MODELLING FIBRE LACE STRUCTURES IN SHAPED FLOW FIELDS

Polymer Processing Society's European Meeting, EAHP, Strasbourg
August 29th-31st 1994, paper 5-3

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The work reported here results from a long-term programme of research under the generic title of **S**elf **A**ssembling **Fi**bre **Re**inforcement (SAFIRE) processes. This work is aimed at providing means by which deformable lace-like structures are obtained within resins and melts in ways which do not interfere with established processing methods such as extrusion, injection moulding and blow-moulding. Earlier results, principally on the resultant solid properties, have been reported at PPS Conferences [1, 2, 3]. The processes involved are now patented world-wide[4, 5] and products dependent on the processes have entered commercial production.

Theoretical work on fibre suspensions reported in the literature has, beginning with Jefferey[6], focussed on the motion of the isolated particle or the semi-dilute case defined by the limits on the volume concentration (c) of fibres as

$$d^2/\ell^2 < c < d/\ell \qquad (1)$$

These limits cover the range from virtually no particle-particle interaction to that where there is the beginnings of significant interaction. For reasons which will be clear, the focus of the SAFIRE work has been on concentrations greater than (d/ℓ) and usually many times greater. Although it has been said[7] that the suspension behaves as a solid for c above (d/ℓ) that has not been found to be the case, although the rheology of the resin-fibre composition is profoundly different from that of the resin alone.

References

[1] Bush S F, Extrusion of Melts Containing Semi-Coherent Fibre Structures, 5th Poly Proc Soc Ann Mtg, Kyoto, Japan (1989) paper 11-02

[2] Bush S F, Ademosu O K, Blackburn D R and Yilmaz F B, Factors affecting the Strength of Long-fibre Reinforced Injection Moldings, Poly Proc Soc, European Mtg, Prague, 21st-24th September (1992) Paper 6-06

[3] Bush S F, Ademosu OK and Blackburn D R, Relationship of Impact Strength and the Fiber-matrix interface in varieties of polypropylene Long-glass-fiber injection moldings, Poly Proc Soc 10th Int Ann Mtg, Akron USA, 5th-8th April (1994) paper 6-2-8

[4] Bush S F, Fibre Reinforced Polymer Compositions and Process and Apparatus for the production thereof, U Pat 5,264,261 (23 Nov 1993)

[5] Bush S F, Filament Separation in Liquids, Euro Pat 0355 116 B1 (31 March 1993)

[6] Jefferey G B, Proc Roy Soc, A102 (1922), 161

[7] Dink S M and Armstrong R C, A Rheological Equation of State for semi-concentrated Fiber Suspensions, J Rheol 28(3) (1984, 207

[8] Ausias G, Vincent M, Agasant J F, Pipe Die extrusion of Reinforced Thermoplastics, Poly Proc Soc. European Mtg, Sicily (15-19 Sept 1991), 186