# EPOXY ASPHALT CONCRETE

## EPOXY ASPHALT MODIFIED BINDERS FOR BRIDGES & STRATEGIC ROADS

## TECHNICAL DATA SHEET

### Description

From the mid-1960s, Epoxy Asphalt Concrete pavement has demonstrated proven durability in one of the toughest flexible pavement applications, providing the surfacing for long span bridges with orthotropic steel decks. There are many examples of high traffic bridges in North America with Epoxy Asphalt pavements in service 35-50 years. Until recently, due in part to Epoxy Asphalt's unique reactive nature and higher cost, road and motorway owners have seldom specified it despite its performance and durability benefits because there are many low cost flexible pavement binder alternatives. Today, Epoxy Asphalt's super durability, high renewable raw material content and low extended life cycle costs are highly desirable features for sustainable roads. For overweight axle loads in hot climates, the non-melting binder used neat stops rutting, shoving and raveling.

### Strategic Roads

With increased focus on safety, cradle-to-grave life cycle costs, sustainability and the social costs of frequent rehabilitation cycles, transportation officials in developed and developing countries are seeking more durable materials to construct and maintain longer lasting roads. Starting from parallel goals, the International Transport Forum (ITF), as a part of the multinational Organization for Economic Co-operation and Development (OECD) recently completed a three-phase study searching for innovative long life (>40 years of service) wearing course materials for pavements on heavily trafficked strategic roads. Epoxy asphalt performance was thoroughly evaluated with state-of the-art binder and mixture testing methods and carefully monitored on roads in several countries including the UK and New Zealand. The OECD/ITF report concludes that epoxy asphalt pavements offer superior performance in overlay applications compared to standard or polymer binders in critical life cycle metrics including permanent deformation, moisture damage, aging (oxidation resistance), low temperature and fatigue resistance and capability to meet a service life goal of 40 years.

### Epoxy Asphalt Binder (100%) Specifications

| PARTS A AND B COMBINED AND CURED (NEAT) | | |
|---|---|---|
| **PROPERTY** | **METHOD** | **VALUE** |
| **Weight Ratio, % A/B** | | 19.38/80.62 |
| **Tensile Strength @ 23°C. mPa, min.** | ASTM D638 | 6.0 |
| **Elongation at break @ 23°C. % min.** | ASTM D638 | 270 |
| **Viscosity increase to 1000 cP @ 121°C, minutes, min.** | See Testing | 55 |
| **Thermoset Property @ 300°C** | Sample placed on hot plate | **Shall not melt** |

### Epoxy Asphalt Concrete Properties, Type IX (Neat), 9 mm Dense Grade ASTM D1559, Marshall Method

| PROPERTY | VALUE |
|---|---|
| **SPECIMENS, CURED** | |
| **Stability at 60°C, kN** | 60, min. |
| **Flow Value at 60°C, mm** | 2.0, min. |
| **Recovery, %** | 60%, min. |
| **Compressive Strength, ASTM D695, mPa, @ 25°C** | 30 |
| **Air Voids, ASTM D3203** | 3.5% max. |
| **Relative Density, ASTM D2726** | 2.4 min. |
| **Composite Beam Fatigue Life**<br>**Cycles to failure for 50 mm pavement on 12 mm steel plate at 23°C. Center point load applied at 10 Hz on 300 mm span using Instron E10000 dynamic tester.** | 25 million at 5 kN load<br>5 million at 6.5 kN load |
| **Permeability, AASHTO T259, (<0.003% wt Cl-/wt concrete)** | 0, (non-detect) |
| **SPECIMENS, UNCURED** | |
| **Stability as 60°C** | 6.8 KN, min. |
| **Flow Value** | 2.0 mm, min. |
| **Air Voids, ASTM D 3203** | 3.5% max. |

