On the isotropic elastic constants of graphite nodules in ductile cast iron: Analytical and numerical micromechanical investigations - DTU Orbit (08/11/2017)

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A comprehensive description of the mechanical behavior of nodules in ductile iron is still missing in the published literature. Nevertheless, experimental evidence exists for the importance of such graphite particles during macroscopic material deformation, especially under compressive loading. In the present paper, the nodules' elastic properties are thoroughly investigated by means of both analytical and numerical techniques. The analysis takes into account the influence of several non-linear phenomena, as local residual stresses arising during solid-state cooling, interface debonding and limited particle strength. It is shown that if the nodule internal structure is considered, the traditional isotropy assumption leads to the definition of a domain of admissible values for the effective elastic constants. However, micromechanical calculations indicate that values within the domain do not provide mesoscopic moduli in agreement with Young's modulus and Poisson's ratio recorded for common ferritic ductile iron grades. This suggests that graphite nodules may not be considered isotropic at the microscopic scale, at least from a mechanical viewpoint.

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