

In memoriam

Academician Božidar Liščić

(17 January 1929 – 19 April 2020)



It is with deep sorrow that we have to announce that our dear colleague, Academician Božidar Liščić, a member of the Department of Materials and the Chair of Heat Treatment and Surface Engineering of the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, and a full member of the Croatian Academy of Sciences and Arts, passed away peacefully. He left behind many close friends and colleagues.

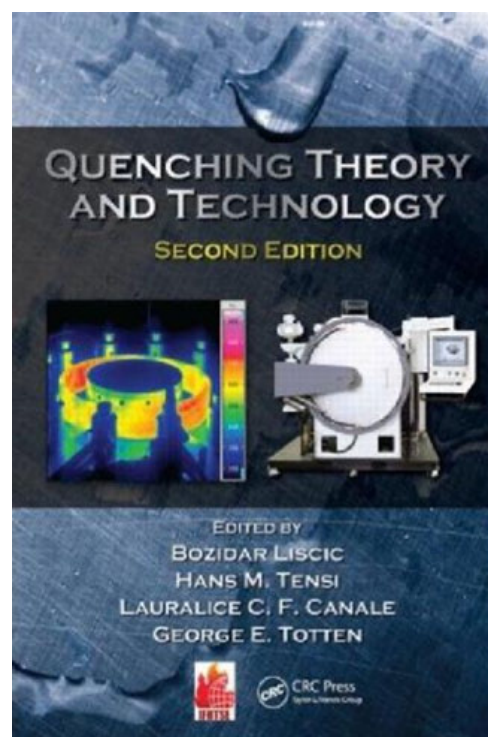
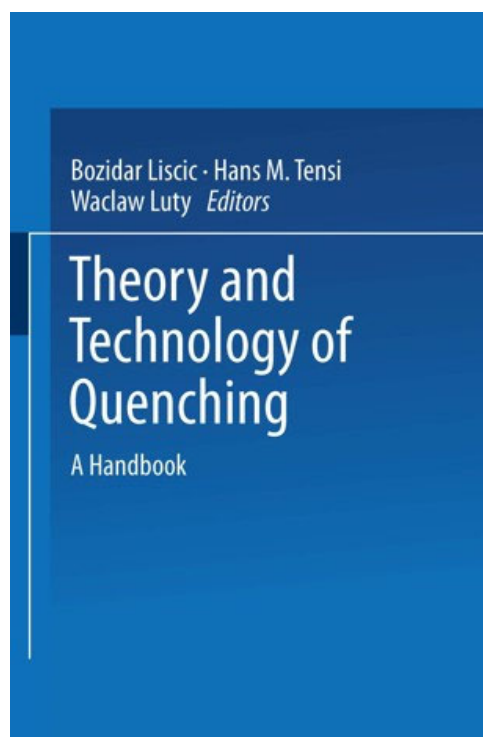
Academician Liščić was born in Karlovac on 17 January 1929, and finished high school in Bjelovar in 1947. He graduated in 1954 from the Mechanical Engineering Department of the Technical Faculty, and received his doctorate in 1975 from the Faculty of Mechanical Engineering and Naval Architecture (FAMENA). He studied in the Federal Republic of Germany in 1959 and 1967 and in Belgium in 1964. From 1954 to 1964, he worked at the Machine Tool Factory "Prvomajska" in Zagreb, where he was appointed technical director in 1961; from 1964 to 1967 he was an advisor in the Chamber of Commerce of the City of Zagreb. He was a lecturer at the Faculty of Mechanical Engineering and Naval Architecture from 1968 until his retirement in 1999; in 1970, he became an assistant professor, an associate professor in 1976 and a full professor in 1982. In 1968, he founded the Heat Treatment Laboratory at the FAMENA. As the head of the laboratory (until 1981), he introduced modern heat treatment and surface engineering technologies. In 1997, he was elected a full member of the Croatian Academy of Sciences and Arts in the Department of Technical Sciences; he actively participated in the work of the Department until 2019.

