

Accelerated Degradation Testing of Polymers



S. Hosseinzadegan¹, A.-M. Baronenkova¹, M. Kadinger¹, A. Murr^{1,*}

¹Research Center Energy, Vorarlberg University of Applied Sciences, Hochschulstrasse 1, 6850 Dornbirn, Austria
illwerke vkw Endowed Professorship for Energy Efficiency, Vorarlberg University of Applied Sciences, Hochschulstraße 1, Dornbirn 6850, Austria

Accelerated Degradation of Materials

Accelerated Ageing

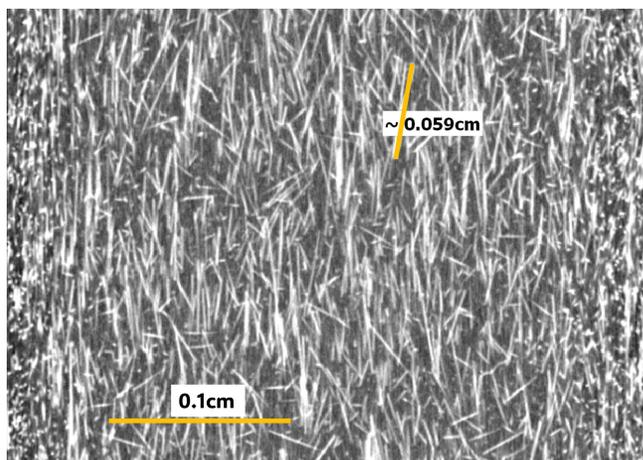
Accelerated ageing is the process in which one or more degradation mechanisms of a material are intentionally accelerated. At FHV, we currently employ several climate simulation chambers, a temperature shock chamber and a Ultraviolet chamber to apply irradiation and thermal stresses and mimic the effect of weather.



Analysis of Aged Materials

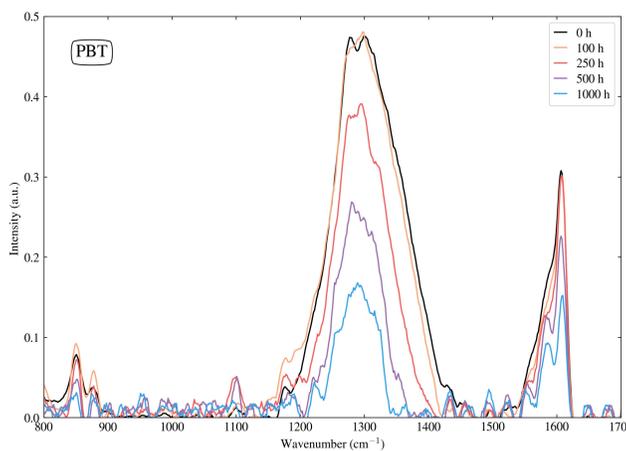
Applying accelerated ageing, the original properties of the materials change and further degrade. We analyze the involved influences to better understand why failure mechanisms occur and how they can be prevented. The analysis techniques include Raman, SEM, CT and mechanical testing.

Results of PBT Analysis



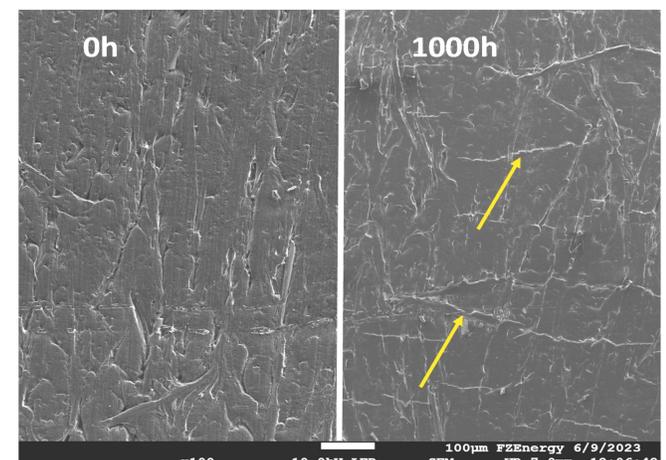
Computed Tomography

CT scan of the unaged glass fiber-reinforced PBT reveals the distribution of glass fibers in the polymer matrix. Orientation of the fibers is more ordered in the bulk of material than in the edges.



Raman Spectroscopy

By ageing of PBT at 180°C, the intensity and width of CH₂ band (1300 cm⁻¹) decreases. Alongside, shoulder separation and intensity decrease in aromatic C=C band (1621 cm⁻¹) are seen.



Scanning Electron Microscopy

SEM of surface microstructure of unaged and aged PBT samples at 180°C show that ageing caused surface damage of the polymer and several horizontal cracks appeared.

Available Infrastructure

- **Climate Chambers**
 - Discovery DM340 and DY110 C
 - Temperature range: -70 to +180 °C
 - Humidity range: 10-98% RH
- **Temperature Shock Chamber**
 - Weiss ShockEvent T/60/V2
 - Temperature range: -80 to +220 °C
 - Shock rate: 30 K/s
- **UV Chamber**
 - BS-02 Opsytec
 - Spectral range: 280 to 400nm
 - Irradiation power: 15 Watts
- **Scanning Electron Microscopy**
 - JEOL JSM-7100F
 - Magnification: up to x1000000
 - Elemental detectability: 0.5 wt%
- **Computed Tomography**
 - Phoenix Nanotom m
 - Magnification: x1.4 to x300
 - Detail detectability: 0.2 µm
- **Raman Spectroscopy**
 - WITEC alpha300 R
 - Magnification: x10 to x100
 - Lasers: 405, 532, 785 nm

How can we help you?

- **Services at FHV**
 - Accelerated degradation, lifetime and reliability testing according to desired requirements or standards
 - Characterisation and analysis on the macro-, and micro-scale
 - Failure identification and estimation of product age or product lifetime

