ASPRO
spread carbon fabric

for ultralight carbon composites

Quite often, composite products designers need lightweight balanced fabric. This is extremely important when they try to maintain a low weight composite construction. In general, when it comes to carbon fiber, the main problem is minimum weight of products, rather than reaching excessive strength for the same weight .

The lightest traditional carbon fabric have weights starting from 70 g/m^2 for 1K carbon fiber and from 200 gr/m^2 for 3K .
Present concept of spread carbon tow allows to create lightweight fabric out of hi-tech 12K and 24K carbon fiber.

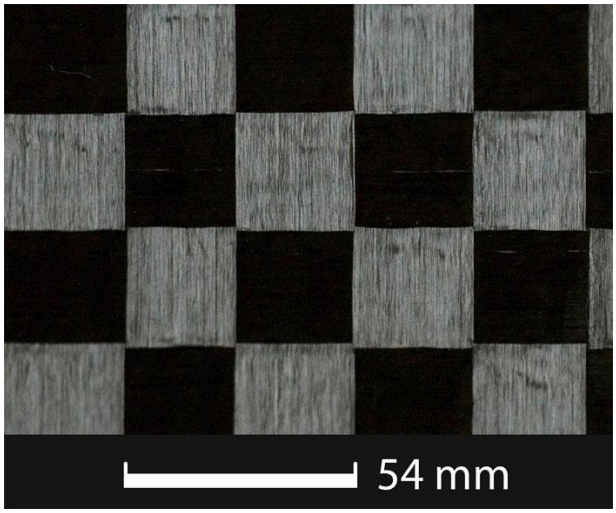

Figure 1. Carbon fabric A-60 with 62g/m^2 weight. Source carbon fiber is IMS65 24K (Toho Tenax).

Aspro was founded in 2011 to organize innovative production of spread tow carbon fabrics. For three years we have constructed special equipment for spreading carbon tow and making fabrics based on it. Technology of producing spread tow carbon tapes and fabrics is the main know-how and is protected by patents in Russia.
Typical width of the spread carbon tape in the fabric is 20-27 mm. For stability of fabric structure carbon tape are fixed with epoxy-compatible binder. Due to its flat structure Aspro fabrics have significant advantages.

High physical and mechanical properties of the final product

In the pictures of cross-sections (Fig. 2) are clearly visible filament directions. In the specimen from twill carbon fabric 200 g/m^2 (left picture) deviation from a predetermined reinforcement direction reaches 6 º. For specimen from Aspro fabric 80 g/m^2 (right picture) filament deviation practically 0 º. When tensile load applied to specimen from twill carbon fabric fiber will seek for flatten before begin to realize their mechanical properties. On the contrary the fiber of specimen from Aspro fabric start working immediately after application of load. This provides more efficient implementation of the carbon fiber properties in the composite. In addition high strength carbon fiber is applied in Aspro fabric. This increases mechanical properties in the composite more.

	Twill 3K 200 g/m^2	Aspro fabric 24K 80 g/m^2
Tensile strength, MPa	630	**1620**
Tensile modulus, GPa	41	**78**
Tensile strength source fibre, MPa	3500	**6000**
Tensile modulus source fibre, GPa	230	**290**
Fabric structure efficiency	0.18	**0.27**

Tab 1. Main fabric characteristics. Fabric structure efficiency defines as ratio of specimen tensile strength(modulus) to source carbon fibre tensile strength(modulus).

Weight reduction

Application with low weight fabrics allows to optimize thickness of the product while saving necessary strength and stiffness. Thus, it is possible to reduce total weight of the product.

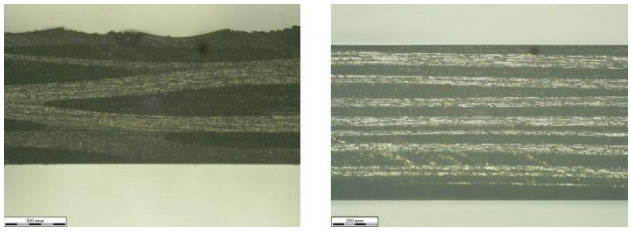

Figure 2. Pictures of cross-sections of the specimen from twill 3K 200 g/m2 (left) and from Aspro fabric 24K 80 g/m2 (right)

Ease of cutting and laying

Carbon fibers are fixed together by epoxy-compatible binder in fabric. Fabric does not crumble and loses structure during cutting and laying in the form. There is no need to use additional binder.

Figure 3. Ease of cutting and laying. Twill 3K 200 g/m^2 (left), Aspro fabric 24K 80 g/m^2(right).

High surface quality

For traditional carbon fabric at high curing on the product surface may occur distortion caused by shrinkage resin or gapping fabric to mold. Due to small amount of gaps (pic. 4) and flat Aspro fabric structure there is no distortion on surface. Final product practically do not require finishing process before painting. We should also note the importance of this property to ensure hermeticity face sheets in sandwich panel.

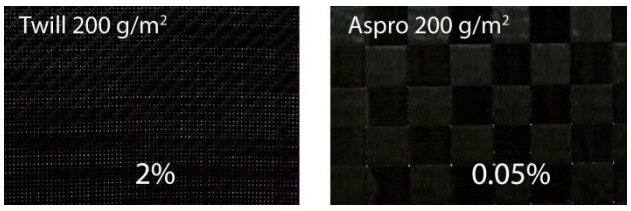

Figure 4. Percentage of gaps. This indicator is defined as ratio of gaps area in the fabric to total area. The smaller percentage of gaps the more qualitative filament arrangement is in the fabric. In composite all gaps places is potential weaknesses.

Light aviation.

Sandwich construction with honeycomb core find widely application in a light aviation. Low weight and high stiffness is very important for wing mechanization (ailerons, flaps), stabilizer, elevator and rudder aircraft. Application of Aspro fabric allow to lower weight of typical sandwich construction until 30%.

Wet penetration inside any sandwich is unallowable. Products working in open air contact with water inevitably. Thus hermeticity of sandwich side sheet is very important. Generally side sheets contain one or two fabric layers. So requirements for qualitative filament arrangement in fabric are extremely high. Aspro fabric answers these requirements fully.

Figure 5. Airplane "Ivolga". Aileron made using Aspro fabric 80 g/m^2.

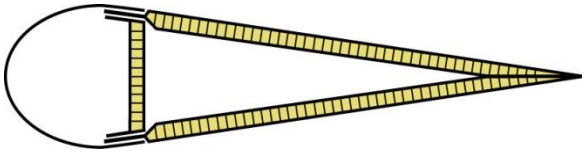

Figure 6. Scheme for construction of aileron airplane "Ivolga". Weight aileron using Aspro fabric 80 g/m^2 is 7 kg, using traditional 3K twill 200 g/m^2 is 11 kg.

	Twill 3K 200 g/m^2	Plane 1K 90 g/m^2	Tape 1K 80 g/m^2	Aspro 24K 80 g/m^2
Weight	★	★★	★	★★★
Constructions strength and stiffness	★★	★	★★	★★★
Smooth surface	★	★	★★	★★★
Workability	★★	★★	★	★★★
Hermeticity	★★	★	★★	★★★
Cost	★★	★	★	★★

Tab 2. Estimated comparison of various reinforcing materials in sandwich structures used in light aviation

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Figure 7. Ailerons, stabilizer, elevator and rudder aircraft L-42m made using Aspro fabrics 80 g/m^2(left and center pic.). Stabilizer airplane "Ivolga" during assembly on the slipway (right pic.).