Scientific and professional activity and research results of Academician Liščić were noticed and appreciated in international scientific and professional associations and institutes. As an expert of the United Nations Development Programs (ILO, UNIDO, ESCAP), he visited 9 missions in Israel (1971), India (1972/73), Egypt (1978), Turkey (1980), Bangladesh (1983/84), India (1986/87), and Pakistan (1986/87 and 1989/90). Since 1989, he had been an expert advisor to the Development Department of the German company IPSEN INDUSTRIES GmbH, a member of the working group "Fachausschuss für Eht-Bestimmung" der Arbeitsgemeinschaft Wärmebehandlung und Werkstofftechnik, Bremen, Germany, and a member of the International Organizing Committee of the First International Conference on Quenching and Control of Distortion, 1992, Chicago, USA. He chaired the Scientific and Technological Aspects of Quenching Technical Committee of the International Federation of Heat Treatment and Surface Engineering (IFHTSE). From 2004 to 2005, he was the president of the IFHTSE; in this capacity, he prepared a proposal for the international project Global Database for Cooling Intensities of Liquid Quenchants, which was accepted, and the database was created and has been used for more than 15 years. In addition, he was a fellow member of the American Society for Metals (ASM) in the USA, a member of the Arbeitsgemeinschaft Wärmebehandlung und Werkstofftechnik (AWT) in Germany, a member of the Croatian Society for Heat Treatment and Surface Engineering,

and a member of the Board of Editors of the International Journal of Microstructure and Materials Properties (IJMMP), published in the U.K. and of the Journal Heat Treatment of Metals, published in Beijing, China. In the Croatian Academy of Science and Arts, Academician Liščić was a member of the Committee for International Cooperation, a representative of the Academy in the Innovation Council for Industry of the Republic of Croatia, a representative of the Academy at the Assembly of All European Federation of Academies (ALLEA). As a representative of the Croatian Academy, he was a member of the Standing Committee for Physical and Engineering Sciences (PESC) of the European Science Foundation (ESF) in two terms (from 2003 to 2009). He chaired the Production Sciences Committee and the Scientific Council for Technological Development of the Academy.

The scientific career of Academician Liščić started with the establishment of the Heat Treatment Laboratory (HTL). His first successful project was carried out in collaboration with the company "Končar", Zagreb, Croatia; the project was aimed at the development of equipment for heat treatment and a prototype of a salt bath, the first of its kind in Europe, was built. In the Heat Treatment Laboratory, the Department of Materials, he also introduced procedures for nitriding in a salt bath and short-term nitriding in a mixture of gases (in 1970), the heat treatment of alloy steels in a vacuum furnace (in 1971) and the induction hardening process (in 1974). The main area of research of Academician Liščić was the rapid cooling (quenching) technology during quenching. In 1975, he defended his doctoral thesis entitled "The Depth of Hardening as a Function of Steel Hardenability and of Quenching Parameters", and received his PhD in mechanical engineering from the University of Zagreb. He conducted part of experiments for his dissertation at the Max-Planck Institute (Institut für Eisenforschung) in Düsseldorf, Germany, and the other part in the laboratory in Zagreb, using an experimental quenching tank built for that purpose by the Swiss company BOREL. In 1978, he developed a method for measuring, registering and evaluating the quenching cooling intensity based on the temperature gradient in the surface layer of a cylindrical probe (the LIŠČIĆ-NANMAC test). He described the physical basis of the method in the world-famous scientific and professional monograph *Technologie der Wärmebehandlung von Stahl*, 2. Auflage VEB Deutscher Verlag für Grundstoffindustrie, Leipzig (1987). He was also the author of a chapter in or a co-editor of the following monographs: "Theory and Technology of Quenching", Springer-Verlag, New York (1992), "Steel Heat Treatment Handbook", Marcel Dekker, New York, (1997), "Fuels and Lubricants Handbook", ASTM International, (2003), "Steel Heat Treatment - Metallurgy and Technologies", CRC Press, New York (2007), "Quenching Theory and Technology", 2nd Edition, CRC Press, Taylor & Francis Group, Boca Raton (2010) and "ASM Handbook, Vol 4A: Steel Heat Treating Fundamentals and Processes", ASM International, Metals Park (2013). Based on the use of the Liscic/Nanmac probe, a unique Temperature Gradient Quenching Analysis System software package has been developed at the FAMENA, University of Zagreb. Together with this software support, this method has so far been the only one in the world to measure, record, and compare the cooling intensity during quenching in industrial conditions. His research work related to the application of the mentioned method and test, also refers to the programmed dynamics of heat dissipation (Controllable Delayed Quenching) during hardening and to the

