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EVALUATION OF FATIGUE CHARACTERISTICS OF HOT MIX ASPHALT WITH POLYMER ADDITIVES

Abstract. This article shows test results of conventional hot mix asphalt and hot mix asphalt with polymers Kraton and Calprene for fatigue in a regime of controlled strain by the device of four-point bending with loading frequency of 10 Hz and temperature of 10 ^{0}C. Dissipated pseudo strain energy, connected with the increase of phase angle and reduce of complex modulus, as well as total dissipated pseudo strain energy were determined. Diagrams of dissipated strain energy changes were made depending on the number of loading cycles. Correlations were stated between the number of loading cycles to failure and constant strain of testing, between the number of loading cycles and total dissipated strain energy at failure. It was found that hot mix asphalt with polymer Calprene has the highest fatigue strength.

Keywords: hot mix asphalt, Bitumen, Polymer additives, Fatigue.

1. Introduction. Asphalt concrete is one of the main pavement materials of modern highways. It represents a composite material including bitumen binder, crushed stone, sand, mineral powder and other additives [1].

Fatigue cracking is one of the main types of destruction for asphalt concrete layers of pavement. Fatigue cracking occurs and develops under the influence of multiple loading [2-4]. Adding of polymers in asphalt concrete increases its resistance to destruction, including a fatigue cracking.

Nowadays, the most widespread test method of hot mix asphalt for fatigue is the test under cycle loading on the device of four-point bending [5-7]. Usually the tests are carried out in a regime of constant strain.

Dissipated energy, connected with increase of defect sizes, has a special place in the continuum damage mechanics. From this classical point of view, it is reasonable to evaluate amount of dissipated strain energy with increase of the number of loading cycles. Dependencies are practically important, which are determined between amount of dissipated strain energy and characteristics of fatigue strength.

2. Materials used.

2.1. Bitumens. Pure bitumen of grade 90-130, meeting the requirements of Kazakhstan standard ST RK 1373-2005, and bitumens modified with polymers Kraton and Calprene 501, meeting the requirements of Kazakhstan standard ST RK 1025-2010, were used in this paper. Polymers Kraton and Calprene 501 were added into the pure bitumen in amount of 4 % from the mass of bitumen. According to Superpave the bitumen grade is PG 64-40 [8]. Tables 1 and 2 show main standard characteristics of pure bitumen and bitumens modified with polymers. Pavlodar petrochemical plant manufactured pure bitumen from crude oil of Western Siberia (Russia) by direct oxidation.

2.2. Hot Mix Asphalt. Dense hot mix asphalt of type B, according to the Kazakhstan standard ST RK 1225-2003, was prepared with the use of aggregate of fractions 5-10 mm (20 %), 10-15 mm (13 %), 15-20 mm (10 %) from Novoalekseyevsk borrow pit (Almaty Region), sand fraction 0-5 mm (50 %) from the plant "Asphalt concrete-1" (Almaty city) and activated mineral powder (7 %) from Kordai borrow pit (Zhambyl Region). Content of the pure bitumen of grade 90-130 in hot mix asphalt is 4,8 % by weight of dry mineral filler. Main standard characteristics of aggregate and hot mix asphalts are shown in Tables 3-5.