EVALUATION OF COKER FEEDSTOCKS BY QUANTIFYING THE FINE MOSAIC TEXTURE IN LABORATORY-PRODUCED COKE

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INTRODUCTION

Needle coke, which is a precursor for the graphite electrode for an electric arc furnace, must have a low coefficient of thermal expansion (=CTE). CTE has been recognized to be strongly influenced by the nature of feedstocks. For the lower CTE, it is necessary to develop the flow texture that can be obtained by keeping viscosity of mesophase lower, and by maintaining proper gas evolution during carbonization [1]. At cocarbonization of vacuum residue of low-sulfur crude (=LSVR) and FCC-decant oil (=FCC-DO), the amount of fine mosaic texture in coke can be an index of the homogeneity of the reactions that control the viscosity of mesophase. The authors studied the relationship between the properties of feedstocks and the amount of the fine mosaic texture in carbonized material, which was named FM-parameter, to make clear the mechanism of fine mosaic formation.

EXPERIMENTAL

LSVR and FCC-DO were used as cocarbonization sample in this study. The properties of samples are summarized in Table 1. To study the mechanism of fine mosaic formation, *fa* (=aromaticity measured by ^{1}H-NMR) and hydrogen donating ability [2] of FCC-DO were also measured.

Measurement of FM-parameter

LSVR and FCC-DO were blended 7 to 3 volume ratio. 50 g of blended sample was carbonized at 450℃ -3hrs under atmospheric pressure through the nitrogen flow. The resultant semi-coke with its hemispherically-shaped bottom was sectioned parallel to the tube axis to take photographs of anisotropic texture under polarized light microscope, after conventional polishing. A montage of the sectioned surface was prepared to measure the amount of fine mosaic texture sedimented in the bottom of the tube. FM-parameter is a proportion of fine mosaic texture's area in whole area of a montage.

RESULTS AND DISCUSSION

Figure 1 shows the relationship between FM-parameter and CTE of lab-scale coke. These factors are well correlated; therefore FM-parameter is a good evaluation factor for the coker-feedstocks. This result also suggests that reduction of fine mosaic texture is useful to lower the CTE.

The relationship between asphaltene content in LSVR and FM-parameter was studied. FM-parameter increases with asphaltene content in LSVR. This result supports the previous study [1] that fine mosaic texture generates from asphaltene micelles as nuclei of mesophase spheres in the early stage of carbonization.

Properties of FCC-DO to reduce the fine mosaic texture were also studied. Figure 2 shows the dependence of the FM-parameter upon the hydrogen donating ability (=HDA) of FCC-DO. FM-parameter decreases with increasing HDA. HDA has been recognized to control the fine mosaic formation at cocarbonization [2,3], but its correlation to the FM-parameter is not very good. It seems too difficult for the one factor to predict the FM-parameter accurately because of complexity of cocarbonization mechanism.

The relationship between FM-parameter and HDA multiplied by *fa* is shown in Figure 3. Its correlation coefficient becomes higher than HDA or *fa* alone. This result suggests that dissolving the asphaltene micelle by poly-condensed aromatic hydrocarbons in FCC-DO contributes to stabilize effectively the free radicals of asphaltene molecules by transferable hydrogen from FCC-DO.

CONCLUSIONS

FM-parameter is not only a good evaluation factor for coker-feedstocks but also a useful tool to study the mechanism of cocarbonization because of its ease of quantitative determination. The mutual solubility of asphaltene micelle and FCC-DO is important for reduction of fine mosaic texture to stabilize effectively the free radicals of asphaltene molecules by transferable hydrogen from FCC-DO.

Table 1 Properties of feedstocks

	Elememtal Analyses (wt%)					Contents of
	C	H	S	N	fa [1]	Asphaltene (wt%)
LSVR	86.9	12.6	0.16	0.27	0.17	12
FCC-DO-1	89.6	9.9	0.37	0.08	0.52	0
FCC-DO-2	89.9	9.6	0.40	0.08	0.55	0
FCC-DO-3	90.5	9.0	0.21	0.23	0.59	0
FCC-DO-4	90.4	9.1	0.28	0.23	0.60	0

[1] Carbon aromaticity according to William method

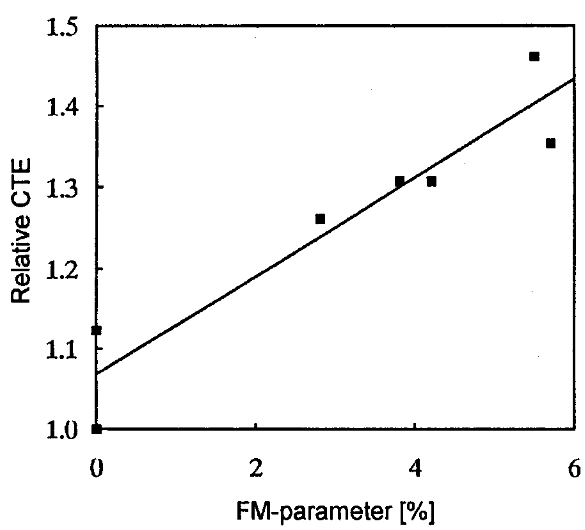

Figure 1 Relationship between CTE and FM-parameter ; CTE values are relative to the lowest CTE in this figure

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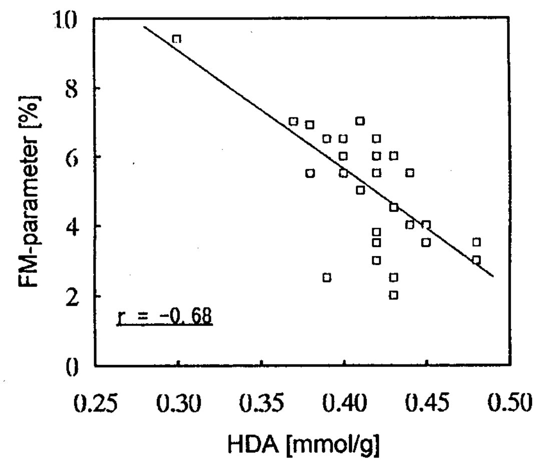

Figure 2 Relationship between FM-parameter and hydrogen donating ability.

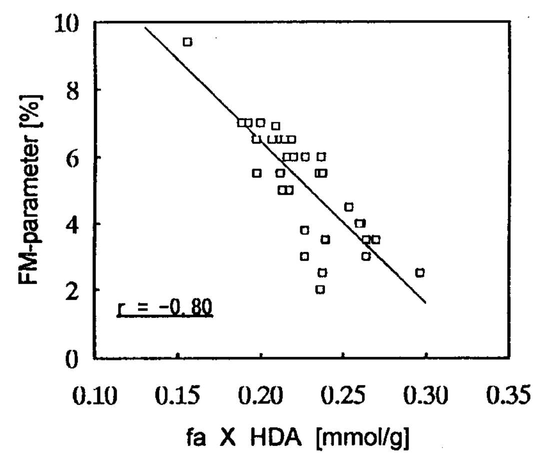

Figure 3 Relationship between FM-parameter and fa X HDA