

SAA (Society for Adhesion and Adhesives)

FORESIGHT DOCUMENT

Adhesives

Introduction

The Society for Adhesion and Adhesives [SAA] was launched during the Adhesives technical session at Materials Congress 2000 in April. The SAA has been formed to promote the advancement of the science and technology of adhesion and adhesives via seminars, conferences, and by co-operation with and between learned societies, for whom adhesion and adhesives are an enabling technology.

The SAA committee consists of representatives from a wide range of sectors, including academia, adhesives production, footwear, aerospace, defence, medical and a broad based joining consultancy. From this experience base the SAA has divided the market into 8 major sectors:-

- Packaging
- Clothing and Footwear
- Aerospace
- Transport and Automotive
- Building and Construction
- Medical
- Electronic
- Offshore

An overview of the key drivers, issues and technologies associated with these sectors is now given.

PACKAGING

Business Drivers	Issues	Technologies/Innovations
Market Expansion and Market Defence	Material cost reduction Increase dispense/cure speed	Rapid mixing of hardeners/adhesives
Environmental Policies and Concerns	Develop green products	Water based adhesives to replace solvents Solvent free system 100% solid adhesives



CLOTHING AND FOOTWEAR

Business Drivers	Issues	Technologies/Innovations
Market Defence	Process cost reduction	Sourcing of prefabricated components
	Simplified processes	Reactive adhesives requiring less process steps
Environmental Policies and Concerns	Develop green products	Water based and hot melt adhesives to replace solvents

AEROSPACE

Business Drivers	Issues	Technologies/Innovations
Market Expansion		
Assembly Cost Reduction	Rapid cure consolidation of thick sections NDT, damage tolerance	Microwave/EB oven curing (not autoclave)
Operating Cost Reduction		
Environmental Concern/Legislation	Surface preparation (elimination of chromium)	
Weight Reduction	Composite joint performance	
	Composite/metal joints	
	Semi-skilled repair in service	Patch repair
	Monitoring in service loading of structures	Fibre optics
	Disposal of composite materials at end of structure life	Burning and safe processing of waste emissions and solids
	Matrix systems	
	Sizing of fibres	

	Surface preparation Self healing composites	Matrix initiation, growing over damaged fibres
--	--	---

TRANSPORT AND AUTOMOTIVE

Business Drivers	Issues	Technologies/Innovations
Market Defence		
More Efficient Manufacturing		
Environmental Concerns	Chromate free pretreatments (+composites)	Silanes, water based primers Some new compounds available
Fire, Smoke and Toxicity		

BUILDING AND CONSTRUCTION

Business Drivers	Issues	Technologies/Innovations
Reduce dead weight	Bonding (not welding)	
Flexible structures	Flexible joining compounds	
Cladding of larger single areas	Sub structure joints	
Increased recycling	Disposal of waste	
Reclamation of old structures	Evaluation	
Repair of concrete structures	Manipulation of materials and applications	
Human interaction within the building	Aesthetics, joints and material choice	
Low cost housing	Material costs	
Modular structures	Joints and joining	
Bridge repair/upgrade	NDT evaluation	
Fire retardant material	New standards to replace BS476 Part 22	
BS/EN consolidation of standards		
H&S	Dermatitis	New generation of reduced/ nill sensitisation

MEDICAL

Business Drivers	Issues	Technologies/Innovations
Market expansion	Rapid cure	Microwave/EB/laser
Environmental concern	Precision dispensing	Microjet printing
	Solvent free systems	Hot melts/ film adhesives
Bonding low surface energy polymers	Bond strength/durability	Plasma, laser, primers, speciality adhesives
Tissue bonding	Cure on demand	Radiation curing Natural polymers/ biodegradable polymers
	Bond in wet conditions, Degradation and Surgeon acceptance	
Bone adhesives and cements	Toxicity	Modified acrylates/ biodegradable polymers
	Desirable mechanical properties	Hydroxyapatite polymer composites

ELECTRONIC

Business Drivers	Issues	Technologies/Innovations
Market expansion	Higher thermal and electrical conductivity	Intrinsically conducting polymers/filled systems
Telecomms/low cost optoelectronic devices	Rapid cure	VFM, laser, EB
	Precision dispensing	Microjet
	Optoelectronic adhesives	Low creep, rapid cure Precision dispensing
High reliability products	Reliability/life predictions	Realistic accelerated ageing tests
		Modelling
		Forensic studies

Automation	Automated dispensing, cure and assembly	Microjet, VFM, robotic
High temperature packages	High temperature adhesives/encapsulents	Polyimides/ BMIs
Adhesives in 'New generation' LCD	Adhesion, optical properties and reliability	Adhesion promoters, surface pretreatments Novel photo-stable/ moisture-stable polymers

OFFSHORE

Business Drivers	Issues	Technologies/Innovations
Lightweight construction (sandwich structures)	Fire, Smoke and Toxicity	

The use of adhesives is pervasive throughout all industry sectors, however the predominant function of such materials from a pure volume basis is concentrated in non-structural packaging applications. The use of adhesives as secondary or even primary structural joining materials is less widespread despite the many advantages such adhesives can bring over more conventional joining methods such as:

- Dissimilar materials and dissimilar dimensions (e.g. polymer to metal, sheet to plate)
- Cold process (little or no thermal distortion)
- Enhanced fatigue properties (no point loading)
- Aesthetic design opportunities (hidden joints etc).

Manufacturing industry can be conservative and often these advantages are overlooked with respect to the perceived disadvantages such as:

- Weakest link
- Poor thermal resistance
- Messy
- Toxic
- Quality control is difficult.

However, all of these negatives are either incorrect or can be overcome through the use of appropriate design, materials selection and testing. Significant areas where such an approach has been successful include:- the elimination of rivets to secure brake pads; the use of composite structures in aircraft; all bonded chassis in the auto industry; helicopter blades; joining and repair of composite piping for the oil and gas industry; composite drive shafts. A slightly less obvious but extremely large area of

application is in the footwear industry where virtually all products employ adhesives in a structural context especially for joining the sole to the upper.

There is therefore a drive to develop the high-value structural adhesive market to enable greater design freedom with materials, reduce mass and improve efficiency in both production and product operation. The community at large needs to see what benefits greater adhesives use can bring in all walks of life.

Future developments

It is envisaged that key areas for innovation and development within adhesives technology will include:

- Self healing adhesives
- 'Green' surface pre-treatments (especially for light metals such as Al)
- Self organising adhesives (to achieve maximum performance in direction of maximum stress)
- Reversible adhesives (to facilitate disassembly)
- High temperature adhesives for both structural application and encapsulation
- Rapid curing systems (milliseconds)
- Improved conductive adhesives (thermal and electrical)
- Tissue and bone adhesives.