Life Cycle Cost Analysis and Performance Comparison of Fiber Reinforced Asphalt Overlay versus Rubber Modified Asphalt Overlay

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Rubber modified binder is added to enhance the binding properties of the asphalt pavements as well as its thermal resistance in cold climate. Due to increasing costs of rubber modified binder in asphalt paving projects, researchers and highway agencies in Flagstaff, Arizona, USA have initiated a pilot study with adding fibers in the conventional asphalt mixtures to produce fiber-reinforced asphalt concrete. This exploratory project intends to evaluate the effectiveness of fiber reinforced asphalt in resisting severe low temperature cracking and high frequency of freezing and thawing cycles (approximately 200-250 in annual) in comparison with currently used rubber modified asphalt. In addition to performance evaluation, a life cycle cost analysis (LCCA) of both mixtures is conducted to provide end users (highway agencies and local governments) with the information of maintenance plan and budget setting. Due to the fact that fiber reinforced asphalt has never been used in Northern Arizona, highway agencies along with local consulting firms as a whole is interested to understand the results from this pilot study. An overlay project was constructed on the Northern Arizona University campus in the May of 2014. Two asphalt mixtures (fiber reinforced asphalt and rubber modified asphalt) were placed adjacent to each travel lane of the road. Asphalt mixtures from the two materials were sampled during paving. Freeze-thaw cycles test and the bending beam rheometer (BBRs) test were conducted on the collected samples. The void ratio, stiffness and relaxation modulus data were obtained from the lab testing, which helped to generate a prediction regarding to thermal cracking. Life cycle cost analysis for both types of asphalt are proceeded with the lab predictions. Field observation were scheduled, in order to validate the lab prediction. After different numbers of freeze-thaw cycles test, less air void were created in fiber reinforced asphalt in comparison with rubber modified asphalt. The BBRs test were conducted on the samples after the freeze-thaw cycles. As the number of the freeze-thaw cycles increases, the stiffness of both asphalt mixtures were decreased. However, the rubber modified asphalt shown more stiffness reduction than the fiber reinforced asphalt. That indicates, under low temperature environment, the rubber modified asphalt may endure less thermal stress, which results less thermal cracking. However, the initial cost for rubber modified asphalt material is much higher than fiber reinforced asphalt. Even though, the fiber reinforced asphalt may requires more frequent maintenance, it may still be more cost effective than rubber modified asphalt.

Key Words: Fiberized Asphalt Pavement, low temperature cracking, freeze-thaw cycle, life-cycle-cost analysis