Aernnova uses ESI's Composites Simulation Suite to design and optimize the RTM process for aircraft components

THE CHALLENGE

Aernnova Engineers develop high performance structural components for Airbus; components that need to meet strict quality acceptance criteria. The switch from a well-controlled but expensive pre-impregnated (prepreg) process to Resin Transfer Molding (RTM) and at the same time maintaining product quality represented a real challenge and led to numerous physical trials.

THE BENEFITS

Introducing ESI's Composites Simulation Suite helped to:

- Understand, control and optimize the draping stage, the injection strategy and the distortion induced by curing,
- Decrease the scrap rate to a negligible level,
- Decrease the number of costly and time-consuming physical trials.

"ESI's Composites Simulation Suite allows better understanding and control of the draping stage, the injection strategy and the distortion due to curing. Thanks to simulation, non-conformities have been reduced drastically"

Federico Martin de la Escalera,
Head of Research and Technology Dept.,
Aernnova Engineering Solutions Iberica.

Aernnova uses RTM to manufacture Airbus aircraft components

Aernnova is a global aerostructures company assuming the integral management of large aircraft sections. It has a widely proven experience in integral design and manufacture of equipped aerostructures. Until recently, Aernnova produced composite aircraft components by manual draping of preimpregnated fibers (prepregs) and curing in an autoclave.

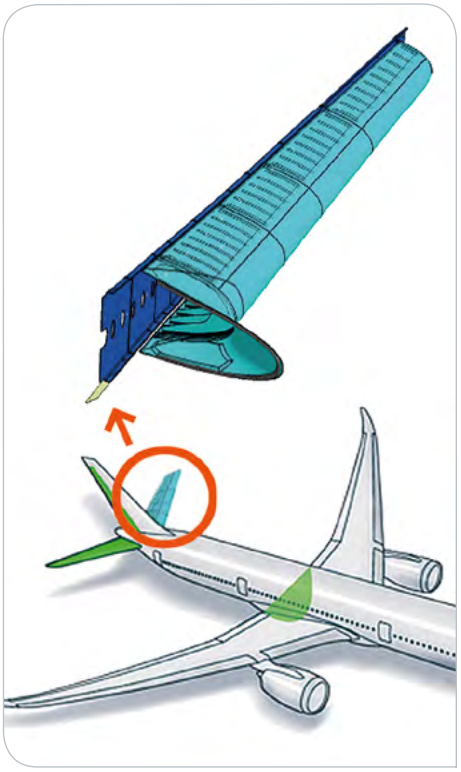
When Aernnova engineers tried for the first time to apply a Resin Transfer Molding (RTM) process to two Airbus A350 XWB parts – the bearing rib and the leading edge of the horizontal stabilizer – they had to get it right. Performance expectations of these critical parts are high and so it was essential that manufacturing defects such as wrinkles, excessive shearing in the preform, level of porosity, etc..., managed within strict tolerance levels.

Drawing on their extensive experience in composites manufacturing, Aernnova engineers in the manufacturing facility generated the RTM mold design and defined the injection strategy (injection pressure, location of vents, and injection gates and channels). Next they investigated the consequences of their selections by conducting a series of tests.

Simulation software PAM-RTM solves defect issues

The first defects Aernnova engineers uncovered were wrinkles in the preforms originating from the manual draping process, inside the laminate or on its surface. They were able to remove most of these wrinkles completely or partially by applying manual pressure on the preform.

Then, additional issues were encountered during the injection process. In spite of several costly and time consuming trials to determine the optimum injection strategy, the team still observed dry spots affecting the mechanical performance of these structural parts.



Leading edge made by RTM process.

After attending ESI's training course on the Composites Simulation Suite in Madrid, Spain, Aernnova introduced ESI's liquid composites molding software PAM-RTM into their engineering process as a means to better understand and control the injection process and to manage final part quality.

As a direct result of PAM-RTM analysis, Aernnova engineers added new vent points to eliminate all dry spots. These improvements in the injection strategy drastically improved the reproducibility of the process. Today, almost all non-conformities have disappeared.

The PAM-RTM analysis also demonstrated the importance of taking into account the shearing of the preform for more accurate prediction of the resin flow during injection.

Aernnova's engineers simulated the preforming stage using ESI's composites forming application, PAM-FORM to predict the fiber angle in the preform and used these results in the PAM-RTM setup. Note that the permeability of a preform can be defined in PAM-RTM as a function of the shear angle, with consequent improvement in the prediction of resin flow pattern and filling time.

