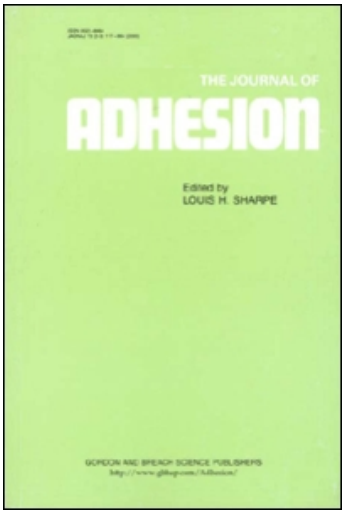

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Contents

Torsional Strength of Adhesive Shaft Joints between CFRP Tube and Stainless Steel at Low Temperature

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(Accepted for publication: November 17, 1993)

Abstract

The strength of adhesive shaft joints between carbon fiber reinforced plastics (CFRP) and stainless steel bonded with epoxy resin was investigated at room temperature and low temperature (−70°C) both analytically and experimentally. The distributions of stress for torsional load and thermal stress for cooling in the joint were analyzed by applying the elastic finite element method. The strength of the joints was predicted by applying the strength law of CFRP, stainless steel, adhesive layer and their interfaces to the calculated stress distributions. The predicted strength was compared with the experimental strength of the joints. The effects of the overlapped length and diameter ratio on the joint strength were examined at both conditions of room and low temperatures. The joint strength for the final failure is saturated by a certain overlapped length. The final joint strength at low temperature is smaller than that in room temperature.

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Study on Interface Segregation of Hot-melt Adhesives

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(Accepted for publication: September 13, 1993)

Abstract

Three model formulations of hot-melt adhesives (HMA) were applied on four adherends, each one having different surface energy: polypropylene (PP), polypropylene with corona discharge treatment (treated PP), polyethylene terephthalate (PET) and aluminium (A1). After that, they were peeled using liquid nitrogen. The fractured surface of HMA was then studied using both ESCA analysis and also contact angle measurements for interface segregation and interface orientation.

According to our results concerning the surface free energy of these adherends, in order: PP, treated PP, PET, and (A1), the polar components of the formulations were segregated; furthermore, we conclude that the compatibility for three components of HMA promoted the segregation.

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Modification of Instant Adhesive in Blending of Cyanoacrylate and SIS-g-MMA

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(Accepted for publication: October 7, 1993)

Abstract

The elastomer, styrene-isoprene triblock polymer (SIS), was modified by graft polymerization with methyl methacrylate (MMA), and the graft polymer indicated an excellent compatibility with ethyl 2-cyanoacrylate (CA). The graft polymer was blended with CA for modification of adhesion strength. We studied both the

relationship between grafting and adhesion strength using a CA: SIS-g-MMA blend solution; and also the compatibility of SIS or SIS-g-MMA with CA by SEM photograph.

The adhesion strength of the CA: SIS-g-MMA blend solution was higher than that of the CA: SIS blend solution; therefore SIS-g-MMA is more compatible with CA than SIS is. This fact was confirmed by SEM photograph. With the CA: SIS-g-MMA blend solution, tensile shear strength increased in proportion to the rise in grafting; however, T-peel strength decreased in proportion to the rise in grafting. The tensile shear strength of the CA: SIS-g-MMA blend solution was lower than that of the CA bulk; however, the T-peel strength of the CA: SIS-g-MMA blend solution was higher than that of CA bulk. It was found that T-peel strength of CA adhesive was modified by blending CA with 5 wt% SIS-g-MMA.

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Retention of Elongated Liquid Drops by Solid Surfaces

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(Accepted for publication : November 25, 1993)

Abstract

Retention of elongated liquid drops by solid surfaces has been studied. A tiltable plane was used to dislodge water drops from silicon wafers and three polymer surfaces. Due to contact angle hysteresis, drops remained stationary until a critical force F was exceeded, then began to slide down the plane. Although, drops elongated before moving, their width did not contract much. Critical values of F were higher than predicted for drops with circular contact lines. F was calculated numerically for elongated drops by integrating the surface forces around an elliptical contact line. The calculation showed F increases with elongation, in fair agreement with experimental data.

