

Optimization of Prepreg Manufacturing with Inflatable Bladder Process

Graduate



Camil Mörgele

Problem: To manufacture hollow composite parts, inflatable bladders can be used. Some types are hard at room temperature and become elastic in the autoclave at elevated temperatures to transfer the pressure during the autoclave process to the prepreg. At room temperature, the prepreg is placed on the core, which is then inserted into a solid mold.

The problem with this configuration is that expansion of the wrapped core might be prevented by the surrounding preform and thus consolidation is not sufficient: Although the prepreg was placed on the core with overlaps to allow expansion, the friction between the overlaps might be too high, preventing the prepreg from sliding against each other.

Objective: The aim of the thesis was to investigate the friction between two overlapped plies and to suggest improvements from the gained results. In addition, it had to be investigated whether the overlap can also be shortened without reducing the mechanical properties of the components.

Result: Using a simplified model, the minimum overlap length was determined mathematically and then validated with tests. The calculation showed that the critical overlap length is about half as long as the standard. However, the tests have shown that real effects such as peak stresses and occurring momentum reduce the strength of an overlap, which is why a reduction of the overlap length is not recommended.

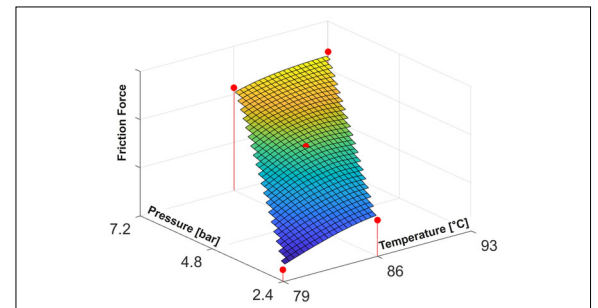
In order to measure the friction in the overlap, a test rig was constructed with which the friction could be measured under autoclave conditions, i.e. at different temperatures and variable pressure. Based on the measurement results and suitable friction models, it

was possible to show what the problem in the inflatable bladder process is based on and how it can be eliminated.

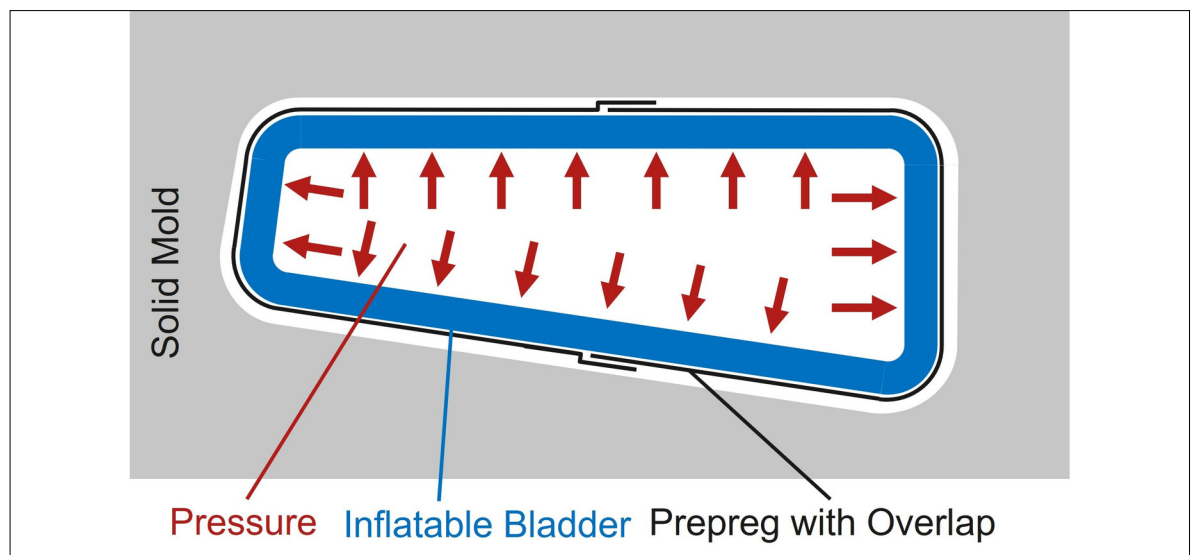
Pilatus PC-24 with composite spoilers.
Picture by Pilatus Flugzeugwerke AG



Friction force during autoclave process, depending on temperature and pressure.
Own presentation



Schematic illustration of inflatable bladder process.
Own presentation



Advisor

Prof. Dr. Gion Andrea Barandun

Co-Examiner

Prof. Dr. Michael Niedermeier,
Hochschule Ravensburg-Weingarten,
Weingarten, BW

Subject Area

Manufacturing Technology, Plastics Technology

Project Partner

Pilatus, Stans, NW