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Photo by Samuel Obando

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Aerogel Coating Technologies **aCT Inc.** is a startup company with the goal of developing and providing aerogel-based composites to reduce thermal susceptibility for different construction material-applications. We are creating resilient materials with a focus on the future.

Our vision is to drive sustainability through the use of longer lasting materials to save energy and raw material consumption levels.

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Aerogel-Modified Bituminous Materials

aMBx

Overview

Researchers at the Advanced Pavement Laboratory (APL), School of Sustainable Engineering and the Built Environment (SSEBE) at Arizona State University (ASU) developed a new technology using aerogel to provide a solution to asphalt pavement temperature susceptibility challenges. Aerogel material is treated with by-products of the petroleum-refinery system and blended with the asphalt mixture to provide thermal resistance.

The implementation of this technology in the asphalt material optimizes the thermal storage and allows less heat flow within the pavement structure. This can trigger a reduction in the thermal susceptibility of asphalt materials, improving their durability.

This technology can lead to asphalt pavements that are less prone to temperature embrittlement which will reduce cracking, permanent deformation, and deterioration.

This technology is versatile enough to be implemented in a wide range of applications, including paving materials, road surface treatments, crack sealants, asphalt roofing shingles, and Portland cement concrete applications.

Aerogel-Modified Bituminous Materials (***aMBx***) is one of the technologies developed and produced by the aCT team. aMBx is an aerogel composite, composed of aerogel in granular and/or powder form, with the presence of a petroleum by-product as an encapsulator. These elements are blended in a proprietary process, and the result is a composite.

The use of pre-treated aerogel composites improves environmental and handling issues. This technology constitutes an innovative nano-porous product (aMBx) as a modifier of bituminous constituents to function as a material with unique thermal resistance properties and provides a sustainable approach.

Exhaustive research outcomes show a decrease in the thermal conductivity and increase in the specific heat capacity of the ***aMBx-modified pavements***, leading to a lower temperature susceptibility of the material.

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Thermal insulation solution to long-lasting roads

aMBx attributes

aMBx is a synthetic porous silica-based aerogel material with dark color. Depending on the raw materials and the final application, its color can be lighter or darker. aMBx is a dry powder with homogeneous quality, trouble-free to handle and ship. This composite has a granular appearance with a very light weight. This material has a relatively low density and thermal conductivity.

Particle Size (mm)	0.1 to 3
Surface Chemestry	Hydrophobic
Bulk Density (g/cm^3)	0.20 to 0.38
Optical	Dark/opaque
Thermal Conductivity (W/m.K)	0.08 to 0.10
Operating Temperature (°C)	up to 200

Appearance of aMBx composite

The aMBx low thermal conductivity is the main property transferred to the bituminous materials such as asphalt pavements, creating a reduction in the heat transfer, and likewise an insulation effect.

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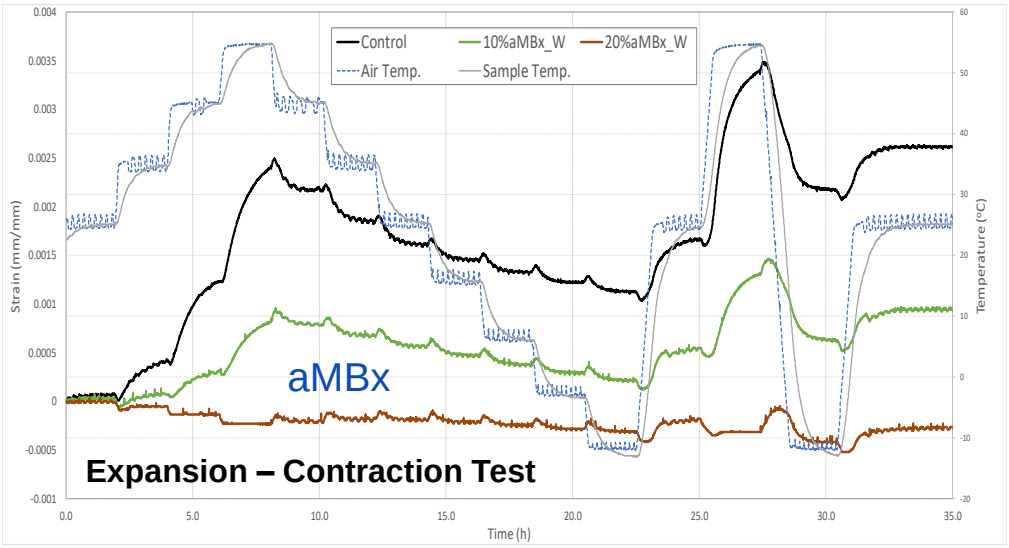
The potential of our technology

Binder samples after 1 hour in a chamber at 70°C (158°F)



Thermal susceptibility is one of the biggest challenges that asphalt pavements must overcome. Asphalt mixture's thermal susceptibility can increase problems related to permanent deformation, and the expansion-contraction phenomenon triggers thermal cracking. The novel aMBx-modified paving material can provide performance benefits solving common shortcomings of asphalt pavements, namely, high temperature deformation and thermal cracking.

The aMBx will increase resistance to temperature susceptibility and provide a more durable roadway.

Significant reduction of thermal strains induced during the temperature cycling processes.

Benefits

- Thermal susceptibility suppressor
- Durability enhancer
- Considerably increases the service life of pavements.
- Energy efficient material that increases durability and reduces CO2 emissions

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Usage/application considerations

aMBx-Modified Mixtures

A dry method can be simply applied. aMBx can be added into the asphalt mixture at the plant. Depending on the concentration, the mixing temperature may be increase slightly (between 3ºC and 5ºC), but additional mixing time is not needed. aMBx does not need extra binder with the exclusion of the film covering on the aMBx particles when they are present in the mix (usually between 0.1% and 0.3%). Typically, there is no need to adjust the standards of the dense graded mix designs because of the presence of the aMBx.

aMBx can be introduced into the mix throughout the RAP band. It is added in about 9 to 15 pounds per ton of mix (about 8% and 13% by weight of the binder for Superpave mixes), depending on the desired performance and/or purpose. It works with different mix designs and can be use with any additives and asphalt binders.

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Sustainability Benefits

The implementation of aMBx in asphalt mixtures can represent a significant improvement in performance and environmental impact. In a 25-years analysis window, the usage of aMBx may reduce the consumption of raw aggregates by approximately 43%, which represents a reduction in terms of Global Warming Potential (GWP) of around 1.178 kg-Co2eq for each Ton of asphalt produced. Also, binder usage may be reduced by about 51%, which accounts for another reduction of the GWP in 7.5 kg-Co2eq for each Ton of asphalt supplied.

aMBx represents a suitable alternative to use less raw materials, improves production processes, and generates less waste materials. The usage of aMBx into the road infrastructure is a contrast with the linear economy approach, which has a "take, make, dispose" concept of production. The implementation of aMBx fits in the circular economy concept where products, materials, equipment, and infrastructure are used for longer, improving the efficiency of these resources.

The implementation of aMBx enables societies and economies to become more sustainable, autonomous and in tune with the environment protection.

Conclusion

The implementation of aMBx reduces different asphalt-pavement distresses highlighting the permanent deformation and the thermal cracking. aMBx-asphalt pavements not only generate better in-field pavement performance (less maintenance and rehabilitation interventions), but also divert less material to landfills, and the reduction of raw materials such as binder and aggregates as a mid-term consequence.

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