

Composite tailored blanks line.

Whether upstream an injection molding machine or a press, a Van Wees composite tailored blank line can make the materials for this process just in time. It starts with the production of the UniDirectional tape on the impregnation machine. The process can be used for thermoplastic and thermoset resin based UD tapes.

The required numbers of UD tape rolls are placed on the (Multi-axial UD) Crossply machine(s) where the UD tapes are positioned in multiple directions and layers. The plies are fastened by spot-welds. From this assembly, rolls can be made or patches which are cut in line with the Crossply machines

For showing the process for a thermoplastic product, we have used a demonstrator product, a crash beam for a car door. This crash beam can be made in a fully automated production cell at GK tools in Switzerland and was originally designed for a fabric based panel. This 'Organoblech' has a relative simple construction and not a specific orientation in the part.

The UD tape based product has 11 UD layers, total thickness is 3 mm. The ply-book is 45/135/0/0/0/90/0/0/0/135/45. The product is composed of three patches; patch 1 has ply-book configuration 45/135/0/0 – patch 2; 0/90/0 – patch 3; 0/0/135/45.

The Crossply machine for patch 2 has two unwinders for the 0 degree and one unit for the 90 degree introduction in the laminate. The bottom layer is 0 degree oriented coming from the first unwinder. The second layer is the 90 degree piece, coming from the second UD tape placement unit. This unit has an unwinder, cutting unit and placement device. The piece coming from the UD placement unit is spot-welded on the bottom layer.

The third layer, 0-degree oriented, is coming from the third unwinder, and is also spot-welded on the 90 degree layer.

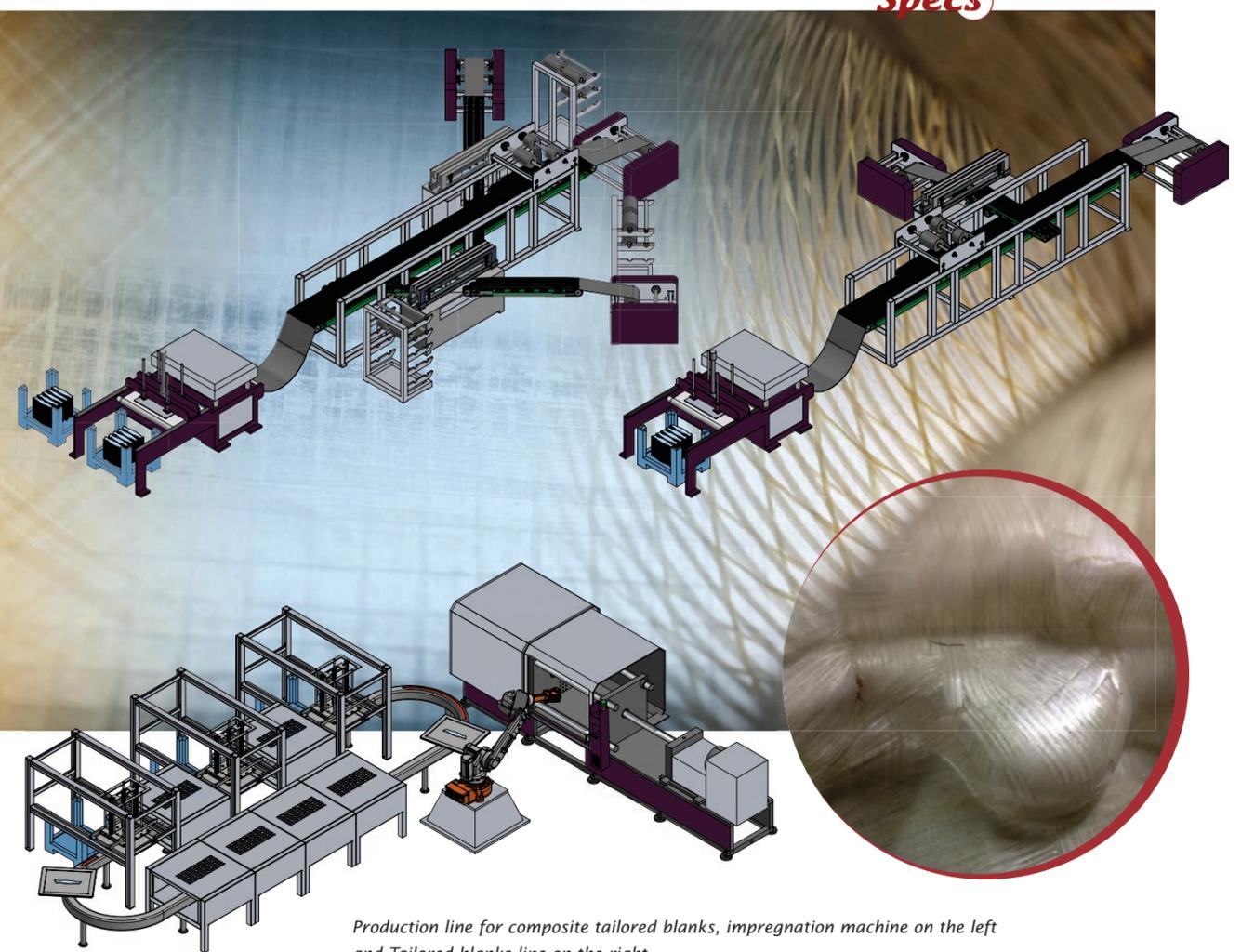
The spot-welding pattern is adjusted to the position of the patches, making sure that the three plies will remain connected after cutting. In-line with the machine is a cutting machine. The patches are cut and placed in a container, ready to be handled in the following step of the process.

