Evaluating Freeze-Thaw Resistance of Asphalt Binders

Chun-Hsing Ho, Ph.D., P.E., and Sean Begay
Northern Arizona University
Flagstaff, AZ

Cold weather climates have been a critical issue that has caused asphalt pavements to crack and deteriorate resulting in a number of modes of pavement distress. In cold regions such as Montana, Colorado, Utah, Northern Arizona, etc. freezing-thawing effect has been considered as a part of factors that influences the performance of asphalt pavements. According to a statistical data, Flagstaff has a mean annual frequency of 250 freeze-and-thaw cycle that has appeared to have affected the performance of asphalt pavements. To date, only a handful of experiments that focus on freezing-thawing durability of asphalt binders. This project is designed to test freezing and thawing resistance of asphalt binders to help pavement engineers better understand the cracking mechanism of asphalt binders under freezing and thawing effect. The objective of the research is to determine a set of promising asphalt binders that could provide better freezing and thawing resistance to cold climates. This project is also used to answer a question of whether a freeze and thaw test provided in the ASTM C666 is a good option for helping highway agencies select asphalt binder grades that would fit local climatic conditions. Five commonly used asphalt binders including a polymer modified binder were selected to evaluate their thermal cracking and shear resistance properties. Each one of the asphalt binders was placed inside of a freeze-thaw apparatus and tested at five different cycles at 100, 150, 200, 250, and 300. After each cycle, the tensile and shear strength of each asphalt binder specimen was tested using a bending bean rheometer (BBR) and a dynamic shear rheometer (DSR) to determine the strength and durability of each asphalt binder. As currently used, the freeze-thaw apparatus specified in the ASTM C666 is only used for testing pervious concrete durability and it has never been used for asphalt mechanical experiment. This project will serve as a pilot study to evaluate the feasibility of using the ASTM C666 standard to test freeze-thaw resistance of asphalt binders. It is expected that the results can be used by state highway engineers for consideration for pavement design and construction in cold regions. In collaboration with Arizona Department of Transportation (ADOT), this project will assist highway agencies in providing creditable tested data for pavement design in cold weather climates. Based on test results, ADOT pavement engineers would be able to select promising asphalt binders to produce mixes that will provide longer lasting properties of asphalt mixtures as well as will increase the life cycle of asphalt pavements. This project is not only beneficial to the study area but any other cold regions where cold weather climates have been a challenge in asphalt pavement design and construction.

Key Words: Freeze thaw cycles, asphalt binder, durability