LIFETIME ASSESSMENT OF PLASTIC PARTS UNDER CREEP-RUPTURE LOADING IN FUEL ENVIRONMENT

M. De Monte[1*], V. Le Baube[1], E. Moosbrugger[1], J. Strauch[1], W. Wettemann-del Chin[2], M. Lechmann[3]

[1] *Robert Bosch GmbH, Corporate Sector Research and Advance Engineering – Advance Production Technology 1 – Plastics Engineering, Postbox 1131, 71301 Waiblingen (Germany)*
[2] *Robert Bosch GmbH, Gasoline Systems, Project Plastic Parts Quality, Postbox 300240, 70442 Stuttgart (Germany)*
[3] *Robert Bosch GmbH, Gasoline Systems, Center of Competence Plastic Parts Engineering, Postbox 300240, 70442 Stuttgart (Germany)*
**Matthias.DeMonte@de.bosch.com*

Keywords: creep-rupture, lifetime assessment, fuel, polyoxymethilene.

Abstract

Lifetime assessment of plastic parts in fuel environment plays an increasing role in the design and dimensioning of automotive components. The trend to fuel diversification leads to increased testing effort for plastic parts to ensure fuel-resistance as well as mechanical-strength requirements. In order to reduce this effort, a better understanding of the damage and failure mechanisms of the polymer itself in fuel environment is necessary.

For this purpose a creep-rupture tester for inner-pressure loaded specimens has been developed at Robert Bosch GmbH. The testing device allows for investigating the combined interaction of temperature, fuel and mechanical loading on the lifetime of plastic parts. A bottle-shaped specimen has been developed as a demonstrator for inner-pressure loaded parts. Bottle-shaped specimens made of polyoxymethilene (POM) are subjected to creep-rupture loading until crack initiation leads to fuel leakage.

Creep-rupture lifetime data are then used to evaluate the performance of a local stress-based concept, comparing model estimation with experimental creep-rupture data on the bottle-shaped specimens.

The lifetime concept is calibrated on creep-rupture data from tensile specimens with different notch geometries in air and fuel environment. The influence of load level, temperature, notch geometry and fuel is discussed and considered in the model.

This work contributes to validate a lifetime assessment methodology for plastic parts operating in fuel environment, delivering an important milestone for the accurate lifetime estimation on parts and consequently reducing the testing effort.