

LOW FLIP

Development of new raw materials



This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration

Objectives

Main objectives:

- Development of new *snap-cure* prepreg materials based on heavy tow carbon fibers
 - Combination of rapid curing at elevated temperatures with long shelf-life at room temperature
 - Suitable for automated processing and out-of-autoclave curing

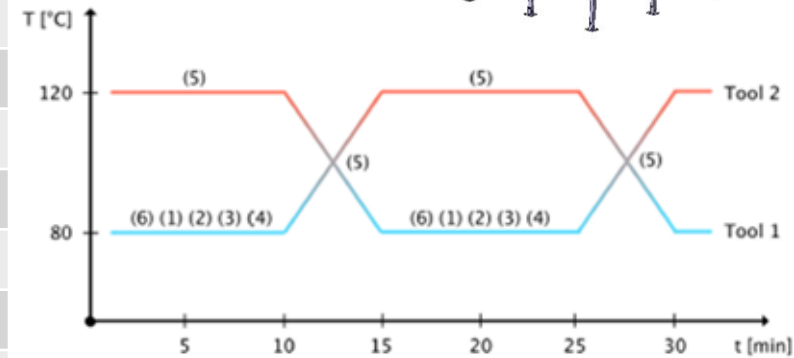
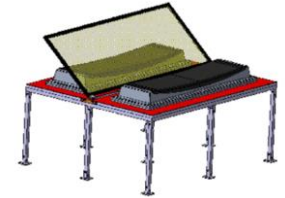


- Characterization of the new materials: curing behavior, mechanical performance, automation capability
 - Determination of kinetic, thermal and mechanical properties
 - Tests of processability in automated deposition units (pick & place, tape laying), drapability etc.

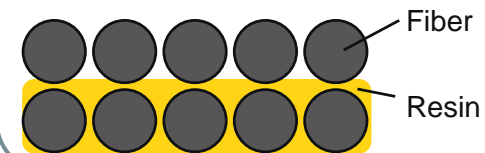


Prepreg development – Material baseline

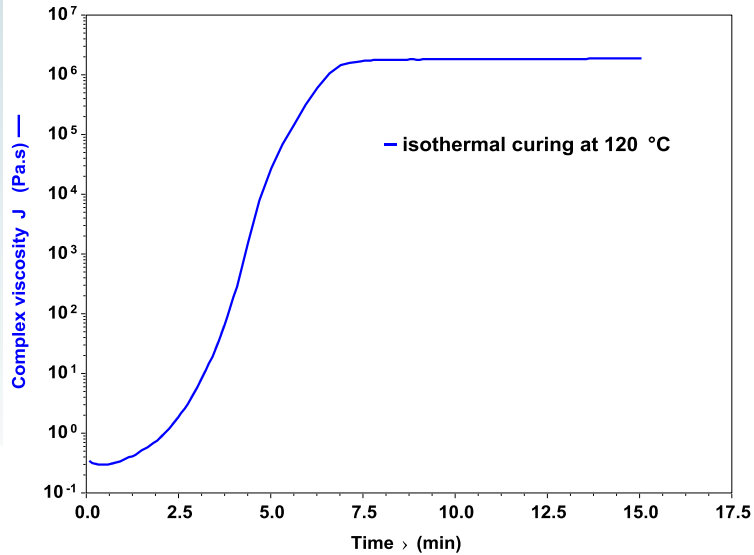
Property	Value
Cure time	≤ 15 min
Cure temperature	120 °C
Applicable heating rate	≥ 10 °C/min
Curing process	out-of-autoclave
Post-cure	preferably no post-cure
Glass transition temperature	≥ 120 °C
Matrix must be toughened	yes
Matrix must be flame-retardant	no
Matrix must UV-stabilized	no
Shelf-life at room temperature	≥ 21 d
Shelf-life at -18 °C	≥ 6 months
Tack at room temperature	low
Textile	biaxial and unidirectional non-crimp fabrics
Fiber areal weight	tbd (e.g. 400 g/m ²)
Resin content	tbd (no excess resin)
Impregnation level	semi- and full-preg