influence of this dynamics on the distribution of mechanical properties in the cross-section of hardened objects. Based on the Temperature Gradient Method, an automatic control system, Flux control, using a probe (the IPSEN-LIŠČIĆ sensor) was designed in 1995 in the Ipsen Industries International. In the field of mechanical engineering, Academician Liščić is the only Croatian scientist after who some scientific methods and tests have been named (the LIŠČIĆ-NANMAC test and the IPSEN-LIŠČIĆ Sensor). In collaboration with the Institut für Werkstofftechnik (IWT), Bremen - Germany, he investigated the application of the LISCIC-NANMAC test in high-speed coolant quenching. He led an interdisciplinary team whose task was to develop a new computer package for evaluating the cooling intensity in liquid media and predicting the hardening distribution after quenching for the company Petrofer, Hildesheim. Also, through the efforts of Academician Liščić, a unique device for testing the cooling of steel in gases under pressure was donated by the IWT to the Chair for Heat Treatment and Surface Engineering, FAMENA, and installed in the Heat Treatment Laboratory. The second area of his scientific research refers to thermal processes used for the surface layer modification, using nitrogen diffusion or laser beam, in order to increase wear resistance. During that research, he collaborated for several years with scientists from the Bergakademie Freiberg, Germany. He led a team which collaborated with the Ruđer Bošković Institute in conducting experiments on the hardening of surface layers on steel and cast iron using a laser beam, for the first time in Croatia. In order to promote the technology transfer to the domestic industry, Academician Liščić constantly advocated the establishment of special service centres for modern technologies, which would be equipped with state-of-the-art equipment and highly qualified personnel capable of meeting the challenges of the world market and scientific research. He stimulated discussions on future opportunities for the development of production in the Republic of Croatia, such as: modern materials, laser technologies, surface engineering, rapid prototyping and parts, renewable energy sources, wind farms, and marine technologies.



In his long and successful scientific career, Professor Liščić published more than 60 scientific papers in journals and conference proceedings. He gave more than 40 public lectures and presentations at scientific conferences, most of them abroad. He led 14 scientific projects, and collaborated on 6 projects. He was the editor or the author of chapters in nine prestigious scientific and professional monographs published in the period from 1992 to 2013, in which he described the field of heat treatment with special reference to modern methods of testing the quenching process and predicting the properties of hardened steels. In that valuable overview, he described the latest world achievements as well as his own ones, thus leaving to his younger colleagues and students a deep insight into the heat treatment field and a permanent record of materials from his lectures he gave at the FAMENA from 1968 to 1999.

Following the trends in the development of science and technology in the world, Academician Liščić was the first in Croatia in 1990 to introduce a group of elective courses, Surface Engineering, in the study of mechanical engineering at FAMENA. Within this group of elective courses, teachers from three departments transferred to students the knowledge from this important interdisciplinary field, which was then just beginning to be developed and applied in the world. During his teaching career, he prepared and gave lectures on a number of graduate and postgraduate subjects in the field of heat treatment and surface engineering. He mentored 30 graduate theses, 5 Master's theses and 3 doctoral dissertations. In his lectures, he always pointed out that our greatest strength and the true value are people with a good understanding of research results before their introduction into practical application. He also stressed the importance of acquiring and improving the knowledge of future technologies which, at the time he lectured on them, were still in the early stage of development. Academician Liščić was marked by a great scientific and professional curiosity, constant monitoring of the latest world achievements, and a selfless transfer of the latest knowledge to younger colleagues and students. In his daily work, he was characterised by diligence, adherence to the principles of humanity, expertise, openness to cooperation, great personal and social responsibility, and personal integrity. Throughout his life, he encouraged younger colleagues and associates to seek scientific and professional cooperation; he himself led interdisciplinary teams promoting cooperation between different disciplines. He connected younger associates with respected foreign colleagues and scientific institutions in Germany, U.K, Slovenia, USA, Brazil, China, India, Hungary, in which his associates were received with special attention and kindness.

For his work and achievements, Academician Liščić received the FAMENA Grand Medal (1976), the Nikola Tesla Republic Award for Scientific Activity (1989) and the Adolf Martens Medal (2006) - the most prestigious prize given by the German association Arbeitsgemeinschaft für Wärmebehandlung und Werkstofftechnik (AWT). In honour of Academician Liščić, an international conference, New Challenges in Heat Treatment and Surface Engineering, was held in Cavtat in 2009. The conference was organized by the CSHTSE and the IFHTSE. In 2010, the Centre for Modelling in Heat Treatment – the Quenching Research Centre was founded at the FAMENA, University of Zagreb, to honour and to express gratitude to Academician Liščić for his outstanding contributions to the

theory and practice of heat treatment. Academician Liščić participated in the work of that research centre as an advisor and helped in the international affirmation of the team of associates.



A photo from the Conference held to honour Professor Božidar Liščić - New Challenges in Heat Treatment and Surface Engineering, 9-12 June 2009, Dubrovnik-Cavtat

The greatest pride of teachers is in their students and younger associates. In this respect, Professor Liščić can really be proud of his students and younger colleagues who established themselves in Croatia and have an impressive record of international achievements.

Dear Academician Liščić, it was an honour and pleasure to have worked with you and to have been a part of your life.

Your faithful friends and colleagues from the Chair of Heat Treatment and Surface Engineering and the Department of Materials