Phase change energy storage road snow melting system

In this paper, the phase change materials suitable for anti-icing and snow melting were investigated and optimized and the silica-based phase change materials were prepared by the sol-gel process ...

Phase changes can have a tremendous stabilizing effect even on temperatures that are not near the melting and boiling points, because evaporation and condensation (conversion of a gas into a liquid state) occur even at temperatures below the boiling point.Take, for example, the fact that air temperatures in humid climates rarely go above (35.0^oC),

Suitable PCMs can also enable additional road surface functions, such as snow melting ability, freeze-thaw cycle resistance, and heat island reduction. ... effect of phase change energy storage on ...

Cold thermal storage can be used to manage peak load when the energy demand is exceeding the capacities of the electric companies. Latent heat thermal storage is more effective because it requires less spacing and has ...

The phase-change snow melting method cleans snow by the thermal energy released from the phase change ... Fig. 2 presents the three main units of the hydronic snow melting system: (a) a road unit, (b) a heat pump unit, and (c) a ground heat exchanger (GHE) unit. The other two auxiliary components are the water pumps and the data acquisition ...

Phase change material (PCM)-based thermal energy storage significantly affects emerging applications, with recent advancements in enhancing heat capacity and cooling power. This perspective by Yang et al. ...

Semantic Scholar extracted view of "Development and characterization of a novel steel slag-based composite phase change aggregate for snow/ice melting of asphalt pavements" by P. Xu et al. ... Journal of Energy Storage. 2024; 3. ... and bitumen or asphalt as a matrix is expected as a new, advanced material for road construction. The main ...

Phase change material slurries (PCS) can serve as both the heat transfer fluids and energy storage media, consequently, they are potentially applicable to the thermal systems, e.g., the secondary ...

Based on the calculation results shown in Fig. 5 and Fig. 6, the combination of n14-n18 can be screened out as the best candidate for pavement snow/ice melting due to its suitable phase change temperature and relatively high phase change enthalpy, which are 3.35 ? and 111.88 J/g, respectively.

The solar-assisted cold water phase-change energy heat pump system is a clean energy heating system which can effectively reduce the ice melting energy consumption of the cold-water phase-change energy heat pump

system. In this paper, the operation mode of the solar-assisted cold-water phase-change energy heat pump system is given, three new ice ...

Recently, energy storage piles utilizing phase change material (PCM) to enhance equivalent heat capacity have become an emerging topic in this field due to their demonstrated ability to increase ...

Abstract A unique substance or material that releases or absorbs enough energy during a phase shift is known as a phase change material (PCM). Usually, one of the first two fundamental states of matter--solid or liquid--will change into the other. Phase change materials for thermal energy storage (TES) have excellent capability for providing thermal ...

This study aims to utilize solar energy and phase change thermal storage technology to achieve low carbon cross-seasonal heating. The system is modelled using the open source EnergyPlus software ...

Under low-temperature conditions in winter, asphalt pavement is prone to cracking, icing and other distresses, which affect its safety and comfort. Therefore, by incorporating phase-change materials into asphalt and conducting relevant performance studies, the aim is to alleviate low-temperature distress and regulate road surface temperature and ...

Xiaolin et al. [189] studied battery storage and phase change cold storage for photovoltaic cooling systems at three different locations, CO 2 clathrate hydrate is reported as the most promising cold energy storage media comparatively with ice and capric acid-lauric acid eutectic mixture for PV cooling systems.

This system incorporates a latent-heat thermal energy storage (LHTES) system utilizing solar collectors and phase-change material (PCM). ... heat transfer rate, and charge/discharge efficiency. This study presents a demonstration application of a road snow-melting system employing LHTES. The system"s flow rate, integrating LHTES for road snow ...

It was observed that the phase change of snow began after 3 h; after 5 h and 30 min, the temperature reached 1.3 °C in an atmospheric environment of -6 °C, resulting in the melting of the 3-cm-thick snow on the surface. ... The inlet and outlet of the latent heat thermal energy storage (LHTES) system are located at the center of the can ...

Key words: 2D model, Phase Change, Heat Transfer, Fluid flow, Ice thermal energy storage, COMSOL Multiphysics ® Introduction Ice Thermal Energy Storage is a form of Latent Heat Thermal Energy Storage in which water is used as the Phase Change Material, which undergoes phase transformation during charging and discharging periods of operation.

Relative to sensible energy storage, the main advantages of such storage systems are the large storage capacity and the potential recovery of thermal energy at almost constant temperature (Choi and Kim, 1995, Agyenim et

al., 2010a). Another advantage of using PCMs for thermal energy storage (TES) compared to sensible storage media, is the ability to ...

Steel slag for road ... eutectic mass ratios and thermal energy storage properties of multiple fatty acid eutectics as novel solid-liquid phase change materials for storage and retrieval of thermal energy." ... H. T. Wu, and Y. N. Sun. 2021. "Snow-melting pavement design strategy with electric cable heating system balancing snow melting ...

Phase change materials for thermal energy storage: A perspective on linking phonon physics to performance. J Appl Phys. 2021;130(22):220903. doi: 10.1063/5.0069342 . Bhagat K, Saha SK. Numerical analysis of latent heat thermal energy storage using encapsulated phase change material for solar thermal power plant. Renew Energy.

Semantic Scholar extracted view of "Improving the melting performance of phase change materials using novel fins and nanoparticles in tubular energy storage systems" by Ji Zhang et al. ... Development of snow-melting system utilizing LHTES for black-ice and snow removal on roads.

AbstractThis work examined the performance of self-heating concrete under laboratory thermal conditions and outdoor real-time conditions during the fall and winter seasons. Snow-melting and freeze-thaw performance of low-temperature phase change materials ...Practical ApplicationsSnowfall and freeze-thaw cycles occur frequently during winter ...

Recently, electrically heated cable has been used to melt snow and ice from roads around the world. To increase the heat transfer efficiency of asphalt pavement and improve its snow and ice removal ability, but decrease summer solar heating, which could cause rutting, a new asphalt pavement system with various thermal conductivity for layered structures was ...

The present study proposes the phase change material (PCM) as a thermal energy storage unit to ensure the stability and flexibility of solar-energy-based heating and cooling systems. A mathematical model is developed to evaluate the PCM melting process, considering the effect of nanoparticles on heat transfer. We evaluate the role of nanoparticles (Al2O3-, ...

The snow-melting (or removal of black-ice) system with solar thermal energy consists of an energy source, a connecting line, energy storage, and pavement. In this study, a new type of black-ice removal system using latent heat thermal energy storage (LHTES) filled with an evacuated-tube solar thermal collector is presented and tested in the field.

This article reviews recent research on phase-change materials (PCMs) used in thermal energy storage systems with the aim of enhancing their performance. The study explores various methods to improve heat transfer in PCMs, such as microencapsulation, infill materials, fins and nanofluids. Additionally, it evaluates techniques

to boost heat transfer in latent heat thermal ...

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