

CHOMARAT News...

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CHOMARAT

free to innovate



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Innovation, a driver for competitiveness and growth

Innovation has been central to CHOMARAT's strategy ever since the Group was created in 1898. Without a far-reaching research and technology (R&T) policy, CHOMARAT could never have become a first-rate international player in terms of innovation.

Its innovation strategy is built primarily around a team with wide-ranging technical skills in textiles, chemistry and mechanics.

To consolidate our expertise, we work closely with internationally reputed universities, research institutes and technical centres. We also participate in a number of collaborative programmes (FUI, PSPC, AMI, CORAC, DGA RAPID, H2020) in support of our strategic priorities.

The aim of these collaborations is to bring the different players in a project chain together, all the way to the end customer. This amplifies the skills and resources, and maximizes the expertise of each contributor in order to achieve the most innovative and relevant solution in terms of materials, tooling and user benefits.

Innovation also develops through technological investment. In early 2017, CHOMARAT announced that it was phasing in a 35-million-euro plan over three years, concerning our three activities: composite reinforcements, construction reinforcements, and coatings & films. We have also invested more recently in a new, more productive carbon technology (C-PLY™ that has no equivalent in the market.

At CHOMARAT, we innovate to develop the materials of tomorrow.



Philippe Sanial
Group R&T Director

Collaborative innovation

One of the group's specificities is to enter into collaborative research programs and to develop partnership with internationally renowned universities as University of Stanford, or Hanyang University in South Korea, and also with the main French and European academic centers.

CHOMARAT sponsor NCF HP² project

Among the Group's recent collaborative projects, CHOMARAT is sponsoring a 4 million euros budget project that has obtained seal of approval from the TECHTERA, AXELERA and VIAMECA competitive clusters.

CHOMARAT has brought Solvay, Mécanium and the University of Nantes together for the joint NCF HP² project. During 42 months, the Group and its partners will develop a new generation of multi-axial carbon fabrics, along with the associated textile processes for producing thermoset composites parts for the aerospace and automotive industries.

The solutions that are developed will provide answers in terms of mechanical properties, weight lowering, and cost-effectiveness, which are priority criteria in aerospace and automotive.

Collaboration in the fast RTM project

The Fast RTM project is sponsored by the IRT M2P technology research institute and brings in manufacturers, universities and technical centres. It demonstrates the feasibility of composite structural automotive parts made using reactive RTM processes. As part of this project, CHOMARAT has developed optimized reinforcements, compatible with the thermoplastic and thermoset resins used on the platform. They have the capacity to be preformable and adapted to high speed processes.

The result is a flexible project that can be adapted to the requirements of builders in the automotive, aerospace and railway industries. This collaborative approach corresponds perfectly to CHOMARAT's innovation strategy.



Fast RTM Platform

First textile group to join the AMRC

Composites have already demonstrated their technical performance. Joining the AMRC (Advanced Manufacturing Research Centre, University of Sheffield), CHOMARAT contributes to the development of the technologies and processes of the future to help the composites industry become more competitive vis-à-vis metallic solutions.

CHOMARAT and the University of South Carolina's McNAIR Center, collaborate for innovation

Named in honor of South Carolina native and Space Shuttle astronaut, the Ronald E. McNair Center for Aerospace Innovation and Research was founded in 2011. The McNAIR Center's mission is to grow South Carolina's knowledge-based economy and support industry through aerospace education, research leadership and industry advancement.



Fiber placement Ingersoll LynX machine- McNAIR

The main areas of the McNAIR Center's research include:

- steered fiber nonconventional laminate design
- automated novel structural composite part production
- multi-disciplinary design optimization of composite (aircraft) structures
- automated, fusion based assembly

Partnerships are critical to McNAIR's success and CHOMARAT has played an important role to further their mission by working with Dr. Michel van Tooren, McNAIR's Director, and his team of researchers in two areas. The team is currently looking at using CHOMARAT's C-PLY™, carbon

non-crimp fabrics (NCF), to build Quasi-isotropic laminates more efficiently than ever before. If successful, the work will allow composite part producers to easily design composite parts without extensive calculations and testing.

The second initiative involves unlocking the benefits of using C-PLY™ in a steered fiber placement process. The McNAIR Center has plans to use CHOMARAT's C-PLY™ with their Ingersoll LynX fiber placement machine to characterize efficiency improvements when laying multiple fiber angles simultaneously. The goal of this project is to demonstrate composite performance and manufactu-

ring efficiency which could substantially reduce product cost.

