

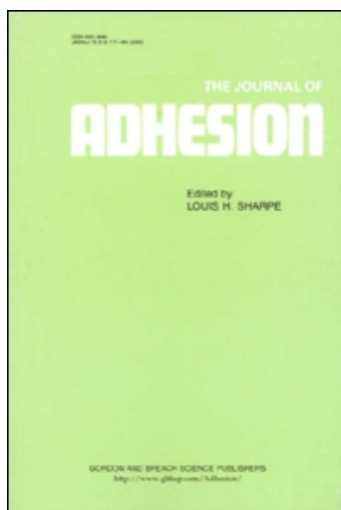
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# Contents Lists and Abstracts from the Journal of the Adhesion Society of Japan\*

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## Poly (Vinyl Alcohol) with Low Surface Free Energy by Fluorinated Agent

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and KATSUHIKO NAKAMAE

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*(Received 18 June 1998; In final form 4 August 1998)*

Poly (vinyl alcohol) (PVA) surface was fluorinated by simply immersing in fluorinated agent. 11H icosafuoroundecanoyl chloride (HF-COCl) and Perfluorooctanoyl chloride (PF-COCl) solutions at 30°C. The contact angle of water increased by fluorination, where fluorinated agent was chemically bonded to hydroxy groups on PVA surface. The contact angle of water became 100° by the treatment with PF-COCl. This corresponds to the surface free energy of 18erg/cm<sup>2</sup>, which is more or less same as that of polytetrafluoroethylene. Fluorinated PVA showed a high resistance against water swelling. These fluorination technique is found to be effective for lowering the surface free energy of PVA.

## An Elast-plastic Finite Element Analysis and Strength Prediction of Single-lap Adhesive Joints Under Tensile Loads

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*(Received 22 June 1998; In final form 25 August 1998)*

Stress distributions of single-lap adhesive joints under tensile loads are analyzed using elast-plastic finite element method in order to predict the joint strength. The effects of yield stress, Young's modulus and tensile strength of adherends on the yielded region of the adhesive and the adherends are clarified. In addition, the crack growth process at the interfaces due to peel stress is examined. Using the crack growth process at the interfaces and the stress distributions in the joints, the joint strength is estimated. It is seen that the peel stress at the interfaces increases as the rigidity of the adherends decreases. Joint strength was measured. A fairly good agreement is seen between the analytical and the measured results of the joint strength. In addition, it is observed that the joint strength increases as the yield strength, Young's modulus and the rigidity of the adherends increase.

## Effect of Coupling Agents on Adhesion Strength of Epoxy Molding Compound for Semiconductor

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*(Received 2 July 1998; In final form 17 December 1998)*

Some types of coupling agents as one of raw materials, were applied to the epoxy molding compound for semiconductor. And adhesion strength of the epoxy molding compound to silver plated copper leadframe was measured. Also, the reactivity between the coupling agent and silver was analyzed. 3-Mercaptopropyltrimethoxysilane is effective to increasing adhesion strength and the reaction of silver and O atom in Si-O-C structure of 3-mercapto propyltrimethoxysilane is related to the adhesiveness.

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## Primer Properties of Chlorinated Polypropylene System Waterborne Emulsion to Polypropylene Substrate

TERUAKI ASHIHARA<sup>a</sup>, SHOJI MAEKAWA<sup>a</sup>, SUSUMU OHNO<sup>a</sup>,  
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*(Received 7 July 1998; In final form 10 August 1998)*

Chlorinated polypropylene (Cl-PP)-system waterborne emulsion was prepared for a paint primer for automobile PP bumper by compelled emulsification and estimated as primer performance. The following results were obtained. (1) This emulsion had a sufficient adhesivity as the most important factor of primer. (2) As the results of analysis of peeled interface, the cohesive destruction took place at the primer layer near the PP substrate. (3) As the other abilities of this primer, the water resistance and the gasohol resistance were excellent. (4) As the results of the promotion test of emulsion stability, it revealed its big stability at  $-5^{\circ}\text{C}$  or  $+50^{\circ}\text{C}$ .



## Enhancing the Performance of Poly (vinyl acetate) Emulsion Adhesive Using Acetoacetylated Polyvinylalcohol

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*(Received 27 January 1999; In final form 30 March 1999)*

Because it is mostly water-soluble, easy to handle, and easy to work with, Poly (vinyl acetate) resin is widely used as a lumber bonding agent.

