

TUFFTREK 4002
Renewable Oil
Technology

For Recycled
Asphalt



Georgia-Pacific

Chemicals

TUFFTREK 4002

Renewable Oil Technology

Renewable oil technology from Georgia-Pacific Chemicals to maintain pavement performance when using RAP and RAS (Recycled Asphalt Pavement and Recycled Asphalt Shingles).

TUFFTREK 4002 Renewable Oil Technology is designed to stabilize asphaltenes for improved compatibility with the maltene phase. This feature enables the incorporation of aged asphalt from RAP and RAS without the detrimental impacts of high asphaltene contribution from oxidized recycled binder.

TUFFTREK 4002 technology benefits include:

- Restorative improvements to DeltaTc (ΔT_c) phase angle, and Glover Rowe of PAV (Pressure Aging Vessel) aged asphalt
- Formulations with improved rutting resistance
- Resistance to long term PAV aging
- Improves Hot Mix Asphalt(HMA) moisture damage resistance
- Improves binder low temperature fracture strength
- Less mass loss compared to some petrochemical-based alternatives
- Biobased, renewable and not hazardous
- Cost-effective, low dosages to achieve performance

TUFFTREK 4002 is easy to handle, with a shelf life up to one year, even when stored at recommended temperature (140-180°F). Low viscosity (65 cps at 25°C) and high flash (Closed cup: 220°C / 428°F) facilitate safe and easy incorporation into the mix. The additive can be terminally blended or added at the hot mix plant or directly to the pug mill. Product is available throughout North America in totes, tanker truck or rail cars.

