Study of the Possibility of Using Indene-Coumarone Resin with Methacrylate Fragments as Polymer Applications for Petroleum Road Bitumen

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Abstract – The effect of indene-coumarone resin with methacrylic fragments amount on the main characteristics of bitumen-polymeric compositions has been studied. It was found that this resin can be used as adhesion additive. It was found that the addition of 1 % indene-coumarone resin to the mixtures does not substantially affect the softening temperature, penetration and ductility, but doubles the adhesion to glass.

Keywords – indene-coumarone resin, bitumen-polymeric compositions, adhesion, softening temperature.

Introduction

The world consumption of bitumen is an average of 87 million tons per year. About 85% of bitumen is used as binder in various types of stacking: pavements, roads, airports, etc. This is the main binding material used in the construction of roads. When using road bitumen a number of problems arises, but the most acute is the insufficient high stiffness and adhesion properties of commercial bitumen (even if they meet the requirements of normative documents) [1].

One of the most promising directions in improving the quality of binders to obtain a pavement with good performance is their modification of polymeric materials [1]. However, the use of modifiers is limited by their considerable cost. Therefore, it is important to search for inexpensive substances, which would improve the performance characteristics of bitumens, first of all adhesion.

In the Department of Chemical Technology for Oil and Gas Processing at the Lviv Polytechnic National University research is being conducted to improve the adhesive properties of road petroleum bitumens by modifying them with an indene-coumarone resin (CIR), which is obtained using a light coal-tar resin fraction [2]. To get the maximum positive result in the structure of the CIR there is a need to introduce a functional group that improves the adhesion properties of the products that contain it.

This work is devoted to study of the possibility of using indene-coumarone resin with methacrylate fragments as adhesion additive of petroleum road bitumen.

Experimental

The indene-coumarone resin is obtained under optimal conditions, which are described in [3]. The resulting resin (CIRM-V) is characterized by yield of 25.5 %, softening temperature of 364 K and molecular weight of 600 g/mol.

Bitumen characteristics: softening temperature 319 K, penetration 70·10-4 m, ductility 63·10-2 m, adhesion to glass 47 %.

The number-average molecular weight (Mn) of the synthesized CIR was determined using cryoscopy in benzene. The softening temperature, penetration, ductility and adhesion were determined according to the standard techniques.

Bitumen was heated in a reactor till definite temperature, then CIRM was added and mixed (Re = 1200) for a definite time.

Results and Discussion

To create bitumen-polymeric compositions (BPC), we used bitumen, the characteristics of which are given in subsection 1.1. CIRM was used as a polymer component. It was necessary to determine the effect of polymer component amount of BPM preparation on its characteristics. The results are shown in Tables 1. Bitumen without the addition of CIRM was studied for the comparison (Table 1). The amount of resin was 1, 2, 3 and 5 wt% relative to the total BPM amount. The introduction of resin from 1 to 5 wt % virtually leads to a slight increase in a softening temperature but penetration and ductility decrease. At the same time, the adhesion of the formed mixtures increases significantly.

Table 1

Effect of polymer component amount on BPM characteristics

BPM composition, wt%,	Softening temperature, K	Penetration at 298 K, 0.1 mm	Ductility at 298 K, cm	Adhesion,%
Bitumen100.0, CIRM 0.0	319	70	63	47
Bitumen 99.0, CIRM 1.0	320	68	60	96
Bitumen98.0, CIRM 2.0	320	69	58	95
Bitumen 97.0, CIRM 3.0	321	67	55	94
Bitumen 95.0, CIRM 5.0	320	66	56	95

Notes: temperature 463 K, time 1 h.

From Table 1 it can be concluded that the best results related to adhesion are achieved with CIRM amount of 1 wt %. Under these conditions, the characteristics of the resulting mixture practically coincide with the characteristics of bitumen without a polymeric component, except the adhesion, which is twice higher.

Conclusion

Regarding the possibility of using synthesized resins as polymeric additives to bitumen-polymeric mixtures, it was found that the addition of 1 % CIRM to the mixtures does not substantially affect the softening temperature, penetration and ductility, but doubles the adhesion to glass. Therefore, based on the obtained results it can be argued that this resin can be used as adhesion additive to the petroleum road bitumens.

References

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