Tough Epoxy Systems for the Impregnation of (Future) High Field Superconducting Magnets

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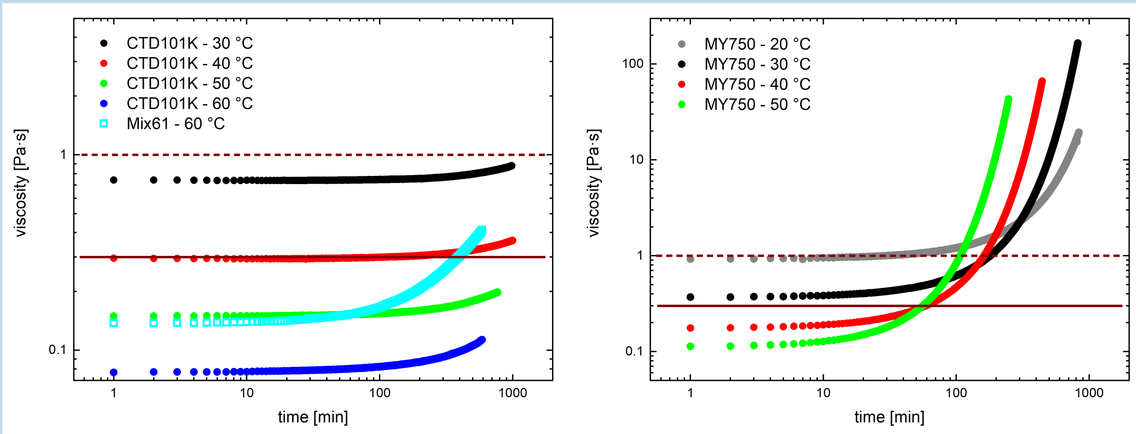
Motivation

The following work addresses **improvements of the resin impregnation systems** with the goal to **overcome** field limiting effects occurring during training like **micro-cracks, plastic events, or delamination**. A current **cooperation between ETH Zürich, Paul Scherrer Institute and CERN**, embedded in the CHART (Swiss Accelerator Research and Technology) initiative, aims at the **development of tough epoxy systems suited for the impregnation of future high field superconducting magnets.** In the first project period a baseline is established by the **characterization of three technically relevant systems (CTD-101K, Mix61, MY750/HY5922)** that are compared with regards to their **mechanical and processing properties at room temperature** which will be transferred to **liquid nitrogen/helium temperatures in the upcoming project period.**

