Winter-damage in Porous Asphalt

Designing a binder solution using Kraton™ polymers

A Delft University of Technology study concluded that two factors are critical to prevent winter damage:

- Limited binder stiffness at low temperature, particularly after ageing;
- Binder stress relaxation at these low temperatures.

A few cold winter nights can cause years' worth of ravelling damage to a road when stresses due to traffic loads and day to night temperature variations reach the binder's breaking point.

Mortars of long-lasting, porous asphalt roads were compared in the lab to those from early-failure roads. A Finite Element model, that predicted the asphalt mix response based on the mortar properties, confirmed actual road performance and generated these conclusions.

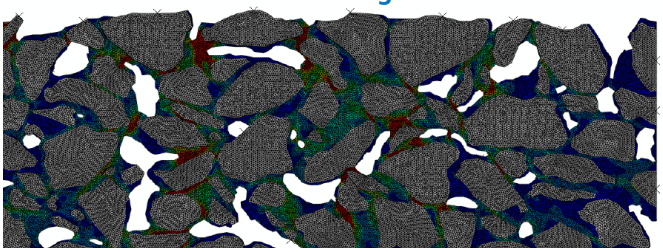
Delft University of Technology in The Netherlands and Kraton Performance Polymers, Inc., headquartered in the USA, used proven knowledge of SBS polymers to tune and enhance the binder's visco-elastic properties over a wide temperature range to formulate a superior, winter-damage resistant binder. Delft University of Technology aged and tested four different Kraton binders and modelled their winter performance, all showing a dramatic improvement in particular in ravelling resistance. The Kraton polymer modified binders demonstrated exceptional performance in the winter and equal performance under summer conditions.

Highly modified binders for porous asphalt have a 20 year track record of durability in Japan with SBS levels typically at 8%, but as high as 11% in the coldest parts of the country. This evaluation reinforces that experience and highlights how to optimize formulations to eliminate winter ravelling damage.

Testing

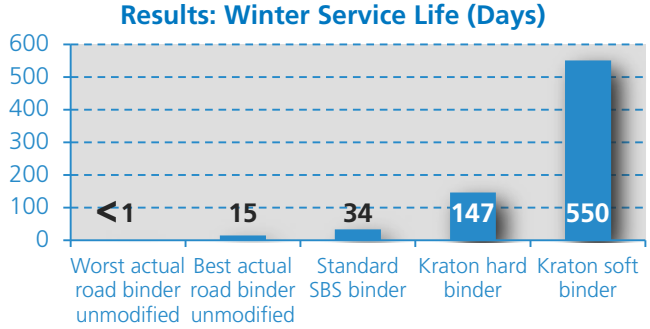
Mortar testing: Material Response parameters, obtained from Dynamic Mechanical Analysis [C] on mortar [A] samples [B], were used as an input for the Finite Element Model.

Modeling



Porous Asphalt Modeling: Modelling of a pavement under dynamic loading.

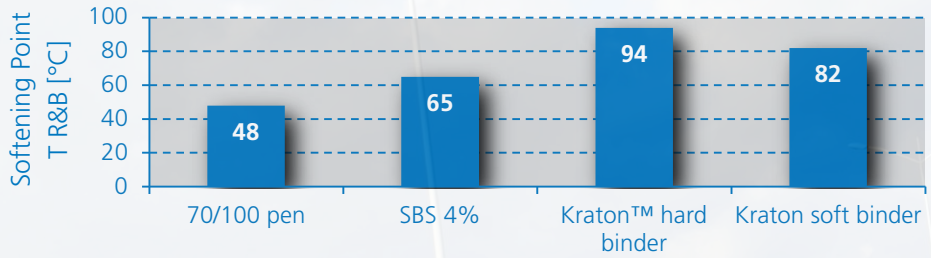
Results: Winter Service Life (Days)



Results: Days of winter service life. Computer modelling results of winter damage of extracted lab tested actual road binders and formulated aged binders at -10 °C (average temperatures and a day and night variation of 6 °C).

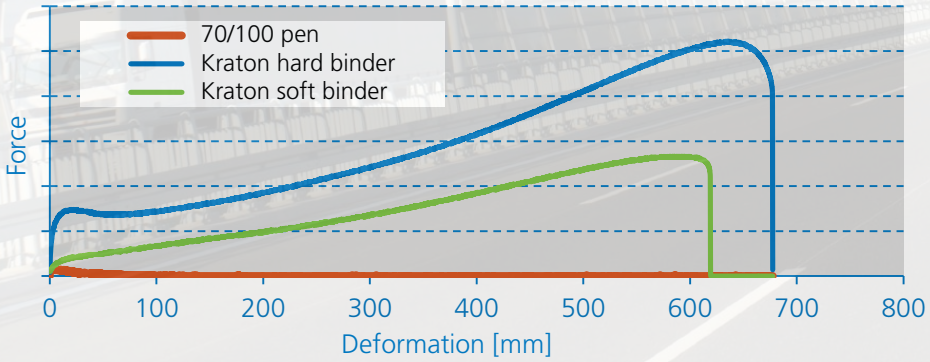
Varying performance of porous asphalt roads

Excellent high temperature performance



Kraton polymer based winter damage resistant binders do not compromise on high temperature performance.

Binders with exceptional breaking energy



Force Ductility [25 °C] measurements showing the dramatic difference in cohesive strength and resilience between unmodified binder and Kraton hard (100 pen base) and soft (300 pen base) binders.

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