

Effect of temperature on phase angle and dynamic modulus of asphalt mixtures using SPT

Juraidah Ahmad^{a}, Mohd Rosli Hainin^b, Ekarizan Shaffie^c, Khairil Azman Masri^d, Mohd Amin Shaffi^b*

^a Faculty of Civil Engineering, Universiti Teknologi MARA, Shah Alam, Selangor 40450, Malaysia

^b College of Engineering, Department of Civil Engineering, Universiti Malaysia Pahang, Kuantan, Gambang, Pahang 26300, Malaysia

^c Institute for Infrastructure Engineering and Sustainable Management, Universiti Teknologi MARA, Shah Alam, Selangor 40450, Malaysia

^d Faculty of Engineering and Built Environment, SEGi University, Petaling Jaya, Selangor, Malaysia

ABSTRACT

The Simple Performance Test (SPT) can be used to characterize the strength and load resistance of asphalt mixtures. The objectives of this study are to determine the effect of temperature on the phase angle and dynamic complex modulus of the asphalt mixtures tested at 30°C, 35°C, 40°C, 45°C and 50°C at 25Hz, 20Hz, 10Hz, 5Hz, 1Hz and 0.5Hz frequencies. The asphalt mixtures of NMAS 12.5mm are prepared using asphalt binder PEN 80/100 and PEN 60/70. The asphalt mixtures are designed using the Superpave system and compacted using the Superpave Gyratory Compactor (SGC). The dynamic modulus test results showed that at a higher temperature, the stiffness of the asphalt mixtures is affected. The dynamic modulus of the mixtures is highest at 30°C and gradually decrease at 35°C, 40°C, 45°C and 50°C respectively. The dynamic modulus values for asphalt mixtures with bitumen grade PEN 60/70 are also higher compared to the asphalt mixtures with bitumen grade PEN 80/100. Results also showed that the low phase angle values indicate low viscosity of the asphalt binder due to increase in temperature. The present study is meaningful in understanding the asphalt mixture behaviour at different temperature and loading frequencies.

KEYWORDS

Asphalt mixture; Dynamic modulus; Phase angle; Simple performance test; Superpave system

REFERENCES

1. R. F. Bonaquist, D. W. Christensen, W. Stump, Simple Performance Tester for Superpave Mix Design: First-article development and evaluation, Transp. Res. Board, 513 (2003).
2. M. W. Witczak, Simple Performance Test for Superpave Mix Design, Transp. Res. Board, 465 (2002).

3. K. P. Biligiri, K. Kaloush, J. Uzan,
Evaluation of Asphalt Mixtures Viscoelastic Properties Using Phase Angle Relationships,
Int. J. Pavement. Eng. 11(2) (2010) 143-152.
4. M. A. Elseifi, I. L. Al-Qadi, P. J. Yoo,
Viscoelastic Modeling and Field Validation of Flexible Pavements, J. Eng. Mechan. 132(2)
(2006) 172-178.
5. R. Nemat, E. V. Fave,
Nominal Property-Based Predictive Models for Asphalt Mixture Complex Modulus
(Dynamic Modulus and Phase Angle), Constr. Build. Mater. 158 (2018) 308-319.