

PhD RESEARCH PROJECT

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Research project: “Defects and mechanical properties (static and dynamic) of ductile cast iron castings”

The research project on the specific issue "Defects and mechanical properties (static and dynamic) of ductile cast iron castings" proposes as a target understanding of the origin of typical defects present in ductile cast iron castings and their effect on the mechanical properties of the material.

Ductile cast iron is characterized by excellent properties together with the low process costs for the realization of foundry castings. These characteristics derive from the solidification process in which, unlike the gray cast iron, the graphite precipitates in the form of spheroids with the addition of elements such as magnesium; the morphology of spheroidal graphite induces a lower stress concentration with respect to that lamellar thus allowing to better exploit the characteristics of ductility of the matrix. For structural elements of large dimensions, produced in small quantities, is very complicated optimize the melting process in an economic way. Research of foundries and study centers to try to improve the level of knowledge on the performance of the material in the presence of defects and anomalous structures is therefore of primary importance.

In many cases, even being aware of the applied loads, a casting with defects can be refused, because it is not completely known the reduction of the mechanical properties determined by the defects present inside the structure.

The aim of this study is therefore to determine accurately and rigorously the incidence of these defects due to melting processes on the mechanical strength and the fatigue behavior of the material, comparing the data obtained with the values of the not altered structure.

The most common and dangerous defects that appear in structural elements of heavy section ductile iron are superficial dross (non-metallic inclusions of irregular shape generally present on the surface of the casting), surface or internal porosity and alterations in the morphology of graphite nodules (exploded, compact, chunky and spiky graphite).

The target of this research work consists in the realization of a series of experimental tests for the processing of data on the mechanical behavior of various types of cast iron.

The weak point in the adoption of a foundry casting as an alternative to an element obtained starting from forgings parts, consists in the presence of internal shrinkage porosity and surface defects hardly avoidable in foundry processes. The presence of defects, their morphology and size and their negative effects on the mechanical behavior must therefore be taken into account before starting the production process, as well as is necessary to adequately know the microstructure and the properties associated with them.

The proposed work plan is thus directed to the understanding of the origin and the location of the defects described, the formulation of rules of calculation for the design and structural verification of mechanical components, the definition of the mechanical properties of possible materials to be used in specific applications and the conception of samples suitable for the purpose.