



ADVISE

Where materials' intelligence creates the advantage

DETA SCOPE

Cure Performance Monitoring System (CPMS)

the intelligent way to optimise and assure quality of the processing of composites

Overview

ADVISE has developed and installed the industrial sensing platform called Cure Performance Monitoring System (CPMS). The system performs intelligent process monitoring of the manufacturing of composite structures and has found application to autoclave and RTM processing.

Current implementations of CPMS are made in a wide range of processing conditions: from standard (up to 200°C and 80 bar) to high temperature (up to 400°C and 20 bar). The number of sensor channels also ranges from 2 up to 8. The sensors are robust and they incorporate dielectric sensing element and thermocouple. The sensor mounting to the process tooling has been optimised to withstand the processing conditions mentioned above.

The real-time output of the CPMS to the supervisory process control of the autoclave or the RTM system is the actual resin properties in the composite structure at the location of the sensors. The relevant resin properties are:

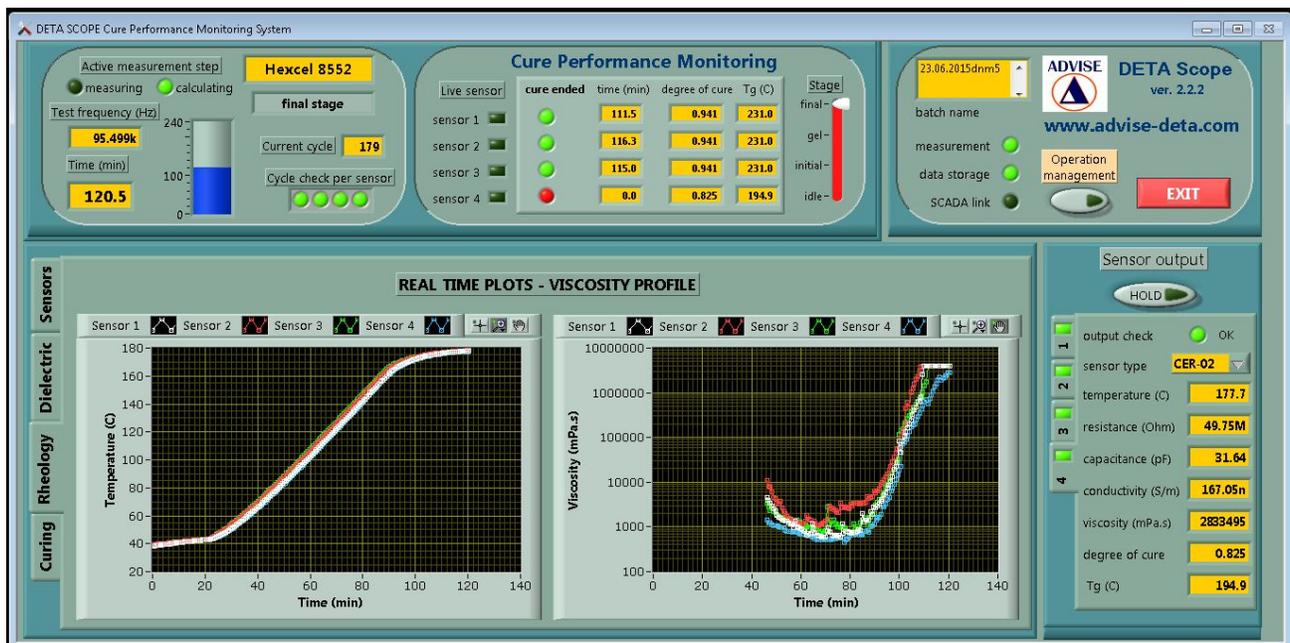
- Viscosity
- Degree of cure
- Glass transition temperature (T_g)