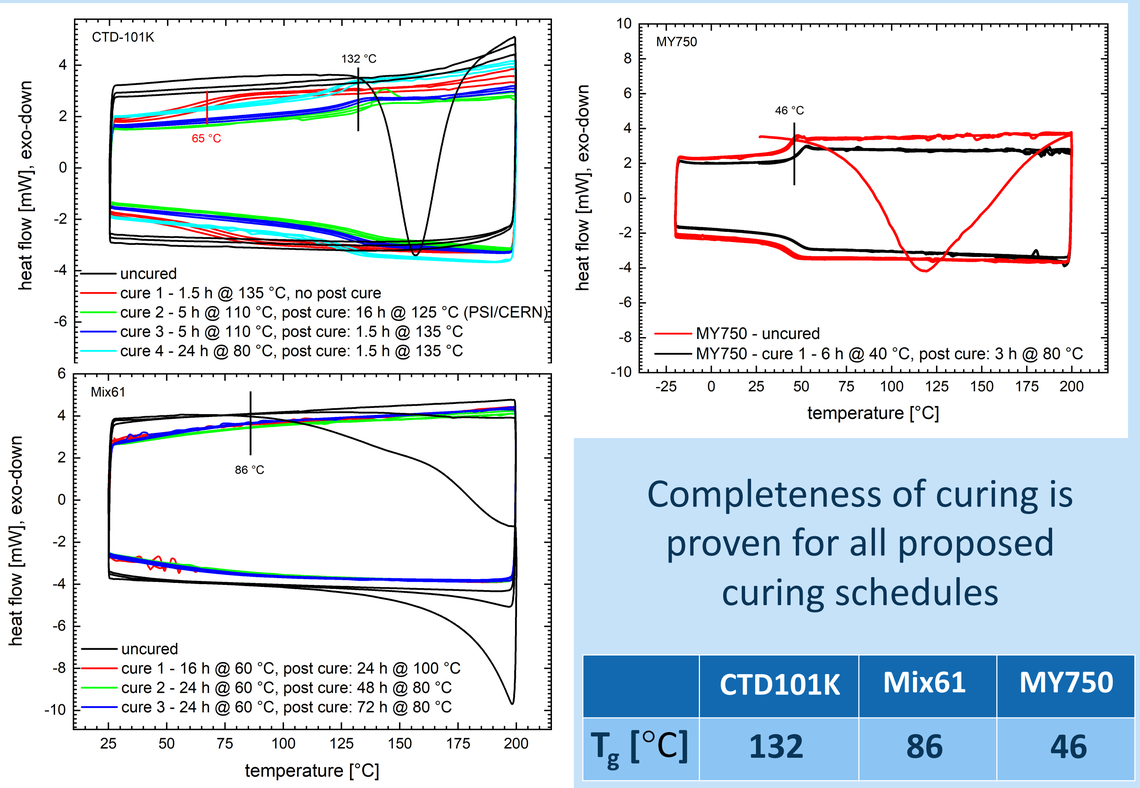
Pot life



- A viscosity of η = 100 - 300 cPoise = 0.1 - 0.3 Pa·s should be guaranteed for 4h - 7h at the processing temperature
- For canted cosine theta coils (PSI) the upper acceptable limit is up to η = 1000 cPoise = 1 Pa·s

CTD-101K and Mix61 fulfill this requirements, while MY750/HY5922 would need modification to lower viscosity.

