Editorial

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Biographical notes: Peter Mayr is a Professor at Chemnitz University of Technology and the Director of the Welding and Joining Chair. He is also the Chairman of the sub-commission IX-C 'Materials subjected to welding – creep and heat resistant welds' of the International Institute of Welding, IIW. He was part of the organising team of the IIW Annual Assembly 2008 in Graz, Austria and the Chairman of the adjunctive conference Safety and Reliability of Welded Components in Energy and Processing Industry. He has published several refereed journal papers on creep, welding and materials development.

Janez Grum is a Professor of Materials Science, Heat Treatment and Surface Engineering. He is also the Founder and Editor-in-Chief of a new journal, the *Int. Journal of Microstructure and Materials Properties (IJMMP)* and has been the Editor of the *Non-Destructive Testing News* issued by the Slovenian NDT Society. He has published more than 200 refereed journal papers and more than 400 conference papers. He has published five books with several reprints and five book chapters at ASM, Marcel Dekker and Taylor and Francis Publishers.

The present special issue of the *International Journal of Microstructure and Materials Properties* comprises eight papers which study and present reliability of welded components and structures for power plant applications. In addition, two more papers are added; the first one is dealing with friction stir welding of aluminium alloy, and the second one with the evaluation of CSM composites by destructive and non-destructive techniques.

In his work, Schröter presents structural steel for the application in offshore, wind and hydro energy production. Energy production by wind and hydropower sets high demands on the steel grades used for structural applications. Steel grade selection is explained by finding an optimum between sufficient toughness, good strength properties and also easy fabrication, especially welding. Toughness is important in order to avoid brittle failure phenomena, however, high strength is necessary to minimise the weight of structures.

The significance of good fabrication properties is unquestioned. For instance, a good weldability can result in easy joining strategies and therefore high productivity. Moreover, material with excellent weldability shows a higher resistance against cracking phenomena in the weldment. Explanation is given for different production methods of structural steel grades as well as its welding behaviour and resulting mechanical properties.

Zhang et al. present properties of T/P92 weld metals for power plant applications. New power plant technologies resulted in the development and application of advanced martensitic creep resistant steels. T/P92 steel has a creep strength 25% to 30% higher compared to its predecessor the currently widely used T/P91 steel. For a better understanding of microstructural characteristics and mechanical properties of the weld metals, investigations were conducted for welds using various welding processes and matching filler metals. The mechanical properties at ambient temperature and creep properties of the weld metals were tested. Recommendations for suitable practical welding and post-weld heat treatment procedures are presented.

Bhaduri et al. investigated hardfacing of austenitic stainless steel with nickel-chromium alloy. Hardfacing by weld deposition improves resistance to high temperature wear, especially galling of mating surfaces in sodium. Based on the induced radioactivity dose and shielding considerations, Nickel-base E NiCr-B hardfacing alloy was chosen to replace cobalt-base Stellite alloys for reactor applications. Studies on this hardface deposit on austenitic stainless steel substrate demonstrated that deposits after exposure at service temperatures up to 823 K maintain adequate hardness (> RC 40) at service-life of over 40 years. The plasma arc welding process was chosen for hardfacing to optimise deposition parameters and ensure an adequate degree of dilution.

Bauer et al. discuss application of weld strength factors for welded components of 9Cr steel. One way of describing the strength of welded joints is the implementation of weld strength factors in the design process or for lifetime assessments. In general, this factor neither takes the influence of the complex, multiaxial stress situation in large components into account, nor considers relaxation or constraint effects. They presented numerical finite element simulations using inelastic constitutive equations, offering the possibility to characterise the influence of the stress distribution and the degree of multiaxiality in the weld region. Through this, it was possible to obtain a more detailed interpretation of reduced weld strength. Different weld geometries were investigated with focus on the influence of the weld on the overall component behaviour.

Kimura et al. studied creep strength and weld strength reduction factors for welded joints of ASME grades 91, 92 and 122 type steels. Creep rupture data for base metal and welded joints of several creep strength enhanced ferritic steels was collected and long-term creep strength of those steels was evaluated. The master creep life equations for base metal and welded joints were developed.

Vlasák et al. discuss the creep behaviour of steel P23 weldments. The resistance to creep and corrosion is the decisive property for this 2 1/4Cr steel operated in the regime of creep. Considerable attention has been paid to the development and production of new martensitic Cr steels. It can be expected that these materials will enable operation at increased temperatures. Low-alloy heat resistant steel P23 has been developed for tubes and pipes for boiler applications in power engineering. Creep resistance of this steel and its welded joints was investigated.

Stoschka et al. studied the influence of welding process parameters on residual stress by thermo-mechanical simulation. To achieve an accurate lifetime assessment for welded

joints, the value of the effective notch stress was determined. The welding process influences the formation of the heat-affected-zone and dictates the local residual stress distribution. The size and shape of the heat-affected-zone was verified by metallographic investigations and a fatigue life calculation based on the structural stress approach is presented.

Koukal et al. present microstructural investigations for advanced creep resistant ferritic steels. During the past two decades, a new generation of creep resistant ferritic steels has been developed for boiler and turbine components for advanced power generation plants operating with an inlet steam temperature in the range of 600°C to 650°C. The development of new steel grades with increased creep resistance must be based on detailed knowledge of strengthening and degradation mechanism as well as microstructural stability during service. The most significant strengthening and degradation processes during creep exposure of ferritic steels with respect to chemical composition and structural changes during creep at elevated temperatures are shown.

Rajakumar et al. worked on the optimisation and sensitivity analysis of the friction stir welding process and tool parameters for joining aluminium alloy. They focus on the development of empirical relationships for the prediction of tensile strength of friction stir welded joints. An optimisation model in a design-expert software is used to maximise the tensile strength of the joints. The results show that an empirical relationship can be derived to estimate the effectiveness of process and tool parameters for a given tensile strength.

Sideridis et al. studied damaging effects induced by creep loading under ambient conditions in chopped strand mat (CSM) fibre reinforced resin composites. Investigation was done by means of a basic type experimental approaching technique which is based on the influence of the creep-induced damaging effect on some relevant mechanical parameters such as elastic modulus and fracture stress. In the NDT methods of ultrasounds, the ultrasonic waves' propagation is prevented by the presence of micro-cracks, cavities and any other internal defect existing in a material. The change of ultrasonic waves' intensity is expressed by their attenuation coefficient.

We sincerely hope that the papers presented on reliability of welded components and structures for power plant applications will be a valuable source of information for researchers and engineers in their professional activities. All papers were carefully selected and present latest findings and results. The first eight papers were presented at the International Conference on Safety and Reliability of Welded Components in Energy and Processing Industry held in Graz, Austria in July 2008.

The papers are the result of the critical work of reviewers and authors and fulfil the high quality standards of the *IJMMP*.