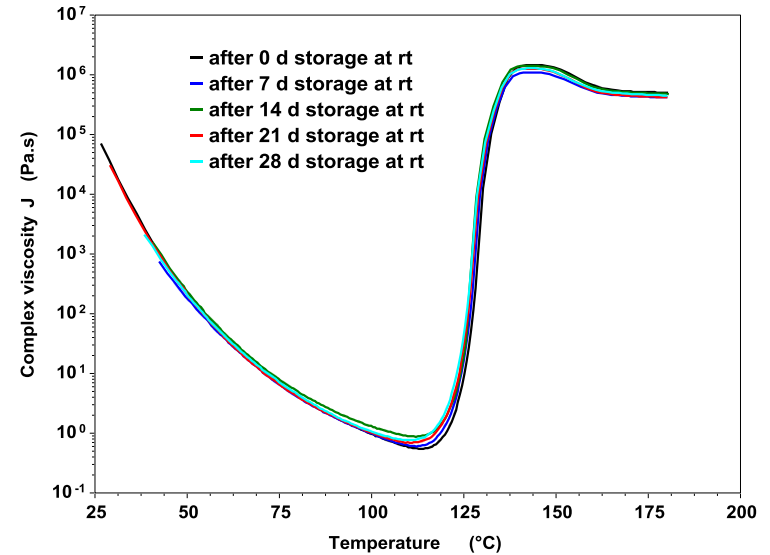
Semi-preg → dry side for improved handling properties



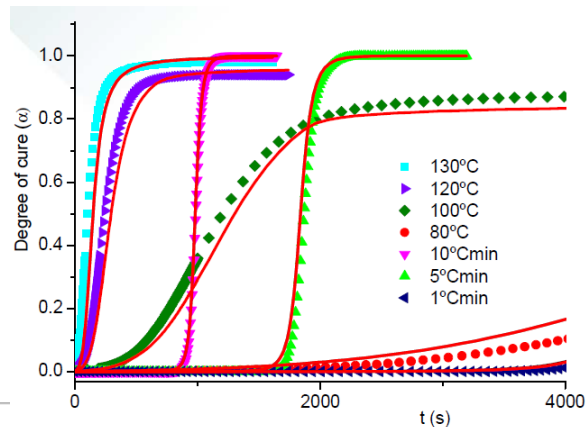
Developed resin system



Isothermal viscosity profile
(plate-plate rheometer, 120 °C)



Dynamic viscosity profiles
(plate-plate rheometer, 5 K/min)

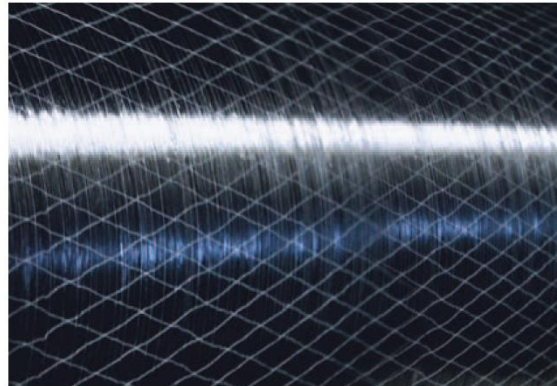


Kinetic models
(based on DSC measurements)