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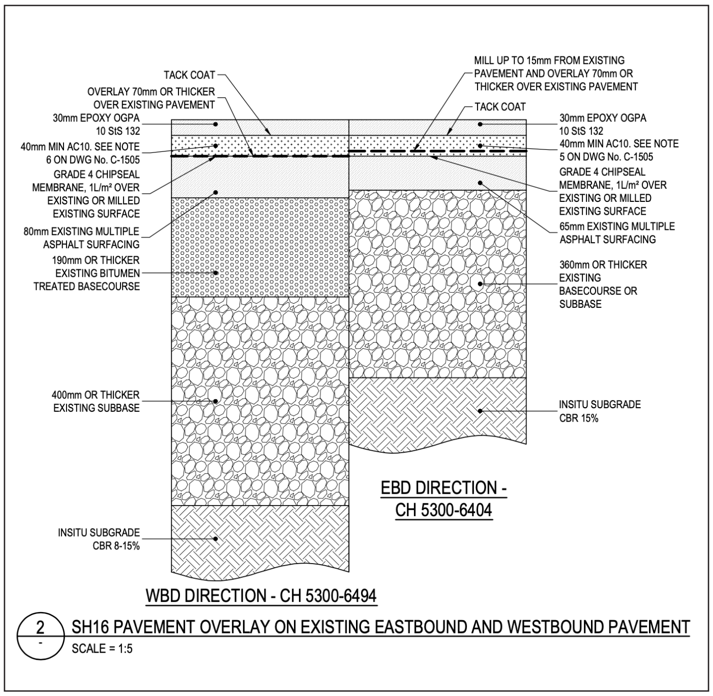
## Modified (diluted) Epoxy Binders for On-Grade Roads

New Zealand, in 2007 as a participant in the OECD research, trialled epoxy asphalt binder in motorway open graded surfaces. In 2012, NZTA added (locally sourced) diluted epoxy asphalt binder to their OGPA (open graded permeable asphalt) motorway national standard where it replaced SBS modified binders for this low noise, high friction pavement design. NZTA durability test models predict epoxy modified OGPA surfacing lifespans of several decades or more. More recently, the Netherlands has installed epoxy modified binders in both SMA (stone mastic asphalt) and open graded pavements in both urban and motorway applications. Within the EU, the Netherlands is a leader in quantifying and implementing sustainability criteria for transportation materials.




NZ motorway as built drawing

Universities and road authorities of several countries (including China, Korea, Ethiopia and U.S.) are now collaborating to install urban road and motorway tests of epoxy modified binders for dense graded, SMA and OGFC overlays. With the superior oxidation resistance of epoxy modified binders, permeable mix designs can last two or three times longer than standard or polymer modified binders. Dense and SMA epoxy mix designs are often preferred if the roadway will be subject to substantial quantities of severe overweight axle traffic.

For road applications, many owners select a 20-30% diluted Epoxy Asphalt binder to reduce upfront costs. Commonly, the two epoxy components represent 20-30% of the binder weight with the remaining portion comprised of a locally sourced asphalt. The local diluting asphalt is often a light PG 64 or a PG 58 or a with a 50-80 pen binder. A wealth of comparative international test data between polymer modified binders and diluted epoxy binders supports the use of diluted epoxy binder.

A critical performance advantage of Epoxy Asphalt is its superior resistance to oxidative aging, so many of these comparison tests are conducted after 20-40 days of accelerated heat aging at 80-85°C. After heat aging, the tensile, fatigue, raveling and cracking test results are demonstrably better in epoxy modified than comparable mix design standard and polymer modified asphalt pavements. Epoxy Asphalt modified OGFC mixtures (20-30% diluted) show reduced Cantabro loss, increased indirect tensile (IDT) strength, and increased IDT fracture energy (Gf) results, indicating improved raveling resistance, tensile strength, and fracture resistance compared to SBS modified and standard binder mixes.


## Features

- Energy Saving
- Record-Setting Stability, no rutting
- Oxidation Resistance
- Renewable Raw Materials
- Fatigue Resistance
- No Raveling, Delamination or Stripping

## Typical Uses

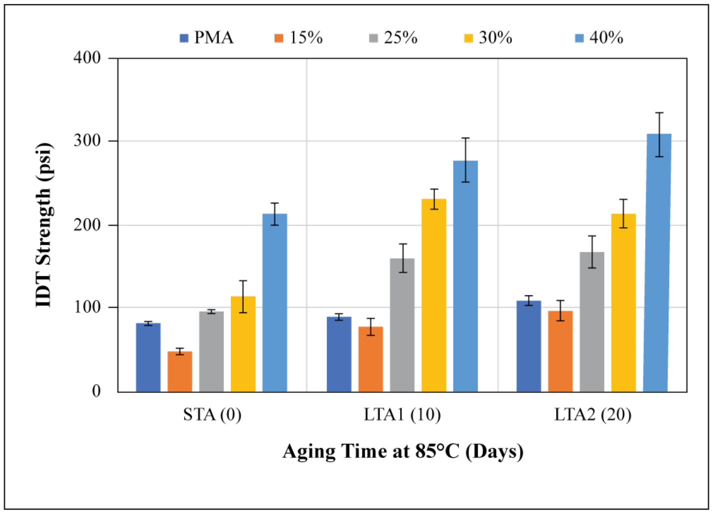
- Orthotropic Steel Deck Bridges
- Overlays on Concrete
- On grade surface courses
- High speed motorways

