The Open Transportation Journal
DOI: 10.2174/0126671212297046240315071059, 2024, 18, e26671212297046

ISSN: 1874-4478
1

RESEARCH ARTICLE **OPEN ACCESS**

Investigating the Dynamic Creep and the Tensile Performance of Zeolitic Tuff-Modified Warm Asphalt Mixtures

Bara Al-Mistarehi[1], Shadi Hanandah[2], Amir Shtayat[3,*], Ali Qtaishat[4], Tariq K. Alhasan[4], Buthainah Al-kharabsheh[5], Rana Imam[6], Reem Abu Salim[1], Amro Alsmadi[1] and Ashraf Abdallah[7]

[1]*Department of Civil Engineering, Jordan University of Science and Technology, Irbid-Jordan*
[2]*Department of Civil Engineering, Al-Balqa Applied University, Salt-Jordan*
[3]*Department of City Planning and Design, Jordan University of Science and Technology, P.O Box 3030, Irbid 22110, Jordan*
[4]*Department of Private Law, Faculty of Law, Al-Ahliyya Amman University, Salt-Jordan*
[5]*Department of Civil Engineering, Al-Albayt University, Mafraq-Jordan*
[6]*Department of Civil Engineering,The University of Jordan, Amman-Jordan*
[7]*Department of Civil Engineering, Aswan University, Aswan-Egypt*

Abstract:

Aims: This research investigates the effect of adding natural Jordanian Zeolitic tuffs to the SUPERPAVE asphalt mixture at the dynamic creep and the indirect tensile performance.

Background: Rutting and fatigue are considered the most common types of distress that affect pavements all over the world. Many factors can affect these properties, such as different aggregate properties, asphalt grades, and properties, as well as the type and amount of the mineral filler. Mineral fillers play an important role in enhancing the asphalt mixtures' performance by filling the voids in the mixture besides improving the cohesion of the binder as it has a small weight in addition to a very large surface area. Generally, the powder of limestone is the most used type of filler. However, studies showed that many materials could also be used as mineral fillers successfully. The focus of this study is using natural Jordanian Zeolitic tuff as a mineral filler. Jordanian zeolitic tuff mainly consists of Phillipsite, chabazite, and faujasite, which are considered the most abundant Zeolitic tuff minerals. The pyroclastic material is widely distributed in the Badia region of northeast Jordan. Zeolitic tuffs are located in Jabal Aritayn (30km northeast of Azraq), Tlul AlShahba (20 km east of Al Safawi), Tal Al-Rimah (35 km northeast of Al Mafraq), and other small deposits in central and south Jordan.

Objectives: The aim of this research was to study the impact of Zeolitic tuffs on overall Superpave asphalt mixture performance.

Methods: The specimens were prepared using the optimum asphalt content obtained by the SUPERPAVE method. Dynamic Testing System DTS-16 was used to apply both dynamic creep and indirect tensile tests that give a good idea about the rutting and fatigue behavior of asphalt mixtures. Both tests were conducted at 25 Cº.

Results: The Zeolitic tuffs modified asphalt mixtures have lower accumulated strains and higher creep stiffness compared to the control mixture. Subsequently, the indirect tensile test results showed that the modified asphalt mixtures have a higher resilient modulus than the control asphalt mix. Generally, using Zeolitic tuffs as a modifier of asphalt mixtures enhanced the rutting and fatigue resistance. The results showed that asphalt mixtures fortified with 25% Zeolitic tuffs emerged as the best contenders for rutting resistance. Also, mixtures enriched with 50% Zeolitic tuffs stood out in fatigue resistance performance.

Conclusion: The best dynamic creep performance was by adding 25% Zeolitic tuffs by the mineral filler mass, while the best resilient modulus was by adding 50% Zeolitic tuffs by the mineral filler mass.

Other: The overarching goals encompass understanding the dynamic creep behavior of Zeolitic tuff-infused asphalt blends, deciphering its indirect tensile performance, pinpointing the ideal replacement ratio for mineral fillers, and drawing a performance comparison between WMA and conventional Hot Mix Asphalt (HMA) compositions.

Keywords: Dynamic creep, Dynamic testing system, Fatigue resistance, Superpave, Zeolitic tuffs.