ASPHENE™
Graphene-Enhanced Bitumen (GEB)

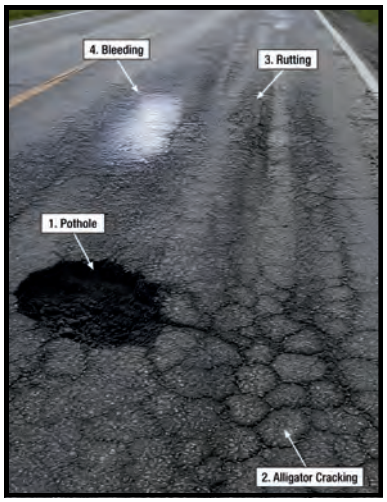
NANOMATRIX® MATERIALS

Nanomatrix Materials (NM) has developed **Asphene™**, a patent-pending **graphene-enhanced bitumen modifier (GEB)** engineered to significantly improve the performance, durability, and consistency of conventional Viscosity Grade (VG) bitumen. The solution is designed to integrate seamlessly with existing refinery and mixing infrastructure while delivering PMB-class or superior than PMB-class performance consistency.

Global Challenges with Conventional Bitumen

Despite widespread use, conventional VG bitumen continues to face structural and performance limitations:

- Rutting and Deformation under high pavement temperatures
- Cracking and loss of elasticity in cold or cyclic climates
- Performance variability within the same VG grade
- Accelerated oxidative aging and reduced service life
- High maintenance and resurfacing frequency leading to increased repair & maintenance costs
- Cost escalation with imported polymers



There is a clear industry need for a stable, high-performance, next-generation modifier that improves bitumen properties without compromising processing, storage, or economics.

Asphene™ : Graphene-Enhanced Performance Advantage

Asphene™ is a proprietary graphene-enhanced modifier that integrates at the molecular level within the carbon chain of bitumen, delivering balanced improvements in stiffness, elasticity, and aging resistance.

Asphene™ is an upgraded bitumen system developed by integrating functionalized robust graphene-based nanomaterials into VG-10 and higher grade bitumen, creating a next-generation alternative to conventional PMB. FTIR analysis confirms stable hydrocarbon structure with graphene-driven interfacial bonding.

Performance Summary

PROPERTIES	VG-10	PMB 76-10E	ASPHENE™ (Modified VG-10)
Softening Point	44 °C	70 °C	**85 °C**
Penetration @25 °C	75 °C	NA	**32 °C**
Elastic Recovery @15 °C	24 %	70 %	**80 %**
Viscosity @150 °C	NA	1.2 Pa.S	**1.1 Pa.S**
Separation Test - R&B	NA	3 °C	**1.9 °C**

From
VG 10 to PMB 76-10E
(Variants - GEB 70, GEB 80)

HIGH SOFTENING POINT

IMPROVED ELASTICITY

IMPROVED RHEOLOGICAL PROPERTIES

WATER PROOFING

IMPROVED MECHANICAL STRENGTH

REDUCE ENVIRONMENTAL IMPACT

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Advantages Over Conventional PMB

Operational Advantages

- Enhanced Stability and Rutting
- Compatible with batch and continuous blending systems
- Low energy requirements and faster blending with VG-grade bitumen
- Stable storage and extended shelf life
- Industry-standard modifier formats



Performance Advantages

- Higher softening point → better high-temperature rutting resistance
- Strong elastic recovery
- Improved fatigue life due to nano-reinforcement
- Compatible with existing PMB plants & blending systems

These results demonstrate long-term chemical stability and service-life reliability

Climate Versatility & Applications

Asphene is engineered for reliable performance across diverse climatic conditions:

- **Hot & Arid Regions:** Rutting and bleeding resistance
- **Coastal & Humid Zones:** Superior moisture and stripping resistance
- **Temperate Regions:** Stable rheology under variable traffic loads
- **Cold Regions:** Maintains flexibility, reducing thermal cracking

Suitable for highways, expressways, heavy-traffic corridors, airports and waterproofing

Economic & Sustainability Value Roads

- **30–50% lifecycle cost savings** due to reduced maintenance
- **30–40% increase in pavement life**
- Lower material consumption and reduce resurfacing frequency
- Reduced lifecycle CO_2 emissions
- Supports durable and climate-resilient infrastructure

Asphene™ enables stronger roads, lower operating costs, and long-term infrastructure sustainability.

Asphene™ can be positioned as:

A premium alternative to PMB-40 / PMB-76-10E, or
A new classified grade under advanced modified bitumen

Asphene™ represents a next-generation bitumen solution that combines graphene nanotechnology with refinery-scale manufacturability to deliver superior road performance without major process changes.



Our Goal: **No More Potholes.**

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