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Production Practice Research of Carbon Increasing in Liquid Steel

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Abstract. According to ULCS production practice in domestic steel, sampling the carbon content of inspection RH, tundish and slab, analysis related raw materials impact carbon increasing in liquid steel, and put forward some corresponding control measures. The impact of carbon increasing for liquid steel by the raw and supplemental materials from big to small in turn as follows: mold flux, coverture, refractory, reduce the original carbon content of the raw and supplemental materials, and some oxidant such as MnO2 are added in the mold flux can effectively reduce carburization.

Introduction

Ultra-low carbon, micro-alloyed and steel pure are the main features of ultra-low carbon steel (carbon content less than 0.005% (w))[1]. It also determines its excellent cold-rolled, plasticity, ultra-low carbon steel has a vital role for the automotive industry to improve the level of production.

All along, the mill by selecting the appropriate packing materials, flux control, the carbonaceous material in the package covering agent associated ratio, stable operation of the continuous casting process, reduce the impact of fluctuations on the surface of the molten steel by carbon, carbon steel was achieved by not more than 3ppm proportion of about 73%. But raw materials related to the degree of influence on the increase of carbon steel was unclear, unstable increase the amount of carbon, which greatly affected the ultra low carbon steels to improve overall quality.

Carbon has significant impact on the performance of ultra-low carbon steel, and mainly from the increase in carbon mold fluxes of carbon[2], control the speed and structure of fluxes melting is essential, because as part of its skeleton particles carbonaceous material into the molten steel, will cause the liquid crystal to increase carbon steel, casting quality deterioration[3]. After tapping, the steel surface plus a certain amount of insulation covering agent can prevent secondary oxidation of molten steel[4]. The package covering agent of carbon with a small number of liquid droplets into the slag layer, most of which will form a layer enriched in carbon, carbon-rich layer and the liquid slag will cause carbon liquid steel by carbon[5]. At the same time, carbon composite refractory material generally contains carbon from 3% to 30%[6], which will also increase carbon liquid steel. Thus, carbon problem ultra low carbon steel is urgently resolve the issue by domestic and international metallurgical industry.

To further enhance the quality of ultra-low carbon steel and ascertain the extent of the relevant raw materials for steel liquid steel by carbon, combined with the actual production of

the mill, in order to test for the MA steel steel, the chemical composition shown in Table 1, the test process contain the KB-smelting-RH-CC, ladle capacity of 150t, tundish capacity of 20t, 200mm (1020~1320) mm slab, end point [C] ≤0.020%,cast take a six-furnace steel mills statistical analysis of the January 2012 to July MA steel production data, the corresponding increase in carbon control measures to improve the stability of ultra-low carbon steel by carbon.

Table 1. Chemical composition of MA/%.

Element	C	Si	Mn	P	S	Als	N
Content	≤0.005	0.007~0.012	0.07~0.15	≤0.025	≤0.025	≤0.035	≤0.002

Experimental Analysis and Results Discussion

The Different between RH end Carbon and the Carbon Content of Packets.

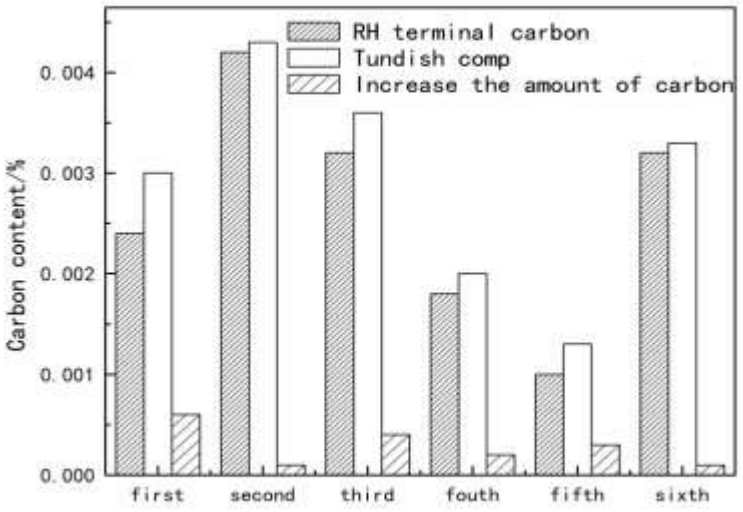

Figure 1. Carbon content differences between RH ending and tundish/%.

Table 2. Chemical composition of tundish powder w_B/%.

chemical composition	CaO	MgO	SiO_2	Al_2O_3	C	Fe_2O_3	H_2O
content	≥40	≥10	≤30	≤10	≤0.05	≤5	≤1.0

Choose a steel furnace steel six ultra-low carbon steel MA pouring a second, the use of lift-like Sampler RH end, tundish 10 sample group, the carbon content is detected and averaged, as it shown in Figure 1, as can be seen from Figure 1, RH refining end to the

middle of the pack, the first furnace increasing carbon content of up to 6ppm, a smaller increase in the next few furnace carbon. RH refining end to the tundish by carbon factors and conclusions are as below.