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Effect of the Addition of Styrene Isoprene Triblock Polymer or Poly (butyl acrylate) for the Epoxy Adhesive

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(Accepted for publication: December 17, 1993)

Abstract

We studied that bisphenol A type epoxy resin (epikote 828) was modified with styrene isoprene triblock polymer (SIS) or poly (butyl acrylate) (ACR) for the purpose of improving the initial bond strength and T-peel strength. Epoxy resin blended with a little of SIS or ACR and added amine curing agent, was fixed a steel plate. And the plate was adhesived with another steel plate, after that was hardened at room temperature. It was observed the initial bond strength and T-peel strength of modified epoxy resin was higher than that of epoxy resin only. Epoxy resin modified with SIS or ACR showed to

improve the initial bond strength and T-peel strength. Thus, it was assumed that SIS or ACR was compatibilized into epoxy resin.

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A Two-Dimensional Stress Analysis of a Butt Adhesive Joint Filled with Circular Holes and Rigid Circular Fillers in an Adhesive Subjected to a Tensile Load

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Abstract

This paper deals with a two-dimensional stress analysis of a butt adhesive joint with rigid fillers and circular holes in an adhesive subjected to a tensile load. We are assuming that the adherends are rigid, and are replacing an adhesive with a finite strip which includes rigid fillers and circular holes. The effects of the location and size of rigid fillers and circular holes on the stress distributions around the fillers, circular holes and at the interface were shown by numerical calculations. For verification, photoelastic experiments were performed. The analytical results were in fairly good agreement with the experimental results. In addition, the stress singularity at the edge of the interface was discussed.

(Received: July 23, 1993)

Effect of Modification with Elastomer on Internal Stress of Cured Epoxy Resins Generated within a Low Temperature Range

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(Accepted for publication: November 8, 1993)

Abstract

Bisphenol-A type epoxy resin was modified with CTBN. The effects of the modification on the internal stress generated within a low temperature range were investigated.

When the content of CTBN was less than 30 wt%, the cured resins had a two-phase structure in which CTBN was dispersed spherically in the epoxy matrix. Their internal stress increased with the addition of CTBN with in a low temperature range; however, an addition of more than 30wt% of CTBN caused a phase inversion and CTBN formed a continuous phase. In the systems which have the continuous CTBN phase, the decrease of internal stress was observed at low temperature. This was due to the decrease in the elastic modulus with the formation of continuous rubber phase.

(Received: September 7, 1993)

Melamine Segregation in Polyester-melamine Cured Clear Film

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Abstract

The surface and the interface of the polyester-melamine cured clear film (we used butyl-, methyl-, methylol-and imino melamine) were analyzed by X-ray photoelectron spectroscopy (XPS) and melamine segregation was discussed after observing surface free energy and compatibility. In polyester-melamine cured clear film, the melamine segregation was greatly influenced by the surface free energy. Methylol and imino melamine, which has higher surface free energy, hardly existed on the surface of the clear film and were enriched on the interface side. Methyl melamine, which has the same level of surface free energy as polyester, was slightly enriched on the surface but was not enriched on the interface side. On the other hand, butyl melamine, which has lower surface free energy, was enriched on both sides of the clear film.

The compatibility was an important factor in that butyl melamine was enriched on the surface and the interface side. Since butyl melamine had poor compatibility with polyester, it was enriched on both sides.

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Effects of Short Time Autoclave Treatment at Pressing on the Bond Strengths of Resinous Apitong (*Dipterocarpus* spp.) and Caribbean Pine (*Pinus caribaea* Morelet)

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(Accepted for publication: December 20, 1993)

Abstract

As an attempt to improve the bond strengths, resinous apitong (*Dipterocarpus* spp.) and caribbean pine (*Pinus caribaea* Morelet) test specimens were subjected to short time autoclave treatment at the start of pressing (clamping) period. Treatment was done for about 4 minutes at 125°C and at an autoclave pressure of 2 kg/cm^2. Results showed that generally, dry heating treatment did not cause significant improvement of bond strengths of apitong but increased that of the caribbean pine to a limited extent. On the other hand, autoclave treatment was found to be useful in increasing the bond strengths of apitong bonded with isocyanate (API), resorcinol formaldehyde (RF), and that of caribbean pine bonded with API, RF, polyvinyl acetate (PVAc) and urea formaldehyde (UF) adhesives. For caribbean pine, the effect was so remarkable that the bond strengths were similar to that of specimens pressed for a long time, although the clamp was released immediately after the autoclave treatment.

