Computed laminography – production-integrated inspection of large-scale CFRP components

Sébastien Papin,
Project Manager,
Rescoll

Production scrap and end-of-life products are a real challenge for the future of composites. The main goal of the WASTEcost project is to find a solution to upgrade waste from carbon-fibre-reinforced composites in order to manufacture an ecoproduct.

Carbon's low-weight and strength properties are now well-known, and carbon is being used more and more in leading industries, like transportation (e.g. aviation, automotive), renewable energies (e.g. wind turbine blades), and competitive sports (e.g. sailing, Formula 1).

Used to reinforce a resin – usually epoxy – it makes the end product remarkably more stable and durable over time. As paradoxical as it may seem, these advantages also constitute a disadvantage insofar as there are currently few industrially viable solutions for recycling waste from this material (production scrap, part trimming) and carbon-containing products that reach end of life, for example, as will be the case for the Airbus A350 (52% carbon) when its operating life is over. In this context, research company Rescoll applied its earlier research (refer to JEC Magazine issues 85 and 90) towards the launch of the WASTEcost project a year ago. The project's main goal is to find a solution to upgrade the waste from carbon-fibre-reinforced composites in order to create an ecoproduct.

Vertical stabilizer during printing with ABS/ Carbon fibre

A chain of partners

interview

François Franche,
R&T Public Relations
IP & Fundings STELIA-Aerospace

How does the WasteCost project fit into Stelia Aerospace's more global initiative to incorporate the notion of sustainable development into its businesses?

François Franche: Sustainable development is moving beyond the "awareness" stage to become a reality. Industrial manufacturers have to consider for instance the European REACH rules that require from us smart designing (including life cycle analysis) and Earth friendly way of manufacturing. In the same way, STELIA-Aerospace has been leading an ambitious action program for years now in order to reach the highest level of compliance with the ISO 14001 standard. Besides WasteCost project, which purpose is to give a second life to industrial waste, some other R&D projects of STELIA-Aerospace (regarding new generation aircraft seats) have, from the very start, included work packages about product life cycle studies (done by Rescoll, as a matter of fact) and about the use of biosourced materials. Generally speaking, most of the R&D projects led by STELIA-Aerospace are challenging best cost and low weight technologies for future generation airframes & systems (topologically optimized fuselage, 3D printing, tailor welding of blanks, thermoplastics fuselage etc.). STELIA- Aerospace is targetting the goal of minimizing the environmental footprint designing simpler, lighter aircraft (reducing "fuel burning") which are manufactured in ISO 14001-certified plants and in compliance with the REACH regulation.

A350 model presented at JEC World 2017

The two-year project is financed by the European Regional Development Fund (FEDER) and led by Rescoll in partnership with Stelia Aerospace, C3Technologies, and the Marcel Dassault secondary technical school for plastics processing in Rochefort. Through this project, the technological, techno-economic and environmental issues involved are explored.

That is the framework around the project. On the technical side, one of the upgrade challenges concerns the mechanical grinding of the carbon/epoxy composite waste, which is a key step in breaking the waste down to a size where it can be integrated into a thermoplastic resin as reinforcement. Rescoll currently uses this new compound (its excellent mechanical properties will be presented later on) to manufacture a yarn dedicated to additive manufacturing. After months spent perfecting this unusual blend and optimizing the different methods for processing it, Rescoll is now focusing on 3D printing of a plastic yarn reinforced with carbon/epoxy composite.

Focus

The partners in the project
www.stelia-aerospace.com/
www.c3technologies.fr/
www.lycee-marcel-dassault.fr
The supports
vlm-robotics.fr/
ima.u-bordeaux.fr/

Additive manufacturing

The first conclusive tests took place in Rescoll's plastics processing laboratory, but to test the reinforced yarn on oversized parts, it was necessary to call on other experts in France's Nouvelle-Aquitaine region. For this new phase, the IMA resource centre for aviation maintenance engineering in Mérignac and VLM Robotics in Mios joined Rescoll.

Early this year, the WASTEcost project team launched production of an Airbus A350 mock-up using the reinforced yarn – in a way, closing the loop, since the waste itself comes from the Airbus A350 manufacturing process within the STELIA Aerospace group (see photo of the vertical stabilizer).

interview

Laurent Bouscaud,
Training Director
Lycée Marcel Dassault

What motivated the school's decision to participate in this R&D project, and how is that participation benefiting the instruction given to your students?

Laurent Bouscaud: By virtue of all its general technological and professional training courses, the Marcel Dassault Lycée, a comprehensive secondary school in Rochefort sur Mer, France, is concerned by sustainable development, and more particularly by material value development.

