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The $4 Million Manufacturing Machine: Aerospace companies in the United Kingdom are developing automated processes for complex parts

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A technician with Coriolis Composites controls the automated fiber placement machine at the National Composites Centre in Bristol, England.

With two heads and long gray pipes, the $4 million investment looked more like a science fiction character than composite manufacturing equipment. But the automated

fiber placement (AFP) machine was welcomed to its new home at the National Composites Centre (NCC) inBristol,England, by U.K. manufacturers. NCC members now have the rare opportunity to optimize parts and processes with state-of-the-art technology.

The unique dual-head automated fiber placement machine allows manufacturers to create complex, double-curved structures in composite materials. It was installed last August by Coriolis Composites,Quéven,France. It has since been used by many of NCC's industry partners, such as GKN Aerospace, Umeco, Airbus and Bombardier.

The AFP machine was paid for by grants from the European Regional Development Fund and the South West Regional Development Agency through GKN Aerospace as part of the Next Generation Composite Wing (NGCW) research program. NGCW is a collaborative research and development program led by Airbus focused on using composite technology to replace metal in airplane wing structures.

The Twin-Headed Robot

Compared to traditional hand lay up, automated fiber placement technology could potentially save the aerospace industry time and money by producing parts faster and with enhanced precision. The AFP machine designed by Coriolis Composites uses a fiber guidance system to feed material to the robot heads using a system of flexible pipes to protect the fibers. The machine has two robotic arms, each with its own head system. The arms work independently to lay the fibers in specific directions and thicknesses. According to the NCC, automated fiber placement technology has the potential to reduce material waste by 75 percent compared to hand lay up. Composite parts are also 20 percent lighter than comparative metal parts.

"The Coriolis robotic lay up cell at NCC is the first dual AFP head system installed, allowing the possibility of increased deposition rates over a single robot and AFP head system," says Matthew Frost, project manager at Coriolis Composites. Additionally, the NCC recently added laser heating capability to the system that allows the deposition of thermoplastic and stabilized dry materials as well as thermoset matrix materials.

The head system is smaller than that of average AFP machines, so it can lay up both male and female molds. This enables aerospace manufacturers to build all sorts of complex parts, such as the fuselage shell. Furthermore, the small size means it can be installed onto a standard industrial robot, reducing the overall investment compared to a gantry system.

Aerospace Adopts AFP

AFP technology is currently being used in the aerospace industry to make parts up to 100 -feet long. According to the NCC, other industries could utilize the AFP machine but robotic deposition would not be applicable to very high-rate deposition. While the aim is to use this technology to create parts faster, the primary benefit is its ability to generate complex geometries demanded by part optimization. AFP is likely to be useful in other large scale, high-performance components.

The investment made by the NCC saves its industry partners money and helps them learn about the new equipment. "Developing future concepts and optimizing processes is something companies need to do when introducing new products or re-engineering existing ones," says Peter Chivers, chief executive at the NCC. "This equipment is expensive. It's also inefficient to interrupt existing manufacturing lines, and hard for most companies to justify the acquisition of equipment just for development purposes."

Aerospace companies are optimistic that the AFP machine will lead to larger breakthroughs due to collaboration. The NCC has already become a focal point for aerospace industrial partners to work together without boundaries, according to GKN Aerospace in Redditch, England.

GKN Aerospace began working with robotic AFP technology in 2009 when the company started developing a composite fan blade. It owns a gantry AFP machine and has continued to use the technology to manufacture the next Airbus A350 rear wing spars. GKN Aerospace uses the AFP machine at the NCC to improve its own processes and work on prototype wing boxes for next-generation wing aircrafts. GKN expects to have models of the wings ready by 2015.

The Future of AFP

NCC hopes to be the hub of the United Kingdom's efforts to develop and implement rapid composite manufacturing technologies and systems. The AFP machine provides a great start. "We're seeing a huge response from mainly aerospace companies interested in optimization for current products and exploring product design for future processes," says Chivers. But to move automated fiber placement technology forward, the equipment needs to be more affordable for manufacturers.

The NCC believes that over time the cost of the machine will decrease as demand rises. The center recently purchased a second AFP machine with a gantry-type system to give companies further insight into different automated processes.

As for GKN, it hopes to gain a better understanding of how to design and program using tape placement as well as develop improved methods for putting down more material in a shorter timescale. High-rate manufacturing in future automated robotic deposition will be essential to achieve the rates of building that are necessary to remain competitive, according to the company.

GKN Aerospace's goal is to target improvements in impact design as well as manufacturing. It plans to focus on more integrated structures, co-cured assemblies and integration of additional functionality into structural parts.

The NCC and its partners expect the investment in high-tech equipment will lead to a new era for automation and composite wing technology.

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