Cast Iron – State of the Art and Forecast, Contributions

Iulian Riposan

POLITEHNICA University of Bucharest, Bucharest, ROMANIA

Cast iron is more than 70% of the total world metal casting production [more than 74 millions tons castings each year], with a great development potential. This material is especially attractive to the automotive industry, because of its excellent properties such as castability, machinability, heat conductivity and vibration damping capacity, at low cost production. Thin walls irons castings [less than 5mm wall thickness] are more and more attractive in this field. Ductile iron is also the material of choice for many of the world major wind turbine manufacturers. The need to ensure optimum, consistent and safe performance of these units makes it imperative that only ductile iron castings of the highest integrity and in complete compliance with the specification can be accepted, especially as requirements for high impact properties in ductile iron at low temperatures.

Industrial cast iron is a multi-element [more than 30 elements usually presence] eutectic alloy. The crystallization conditions are significantly different from that of equilibrium phase diagram measured at very slow cooling rate, using very pure materials, under vacuum melting, etc. Non-equilibrium solidification conditions, typically for iron castings in foundry industry, favour stable to metastable system crystallization transition, austenitic dendrites formation also in eutectic-hypereutectic chemical composition ranges, elements segregation, different eutectic solidification undercooling [up to 50^{0}C or more], etc.

The representative international conference and symposium systems [World / European / American] are reviewed to underline the research and development activities in the cast iron field. A review of Si-alloyed ductile cast iron data shows that the instability of a mixed ferrite-pearlite matrix could be replaced with more predictable and controllable ferritic grades [3.0 to 4.3%Si], while supplementary Mo additions favour superior mechanical properties and improved resistance to oxidation and corrosion at high temperatures. For most applications, alloying with 0.4 to 1.0%Mo provides adequate elevated-temperature strength and creep resistance, while higher molybdenum additions [1.0 to 2.5%Mo] are necessary when maximum elevated-temperature strength is needed. The solidification pattern and structure characteristics of three ductile iron compositions [I-2.5%Si; II-4%Si and III-4%Si - 1.6%Mo] were studied, for higher molybdenum content and low level of Si : Mo ratio, respectively.