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ABSTRACT

The work performed in this research allowed for the successful development of a new high yield ductile iron alloy, whose static mechanical properties outperform those of any conventional ductile iron and even most heat treated ductile irons. The addition of certain alloying elements to the typical production specification of a GJS-700-2 allowed for a significant relative improvement in all static mechanical properties. The tensile strength was successfully enhanced in 15%, the yield strength in 22% and the elongation was improved in 5%. This research also showed that if a consistent work method is applied, the transferability between laboratory and industrial conditions is perfectible doable. The fact that all experiments performed under laboratory conditions were found to be transferable to industrial conditions attests to this success.

The up-scaling between laboratory and industrial environment of the new alloy proved also to be a success. The new alloy was successfully produced in both control Y-shaped castings as well as in a demonstrator cast part. The demonstrator cast part was chosen due to its particular geometry, which permitted verifying the influence of the new alloy chemical composition on significantly different cast wall thicknesses. The influence of nickel on the thinner wall thicknesses was of particular interest in this particular investigation. The results of the analysis showed, however, that no bainite was present in the structure. Furthermore, the thickest section of the part presented enough pearlite to guarantee the desired structure.

The systematic error associated with measuring static mechanical properties was also focused in this work. It was found that not all static mechanical properties can be measured with the same degree of accuracy. The analysis of the data acquired during the investigations showed that both tensile and yield strength can be measured with a relative good accuracy (up to 3%). The elongation measurements, however, showed a systematic error of about 12%, which is several times higher than the error found for tensile and yield strength. In any case, these errors are expected to always be present and should be taken into consideration when comparing static mechanical properties between different batches. The influence of nickel, silicon and copper proved to have synergetic effects if added in certain amounts. Each of these elements, however, influences the mechanical properties of pearlitic ductile iron in different ways and through different mechanisms.