Evaluation of Petroleum Residues and Pitches as the Needle Coke Feedstock

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Several petroleum residues were carbonized in the tube bomb under pressurized and rapid heating rate conditions to evaluate them as the needle coke feedstock. The quality of the resultant cokes was evaluated by means of optical microscopy, CTE and bulk density measurement in order to correlate it to the structural characteristics of the feedstocks.

INTRODUCTION

It is most deserable to evaluate a feedstock for the needle coke in a small quantity since some trial feedstocks require a large effort to be prepared.

The present authors have reported in a previous paper(1) that the carbonization in a tube bomb could provide a lump coke comparable to a commercial needle coke from the same feedstock.

In the present study, the carbonization properties of several feedstocks a HDS feedstock, and fractions of a feedsotck were examined using a tube bomb. The qualities as a needle coke were observable with a resultant lump coke. The qualities can be correlated to the structural characteristics of the feedstocks.

EXPERIMENTAL

Residues (Five vacuum residues, a HDS residue, two fractions of a residue, and FCC decant oil) used in the present study are listed in Table 1 with some of their analytical data. A sample of about 10g in a glass tube or wrapped with a alminium foil was carbonized in a stainless tube bomb. Detail carbonization procedures have been described in a previous paper(1).

Table 1 Properties of Samples

Sample	KF VR	HDS(KF VR)	Taching VR	Gilsonite	LS_2 VR	FCC DO
SP.GR	1.065	0.9649	0.9169	1.073	0.950	1.003
CCR	52.6	12.9	6.86	16.2	11.2	5.83
TS(wt%)	4.44	1.09	0.16	0.54	0.25	0.71
Vis(cst) at 100°C	–	124.5	70.25	–	120	(79) at 75°C
C	86.3	86.0	86.4	85.2	87.0	89.62
H	7.6	11.4	12.9	9.9	12.0	9.37
H/C	1.06	1.59	1.79	1.39	1.66	1.25
Satu.		23	58	–	44	
Aroma.		53	20	–	27	
Resin		14	19	–	17	
Asph.		10	3	–	12	

Carbonization temperature was fixed at 500 °C and several pressure levels were examined to develop the flow texture in the resultant coke. The lump coke in a tube was evaluated as a needle coke according to a previous paper.

RESULTS

All feedstocks examined in the present study provided lump cokes by the present procedure. The quality of the coke varied very much from a feedstock to another.

The appearance, density and optical texture of the cokes produced from five residues, a HDS residue, a FCC decant oil are summarized in Fig. 1 where the carbonization pressure was fixed at 15K. HDS-KF and the decant oil provided hard and bright cokes of flow texture, which developed uniaxially along the tube axis. Their densities were around 1.0.

LS2 provided a similar coke, however its density was slightly lower. Taching KF-VR provided a porous, coke of elongated mosaic, of which density was as low as 0.68, gilsonite produced a mosaic coke of low density tends the present conditions.

Fig. 2 shows the correlation between the optical texture and carbonization pressure. FCC-DD and the maltene gave needle-like texture at 7 kg, whereas HDS,LS1, LS2 required 15 kg/cm to exhibit the needle-like texture.

The cokes prepared from the maltene and asphaltene of LS residue are also shown in Fig. 1. The maltene produced a coke of similar optical texture to that from LS, however its density was as low as 0.7 probably reflecting its low coking value.

KF VR	HDS (KF VR)	Taching VR	Gilsonite	LS_2VR	maltene (LS_1VR)	asphaltene (LS_1VR)	FCC DO
P*	H*	H	H	H	HB*	P	HB
0.68 g/cm^3	1.01	0.96	0.78	0.96	0.70	0.69	1.20

*H=Hard B=Bright P=Porous

Fig. 1 Optical texture and density of several cokes at 15K.

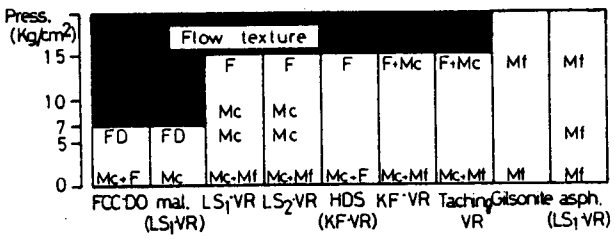

Fig. 2 Influence of carbonization pressure on development of optical texture.

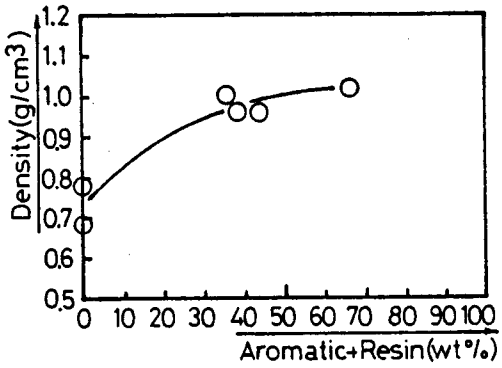

Fig. 3 The correlation of aromatic+resin versus density.

The asphaltene provided a very porous coke of medium mosaic texture. In spite of high coking value of 54 %, the density of the coke was as low as 0.7. Thus, the asphaltene without the maltene fraction lacks of fusibility.

DISCUSSION

The carbonization properties of several feedstocks are properly evaluated by the carbonization in a tube bomb. The carbonization pressure which is variable in the present study is found a key factor to control the coke quality. The quaities of a coke its appearance optical texture, density and CTE are hopefully correlated to the structural characteristics of the feedstocks based on the sound understanding of the carbonization mechanism. Fig. 3 shows a correlation between the density of the coke and the content of aromatic & resin in the feedstock. The fraction may be key substances to control the fusibility during the carbonization.