# Method developed to enable Asphalt roads to weather cracking due to climate changes and heavy traffic load

*Scientists develop a method to build durable and lasting asphalt pavements that can withstand  cracking due to low temperatures and heavy loads.*

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SHARJAH, UNITED ARAB EMIRATES, September 30, 2024 / EINPresswire.com/ -- Scientists from the University of Sharjah in the United Arab Emirates and China's Hefei University of Technology have developed a method to build durable and lasting asphalt pavements that can withstand rutting and cracking due to low temperatures and heavy loads.

They believe the method could reduce overall costs that normally accompany the purchasing and maintenance of expensive road durability testing equipment and improve testing of asphalt to make sure it holds up well in cold and hot weathers.

Engineers and transportation authorities have for long grabbled with how asphalt roads can brittle or bloat with slumps and surges in temperature and how heavy load traffic can damage the asphalt.

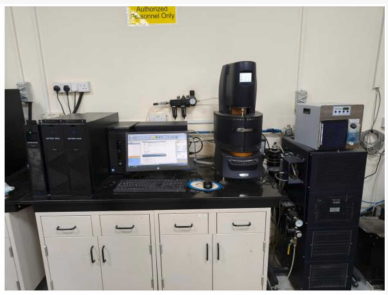
Now the scientists claim their technology can produce the type of asphalt binders with the ability to weather pavement cracking and rutting and shorten training time for operators to learn how to use sophisticated asphalt binder devices to make asphalt roads more resistant and lasting.

In the words of the study's lead author Dr. Waleed Zeiada, University of Sharjah's associate professor of asphalt concrete mixtures, "The major takeaway is that our method can save

engineers time and resources while still providing reliable information about how asphalt will perform in cold temperatures.

“This means better, longer-lasting roads, with less effort required to test the materials beforehand. This approach has the potential to greatly enhance the efficiency and practicality of Superpave implementation, particularly for agencies and contractors who face high equipment and operational costs.”


(a) Overview of BBR



(b) Overview of DHR

Due to growing concerns regarding BBR applicability to field studies and special asphalt binders, the research team enhanced a new method to assess the thermal cracking of asphalt binders namely the Dynamic Shear Rheometer (DSR), itself part of the Superp

Superpave, an abbreviation of the term superior performing asphalt pavement, is a mix design method in which materials in optimum properties are selected for analysis and testing. Road engineers use to Superpave to provide durable and long-lasting roads and highways.

The research, published in the journal Construction and Building Materials, employs the typical Superpave Bending Beam Rheometer (BBR) device to assess the thermal cracking of asphalt binders at low temperatures ranging from 0 to -18 °C by measuring the creep stiffness and m-value.

However, and due to growing concerns regarding BBR applicability to field studies and special asphalt binders, the research team enhanced a new method to assess the thermal cracking of asphalt binders namely the Dynamic Shear Rheometer (DSR), itself part of the Superpave testing system anyway, added Dr. Zeiada.

The DSR was used to perform frequency sweep tests on twelve asphalt binders at temperatures ranging from 0 to 25 °C using the 8-mm parallel plate geometry. The scientists then made a comparison between the results they obtained from both the BBR and DSR devices.

The DSR instruments are highly sophisticated gadgets designed to help scientists seek better rheological data under various climatic and other conditions in order to obtain measurements with superior precision.

The authors breakthrough came when they compared their BBR results and their corresponding DSR counterparts with an efficient and robust method they developed to predict the flexural creep stiffness and m-value of asphalt binder below 0 °C from frequency sweep test data .

They say in their research the objective was to develop an accurate and effective approach “to evaluate the low-temperature performance of asphalt binders based on DSR testing.”

Road engineers use DSR, or the dynamic sheer rheometer, as an instrument to gauge and characterize the elastic features of asphalt binders at temperatures of varying degrees.

Co-author Dr. Hanqi Liu, from the Chinese School of Automotive and Transportation Engineering, Hefei University of Technology, described the method as outlined in the study "a major step towards characterizing the performance of asphalt binders at different temperatures using a single testing device."

The project aims to improve the testing of asphalt binders "especially at low temperatures to predict their (asphalt binders) performance in real-world conditions," noted Dr. Zeiada. "Our method represents a significant advancement in asphalt binder technology which "traditionally has relied on a text called the  Bending Beam Rheometer (BBR) to measure how well asphalt can resist cracking, particularly at low temperatures."

The authors tested various asphalt binders at different temperature ranges using mathematical models to arrive at accurate predictions of their DSR data about the performance of asphalt binders particularly in low temperatures. The DSR test was found to be better and with a higher degree of accuracy when compared with BBR counterpart traditionally used to measure asphalt binders' low temperature stiffness properties.

When comparing the predictions with actual BBR test results, the researchers found that the DSR method to be more accurate and reliable. "The results of this research are significant because they offer a faster, more efficient way to assess asphalt binder performance at low temperatures. This method could help engineers save time and resources while ensuring that pavements are designed to resist cracking in cold seasons," maintained Dr. Zeiada.

The research project, Dr. Zeiada pointed out, has already attracted the attention of world's key industrial players like Shell and Richmond in recognition of the significance of its findings and the contribution they can make to advancing the testing of asphalt binders.

"The collaboration between academic research, industry, and government institutions was crucial to the success of this project. The involvement of key industry players like Shell, Richmond, and Mena Energy underlines the real-world importance of this work."

The authors tout their method as a breakthrough in the construction of pavements and roads as it can help road builders to produce the type of asphalt binders that can weather damage due to climate conditions.

"It has been always a dream to have a universal machine that can test asphalt binders against rutting, fatigue, and thermal cracking. This research work is a step towards achieving that," said co-author Dr. Helal Ezzat of Sharjah University's Research Institute of Sciences and Engineering.

The authors are upbeat about the method they have developed. Dr. Ghazi Al-Khateeb, Sharjah University's professor of transportation engineering and a co-author said, "The proposed conversion method presented in this paper demonstrates superior efficiency and robustness compared to existing techniques. The correlation between predicted and measured values is generally strong, with high $R^2$ values indicating precise predictions for both creep stiffness and the m-value."

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