C1.2, a versatile machine for complex shapes

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Designed for creating complex composites parts with high precision and efficiency, the C1.2 is versatile and can handle multiple materials, including thermoset and thermoplastic prepregs, as well as dry fibres. With its advanced cutting and adding capabilities, and a high-capacity creel house capable of supporting heavy spools, this solution is particularly suitable for applications in aerospace, such as fuselage panels, spars, frames and honeycomb sandwich structures.

Launched in late 2022, the C1.2 is available in 8 and 16 fibres version with 1/4 in (6.35 mm) material width. Before conceiving the C1.2 (Figure 1), Coriolis has produced 80 C1 machines operating all around the world since 2010. The French company based in Brittany used its experience and a long period of observation to select the characteristics of the new model.

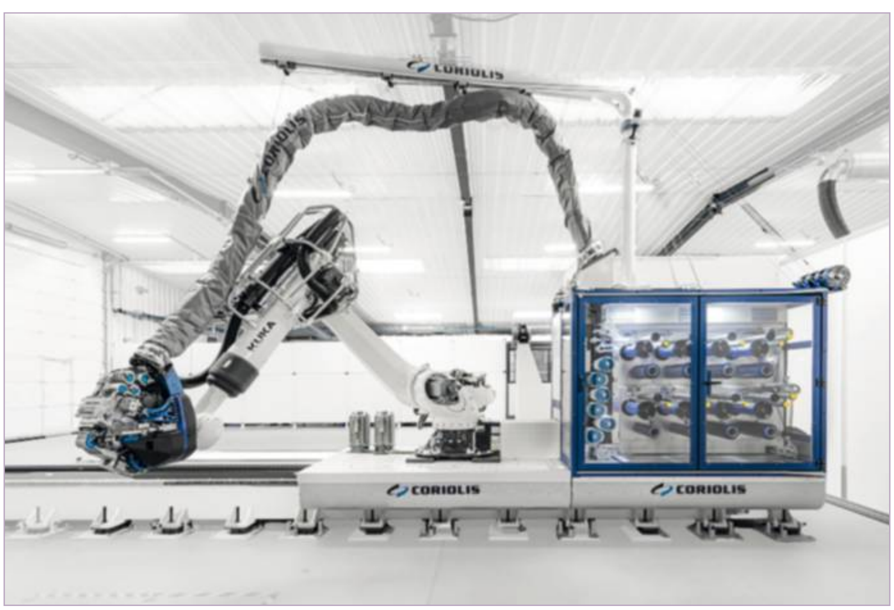

Fig. 1: The C1.2 is a compact, easy-to-use and versatile machine for depositing multi-materials (thermoset, thermoplastic and dry fibre)

Sustainability and AFP objectives

Using composite materials for structural parts in aeronautics is not new: aircraft manufacturers such as Airbus and Boeing did it in their latest industrial programs, Airbus A350 and Boeing 787. By doing so, they manage to reduce the weight of the aircraft, resulting in a significant lower fuel consumption. Composites materials indeed have a major role to play in decarbonating air transport.Automated Fibre Placement (AFP) makes it possible to apply high-performance composite materials in several fields – boating, space and aeronautics for example. In aeronautics, the AFP process is well-known for lowering the sink rate and minimising production costs. Moreover, it permits to reduce the carbon footprint during the manufacture of the aircraft parts.
Optimising high-performance unidirectional fibre paths and the correlation between programmed and realised makes it possible to lighten the structures even more. In addition to delivering turnkey AFP solutions to its users, Coriolis provides software to program AFP machines. CADFiber, a stand-alone solution, and CATFiber, integrated into Dassault Systems' CATIA/ DELMIA environment (Figure 2), are designed to ensure customers to adapt to their work environment. In brief, using composites, especially with the AFP process and software designed to optimise AFP parts, contributes to the mass reduction of high-performance structures. However, AFP is facing multiple industrial challenges.

