Humidity's critical impact on the durability and load-bearing capacity of bonded joints

A Akhavan-Safar (INEGI, Portugal), RJC Carbas, EAS Marques, LFM da Silva

INTRODUCTION

This study examines the impact of humidity on the durability and load-bearing capacity of adhesive joints, with a particular focus on how a humid environment affect the joint performance. The research evaluates the behavior of an epoxy based adhesive system under various loading conditions and environmental scenarios.

The investigation involves testing the adhesive under different loading modes such as tensile, shear, and mixed-mode loading, both in aged and unaged states. In addition to constant ageing, hygrothermal cyclic aging was performed to simulate real-world exposure to moisture and cyclic environmental conditions. The study also explores how factors like loading type and aging cycles influence adhesive performance.

METHOD

Strength (tensile and shear), fracture energy (mode I and mode II) and S-N fatigue (mode I and mode II) experiments were conducted on aged and unaged epoxy adhesive joints.

RESULTS

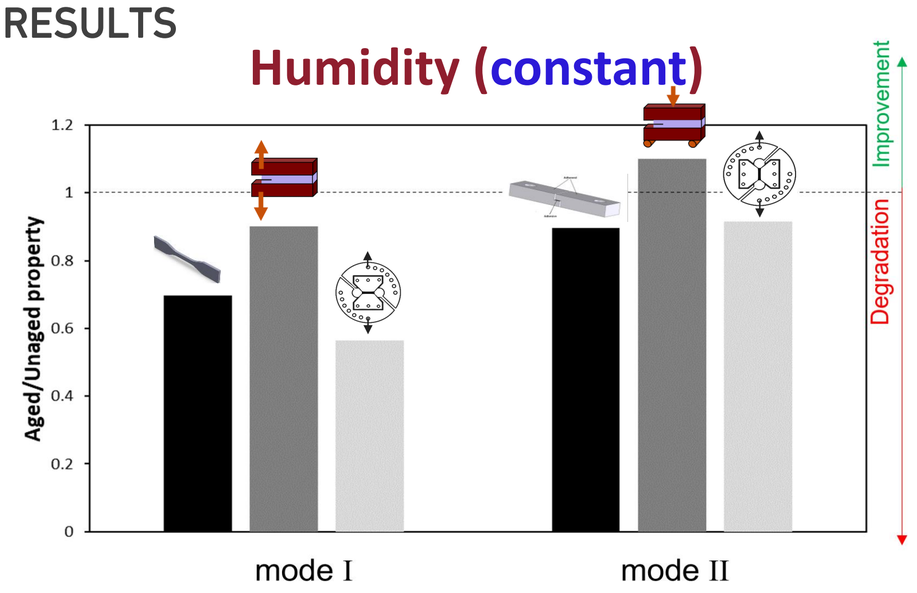

Figure 1 – Effects of constant and cyclic ageing on mode I and mode II properties of epoxy adhesives