## Pavements

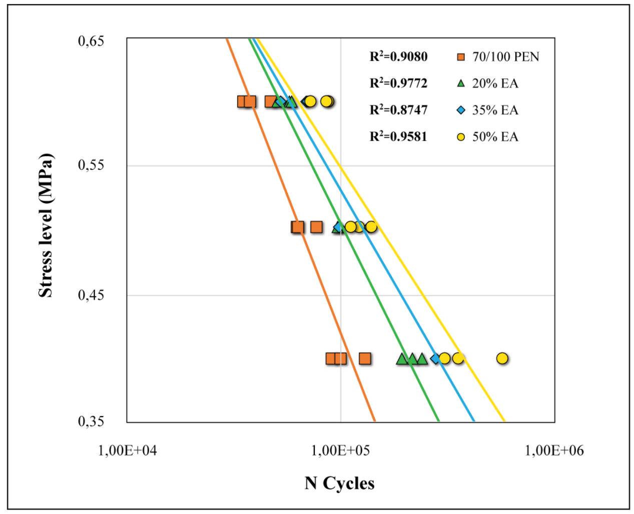
- Open Graded Pavement (OGFC)
- Dense Graded
- Gap Graded
- Stone mastic (SMA)

## Diluted Epoxy Binder vs. SBS Polymer Modified

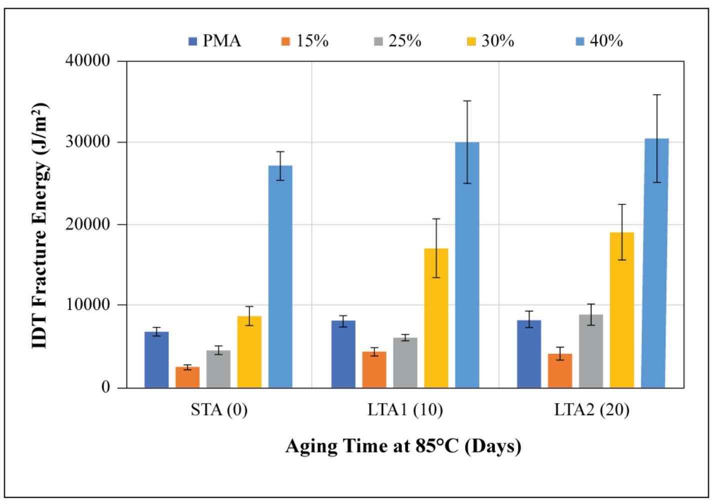
The following charts from 3rd party sources illustrate performance differences between (diluted) epoxy modified binders and standard or SBS asphalt binders. Most of this comparative data is based on open graded, permeable pavement design.




Various epoxy asphalt dilutions compared to SBS Polymer Mod. Binder
NCAT report, for Florida DOT contract BE702 (July 2021)




TU Delft Netherlands fatigue comparison,
G. Pipintakos thesis. (2018)

