



**UNIVERSITÀ
DI TRENTO**
Dipartimento di
Ingegneria Industriale

DII

Seminar



Integrity assessment of castings: a novel procedure based on physical base model of tensile strain hardening

March 3, 2023 - h. 10:30

Polo Ferrari 2, Via Sommarive 9, Trento - Seminar room

Speaker: Giuliano Angella, CNR

Process–microstructure–property relationships represent a key issue in the industrial production and application of materials. Castings may enclose defects and metallurgical discontinuities that can cause high variability and reduction of mechanical properties. To minimize this variability and reduction, the integrity of castings should be evaluated quickly and cheaply through procedures based on tensile testing. A novel procedure for material quality assessment, developed for castings like ductile irons and Al alloys, is based on the analysis of tensile strain hardening through a dislocation-density-related constitutive equation, and has been proven to be a promising tool in detecting defects and metallurgical discontinuities in castings. The procedure consists of plotting the Voce equation parameters found through modelling the tensile strain hardening data with the Voce constitutive equation, producing the Matrix Assessment Diagram (MAD). For sound materials the Voce parameters have a regular trend in MADs, which is consistent with the physical meaning of the dislocation-density-related Voce equation. However, it has been reported that the Voce parameters identify a regular trend also in defective materials, even if defects and metallurgical discontinuities might be expected to add a random and unpredictable component to the plastic behavior. This unexpected regular behavior in defective materials allowed to introduce the neologism “Defect Driven Plasticity” (DDP) and could be successfully used for the integrity assessment of castings.

So the novel procedure based on modelling tensile strain hardening through Voce equation and MADs has given excellent results on both process–microstructure classification and integrity assessment of a wide number of different castings, suggesting also the identification of possible quality indexes with physical meaning and practical use. Examples of applications on ductile irons (ferritic and pearlitic-ferritic; high silicon strengthened; austempered and isothermed) and aluminium alloys will be presented.

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