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# COMPOSITES MATERIALS: NUMERICAL SIMULATION OF INJECTION PROCESSES

#advanced characterization #thermal engineering #PVT- $\alpha$   
#composites materials #sheet molding compound #thermal expansion

The company, supplier of the aerospace industry with high performance composite materials, needed data to feed the numerical simulation of a manufacturing process. They approached the specialists at CAPACITÉS to assist them with an accurate characterization of the thermal phenomena at work during this process. The relevant data included the interaction between pressure, temperature and the degree of cure of the resin. In order to analyze these three phenomena simultaneously, CAPACITÉS's experts were required to leverage their key resources in terms of exclusive knowledge and equipment.

## CHARACTERIZING THE VOLUME SHRINKAGE OF COMPOSITES DURING THE SMC PROCESS

The industrial group wished to investigate, via numerical simulation, the heat exchange and stages of material processing during the injection of sheet moulding compound (SMC) type composites. This material is made up of short fibres, impregnated with thermoset resin, that are shaped by the joint action of pressure and temperature in a heating mould.

This company entrusted the specialists at CAPACITÉS with characterizing the chemical shrinkage of the material (i.e., its contraction induced by the resin curing), and the influence of moulding pressure on this parameter.

These thermal phenomena were characterized by means of a specialized measuring apparatus: a PVT- $\alpha$  mould (Pressure-Volume - Temperature - Degree of cure), which makes it possible to track

the volume evolution of the composite sample as a function of pressure, temperature and degree of cure. Owing to this rare piece of equipment, CAPACITÉS's experts were able to perform a complete analysis of the thermal phenomena in a single test. They were also able to identify the evolution of the thermal expansion coefficients in the raw and cured states of material, as well as the crosslinking enthalpy. The company will be using the results of this analysis to feed data into their simulation tools.

To complete this ambitious project, the CAPACITÉS' experts benefited from support and technical equipment from the LTEN laboratory (Heat Transfer and Energy Laboratory), joint research unit of Nantes Université and the CNRS. ■

### Expertises mises en œuvre :

- Thermal engineering
- Polymers and composite materials engineering

### CAPACITÉS

CAPACITÉS SAS is engineering and research valorisation subsidiary of Nantes Université. Working in the field of innovation, it employs near by hundred staff members and carries out over 350 projects per year. CAPACITÉS works alongside with the researchers in scientific laboratories in order to provide tailor-made solutions and expertises.