

## **Bio-based binders in asphalt – summary note**

### **Overview**

Bio-based binders are alternatives to conventional petroleum-based bitumen used in asphalt. They incorporate materials derived from biomass (plant or animal products) or waste streams such as used cooking oils. Their purpose is to reduce the carbon footprint of asphalt mixtures while maintaining similar performance to traditional binders.

### **Key Terminology**

- Bio-modified binder: typically <10% bio-based material replacing bitumen.
- Bio-extended binder: typically 10–75% replacement.
- Bio-replacement binder: >75% replacement.

### **Specifications and Quality Assurance**

Bio-based binders should comply with relevant European standards such as BS EN 12591 (paving grade bitumen), BS EN 14023 (polymer modified bitumen), and BS EN 13108 (bituminous mixtures). Additional testing such as Pressure Ageing Vessel (PAV) testing is recommended to assess long-term ageing. Suppliers should provide quality control data, a Declaration of Performance (DoP), and Environmental Product Declarations (EPDs).

### **Types of Bio-Based Materials**

Common bio-derived materials include tall oil pitch (a pulp industry by-product), lignin (from paper production), vegetable oils, food-waste pyrolysis products, and cashew nut shell liquids. Some bio-materials can act as rejuvenators for recycled asphalt pavement (RAP) by softening aged binders.

### **Advantages**

- Reduced embodied carbon in asphalt mixtures.
- Use of renewable or waste-derived feedstocks.
- Potential improvement in resistance to oxidation and ageing.
- Useful for rejuvenating binders in recycled asphalt mixtures.

### **Challenges**

- Limited long-term performance data in service.
- Variability depending on biomass source and dosage.
- Possible reduction in rut resistance if binders become too soft.
- Increased complexity in asphalt plant operations and mix design.
- Higher initial costs compared with conventional binders.

## **Environmental Impact**

Replacing a portion of bitumen with bio-derived material can significantly reduce the carbon footprint of asphalt. For example, replacing about 10% of bitumen with tall oil pitch can reduce the embodied carbon of asphalt mixtures. However, overall sustainability not only depends on feedstock sourcing, processing energy, for production, but also energy used in transportation and laying; which is measurable. The lifecycle impacts are as yet merely predictions.

## **Key Takeaways**

Bio-based binders can contribute to lower-carbon road construction while maintaining performance comparable to conventional materials. However, consistent quality control, appropriate specifications, and continued monitoring of field trials are essential to ensure durability and whole-life value.

A more detailed explanation can be found on the ADEPT website here.

<https://adeptnet.org.uk/documents/adept-use-bio-based-binders-asphalt>

ADEPT Soils & Materials Design & Specification Group

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