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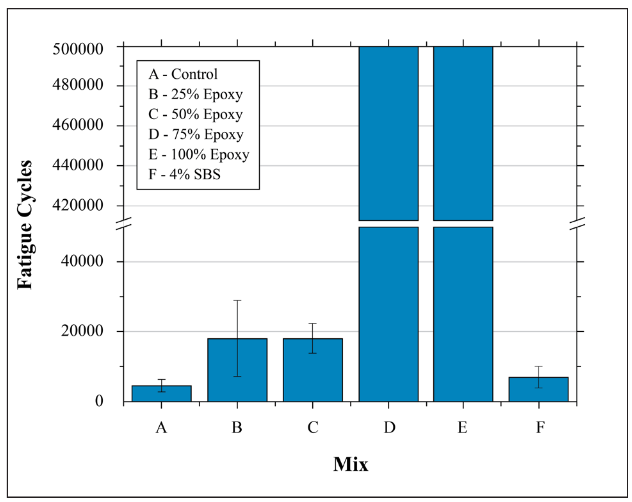
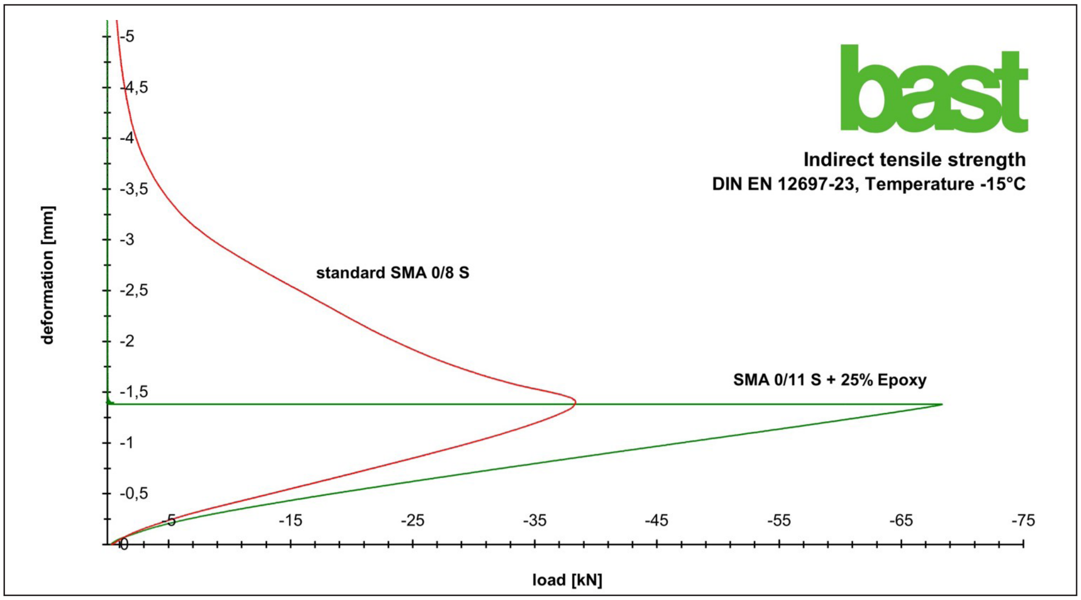
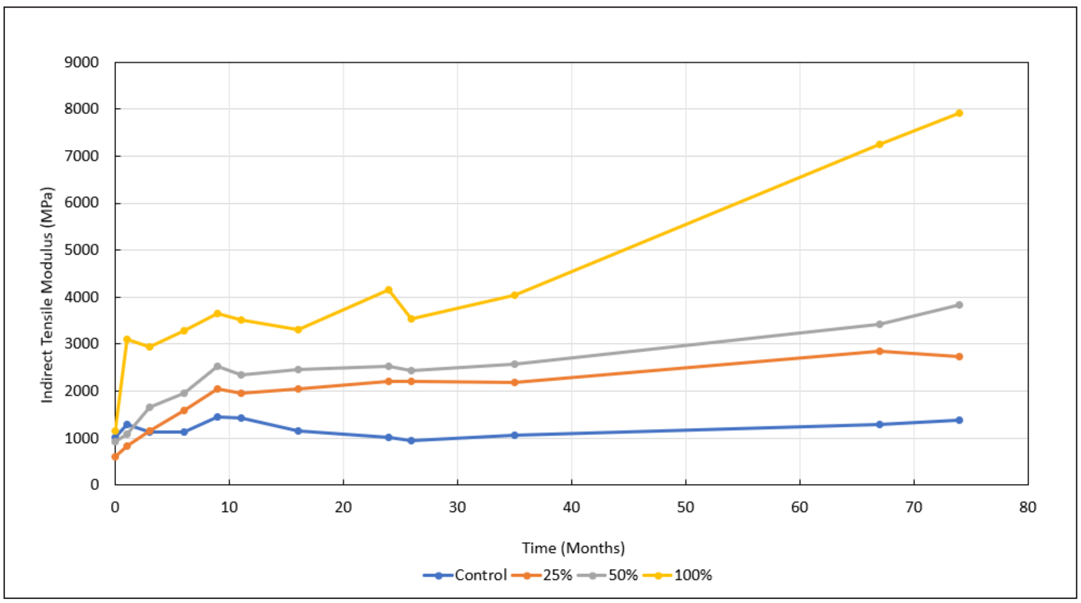



NZ test data (after heat aging),
"Long term durabilty of epoxy modified open-graded asphalt wearing course"
Wu, et al. (2017)




BAST is German federal paving authority,
OECD/ITF long-life surfaces or busy roads (2008)




Change in IDT with aging at constant 23°C
"Optimizing long life, low noise porous asphalt"
D. Alabaster, et al. (2014)

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