Embedded Life-Cycle Management for Smart Multimaterials Structures: Application to Engine Components

MORPHO FINAL CONFERENCE

TURBO: Towards Turbine Blade Production with zero waste

Online Flow, viscosity and Tg for intelligent turbine wind blade production

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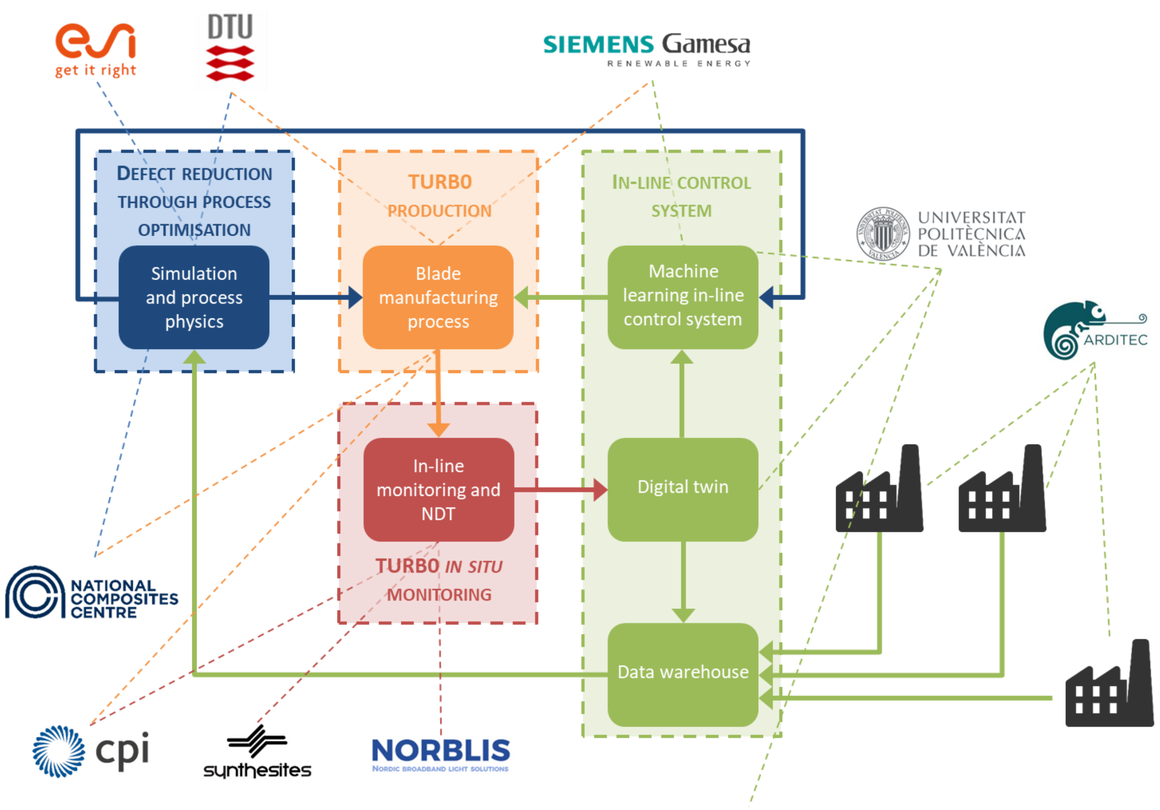
Consortium

No.	Short name	Name	Country
Beneficiaries			
DTU		DANMARKS TEKNISKE UNIVERSITET	DK
SGRE		SIEMENS GAMESA RENEWABLE ENERGY AS	DK
ESI		ESI GROUP	FR
UPV		UNIVERSITAT POLITECNICA DE VALENCIA	ES
SYN		SYNTHESITES	BE
NORBLIS		NORBLIS APS	DK
VIV		VIVID COMPONENTS GERMANY UG	DE
ARDITEC		ARDITEC	FR
Associated partners			
NCC		NCC OPERATIONS LIMITED	UK
CPI		CENTRE FOR PROCESS INNOVATION LIMITED	UK

Partner key contributions



Demo @ Siemens-Gamesa @Aalborg

TURBO demo

- SGRE will dedicate space in its Aalborg factory to preparations for the TURBO demo
- A large section of a >80 m blade will be used to demonstrate TURBO advances
  - Allows analysis of large blade aspects not possible on a smaller scale blade
  - Assess how TURBO technology can be integrated into a real production line
  - Quantify benefits in terms of improved quality and reduced scrap

Images courtesy of Siemens Gamesa Renewable Energy A/S.

