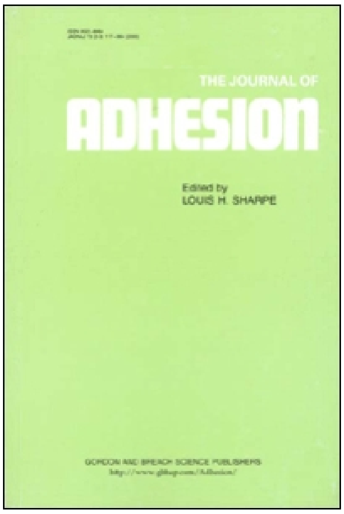

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Journal of The Adhesion Society of Japan
Vol. 25 No. 2 1989

Contents

Effect of Boundary conditions on Relation between Bending Moment and Tensile Shear Load for Single Lap Joints

Sadao AMIJIMA, Toru FUJII and Kouji IIZUKA

Faculty of Engineering, Doshisha University

Abstract

This paper presents the theoretical treatment on the relation between bending moment and tensile shear load for single lap joints having fixed ends with consideration of large deformation of the joints. An basic concept for the theory is similar to the Goland-Reissner's theory, but the thickness of adhesive layer is included. The present method was examined by experiments and good agreements were obtained between both results. The effect of boundary conditions, namely fixed ends and round ends, on the relation between bending moment and the tensile shear load was discussed. Consequently, it is found that the bending moment at the lap end is less dependent on the difference of the boundary condition for the single lap joints having long adherend length in comparison with the

lap length. Relations between bending moment and tensile shear load for some special cases were also given in the paper.

(Received: August 3, 1988)

Solute Permeability of Composite Membrane Containing Polyvinyl Alcohol and Poly-2,2,2-Trifluoroethyl Acrylate.

Toyoji Tsuchihara, Motonori TAMADA and Kenyi IKEDA

Faculty of Engineering, Yokohama National University:
156, Tokiwadai, Hodogaya-ku, Uokohama-shi 240, Japan

Abstract

Asymmetric composite membranes were prepared through mixtures of hydrophilic and hydrophobic polymers. Crosslinking polyvinyl alcohol was used as hydrophilic polymer. Poly-2,2,2-trifluoroethyl acrylate containing polar group in side chain, and polyvinyl acetate containing less polar and structural similar side chain were used as hydrophobic polymers.

Ultrafiltration through membranes containing various mole ratios of hydrophilic and hydrophobic polymers were examined, and permeabilities of water and solutes of molecular weights 100–10000 were stuided.

Consequently, composite membrane containing polar poly-2,2,2-trifluoroethyl acrylate had good water permeability and solute permeation selectivity.

(Received: August 26, 1988)

Journal of The Adhesion Society of Japan
Vol. 25 No. 3 1989

Contents

Original

Technical Report

Review

Series of Molecular Desgin (11)

Fatigue Behavior of Steel-Adhesive-Butt-Joint in Aqueous Environment

Tsuyoshi MIURA,** Katsuhiko MOTOIE,* Hiroshi KAMATA,* Yutaka ARAKITA,*
Yukio NOBUKI*** and Tadashi KAWASAKI*

* Hiroshima Denki Institute of Technology
** Japan Steel Works, Tokyo Research Institute
*** Hiroshima Junior College of Automotive Engineering

Abstract

Rotating beam fatigue test was performed in the atmospheric air and aqueous environment for steel butt joints bonded with an acryle adhesive. The fatigue strength of the joints in aqueous environment is very low compared with that in the air. The extent of decrease in strength is greater for the joints which show higher fatigue strength in the air, and it seems to be that the joint with higher strength in the air, such as cured at 70°C, is more sensitive to the environment.

The S–N curve obtained in the aqueous environment becomes horizontal at high cycle region, like a fatigue of steel in the air. This may be explained that the decrease in fatigue strength of bonded joint is governed by the diffusion of water into the adhesive during the fatigue process.

Observation of the fracture surface of the bonded joint reveals that major part of fracture surface of specimens fatigued in the water is covered by the interfacial failure.

(Received: August 12, 1988)

Film Formation from Alkali-Swollen Carboxylated Polymer Emulsion†

Masayoshi OKUBO,** Atsushi TAKAMATSU,** Tsuneo WAMURA,** Kazuhiro HARA** and
Tseuntaka MATSUMOTO**

** Department of Industrial Chemistry, Faculty of Engineering,
Kobe University (Rokkodai-cho, Mada-ku Kobe 657)

Abstract

In order to compare the film-formation mechanisms of alkali-swollen carboxylated polymer emulsion with that of unswollen emulsion, ethyl acrylate-methyl methacrylate-methacrylic acid terpolymer emulsions of which alkali-swollen state was controlled with diethyl aminoethanol by changing the degree of neutralization and heat treatment after neutralization were used. Minimum film-formation temperature of each emulsion and properties, e.g., internal stress, heat shrinkage and expansion in water, of the emulsion film were examined. As the degree of alkali-swollen state was increased, the MFT fell and the apperance of obtained emulsion film became good. However, the internal stress, the heat shrinkage and the expansion in water became higher. This seems to be based on that the contact among alkali-swollen emulsion particles in the film formation process begins at high water content.

