Commercial Opportunity

Carbon / Polymer Adhesive

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THE CHALLENGE

Enhanced performance for ever more demanding end user applications, coupled with a desire for more environmentally friendly technologies, pose a major innovation challenge to the adhesive industry. Metals and other non-porous substrates (e.g. plastics) present a particular problem, as they are known "difficult-to-bond" materials and usually require extensive surface pre-treatment to achieve satisfactory adhesion. It is unlikely that fundamentally new classes of polymers will provide the solution, hence, the emphasis must fall on the enhancement of existing systems to rise to this challenge.

THE DSTL INNOVATION

The UK MoD's Defence Science & Technology Laboratory (Dstl) has developed a novel "hot melt" adhesive composition suitable for bonding metals and other non-porous materials.

The core technology developed from a programme to incorporate activated carbon powder into a low-cost polymer (polyethylene) to act as a chemical barrier for high worth battlefield assets. However, quite unexpectedly, the carbon / polymer composite was found to have adhesive properties.

In particular, certain mixtures of Low Density Polyethylene (LDPE) and powdered activated carbon were found to provide good adhesion between similar and dissimilar metals (such as stainless steel, mild steel, aluminium, copper and brass). Moreover, this adhesion was achieved without the need for extensive surface preparation.

The carbon / polymer adhesive possesses the following key features and benefits:

- **Simple Raw Materials** - commonly available, low cost components with few anticipated regulatory, H&SE or toxicity issues surrounding its manufacture and use.
- **Bond Strength of 6.7 Nm^{-2}** – lap shear strength experiment with stainless steel
- **Bonds Untreated Surfaces** – minimal surface preparation required i.e. no need for abrasion, pre-priming, chemical, plasma or radiation etching.
- **Bonds Similar / Dissimilar Materials** – providing a multi purpose solution to difficult to bond metal-to-metal and metal-to-polymer applications.
- **Insulator** – despite its high carbon loading the adhesive is non-conducting, providing a potential solution to galvanic corrosion issues e.g. aluminium to steel bonding.
- **Thermoplastic** – reheating above melting point (Mp = 120 ^{o}C) enables easy disassembly, recycling and reuse of substrate components.
- **Hot Melt Application** – simple, low tech application process.

In addition to LDPE, beneficial results have also been obtained on the adhesive performance of certain copolymer mixtures.

THE OPPORTUNITY

The global "hot melt" adhesive market was valued at £1.08bn in 2005 with application across a wide variety of industries ranging from the building, packaging and woodworking sectors at one end through to high technology aerospace, automobile and biomedical engineering sectors at the other.

In recent years, advances in technology have expanded the range and type of "hot melt" adhesives to suit ever more demanding applications. Looking forward there is much interest in enhancing the performance of existing polymer systems through the use of novel fillers and composites.

The Dstl carbon / polymer adhesive offers just such a solution, expanding the range of application of polyolefin based "hot melt" adhesives into traditionally "difficult to bond" similar and dissimilar metals. Potential uses include: as a specialist stainless steel adhesive (e.g. cladding modular steel building systems), as a bridging adhesive (e.g. new market for aluminium / steel bonding), as a general metal adhesive (e.g. auto industry) or as a medical devices adhesive.

Dstl has undertaken an extensive programme of research in connection with the carbon / polymer adhesive for which it owns the IP rights. These IP rights comprise mainly know-how in the form of carbon / polymer formulations, processing methodology and application procedure as embodied in a number of technical reports. Patents have been applied for, however, recently uncovered prior art from the academic literature may limit their value.

Ploughshare Innovations, the technology transfer company for Dstl, is seeking suitable licensees to develop the carbon / polymer adhesive technology and exploit it in new and existing "hot melt" markets.