenching shows numerous advantages over quenching in liquid quenching agents. The basic problem is how to achieve adequate dynamics of heat removal regardless of a part mass, so that the desired hardness profile after quenching and control of residual stresses may be accomplished. The theoretical background of a quenching process is illustrated by calculation of the heat transfer coefficient. The experimental results include quenching by a water jet of different temperatures and different velocities of the impinging jet.

The development and application of a new sensor to a study of heat transfer in real time are shown as well. The sensor makes it possible to create a database of experimental results for the prediction of the quenching process. In short-time laser transformation, hardening, influences of heating and cooling rates on the microstructure are shown.

Heat treatment of aluminium alloys is represented by a commercial programme of stress and hardness analyses by means of the method of final elements called ABAQUS, with subprograms for an inventory of visco plastic constitutive equations, and VEXPAN for a description of specific extension of a material as a function of temperature.

A practical example is given of heat treatment of a nodular alloy and steels ensuring as little as possible distortion of the nodular alloy and steels. Particular attention is paid to the results of steel quenching with high cooling rates, in which case the transformation of austenite to martensite will shift to lower temperatures, which produces, as the results show, smaller deformation of machine parts.

Special thanks are due to the authors contributing their papers to this special issue of the IJMPT. They are a result of very critical work of reviewers and the authors. It can be said that the papers satisfy high standards of quality.

Our great thanks are due also to our co-workers, Mr. Franc Ravnik and Ms. Nevenka Majerle, who took care of the coordination among the reviewers and the authors, and prepared the papers for the publication.

Finally, we wish to thank the journal IJMPT and the Editor Professor Dr. Dorgham, who accepted and endorsed our invitation to prepare a special issue. Many thanks are also due to the team of the Inderscience Publishers for the assistance offered in preparing the special issues.

We sincerely hope that the papers presented on quenching and distortion will be a valuable source of information to researchers in various scientific fields, and users in the field of materials and production.