(Received: September 27, 1988)

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† Studies on Suspension and Emulsion, CIX.

Acetylene Terminated Polyisoimide Adhesive

Masao FUJIMOTO and Syuichi Kumanoya

KANEBO NSC LTD. Performance Polymers.
6–5, 1-Chome, Semba-nishi, Mino, Osaka 562, Japan

Abstract

The application of acetylene terminated polyisoimide (one of addition type polyimide) to high temperature adhesive was investigated in the form of prepregging glass cloth and filler mixed solution changing cure temperature, cure time, heat aging time and other parameters.

High adhesion force was anticipated because of meta-linkage of benzene ring and good processability was also expected because of longer gel time compared to that of imide isomer.

Glass cloth prepregging film adhesive showed 135Kgf/cm^2 lap shear strength at 260°C, which was 60% of value at 20°C in case of 260°C 2 hours cure and showed 151Kgf/cm^2 lap shear strength at 260°C after 260°C 200 hours aging. Adherend were steel and steel.

(Received: October 19, 1988)

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Contents

Original

Review

Series of Molecular Design(12)

Adsorption Behavior of Polyurethane at the Water-Oil Interface

Katsuhiko NAKAMAE, Phongsak WIWATTANADATE,
Teruaki ASHIHARA and ZHAO Wei

Faculty of Engineering, Kobe University

Abstract

The adsorption behavior of Polyethylene glycol (PEG), at water-toluene and water-air interface from water phase was investigated by the interfacial tension measured with the du Noüy ring method, as a function of molecular weight of PEG. The same investigation in Ethylene oxide (EO) segmented polyurethane (EO-PU) was done as a function of the length of EO-segment in EO-PU molecule.

The following results were obtained;

1) Both the interfacial tension of water-toluene interface and the surface tension of aqueous solution of PEG decreased, with the increase of the molecular weight of PEG. The good stability of emulsion of water and toluene was obtained in the case of the larger molecular weight of PEG.

2) The interfacial tension of water-toluene interface and the surface tension of aqueous solution of any EO-PU, was lower than that of the original PEG. With the decrease of the length of EO-segment in EO-PU molecule, the interfacial and the surface tension decreased, and the stability of water-toluene emulsion increased.

3) Cloud point of any EO-PU was lower than that of the original PEG. The cloud point of EO-PU decreased, with the decrease of the EO-segment length.

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Contents

Original

Review

Co-condensation of Hydroxymethylphenols with Resorcinol and 5-Methylresorcinol

P. CHRISTJANSON and A. KÖÖSEL

Tallin Technical University,
Ehitajate tee 5 Tallin 200108 Estonian SSR USSR

Abstract

Co-condensation reaction of 6-hydroxymethyl-2,4-dimethyl-phenol, 4-hydroxymethyl-2,6-dimethylphenol, 2,6-dihydroxymethyl-4-methylphenol and 4,6-dihydroxymethyl-2-methylphenol with resorcinol and 5-methylresorcinol in the melt has been studied using ^1H NMR spectrometry. ^1H chemical shifts for methylene groups formed in the co-condensation reaction have been determined.

The first order rate constants with respect to hydroxymethyl groups have been calculated from the loss of $—CH_2OH$ groups during the reaction.

Determining factor in the electrophilic substitution of resorcinols is the reactivity of hydroxymethyl compounds. The co-condensation rate does not depend upon the resorcinolic partner to any significant extent. In the noncatalytic condensation, reaction of the ortho-CH_2OH is favored in case of monohydroxymethylphenols, while reaction of the para-CH_2OH is favored in case of 4,6-dihydroxymethyl-2-methylphenol.

Dependence of the rate constant upon the amount of alkaline catalyst is given. It appears that an alkaline catalyst enhances preferably the reactivity of para-CH_2OH groups.

