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Nanostructured Wax-Carrying Additive for Improved Asphalt Workability and Durability

Background

Paraffin wax has been used as a warm-mix additive for asphalt to improve the workability of bitumen and to extend the construction season. The addition of paraffin wax to asphalt reduces energy consumption and carbon footprint by reducing the mixing and compaction temperatures of asphalt. These lower temperatures during the mixing and compaction stages also reduce the extent of oxidation aging of bitumen. However, the presence of paraffin wax and its crystallization behavior can form weak spots in the bulk of bitumen, leading to cracks at low temperature. Therefore, a need persists for an asphalt additive that combines the benefits of wax with a mechanism to decrease unwanted wax crystallization.

Invention Description

Researchers at Arizona State University have developed a hybrid additive for warm-mix asphalt (WMA). The hybrid additive is produced using a process that includes impregnating a nanostructured aluminosilicate (e.g., nano-zeolite) with paraffin wax. The porous nature of nano-zeolite facilitates wax impregnation at liquid phase, promoting isomerization and preventing wax crystallization in the bulk of the bitumen. From the nanostructured aluminosilicate, the paraffin is slowly released and uniformly distributed in the asphalt, improving bitumen workability during mixing and compaction, as well as reducing the temperatures of the mixing and compaction phases. Notably, the hybrid additive also serves as an adsorbent to scavenge acidic compounds from asphalt, thereby improving the durability of the asphalt.

Potential Applications

- Asphalt
- Construction

Benefits and Advantages

- Reduces the adverse effects of wax on low temperature properties of bitumen

- Improves the workability of bitumen during mixing and compaction
- Adsorbs acidic compounds upon release of wax molecules which enhances bitumen resistance to moisture damage
- Reduces detrimental wax crystallization in bitumen

Related publication (link): Exploratory Synthesis of Low-Silica Nanozeolites through Geopolymer Chemistry

Related publication (link): Examining the Implications of Wax-Based Additives on the Sustainability of Construction Practices: Multiscale Characterization of Wax-Doped Aged Asphalt Binder

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