Microscale characterization of the dissipation fields around CB inclusions in elastomers and comparison to macroscopic data

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Résumé

The fatigue properties of filled elastomers are strongly connected to the population of inclusions induced by their complex recipes and mixing / injection processes. The description and understanding of the basic mechanisms involved around these inclusions, depending on their nature, geometry, interface and cohesion properties are therefore of primary importance to optimize the fatigue design of industrial compounds and parts. Despite numerous studies based on SEM or tomography measurements, the understanding of the basic mechanisms at the scale of inclusions remains difficult. The objectives of this study are to take advantage of thermomechanical observations at the scale of the inclusions to characterize the early stages of the fatigue damage scenario. Several difficulties are at stake here, as high thermal and spatial resolutions are required to describe accurately the heterogeneous local fields. In order to simplify the resolution of the heat equation, thin specimens are considered here, presenting inclusions of about 500 micrometers. The experimental set-up includes an infrared camera and a digital microscope to measure both thermal and strain fields. The well resolved dissipation fields obtained are then used to characterize the heat build-up response at the inclusion's scale. The curve obtained is then challenged by comparing the response obtained for several areas on a given sample and for several samples. Finally, the heat build-up curves obtained around the inclusions and for a classical diabolo-shaped fatigue sample are compared. The very good agreement obtained validates a possible shift in scales and opens the way to the transposition and validation of macroscopic constitutive models and failure criteria at microscopic scale to identify damage scenario.

Mots-Clés: Elastomers, microstructure, thermography

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