Studies on The Modification of Epoxy Resin with Silicone rubber

Tomoyuki KASEMURA, Kazuo KAWAMOTO and Yoshiaki KASHIMA

Department of Applied Chemistry, Faculty of Engineering, Gifu University
1-1 Yanagido Gifu-shi 501-11 Japan

Abstract

In order to find the compatibilizer for epoxy resin/silicone rubber systems, interfacial tension of epoxy resin mixed with modified silicone oils which had the compatible groups to epoxy resin was measured against RTV silicone rubber and silicone oil. From the results, it was found that one of polyether modified silicone oils (EtMPS) had a strong interfacial activity. Then using the EtMPS as the compatibilizer, RTV silicone rubber or silicone diamine was filled in epoxy resin. The effects of silicone content of these materials to impact fracture energy and to peel strength were investigated. Impact fracture energy of epoxy resin increased by the addition of RTV silicone rubber up to two times of none filled one, while silicone diamine had almost no effect which might be due to the small molecular weight. T-peel strengths of alminium plates bonded by epoxy resin filled with RTV silicone rubber and with silicone diamine effectively increased with the increasing of silicone content showing the maximum at $10 \sim 20$ phr. The fracture surfaces after the mechanical tests of these materials were observed by the scanning microscope. Many particles of silicone rubber in the size of $1 \sim 20\ \mu$ were observed over the fracture surface.

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Journal of The Adhesion Society of Japan
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Contents

Original

Note

Review

Surface Modification of Fluorinated Polymers by Microwave Plasmas

Tomoyuki KASEMURA, Shuichi OZAWA and Kiyomi HATTORI

Department of Applied Chemistry, Faculty of Engineering, Gifu University
1-1 Yanagido Gifu-shi 501-11 Japan

Abstract

We developed the new plasma treating method, incorporating the use of the microwave generated by an electronic cooking range. Using this method, polytetrafluoroethylene (PTFE) and copolymer of tetrafuluoroethylene and hexafluoropropylene (FEP) were treated. Dialkylphthalates (DAP) were used as the standard liquids of contact angle measurements for evaluation of the wetting properties of plasma treated polymers. The components of surface tension (γ_L) due to the dispersion force (γ_L^d) and the polar force (γ_L^p) of DAP were calculated by Fowkes' equation from the contact angles (θ) on polypropylene. After plasma treatment $\cos\theta$ of several standard liquids on PTFE and FEP increased. The linear relationship between $\gamma_L(1+\cos\theta)/\sqrt{\gamma_L^d}$ and $\sqrt{\gamma_L^P/\gamma_L^d}$ was verified. γ_S, γ_{S^d} and γ_{S^P} of the plasma treated PTFE and FEP also increased. From the results of ESCA analysis, it was found that the significant amount of oxygen was introduced to the polymer surface by the plasma treatment. Peel strengths of pressure sensitive adhesive bonded to PTFE and FEP increased approximately two-to-threefold if the plasma treatment was used prior to bonding.

(Received: November 7, 1988)

Internal Stress in Epoxide Resin Networks Including Naphthalene Structure

Mitsukazu OCHI, Takumi TSUBOI, Hiroyuki KAGEYAMA,
and Masaki SHIMBO

*Faculty of Engineering, Kansai University
(3-3-35, Yamate-cho, Suita, Osaka 564, Japan)

Abstract

Effect of the introduction of naphthalene ring on the internal stress of cured epoxide resins was investigated. Elastic modulus and expansion coefficient in glassy region increased and decreased, respectively, by the introduction of naphthalene ring into the backbone structure of epoxide resin. Thus, internal stress decreased slightly, because the decrease of expansion coefficient was counteracted by the increase of modulus. These phenomena were explained as a result of the increase in packing density of network chains which arises from the planar structure of naphthalene ring.

On the other hand, the glass transition temperature of the cured resins increased by the introduction of naphthalene ring into diamine used as a curing agent. However, the modulus and the expansion coefficient were little affected by the naphthalene ring induced in the curing agent. This is seemed to be due to the low mobility of the ring which should neighbor upon crosslinking points in the networks.

(Received: November 24, 1988)

Strength and Fracture of Steel-Adhesive Butt Joint

Katsuhiko MOTOIE, Tsuyoshi MIURA, Hiroshi KAMATA,
Yutaka ARAKITA and Tadashi KAWASAKI

The strength and fracture of butt joints consisting of mild steel substrate bonded with an acryle adhesive was investigated. From observation of fracture surface of bonded WOL-specimen, the process of crack propagation in the adhesive layer was discussed and apparent fracture toughness of joint is determined to be 2.76 MPa$\sqrt{m}$, comparing favorably with the value of 2.69 MPa$\sqrt{m}$, obtained by three-point bending test. It is found that fracture mechanics criterion on strength evaluation is available for joints containing rather larger defect, while in the case of the defects in the joint smaller than about 0.24 mm, strength evaluation of adhesive joint should be made on the basis of theory of strength of materials.

(Received: November 22, 1988)