Nanoindentation Characterization of Aging in Different Phases of an Asphalt Concrete

Rafi Tarefder, University of New Mexico

Abstract:
To this day, a number of methods have been developed and used to predict aging behavior of asphalt binders. In the last decade alone, there have been significant improvements in aging simulation equipment such as rolling thin film oven and pressure aging vessel. Our understanding of the bulk thermal and rheological properties such as viscosity and consistency of aged and unaged asphalt binders has also improved. However, the test methods developed, to this day, are mostly rheological shear and bending beam tests performed on the bulk volume of aged and unaged binders. No studies have been performed to determine the stiffness and hardness of binder being an integral part of an asphalt concrete (AC). Because the existing tests used in the asphalt area cannot be performed on binder and mastic while they are an integral part of AC. Recently, nanoindentation has brought an opportunity to conduct tests on binder, mastic and aggregate while they are integral parts of AC. Because, in nanoindentation test, a nanometer size tip, which is smaller than binder film thickness as well as mastic phase, can be accurately position on these phases to indent them. In the proposed study, nanoindentation test will be used to measure mechanical properties such as stiffness and hardness of asphalt binder, mastic, and aggregate while they are being a part of an AC sample, as a function of aging time and/or temperature. In addition, mathematical models will be developed to determine the fracture properties (e.g., embrittlement) of asphalt phases from indentation test data.