MATERIALS

Tests for Composites

from a Correspondent

CARBON fibre reinforced plastics dominated the proceedings of the conference on testing fibrous composites for mechanical properties, held at the National Physical Laboratory, Teddington, on July 15–17. A problem that arose early in the meeting was the difficulty of interpreting short-term interlaminar shear tests and using the results in design. Dr K. T. Kedward (Rolls-Royce Ltd, Derby) has developed a theoretical analysis of the short-beam shear specimen which shows the influence of the geometry of the specimen on the results of the test. Dr A. Maybury and three colleagues (Rolls-Royce) have followed this up with experimental results for both shear and flexure. These two studies enhance the value of these test methods as research tools, but will not make the results any more useful for design.

Tubes are most attractive as test specimens for bidirectional materials, and Dr N. J. Pagano (US Air Force Materials Laboratory, Ohio) has analysed tubes with reinforcements inclined to the axis both in tension and torsion. For highly anisotropic materials with a ratio of wall thickness to radius of 1:10 the stress variation through the thickness can be as much as ± 45 per cent, whereas in isotropic material the variation would be almost negligible. Dr G. J. Buchi and two colleagues (English Electric Co. Ltd) have tested vacuum impregnated dry wound tubes in tension, torsion and compression, obtaining good results except at high fibre loadings when difficulties were attributed to voids.

Dr I. Wolock *et al.* (US Naval Research Laboratory, Washington) have used thick walled glass reinforced plastic tubes subject to external pressure to study the growth of cracks from a notch on the inside surface. The tests gave a background for failure analysis, but prompted studies of fracture mechanics in a splitting mode with double cantilever specimens. Apparently the energy absorbed increased with crack velocity. Tests of this type can readily be extended to environmental studies, and the hope was expressed that it will be possible to control the rate of crack propagation in glass reinforced plastics.

Drs G. R. Sidey and F. J. Bradshaw (Royal Aircraft Establishment, Farnborough) showed that conventional Charpy and Izod impact testing of fibre reinforced polymers gives misleading results because much energy is absorbed in producing secondary damage. Ballistic impact tests with the apparatus of Drs A. W. H. Morris and R. S. Smith (National Gas Turbine Establishment, Pyestock) showed that splitting was the predominant failure mode. Sidey and Bradshaw therefore carried out fracture mechanics tests in the I, II and III modes. The specimen for the III mode was similar to that used by Wolock. They found that in the I mode crack opening displacements had to be large enough to break all the fibres in the tied zone to obtain reliable results. Morris and Smith found that the impact properties of fibre composites with both metal and polymer matrices were distressingly low compared with metals, especially titanium.

Dr M. J. Owen (University of Nottingham) drew attention to the fact that fatigue testing practices for fibre reinforced plastics rely heavily on standards devised for metals. Particular attention must be paid to the design of specimens, test frequency and failure criterion. Owen reported very good fatigue results for carbon fibre reinforced plastics, especially compared with high strength metals on the basis of the ratio of strength to specific gravity.

The urgent problem of finding non-destructive test techniques for quality control and material property determinations in composites has been tackled by Dr M. F. Markham (National Physical Laboratory). Using a theory developed by Drs M. J. P. Musgrave (Imperial College, London) and G. Dean (NPL), Markham described ultrasonic pulse techniques that can be used to determine elastic constants. Recent developments have made it possible to reveal clusters of voids and other defects in this way. Dr G. J. Curtis (Atomic Energy Research Establishment, Harwell), however, using a goniometer technique, found inexplicable anomalies in results obtained from ultrasonic testing.

PROTEINS

NMR in Spate

from our Molecular Biology Correspondent

PROTON magnetic resonance, it is safe to say, has caught on in biochemistry. The fortunate possessors of high-resolution instruments have been able to exploit the mystique that now envelops the technique—which indeed is arguably still novel enough that the display of its scope on known systems is justified. At some point, none the less, promise must give way to performance, and if for the most part this consummation has not yet been realized, a few well-judged applications have been described.

Nuclear magnetic resonance (NMR) has, for example, been used to determine with fair confidence the conformation of small, especially cyclic peptides, and it has also given new impetus to the study of synthetic polypeptides, for it has made possible the examination of the structural basis of conformational transitions in new detail. Joubert, Lotan and Scheraga (*Biochemistry*, **9**, 2197; 1970), for example, have studied the behaviour of the side chains in a series of water-soluble glutamine derivatives, the helicity of which can be controlled by adjusting the temperature and solvent composition. Comparison of large and small polymers reveals that the line-widths are substantially determined by internal freedom and not the overall tumbling rate, and that the side chains at the ends of helices have more freedom than those in the middle. The authors are led to ponder the reasons for the much debated occurrence of two peaks in the α-carbon proton resonance in some polymers in the transition range in certain solvent systems. From all that is known of the kinetics of the helix-coil transition, it follows that there should be only one peak, to reflect the rapid rate of interconversion, and Joubert *et al.* suggest an explanation of the effect in terms of a slow specific solvation of the coil. A quantitative explanation of the phenomenon has also been given (Ullman, *Biopolymers*, **9**, 471; 1970) in terms of the tendency of the ends of the chains to be less helical in the transition range, and of the polydispersity of the materials,