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Contents

Surface Topology and Fractal for Fractured Surface of Adhesives under Static and Fatigue Loadings

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Abstract

Whether fractured surfaces of epoxy adhesives have fractal characteristics is investigated, using the Box Counting Method. From the experiments, it was confirmed that both surfaces of epoxy adhesives under static and fatigue (cyclic) loadings have fractal characteristics. Fractal dimension is effective to characterize fractured surfaces of adhesives quantitatively. It was also found that fractal dimensions of the fractured surfaces might correspond to the fracture toughness and the fatigue crack growth rate.

The fractal dimension was also examined from a physical point of view using a linear finite element analysis. The energy release rates for different model surfaces having the same nominal roughness (evaluated by the maximum depth) but different topology were calculated. Consequently, it was found that the energy release rate increases more for surfaces having more complex topology and for the larger fractal dimensions. It might be said that the fractal dimension shows the complexity of the fractured surface and there exists a certain relationship between the fractal dimension and the energy to create the surface.

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Holding Power (t_b) and Sliding Friction Coefficient of Pressure Sensitive Adhesives

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Abstract

It is necessary to describe the practical performances of pressure sensitive adhesives (PSA), i.e., adhesion, tack and holding power, in terms of physically well-defined quantities in order to elucidate the mechanism of pressure sensitive adhesion. It has been shown in previous studies that the tack of PSA must be related to the rolling friction coefficient of the materials in the velocity region between 10^{-1} and 10^{0} m/sec. In this study, holding power t_b of two series of PSA is compared with the sliding friction coefficient μ of them in a low velocity region. It was found that both a master curve of log σ_0 vs. log a_T/t_b and a curve of μ vs. log v shifts towards a longer time-scale as the rubbery plateau modulus of the PSA increases, no matter how the variation of Tg with respect to composition may be. Therefore, a conclusion of this study is that holding power of PSA must be closely related to μ of the material in a low velocity region, and that they are dependent upon the rubbery plateau modulus.

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Damping Properties of Wood/Polymer Composites
Preparation of Epoxide Resin Blends and IPNs Showing a Broad Damping Peak

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(Accepted for publication: February 22, 1994)

Abstract

Polymeric materials that are used as noise and vibration damper in sandwich structures must have a high loss factor (tan δ), and at the same time the storage modulus (E') of $5 \times 10^7 \sim 10^9$ dyne/cm^2 must withstand broad temperature and frequency ranges. In this study, we tried to prepare such polymers by blending epoxide resins and by synthesizing epoxide resin/polyacrylates IPNs. The two series of Epikote871/Epikote828 blends cured with triethylenetetramine, and the cured Epikote871/P(n-BMA) IPNs were prepared by mechanical blending and simultaneous polymerization, respectively. Their dynamic tensile properties were measured at 110 hz using Rheovibron. Loss factor (tan δ_c) and dynamic bending modulus (E_c', E_c'') of wood/polymer/wood sandwich structure were measured at 110Hz using Rheovibron in bending mode of vibration. These dynamic tensile studies indicated that both cured Epikote blends and IPNs were semicompatible in the sense that both the shifting of $T(E''_{max})$ or $T(\mathrm{Tan}\delta_{max})$, as well as the broadening of glass transition temperature range were observed. Tan δ_c curves of wood/curve Epikote blends/wood sandwich structures shifted to the higher temperature side and became broader as the content of Epikote828 in the blends increased; however the maximum value became somewhat lower. Cured Epikote871/P(n-BMA) IPNs of composition 70/30 to 50/50 showed a relatively high tan δ and appropriate E' value over a wide temperature range; consequently, the tan δ_c curve of wood/IPNs/wood sandwich structures was broadened over a wide temperature range.

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Detection of Defective Adhesion Parts in Adhesive Bonded Structure with an Impact Hammer

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(Accepted for publication: January 7, 1994)

Abstract

This report concerns the fundamental characteristics of the simple and useful non-break down test. This test is conducted by hitting the adhesive bonded structure with an impact hummer. A Piezo electric element is used to detect defective adhesion points such as voids or cracks in the adhesive layer.

Two measurement methods have been applied to the test pieces adopted as a standard of adhesive bonded structure. One method makes it possible to detect the position and scale of defective adhesion points by comparison of the periods of the impulse forces. The other utilizes the premise that adhesion-defection interface nearly coincides in node with the modal vibration shape of the test piece. This is computed from measurements taken upon impact of both the impulse forces and the test piece vibrations. As a result, the sensitivity of detection as affected by adhesive thickness, adherent thickness, defection scale and adhesive hardness has been clarified.

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