Master Assignment:

"Mechanical Characterization of Wind Turbine Blade Coating Materials"

Summary:

Wind turbines are increasing in diameter (>220 m) leading to higher tip speeds (>100 ms^{-1}). Interactions of the high tip speed blades with rain droplets causes erosion damage over time. In order to model coating performance, the (visco-) elastic material properties at high strain rates need to be evaluated. For this purpose, mechanical testing at various strain rates and temperatures needs to be performed and a time-temperature superposition has to be applied. Typically, this is done using DMA testing and tensile testing in combination with the Ree-Eyring relation. This assignment is in close collaboration with Akzo Nobel. Two wind turbine coating systems will be considered and their performance will be modeled and compared with experimental results. Good communication skills with the involved partners are required.
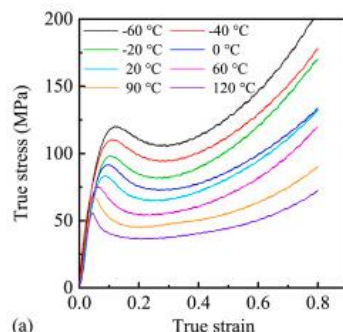
Objectives:

Characterize the (visco-) elastic and (fatigue) strength material properties at high strain rates using low temperature test methods for two different wind turbine blade coating systems provided by Akzo Nobel.

1. Perform a literature study on mechanical testing of high strain rate properties of polymers using low temperature tests.
2. Perform mechanical testing using a universal tensile testing machine with climate chamber.
3. Assess the time-temperature dependent (visco-) elastic mechanical response of the considered polymeric material systems using the Ree-Eyring framework.
4. Characterize the fatigue strength dependence on time-temperature using low temperature fatigue tests.
5. Model the coating performance using a pre-developed lifetime prediction modeling framework for wind turbine blade coating systems.
6. Compare the predicted lifetime with experimental results from a rain erosion test.
7. Present the outcomes in oral presentations for Akzo Nobel and write a report.

Contact:

Nick Hoksbergen (t.h.hoksbergen@utwente.nl)