Fatigue of natural rubber at different temperatures: lifetime reinforcement and industrial application

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Abstract

Natural Rubber (NR) is one of the most commonly used elastomers in the mobility industry thanks to its remarkable fatigue resistance. Typically, it exhibits a fatigue life reinforcement under non-relaxing loadings (Cadwell *et al*., 1940). During the development process of rubber parts, Contitech AVS France uses predictive approaches to supplement experimental tests and optimize the design loop. The robustness of the fatigue approach relies on two key pillars: *(i)* characterizing and modelling the fatigue life of rubber and *(ii)* understanding damage mechanisms. With the objective of perfecting the development process and therefore proposing more innovative technical solutions to customers, the effects of temperature and loading on the fatigue behavior of NR are here addressed. Both these parameters strongly affect the ability of NR to crystallize under tension. Since strain-induced crystallization (SIC) is commonly admitted as being responsible for the fatigue reinforcement of NR, it appears of paramount importance to characterize these effects. At 23°C, significant crystallization effects are highlighted under non-relaxing loadings, namely, a lifetime reinforcement (Ruellan *et al.*, 2019) and the presence of SIC markers at the failure surfaces (Ruellan *et al.*, 2018). It is here found that a fatigue reinforcement is still present at 90°C, while SIC markers disappear. At 110°C, crystallization effects are no longer observed. On an industrial point of view, a fatigue life prediction model that accounts for the fatigue reinforcement at various temperatures is proposed. Finally, a case study of damage analysis is given.

References

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