Evaluating Asphalt Mixture Performance

Introduction
The goal of this research is to develop a strategy to select the type/quantity of recycled material, and the PG grade for the virgin binder of an asphalt mix to provide optimum performance in a local environment.

The performance of mixtures with 5 combinations of recycled asphalt pavement (RAP) and recycled asphalt shingles (RAS) and, 3 binder grades were evaluated.

Below is a matrix of the mix designs and binder grades compared in this study.

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Testing Methods
This study used an Asphalt Material Property Test (AMPT) device to evaluate the dynamic properties of each mixture.

Mixtures were tested at a range of frequencies and temperatures and Master Curves developed.

Dynamic properties can be used to predict field performance via the mechanistic-empirical pavement design guide (MEPDG).

Sample Preparation
Each mix design required two samples for the AMPT and were required to have the following qualities:
- Air content 7%
- Height 150mm
- Diameter 100mm
- Binder content 6%

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### Performance of the asphalt mix designs

**Dynamic Modulus**
- The dynamic modulus describes how an asphalt mixture’s stiffness changes with respect to temperature and loading rates.
  - High dynamic modulus values indicate probability of premature cracking
  - Low dynamic modulus values indicate probability of rutting

**Phase Angle**
- The phase angle is the delay between the maximum stress applied to a sample and the maximum strain a sample experiences.
  - High phase angle indicates high energy absorption within the sample
  - Low phase angle indicates low energy absorption within the sample

**Results and Discussion**
- As recycled material is increased in the design mix the dynamic modulus increases and the phase angle decreases.
- As PG Binder grade is softened in the design mix the dynamic modulus reduces and the phase angle increases.
- Mixtures with RAS show more consistency with the dynamic modulus and phase angle.

**Conclusion**
These results will assist in the asphalt design process by providing comparative performance measurements with respect to recycled material. This will likely allow designers to incorporate more recycled material in the asphalt which will reduce the consumption of virgin binder.

**Recommendations**
Research on the effects of aging on asphalt with higher contents of recycled binder could discover additional benefits of incorporating more recycled binder in the asphalt.

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