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AUSTRALIAN PRODUCT IN RESEARCH TO REDUCE WEIGHT OF AEROENGINES

The shift towards composites in all forms of mass transit vehicles is driven by the economics associated with weight reduction, not only because of reduction in the running costs of a vehicle over its lifetime, but also because of the ability to reduce infrastructure costs, and to reduce environmental impacts.

However, polymer based composites burn.
Organic matrices first soften on heating causing a loss of mechanical properties.
At higher temperatures they decompose, typically producing smoke and toxic or flammable decomposition products.
Loaded composite structures often fail within a period of minutes

Dr. Joe Carruthers of NewRail, at the Fire Protection of Rolling Stock conference in Brussels 23rd March 20011, commented:

Existing methods of improving the fire performance of composites tend to compromise the structural (or wider) performance of the composite in some way, e.g.:

– Inherently good-in-fire resins such as phenolics tend to produce composites with only average mechanical performance and/or poor surface finish.

– Particle-based fire-retarding additives add mass and compromise processability.

– Non-structural fire-barrier coatings add mass and often compromise appearance.

One response to the problems associated with loading chemicals into the resins was developed by the Advanced Composite Structures CRC. They restricted the fire retardant chemicals to a narrow zone immediately below the surface of composite laminates. This was achieved by using a carrier for the chemicals, such as glass cloth or tissue, which could be incorporated into the laminate during manufacture.
The approach allowed standard resins to be used, avoiding the degradation of strength or stiffness of the composite section, which would otherwise have been caused by the presence of intumescent chemicals within the base resins.

An Australian company, Regina Glass Fibre Pty Ltd, developed the CRC-ACS laboratory concept into a commercial product, FireShield®.

Although nonwoven glass tissue provides the least-cost method for placing the intumescent chemical into the laminate, other fibres such as polyester or carbon, can be used as carriers, both in non-woven and woven form, to meet particular engineering requirements.

One current example is the research being undertaken to incorporate composite parts into aeroengines.
Such parts need to be fireproof according to ISO 2685.
This standard requires that, under test:
- Flame does not go through the component at the end of 15 min (15min at 2192F/1200°C flame).
- The flame must be extinguished as soon as the burner is removed.

Initial trials with FireShield® fire performance, but the lack of shear in the carrier of the FireShield® being tested prevented the moulding of the complex, three dimensional laminate shapes required for the engine.

A rapid development program was conducted by Regina, and produced a FireShield® variation in which the chemical was impregnated into a light, 45°/45° bias glass cloth. This variation is now being trialed, and compared to other competitive approaches, at the aeroengine manufacturer.