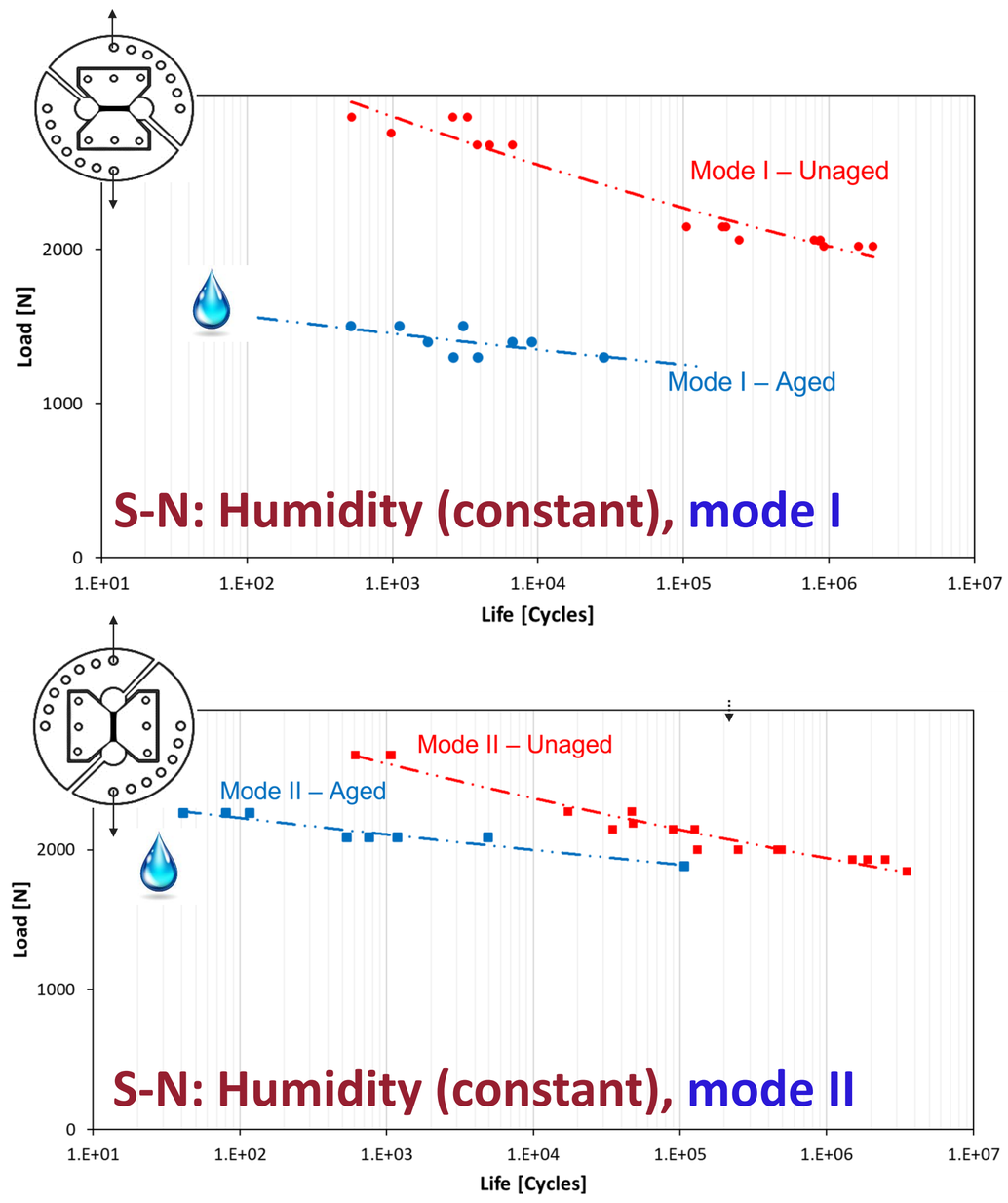

Figure 2– Effects of humidity on modes I and II fatigue life of an epoxy based adhesive

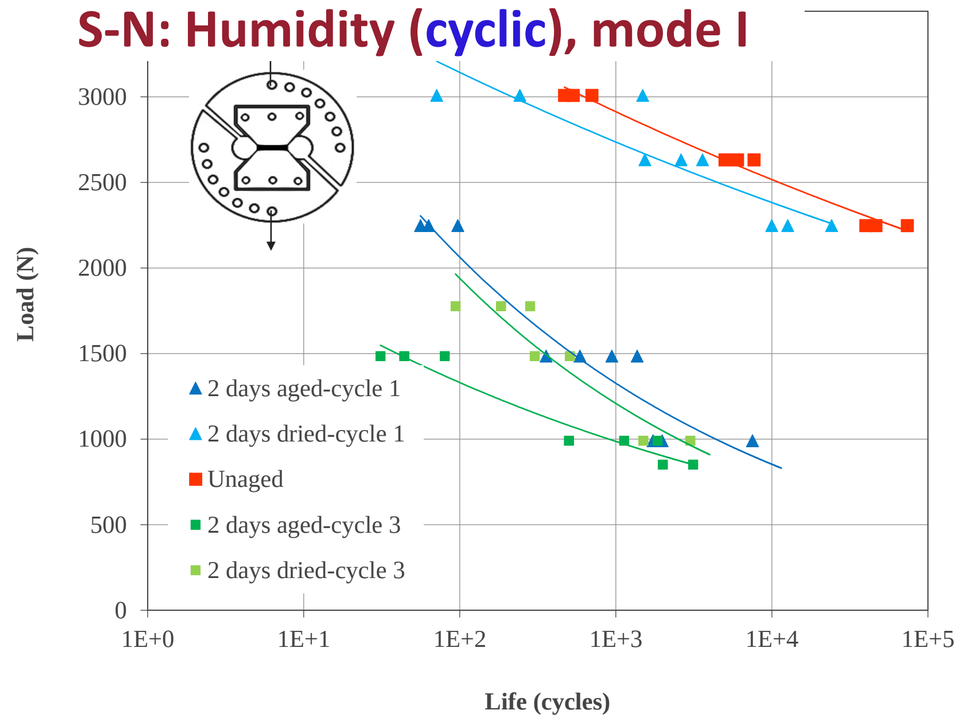

Figure 3 – Effects of cyclic ageing on mode I S-N fatigue life of an epoxy adhesive

Conclusions

Mode I loading is much more sensitive to humidity than mode II. Ageing cycles reduced fatigue strength by 46% and 34% (2-day cycles). Increased ageing cycles accelerated water diffusion at the interface, leading to adhesive failure.

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