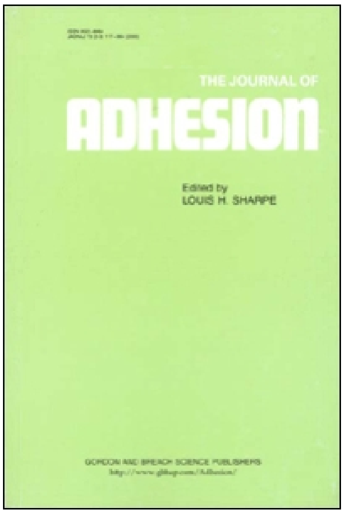

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Contents

Electrophoresis of Semi-non-aqueous Polystyrene Emulsion

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Abstract

Electro-chemical properties of polystyrene emulsion were investigated by electrophoresis of particles. Emulsions were prepared by emulsifier-free emulsion polymerization in acetone-water medium using potassium persulfate as initiator. Electrophoresis of emulsion particles was observed by using a special microscope designed for this purpose with He-Ar laser as light source.

Mobility of particles was measured. Mobility of polystryrene emulsion particles in acetone-water medium decreased with increasing of acetone content in the medium. This decrease of mobility is attributed to an increase of viscosity and a decrease of dielectric constant and thickness of electrical double layer caused by presence of acetone. The number of charges per unit surface area of particle were calculated from values of mobility using Debye-Hückel–Henry equation. The number of charges per unit area were constant independent of acetone-water ratio in polymerization. Thus, in spite of semi-non-aqueous system, it was shown that the sulfate ions on the surface of particles formed a hydrated layer in which the sulfate ions dissociated completely.

(Received: August 4, 1986)

Creep Rupture of the Film Adhesive Joint of Metal to Metal

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Abstract

The purpose of this article is to investigate the effect of coupling agent treatment on the creep rupture characteristics of the film adhesive joint between metals. The adhesives are epoxy resin and nitrile-phenolic resin, and adherend is stainless steel.

The results obtained are as follows;

(1) The empirical formula for creep rupture strength of adhesive bonded joint or adhesive itself was presented in the following, as shown in former papers.[1]

$$\sigma = (\sigma_{00} - \alpha\tau) - (m_0 - \beta\tau) \log t$$

where σ is creep rupture strength at t hr loading, σ is creep rupture strength under 0°C at rupture time of 1 hr loading, m_0 is amount of stress change per log of t, α and β are constants, τ is temperature (°C). The value of α ranges from 0.9 to 1.6, and that of β from 0.1 to 0.175.

(2) The creep rupture strength of adhesive bonded part for silane coupling treatment (γ-glycidoxypropyltrimethoxysilane) was larger than that for no treatment.

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[1] H. Ishii, Y. Yamaguchi; Journal of The Adhesion Society of Japan, **15**, 7, 1 (1979).

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Contents

Effect of Curing Condition and Test Temperature on Shear Strength of Adhesive and Adhesive-bonded Joint

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Abstract

Effect of curing temperature θ(°C), cure time m_1 (min), setting time m_1 (min), resin-hardener mixing ratio AW/HV(−) and test temperature θ_t(°C) on modulus of transverse elasticity G_a (Kg/mm^2) and shear strength τ_B (Kg/mm^2) of adhesive is experimentally investigated. Some experimental relations are proposed. Substituting these experimental relations into four formulas on average ultimate shear stress of adhesive-bonded single lap joint, the effect of the curing temperature, resin-hardener mixing ratio and test temperature on the strength of the joint can be calculated. Where any one of them is changed, the classification of failure in the adhesive-bonded single lap joint can be given by one of the following four types, (1) cohesive failure in the adherend (τ_{ud}), (2) interface failure (τ_{ui}), (3) cohesive failure in the adhesive layer (τ_{us}), and (A) shear failure in the adhesive layer (τ_{ut}). The average ultimate shear stress τ_u changes remarkably.

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Mean Friction Coefficient of Pressure—Sensitive Adhesives by J. Dow-Ball-Tack Tester

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According to the J. Dow Method, the maximum diameter of a steel ball coming to a stop on an adhesive surface is a measure of the tackiness of pressure-sensitive adhesives (PSA's) despite rolling out distance.

The tackiness of PSA's in this article has been expressed by the mean friction coefficient ($\bar{\mu}$) in terms of rolling distance (x) on PSA surface of the J. Dow-ball-tack Tester as follows:

$$\mu = \frac{a+x}{x}\tan\theta$$

where a stands for the distance of approaching runway, and θ the angle of inclination.

