STUDIES INTO BITUMENS PENETRATION AND TEMPERATURE AS FUNCTIONS OF TIME

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Bitumens can be considered as dispersion or colloidal systems, or solutions of high molecular components. However, in the course of time, bitumen can be affected by deformations similar to those characteristic of visco-elastic materials.

According to the accepted views, this structure consists of a frame of asphaltenes that form spatial grids within the petroleum structures. This ability of bitumens to form structures can increase the number of asphaltenes in the system, which leads to transition into a more viscous state [1].

The effect of stress on bitumens characteristics hasn't been completely studied. When performance characteristics are measured using standard methods [2], the results are not accurate because of deformation.

The purpose of the research was to develop a method for determining a time-penetration dependence for bitumens.

Experiments

In our research we compared bitumens of equal penetration, but of different types. Two types of bitumens were studied: oxidized and residual. The residual bitumens were Ninas bitumens of the Akzo Nobele Company and the oxidized bitumens were from the Lisichansk plant. Their penetration was determined using two methods: that of a sharp-point needle (a standard method) and that of a blunt-point needle (the method of our research). For measuring penetration we used standard and cylindrical needles. The needles were 100 mm long and 1 mm in diameter. The process of measurement was recorded by a Web-camera.

The following stage of the research included studies into the dynamics of the ball penetration into bitumen at a fixed temperature. As a comparative structure, bitumens containing 3% of SBS 1101 polymer were added.

The results of the experiments are listed in Table 1. They show the dynamics of the ball penetration into Lisichansk and Ninas bitumens of the grades 90/130; 60/90 i 90/130 containing 3% of SBS 1101 polymer. The data were obtained at the temperature of 45 degrees Celsius.

Discussion of the results

The results of the experiments can be interpreted as follows:

1) at all stages of the ball penetration into the bitumen there is a noticeable difference in the data for bitumens of different viscosity. It is true for both residual and oxidized bitumens;

2) a similar difference can be observed in the speeds of the ball penetration into the bitumens.

It means that there is no need to measure indices of penetration and softening temperature in order to determine the performance characteristics of bitumens. It is more rational to assess their stress resistance.

Table 1

Experimental data obtained at 45 ℃

Fluidity parameters	Experi-mental tempe-rature	Bitumens					
		NB 2	**NB 3**	**NB 3 P3**	**LB 2**	**LB 3**	**LB 3 P3**
Penetration at 25°C		79	118	77	75	105	57
Softening temperature according to ISO		48,4	42,3	52,6	50,4	48,0	57,2
Softening temperature according to the standard method		45,4	40,4	50,6	50,3	46,1	56,6
Penetration time, sec.: upper boundary	45 °C	20	8	45	30	5	60
lower boundary	45 °C	47	28	134	64	23	160
control plate	45 °C	97	61	240	90	40	270
Penetration speed, mm/sec : first section	45 °C	0,23	0,58	0,103	0,15	0,93	0,077
second section	45 °C	0,01	0,17	0,035	0,072	0,20	0,029
third section	45 °C	0,048	0,076	0,019	0,051	0,12	0,017

Conclusion

Our research has made it possible to arrive at the following conclusion:

1) Measurements with the use of the standard (sharp) needle produce errors within the first few seconds of penetration, and this information is important for high viscosity bitumen.

2) Penetration data obtained with the use of the cylindrical needle more accurately reflect the true state of bitumen from the starting point to the full length of penetration.

References

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PROBLEMS OF URBANIZATION IN THE CONTEXT OF UKRAINE'S NATIONAL SECURITY

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Urbanization is the most general trend of the last 50 years, but in Ukraine it becomes major, because villages disappear, cities become more popular.