The measurement hardware of the CPMS is compacted in an enclosure which is typically placed in the control cabinet of the autoclave or the RTM. The enclosure hosts a mini-computer which runs in continuous mode the DETA SCOPE software. The technological superiority of the CPMS is expressed by its autonomous operation as a service to the SCADA software of the manufacturing process. The SCADA software is programmed to interact with DETA SCOPE to receive the material properties in real time and utilise this knowledge appropriately for control purposes. The unique features of the DETA SCOPE software include:

- Remote start/stop commands
- Automatic detection of connected sensors
- Automatic compensation of sensor cable length
- Rich database of material properties models
- Secure transmission of resin properties
- Auto resume in case of disrupted process

The process events detected by CPMS in real time are:

- Resin melting/thinning
- Onset of cure
- Gelation
- End-of-cure



DETA SCOPE - Cure Performance Monitoring System

For further information check our site www.advise-deta.com or contact us at info@advise-deta.com



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System components

Durable dielectric sensors with embedded thermocouple for adaptation to process tooling

The durable dielectric sensors for autoclave and RTM are the key components of the monitoring system. They are designed with flexibility to satisfy the requirements of industrial tooling, where they will be mounted and integrated.

The sensing element and the thermocouple are packed in the cylindrical housing.



Dielectric sensors attached to autoclave tooling (sensors viewed under the tooling surface). The sensor housing is robust and the custom fitting ensures that the mounting to tooling is **vacuum and pressure proof**.



Permanent wiring and panels for new or retrofit process instrumentation withstanding up to 400°C

The operation of sensors in a new or existing autoclave or RTM up to 400°C and 20 bar requires custom-made coaxial connectors, special cables and dedicated panels. The installed wiring system is robust with ease of use and maintenance.

External autoclave connection box with feedthroughs for sensor coaxial wires (left) and thermocouples cables (right)



Dedicated sensor instrumentation panel for connection of sensors (white plugs) and thermocouples (colour plugs)

Measurement hardware for interrogation of sensors

The hardware unit of CPMS commands the measurements from dielectric sensors and corresponding thermocouples. The hardware unit includes a mini-computer module, which runs the DETA SCOPE software. The unit is placed in the autoclave control cabinet.

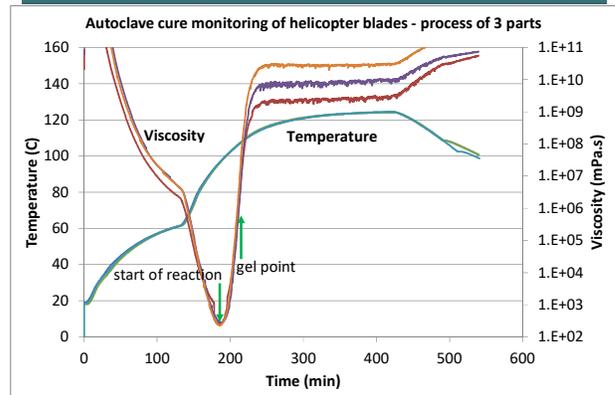
4-channels dielectric unit for fast interrogation of dielectric sensors



Flexible software for signal acquisition and analysis and transmission of properties to process SCADA

DETA SCOPE is the software of the CPMS and operates either as a standalone application or as a slave process through commands from the SCADA software. DETA SCOPE captures the long expertise of the developing team on dielectric technology in order to serve the industrial requirements for a reliable quality control tool. To this end it performs ultra-fast (down to 0.4s per frequency sweep) and intelligent scans of sensors to derive material properties from a large database of models, to detect process events (cure onset, gelation) and determine automatically the process stage (initial, gelation, final cure) while transmitting this information for on-line control and documentation (see below screenshot and diagram).

Live sensor	cure ended	time (min)	degree of cure	Tg (C)	Stage
sensor 1	●	156.4	0.884	213.1	final
sensor 2	●	155.9	0.884	212.9	gel
sensor 3	●	0.0	0.877	210.8	initial
sensor 4	●	0.0	0.875	210.3	idle



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