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USE OF "FLUID COKE" FOR RECARBURIZING MOLTEN IRON

by

R. K. BUHR

PHYSICAL METALLURGY DIVISION

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SUMMARY OF RESULTS

"Fluid coke", a dense material of high fixed carbon content, was injected into molten iron to determine the suitability of this material for recarburization.

Although the recoveries were not exceptional in these small heat trials, they were similar to those obtained with Gilsonite coke, which is currently being successfully used in industry. It was felt, therefore, that the results were sufficiently encouraging to warrant further testing on a commercial scale.

* Head, Foundry Section, Physical Metallurgy Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada

INTRODUCTION

"Fluid coke" is a by-product of a process being developed by Shawinigan Chemicals Limited, Shawinigan Falls, P.Q. It is a dense, uniformly sized material and has a high fixed carbon content. The Physical Metallurgy Division was requested to carry out tests designed to determine the suitability of this material for the recarburization of molten iron. Shawinigan Chemicals arranged to supply the necessary materials for the proposed test program.

EXPERIMENTAL PROCEDURE

A basic charge, calculated to melt in at about 3% C was used for the tests. The charge was made up from a combination of F-1 and D-1 Sorelmetal because Quebec Iron and Titanium Corp. (Q.I.T.), producers of Sorelmetal, carry out considerable recarburization of their irons. All injection tests were carried out on 500 lb heats produced in a 250 kVA direct arc, basic-lined furnace. The injection temperature was 1500°C (2730°F).

Gilsonite coke, the normal recarburizing material used at Q.I.T., was also injected in a number of tests for comparison. Five pounds of either material was injected into each heat using nitrogen as a carrier gas. This allowed four tests to be carried out using the 20 lb of fluid coke supplied. The effect of a lower melt in carbon content was checked in single heats for each of the two materials.

RESULTS

The available data for both the Gilsonite and fluid coke are listed in Table 1, while the composition of the F-1 and D-1 Sorelmetal supplied is given in Table 2. Table 3 lists the pertinent data obtained from the heats produced for the tests.

TABLE 1

Data Available for Gilsonite Coke and for Fluid Coke

	Gilsonite	Fluid Coke
Fixed Carbon - (wt %)	97.2	98.6
Ash - (wt %)	1.0	1.29
Volatile Matter, by diff. - (wt %)	1.8	0.11
Screen Distribution		
+12 %	3.2	--
20 %	31.1	0.10
30 %	30.5	9.60
40 %	15.2	38.2
50 %	11.8	36.8
70 %	6.0	13.3
100 %	1.7	1.8
140 %	0.24	0.3
200 %	0.10	0.2
270 %	0.10	Tr.
Pan %	Tr.	Tr.

TABLE 2

Composition of F-1 and D-1 Sorelmetal Used in all Tests

Element, %	F-1	D-1
Carbon	4.26	2.42
Silicon	0.070	0.075
Manganese	0.009	0.009
Sulphur	0.015	0.025
Phosphorous	0.025	0.025

TABLE 3

Composition of F-1 and D-1 Sorelmetal Used in all Tests

Heat No.	Material Injected	Injection Temp - °C		Cubic Feet N_2	Inject Time Sec	% Carbon			% Recovery	
		Before	After			Initial	After Injection	Final	After Injection	Final
A2320	Gil.	1500	1425	13.0	55	3.30	3.49	3.53	18.5	22.6
A2331	"	1510	1420	14.3	112	3.16	3.54	3.59	39.1	42.1
A2353	"	1490	1420	12.1	60	3.00	3.35	3.63	35.0	64.7
A2313	"	1500	1450	--	57	2.43	3.32	3.26	86.5	81.0
A2337	Fl. Coke	1515	1450	6.6	44	3.10	3.51	3.60	40.6	48.7
A2344	"	1500	1435	13.2	50	3.08	3.50	3.58	39.6	46.8
A2346	"	1500	1420	5.5	59	3.09	3.55	3.74	44.5	63.0
A2349	"	1490	1395	8.25	65	2.39	2.89	3.03	47.8	61.0

DISCUSSION

The recoveries obtained for either material were not as good as those obtained commercially. Three factors, which are believed to have contributed to these low values, are:

1. The maximum bath depth in the furnace was only about six inches. Thus, the ferrostatic head was much lower than in commercial practice, with a consequent reduction in efficiency.

2. The temperature losses encountered in these tests were much higher than in commercial operations due to both the relatively small weight of metal and to the high nitrogen dilution required with the equipment available in order to prolong the injection time of the small charge beyond thirty seconds (ranging from 1.1 to 2.9 cu ft N_2/lb of solid). The longer time was considered necessary to allow more time for reaction.

3. In the commercial operation, Q.I.T. normally start from a lower initial carbon content of around 2-1/4%. As shown by the results from heats A2313 and A2349, the recoveries are much better under such conditions.

These limited tests indicate a generally slower rate of adsorption of the carbon into the molten iron when the fluid coke is used. This is based on the larger differences between recoveries for the "final" and "after" injection carbon contents for the fluid coke than for the Gilsonite. Whether or not this is significant can only be verified by larger-scale and more numerous tests.

CONCLUSIONS

1. These few tests indicate little difference between the Gilsonite and fluid coke with respect to their potential as recarburizers. Since Gilsonite coke is used successfully in industry, it would be reasonable to expect the fluid coke to be successful as well.

2. Fluid coke might be more suitable from the standpoints of size uniformity, lack of dust, and flowability.

3. It is felt that these tests are sufficiently encouraging to warrant commercial testing.

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