T_g and completeness of curing

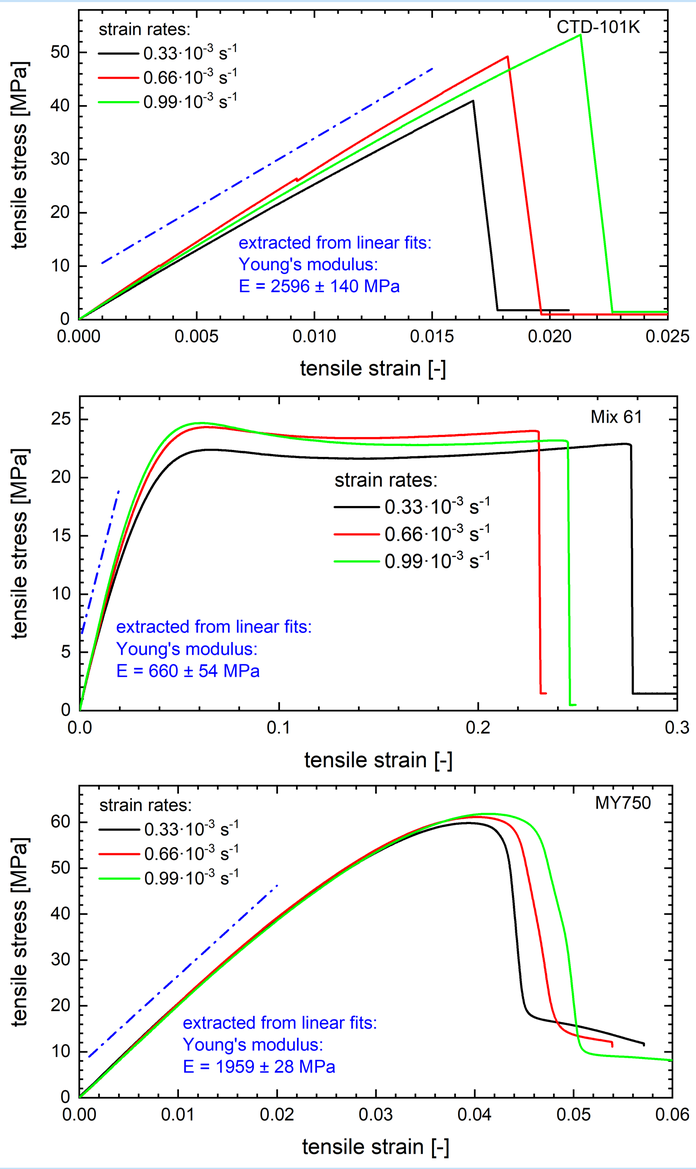


Completeness of curing is proven for all proposed curing schedules

	CTD101K	Mix61	MY750
T_g [°C]	132	86	46

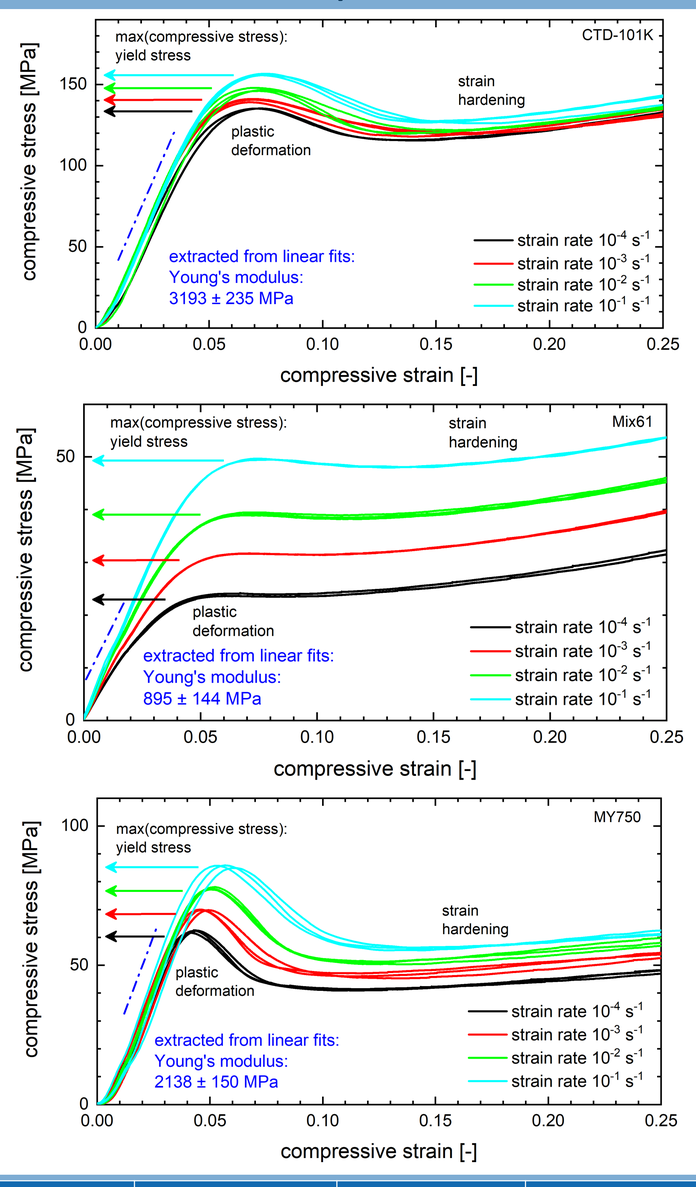
Mechanical testing at room temperature

uniaxial tensile tests



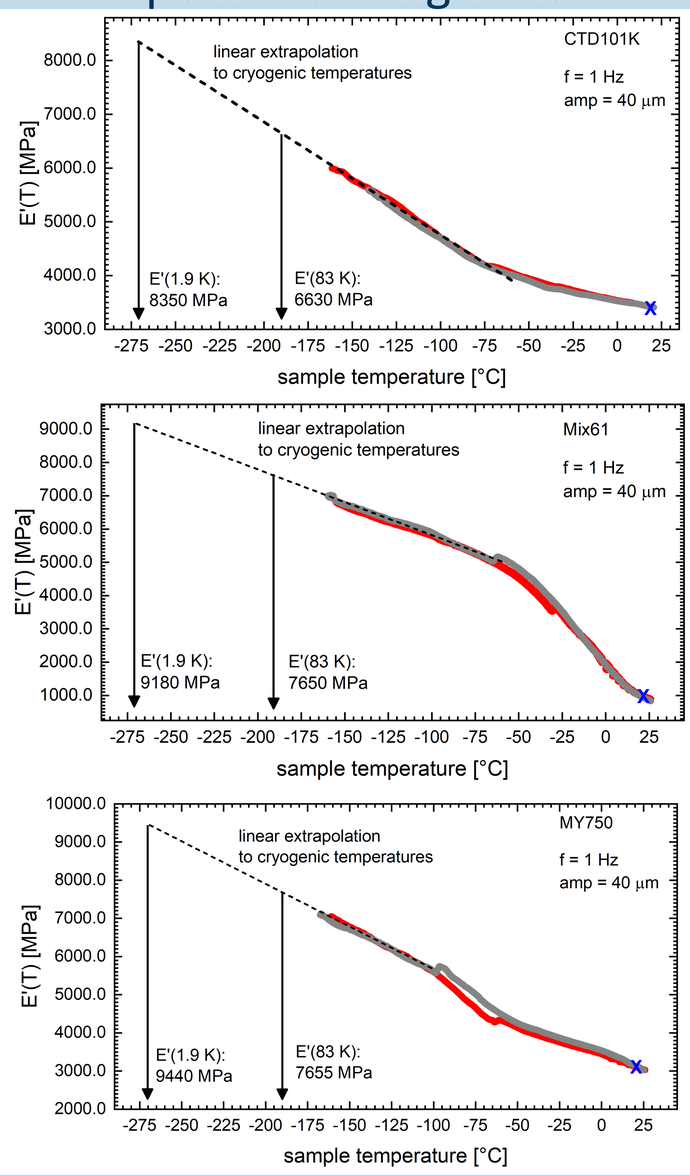
	CTD101K	Mix61	MY750
E [MPa]	2596 ± 140	660 ± 54	1959 ± 28

uniaxial compression tests



	CTD101K	Mix61	MY750
E [MPa]	3193 ± 235	895 ± 144	2138 ± 150

3-point bending tests



	CTD101K	Mix61	MY750
E [MPa]	3413 ± 100	819.0 ± 80	2988 ± 300