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MATERIAL CHARACTERIZATION OF BIO-BASED POLYURETHANE AND ITS MODELING UNDER CYCLIC LOADING

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Abstract. Long term mechanical performance of bio based resin subjected to cyclic loading is studied and modeled. The Integral approach for time dependent materials using finite element method is used for simulation of linear non aging viscoelastic materials. This method does not require integration thru time and instead an internal state variable represents the entire past history. However it does not take into account internal heating due to viscoelastic dissipation. To overcome this, the dissipated thermal energy is calculated at each timestep thus generating heat and the new temperature is fed back into the mechanical properties to assemble a fully coupled model. This model is developed towards high cycle fatigue life prediction of composite materials. The model relies on material characterization of the creep and relaxation spectrums at different temperatures to determine the shift function and the Dirichlet-Prony series coefficients. Bio based polyurethane resin was characterized, tested and simulated. Tensile, DMA, creep and relaxation tests were performed at different temperatures. To determine the energy converted into thermal energy the simulation must be fitted with experimental data. Several isothermal and cyclic loading were performed. The model was validated with theoretical values, literature examples and experimental results.