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INFLUENCE OF STEEL MODIFICATION ALLIED WITH 4-7%Si ON MACROSTRUCTURE

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ABSTRACT

The goal of this paper is to test the effect of odification process of liquid steel with 4-7% silicon content, in the course of pouring out from steel-smelting furnace into ladlet, on macrostructure. The research settled down that the mofification has a strong influence fulfilling a stressed refining of macrostructure.

KEYWORDS: modification, silicon steel, macrostructure

1. Introduction

The coarse grain of metallic materials means a negative factor for whole technological process of obtaining of finished products, this influencing both casting and semi-finished working. Actually, the favourable structure is the fineness structure with homogeneous distribution of all phases. The obligation,of the foundry departments consist in to obtain fineness pieces providing for made good technological properties and strength features associated to plasticity features. But, as industry, specially, at the solidifying of large weight metals, practically, never an ideal structure is obtained.

Relative to steels, naturally, without other technological interventions, the solidifying develops that a coarse, dendritic, heterogeneous structure being obtained. The phenomenon is amplified on high silicon content steels. The research done on the world plane carry on the silicon steel allied with 6.5% classically elaborated and cast is characterized by a very powerful transcrystallization, the area of columnar grains occupying complete section of cake ingot. These steels are characterized by a marked brittleness and cannot be rewardingly plastic deformed.

The operated tests consisted in the change of this natural trend of solidifying by adding of exogen crystal nuclei, phenomenon being as modification.

2. Experimental tests

The tests have been made in laboratory. Steels manufacture has been made in induction acid furnace of 50 kg capacity, metallic charge being consisted in silicon-steel sheet with the following chemical composition: 0.01 %C; 1.98%Si; 0.18%Mn; 0.045%P; 0.010%S; 0.01%Cr; 0.04%Ni; 0.03%Mo; 0.13%W; 0.01%V; 0.29%Al; 0.01%Ti; 0.05%Cu; 0.03%Ni. Alloying has been fulfilled by means of FeSi. After melting, steel has been poured out in a redness ladlet. During the pouring out from furnace into ladlet, into the stream of liquid metal an inoculant in proportion of 2% from liquid mass.

As inoculant, preheated,clean, metallic spherical bits, shots, respectively, oxides traceless with the diameter of 1-2mm. The shots characteristics are according to STAS 7482-86. Melting has been made into diameter bars of 50 mm and 80 mm, with and without modification. Chemical composition are listed in Table 1.

Table 1. Chemical composition of cast steels

Chemical composition, %	**Nr. of charge/ Nr. of sample**			
	1 / 1	1 / 1m	2 / 2	2 / 2m
C	0,11	0,11	0,12	0,12
Mn	1,27	1,27	1,35	1,35
Si	4,48	4,48	7,01	7,01
S	0,01	0,01	0,01	0,01
P	0,07	0,07	0,07	0,07
Cr	0,05	0,05	0,05	0,05
Ni	0,04	0,04	0,04	0,04
Cu	0,05	0,05	0,05	0,05
Mo	0,03	0,03	0,03	0,03
Al	0,32	0,32	0,26	0,26

The following samples have been taken:
* from charge 1
- sample 1(from unmodified steel)- Φ80*70
- sample 1 m (from modified steel)- Φ80*70
* from charge 2
- sample 2 (from unmodified steel) – Φ50*70
- sample 2 m (from unmodified steel) - Φ50*70

The obtained samples have been processed to study their macrostructure. Their process has consisted in:

- restriking
- polishing
- HCl solution pickling at 800C, from 20..30min;
- introducing into ammonium persulphate (10%), for5 min;
- cold washing;
- air jet drying.

3. Obtained results

The inoculant influence of liquid steel on macrostructure is powerful. In the case of unmodified steel the macrostructure consists in globular and columnar grains areas (fig.1 and fig. 2): cracks are performed.

Fig.1. *Unmodified steel macrostructure with 4%Si. Columnar crystals area is highlighted*

Fig.2. *Unmodified steel macrostructure with 7.07%Si. Columnar crystals area is seen. Also, cracks are observed.*

Modified structure steel consists in very high fine globular grains area and very high fine equiaxed presents in all sample section. It is highlighted that the columnar crystals completely came out (fig. 3 and fig. 4).

Fig.3. *Modified steel macrostructure with 4.48%Si. Columnar crystals are not found*

Fig.4*. Modified steel macrostructure with 7.07 %Si. It is noticed that the columnar crystals and cracks are not seen.*

4.Conclusions

The paper followed avoiding transcrystallization of steel cake ingot with high content of silicon. To achieve this goal by made modification tests, the obtaining of semi-finished product improved as structural as structural form. By introducing of exogenous crystal nuclei carried out the columnar dimension reduction crystals, which stimulates the marked reduction hypothesis of brittleness and plasticity improvement.

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