



#### Researcher

Dr. Zhanping You  
Associate Professor  
Department of Civil and Environmental Engineering

[zyou@mtu.edu](mailto:zyou@mtu.edu)  
906.487-1059

#### Sponsor

University Transportation  
Center for Materials in Sustainable  
Transportation Infrastructure

#### Project Title

Durability of Porous Pavement  
Materials with Recycled  
Materials and Warm Mix  
Asphalt Technology

#### Project Manager

Elizabeth Hoy  
Assistant Director, UTC-MiSTI

#### Co-Investigators

*Michigan Technological University*  
Shu Wei Goh  
Graduate Research Assistant

Kelly Heidbrier  
Undergraduate Research  
Assistant

# Project Summary

Technology Transfer Outreach Publication

## Performance of Porous Pavement Materials with Recycled Materials and Warm Mix Asphalt Technology

This project integrates three innovations in the pavement engineering field, Permeable Pavements (porous pavements), Warm Mix Asphalt (WMA), and recycled materials. Porous pavements allow water to penetrate to the underlying surfaces so that drainage collection can be enhanced. Porous asphalt pavements are designed with increased air voids in the mixture which allow water to flow through the pavement. A reduction in construction and maintenance costs of drainage structures has been reported with this type of pavement construction. Hot Mix Asphalt (HMA) has been a traditional pavement utilized in pavement construction. It is produced at a discharge temperature of between 280°F (138°C) and 320° F (160°C). This results in high energy (fuel) costs and the generation of greenhouse gases. Environmental awareness and the need for improved energy efficiency has increased rapidly over the past few years and extensive measures such as air pollution reduction targets set by the European Union under the Kyoto Protocol have encouraged efforts to reduce greenhouse gas emissions. Warm mix asphalt (WMA) is one technology in response to these efforts. WMA is produced at a lower temperature. The goal for WMA is to use existing HMA plants and specifications to produce quality dense graded mixtures at significantly lower temperatures. When compared with conventional HMA, a reduction in emissions and energy consumption has been reported. Recycled materials, including recycled asphalt pavements (RAP), waste shingles, and recycled aggregates have been widely used in traditional HMA in several states; however, the integration of these three aspects of innovations has not been widely pursued.

# Project Summary

Technology Transfer Outreach Publication



## University Facts (2008-2009)

Total Enrollment	7018
Graduate Enrollment	984
Number of Faculty	445
Placement Rate	96%

*Michigan Technological University is located in Houghton, Michigan on the south shore of Lake Superior. This rural area is known for natural beauty, pleasant summers, abundant snowfall, and numerous all-season outdoor activities. In addition, the University maintains its own downhill and cross-country ski facilities and golf course. There are numerous cultural activities and opportunities on campus and in the community. Michigan Tech has also been rated as one of the safest college campuses in the United States, and the local community provides excellent resources conducive to an outstanding quality of life.*

For more information, visit the University's website.

[www.mtu.edu](http://www.mtu.edu)

## Research Objective

The objectives of this research are to investigate porous asphalt mixture containing recycled materials such as RAP incorporating WMA technologies.

## Methodology

This research will be conducted using the following methodologies:

Perform literature reviews on the integration of porous asphalt mixture, WMA and RAP.

Identify the critical tests needed and develop an experimental plan to evaluate the performance of asphalt mixture. The tests include: volumetric properties, dynamic modulus testing, NCAT ignition oven test, Superpave™ gyratory compaction, and tensile strength ratio (TSR) testing.

Collect the materials for the study consistent with the developed experimental plan.

Evaluate the rutting performance, freeze-thaw, and fatigue properties of asphalt mixture using simple performance and TSR tests.

## Research Findings

The anticipated research findings will be the characterization and performance data of porous asphalt mixtures, porous asphalt mixtures containing RAP, and porous asphalt mixtures with the integration of WMA technology.

## Anticipated Implementation

This project will assist researchers and engineers in identifying problems in designing porous pavements with RAP and WMA technologies. This will improve the sustainability of pavement construction and maintenance.

*This publication was produced by the U.S. Department of Transportation University Transportation Center for Materials in Sustainable Transportation Infrastructure (UTC-MiSTI) at Michigan Technological University under the program management of the Office of Research and Technology Administration-U.S. Department of Transportation. The contents of this summary reflect the views of the authors, who are responsible for facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the Department of Transportation University Transportation Centers program in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof. For more information or additional copies, visit the Center's Web site at [www.misti.mtu.edu](http://www.misti.mtu.edu), call 906.487.3154, or write to UTC-MiSTI, 301 Dillman Hall, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931*