The reason to increase carbon from the end of the RH refining to tundish:

(1) Consume a lot of covering agents, basically into the molten steel, the first open casting furnace cover agent consumption 150 ~ 250kg, causing serious head heats by carbon;

(2) During operation, the liquid level of tundish is too low failed to meet process requirements, increasing the possibility of slag entrapment. Production scheduling and other causes of the continuous casting of molten steel can not keep up, leading to the tundish level is too low, which greatly increases the possibility of covering agent involved in the vortex of molten steel caused by carbon;

(3) Liquid steel temperature fluctuations, increasing the likelihood of covering agent involvement. When changing bag when emptying the ladle, ladle into the tundish water temperature is low, the next packet open casting, molten steel temperature rises rapidly, within the tundish down the formation of the temperature difference, convection, caused by fluctuations in the level of the tundish;

(4) Change package open casting, the molten steel tundish level the impact is relatively large, resulting in large fluctuations in the level, which also increases the possibility of covering agent involvement. Wave phenomena can be verified by mold level fluctuation;

(5) Behind several furnaces, operations, and other steel surface gradually stabilized, by a smaller amount of carbon.

To sum up,covering agent carbon is caused by carbon Tundish and carburizing the underlying causes.

Tundish Sample and Blank Sample Carbon Content Difference

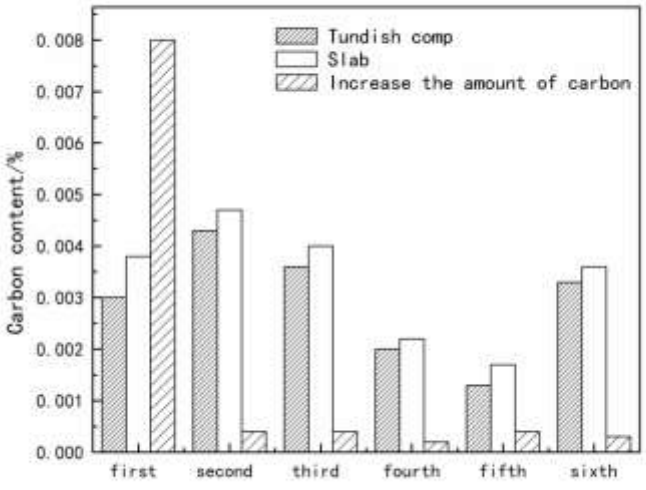

Figure 2. Carbon content differences between tundish and casting/%.

As can be seen from Figure 2, the tundish to the slab, first carburizing furnace to 8ppm. Second stoves, third furnaces, four furnace, furnace five, six normal carburizing furnace.

Carbon steel by the continuous casting process is due to molten steel caused by contact with the carbonaceous material.Continuous casting process carbonaceous material sources are:

Mold carbon residue;

After the immersion nozzle and the stopper and stopper carbonaceous nozzle erosion, can be solidified shell is formed on the carbon lumps, bond;

Adhered to the stopper and carbonaceous aggregates immersed within SEN within the stopper when the argon gas pressure exceeds a certain value, these aggregates may be washed away by the molten steel, the molten steel in contact with the mold.

Wherein (2), (3) by improving the outlet, material and casting process so that the stopper is improved.From the middle of the pack to the slab, poured the same time the first furnace by carbon is the most serious, the main source of carbon is increased and protective covering slag.

Differences between Tundish and Mold Increase the Amount of Carbon

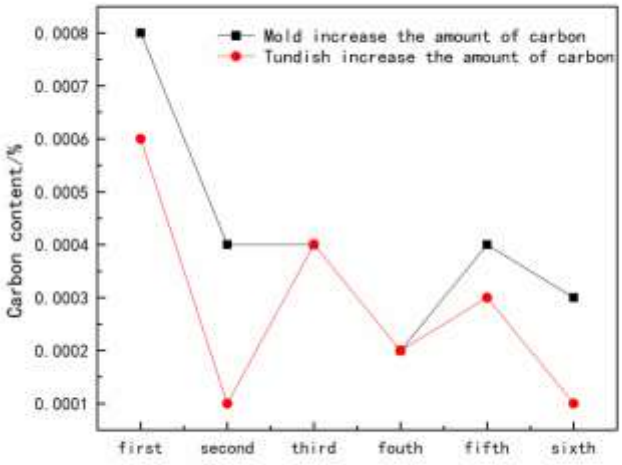

Figure 3. Carbonization of tundish and mold/%.

As is apparent from Figure 3, mold growth was significantly higher than the carbon carbon tundish, the key factor in the protection against contamination of liquid steel slag is ultra low carbon steel successful operation[7], compared to the mold powder for tundish covering flux of molten steel have a stronger effect by carbon, mold powder is the most important factor ultra-low carbon steel by carbon.

Conclusion

(1) Through the steel-related raw materials (powder, cover agent, refractories) increase carbon survey, a large amount of frequency of use, high carbon content of the powder, coating agent by carbon steel was much greater than on the use of multiple heats, the structure of dense refractories.

(2) Due to the presence of flux is much higher than the original carbon content of the carbon-rich layer, and easy-liquid contact with the steel, increasing its impact on the carbon

steel is greater than the liquid coating agent, thus, an important consideration for the protection of the slag of molten steel by carbon.

(3) Reduce the associated raw materials (powder, cover agent, refractories) the carbon content of the original while adding a certain amount of oxidizing agent such as MnO_2 in powder, it can significantly reduce the liquid steel by carbon.

(4) Ultra-low carbon steel by carbon is influenced by original materials and operating processes, and other factors.

Acknowledgement

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