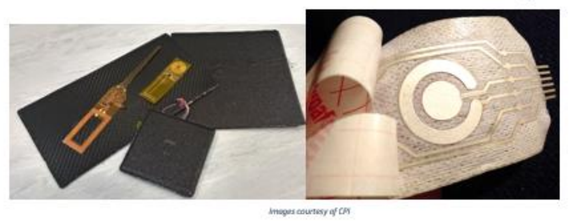
Results

In-line process monitoring

- Synthesites TURBO system will
  - Measure resin arrival during infusion and temperature measurement (≤ 56 points)
  - Calculate online resin viscosity and gelation time
  - Track the evolution of glass transition temperature (T_g) at several locations
  - Broadcast all data in real-time to help define system control signals

Images courtesy of Synthesites

- CPI will develop a TURBO embedded wireless sensor system
  - Measures resin arrival and temperature
  - Fabricated on flexible substrate
  - Wireless communications will send data from inside the mould (*i.e.* LoRaWAN)



Images courtesy of CPI

A first trial with Synthesites equipment and the materials that will be used in the project has been performed at SGRE. Introducing a disposable cure sensor at the top of the thick sandwich laminate as can be seen in fig.1 the temperature and resistance were recorded using an Optimold unit. The temperature and resistance history can be seen in fig.2 with the corresponding process milestones. Due to the thermal insulation and the cure reaction the temperature was escalated quite quickly which accelerated the curing significantly.

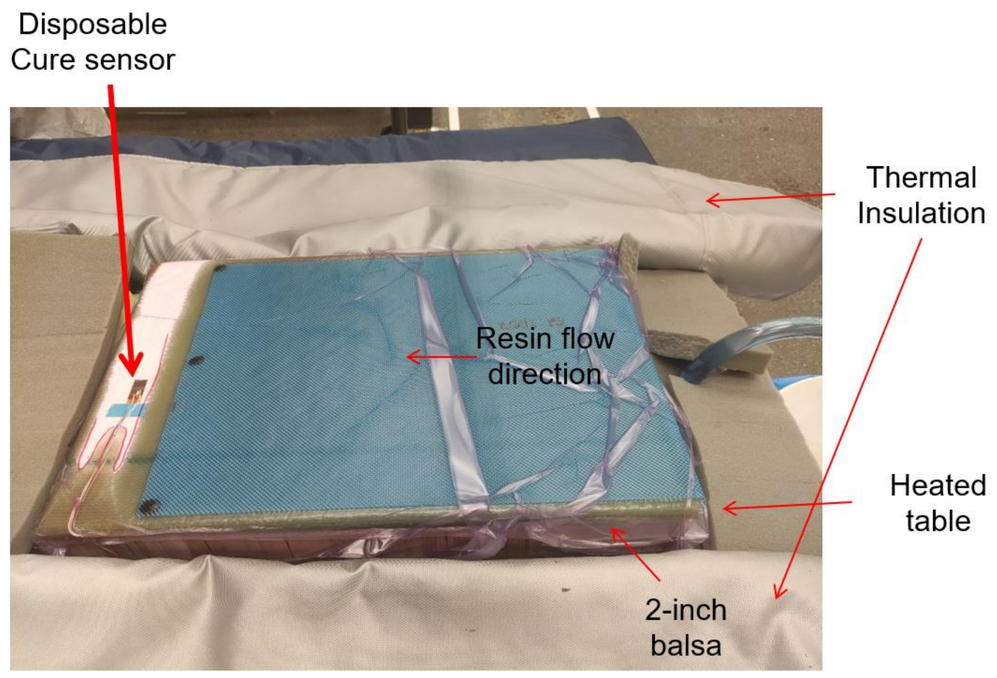


Figure 1. Panel during the infusion with epoxy resin.

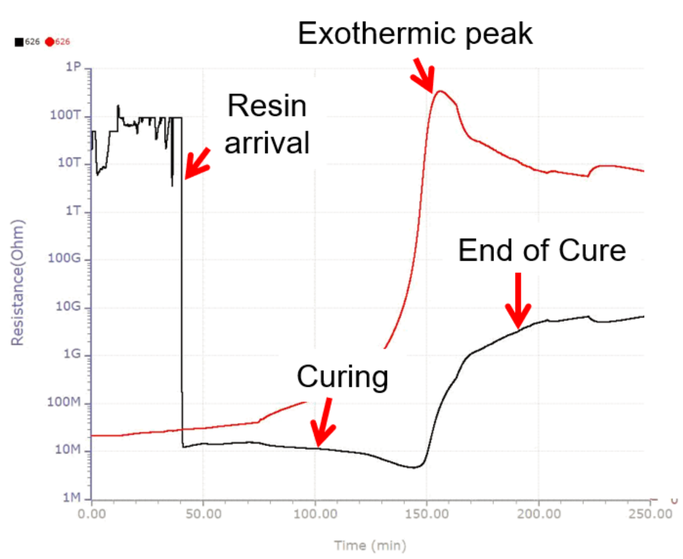


Figure 2. Recorded temperature and resistance during the infusion and the curing

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