Editorial

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Biographical notes: Janez Grum is a Professor of Materials Science at the Faculty of Mechanical Engineering, University of Ljubljana, Slovenia. He is also the founder and Editor-in-Chief of a new journal, the *International Journal of Microstructure and Materials Properties* (IJMMP) and has been Editor of the *Journal News of Society for Nondestructive Testing* by the Slovenian Society for Non-Destructive Testing, Ljubljana, Slovenia since 1994. He is also a member of the editorial board of several international journals. He is the Editor of the six *NDT Conference Proceedings*, two ASM and Marcel Dekker book chapters and five books with several reprints. He has also published more than 200 refereed journal papers and more than 400 conference papers on heat treatment and surface engineering, laser materials processing and materials testing, including nondestructive testing.

The present issue brings together the papers of authors who deal with steels and thermal treatment, as well as investigations of steel in various applications.

In a review paper, Canale *et al.* present different views on the determination of tempering parameters in the heat treatment of steels. A starting point to determine a tempering temperature is a Holloman-Jaffe or Larsen-Miller parameter, on which other authors also elaborated their models with different modifications. Thus, Fullman proposed a parameter based on Johnson and Mehl's inventory of heterogeneous transformation using a kinetic theory. Reti, with his co-authors, also started from the kinetic theory and elaborated generalised nomograms for the determination of hardness variation in both isothermal and non-isothermal tempering. Lin proposed an equation with adapted nomograms with a correlation between the hardness, tempering temperatures and tempering times. In the paper, numerous reference data for individual steels are given for isothermal and non-isothermal tempering, thus providing users with numerous useful data on tempering conditions.

In his paper titled 'The steel super strengthening phenomena – Part 2' Kobasko deals with the thermo-mechanical treatment of steel by final quenching, which ensures considerable economic effects in the manufacture of forged components. The author uses computer simulaton in order to choose the suitable conditions of thermal-mechanical treatment, which provides high compressive residual stresses at the surface and the desired variations of hardness and strength within a forged product. The modelling results were confirmed by the experiments. The first part of the paper was published in the *International Journal of Materials and Product Technology*, Vol. 24, Nos. 1–4, 2005, pp.361–374.

Palaniradja *et al*. present temperature distributions at toothed wheels during a quenching process using Finite Element Analysis (FEM) and mathematical modelling approaches. A temperature distribution is calculated with the two methods in the quenching of toothed wheels with different quenching media. The presented approach makes it possible to predict a microstructure, the hardness and strength of a heat-treated toothed wheel for a given steel using a Time-Temperature-Transformation (TTT) diagram.

Vatavuk *et al*. describe the various nitriding processes in gases and salts under different conditions and study the influences exerted on the toughness and bending resistance of numerous tool steels, *i.e.*, H13, D2, D6 and M2 and K340 in accordance with the AISI standard.

Deabarberis *et al*. conduct investigations on the influence of irradiation exerted on mechanical properties in the case of substitutional alloys. The chemical composition and properties of substitutional alloys are similar to those of materials that are suitable for the manufacture of reactor pressure vessels. Three low-nickel alloys and eight high-nickel alloys with different copper and phosphopus contents are chosen for the investigation of embrittlement trends regarding Cu/Ni/P contents. It turns out that after irradiation, the new and irradiated materials show a higher yield strength and, consequently, their toughness changes as well. Important experimental data are available on the set of reactor pressure vessel model alloys and are summarised in this paper. The studied data can also be of great interest to benchmark model simulating irradiation effects in reactor pressure vessel steels that are currently developed under the sponsorship of different programmes.

Celigiuri *et al*. investigate the deformation stability of ultra-high carbon steel at very high strain rates, *i.e.*, those exceeding 10^6 s^{-1}. Three microstructures of ultra-high carbon steel were examined at three different temperatures. The strain hardening behaviour is strongly history-dependent as a result of solute-enhanced strain hardening in ultra-high carbon steel at elevated temperatures. The ductility of ultra-high carbon steel is reduced at temperatures higher than 600°C because of the sharp increase in the temperature sensivity of strength which, in turn, increased the properties for shear localisation.

Jasinski *et al*. study the precipitation processes in a Monaurite 8M superalloy that has an austenitic microstructure under operating conditions at elevated temperatures ranging between 550°C and 900°C and an elevated pressure of 4MPa. Under these conditions, the creep and failure of a material will occur. The precipitates of a type of $M_{23}C_6$ and MC, which precipitate close to the grain boundaries, have an important influence on the creep behaviour of materials. It is also proved that these precipitates essentially affect the mechanical properties of a material.

Khan *et al*. study the effect of the thermal ageing of 800 HT steel on microstructure and fatigue strength. Steel ageing was carried out at three temperatures (650°C, 760°C and 870°C) and in different durations, *i.e.*, for 24 h, 100 h, 500 h and 1000 h. In long-time annealing at elevated temperatures, various types of carbides (MC, M_6C, M_7C_3 and $M_{23}C_6$) and polihedral Ti (CN) particles, which precipitate both at grain boundaries and inside the grain matrix, will form. The formation of the precipitates results in the significant lowering of the alloy's fatigue strength. This reduction in the fatigue strength is produced by the embrittling effect of precipitate particles, which results in extensive secondary cracking and, thus, causes a reduction in the fatigue strength.

Martins *et al*. study two types of duplex stainless steels that are related in their chemical composition and have the same fractions of ferritic and austenitic microstructures. In particular, they study a microstructure of the ASTM A860 alloy formed with a modification of 1A and 1B, which should preserve the ratio of ferrite to austenite. The two cast irons contain 0.027% to 0.032% of carbon, 24.67% to 5.01% of chromium, 5.43% to 25.70% of nickel and different portions of nitrogen. In the solution-annealed condition at 1160°C followed by water quenching, the higher volume portion of austenite in CD4MCuN leads to high energy absorption when compared to CD4MCu.

Boutana *et al*. treat the microstructure modelling of creep of a titanium alloy at room temperature. A celular automata model is a well-known mathematical method for simulating the mechanical properties of materials. The authors treat the creep behaviour of a titanium alloy that has different microstructures and different crystallographic textures. The simulation results show strong deviations in response to the creep occurrence of different titanium alloys under similar load conditions.

In a study titled 'Experimental investigation of propagation of wetting front on curved surfaces exposed to an impinging water jet', Akmal *et al*. treat steel quenching. They constructed a special device for the quenching of cylindrical components. The propagation of a wetting front is recorded by using a high-speed camera. Video images are collected at a rate of 500 frames/s and a linear scaling factor is calculated. The propagation of the wetting front is analysed with reference to the water temperature, jet velocity, jet diameter and initial surface temperature of a steel specimen. In all of the cases considered in the present study, the relationship between the radius of the wetting front (R) and time (t) has been assumed in the form of a power function.

Bergant and Grum present the optimisation of flame-spraying parameters using the Taguchi method. Four process parameters, *i.e.*, the surface condition of a substrate, the preheat temperature of a substrate, the distance of the flame burner and the type of oxyacetylene flame, are chosen for the investigation. The fraction of the individual relative influences of the chosen factors is calculated using an analysis of variance. A mean value analysis is used to determine the parameter influences that enable the optimum performance of flame spraying.

Special thanks are due to the authors who have contributed their papers to this double issue of IJMMP. The papers are a result of the very critical work of the reviewers and authors. It can be said that the papers satisfy high standards of quality. We sincerely hope that the papers presented on steel research after heat treatment and/or the behaviour of steels in various industrial applications will be valuable sources of information to the researchers in various scientific fields and users in the field of production engineering.