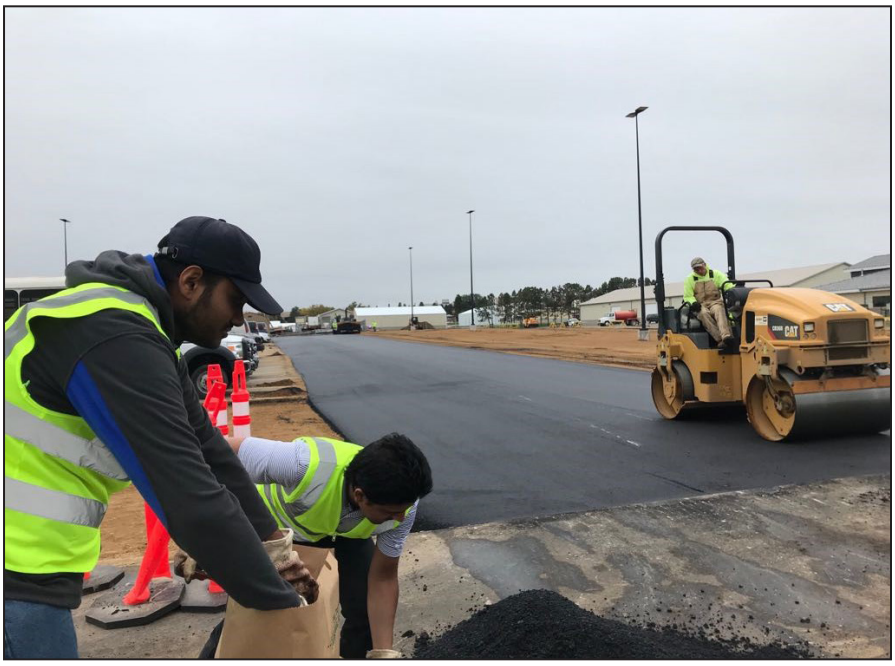
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 20-421 (project 530) | October 2020

Screening of South Dakota Asphalt Mixes for Moisture Damage Using Conventional and Innovative Approaches



the ISSUE

The loss of bonding between aggregates and the asphalt binder that typically begins at the bottom of the hot-mix asphalt layer and progresses upward is a serious form of roadway deterioration that can be difficult to recognize because it shows up as other forms of distress, such as rutting, raveling, corrugations, or cracking. With increased use of warm mix asphalt, reclaimed asphalt pavement, polymer-modified asphalt, and anti-stripping agents, evaluation of stripping of asphalt mixes has become particularly important. The present study was undertaken to evaluate the moisture-induced damage potential of asphalt mixes used in South Dakota.

the RESEARCH

The moisture-induced damage potentials of the asphalt mixes were evaluated by conducting tensile strength ratio and semicircular bend tests. The effect of moisture on asphalt binder-aggregate adhesion was evaluated by conducting binder bond strength tests. Asphalt mixes containing hydrated lime, an amine-based warm mix asphalt additive, or reclaimed asphalt pavement were evaluated. Asphalt binder-aggregate adhesion evaluation is composed of testing 16 types of asphalt binder blends, namely PG 64-34, PG 64-22, PG 58-28, and PG 70-28, blended with simulated reclaimed asphalt pavement, an amine-based anti-stripping agent, and an amine-based warm mix asphalt additive. The binder-bond tests were conducted on binder blends with three aggregates: quartzite, granite-I, and granite-II. A tensile strength ratio obtained from tensile strength ratio test, critical strain energy release rate, and an energy release ratio obtained from semicircular bend test, along with pull-off strength obtained from a binder bond strength test for unconditioned and moisture-conditioned samples, were used to evaluate the moisture-induced damage. Indirect tension test results were used

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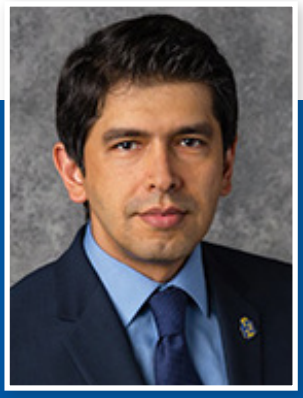

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Project Title

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the **RESEARCH** cont.

to perform a fracture energy analysis of the tensile strength ratio samples in dry and moisture-conditioned states to explore the feasibility of applying this method for evaluating the moisture-induced damage utilizing parameters such as toughness index, toughness index ratio, fatigue index, and fatigue index ratio.

the **FINDINGS**

The results showed that incorporation of an amine-based warm mix asphalt additive or anti-stripping agent in asphalt binders, in general, resulted in a better resistance to moisture-induced damage. Also, testing different aggregate and different asphalt binders showed that the mineralogy of aggregates and asphalt binder types are the parameters determining the effectiveness of the additives in improving the resistance of asphalt mixes to moisture-induced damage. Additionally, it was found that including reclaimed asphalt in mixes can result in a reduction in their resistance to moisture-induced damage. Furthermore, it was found that while use of lime in asphalt mixes can improve their resistance to moisture-induced damage, the lime may make mixes susceptible to cracking after exposure to moisture.

the **IMPACT**

Departments of transportation in the Mountain-Plains region spend millions of dollars to combat stripping of asphalt pavements. Accurate screening of mixes for stripping susceptibility will help agencies avoid the use of stripping-prone mixes in construction of new pavements and maintenance of existing pavements. The outcomes of this study, including the asphalt binder-aggregate compatibility database and the proposed testing and analyzing methods for screening asphalt mixes for moisture damage, will lead to a better pavement performance and service life, resulting in significant cost savings.

For more information on this project, download the entire report at https://www.ugpti.org/resources/reports/details.php?id=1001

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.

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