The effect of vertical reaction and initial velocity of a ball, and the curing-agent content of acrylic PSA on the $\bar{\mu}$ has been studied.

This work has shown the $\bar{\mu}$ is good enough as a measure of the tackiness of PSA's.

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Contents

Development of a Peel Adhesion Tester of Wide Range of Test Conditions and a Proposal of Analyzing Method of the Test

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Abstract

A new peel adhesion tester for a PSA tape is developed by which peel adhesion test becomes possible under such a wide range of test conditions that peel adhesion test can be carried out from ordinary peel adhesion to peel tack. And the optional testing conditions of peeling velocity and peel angle can also be applicable.

Peel adhesion of a polyester tape for electrical insulation is measured under the following test conditions: 300 mm/min in peeling velocity, 90° in peel angle, from 5 to 4800 s in dwell time and from 200 to 2000 gf in contacting pressure. As no interaction effect between contacting pressure and dwell time can be recognized at the analysis of variance, the following equation of the peel adhesion is assumed,

$$F=(F_{TO\bar{P}}-a\bar{P})+aP+F_{\bar{P}_1}|1-\exp(-T/\tau_1)|+F_{\bar{P}_2}|-\exp(-T/\tau_2)|$$

Where F: peel adhesion, $(F_{TO\bar{P}}-aP)$: extrapolated value of peel adhesion at which both of contacting pressure and the dwell time are zero, $F_{\bar{P}_1}$, $F_{\bar{P}_2}$: primary and secondary terminal peel adhesion, P: contacting pressure, $\bar{P}$: average pressure, a: increasing rate of peel adhesion to the pressure and τ_1, τ_2: primary and secondary relaxation time.

Fitting the experimental results to the equation by the aid of the least squares method, it becomes clear that the fitting is so good that the relative error of the residuals to estimation is within ±5% all over the conditions of the experiments. Tack of a PSA tape can be given by the third term of the equation, and the ordinary peel adhesion is given by substituting infinity to T and 200 gf to P in the equation.

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Curing Mechanism of Epoxide Resin Cured with Curing Agent or Catalyst

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Abstract

The curing processes of epoxide resin systems cured with the primary and tertiary amines were investigated by monitoring the conversion of reactive groups and the changes in the viscosity, gel fraction, and crosslinking density with the progress of curing.

It was found from these results that the mechanism of the network formation is entirely different in each system. In the primary amine-cured system, the non-crosslinked and high molecular weight polymer is formed up to 80% of the conversion of epoxide groups, and then the network structure is rapidly increased with the progress of curing. On the other hand, in the tertiary amine-cured system, network structure is formed from about 25% of the conversion of epoxide groups and is gradually increased with increasing the conversion of these groups. Accordingly, it is considered in this system that the network structure is locally formed in the residual unreacted oligomer and this local network progresses to the whole with the progress of curing.

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Size Effect on Ultimate Torsional Stress of Adhesive-bonded Joint with a Rectangular Cross Section

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Abstract

An adhesive-bonded lap joint with a rectangular cross section is widely used in four corners of a square box made of wood or aluminium. A beam made of wood or aluminium with a rectangular cross section is effected by a bending moment load, and the adhesive-bonded lap joint with a rectangular cross section is effected by a twisting moment load. The ultimate torsional stress of the adhesive-bonded lap joint with a given thickness of adhesive layer (d), a given thickness of adherend (t), a given width of adherend (h), a given length of overlap (l), and a given longest distance (c) away from an immovable point 0, can be calculated from the following formulas:

$$\tau_u = T_c \Big/ \int \rho^2 \, dA = T/(hlc/3)$$

$$\tau_{ud} = \sigma_B(t/l)\{h/(2c)\}$$

$$\tau_{ut} = (\tau_B/2.5)\sqrt{(E/G_a)(d/l)} = \tau_B/a$$

$$\tau_{us} = 6.25\sigma_B(G_a/E)(t/d)\{h/(2c)\}$$

$$\tau_{ut} = \tau_B$$

Here E and σ_B represent the modulus of longitudinal elasticity and the tensile strength, respectively, of the adherend, and G_a and τ_B represent the modulus of transverse elasticity and the shear strength, respectively, of the adhesive, and a represents the stress concentration factor.