FX: a new range of adhesive composite reinforcements

CHOMARAT recently introduced its new range of adhesive reinforcements. The benefits are productivity and improved working conditions.

Facilitating reinforcement placement in closed mould

The FX is an adhesive solution that makes it easier to position reinforcements in moulds. Available on most of CHOMARAT's glass reinforcements, it is a true alternative to adhesive sprays. Thanks to an innovatory process, FX offers highly uniform placement, minimizing the risk of delamination. The resin cure is not affected by the addition of the adhesive and the mechanical performance is optimal. FX also facilitates the layup of parts, saving time and reducing the production costs.

FX can facilitate the closed-mould production of large or complex-geometry parts, so the solution is suitable for a number of markets, including marine and transportation. FX emits no volatile organic compounds (VOC), so it contributes to better working conditions in user facilities.

A complete, flexible range

The FX solution is a new service that we offer to our customers. FX is available on CHOMARAT's ranges of fabrics, multiaxials and core materials G-WEAVE™, G-PLY™, ROVICORE™, ROVIFLOW™



G-PLY™ FX

et ROVIMAT™. The adhesive can be placed on a single side, or both.

We are already studying how to integrate this function into new reinforcements.



The FX range joins EASYTAPE, the range of adhesive glass tapes for specific zones, in the portfolio of adhesive solutions

C-WEAVE™ DESIGN : design appeal & structural benefits

C-WEAVE™ DESIGN is a range of carbon premium-quality products for surface finishes, developed specifically to meet with industry demand for high quality aesthetic fabrics. These reinforcements are dedicated more specifically to the automotive and sports equipment markets.

Two products are now available: A 100% carbon reinforcement and a hybrid carbon/Innegra™ reinforcement

- **C-WEAVE™ DESIGN 100% carbon** : a 245 gsm carbon fabric. and a design alternative to standard carbon fabric. It offers an alternative to standard carbon fabric used in the automotive industry thanks to a subtle hexagonal pattern playing on differential light reflection.

- **C-WEAVE™ DESIGN carbon/Innegra™** : a 176gsm hybrid fabric. It combines the ductile behavior of Innegra™ with the stiffness behavior of carbon into a very light and visual woven carbon look. Innegra™ which is a Polypropylene based Fiber brings impact resistance and vibration damping benefits balancing the carbon high frequency vibration mode and low impact resistance. Very valuable in all dynamic sports equipment products.



C-WEAVE™ DESIGN

C-WEAVE™ DESIGN carbon/Innegra™ offers also a smart feature on both sides.

With C-WEAVE™ DESIGN, we are expanding our range with premium-quality products for surface finishes, developed to satisfy industries with stringent requirements. The design is especially suitable for large parts like automotive body panels or longboards.



Maui Fin Company - Hydrofoil

C-WEAVE™ DESIGN is already visible on a surfboard manufactured by UWL (France) and on a Windsurf foil marketed by MFC (Spain).



Surfboard

https://youtu.be/_smwtT8G8DI

C-PLY™ HEXAGONAL, visual and structural stitching inside NeilPryde RS:X Convertible windfoil board

The NeilPryde RS:X Convertible board has been developed to deliver ultimate performance in both operating modes - Foil Racing and Slalom. This uncompromising board features the latest technologies and materials available today in the high-end composites industry.



capture resin color pigment and contribute to additional reinforcement in the Z axis.

Board construction

Full carbon PVC Sandwich construction using 100% Bi-axial layers on bottom and C-PLY™ on deck and rails.

The primary objective for the construction of the new RS:X Convertible was to maximize performance while maintaining uncompromised shape consistency.

Manufacturing process is wet resin layup with an innovative combination of vacuum compression and carbon mold to achieve hull accuracy and consistency of every single board.

C-PLY™ contribution

C-PLY™ HEXAGONAL is an innovative carbon NCF with a unique stitching yarn designed to remain visible after resin impregnation to



C-PLY™ HEXAGONAL

New Carbon Look and better resistance to crack propagation

C-PLY™ with visual stitching combines visual appeal and mechanical performance.

- Unique hexagonal carbon look appeals to end users.
- High mechanical performance of thin ply NCF to reduce weight and delay micro-cracking versus thick plies and enhance mechanical performance versus a traditional 3K woven fabric.

The special stitching yarn improves the fracture toughness of the laminate.

It was observed upon comparing C-PLY™ BC3,4 standard stitching

NEILPRYDE RS:X CONVERTIBLE

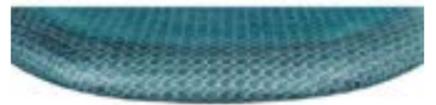
Product:
C-PLY™ HEXAGONAL Biax +/-45° 150 gsm

Process:
Carbon compression Mold & Vacuum

Part producer:
Cobra International

Key Benefits:

- New carbon look with NCF
- Resistance to crack propagation



reference sample with hexagonal X1 stitching sample (see fig1).

