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Infrared thermography applied to surface temperature survey of enhanced pavement sample addressing self-de-icing functionality

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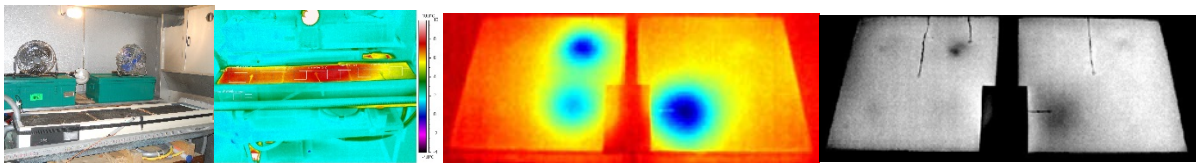
The mobility during winter season in France mainly relies on the use of de-icers, with an amount ranging from two hundreds thousands tons up to two millions tons for the roads only. Besides the economic impact, there are many concerns on their environmental and infrastructure, both on roads and on airports.
In such context and in the framework of the R5G (5th Generation Road) project driven by IFSTTAR, investigations were carried out on the way to modify the infrastructure to maintain pavement surface at a temperature above water freezing point. Two distinct approaches, that can could be combined, were selected. The first one consisted in having a heated fluid circulating in a porous layer within an asphalt concrete pavement sample. The second one specifically relied on the use of paraffin phase change materials (PCM) in cement concrete pavement ones.
Experiments on enhanced pavement samples were conducted in a climatic chamber to simulate winter conditions for several continuous days, including wind and precipitations, and monitored by infrared thermography.
Studies concerning the first approach consisted in identifying the temperature range of the fluid to maintain asphalt concrete surface freezing-free. Both experimental and numerical approaches were conducted showing the importance of the role of the hydraulic conductivity of the porous layer. The analysis of infrared images indicated a surface temperature above freezing excepted in one situation, for which cold air convection and precipitations were combined at pavement surface. A temperature gradient along the surface was also observed. A good agreement was found between numerical and experimental results.
To moderate the effect of precipitation, several PCM insertions were chosen and inserted at different depths, with various volumes and packaging (liquid, or powder of encapsulated liquid paraffin). At this stage of the study, rather mixed results were obtained. Delay in the surface ice formation was not conclusive, probably due to deeper location and an unsufficient amount of PCM used. Further investigation to carry out by coupling numerical and experimental approaches would help in refining the use of PCM for this application. The proposed paper will address the presentation of infrared monitoring developed during these studies.



(a) (b) (c) (d)

Figure 1: Hydro-thermal test device (a) and surface temperature infrared images (b) - Amplitude (c) and phase (d) maps of a test with PCM inclusion in concrete samples

Keywords: Infrared Thermography, porous asphalt concrete, phase change materials, winter maintenance.