For making patch 1 and 3, the Multi-axial UD machine is used. The machine has two unwinders for the 0 degree plies and two UD tape placement units for the 45 and 135 degree layers. The two 0 degree layers are unwound and spot-welded for fixation. The 45 and 135 plies are placed on the bottom layers and connected.

In the cutting unit, two patterns are cut. Patch 3 has the shape of the product and patch 1 is the mirrored version of patch 3. The patches 1 and 3 are placed in two different containers.

Following step in the process is the placement of the patches in the assembly and consolidation machine. The containers with patch 1, 2 and 3 are placed at the different units of the assembly line. Patch 1, with the ply orientation 45/135/0/0, is taken by a manipulator and placed in a tool. The tool makes a step, tuned to the cycle time of the press or injection molding machine and patch 1 is placed in a heating zone. The four plies are heated and melt together.

Patch 2 is placed on top of the hot patch 1 and consolidates patch 1. The tool makes the following step and patch 2 is heated. Patch 1 is cooling down slowly. Patch 3 is placed on the hot patch 2, consolidating the 0/90/0 plies. Patch 3 is heated and in a next step, consolidated.



Production line for composite tailored blanks, impregnation machine on the left and Tailored blanks line on the right.

In the following units, the tailored blank is released from the tool and heated to the temperature which is best suited for the press forming or injection molding.

Because the consolidation is done in steps, heating and placement can be tuned to optimum circumstances. Cycle times of less than 60 seconds for injection molding or compression molding are very well possible.

A large advantage of the patches process is the shape of the residual material that is left from the cutting of the patches. These UD chips can be relatively long and can be pressed to panels or products with high performance. Different material suppliers have this material in their portfolio. The use of fabric based (Organoblech) materials or other full consolidated panels will result in scrap of several millimeters thickness which can only be chopped to injection molding quality.

Van Wees will publish a study by the end of this year in which we have investigated whether this crash beam can be made as a zero waste product. For that matter, the chips will be placed in an intermediate layer.

Second option of this process is making stock material for production in an autoclave or an oven with much larger dimensions. A study has been made for an aerospace OEM showing the feasibility and interesting output. This study was based on thermoplastic resin based UD tapes which is most logic due to the indefinite shelf life of these materials.

Using this process for thermoset resin based materials makes it suitable for SQRTM. In that case, the heating steps between the placement of the patches is not necessary or at relatively low temperatures.

