The influence of charge materials and final inoculation on metallurgical quality of cast iron intended for automotive castings

The paper presents the characteristics of cast iron, the influence of chemical composition on the formation of the structure, properties and ability of cast iron to graphitize. Factors influencing the metallurgical quality of liquid cast iron were characterized. The processes of inoculation and spheroidization of cast iron, which are the essence of the production of nodular cast iron, are described in detail. The basics of graphite crystallization and the mechanisms of cast iron solidification are presented. Characteristics of individual stages of cast iron shrinkage, such as: shrinkage in the liquid state, shrinkage of solidification and shrinkage in the solid state, were made. The application of thermal analysis techniques for the production of cast iron and the importance of individual parameters determined on the basis of cooling and crystallization curves are described.

In the research part, tests were carried out on the influence of the source of cast iron, changing proportions of charge materials and various final inoculants on the metallurgical quality of cast iron depending on the casting wall thickness. Physical and chemical parameters, mechanical properties and microstructure parameters as well as the size of defects were assessed depending on the reduced amount of pig iron and the type of final inoculants.

Based on the tests carried out in laboratory conditions, it was found that the Temin value obtained on the basis of ATD tests and related to the ability to nucleate graphite increases with the content of pig iron in the charge. This allow you to reduce the amount of added inoculant. The results of tests and analyzes obtained in production conditions for various sources of cast iron origin allowed to introduce the principle of assessing the tendency of cast iron to overcooling using the ATD analysis and to eliminate the problem of the formation of hard and brittle iron carbide in thin-walled castings. Based on the study of the influence of the charge materials on the microstructure and mechanical properties of ductile cast iron using step casting, the charge recipe for cast iron melts EN-GJS 500-7 was changed by reducing the amount of pig iron from 30% to 10%. The difference was replaced with own scrap and steel scrap in a 1:1 ratio. The results of the research on the influence of various final inoculants on the quality of cast iron made it possible to replace the yet used inoculant with a inoculant containing cerium. The newly introduced inoculant ensures the preservation of higher plastic properties and minimization of shrinkage defects.

The entire work is completed by a list of the referenced literature covering 89 items.