Increased productivity

Aircraft manufacturers, as the others AFP solutions users, always seek to improve their resources performance. To help them, the C1.2 machine can achieve higher layup speeds (up to 1 m/s during feeding and cutting, and

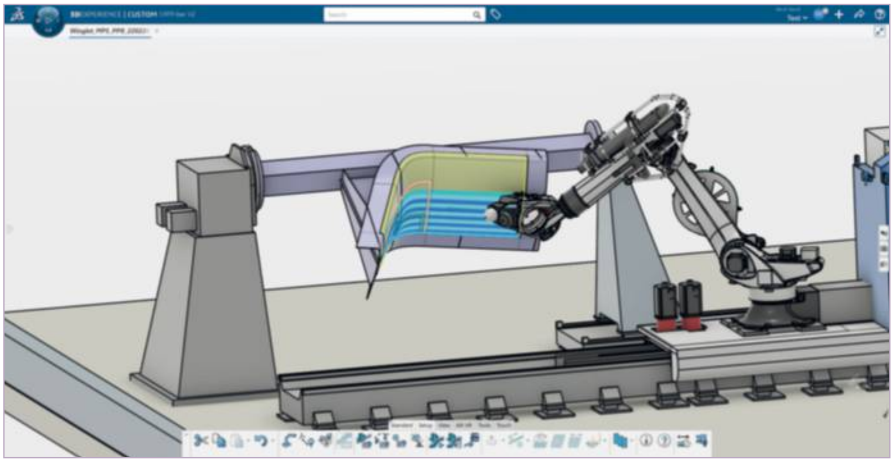

Fig. 2: CATFIBER workbench with C1.2 – 8 fibres version effector

Fig. 3: Increasing productivity with the C1.2

more than 1.5 m/s during layup) with improved reliability, thanks to motorised modules used in the creel, accommodating fibre spools up to 15 kg of raw material, i.e., 3 times more material on board combined with a better management of the dancing arms which improve the material flow (Figure 3). Three infrared lamps are supplied as standard to go faster, saving time once again on the link paths. The equipment also provides cleaner, straighter fibre cuts, even at high speeds, and better feeding. Moreover, the C1.2 can use very thick materials, crucial to increase the productivity, generally defined by the mass of material deposited over a given period of use.

Coriolis also provides Simureal NC-ASSESS, a standalone time-saving software solution to put parts into series production, with a rapid launch of a virtual controller that check collision and near-misses very accurately in a few minutes only. It can also calculate the exact cycle time of programs long before they even run on the real machines. Productivity can therefore be optimised offline using this software, which proves to be an asset for programmers and production managers. The software also includes a physics-based Laser Heating simulation capability to predict the absorbed heating flux and surface temperature field, even for complex 3D layup programs.

Reliability and performance

Reliability of the AFP product is also crucial. A mean swap before failure test was performed at high speed to evaluate the overall reliability of the C1.2 process. This performance and reliability test was carried out with more than 28,000 cuts per fibre through hundreds of small panels made of fibre feeding and cuts separated by gaps of a few millimetres by nearly 20 mm thick. This MSBF indicator on the 8-fibre machine was measured at almost 15,000 (Figure 4).

The compaction pressure also increased: a good thing to reduce porosity during in-situ deposition of thermoplastic materials.

Improved maintenance

Reliability and productivity are important, but ease and ergonomics of the machine maintenance too. Routine head maintenance operations can now

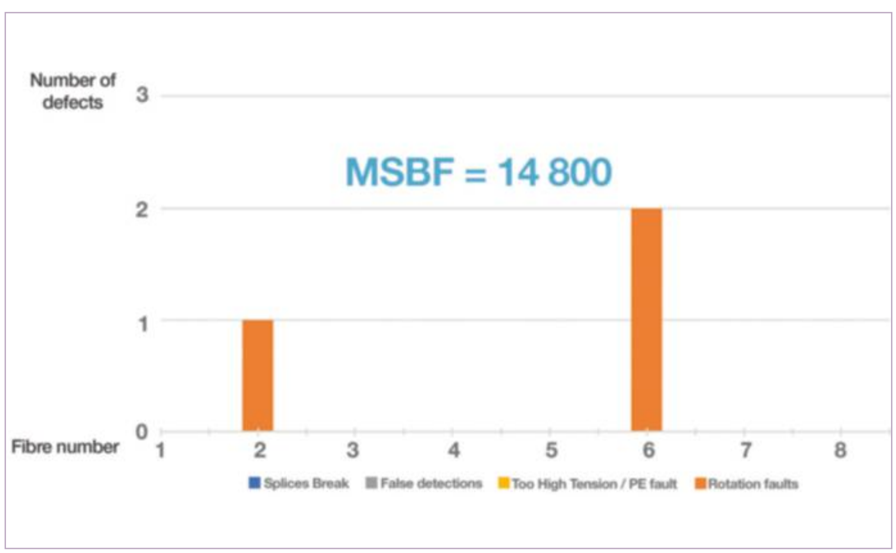

Fig. 4: Mean Swap Before Failure (MSBF) test results