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NetCastPL4.0 Seminars Series

May 26, 2025, 02:00 – 03:15 pm CET

Production-microstructure-properties of ductile cast irons

Aims of the seminars

Material defects and metallurgical discontinuities greatly impact an alloys' mechanical properties – especially in castings, where section sensitivity and variations in chemical composition can significantly affect the microstructure. Defects in materials cannot be easily quantified through conventional testing techniques, so, it should be required that the index of a material's integrity could be obtained from its tensile-flow behavior, as tensile testing is the simplest technique to perform. Today's NetCastPL4.0 seminars are focused on the correlations between production-microstructure-properties through tensile behavior analysis and the fatigue resistance of ductile cast irons produced through different sections.

02:00 pm – Giuliano Angella (20-25 minutes)	02:30 pm – Stefano Masaggia (20-25 minutes)
A New Material Integrity Index for foundry castings: the case of 4.2 wt.% Silicon Ductile Iron produced through different sections. A new procedure for assessing the ductile iron castings integrity has been proposed and is based on the tensile-flow curve analysis through the modelling of the experimental tensile-flow curves using the Voce equation. If the parameters from the best-fitting Voce equation of a statistically meaningful set of experimental tensile-flow curves are plotted in a Matrix Assessment Diagram (MAD), they are found to lie along straight lines. The coefficients of the best fitting lines provide information on the soundness or defectiveness of the castings. The quality of this approach is based on the unexpected regular strain-hardening behaviors of defective materials, referred to as Defects-Driven Plasticity that gives rise to the definition of a new Material Integrity Index (MII). As study case of application of this MII, the section-sensitivity assessment of a 4.2 wt.% Silicon Ductile Iron is reported in the seminar.	The Influence of wall thickness on the fatigue limit of V-notched bars made of as-cast or heat treated ductile irons. The presentation reports the fatigue investigation and illustrates the application of a fatigue design procedure in the presence of notch effects, which represents an unconventional extension of Linear Elastic Fracture Mechanics to U- and V-shaped notches with arbitrary notch opening angle, size and root. A complete and homogeneous set of data for fatigue design has been developed and optimal fatigue strength conditions were found: the HCF behavior of heat-treated DIs can be adequately described by considering hardness and size of the graphitic nodules. In the absence of pre-existing defects, the material containing small graphite nodules is favored. If instead a defect tolerant design approach is adopted and is required that mechanical components, characterized by severe defects and/or notches, and operate for a prolonged time in the propagation threshold regime, the material containing coarse graphite nodules would be more effective.

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Giuliano Angella

After achieving the Philosophical Doctor degree in Materials Engineering at the University of Sheffield (UK), since 2001 he is employed in the research institute CNR-ICMATE, and now he is senior researcher working on mechanical and microstructure characterization of metal alloys for industrial applications. From scientific collaborations with some of the main Italian metallurgical companies, he has dedicated his recent research activity to the development of constitutive equations and correlations between production-microstructure-properties of conventional and advanced cast irons.

Stefano Masaggia

After his degree in Mechanical Engineering, since 1996 he has worked in Zanardi Fonderie S.p.A., Italy, first as Foundry Designer, later as R&D Engineer, and currently as Foundry and Heat Treatment Technologist. He has been mainly involved in process and product development of conventional, austempered and isothermed ductile irons, as process simulation developer and R&D project leader. His expertise is also on failure analysis, mechanical testing and plant operations. He has been supervisor of thesis works with students from University of Padua and author/co-author of papers published on International Journals.

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