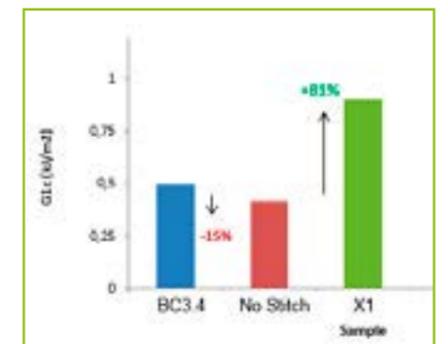


Fig1: Critical Energy Release Rate Data courtesy of Institute for Sports Research, Singapore

Bringing a new carbon visual for our high-performance, C-PLY™ range is a retail sales booster in the whole sports & consumer product industry.

C-PLY™ : an innovative solution to the automation of the sports equipment industry



The technological change of the Sports Equipment industry

Almost all manufacturers of tubular carbon sports equipment like rackets, bicycle frames, baseball bats, golf clubs, fishing poles, or masts depend on a traditional process : UD prepregs molded using an inflatable bladder inside the tube. Its limits are well known: too much labor required for UD ply lay-up and for the painstaking finishing operations after mold release; too many human errors leading to inconsistent structural quality (plies and varying thicknesses); and costs that increase along with wage rises in China.

Most of the OEMs prefer to relocate to ASEAN countries like Vietnam to take advantage of cheaper labor rather than make any changes to their process and industrial plant. And yet, the aviation industry that served as their model is once again showing them the way, as it has been making considerable efforts over recent years to develop infusion and out-of-autoclave processes to increase output without having to invest more in costly, energy-intensive autoclaves.

And then there is the automotive industry: seeking to mass-produce in series that are more like those for sports articles, it is investing heavily in ultra-automated, mostly wet processes like lay-up of dry NCF preforms, HP-RTM, compression or resin infusion...

C-PLY™ in dry preforms

To keep up with the shift to more robotized processes and the desire of sports-article brands to minimize logistic costs and react rapidly to market trends by bringing their production closer to catchment areas, CHOMARAT developed and patented C-PLY™, a range of dry carbon reinforcements consisting of thin plies of fibers that are spread and stitched along a number of different fiber orientations.

These reinforcements now serve to fabricate dry preforms using robots and to create RTM-molded parts with direct-from-mold quality.

Thanks to the powder-coated C-PLY™ reinforcements in association with the latest advances in robotized carbon fiber placement,

it is possible to create net-shape preforms designed for greater drapability and permeability, with a greater than 63% fiber content by volume.

This has also become possible due to the progress made with new-generation epoxy resins and to new thermoplastic-monomer-based types of chemistry (such as Elium by Arkema).



Carbon racket and bike saddle

that are highly fluid at the ambient injection temperature and have short cycle times. All these results are the fruit of four years' participation in the I-COMP Sport applied research consortium.

The consortium's research takes place in Singapore, in the **Institute for Sports Research** within the prestigious **Nanyang Technological University**. We worked there with our partners to develop a new industrial process to produce RTM tubular parts with a dynamic performance equal to that of UD prepreg productions.



Robotic tape application at the ISR

C-PLY™ Shallow angles

In boards sports (ski, snowboard, surf, windsurf, stand up paddleboard, kayak, wakeboard, Kiteboard), where CHOMARAT has always maintained a strong position, we continue to innovate with C-PLY™ shallow angles (20° to 30°), developed to apply the theories of the eminent Dr. Stephen Tsai (Stanford University). On objects like skis or hydrofoils with a preferential loading



Carbon bike frame

direction, the 20-30° angles serve to raise the threshold for microcracking, and therefore to improve the fatigue resistance, making the products lighter for better control over the dynamics.

C-PLY™ Carbon look and performance

For all these applications such as the NeilPryde RS:X Convertible windfoil board (see P7), produced by Cobra international (Thailand), we offer C-PLY™ products with interesting visual properties due to the honeycomb stitching, which also enhances the crack propagation resistance.

*Pascal Joubert Des Ouches
Sports Equipment Market Director*



C-PLY™ signature

The C-PLY™ mark is now associated with a logo that you can apply on your products.

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To date, C-PLY™ reinforcements are industrial products that are both cost-effective and highly sophisticated thanks to their textile concept.



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