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STUCTURE ASPECTS OF MECHANICAL PROPERTIES OF DUCTILE IRON FORMATION

СТРУКТУРНІ АСПЕКТИ ФОРМУВАННЯ МЕХАНІЧНИХ ХАРАКТЕРИСТИК ВИСОКОМІЦНОГО ЧАВУНУ

Pashynskyi V.V.
DSc (Engineering), Associate Professor, LLC "Technical university "Metinvest polytechnic", Zaporizhzhia, Ukraine

Пашинський В.В.
д.т.н., доцент, ТОВ «Технічний університет «Метінвест політехніка», м. Запоріжжя, Україна

Pashynskaya O.G.
DSc (Engineering), Senior Researcher, LLC "Technical university "Metinvest polytechnic", Zaporizhzhia, Ukraine

Пашинська О.Г.
д.т.н., старший науковий співробітник, ТОВ «Технічний університет «Метінвест політехніка», м. Запоріжжя, Україна, ІЄС ім. Е.О. Патона, м. Київ, Україна

Boyko I.O.
PhD (Engineering), Associate Professor, LLC "Technical university "Metinvest polytechnic", Zaporizhzhia, Ukraine

Бойко І.О.
к.т.н., доцент, ТОВ «Технічний університет «Метінвест політехніка», м. Запоріжжя, Україна

Ductile iron is widely used material for production of different details for machinebuilding by the cast technology because of its unique combination of excellent cast properties, high mechanical properties, and relatively low price. In international practice some standards and specifications that determined the chemical composition and mechanical properties of this material, for example [1, 2]. But main peculiarity of a ductile iron is absence of the direct relation between the composition and properties. Besides these parameters, final mechanical properties depend on technology of modification and nodularization, technology of the casting process (duration of the mould pouring, type of the moud) and design of the cast part. Therefore, to receive the required grade of material for the certain conditions, the long and expensive stage of the experimental determination of technology parameters is necessary.

To simplify the process of technological parameters adjustment, it is necessary to collect the information concerning the relationship between chemical composition, production technology and mechanical properties for the stable parameters of casting (design of the mould, duration and temperature of mould pouring).

Current investigation is directed on comparing of structure of ductile iron produced by technology of the modification and nodularization in the ladle (so called "sandwich» technique). Current technology (Tech 1) was compared with experimental (Tech 2). Main difference deals with using of additional secondary modification of metal by the adding of modificator to the stream of metal during the ladle pouring. Microstructure of materials is shown on Fig. 1.

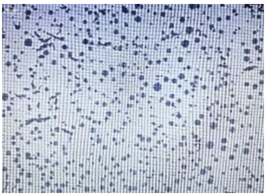
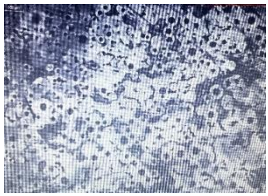
Technology	Nodularity	Ferrite/Pearlite ratio
Tech 1		
Parameters according to ISO 945	Graphite form – VI Nodularity – 70–80% Nodular density –150 n/mm^2 Graphite size – 6	Ferrite/pearlite ratio 30%/70%
Tech 2		
Parameters according to ISO 945	Graphite form – VI Nodularity – 75–85% Nodular density – 300 n/mm^2 Graphite size – 7	Ferrite/pearlite ratio 70%/30%

Fig. 1. Microstructure of ductile iron, produced by different technologies

As we can see, secondary modification permits to obtain As we can see from the structure, secondary modification permits to receive the improvement of nodularity parameters – higher the nodularity and nodule density and finer graphite size. But improvement in structure is not corresponds with increasing of mechanical properties. As we can see from the Table 1, material, produced by Tech 2 technology, has lower strength and plasticity. It may be explained taking into account the chemical composition of materials (see Table 2). As we can see from the table, both melts have the similar content of Mn, S, P and different content of C, Si, and Mg.

Materials have ferrite pearlite ratio (70/30 with Tech 1 technology against 30/70 with Tech 2 one). Ferrite pearlite ratio depends on:

– content of Si – ferrite content increases with growth of Si content;
– content of Mg – ferrite content decreases with growth of Mg content.

We also see that elongation with Tech 2 technology is lower than with Tech 1 despite of more favorable structure. It may be explained by the decreasing of ferrite plasticity with growth of Si content higher than 2,8–3% [3].

Table 1

The mechanical properties of the samples

Technology	**Hardness, HB**	**Yield strength, MPa**	**Tensile strength, MPa**	**Elongation, %**
Tech 1	195 – 200	388	585	10,6
Tech 2	180 – 185	335	487	8,2

Table 2

Chemical composition of metal in the ladle after pouring

Technology	**C**	**Si**	**Mn**	**Mg**	**P**	**S**
Tech 1	3,63	2,48	0,3	0,0418	0,001	0,011
Tech 2	3,36	3,12	0,33	0,035	0,001	0,011

Conclusions

Obtained results shows that the optimization of ductile iron structure demands corresponding adjustment of chemical composition. Tech 2 technology demonstrated the potential for improvement of microstructure parameters, but for realization of this potential, it is necessary to realize new step of investigations with corrected chemical composition. According the obtained results, following recommendation was proposed: Si content in the ladle 2,4–2,6%, Mg content in the ladle ≥ 0,04%.

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DEVELOPMENT OF PRODUCTION TECHNOLOGY IN ORDER TO OBTAIN REQUIRED MECHANICAL CHARACTERISTICS DUE TO THE FORMATION OF AN IMPROVED COMPLEX OF STRUCTURE AND PROPERTIES OF 30MNB5 STEEL PRODUCED BY PJSC "ZAPORIZHSTAL"

РОЗРОБКА ТЕХНОЛОГІЇ ВИРОБНИЦТВА З МЕТОЮ ОТРИМАННЯ ЗАДАНИХ МЕХАНІЧНИХ ХАРАКТЕРИСТИК ЗА РАХУНОК ФОРМУВАННЯ ПОЛІПШЕНОГО КОМПЛЕКСУ СТРУКТУРИ ТА ВЛАСТИВОСТЕЙ СТАЛІ МАРКИ 30MNB5 ВИРОБНИЦТВА ПАТ «ЗАПОРІЖСТАЛЬ»

Pashynskyi V.V.
DSc (Engineering),
Associate Professor, LLC "Technical university "Metinvest polytechnic",
Zaporizhzhia, Ukraine

Пашинський В.В.
д.т.н., доцент,
ТОВ «Технічний університет «Метінвест політехніка»,
м. Запоріжжя, Україна

Tereshchenko A.H.
Engineer of the First Category,
Center for testing and certification of products of PJSC "Zaporizhstal";
master's student (group 132-22-1m),
LLC "Technical university "Metinvest polytechnic",
Zaporizhzhia, Ukraine

Терещенко А.Г.
інженер першої категорії,
Центр з випробувань та атестації продукції комбінату ПАТ «Запоріжсталь»;
магістрант (група 132-22-1м),
ТОВ «Технічний університет «Метінвест політехніка»,
м. Запоріжжя, Україна

Метою даної роботи було дослідження та встановлення можливості отримання необхідних механічних властивостей та твердості сталі