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Who needs the pressure?

Composite material companies continue to develop resins designed for out-of-autoclave (OOA) cures. **Dr Neil Calder** reports.

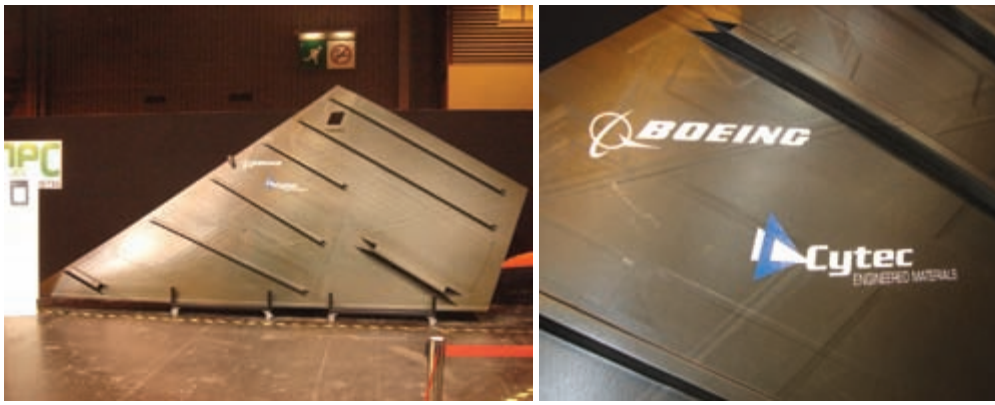
Since we last reported on OOA materials in *Aerospace Manufacturing* October 2008 there has been considerable action on a number of fronts, most significantly in opening up applications in primary as well as secondary airframe structures that eliminate the requirement for autoclave cure cycles.

At the recent JEC show, Cytec unveiled its CYCOM 5320 resin system as an addition to the line-up of high performance OOA aerospace products that now includes Hexcel's M56 and ACG's MTM44 resins. In addition to giving Cytec a presence in this growing sector, it could represent a significant advancement in composites materials processing capability and a lowering of many entry barriers into the sector.

CYCOM 5320 has been developed from the high strength high toughness epoxy resin 977-3, used on many F-35 components, through a collaborative project led by Boeing and funded by the US DARPA Defence Sciences Office as part of its disruptive manufacturing programme. The aim of this was to develop and demonstrate non-autoclave manufacturing technology for production of polymer matrix composites for aerospace components and to establish a robust process for full-size components.

The key issues with OOA curing are in the elimination of porosity and the compaction of the lay-up to give a high resultant fibre volume fraction. Autoclave pressures of around 7atm have been used in the past to deal with these two factors and to ensure good properties for highly engineered applications.

The technical approach has been through packaging of the cure cycle.



Revealed at JEC Paris: Wing skin demonstrator part using CYCOM 5320

CYCOM 5320's fibre volume is achieved through the optimal combination of resin viscosity, resin advancement, degree of impregnation and cure temperature. A resin content of 33% by weight is cited for unidirectional tape. CYCOM 5320 has a slightly higher cure temperature and is designed to have just the right amount of flow to consolidate during cure. It developed the majority of the porosity formation science using CYCOM 5215 prepreg. The final CYCOM 5320 system combines a few recently discovered key technology developments in resin formulation. This combination has allowed CYCOM 5320 to have an excellent balance of mechanical (toughness, compression and tension) properties, out-time and reactivity at low temperatures.

Cytec selected vacuum bag processing because it is the most versatile process and in the belief it is easier for their customers to adopt and automate, which has a large cost advantage. Throughout CYCOM 5320's development, Cytec and Boeing collaborated on ensuring the correct challenging parts were being made with a progression of easy to difficult parts.

First airworthiness approvals for this material are expected within a couple of months, but Cytec is now offering CYCOM 5320 as a commercial product. We can assume that Boeing is one of the active companies involved as it has manufactured a vacuum bag cured wing skin panel demonstrator incorporating many features of primary aircraft structures exhibited at JEC.

Hexcel's thermoplastically toughened HexPly M56 is now also rated for primary parts, with a number of Tier 1 suppliers cited as being in the process of qualification. From these trials Hexcel reports very positive feedback regarding product handling and processing. In particular the resin appears well adapted for Automated Tape Laying (ATL) and has demonstrated less than 0.5% porosity.

Whilst definitions of primary structures may be subjective, it is clear that OOA materials are applicable across many aerospace applications. |

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