POSTER

THE UTILIZATION OF INDONESIAN BRIQUETTED PETROLEUM COKE FOR FOUNDRY

Theresia I. Pudiyanto and S. Nurlatifah

PERTAMINA, Petrochemical and Non Fuel Product R&D Centre
Jalan Raya Bekasi Km 20, Jakarta 13920
INDONESIA

INTRODUCTION

Petroleum coke is produced by one of Pertamina's oil refineries located on Sumatra island. The calcined coke is mainly used for carbon anodes for an aluminium smelter, and the green petroleum coke is considered to have less value. To increase its added value, the green petroleum coke has been used to develop a briquetted petroleum coke.

Briquetted coke comprised of green coke and a binder, is moulded in cylindrical form. Afterwards it proceeds to a baking process in a furnace at 900 - 1100° C to release its moisture and volatile matter and to increase density as well as strength.

The resulting properties fulfil the most requirements for a foundry coke, so this briquetted coke can be used as fuel for melting iron in the cupolas of foundries.

The typical properties of the briquetted coke are as follows : moisture 0.3 % by weight, volatile matter 0.2 %, fixed carbon > 90 %, ash 0.1 %, sulfur < 0.5 %, phosphorus 0.001 %, calorific value > 8000 kcal / kg , and size (dia x height) = 8 x 9 cm.

EXPERIMENTAL

A cupola consisting of a vertical, cylindrical, steel shaft lined with fire clay brick, with a diameter of 450 mm and an effective height of 2000 mm was used to test the quality of the briquetted coke. Four charge ratios with 100 / 20 ; 100 / 16 ; 100 / 12 ; 100 / 10 iron to coke were selected and each ratio was tested in 10 runs with the same iron to coke ratio. A charge, which consists of alternate layers of scrap, coke and lime-stone, is introduced into the cupola through a door near the top. Air that is not preheated is introduced through tuyeres, and the coke bed burns in the blast of air. The generated heat is sufficient to melt the scrap iron which trickles to the base of the cupola. The molten iron trickling over the incandescent coke absorbs small amounts of C as well as S and P. The combustion gases are slightly oxidizing in character and small amounts of Si, Mn, Fe and C are oxidized.

The melting temperatures of iron were monitored and found to be in the range of 1380° C to 1440° C during the experiment. The average tapping temperature was 1420° C and constant during operation. The first molten iron could be poured into the mold after 75 minutes compared to the usual time of 270 with reference materials . The resistance of the briquetted coke to the harsh treatment is good. The oxides of iron, Si, Mn as well as sand, dirt and oxides a ssociated with the charge and the ash of the coke are fused with the lime stone to form the slag which is withdrawn from the tap hole periodically. The visual color of slag was dark green, and its viscosity can be adjusted by adding lime stone. The combustion products, white - grey in color, smokeless and of clear appearance, are emitted from the charge and pass through the stack to the atmosphere. The moulded iron shows properties of FC 10 type and has an average tensile strength of 11.3 kg / mm^2 and hardness 135 HB.

RESULT AND DISCUSSION

The parameters characterizing the performance of briquetted coke in the cupolas are given in table 2 :

Table 1 : Iron To Coke Ratio

Charging Step	Weight Ratio (kg)	
	Iron	Briquetted Coke
I	100	20
II	100	16
III	100	12
IV	100	10

Table 2 : The Performance Of Briquetted Coke In The Cupola

Parameter	Briquetted Coke	Coke Reference
Bed coke consumption (kg)	147.5	150
Incandescent time (hour)	2.5	3
Melting time of iron (minute)	75	270
First tapping to withdraw iron (minute)	100	290
First tapping temperature of iron (° C)	1300	< 1200
Average tapping temperature of iron (° C)	1420	–
Iron to coke ratio	1 : 8 to 1 : 10	1 : 5 to 1 : 6
Resistance to the harsh treatment	Good	Good
Combustion products	White - Grey Smokeless Clear appearance	Smoky and Dusty

The high heating value of the coke contributes to the reduction of coke consumption. The iron to coke ratio can be reduced to 1 : 10 without disturbing the process. Briquetted coke incandesces in a short period of time , and molten iron occurs within 75 minutes . The first tapping of iron can be withdrawn within 100 minutes . For comparison with the reference material , the iron is usually withdrawn after 290 minutes . The average tapping temperature was 1420° C , and it was in the range of usual melt temperature (1370° C to 1600° C).

The average quality of the reference coke is as follows : ash 12 % by weight, volatile matter 2.5 %, sulfur content 0.8 % , fixed carbon 84 - 88 % , calorific value 7200 kcal/kg. The higher ash content of reference coke tends to reduce the fuel value of the coke and increase the coke consumption. The lower calorific value of reference coke prolongs the melting time and tapping of iron. The smoke and dust of the combustion products is caused by the higher ash content of reference coke.

The briquetted coke, with a compressive strength 120 - 150 kg / cm^2 , was able to withstand the harsh treatment it receives in handling , charging and the weight of the charge above it . The environmental effect can be minimized by using this briquetted petroleum coke . The typical moulded iron is FC 10 with compositions : carbon content = 4.04 - 4.11% ; S = 0.17 - 0.21% ; P = 0.12 - 0.33 % ; Mn = 0.34 % .

CONCLUSIONS

The briquetted petroleum coke can be used for melting iron in the cupolas of foundries. The average temperature during tapping of molten iron was greater than for the reference coke. Briquetted coke consumption was less than for reference coke, and operating temperature was higher , therefore it will more effective and efficient.

REFERENCES

1. Falcone J. S., Kirk Orthmer Encyclopedia of Chemical Technology, 3rd ed., John Wiley & Sons. New York, 20, 1982.
2. Van Vlack L. H., translated by Djaprie S., Element of Materials Science and Engineering, 4th ed., Addison Wesley Publishing Co., Michigan, 1980.
3. Practical experience at iron industries located at Ceper, Central Java, Indonesia, 1993.