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Technological sides of crack sealing in asphalt pavements

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Abstract

Cracks are one of the most widespread modes of deterioration of asphalt concrete road pavements in Ukraine. The main cause of cracking in asphalt pavements is tensile stress due to loads from vehicles as well as abrupt temperature decrease and its significant gradients in winter. Observations indicate that joint influence of the above-mentioned factors results in cracking in relatively thin asphalt overlays (5 to 10 cm), placed on existing pavement surface with cracks in wearing course, during the first year of performance. Most extensively cracks appear in spring and autumn, and open in winter. Cracks have different length, width and depth. At high temperatures in summer period “young” minor cracks can partly be rolled by wheels of vehicles at wheel path due to bitumen softening in asphalt concrete.

Practice of repair works shows that crack sealing at early stage of their initiation allows us to avoid premature pavement deterioration and increase its service life. Particular significance has crack sealing prior to beginning of precipitations in autumn as moisture penetration in pavement layers through cracks in surface layer and then in subgrade soil accelerates premature deterioration of the whole structure.

In severely continental climate of Ukraine surface of asphalt pavements in summer can have a temperature up to 60 – 65 °C, and up to minus 30 °C in winter, which requires from materials for crack sealing special properties as heat resistance and flexibility at low temperatures.

In Ukraine sealing of cracks with polymer modified bitumen sealants and hot applied mastics in asphalt pavements is applied, allowing block access of moisture to lower pavement layers and increase its durability. Petroleum road bitumen, modified with plasticizer, is used as base for production of bitumen-polymer sealants. Combination of plasticized bitumen and SBS-type polymer, and cationic polymer latex allows to obtain sealant characterized by both high elasticity, flexibility at low temperatures and heat resistance. Addition of mineral filler to the composition of bitumen-polymer sealant gives us bitumen-polymer mastic.

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Results of research of different filler influence on heat resistance, elasticity, flexibility and performance of polymer modified mastics at low temperatures have been highlighted in the paper. Influence of temperature of asphalt pavement on strength of adhesive interaction with polymer modified mastic has been determined.

Experience of practical implementation of techniques of crack sealing in asphalt pavements on motor road network in Ukraine indicates that technique of filling of beforehand prepared “reservoir” with hot bitumen-polymer sealant or mastic with overband on the surface of asphalt pavement results in the highest impermeability of crack, compared to flush filling of “reservoir”. To increase durability it is important that the “reservoir” created by milling of asphalt pavement had square or rectangular cross-section and passed through crack. Technological sides of practical implementation of techniques of crack sealing in asphalt pavements are covered in the paper.

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1. Introduction

In climate conditions of Ukraine materials in road pavements are subject to freezing in winter and thawing in spring. In winter stiffness of road pavement increases due to water freezing in granular base and subgrade as well as increase of bitumen film viscosity in bituminous materials. After spring thawing materials in pavement layers become saturated as a result of frozen moisture thawing. Subgrade soil is waterlogged which decreases its bearing capacity. Period of road pavement weakness depends on depth of freezing, soil type, degree of water saturation and condition of water drainage. Weak road pavements cannot carry design loads and in this condition they accumulate most part of defects, significant number of which can appear as cracks in asphalt concrete pavement layers.

Experience proves that cracks are one of the most widespread modes of deterioration of asphalt pavements in Ukraine. Main cause of asphalt pavement cracking is tensile stress due to loads from vehicles as well as abrupt temperature decrease and its significant gradients in winter. Observations indicate that joint influence of the above-mentioned factors results in increased rates of crack formation and propagation in asphalt pavements, which can appear during first year of performance. Experience shows that first of all asphalt pavements suffer from random transverse cracking. In old pavements strengthened with overlays reflective cracks can appear on the surface of new layer already in few years of service. The cracks have different length, width and depth. Most extensively cracks appear in spring and autumn, and open in winter. In summer cracks can decrease its width due to asphalt pavement expansion. At high temperatures in summer period “young” minor cracks can partly be rolled by wheels of vehicles at wheel path due to bitumen softening in asphalt concrete.

Cracks significantly influence durability of road pavement in general, as they break integrity of layers dividing them into separate blocks. As a result load from vehicles transfers to significantly weakened structure and is distributed over smaller area. New cracks have almost no influence on traffic conditions until crack develops into pothole. When wheels of vehicles ride on crack edges its sides move vertically relative to one another. Edges and walls of crack, saturated with water, break down and gradually crack turns into pothole, which allows free water penetration to base and subgrade and causes premature deterioration of the whole pavement structure. Potholes are widespread secondary mode of deterioration in areas of late crack sealing. Repair of potholes and cracks with broken edges can be much more expansive than crack sealing at the beginning of its development.

Practice of repair works shows that crack sealing at early stage of their initiation allows us to avoid premature pavement deterioration and significantly increase its service life. Particular significance has crack sealing prior to beginning of precipitations in autumn that can prevent moisture penetration in sub-base through cracks in pavement and then in subgrade soil.

2. Crack sealing materials

In many countries crack sealing with hot-applied bitumen-polymer sealants or mastics is in practice. Mastics differ from sealants by presence of fillers in their composition. Today many foreign companies are main suppliers of

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