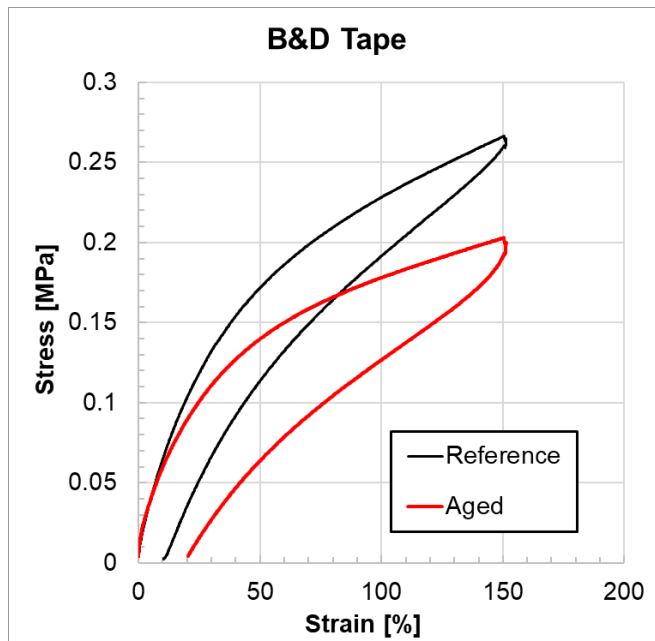


MiMM Day 2023 - Modelling the aging of adhesive tapes

Pressure sensitive adhesives (PSAs) as all polymeric materials undergo aging. Some PSAs are influenced more than others. To understand the impacting factors and hence being able to design materials less affected by aging, mathematical models of the corresponding chemical diffusion-reaction-systems can be of great help. As chemical reactions and diffusion processes are highly temperature dependent, the modelling of heat conduction is crucial, too.



Due to chemical transformation of the PSAs further properties like mechanics are affected as well.

In the shown example for instance the aging influenced the stiffness of the material heavily. Here, we can assume that a chain scission reaction triggered by temperature. Short polymer chains yield a softer mechanical response.

In other cases, or with ongoing aging other mechanism like oxidation play an additional role. Oxidation triggers a concurring effect. The material stiffens. Overall, under aging one collects many time-dependent effects.

Mathematical modelling approaches to describe those effects are

- Heat transfer and conduction
- Humidity - Water uptake and diffusion
- Oxygen uptake and diffusion, including diffusion-limited oxidation
- UV Light penetration
- Chemical reaction (stationary)
 - Crosslinking of different types
 - Chain scission
 - Oxidation by O₂ and O₃; and effect of anti-aging agents
 - Hydrolysis
- Influence on mechanical properties

And maybe you will find even more! The stepwise separation and analysis of the effects within the complex system may be the point of departure.

Of special numerical interest are additionally attractor sets of the dynamic systems, and what kind of nonlinear reaction equations are allowed such that the resulting system is still solvable.

The tesa SE team will be happy to discuss this challenging modelling task with you!