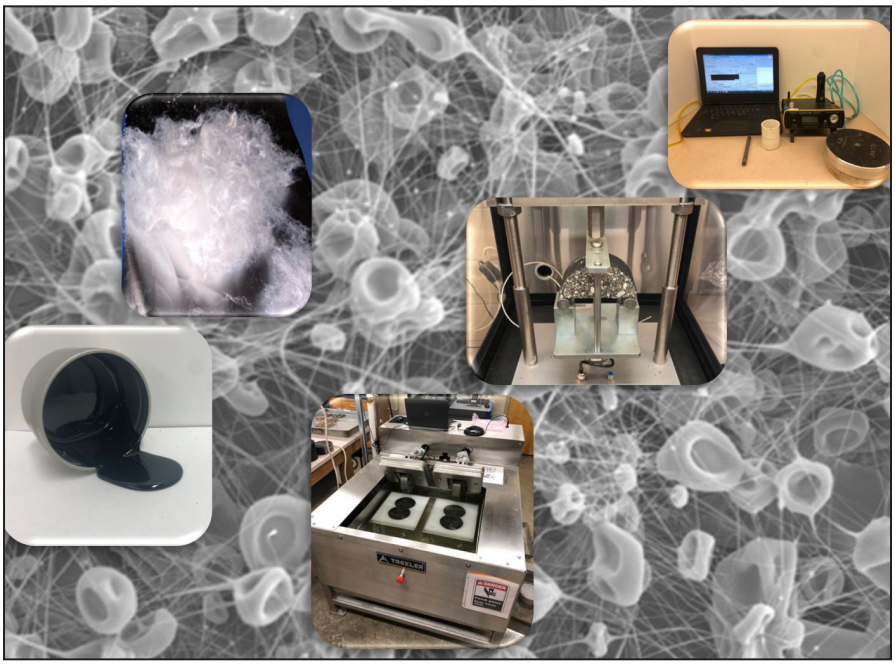
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 24-544 (project 575) | August 2024

Development and Characterization of a Plant-Based Bio-Additive for Asphalt Binder



the ISSUE

Scarcity of natural resources, environmental concerns, and emerging needs for sustainable materials have spurred the development and use of renewable and environmentally friendly materials and processes. In response to this need, this study focused on developing a plant-based asphalt binder additive to address these challenges.

the RESEARCH

Cellulose nanofibers (CNF) were produced in the laboratory by applying an electrospinning technique. The structure, morphology, and size distribution of the produced CNF were evaluated using scanning electron microscopy. Also, tensile strength tests in two perpendicular directions were conducted on lab-produced CNF. The effect of incorporating different amounts of CNF in three types of asphalt binders—PG 58-28, PG 64-34, and PG 70-28—on fracture energy and dynamic viscosity of binder blends were evaluated by conducting Izod impact and rotational viscometer tests, respectively. Additionally, the effect of CNF dosage in the binder on its adhesion and moisture-induced debonding potential with three types of aggregates was evaluated by conducting a binder bond strength test. In addition, the effect of incorporating CNF in asphalt mixes on their cracking, rutting, and moisture-induced damage potential was evaluated by conducting semi-circular bend, Hamburg wheel tracking, and tensile strength ratio tests.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

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

Characterization of the Plant-based Bio-asphalt Binder and Bio-Additives

Sponsors | Partners

South Dakota State University, Brookings, SD

USDOT, Research and Innovative Technology Administration

the **FINDINGS**

The tests conducted on asphalt binders and mixes revealed that incorporation of CNF resulted in an overall improvement in binder-aggregates adhesion, an asphalt binder with a higher fracture energy and dynamic viscosity, and an asphalt mix with a higher resistance to rutting, cracking, and moisture-induced damage.

the **IMPACT**

After implementation, this project is expected to result in a reduced need for petroleum-based products, which leads to numerous environmental benefits. In addition, due to the availability of biomaterials and their low cost, this project is expected to produce significant cost savings.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1193

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.