

# literature survey literature survey

Prepared by M.E. Adams, L. Boniface, T. Nensi and P. Sheard

---

## CARBON FIBRES

---

### ESCA studies of carbon fibres. Part III — surface reactions of carbon fibres with amines

Waltersson, K. *Composites Science and Technology Vol 23 No 4 (1985) pp 303-321*

Carbon fibres were oxidized in a mixture of  $H_2SO_4$  and  $HNO_3$  and then refluxed in amines or solutions of amines. Studies of the treated fibres are reported. There is some evidence to indicate that the amines become covalently bonded to the surface of the fibres. The work supports the concept of modifying carbon fibres with diamine hardeners before the fibres are used to reinforce epoxy resins.

### Modification of polyacrylonitrile fibres to make them suitable for conversion into high performance carbon fibres

Bahl, D.P., Mathur, R.B. and Dhami, T.L. *Materials Science and Engineering Vol 73 (August 1985) pp 105-112*

Methods of modifying PAN fibres and their effect on the resultant carbon fibres are reviewed. A method of precursor treatment in  $CuCl$  solution which reduces the energy of cyclization and yields carbon fibres with improved tensile strength and improved Young's modulus is reported. A stepwise pre-oxidation of PAN fibres at a series of temperatures is also investigated.

### Transitions in second stage alkali metal intercalated carbon fibres

Manani, C., McRae, E., Mareche, S.F. and Herold, A. *Carbon Vol 25 No 5 (1985) pp 465-471*

The electrical resistivity of single, second stage, alkali-metal intercalated fibres (ex-PAN, ex-mesophase and benzene-derived) was studied from 4.2 to 550 K. The results are discussed in terms of decreasing intercalant order as the temperature rises, comparison being made with highly oriented pyrographite counterparts.

---

## CARBON MATRICES

---

### Fracture toughness of 2-D carbon fibre reinforced carbon composites

Kim, H.C., Yoon, K.J., Pickering, R. and Sherwood, P.J. *Journal of Materials Science Vol 20 No 11 (November 1985) pp 3967-3975*

This study investigates the applicability of LEFM,  $R$ -curve and  $J$ -integral in fracture toughness tests on 2-D cloth-based CFRC materials. Three commercial grades of woven graphite fibre cloths were impregnated with graphite and carbonized at  $950^\circ C$  under nitrogen. Single edge-notched bending specimens of flatwise (long axis parallel to warp direction) and edgewise geometries were cut and slits were

machined in; crack propagation was measured by acoustic emission during three-point bending tests. The development of the damage zone at the crack tip was monitored photographically using brittle lacquer coatings and its shape was found to depend on specimen geometry. Edgewise specimens fractured by small extensions of the crack; flatwise specimens failed by delamination. Acoustic emission and damage zone size increased in two linear stages with  $K^2$ .

---

## CEMENT MATRICES

---

### Compressive strength and deformation of steel fibre reinforced concrete under high rate of strain

Rostásy, F.S. and Hartwich, K. *The International Journal of Cement Composites and Lightweight Concrete Vol 7 No 1 (February 1985) pp 21-28*

The influence of high strain rates on the strength and deformation of fibre-reinforced concrete in uniaxial and eccentric compression tests is reported. The results show that the dynamic strength is about 20% higher, at which the ultimate strain also increases by 10 to 20%. The failure of the fibre concrete specimens occurred in a much more ductile manner than plain concrete. The residual static strength of eccentrically loaded concrete is slightly diminished by a dynamic preloading.

### The effect of PFA additions on the properties of GRC

Singh, B. and Majumdar, A.J. *The International Journal of Cement Composites and Lightweight Concrete Vol 7 No 1 (February 1985) pp 3-10*

Bending, tensile and impact properties of GRC containing 5 weight % alkali-resistant fibres and up to 50% replacement of cement by PFA, which had been kept in three different environments for up to 11 years, are reported. In general, the changes in mechanical properties were little different from those of GRC itself.

### Natural twines as main reinforcement in concrete beams

Mwamila, B.L. *The International Journal of Cement Composites and Lightweight Concrete Vol 7 No 1 (February 1985) pp 11-19*

Beams reinforced with 1% or 2% twines of different diameters were tested under static short-term loading, repeated loading and sustained loading. The deficiencies found are discussed. Attempts to improve performance by the addition of short sisal fibres or small proportions of mild steel are also reported.

### Pull-out processes in steel fibre reinforced cement

Bentur, A., Mindess, S. and Diamond, S. *The International Journal of Cement Composites and Lightweight Concrete Vol 7 No 1 (February 1985) pp 29-37*

The physical processes that take place during the pull-out of steel fibres of various geometries from Portland cement paste were studied micro-

scopically by *in situ* testing. Two types of specimens were tested: compact tension specimens reinforced with a single short fibre placed in front and perpendicular to a cast-in notch; and specimens of a simple pull-out test geometry. Observations by optical microscopy and by SEM indicated that the pull-out processes observed in the compact tension specimen, after it was cracked and the fibre bridged across the crack, were different from those in the simple pull-out test.

---

## CERAMIC FIBRES

---

### High strength fibres for thermoplastic composites

Klein, A.J. *Advanced Materials and Processes Vol 1 Issue 2 (October 1985)*

The article reports on the new submicron ceramic reinforcing fibre with a chemical formula similar to silicon monoxide. Amenable to silane coupling agents for glass fibres, it grows in a fibrous bulk with increasing fibre concentration towards the centre of a ball. Aspect ratios of 50 to several hundred are achieved and its advantages for processing with thermoplastics, amongst other applications, are discussed. A high strength crystalline polyethylene fibre and its uses are also discussed.

### The homogeneity of a glass wool based composite

Järvelä, P.K., Pohjonen, T. and Järvelä, P.A. *Plastics and Rubber Processing and Applications Vol 5 (1985) pp 149-155*

An attempt has been made to measure the homogeneity of a glass wool based composite by using data obtained from tensile testing, density and matrix material content studies. A good correlation between these properties has been reported within a certain range of density and matrix material content.

---

## CERAMIC MATRICES

---

### Glass and glass-ceramic composites for high temperature toughness

Bittence, J.C. *Advanced Materials and Processes Vol 1 Issue 2 (October 1985)*

The article reviews glass-ceramic composites at today's state-of-the-art and concludes that future developments in ceramics will be in the area of fibre-reinforced glass and glass-ceramic composites.

### New generation ceramics

Sheppard, L.M. *Advanced Materials and Processes Vol 1 No 1 (1985) p 39*

This paper reviews recent developments in the fabrication of ceramics and ceramic composites and reports on their improved impact and tensile performance.