Desulfurization of Pipeline Steel by Blended Mix Addition in RH Degasser

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ABSTRACT The experiments of deep desufurization for pipeline steel in 300 t RH degasser at Baosteel were carried out by blended mix addition from overhead bin system of RH equipment. The results showed that the average desulfurization ratio of liquid steel in RH process reached 50%, and the average sulphur content in molten steel could be reduced from 0.0030% to 0.0015%, the minimum could reached 0.0007%. The present results were also compared with the desufurization of molten steel in LF, VD and KIP process.
KEYWORDS Desulfurization, molten slag, RH degasser, pipeline steel

1 INTRODUCTION

In recent years, steel products have been demanded to meet quality requirement of ever increasing severity. The sulphur content in pipeline steel has great effect on the properties of the steel, it should be reduced to less than 0.0020%, better less than 0.0010%. So special processing technology is required from hot metal pretreatment and steelmaking modules to refining processes.

The No.1 RH degasser at Baosteel has the function of heating by oxygen blowing (RH-OB) for the production of ultra low carbon steel, it is utilized for decarbonization, deoxidation, dehydrogen, the composition and temperature control in view of ease of operation and capability of volume production, it has not been equipped with a powder injection lance so far. Desulfurization by blended mix addition from overhead bin system of RH equipment was expanded to meet the requirement of ultra low sulphur steel in the present study. The characteristics of this desulfurization method are high productivity and low cost of equipment due to that there is no need for another desulfurization process, the increase of the degassing time at RH and the drop in temperature by the addition of blended mix desulfurization agents are little. Furthermore, the increase in nitrogen and hydrogen during desulfurization treatment by this method is negligible compared with the LF and powder injection process.

2 EXPERIMENTAL PROCESS & RESULTS

Based on the literature study [1-3], a lot of laboratory-scale experiments were carried out to get the excellent desulfurizer which not only has satisfied desulfurization capacity and liquidation, but also has less erosion to the snorkels of RH degasser. The final addition for industrial experiment contained CaO, CaF_2, MgO, etc.

Fig. 1 demonstrated the experimental process of this desulfurization method. The ladle slag must have and keep a high basicity and a low oxygen potential to get good desulfurization effect, so during the tapping of molten steel from BOF, the slag cut is very important to reduce the oxygen slag to enter the ladle. 3-5 kg/t of lime are poured into the ladle to increase the basicity of the top slag and slag deoxidation is to reduce the iron oxide of the top slag by Al and other reducers [4] as follow:

$$(FeO)+Al=(Al_2O_3)+Fe$$

With the slag deoxidation and the addition of lime to the top slag, the basicity and the T-Fe content in the top slag could reach 3-5 and less than 3% respectively.

Fig. 2 demonstrated the desulfurization ratio of pipeline steel at RH degasser. It was showed that average 50% of the desulphurization ratio was achieved. The sulphur content in molten steel could be reduced from 0.0030% to 0.0015% averagely by this desulfurization method in RH process, and the minimum could reached 0.0007%.

3 DISCUSSION

The desulfurization effect of molten steel in RH degasser was determined mainly by the oxygen potential of ladle slag. Fig. 3 shows the relation between (S)/[S] and (%FeO+%MnO) in the end of RH treatment. It was clear that the sulphur distribution between slag and molten steel ((S)/[S]) decreased with the increase of the oxygen potential of the top slag in RH process. So before desulfurization, the deoxidation of the top slag was required to reduce the iron oxide and manganese oxide. The de-oxidation of the molten steel before desulfurization was also required, otherwise resulfurization would occur as follow:

$$(CaS)+[O]=[S]+(CaO)$$

So the desulfurization operation should be done after the ladle slag deoxidation and the deep de-oxidation of the molten steel.

Tab. 1 shows the desulfurization results for different refining processes. Compared with the KIP and LF process, the desulfurization ratio of RH degasser was little less than those of LF and KIP process. The capacity cofficience(K_s)[1,3] of RH process was close to that of LF process.

4 CONCLUSIONS

The desulfurization function was developed for No.1 RH degasser at Baosteel by blended mix addition from overhead bin system. The experimental results showed that the sulphur content in pipeline steel could be reduced averagely from 0.0030% to 0.0015%, the minimum sulphur reached 0.0007% and the average desulfurization ratio in RH process reached 50%. The desulfurization effect of this method was close to those of LF, VD and KIP processes and it made possible the mass production of low sulphur steel in the present condition of No.1 RH at Baosteel.

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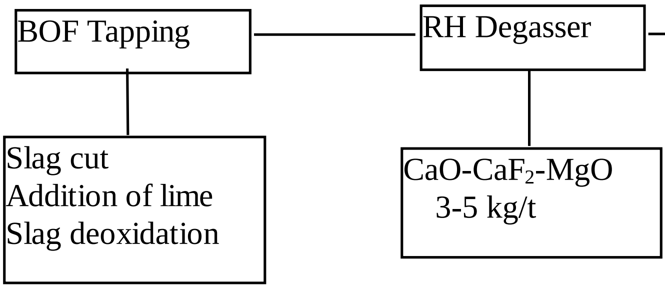
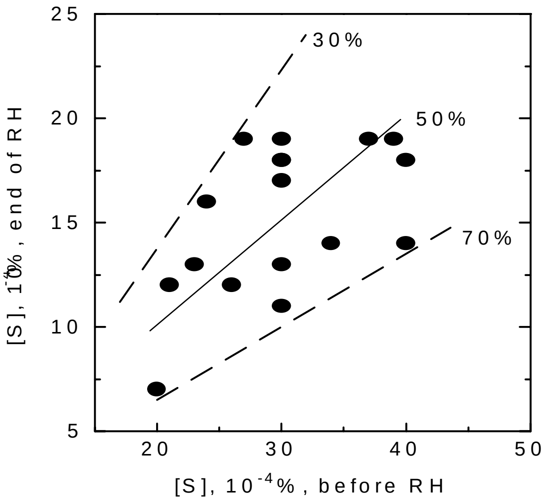


Fig.1: Experimental process of desulfurization in RH degasser



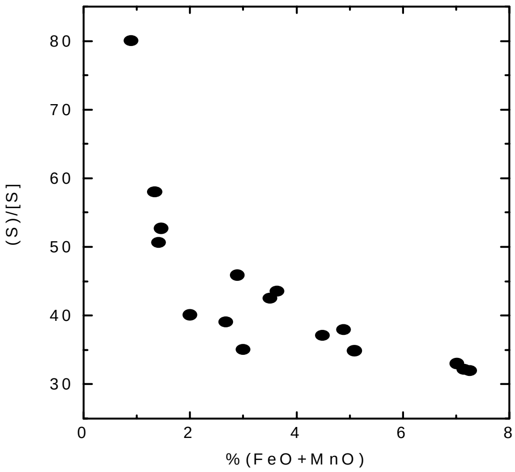


Fig.2: The desulfurization results in RH

Fig.3: Relation between (S)/[S] and degasser oxygen potential of top slag

Tab. 1 Comparision of desulfurization results of different refining processes

	LF[5]	VD[5]	KIP	RH
Initial [S], 10^{-4}%	108	44	40.7	30.1
Final [S], 10^{-4}%	44	27	17.7	15.1
Desulfurization ratio,%	59.3	38.6	56.5	50.0
K_s, min^{-1}	0.02-0.05	0.02-0.04	0.06-0.10	0.02-0.06