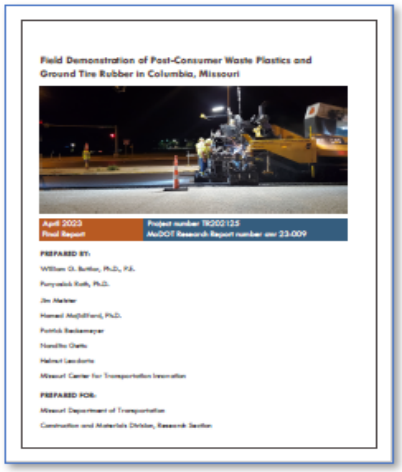
For more information contact: Scott Breeding (573) 526-4325

Research Summary

Field Demonstration of Post-Consumer Waste Plastics and Ground Tire Rubber in Columbia, Missouri



The issue of waste plastics has emerged as one of the most pressing environmental crises in recent times. Over the past five years, one of the more popular ways identified with the potential to recycle vast amounts post-consumer waste plastics is their incorporation into asphalt pavement mixtures. Preliminary research into the use of waste plastics as either an asphalt binder or mixture modifier have shown positive results in laboratory trials, but prior to this research, very limited field data was available. It has been reported that about 60% of the existing literature on plastic use in asphalt is focused on wet process modification, but the use of waste plastic additives, or the 'dry process' is generally less expensive and opens the door for the use of higher amounts of recycled plastics in asphalt. In 2021, University of Missouri-Columbia (Mizzou) researchers partnered with the Missouri DOT (MoDOT) and other stakeholders to design and construct a field demonstration project with dry-process post-consumer recycled (PCR) plastics. The project was undertaken to better understand the constructability and performance of asphalt mixtures modified with PCR plastics. The Mizzou research team had extensive prior experience in incorporating ground tire rubber (GTR) in asphalt mixtures via the dry process and surmised that the same asphalt plant equipment and general design methodologies could be used for the use of dry PCR plastic additives in asphalt. In addition, the project provided an opportunity for a real-world experience in implementing balanced mix design (BMD) while promoting the use of modern, heterogeneous recycled asphalt mixtures.

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For the demonstration project, 1.64 miles (centerline) (2.64 km) of a four-lane road on Route 740, also known as Stadium Boulevard, in Columbia, MO was selected from the eastern side of the 7.2-mile (11.6 km) resurfacing project. The lanes were divided into four sections to include four mixture types including three mixtures modified with polyethylene and one with engineered crumb rubber (ECR). For the PCR plastic mixes, a post-consumer recycled pellet comprised mainly of linear, low-density polyethylene (LLDPE) was used (Figure 1).

For dry process GTR modification, an engineered crumb rubber (ECR) product was used. The mix also used recycled aggregate stockpiles – coarse RAP and boiler slag. From a production and construction point of view, the operations went smoothly and closely mirrored

the equipment, procedures and results observed early in the project during the control mixture production and laydown stage. The produced mixtures were found to be quite workable, with no issues reported at the plant or in the field with regards to odors or emissions. An in-place field density of greater than 95.0% on average was achieved with less than 1.0% variation.

After the first two winters, a moderate amount of reflective cracking was noted in all test sections and in the control. The 50PEL section performed the best followed by the 10ECR section in terms of reflective cracking resistance. Aside from reflective cracking, the ride quality and overall condition of the test sections is still excellent.

The findings from this study show that both waste plastics and ground tire rubber modified asphalt mixtures can perform well in the Midwest and can enhance mixture performance. More demonstration projects in different geographical locations and traffic conditions will be helpful in reinforcing the findings of this study. It is envisioned that a similar specification as recently developed for dry process GTR mixes can be developed for the routine design and control of asphalt mixtures containing waste plastic additive.

Figure 1. Post-Consumer Recycled Plastic used in demonstration project.

Project Information

PROJECT NAME: TR202115—Lab and Field Evaluation of Asphalt Mixtures with Post-Consumer Recycled Plastic Waste: Phase II

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PROJECT COST: $324,475

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PRINCIPAL INVESTIGATOR: William G. Buttlar, PhD, PE

REPORT NAME: Field Demonstration of Post-Consumer Waste Plastics and Ground Tire Rubber in Columbia, Missouri

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Project Manager

CONTACT INFORMATION:

Scott Breeding
Senior Research Analyst
Missouri Dept. of Transportation
1617 Missouri Blvd.
Jefferson City, MO 65109
(573) 526-4325
Scott.Breeding@modot.mo.gov