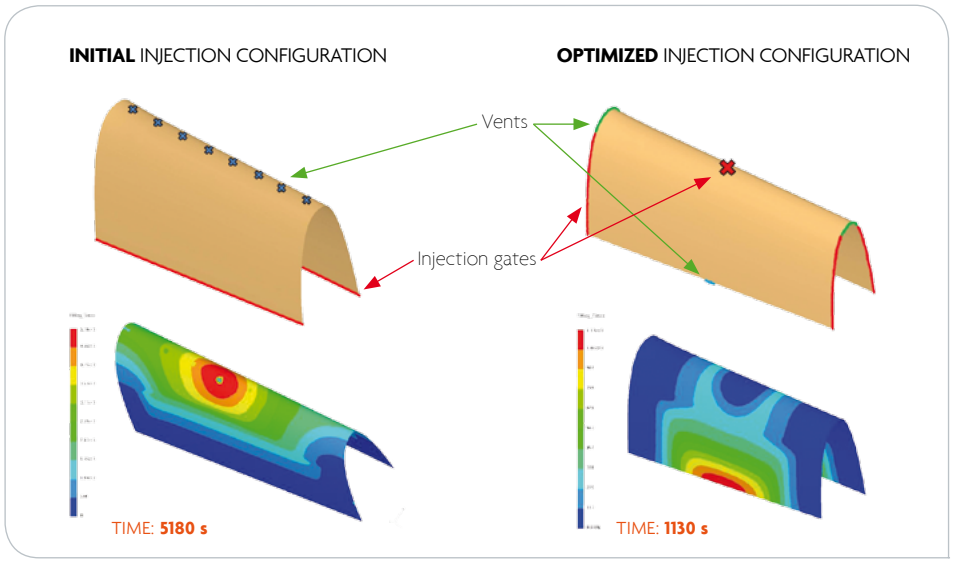
Aernnova gains time and reduces cost

Aernnova made a video recording of the actual RTM leading edge injection process and confirmed the accuracy of the PAM-RTM filling simulation when taking into account the draping effect. These impressive correlations resulted in Aernnova's high confidence in simulation results. Consequently, and at little cost, they modified the leading edge mold, thus resulting in a much higher part quality.

The preforming simulation brought about a more accurate prediction of the injection process by defining the local permeabilities in the PAM-RTM model. It also allowed for a better understanding of the preforming process itself and the way wrinkles were created during the draping stage.

Aernnova still preforms the leading edge through manual draping today and corrects it "by hand" as well.

However, simulating the preforming process with ESI's PAM-FORM is helping them move towards automating this operation using male or female rigid molds that ensure better part quality and process reproducibility.

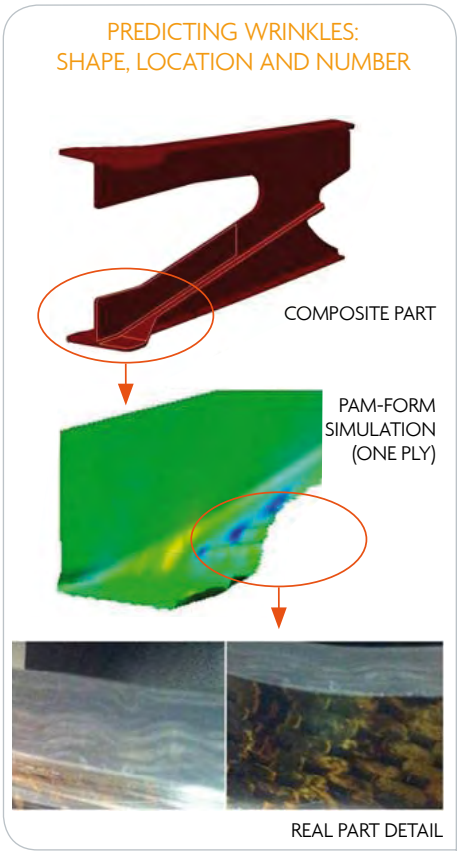


Filling time prediction with PAM-RTM.

This new process for the preforming stage is today under evaluation at Aernnova, who simulate alternative configurations and processes using PAM-FORM.

"With ESI's PAM-RTM, we now have a tool and a methodology to predict and correct all possible defects occurring during the injection process; starting at the beginning of the design of the mold, before any physical trial."

Federico Martin de la Escalera,
Head of Research and Technology Dept.,
Aernnova Engineering Solutions Iberica.



Wrinkle prediction on Airbus A350 bearing ribs with PAM-FORM.

ABOUT AERNNOVA

Aernnova is a global aerostructures company assuming the integral management of large aircraft sections. In parallel, Aernnova provides to the market engineering services, composite and metallic parts, as well as repair and product support services. It has a wide proven experience as integral designer and manufacturer of equipped aerostructures such as AIRBUS A350, A380, Embraer. Aernnova's turnover in 2011 reached 476 Millions € for 4122 employees.

ABOUT ESI GROUP

ESI is a pioneer and world-leading provider in Virtual Prototyping that takes into account the physics of materials. ESI boasts a unique know-how in Virtual Product Engineering, based on an integrated suite of coherent, industry-oriented applications. Addressing manufacturing industries, Virtual Product Engineering aims to replace physical prototypes by realistically simulating a product's behavior during testing, to fine-tune fabrication and assembly processes in accordance with desired product performance, and to evaluate the impact of product use under normal or accidental conditions. ESI's solutions fit into a single collaborative and open environment for End-to-End Virtual Prototyping. These solutions are delivered using the latest technologies, including immersive Virtual Reality, to bring products to life in 3D; helping customers make the right decisions throughout product development. The company employs about 1000 high-level specialists worldwide covering more than 30 countries. ESI Group is listed in compartment C of NYSE Euronext Paris.

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