

# Pavement Materials with Recycled Rubber: From Research to Practice

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## Abstract

Stockpiles of waste tires pose concerns of potential contamination of local groundwater and fire risk from the massive amounts of tires. To properly use the waste tires, tire rubber recycled from waste tires has been used in the pavement industry for decades. However, the function of such recycled tire rubber in the internal structure of asphalt mixtures was not fully understood. This study attempted to establish discrete element models (DEM) and laboratory experiments to investigate the strength, skeleton structures, and stress distribution of rubber modified asphalt mixtures. New modeling procedures were developed to incorporate coarse aggregate shapes and rubber particles. Indirect tensile strength (ITS) of specimens with rubber materials was tested in the laboratory and also modeled in simulations. The internal-structure and stress distribution of specimens with different rubber contents were analyzed. The gap gradation was proved to have a functional capacity of accommodating fine aggregates and rubber particles, all while forming a coarse aggregate skeleton. The research team also expanded the research work from models and lab work to field pilot projects. Quite a few pilot projects that using recycled tire rubber were constructed as asphalt pavements in Michigan (MI). A recent project used a reacted rubber in Kalamazoo, MI and the other project used a pre-swollen rubber in Dickinson, MI. In general, the test results from the laboratory were favorable regarding moisture damage resistance, low temperature cracking resistance, and noise reduction. In the Kalamazoo project, it was estimated that approximately 5,300 passenger tires been recycled to the road that would otherwise be disposed of in a landfill. In the Dickinson project, the amount of recycled tire is equivalent to about 3,500 passenger tires.

## Biography of Presenting Author



**Zhanping You** earned his PhD in Civil Engineering from the University of Illinois at Urbana - Champaign in 2003. Dr. You served as Director of the Center of Excellence for Transportation Materials, which was in partnership between Michigan Department of Transportation and Michigan Technological University for a few years. He was entitled Donald and Rose Ann Tomasini Assistant Professor of Transportation Engineering in 2005 and was promoted to Associate Professor in 2009, to Professor in 2014, and to Distinguished Professor in 2019.

In his capacity as a Professor, he has completed research projects related to road materials. His contribution to pavement and materials research has been featured in newspapers, magazines, and other media. Dr. You has published over 400 papers in peer reviewed journals and conference proceedings. These publications include prestigious journals such as the Journal of the Transportation Research Board published by the National Academy of Sciences, the ASCE Journal of Materials in Civil Engineering, ASCE Journal of Engineering Mechanics, ASCE Journal of Computing in Civil Engineering, Road Materials and Pavement Design, and Construction and Building Materials.

Dr. You has been an effective teacher with his unique teaching philosophy. His teaching interests include transportation materials, pavement design, asphalt materials, and transportation engineering. In 2009, he received the ASCE fellowship of Excellence in Engineering Education (ExCEED), and he attended the Teaching Workshop at the United States Military Academy at West Point. In 2018, he was named as Outstanding Advisor in Department of Civil and Environmental Engineering at Michigan Tech. He earned the prestigious Michigan Tech Research Award in 2019.

Dr. You is an active member in the professional community. He has served as an associate editor for the American Society of Civil Engineers' (ASCE) Journal of Materials in Civil Engineering since 2008, and for the Journal of Traffic and Transportation Engineering (English Edition, published by Elsevier) since 2017. He is also a member of the Board of Directors for the International Journal of Pavement Research and Technology, Malaysian Construction Research Journal, and the Journal of Traffic and Transportation Engineering (published by Elsevier). He has been involved in professional services for many professional organizations including: ASCE (Chair of Mechanics of Pavements Committee and Chair of Bituminous Materials Committee), the Transportation Research Board (TRB), Association of Asphalt Paving Technologists (AAPT), International Society of Asphalt Pavements (ISAP), American Association for the Advancement of Science (AAAS), and International Union of Laboratories and Experts in Construction Materials, Systems and Structures (RILEM). Dr. You has reviewed technical papers for over 35 journals and has edited four ASCE special publication books. In 2004 and 2005 he was a recipient of the U.S. Department of Transportation's Dwight David Eisenhower Transportation Faculty Fellowship.

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