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Development of Hybrid Bio-cokes for Cast Iron Melting and Establishment of Cupola Operation Method

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To produce bio-coke from apple pomace as a raw material as fuel instead of purpose of coal coke, technology was studied. When the moisture content of the apple pomace decreased, the compression strength of the biocoke was increased. When compounding added limestone to apple pomace, bio-coke indicated more than 15 MPa of compression strength. It was to increase the formation temperature of the bio-coke to 423K from 403K and increased in the compression strength. The compression strength was more excellent than coal cokes. Hybrid bio-cokes for casts have been developed. After cast iron was melted by 0.7t/hr, 2t/hr and 6t/hr cupola using these bio-coke, operation method of the cupola by which temperature change and a chemical composition change become little was established.

Keywords: *Cast Iron, B*io-coke,, *Cupola*、 *Bentonite* 、

1. Introduction

Because the temperature in a furnace will be high temperature when coal cokes burn, coal cokes are used for cupola at present. The sulfur content of the coal cokes is becoming a lot recently. Coal cokes are becoming expensive.

CO_2 gas is discharged by fossil-fuel consumption of coal cokes, so we have to reduce greenhouse effect gas for a global environmental problem.

Bio-cokes is the solid fuel which can be formed out of a plant caused by photosynthesis. In case of photosynthesis, a plant absorbs carbon dioxide in the atmosphere. When burning this plant as fuel, the amount of released CO_2 will be the same amount as absorbed CO_2 gas by photosynthesis. In other words, it's possible to think as carbon neutral. Bio-cokes is watched as the substitution material of the coal cokes from such background.

Bio-cokes are primary made up of photosynthetic plant matter. Bio- cokes are the solid fuel of the domestic product with fixed calorific power, and the price becomes stable. Bio-coke does not produce harmful sulfides.

In this research, bio-cokes were made using bio-cokes production equipment of cokes made from the various biomass. The mechanical property of the made bio-cokes was investigated. Melting test was performed by a cupola as fuel of obtained bio-cokes.

2. Experimental procedure

2-1 Production of bio-cokes

Fig.1 shows a bio-cokes production equipment. The marc of apple, the chaff and the rice straw were made a raw material of the biomass. The drying time, crush time were changed every raw material. The formation pressure was changed from 20 in 30MPa.

The formation temperature was changed from 383K to 423K. Bentonite or slaked lime was added to marc of apple and hybrid biotechnology cokes were made too.

Chemical composition of bio-cokes was analyzed. Compression strength and specific gravity were measured.

Fig.1 Production epuipment

2-2 Melting of bio- cokes by cupola

Extraordinarily small cupola (0.05t/h), a small size cupola (0.7t/h), a medium size cupola (2t/h) and a large cupola (6t/h) were used for melting of cast iron.

Cokes used the bio-cokes made from marc of apple or hybrid bio-cokes. The cokes used for the other of coal cokes changed biotechnology cokes from 0 to 30%.

The temperature of the molten metal from a cupola was measured. A chemical composition of obtained molten metal was analyzed by a spectrometer.

3. Result

3-1 The quality of the bio-cokes

Fig.2 shows a relation between the specific gravity of the bio-cokes and the amount of bentonite. When increasing in the amount of bentonite addition, the specific gravity was increased. This is because the percentage of the bentonite with the large specific gravity becomes a lot more than bio-cokes.

More than 10 MPa of compression strength is needed for bio-cokes for cupolas to stand up to the weight of the metal in the furnace.

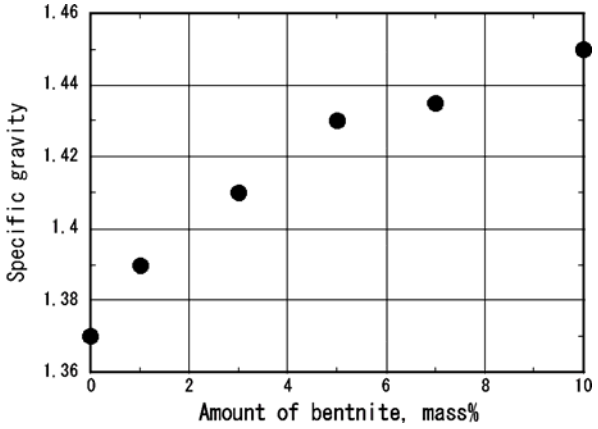

Fig.2 Relation between specific gravity and amount of bentnite

Fig.3 shows a relation between the compression strength of the bio-cokes and the amount of bentonite. Compression strength increases with increasing of amount of bentonite until 3%.

3-2 Melting of bio- cokes by cupola

When using an extraordinarily small cupola and a small cupola for melting test, it was possible to substitute for bio-cokes in 30%.

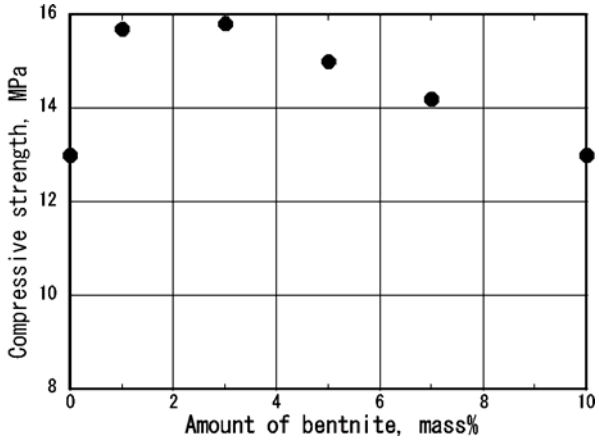

Fig.3 Relation between compressive strength and amount of bentonite

In case of a medium cupola, it could substitute for bio-cokes to 20%. In case of a large cupola, it could substitute for bio-cokes to 15%.

Fig.4 shows a change in chemical composition of molten metal when using a small cupola. Even if it increased in the substitution rate of the biotechnology cokes by operation of a small cupola, there were no big changes in C and Si amount in the molten metal.

When increasing in the substitution rate of the bio-cokes, the amount of sulfur decreased. Even if it increased in the substitution rate of the bio-cokes, the mechanical property did not change compared with 0% bio-cokes.

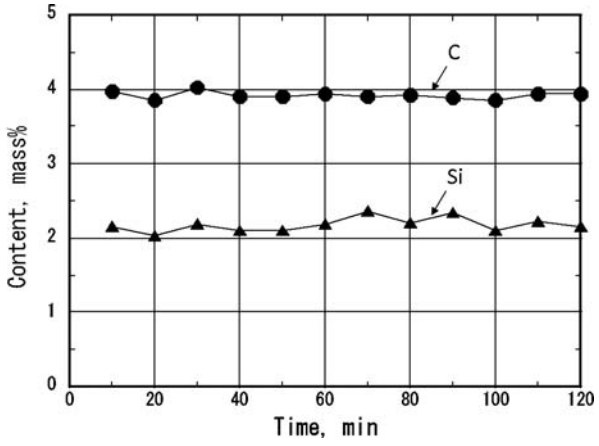

Fig.4 Change in chemical composition of molten metal

4. Conclusion

1) The specific gravity of the bio-cokes is increased by increase of the bentonite amount
2) The compressive strength is increased by increase of the bentonite amount to 3%.
3) It was possible to substitute for bio-cokes in 30%.