

Politechnika Śląska

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**Wpływ premodyfikatorów na podwyższenie i stabilizację  
jakości metalurgicznej ciekłego żeliwa**

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# **Preconditioning influence on the enhancement and stability of the metallurgical quality of the liquid cast iron**

## **ABSTRACT**

The procedure of cast iron pre-conditioning is currently not a widely used concept among metallurgists. This applies to both grey cast iron with flake graphite and ductile cast iron with spheroidal graphite. Previous scientific works have presented data on the effect of preconditioners (of various types) on grey cast iron, where some benefits were obtained from the use of this treatment (in terms of microstructure, an improvement in the morphology of graphite precipitates, improvement in mechanical properties, and reduction of the tendency to create internal defects were achieved). On the other hand, research on the influence of pre-conditioning on ductile cast iron has not been conducted so far (according to the author's best knowledge). Hence the idea to investigate the influence of the pre-conditioning treatment on increasing the stabilization of the metallurgical quality of ductile cast iron, expressed in the number of graphite precipitates, the degree of spheroidization, and the population of micro inclusions constituting the basis for the nucleation of graphite. The conducted analysis of the literature in this area assured the author of the appropriateness of taking up this topic. The description of the graphite nucleation phenomenon, presented in detail in the work (together with the latest scientific achievements) indicates that this procedure is an important stage in the preparation of high-quality ductile iron, used in the automotive industry for safety castings, such as suspension system components (steering knuckles, rocker arms), which are produced by Teksid Iron Poland Sp. o.o.

The thesis presents a series of test results (representative for individual samples), where the influence of pre-conditioners on some parameters of thermal analysis, microstructure (number of graphite precipitates, degree of spheroidization), and mechanical properties of castings was examined in preliminary tests. Preliminary studies have shown the validity of undertaking further research. The results (in relation to the microstructure) were also confirmed in further research in a doctoral dissertation. An additional scientific aspect is advanced research, carried out jointly with the R&D department of Elkem, on the identification of micro inclusions, the population of micro inclusions, the number of graphite precipitates, as well as the degree of spheroidization concerning spheroidized cast iron. The research indicated that the use of pre-conditioning increases the population of micro inclusions, improves the degree of

spheroidization, and this (improvement in the degree of spheroidization) is very important in terms of resistance to fatigue properties, where, referring to the literature, cracks are initiated precisely on the precipitates with a lower degree of spheroidization.

The research carried out in the scope of the doctorate with the use of advanced techniques AMICS, EELS, SEM, EDS showed that a new mechanism of graphite nucleation in ductile iron was probably discovered, describing the combination of carbide nucleation (Ti, Zr, Nb) on nitride (Al, Mg, Si). These studies should indicate the direction for future studies to confirm this hypothesis. In addition, the presented research results in the Inmould process also confirm the appropriateness of taking up this topic, where a new concept was additionally defined, i.e., MSP (Metal Stream Preconditioning) - pre-conditioning to the stream, which increases the scientific and utilitarian value of the work.