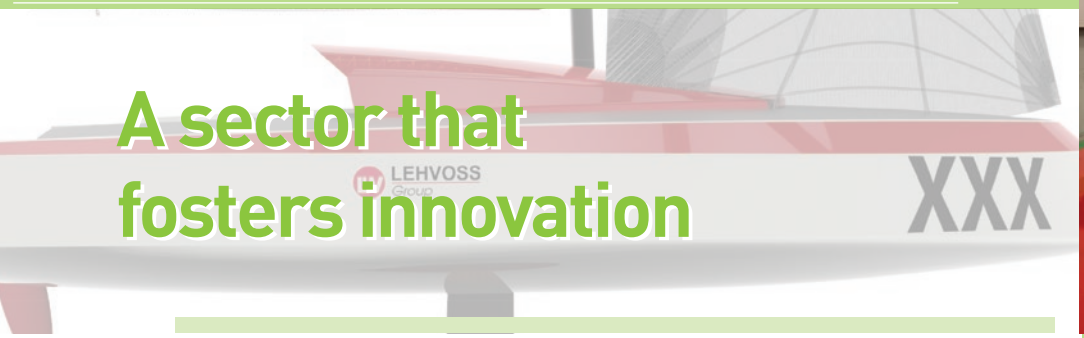

A sector that fosters innovation

passenger ship

A carbon fibre composite propeller for a passenger ship

The sea trials for a composite propeller one metre in diameter took place at Lorient, France on 19 March 2018. The propeller served to drive the passenger ship Le Palais, with a capacity of 286 passengers, between Lorient and Brest at a speed of 21 knots. The ship is 30 metres long, weighs 84 metric tons, and has two 1100-hp engines.

This performance is the fruit of the Fabheli (FABrication d'HELice en composite) composite propeller project, which is subsidized by the French Directorate General of Armaments (DGA) and sponsored by Loiretech and its partners Meca and Naval Group. The purpose of the project was to develop a propeller with a reduced environmental footprint (in particular with an estimated 15% lower energy consumption) and produce it at the industrial level, at lower cost. Other objectives were to reduce the maintenance costs and improve the hydrodynamic efficiency.

One-shot RTM

The project started in April 2016 with a digitization and analysis phase, carried out by Meca for the mechanical aspect and by Naval Group for the hydrodynamic aspect, towards the structural design of the carbon-fibre composite propeller (two times lighter than its metal equivalent). The project also provided the opportunity to make use of new design methods to calculate the adaptable profile, the hydrodynamic and mechanical torque, and the layup optimization, and to obtain a stronger, more flexible blade. The goal was to meet a stringent set of specifications. The propeller would be subject to high mechanical stresses during use, and this required innovative concepts, production technologies and surface treatments so that it could withstand such stresses. Validation in the laboratory involved a large number of non-destructive ultrasound tests, physiochemical tests, mechanical tests (tensile, bending) and impact/collision tests.

The five-blade propeller was produced using a one-shot RTM process.

First success on 19/03/18: sea trials between Lorient and Groix

Series production

The new composite propeller was mounted on the ship by AML to replace the metal one, and was put to the test during sea trials. With the support of the Bureau Veritas, the intrinsic properties of the composite propeller were validated during the many manoeuvres carried out at the ship's maximum power output. At the end of the operation, the propeller appeared to be in very satisfactory shape.

This opened the possibility for a follow-up to the project to optimize the functional and manufacturing process aspects before launching series production, which is Loiretech's and Meca's stated objective. This project is civil and defence oriented.

- Le Palais: 286 passengers, 30 metres long, 84 metric tons, power output 2 x 1100 hp
- Installing the propeller to replace the metal one
- Underwater instrumentation, one day of testing at full speed 21 knots and during manoeuvres
- 5 days of sea trial in real conditions
- Result: propeller intact
- The Fabheli propeller following the sea trial, with representatives from Meca, Naval Group, Loiretech and the contributors AML Atelier Lorientais, Bureau Veritas and DGA. □

Focus

Established in 1988, **Loiretech** has 140 employees. The company designs and manufactures large-scale complex tooling assemblies to shape, mould, assemble and inspect composite, thermoplastic and metal parts. Its main markets are commercial aviation, automotive, defence, and renewable energies. On average, Loiretech invests 7% of its sales in R&D each year.

Meca is a design and engineering company for innovative structures that specializes in composite materials. Its teams of engineers and technicians are backed up by experts who are specialized in material behaviour, structural analysis, multimaterial design and hydrodynamics. All these complementary skills cover a vast field of technical expertise, including:

- material behaviour and multimaterial assembly,
- overall design and detailed design,
- definition of the stresses and strains along with the associated design methods,
- building codes and analysis as regards reliability criteria,
- fitness for purpose in field conditions, integration of sensors and monitoring strategies,
- failure modes and criticality analysis.

Naval Group is a high-tech industrial group of international dimension and Europe's leading naval defence specialist. It designs, builds and services submarines and surface ships, and also provides services to shipyards and naval bases. The group also proposes a range of solutions in renewable marine energy. In 2017, it had sales of 3.7 billion euros and 13,429 employees. □

More information:
www.loiretech.fr
http://cluster-meca.fr
www.naval-group.com/fr/