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Contents

A Simple Numerical Method for Dynamic Analysis of Adhesive Bonded Sandwich Beams (A Generalized Maxwell Model is Used for Representing the Dynamic Characteristics of the Adhesive Layer)

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Abstract

This paper describes a simple numerical method developing the previous work using one-dimensional approximation for stiff plates, where the viscoelastic characteristics of the adhesive damping layer are represented by a generalized Maxwell model. The constitutive equation (differential equation with time) for a generalized Maxwell model solid must be converted into an incremental equation for numerical calculation. Using the incremental constitutive equation for the solid between time t and $t + \Delta t$, the finite element discretization of the principle of virtual work for the adhesive bonded beam element yields incremental equilibrium equations of motion at time t. The transient dynamic response of the structure can be calculated by the step-by-step integration method applied to those incremental equations. However, in the case where the structure is subjected to periodic load, it is more convenient to represent the dynamic characteristics of the structure by the frequency response function (transfer function). Therefore, we also show a new technique to obtain such frequency response function by connecting the transient response calculated numerically for the impulsive excitation using the above equations to the experimental modal analysis method. Experimental examination for the present method and technique where a canti-lever beam with a thick rubber adhesive layer was impacted by an impact hammer, was conducted. Good agreements between experimental and calculated results as for the resonant frequencies and damping coefficients were found.

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Size-effect on Adhesive-bonded Cleavage Strength

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Abstract

The cleavage strength P_B/b or the nominal maximum tensile stress $\sigma_u = (P_B/b)(3/l)$ of the adhesive-bonded cleavage strength specimen with a given effective length of overlap (l), a given actual length of overlap (L), a given thickness of adherend (t), (t_1), a given thickness of adhesive layer (d), and a given width of adherend (b) can be calculated from the following formulas:

$$(P_B/b)_d = \tau_1 t_1$$
$$(P_B/b)_i = (\sigma_{aB}/10.8)\sqrt{Eld/G_a}$$
$$(P_B/b)_s = 13\tau_1(G_a/E)(t, l/d)$$
$$(P_B/b)_t = \sigma_{aB} \cdot l/3$$
$$\sigma_{ul} = \sigma_{aB}/\alpha = (\sigma_{aB}/3.6)\sqrt{(E/G_a)(d/l)}$$
$$l = 10\sqrt{(G_a/E)(t^3/d)} \leqq L$$

Here τ_1 and E represent the shear strength and the modulus of longitudinal elasticity, respectively, of the adherend, σ_{aB} and G_a represent the tensile strength

and the modulus of transverse elasticity, respectively, of the adhesive , P_B represents the ultimate load, and α represents the stress concentration factor in the case of interface failure, $(P_B/b)_d$ represents the cleavage strength in the case of cohesive failure in the adherend, $(P_B/b)_i$ represents that in the case of interface failure, $(P_B/b)_s$ represents that in the case of cohesive failure in the adhesive layer, and $(P_B/b)_t$ represents that in the case failure in the adhesive layer.

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Contents

Behavior Analysis at Peeling Pressure Sensitive Adhesive Tapes Part 1. Observation of Stringiness Phenomena at Peeling Pressure Sensitive Adhesive Tapes

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Abstract

Stringiness phenomenon of pressure sensitive adhesive tapes at peeling were observed by using Miyagi's observation apparatus.

Effects of the following two factors on stringiness conformation were studied:

1) type of backing materials: porous or nonporous
2) type of adhesives: elastomer or acrylic polymer

In the relatively low peeling speed range below 10 mm/min., stringiness conformation of adhesives of the porous backing was observed as a honeycomb structure and that of the nonporous backing was a sawtooth shape structure.

Furthermore, each stringiness conformation was divided into more detailed classes, regardless of adhesive nature, elastomer or acrylic polymer.

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The Distribution and Time Dependence of Moisture Content and Peel Strength in the Bondline

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Abstract

In the case of moisture penetration into the long bondline of 50 mm width, the distribution of moisture content and peel strength in the bondline and its time dependence were experimentally investigated. The correlation between moisture content, peel strength and fracture mode was investigated.

The results obtained are as follows:

(1) Moisture content in the outer part of the bondline was higher than that in the inner part of the bondline. Moisture content increased in dependence on exposure time in high humidity environment.
(2) Deterioration of peel strength began in the outer part of the bondline and went on to the inner part. The part where peel strength was deteriorated was clearly divided from the part where peel strength was not deteriorated.
(3) Strong correlation was observed between moisture content and peel strength. In this experiment, deterioration of peel strength was not found in the part with less than 0.8% moisture content, and large deterioration of peel strength was found in the part with more than 0·8% moisture content.
(4) Interface failure was found in the part with more than 0·8% moisture content and cohesive failure was found in the part with less than 0·8% moisture content.

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