Ohio's Research Initiative for Locals (ORIL) Project Fact Sheet

Optimizing the Effective Use of RAP in Local Roadways

The Problem

Asphalt pavement is the most recycled material in the United States. Reclaimed asphalt pavement (RAP) material contains asphalt binder and aggregates. Therefore, using RAP in new asphalt mixtures results in significant economic savings and environmental benefits. However, using high amounts of RAP in new paving mixtures presents a concern that the resulting mixture may be more prone to cracking, which adversely affects the performance and durability of those mixes. This is due to fact that the asphalt binder contained in the RAP is oxidized/hardened due to aging. Several research studies have been conducted to address issues with using higher percentages of RAP in asphalt mixtures. Most of these studies have focused on developing mix design procedures and specifications for mixtures used on interstates and highway systems only. Therefore, the results of these studies may not be directly applicable for mixtures used on local roads. Using RAP may influence the performance of local roadways in a different manner. Therefore, research was needed to develop a method to design cost-effective, well-performing, and durable asphalt mixtures with various RAP contents to be used in the surface course of local roadways in Ohio as well as to provide recommendations for a quality control procedure of RAP incorporated into these mixes.

What the Researchers Did

This project was divided into two phases. The results of laboratory tests conducted in Phase 1 of this project indicated that the use of RAP adversely affected the fatigue cracking resistance of asphalt mixtures when more than 30% RAP was used. The use of a softer binder (PG 64-28) was not effective in maintaining the fatigue cracking resistance of the mixes when more than 30% RAP was used. Laboratory test results showed that the Hydrolene recycling agent (RA) and the Sylvaroad RA significantly improved the cracking resistance of mixes with up to 50% RAP. The results of cost analyses conducted in Phase 1 showed that a 50% RAP mix with Hydrolene RA can be 26% less expensive than 20% RAP mixes currently being used. In addition, a 50% RAP mix with Sylvaroad RA can be 13% less expensive than 20% RAP mixes currently being used.

Based on the results of Phase 1, Phase 2 of this project involved constructing eight test sections as part of a resurfacing project on Hall Road in the City of Columbus. In these test sections, a 1½-in asphalt concrete surface course was placed.

The surface course asphalt mixtures were Marshall mixes and had the similar aggregate blend but different percentages of RAP. The first section (control section) had a mix with 20% RAP and PG 64-22 binder. While three sections had mixes with 30%, 40%, 50% RAP, PG 64-22 binder, and Sylvaroad RA, three other sections had mixes with the same RAP percentages and binder but used Hydrolene as the recycling agent. Finally, the last test section was constructed using a mixture with a 30% RAP and PG 64-28 binder. Cores were obtained at different locations within each test section. In addition, specimens were compacted in a laboratory from loose mixtures that were obtained during the construction of each test section. Laboratory tests were conducted to evaluate the cracking resistance of the field cores. Likewise, tests were conducted on the laboratory compacted samples to examine their cracking and rutting resistance.

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What They Found

- The test results showed that the 30% and 40% RAP mixes with Hydrolene had slightly better resistance to fatigue cracking than the control mix with 20% RAP. However, the control mix had better resistance to fatigue cracking than the 50% RAP mix with Hydrolene.
- The test results also showed that while the 30% RAP mix with Sylvaroad had better fatigue cracking resistance than the control mix, mixes with 40% and 50% RAP and Sylvaroad had significantly lower resistance than the control mix.
- The softer binder PG 64-28 in the 30% RAP mix resulted in similar fatigue cracking resistance to that of control RAP mix with 20% RAP and PG 64-22 binder.
- The test results showed that the 30% RAP, 40% RAP, and 50% RAP mixes had similar low-temperature cracking resistance to that of the control. The 30% RAP mix with a softer binder (PG 64-28) had the best low-temperature cracking resistance.
- The test results indicated that all constructed mixes had acceptable rutting resistance.
- The cost analyses conducted in Phase 2 indicated that using higher RAP content of 40% and recycling agents can reduce the cost of an asphalt mixture by at least 15%.
- Preliminary field evaluation showed that there was no observed distresses in the test sections after seven months of construction.

What They Recommend

- The initial performance of the RAP test sections was evaluated and documented in this report; however, it is recommended to monitor the long-term performance of these sections according to the methodology provided in Appendix C. The long-term evaluation data should be used to make final conclusions regarding the cost-effectiveness of RAP mixes for local roads.
- Design specifications and quality control/assurance criteria for mixtures with high RAP content were developed in this study. It is recommended that local public agencies (LPAs) use these specifications to implement the use of high RAP mixes on local roads. This implementation can start by using mixtures with up to a RAP binder replacement (RBR) of 0.4 and aromatic extract recycling agents such as Hydrolene in pilot projects in different cities, counties and townships. The wide use of high RAP mixes by local agencies is expected to reduce the cost as well as the environmental impacts of asphalt mixtures.
- Further evaluation of the effect of recycling agents should be performed. This evaluation should include different types of recycling agents and RAP materials from various sources.

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