Performance of Fiber-Reinforced Polymer-Modified Asphalt: Lab Experiments and Field Observations

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This project presents the performance and evaluation of fiber-reinforced polymer-modified asphalt concrete (FPMAC) through laboratory experiments and field observations. Polymers are believed to enhance the binding properties of the asphalt pavements to increase their engineering characteristics. Some of researchers and highway agencies in the cold regions have considered to add fibers in the currently used polymer modified asphalt concrete (PMAC) to produce fiber-reinforced polymer-modified asphalt concrete (FPMAC) to improve its resistance to low temperature cracking and reflective cracking. FPMAC has potential to enhance the asphalt pavement properties such as increasing stiffness, resistance to deformation, and stability. However, there is no any research projects that study the properties of FPMAC. Therefore, this research is designed to characterize the performance of PMAC and FPMAC and compare their difference using lab tests and field observations, thus helping local agencies better understand the use of fibers in polymer modified asphalt design and construction. An asphalt paving project using both PMAC and FPMAC was implemented in Flagstaff, Arizona. This project provided us an opportunity to evaluate the effect of fiber reinforcement in the performance enhancement of asphalt mixtures. Samples were collected at the job site and shipped back to the Materials Laboratory at Northern Arizona University for experiments. Thermal cracking tests, dynamic modulus tests, were performed on both FPMAC samples and PMAC samples, along with field observations. According to the test results, FPMAC mixtures have greater relaxation modulus values than the PMAC's at low temperatures, due to the effectiveness of the polyolefin fiber. Also, FPMAC shows higher dynamic modulus values than the PMAC's at high temperatures. This is advanced by the reinforcement effect of the aramid fibers that enhances the dynamic modulus values and deformation resistance (rutting). The findings of field visits confirm the prediction and validate the viscoelastic analysis. To date, after one and half year of installation, thermal cracks has been observed on both PMAC and FPMAC, among which most of the cracks are observed on PMAC. Fatigue cracks are observed only on PMAC, and there is no rutting deformation being observed on both PMAC and FPMAC. Continuous field visits have been scheduled by the research team to keep tracking and monitoring the progress of existing thermal cracks and pavement conditions. In general, FPMAC has been successfully demonstrated its abilities to resist thermal cracking and rutting deformation through lab experiments and field observations. So far, it has been proved that FPMAC is a better pavement choice than PMAC in cold climates.

Key Words: Fiberized Asphalt Pavement, low temperature cracking, relaxation modulus, dynamic modulus, field observation