POSTER

ACOUSTIC PROPERTIES OF PITCH-CARBON COMPOSITE

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INTRODUCTION

Coal-tar pitch and pitch-carbon composite (PC) have many structural changes during heating. Structure changes decrease a viscouns and strength of the pitch. The conditions of elastic wave spreading get worse and the acoustic properties of pitch vary in wide range due to this changes. That's why the close correlation between parameters of pitch state and the acoustic wave parameters must exist. For example these acoustic parameters may be the amplitude and velocity of ultrasonic wave.

EXPERIMENTAL

The velocity (V) and amplitude (A) of ultrasonic waves (US) were measured during heating and cooling. Longitudinal US waves (60 kHz) were directed into specimens by means of fused quartz rods. The temperature was measured with an accuracy of 1 °C. The accuracy of velocity measurement US was 1 %, the amplitude was 2 %. The specimens were heated by means of the electric tube furnace.

The pitches had softening temperatures of 69, 92 and 135 °C. The composites contained 75-95 % of petroleum coke with grain size less than 0.071 mm. The composites were pressed under 80 MPa.

RESULTS AND DISCUSSION

The transition of a pitch from solid vitreous state to liquid molten state is accompanied by a decrease of US velocity by 5-10 times, the amplitude by 500-1000 times. Temperature curves of US velocity and amplitude in pitch consists of some sections.

The sections are: elastic (vitreous) state, plastic state and liquid (molten) state (1) on the curve. The lengths, angles of sections, dislocation of its boundaries are highly individual for pitches.

The typical pitches have clear boundaries of the sections on temperature curves.

Temperature US curves become smoother and displace to higher temperatures and bigger US parameters depending on increase of structural condensation (Figure 1).

US parameters in pitch about 20 °C depend on the quality of α-fraction and temperature of the pitch softening.

The addition of 80-95 % coke powder decreases US velocity and amplitude in pitch composites sharply (Figure 2).

The reason of the decrease is a lack of pitch quantity for the formation of binder film on the surface of coke particles. The coke particles are united by individual meniscus which have high level of structure (high activation energy, Table 1).

The approachment temperature boundaries of sections and increase angles show a high cooperative transitions of pitch from one to other physical state. After the pitch content has been reached 20-25 % the US temperature curve in pitch composites approach to the curve of pure pitch. This may be explained the influence of pitch which not connected by the coke surface.

The slight change of the transition temperature in the plastic state (T_1) and the visible influence on the transition

temperature in liquid state (T_2) show that high temperature components interact with the coke surface more than low temperature components.

CONCLUSION

US temperature curves in pitches and its composites are typical for amorphous polymers which may contain three types of transitions as well. However, the origin of temperature transition on the pitch temperature curves are due to the complex pitch molecular structure.

The results of this paper allow to speak of the ultrasonic usefulness for the further investigations of coal-tar pitches as well as pitch-carbon composites.

TABLE 1: Temperature curve parameters boundaries

Pitch content, %	Section 1			Section 2		
	US velocity, m/s	Boundary temperature, °C	Activation energy, kJ/mol	US velocity, m/s	Boundary temperature, °C	Activation energy, kJ/mol
5	780	70	351.0	250	120	1046.0
15	1300	70	85.0	450	140	401.0
25	2400	70	27.5	500	150	259.0
100	2500	70	7.5	250	150	189.0

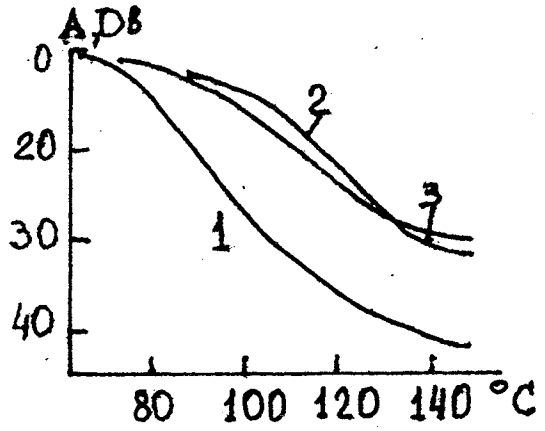

FIGURE 1: US amplitude - temperature curves of pitches: 1, 2 - pitch softening temperature 69 °C, 3 - 135 °C (1 - initial state, 2 - after exposure at 170 °C)

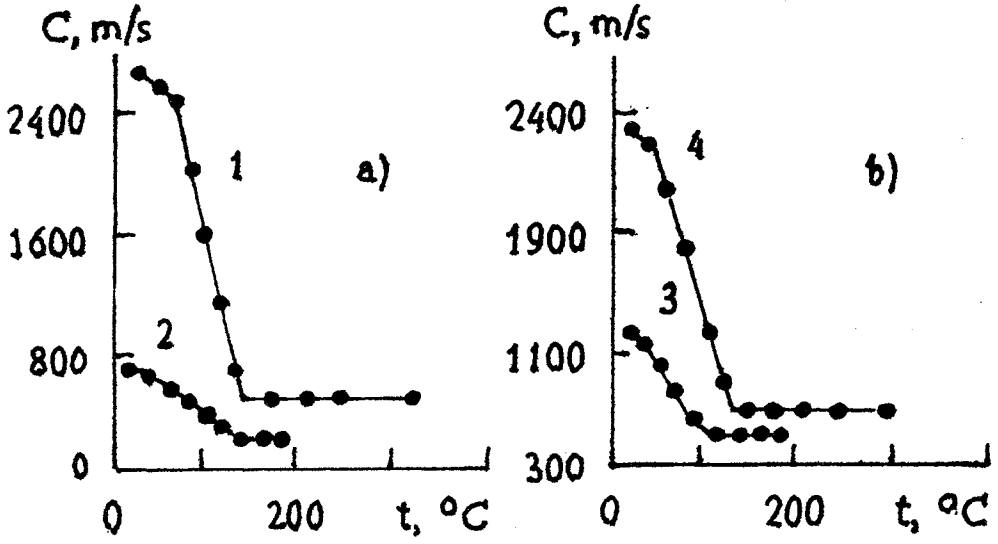

FIGURE 2: US velocity - temperature curves of pitch and composites: 1 - 100 %, 2 - 5 %, 3 - 15 %, 4 - 25 % pitch component

REFERENCES

1. J. D. Ferry, "Viscoelastic properties of polymers", New-York/London, 1961.