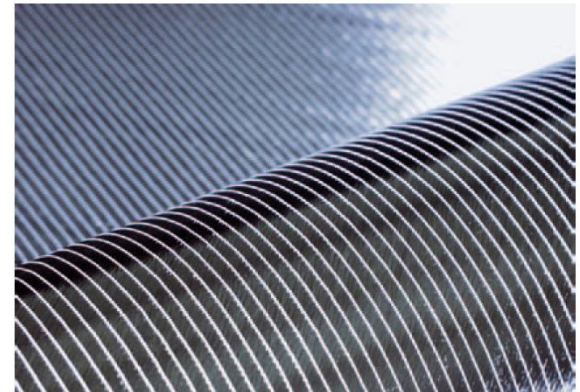
Impregnated trial materials



UD prepreg



UD NCF with scrim-bonding

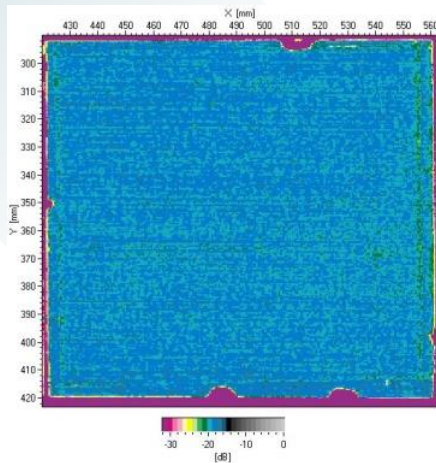


Biaxial ($\pm 45^\circ$) NCF with sewing yarn

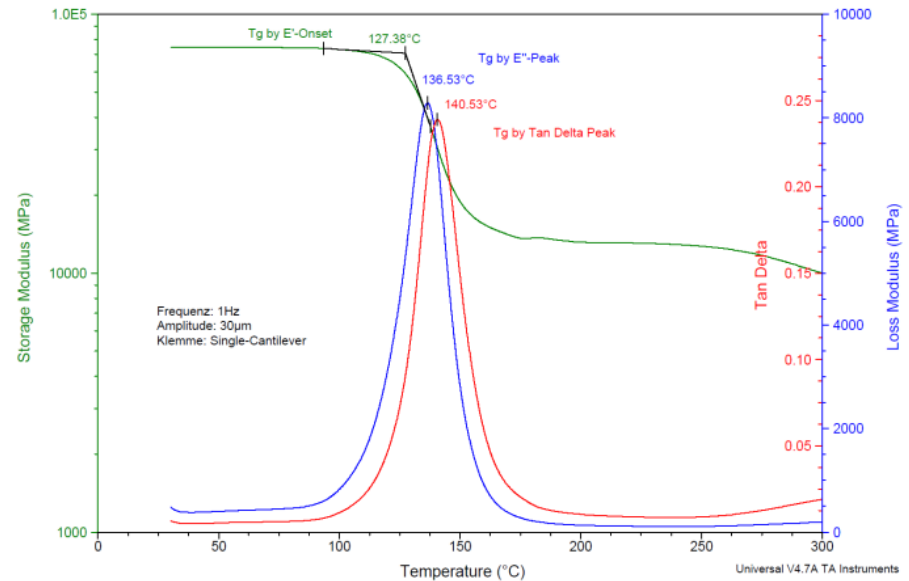
- Types of prepreg trial materials prepared:
 - UD prepreg (“full-preg”), out-of-creel, FAW 300 g/m²
 - UD semi-preg, UD NCF with scrim bonding, FAW 600 g/m²
 - Biaxial ($\pm 45^\circ$) semi-preg, sewn NCF, FAW 300 g/m²
 - Biaxial ($\pm 45^\circ$) semi-preg, NCF with scrim bonding, FAW 400 g/m²

Characterization of prepreg materials

- Materials feature high curing performance and give good laminate qualities



C-Scan of UD laminate



DMA of cured UD laminate (15 min @ 120 °C)

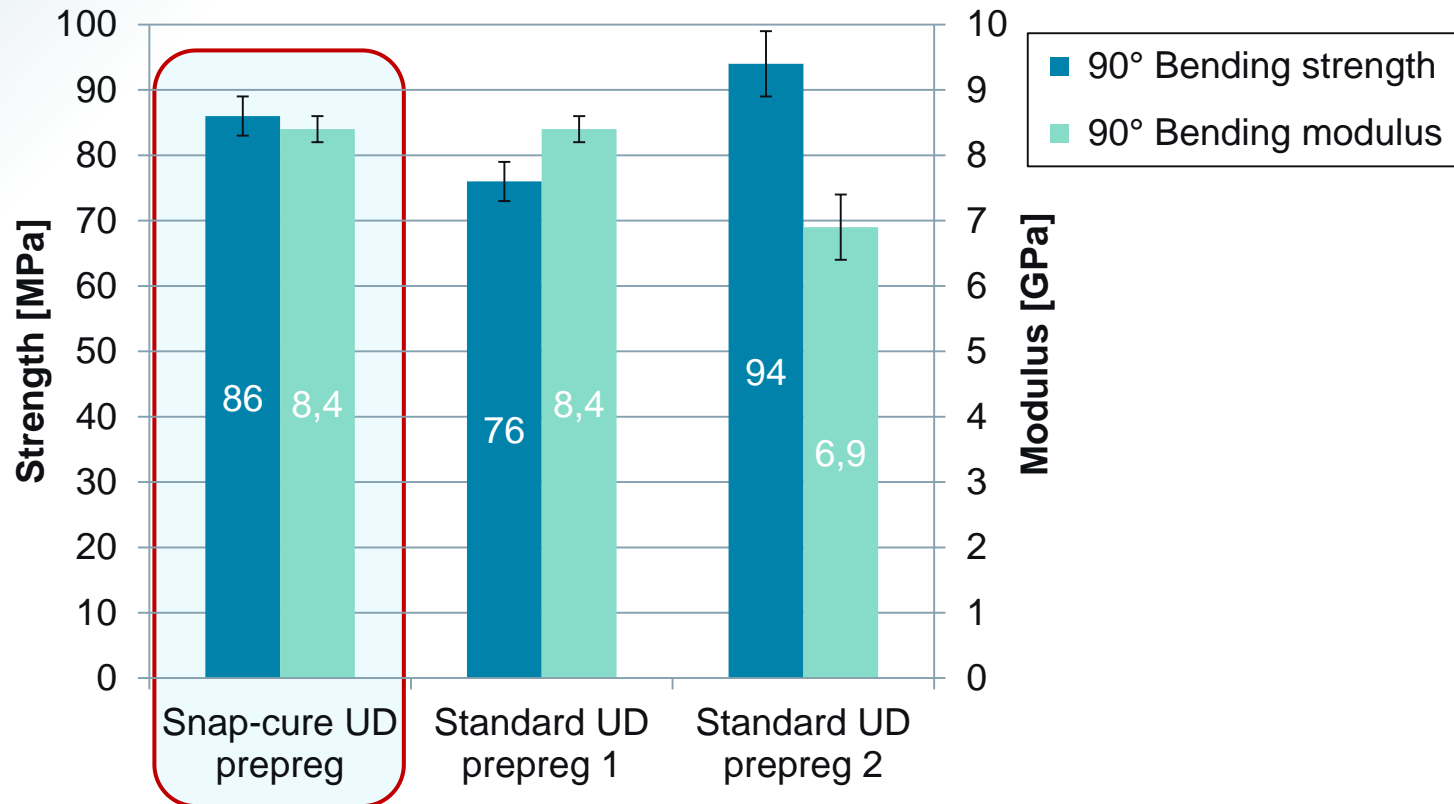
Void Content [%]

