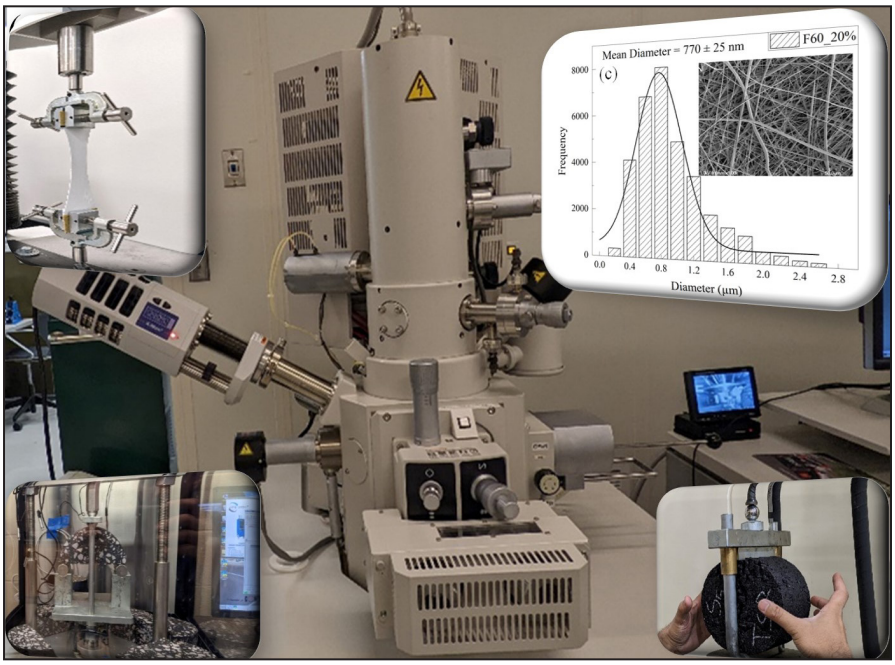
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 24-555 (project 664) | September 2024

Electrospun Recycled Polyethylene Terephthalate Microfibers as an Asphalt Binder Modifier



the ISSUE

Previous studies showed that recycling polyethylene terephthalate (PET) plastic in asphalt as synthetic aggregates did not significantly enhance its mechanical properties. Therefore, the feasibility of recycling plastics in asphalt in other forms, such as microfibers, to benefit from the mechanical properties of PET plastic needs to be studied.

the RESEARCH

A laboratory study was conducted to introduce electrospun PET microfiber (EPM) as an asphalt binder modifier as well as an asphalt mix additive to increase the recycling rates and generate a value-added product from waste PET plastic bottles, mainly used in the beverage industry. For this purpose, a solution-based electrospinning method was employed in the laboratory to produce EPM by using different concentrations of PET in the solution and flow rates. The effects of EPM as an additive on asphalt binder and mix properties were then investigated. EPM was produced from a solution of PET in a mix of dichloromethane and trifluoroacetic acid. Two PET concentrations of 15% and 20% were utilized, and various solution flow rates (40, 50, 60, 120, and 250 µL/min) were used. Fourier transform infrared spectroscopy, scanning electron microscopy (SEM), and tensile strength tests were conducted on EPMs to characterize their chemical composition, mechanical properties, and morphology.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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Colorado State University
North Dakota State University
South Dakota State University
University of Colorado Denver
University of Denver
University of Utah
Utah State University
University of Wyoming

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Project Title

Electrospun Recycled Polyethylene Terephthalate (PET) Microfibers as an Asphalt Binder Modifier

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the **FINDINGS**

Researchers found that the electrospinning parameters and solution proportions did not alter the molecular structure of the PET. The SEM micrographs suggested that the most uniform and smooth fibers with superior mechanical properties were consistently produced at the lowest flow rate. Hence, the EPM produced using 20% PET concentration and a 60 µL/min flow rate was used to modify the binder and mix. Different EPM contents (0.2%, 0.5%, 0.7%, and 1.0% by binder weight) were blended with a PG 58-28 binder. An increase in EPM content increased resistance to rutting and fatigue and improved high-temperature PG grade compared with neat binders. Tests were conducted on asphalt mixes, which contained different amounts of EPM, to assess their performance. It was observed that adding EPM to asphalt mixes improved their resistance to rutting, cracking, and moisture-induced damage compared with the mixes without any EPM.

the **IMPACT**

The study's findings are expected to promote using EPM from waste PET as a binder modifier to improve asphalt binders' mechanical properties. This will reduce landfilled PET plastic and the need for expensive petroleum-based polymers, offering a hopeful outlook for the future of ground transportation systems. The findings of this study showed that EPM-modified asphalt binders had better resistance to cracking and rutting compared with pavements without any EPM in their composition. As a result, this will reduce the need for polymer-modified asphalt binders and extend pavement life, leading to lower construction and maintenance costs.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1202

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.