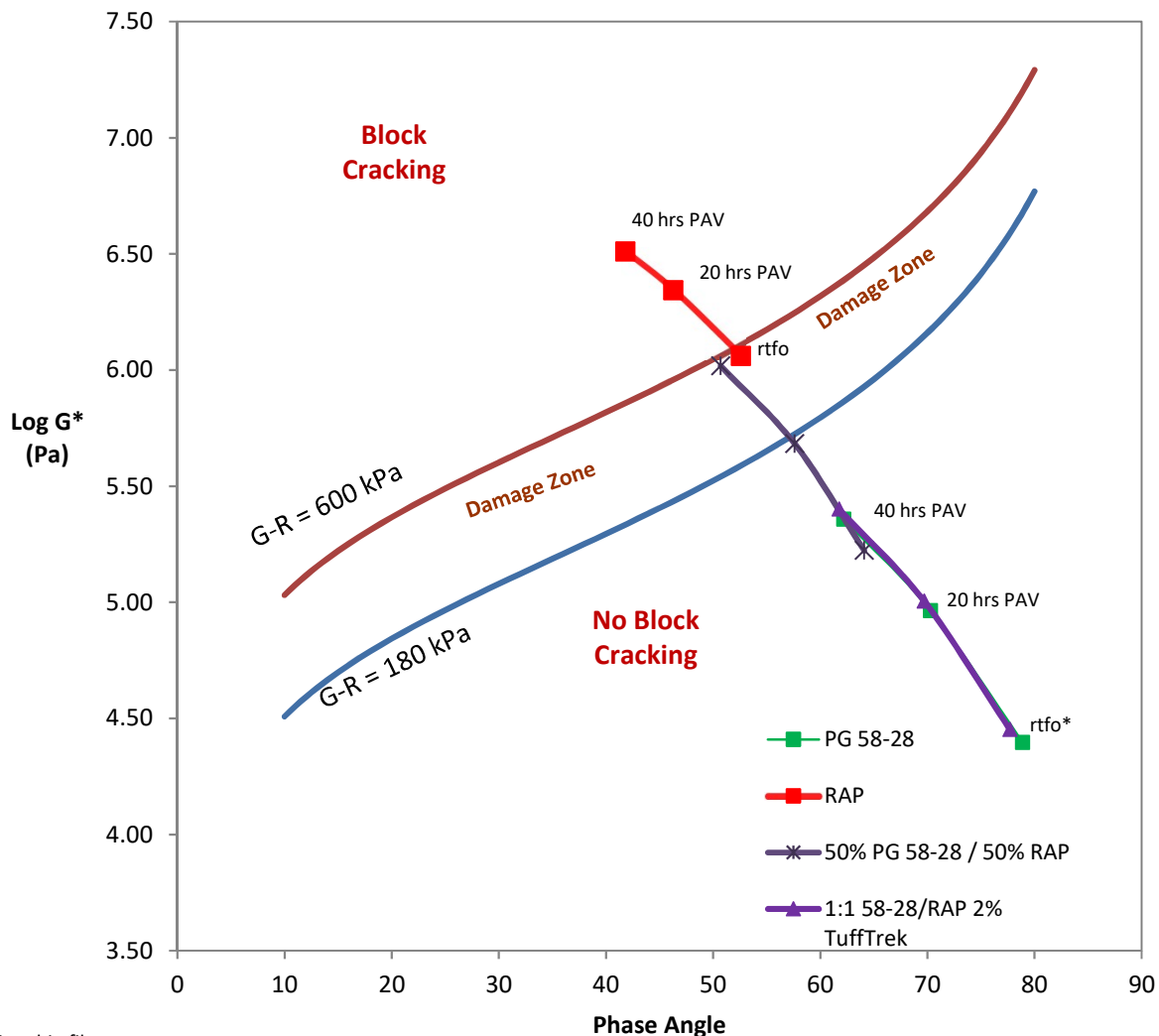


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Restorative improvements to ΔT_c , phase angle, and Glover-Rowe of a simulated 50% RAP blend with as little as 2% TUFFTREK 4002.

| Sample | PG 58-28 | 60hr PAV 64-22 (RAP) | 50% PG 58-28 50% RAP | 50% PG 58-28 50% RAP w/2% TuffTrek |
|------------------------------|----------|----------------------|----------------------|------------------------------------|
| % TUFFTREK Added | 0 | 0 | 0 | 2 |
| PG Temp Range | 88.3 | 110.4 | 100.4 | 92.6 |
| High PG | 59.9 | 94.6 | 77.4 | 62.9 |
| Low PG | -28.4 | -15.8 | -23.0 | -29.7 |
| 20 hr PAV ΔT_c (S-m) | 1.6 | -5.0 | -2.1 | 1.1 |
| 40 hr PAV ΔT_c (S-m) | -1.1 | -6.8 | -3.8 | -1.4 |



*Rolling thin film oven

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Formulations with TUFFTREK 4002 have improved rut depths and Stripping Inflection Point (SIP).

| TUFFTREK 4002 wt % | Final Asphalt Binder PG | Passes to Failure | | Maximum Rut Depth (mm) | | Average (SIP) |
|--------------------|-------------------------|-------------------|-------|------------------------|-------|---------------|
| | | Left | Right | Left | Right | |
| 0 | PG 58-28 | 3772 | 4918 | 20.2 | 20.2 | 2450 |
| 3 | PG 58-28 | 5448 | 8836 | 20.2 | 20.1 | 3000 |
| 0 | PG 58-34 (w/PPA&SBS) | 2796 | 4958 | 24.2 | 24.2 | 1375 |
| 3 | PG 58-34 (w/PPA&SBS) | 6250 | 8246 | 23.4 | 24.4 | 3650 |
| 0 | PG 58-34 (w/PPA) | 6900 | 7892 | 23.8 | 23.8 | 4650 |
| 3 | PG 58-34 (w/PPA) | 8574 | 12144 | 24.3 | 24.3 | 5500 |
| 0 | PG 70-34 (w/SBS) | 12000 | 12034 | 19.4 | 19.9 | 5850 |
| 3 | PG 70-34 (w/SBS) | 20000 | 20000 | 16.6 | 10.4 | 13400 |

A low volume road mix design (1M EASLs) was used so the mix design would not mask the effects of the binder.*

Formulations with TUFFTREK 4002 have improved fracture strength.

| TUFFTREK 4002 wt % | Final PG | ABCD* Cracking Temp °C | ABCD Fracture Strength (MPa) |
|--------------------|----------|------------------------|------------------------------|
| 0 | PG 48-35 | -37.4 | 3.43 |
| 3 | PG 50-36 | -37.7 | 3.38 |
| 0 | PG 59-36 | -37.8 | 3.54 |
| 3 | PG 59-35 | -40.6 | 3.75 |
| 0 | PG 61-36 | -39.7 | 3.85 |
| 3 | PG 62-35 | -40.6 | 4.35 |

*EASL = Equivalent Single Axle Load
ABCD = Asphalt Binder Cracking Device

For samples please contact:

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