IMPROVEMENT OF PITCH/COKE INTERACTIONS BY ADDITION OF SURFACE TENSION MODIFIERS

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Introduction

The manufacture of granular carbons requires the use of a filler (e.g., coke) and a binder (e.g., pitch). These two components must interact with each other in such a way that adequate bonding is generated, resulting in structurally sound materials with a high density and good mechanical properties. The ability of the binder to wet the filler surface during the mixing process, generally at a temperature lower than 200 °C, is critical to ensure further good adhesion. The use of petroleum pitch as binder is hindered by its poor capacity to wet the filler particles [1]. This drawback can be overcome by using additives that modify the flow properties, especially pitch viscosity and pitch surface tension.

In this study two different additives were used to improve the wetting behavior of a petroleum pitch. The addition of these additives in various proportions gave rise to two series of pitches. Pitch wetting behavior was examined by means of a spreading drop test, which consisted in measuring the height of a pitch drop positioned on a bed of granular coke.

Experimental

A petroleum pitch (PP-A) and two additives produced in the fine chemical industry (Additive A and Additive B) were used in this study. Additive A was added to the pitch in proportions of 2.5, 5 and 10 wt.% (AA2.5, AA5 and AA10, respectively), while Additive B was added in proportions of 5, 10 and 15 wt.% (AB5, AB10 and AB15, respectively). A conventional binder coal-tar pitch (CTP-1) was used as a reference. The main characteristics of the parent pitches and the additives are summarized in Table 1.

Pitch wetting behavior was determined by a spreading drop test similar to that used in the aluminum industry for the preparation of carbon anodes [2]. In this test, a molded pellet of pitch was placed on a granular bed consisting of calcined petroleum coke sieved to between 100-125 μm. The crucible containing the materials was heated in a horizontal tube furnace in an air-rich atmosphere. Two quartz windows located at each end of the tube enabled the variation of pitch height with temperature to be monitored by means of a video camera.

Table 1. Characteristics of parent pitches and additives.

Sample	Elemental Analysis (wt.%)					SP[1]	TI[2]	QI[3]	CY[4]
	C	H	N	S	O				
CTP-1	93.2	4.2	1.1	0.5	1.0	116	31	9	59
PP-A	93.2	5.7	0.1	0.1	0.9	106	19	0	52
Additive A	54.6	11.5	0.0	0.0	22.8	-	0	0	30
Additive B	80.2	9.0	0.0	0.0	10.8	-	0	0	0

[1] Softening point (Mettler, °C)
[2] Toluene-insoluble content (wt.%)
[3] Quinoline-insoluble content (wt.%)
[4] Carbon yield (Alcan, wt.%)

Results and Discussion

The use of petroleum pitches in fields that traditionally employ coal-tar pitches (i.e., carbon anodes) makes it necessary to process petroleum feedstocks in conditions which ensure that the pitches satisfy certain industrial parameters (e.g., softening point). However, some parameters, such as pitch wettability, frequently need to be readjusted at a later stage of the process.

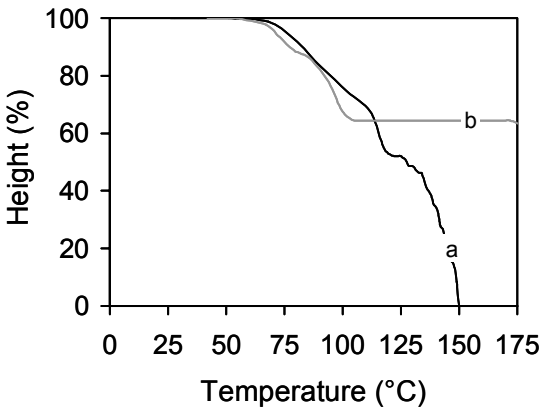

Figure 1. Variation of pitch height with temperature for (a) CTP-1 and (b) PP-A.

Figure 1 illustrates the different wetting behavior of PP-A and a typical binder coal-tar pitch (CTP-1). PP-A is not able to penetrate into the coke bed even at temperatures as high as 200 °C. In order to improve pitch wetting behavior, PP-A was blended with two surface tension modifiers (Additive A and Additive B).

The addition of 5 and 10 wt.% of additive A to PP-A causes a significant improvement in pitch wetting behavior (Figures 2b and 2c), penetration being completed at 144 and 140 °C, respectively. However, the addition of 2.5 wt.% does not produce any relevant change in the wetting curve of PP-A (Figure 2a). This is in agreement with the values of surface tension found for the pitches. Thus, the surface tension is 44-45 din cm^{-1} in PP-A and AA2.5. This value decreases to 38 and 32 din cm^{-1} when the pitch is modified with 5 and 10 wt.% of Additive A.

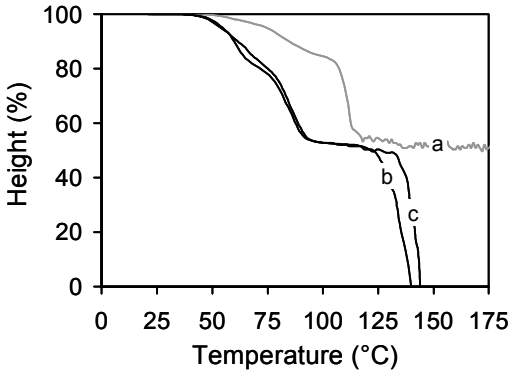

Figure 2. Variation of pitch height with temperature for (a) AA2.5, (b) AA5 and (c) AA10.

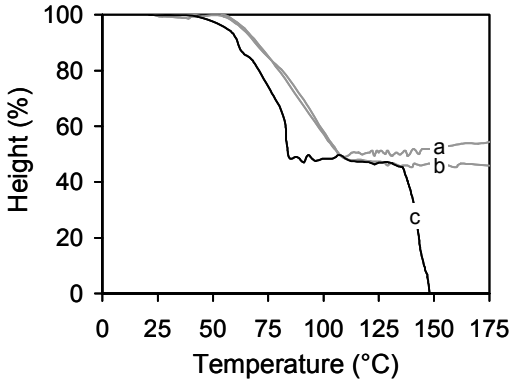

Figure 3. Variation of pitch height with temperature for (a) AB5, (b) AB10 and (c) AB15.

In a similar way, the wetting behavior of PP-A is improved by the addition of Additive B (Figure 3). However, in this case, it is necessary to add 15 wt.% of additive to reverse the wetting capacity of the pitch.

Conclusions

The wetting behavior of a petroleum pitch can easily be modified by the addition of surface tension modifiers. These additives help the pitch to spread and flow through the coke particles by reducing its surface tension.

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