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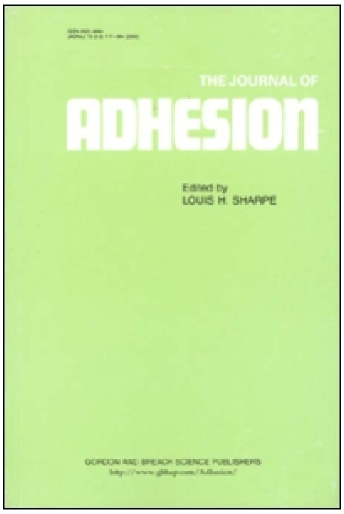

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Contents Lists and Abstracts from the Journal of the Adhesion Society of Japan

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Journal of The Adhesion Society of Japan
Vol. 29, No. 11 1993

Contents

A Simplified Design Process of α-Cyanoacrylate (Instant Glue) Adhesive-bonded joints Based on Static and Fatigue Strength

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(Accepted for publication: February 22, 1993)

Abstract

In the procedure for the design of α-cyanoacrylate adhesive-bonded joints, there are, in general, seven main steps, as follows.

Step 1. Determine the design's ultimate load $P_B/P = M_B/M = T_B/T = 4$, the design's environmental temperature θ_t and the number of cycles of repeated loading N (where $N = 1$, is called static design and where $N = 10^7$, is called fatigue design).
Step 2. Determine the values of the modulus of transverse elasticity G_a, the shear strength τ_B and the tensile strength σ_{aB} of the adhesive.
Step 3. Determine the values of the shearing strength τ_{IN} and the tensile strength σ_{BN} of the adherend under the number of cycles N.
Step 4. Determine the most suitable size of adherend.
Step 5. Determine the most suitable thickness of adhesive $d = 0.10$ mm.
Step 6. Determine the most suitable length of overlap l.
Step 7. Draw the lines of the Equations 1, 2 and 4, on the $\sigma_u \sim d$ or $\tau_u \sim d$ log-log diagram.

The classification of the type of failures are given by: cohesive failure in the adherend (Eq. 1); interfacial failure (Eq. 2); and adhesive failure (Eq. 4). Three criteria of the failures are summarized in the three formulae (Eqs. 1, 2 and 4).

(Received: December 18, 1992)

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Improvement of Adhesive Strength of Polypropylene Sheet for Coating Film by Plasma Treatment

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Abstract

The surface of polypropylene (PP) sheet was treated with microwave plasma which was generated by an electronic oven. Functional groups appeared on the surface of PP sheet and the surface was analyzed by ESCA. The ratios of functional groups were obtained by curve fitting for C/C_{1s} spectrum, *i.e.*, —OH, >C=O, —COOH. On the other hand, coating was spread onto the surface of the PP sheet. The adhesive strength and the fractional amount of coating remaining on the surface of PP film per one cm^2 (FCR) was obtained by using a cross-cut tape test. The relationship between the adhesive strength and the functional groups was determined by multiple regression analysis.

We found that carboxy 1 group was the most important factor among the above three functional groups for the adherence of the coating on PP sheet.

(Received: January 24, 1993)

Study on Modified Phenolic Resin [VI]: Properties of Phenolic Resin Modified with Poly (*p*-hydroxyphenylmaleimide)-Poly (*n*-butylacrylate) Block Copolymer

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(Accepted for Publication: February 25, 1993)

Abstract

The improvement of heat resistance and toughness of phenolic resin was examined by modification with poly (*p*-hydroxyphenylmaleimide)-poly (*n*-butylacrylate) block copolymer (HPMI-b-BuA). These properties of the modified phenolic resin were compared with those of the random copolymer (HPMI-r-BuA). Both modified phenolic resins had better heat resistance, impact strength, and fracture toughness than unmodified phenolic resin. There was little difference between heat resistance of both modified phenolic resins. Impact strength of both phenolic resin modified with HPMI-b-BuA increased with an increase of the content of the copolymer, and the degree of the latter was superior to those of the former. When content of the copolymer was 10 phr, fracture toughness of both modified phenolic resins showed the maximum, and the degree of the latter was superior to that of the former. By observation with scanning electron microscope, many domains consisting of the copolymer were observed over the fracture surface. On these domains, size was smallest, distribution was narrowest, and density was highest, when content of HPMI-r-BuA was 10 phr.
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Contents

A Study on Heat Resistant Anaerobic Adhesives Containing N-Substituted Maleimide Compounds II. The Effect of Additives on Heat Resistivity

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(Accepted for publication: March 6, 1993)