However, because Poly (vinyl acetate) by itself is low in water resistance and heat tolerance, if a method can be found to improve the water resistance of the Polyvinylalcohol that is used as protective colloid, the water resistance of Poly (vinyl acetate) resin should also increase.

Therefore, a study was conducted to determine whether the water resistance of Poly (vinyl acetate) Emulsion can be improved by using Polyvinylalcohol in which an acetoacetyl group is introduced into protective colloid.

The results indicate that, when compared with Poly (vinyl acetate) with generic Polyvinylalcohol, the Poly (vinyl acetate) using Acetoacetylated Polyvinylalcohol produces favorable numerical values in both film properties and lumber bonding capacity, thus exhibiting improved water resistance.

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## Effects of Rind Surface and Orientation Angle on the Bonding Properties of Sugar Cane Rind Elements

JUVY MARIE V. PABLO and TOMOYASU SAKUNO

*(Received in final form 14 October 1998)*

As a basic study on the use of sugar cane rind as an element in board production, the effects of rind surface (inner and outer) and orientation angle on the bonding properties of sugar cane rind were examined. Sugar cane rind at various orientation angles and rind surface combinations were glued using 3 types of adhesives (Isocyanate: IC, Urea Melamine Formaldehyde: UMF and Phenol Formaldehyde: PF). Internal bond strength and bending strength tests were done on the glued specimens and the internal bond strength (IB), modulus of rupture (MOR) and modulus of elasticity (MOE) were measured. Data were statistically analyzed to determine the effects of the factors and their interactions on bonding properties. Results of the analysis of variance showed that IB strength was affected by angle, adhesive type and rind surface. Among these factors, adhesive type exhibited the largest effect. Moreover, as indicated by Duncan's Multiple Range Test, the interaction between angle of 0° and IC as adhesive at any rind surface combination proved to be superior than their counterpart treatments. On the other hand, both MOR and MOE were affected only by orientation angle. Optimum bending strength values were obtained at 45° angle using any of the adhesives at any rind surface combination.

## Two-dimensional Transient Thermal Stress Analysis of Adhesive Butt Joints Subjected to Temperature Change by Surrounding Fluid

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*(Received 4 August 1998; In final form 29 October 1998)*

This study deals with the transient thermal stress of the adhesive butt joint which is made of three components of finite length and manufactured at a certain constant temperature and then both the upper and lower surfaces of the joint are heated suddenly at a certain point in time by surrounding fluid and the side surfaces are insulated. In the analysis, unsteady one-dimensional temperature distribution in the joint is analyzed using the Laplace transform and the residue theorem, and then the transient thermal stress distribution is analyzed using a two-dimensional theory of elasticity. The effect of material properties of the joint on the transient thermal stress distributions at the interfaces between the adherends and the adhesive are clarified by the numerical calculations. As a result, it is found that the normalized transient thermal stress is tensile near the edges and singular at the edges of the interface and compressive in the middle section of it, when both the upper and lower surfaces of the joint are heated. Also, it is seen that the thermal stresses near the edges increase rapidly with a short passage of time. In addition, photoelastic experiments were carried out in order to confirm the transient thermal stress analysis in which an epoxide plate was modeled as an adhesive. A fairly good agreement is seen between the numerical and the experimental results.

## Direct Adhesion of Poly(butylene terephthalate) and Phosphor Bronze Plates Treated with Triazine Thiols by Injection Molding\*

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Direct adhesion of Poly(butylene terephthalate) (PBT) to phosphor bronze (PB) plates during injection molding was investigated. In this adhesion, PB plates treated with 1, 3, 5-triazine-2, 4, 6-trithiol monosodium salt (TTN) aqueous solution were inserted in a mold and then PBT was injected. PBT adhered strongly to the PB plates treated with TTN. The optimum conditions of TTN treatment were in the range of 0.5–1 mmol/l of TTN concentration and in the range of 10–120 sec. of immersion time in TTN solution. Under the optimum conditions, the adhesive strength exceeded 8 MPa in a shearing test. The triazine - Cu mercaptide (TT-Cu) film having electron density as low as Cu atom in CuO was formed on the PB plate treated with TTN. The mechanism of adhesion is considered to be due to formation of acid-base interfacial bonding between PBT and TT-Cu coating on PB plates treated with TTN.

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\*Studies on Direct Adhesion between Plastics and Metal Using Triazine Thiols III.