Through its professional training courses in plastics processing, composites and aeronautics, the school has always maintained special ties with the Rescoll laboratory and Stelia Aerospace.

The synergy around the WasteCost project in which the school participated enabled it to pass a milestone in the recycling of carbon/epoxy composites. As part of their end-of-studies project, a group of four students in the "Europlastics and Composites" Advanced Technician's Certificate programme were able to work on the injection moulding and characterization of a recycled carbon/epoxy-reinforced thermoplastic-matrix material. One of the school's teachers mentored the project in conjunction with the Rescoll laboratory and Stelia, making it possible for them to contribute to the feasibility stage.
In a follow-up to that collaborative project, a head of project from the Rescoll laboratory will lead a material-recycling-themed activity for the students in the STI2D (industrial science and technology and sustainable development) baccalaureate programme.

LYCÉE MARCEL DASSAULT

interview

José Alcorta,
Manager
Rescoll

Mr. Alcorta, you are the manager of Rescoll. Can you give us a brief presentation of your company?

José Alcorta: Rescoll is an SMI with about a hundred employees that has been working for the past twenty years or so in material studies and testing. We have two sites, one in Rochefort and another in Pessac on the outskirts of Bordeaux.
More specifically, Rescoll carries out two types of activity:
- technical innovation studies for the purpose of developing new materials, products, and processes, and
- laboratory analysis, testing and characterization of these materials and structures under a highly effective quality management system (ISO 17025, NADCAP NMMT, and certification from Airbus, Dassault and General Electric, among others).
Thanks to these two complementary activities, we are able to offer our manufacturer customers a broad range of services.

What manufacturing sectors do you address?

J.A.: You might say that any manufacturing sector could require our services sooner or later. Companies have understood that investing today in technological innovation turns into tomorrow's sales. Therefore, we are led to work in sectors as different as building & construction, transportation, and the food industry, where the demand for technical materials – in particular composite materials – is growing.
However, we have developed a specific commercial offering that targets three business sectors where the demand for innovation and testing of the materials they use is high:
- Aerospace – a traditional sector that has enabled Rescoll's development, with an offering of material tests (notably for composites where we are concerned) that are certified by principals in the field.
- Medical – more precisely implantable medical devices, a sector where we meet increasingly stringent technical and regulatory requirements.
- Energy – given that new types of energy like wind, photovoltaic, fuel cell, or hydrogen and methane storage have very strict in high-performance materials.

And what about environmental concerns?

J.A.: Our industrial customers have specifications that contain standard technical and economic clauses, among others, as well as more and more environmental requirements. Therefore, we have trained our teams specifically to take these requirements into account in all of our studies, and even in carrying out studies that focus mainly on the environment (you have an example in the attached article).
In this way, we gradually shifted from quantifying the environmental impact of the innovations we develop in our innovation studies through life cycle analysis, to verifying environmental performance under the Environmental Technology Verification (ETV) programme (for which Rescoll is one of the 5-6 laboratories selected by the European Union) and to carrying out full studies on the recycling of materials and their reutilization, or developing materials from biosourced products.
To take one example, at JEC 2016, we presented an A350 mock-up made using additive manufacturing, and for which the base material consisted of composite waste from A350 parts.

What are your activities in the field of composite materials?

J.A.: Rescoll is the result of the merger of two companies with complementary activities. Rescoll Pessac has significant expertise in chemistry and formulation, while Rescoll Rochefort is specialized in the design, analysis and dimensioning of parts.
So, Rescoll's global offering now extends from design to structural testing, an area for which both sites are especially well equipped.

Together with our environmental expertise, this broad offering enables us to work on a large number of studies on composite materials. For example, we are working on developing biosourced matrices for Class 120 and 180 composite materials/Class 120 and 180 biosourced matrices for composite materials for aviation specifications, and sizing coatings for carbon fibres that can be used in thermoplastic composites.
To learn more about our activities, you can consult our website at www.rescoll.fr.

The 3D-printed airplane is a meter long, for an equivalent wingspan. The IMA and VLM Robotics pooled their human and material resources to perfect a printing technique compatible with both the material and the prototype dimensions, with spectacular results: a printing head mounted on a KUKA robot enables movement over long distances as the molten yarn is deposited.

Ecoproducts

The WASTEcost prototype represents real technological progress, and has been selected as one of the innovations on the Aerospace Planet at the JEC trade fair on 14-16 March 2017.

As the project's "spearhead", the prototype draws the contours of two future ecoproducts that have been selected by Stelia Aerospace, and which will soon be manufactured by the WASTEcost consortium. The group would also like to move towards an ecodesigned version of interior cabin elements using the carbon/epoxy composite waste. □

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