Abstract

The effect of additives added to the anaerobic adhesives containing N-substituted maleimide compounds on heat resistivity of adhesion was studied. As the additives, fillers such as metal oxide, metal hydroxide, metal chelate, metal alcoholate, etc. and organic acid compounds such as carboxylic acid compounds, sulfonic acid compounds and phosphoric acid compounds for promoting adhesive strength were used. Among the fillers, TiO_2 was the most effective in improving the heat resistivity of adhesion. The heat resistivity was further improved remarkably when a small amount of 2-acidphosphoxyethylmethacrylate (APEM) as the phosphoric acid compound was added to these TiO_2-containing adhesives. Such effect of these additives was not observed in the adhesion systems not containing maleimide compounds. Therefore, it was thought that the multiplication effects of maleimide compounds as a heat resistant monomer, TiO_2 as a shrinkage depressing filler and APEM as an adhesive strength promoter induced such high heat resistivity.
(Received: February 19, 1993)

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

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(Accepted for publication: April 15, 1993)

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Abstract

This paper deals with a two-dimensional stress analysis of a butt adhesive joint with rigid fillers in the adhesive subjected to a tensile load. Similar adherends were replaced with finite strips, and an adhesive was replaced with a finite strip including rigid fillers. The analysis was done using the two-dimensional theory of elasticity in order to evaluate the joint strength. The effects of the location and size of rigid fillers on the stress distributions around the fillers and at the interface were shown by numerical calculations. For verification, photoelastic experiments were performed. The analytical result was consistent with the experimental result. In addition, the stress singularity at the edge of the interface was discussed.
(Received: February 17, 1993)

Surface Modification of Poly(ethylene terephthalate) Fiber Due to Excimer Laser Radiation

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(Accepted for publication: June 14, 1993)

Abstract

When the surface of PET fiber is exposed to excimer laser irradiation, improved adhesion between PET fiber and rubber has been observed.

Glycidylether compound contains acrylic acid and reacts to ultraviolet rays. By applying this compound to PET fiber as a primary dipping adhesive, then curing with a KrF Laser, then applying the widely used RFL (Resorcinol Formalin Rubber Latex) as a secondary dipping adhesives and heat curing, adhesion with rubber, especially heat-resistant adhesion, is improved.

It is thought that this occurs for the following reasons:

a) excimer laser irradiation generates OH groups on the PET fiber surface;
b) non-crystallization of the PET surface enhances affinity with acrylate compound;
c) the formation of a micro-structure of un-evenness on the surface increases the surface areas;
d) the polymerization of acrylate compounds improves the cohesive strength of the adhesive.

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Contents

A Two-Dimensional Stress Analysis of a Butt Adhesive Joint Filled with Rigid Circular Fillers in the Adhesive Subjected to an External Bending Moment

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(Accepted for publication: May 21, 1993)

Abstract

This paper deals with a two-dimensional stress analysis of a butt adhesive joint with rigid fillers in the adhesive subjected to an external bending moment. Similar adherends were replaced with finite strips, and an adhesive was replaced with a finite strip including rigid fillers. The analysis was done using the two-dimensional theory of elasticity in order to evaluate the joint strength. The effects of the location and size of rigid fillers on the stress distributions around the fillers and at the interface were shown by numerical calculations. For verification, photoelastic experiments were performed. The analytical result was consistent with the experimental result. In addition, the stress singularity at the edge of the interface was discussed.

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Copolymerization of Ethyl-2-Cyanoacrylate with Epoxy Compounds

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(Accepted for publication: May 25, 1993)

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Abstract

2-Cyanoacrylates, which are anionically polymerized in the presence of weak bases, such as water or amine, are used as instant adhesives. Poly-2-cyanoacrylate has inferior water resistance; however, we have found that the blend of 2-cyanoacrylate and epoxy compounds showed outstanding water resistance.

So we studied copolymerization of ethyl-2-cyanoacrylate (CA, M_1) with epoxy compounds (M_2). It was found that CA was anionically copolymerized with the epoxy compounds and monomer reactivity ratios were $r_1 \gg r_2$ from IR spectrum analysis. Consequently, the copolymers contained a lot of CA composition.

(Received: April 26, 1993)

A Simplified Design Process of the Adhesive-bonded Joints Between Different Materials

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Abstract

The nominal or average ultimate tensile stress σ_u or shear stress τ_u of the adhesive-bonded joints between different materials, needed to produce failure, can be calculated from Table 1, on the condition that both cohesive failure in adherend (S) with high modulus of elasticity (E_1) and the cohesive failure in adherend (A) with low modulus of elasticity (E_2) occur at the same time. The classification of the type of failures is given by: cohesive failure in the adherend (Eq. 1); interfacial failure (Eq. 2); cohesive failure in the adhesive layers (Eq. 3); and adhesive failure (Eq. 4). Four criteria of the failures are summarized in four formulae (Eqs. 1, 2, 3 and 4).

The most suitable size of adherend can be given by using Eq. 0–2, the most suitable length of overlap can be given by Eq. 5, and the most suitable thickness of adhesive can be given by Eq. 6. Draw the lines of the Eqs. 1, 2, 3 and 4 on the $\sigma_u \sim d$ or $\tau_u \sim d$ log–log diagram.

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