	C1 (350 mbar)	C2 (350 mbar)	C3 (350 mbar)	C4 (30 mbar)	C4 (2-sided release film)	C5 (=C2, 30mbar)	C6 (30mbar)
Scrim VARI	0,76	1,00	0,38	-0,24	0,10		
Scrim VAP	0,41						
Sewed VARI	8,58	6,94	7,37	7,01	6,60		
Sewed VAP	8,89						
UD 300gsm VARI	1,90	2,53	1,93	1,44	1,76		
UD 300gsm VAP	2,77						
UD 600gsm VARI						0,21	0,37

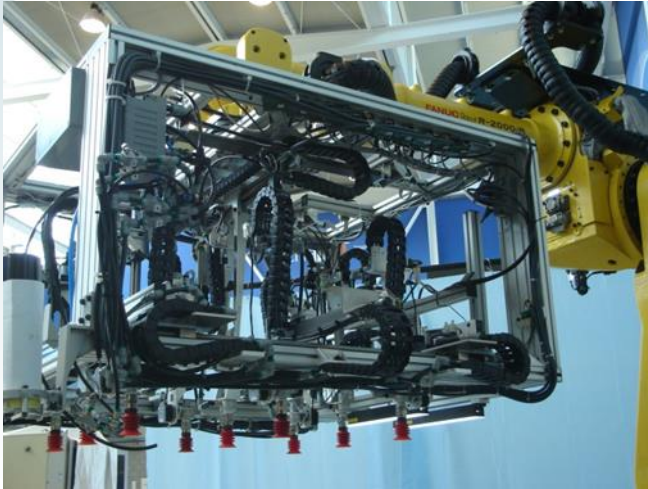
Mechanical characterization

- First results obtained with trial materials show high performance

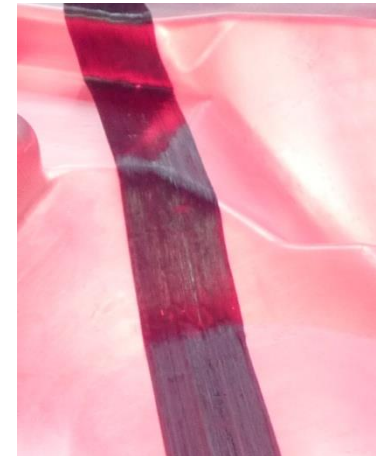
4p-Bending test of UD laminates



Tests of processability



Easy to process in automated pick & place and lay-up processes



Good drapability

Material development – Conclusion

- Prepreg materials showing the desired snap-cure and processing properties successfully developed
- Range of impregnated trial materials prepared
- Detailed mechanical characterization of materials ongoing, first results show high performance