Multi-axial UD Crossply machine

With the Multi-axial UD Crossply machine in our Research and Technology Center we are able to make 1800 millimeters wide Crossply products.

In a Uni-Directional or UD the individual fibres are oriented parallel to each other and kept in this aligned position by a matrix material. This is realized by unwinding yarns from a creel, spreading them to a continuous layer of several fibres thickness, which is subsequently stretched by means of a considerable force for impregnation with the matrix material. In case of thermoplastics an extruder is used in combination with a calendar to guarantee thorough immersion of the fibres with matrix. The simplest way of making crossply is cutting segments from the UD, stacking them in the desired orientation – normally 0/90° – and pressing them together. To transform this time consuming activity into a continuous process, Van Wees developed the multi-axial crossply machine in which splicing and lamination are combined. This means that rolls of crossply laminate can be generated in which the orientation between the continuous- and segmented layer can be varied from 45 to 90°. The thermoplastic behaviour of the matrix material not only enables the lamination in the crossply, but also makes it possible to weld the final material to the desired product instead of stitching. In comparison with coated fabrics, crossply laminates have distinguished advantages. Thanks to the spreading of the fibres into a thin layer, the impregnation with matrix material is much more effective, leading to intrinsically higher mechanical performance. Besides, the UD-layers can be orientated in directions that are optimal for accommodating the forces in the end application. In this way the reinforcement can be made more efficient, leading to a more lightweight and thinner technical textile.
PET/THV for architecture

At the moment PTFE-coated glass fibers or PES-PVC fabrics and ETFE films are predominantly used for this purpose. However, sunlight transmission of these fabrics is limited and their areal weight is substantial. Therefore Van Wees developed a laminate based on an alternative fluoropolymer, namely THV, which has excellent optical properties and thanks to its thermoplastic nature can be welded to the dimensions which are common in architecture. For weight reduction polyester instead of glass yarn has been chosen as reinforcement, which is visible as an open web in the THV-laminate. Of course, the orientation of the yarns can be varied to optimize the mechanical properties in the critical directions: for instance three yarn layers in a -60°/0°/60° geometry (triangular) or four in a -45°/0°/45°/90° one (diagonal). This simultaneously contributes to the aesthetic appearance, which can be even more enhanced by using attractive dyes in the impregnation treatment of the yarns. In this manner laminates can be produced with an areal weight of about 500 g/m² and a reinforcement factor of six in tensile as well as tear strength compared to a THV film.

Steel reinforced PET/PVC for tarpaulin

Although its production process is already highly efficient, this can be surpassed by using the same ingredients for making a crossply laminate. Instead of weaving the polyester fabric at a low speed, the production of a UD by impregnating a thin layer of these fibres with PVC emulsion can be realised at twenty meters per minute. Subsequently, the thermoplastic nature of the PVC makes it possible to combine two of these UD-rolls to one roll of laminate with mechanical properties that are appropriate for aforementioned demanding purposes. Moreover, extra functionalities can be integrated straightforwardly by locally increasing the fibre weight – for creating stretchers in the tarpaulin – or by introducing different yarns for additional reinforcement. Last mentioned option is especially interesting for making a theft-proof laminate. Reality namely learns that tarpaulin covered trailers are extremely vulnerable to this form of crime, which normally starts by cutting spy holes in the fabric for a quick inspection of the content. This can be prevented by incorporation of steel cord in the UD at a spacing of one to several centimetres. The grid which then automatically is formed in the crossply process provides a cutting resistance that is considerably higher than the protection meshes which are currently available. While the Defender® fabric from Ferrari fails at a force of 350 N, a steel cord reinforced crossply laminate holds on up to 580 N. Under these circumstances, perhaps only a few persistent thieves will manage to get a glimpse of the cargo.

PVC-coated polyester fabric is a mass product that can be found in a variety of applications like bill boards, tents, roofing membranes and tarpaulin for covering trailers.

Coated textiles find more and more application in architecture as membranes for tensioned structures.

PET/THV for architecture

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After introduction of the driver airbag in the eighties, the growth of this safety product for the automotive has been tremendous. Besides, the development of variants for protection against rolling over, the so-called side curtains, and injury of legs and cervical has increased the need of fabric even more. Therefore a high-throughput technology like UD & Crossply production would be more than welcome. Rashly transforming the current production process of weaving a nylon fabric and subsequent silicone coating into a lamination route is no option. The thermoplastic properties of silicones are poor or completely absent and consequently an alternative matrix material is required. Polyurethanes, however, are a promising alternative because they combine thermoplasticity with high elasticity and good film-forming properties. The somewhat higher stiffness of such a polyamide/polyurethane crossply laminate is no objection for a side curtain airbag, because of their way of deployment: rolled up instead of folded. Besides, for this type the low permeability of crossply laminate is desirable in order to keep the bag inflated during the couple of seconds that a serious roll-over accident can last. Finally, especially the elaborate dimensions of a side-curtain airbag justify a production technology like UD & Crossply because of its high capacity. To demonstrate these benefits, Van Wees developed a prototype in which the seams were created by welding instead of stitching: another advantage of a crossply!
Sail cloth for yacht racing is such an example and thanks to its experience in ballistic textile, Van Wees managed to develop a laminate based on these high-performance fibers that can meet the demanding conditions on the ocean waves. Analogous to the production of ballistics, the UHMWPE yarns – for instance Dyneema® – are spread to a UD of less than two filaments thickness and impregnated with a hotmelt adhesive that is compatible with polyolefins. The resulting “prepregs” with a tensile strength of 2 kN/50 mm and areal weight of only 60 g/m² can be sandwiched between HDPE films in the required numbers and orientations in order to create a sail cloth with an optimum strength to weight ratio. This “All-Polyolefin” sail cloth has already been demonstrated in a simple 0/90°-geometry which could be realized with a total areal weight of only 200 g/m².