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Thermomechanical response of bituminous pavements to hot and dry tropical weather conditions

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The main objective of this paper is to propose a two-dimensional (2D) model of temperature distribution and deformations of bituminous pavements under extreme climatic conditions in Burkina Faso (heat wave) using the COMSOL Multiphysics software. This model takes into account the geometry, the hourly weather conditions (solar radiation, air temperature, air humidity, dew point temperature, wind speed) as well as the temperature dependence of the mechanical parameters (modulus of elasticity, Poisson's ratio), thermo physical properties (thermal conductivity, diffusivity) of the materials. The results obtained show that it is possible to identify, for periods of the day, the existence of non-linear and permanent deformations in the surface layers of the pavements. The meteorological factor, namely temperature, was found to be very important in the choice of bitumen used for asphalt pavement construction in tropical areas.

Importance of Research:

Burkina Faso is served by an asphalt road network of 2654.482 km (17%), which is expanding rapidly to meet societal and economic challenges. The periodic maintenance of this network due to its deterioration occupies a significant part of the budget allocated to the ministries in charge of infrastructure.

The evolution of weather conditions increases the vulnerability of these road infrastructures to deterioration. During periods of high heat, for example, the pavement expands (Hermanson, 2000).

The issue of pavement behaviour in the face of climatic hazards has not yet been scientifically addressed in Burkina Faso. Road infrastructures are built using old pavement design methods (CEBTP, 1984) that take the climate into account based on the notion of equivalent temperature. However, these methods do not currently make it possible to reduce the problems of pavement deterioration linked to meteorological fluctuations.

The research work carried out by Professor David Yemboini Kader TOGUYENI's team, with the pioneering work in Burkina Faso of KOUDOUGOU Sidpouita Mathilde's thesis, is aimed at designing sustainable road infrastructures in dry tropical zones through diagnostic and prospective studies of the behaviour of bituminous pavements in order to provide technical and scientific solutions in terms of formulation and sizing, which will make it possible to limit the phenomenon of rutting, but also to design new eco-responsible substitute materials.

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Biography

Koudougou Sidpouita Mathilde obtained her scientific baccalaureate in 2005 in Ouagadougou, Burkina Faso, followed by a Bachelor's degree in Mechanical Physics and a Master's degree in Complex Systems with a specialization in Complex Fluids and Divided Media at the Faculty of Sciences of the University of Paris Saclay in France from 2008 to 2011. Her various internships and professional experiences in academia and industry (Psa Peugeot Citroen, Colas etc.) in the field of Research and Innovation in France have fuelled her desire to pursue a career in research. This is how she carried out her PhD thesis in Applied Physics specialising in thermophysics/complex materials from 2016 - 2020 at the Joseph Ki-Zerbo University of Ouagadougou under the supervision of Professor David Yemboini Kader TOGUYENI within the Laboratory of Environmental Physics and Chemistry. Her research work earned her an award at a scientific seminar dedicated to doctoral students and young doctors, conducted by the doctoral schools of the Joseph Ki-Zerbo University. Since June 2021, she has been a research assistant in physics at the Ecole Polytechnique de Ouagadougou.

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