Technology Offer

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On-demand asphalt healing using nanomagnets

Invention

The invention offers an enhanced and simplified method for the healing of stress-induced cracks in bitumen-based road pavements. Magnetic nanoparticles embedded in the bituminous pavement material serve as heating agents, remotely excited with an electromagnetic field; as the nano-magnets heat up, they locally melt the bitumen and reduce its viscosity, such that small cracks from loss of cohesion and adhesion of pavement components are healed. The novel material can be applied to road construction without requiring additional skills or equipment, since the embedded magnetic nanoparticles are added to the asphalt during its preparation at the provider's site. Crack healing is easily achieved by locally applying an alternating magnetic field using standard equipment.

Background

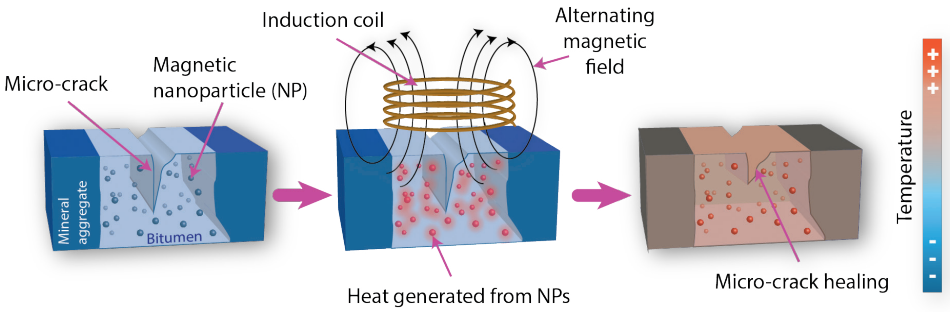
Road pavements are exposed to years of mechanical and thermal stress as well as environmental effects (oxidation from the air, UV, moisture). As a consequence, debonding at the interface between bitumen and mineral aggregates or cracks within bitumen can occur. If not closed early enough, irreversible damage will eventually be caused. Healing systems using pre-embedded encapsulated solving agents, or metallic additives heated by an electromagnetic field, have been previously investigated. Disadvantages are their lack of repeatability, the tendency to corrode, the temperature gradients they generate due to their large size, or their adverse effect on the material's integrity.

Advantages

The proposed bituminous composite material provides a cost-effective, and repeatable method to rapidly decrease binder viscosity for healing. Using magnetic nanoparticles, when dispersed uniformly in a small quantity, does not influence the mechanical properties. Due to the nanoscale size of the heating agents, only about 0.1–1% of the amount of magnetic metal of conventional systems is needed to achieve the same heating effect. In addition, magnetic materials in their oxide form such as iron oxide do not cause any corrosion as opposed to metallic additives. At the nano-range, such magnetic nanoparticles exhibit a strong magnetic response resulting in heat dissipation and therefore an accelerated decrease of the binder viscosity in the bituminous composite materials.

Applications

Our technology enables to provide a feasible alternative to heal cracks and debonding present in the topmost layer of road pavement. In addition, the "on-demand" melting of bituminous composite materials allows, for example, to promote adhesion of the bituminous composite material to different surfaces, like attaching bituminous joint sealings to structural elements (e.g. made out of concrete) or glueing waterproofing membranes to a substrate.



Ownership

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Keywords

Bitumen, Asphalt, Crack healing, Induction heating, Magnetic nanoparticles, Magnetic field, Waterproofing membranes, Dynamic materials

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