POSTER

RELATION BETWEEN CTE OF COKES WITH THEIR X—RAY DIFFRACTION MEASUREMENTS

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INTRODUCTION

It is common knowledge that quality of the graphite electrode for electric arc furnace depends to a large extent on characters of the raw material—coke filler. Undoubtedly, it is important for all electrode manufacturers to select suitable cokes in the exact design of electrode tailored to meet specific needs of consumers. Certainly, the routine determination of quality of cokes is also absolutely necessary in order to ensure satisfactory quality of final products.

Many properties of raw materials might be the criterion for the selection of a particular coke for a given application, such as micro and macro structure, strength, desity, sulphur content and CTE.[1] The low CTE is one of the important factor for selecting premium coke for electrode manufacture. The method of measuring the CTE of cokes seem to be a bit overlaborate, having a number of process stages. Besides, the X—ray diffraction is usually used to assess characters of the cokes. By means of analyzing results of experiments, we found that the CTE values have a good correlation with the X—ray diffraction intensities.

EXPERIMENTAL

The experiments were carried out using 7 cokes, among which C, D and E represent petroleum cokes from 3 different origins, F and G are coal-tar pitch cokes, B is a coal-tar pitch needle coke, and A represents a petroleum needle coke, both are imported from Japan. First of all, a given amount of representative sample of each coke are taken, then pulverized, sieved, formulated, kneaded with coal-tar pitch, extruded into rod samples repectively. Afterwards the green rod samples were converted to final test samples by setting them through baking and graphitizing at elevated temperatures.

The CTE values were measured by the dilatometer made in our works, in the temperature range 100～600℃, at a rate 3℃ per minute. X—ray diffractions of calcined and graphitized powder for 7 cokes were carried out in turn by a D/Max-RB X—ray diffractometer made in Japan, copper target, K_α radiation. Table 1 shows the experimental results.

RESULTS AND DISCUSSION

From coke A to G, the diffraction intensities of not only graphitized, but also calcined sample decreased gradually, whereas the CTE values increased successively. The intensity is repressed as counts per second by a counter. It indicated that there should be a relation between CTE values and intensities for these cokes. In fact, if the CTE is plotted versus intensity, we can find that a straight relation exists both for graphitized and calcined samples (Figure 1 and 2). By linear regression, the following empirical correlations were yielded,

$$CTE = 4.62 - 0.01 \times 10^{-2} I \qquad (1)$$

(for graphitized sample)

correlation coefficient=0.97

$$CTE = 4.07 - 0.17 \times 10^{-2} I \qquad (2)$$

(for calcined sample)

correlation coefficient=0.86

Where, I=X-ray diffraction intensity. It is quite evident that both needle cokes with low CTE are ultra-premium raw material for the production of ultra high power (UHP) electrodes. On the other hand, both coal-tar pitch cokes with higher CTE are totally unacceptable for the production of UHP electrodes. Between them lie the other cokes which are useful for the production of regular power electrodes.

CONCLUSIONS

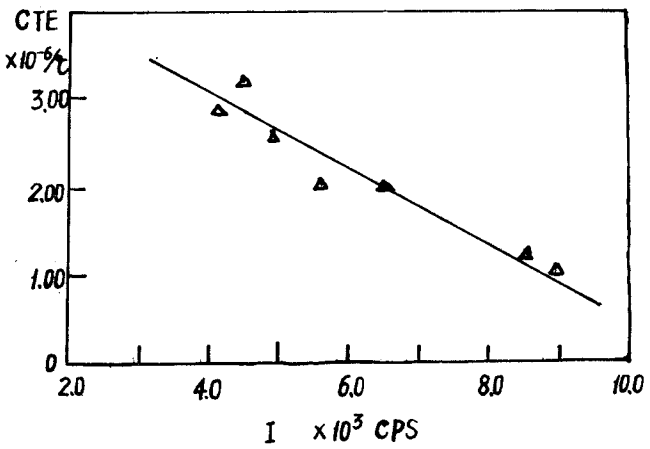
Even through, no one quality of a coke dominates the properties of the electrodes, the CTE of a coke plays a very important role in the acceptance of the coke by the electrode manufacture. The measure of CTE values and X-ray diffraction intensities for 7 cokes shows that the former correlates well with the latter, especially for calcined powder sample. It might enable us to easily evaluate the CTE of the final graphite product by measuring the X-ray diffraction intensity during the calcining coke stage.

REFERENCES

1. Edward A. Heintz, FUEL, Volume 64 No. 9, 1192 (1985).

TABLE 1-Experimental Results

Sample		A	B	C	D	E	F	G
CTE×10⁻⁶/℃		1.075	1.180	1.990	1.980	2.575	3.170	2.900
I(cps)	calcined	1526	1898	1024	934	930	859	823
	graphitized	8907	8696	5719	6663	4970	4506	4168



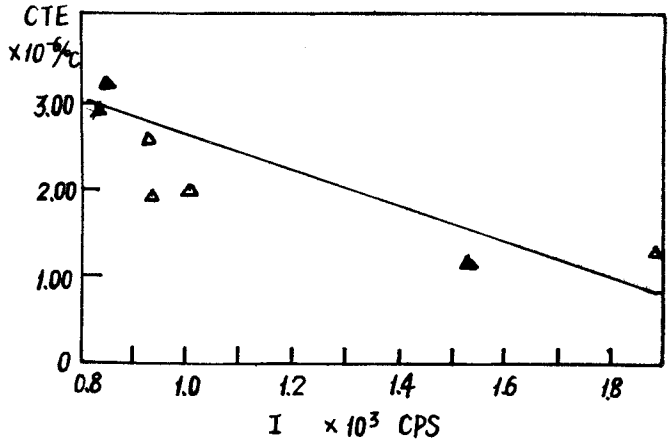


Figure 1 CTE versus the intensity(I) of X-ray diffraction for graphitized powder sample

Figure 2 CTE versus the intensity(I) of X-ray diffraction for calcined powder sample