Glass fibre sizings and the composites industry: The current state of play

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1.Introduction

Glass fibre reinforcements form the backbone of the composites industry. Possibly the most critical component involved in the manufacture of glass fibres and their composites is the fibre sizing. The formulation and application of a glass fibre size to reinforcement fibres is a key contributor to the cost-effective production of glass fibres and their processability into composite materials with optimized short and long term performance. However, due to the lack of reliable and verifiable information on the physical and chemical nature of sizings the generally available understanding of these complex chemical mixtures does not reflect the level of importance that they have in determining the success of any glass reinforced composite material in a specific application.

A number of recent reviews have highlighted some serious issues for the composites industry related to the state of play in glass fibre sizing technology [1-4]. It has been suggested that the nature of all the complex interactions involved in size formulations, size application, fibre drying, fibre wetting impregnation and composite performance are not at all fully understood, even by those with inside knowledge of size formulations. It has also been highlighted that there is practically no information available in the open literature on what methods, if any, the manufacturers of glass fibres

use to characterise their sizings and control the quality and consistency of their sized products. This problem extends to their composite industry customers who consequently have little, or no, real guidance on tools to employ for quality control of sized glass fibres, other than monitoring issues during full production processing. Even then, quality issues with sizings may only become apparent after many years in the long term performance of the final composite parts.

Because of the lack of any comprehensive or reliable database on the science and technology of glass fibre sizings and the lack of accepted analysis and characterisation techniques and standards for sizings the number of knowledgeable researchers outside of the glass fibre producers is extremely small. This is compounded by the secrecy surrounding sizing formulations, the unique conditions of sizing application during glass fibre manufacture [2], and the very small concentration of the complex size mixtures in a final composite part. This situation makes it challenging for those without insider knowledge to draw any significant conclusions about the state of play and whether real progress is being made in this important area of composites science. However, there is little evidence of any recent real innovation in commercial glass fibre sizing development and it seems likely that the area is in near stagnation as many glass fibre products and their sizes are high up on the development S-curve, resulting in rapidly diminishing returns on effort. Indeed the glass fibre industry is on record as saying that product (i.e. sizing) development across the glass fibre industry is moving at a slower pace than in the past [5].

It is well established that the pace of technology development in any scientific field is directly proportional to the level of information sharing and to the number of well-informed researchers active in the field [6-8]. While rapid and expanding progress is made in developing areas of materials science where background information is more openly available, new size development continues to be carried out by an exceedingly small number of

researchers. These very limited numbers of researchers operate in an isolated and restricted environment with little or no open exchange of information. This situation seriously reduces the probability of an innovation in the field leading to a jump to a new S-curve which could bring rapid acceleration in the performance of resultant new composite products.

Consequently, it seems that it is highly likely that the current overall state of size development is a serious barrier to the innovation of improved glass fibre reinforced composite materials and is something that urgently needs to be addressed on an industry-wide level.

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