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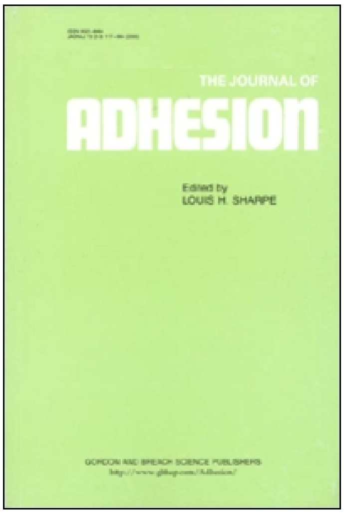

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Abstracts

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Abstracts

Journal of the Adhesion Society of Japan

SURFACE TREATMENT OF PLASTICS BY PLASMAJET

(*Received August* 2, 1968)

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Abstract

By applying a simple device comprising a power supply for arc welding and a plasmajet torch, a new method for plastic surface treatment to improve adhesion of the plastic was developed. The method enables such surface treatment instantly in the air atmosphere by applying the plasmajet to test pieces and is effective to various kinds of plastics, especially to crystalline plastics as polyethylene.

When several pieces of polyethylene were treated under the following conditions in our experiment, the contact angle of water on the surface was improved from 80° to 20° and the adhesive strength by the tensile test was also remarkably improved from a few kg/cm^2 to 120kg/cm^2.

Arc current	: 200 A
Quantity of Argon	: 50*l*/min
Treatment time	: 0.1 sec
Distance from the jet nozzle to the test pieces	: 5 cm

After the treatment, weight of test pieces decreased slightly in comparison with that before the treatment, and an increase of the absorption peak by carbonyl groups was observed.

Accordingly, judging from the above mentioned facts, it would be concluded that the surface treatment by the plasmajet is very effective for plastics.

J. ADHESION SOC. JAPAN 6 (No. 4), 265 (1970)

STUDIES ON ADHESION OF POLYOLEFIN

Part 6 Bonding of polyethylene to aluminum—effect of addition of polyethylene treated with potassium dichromate/sulfuric acid solution to untreated polyethylene

(*Received March* 11, 1969)

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Abstract

In general, it is said that the increase of adhesion of polyethylene by surface treatment with potassium dichromate/sulfuric acid solution is due to the formation of polar groups such as carbonyl, but the relation between the content of these polar groups and bond strength of dichromate treated polyethylene had not yet been reported.

In our previous paper, it was shown that the peel strength of aluminum plate-foil laminate bonded with dichromate treated polyethylene melt decreased rapidly with increasing content of C=O group, which was determined by infrared spectroscopy (base line method).

In this paper, it was shown that the peel strength of the laminate increased remarkably by blending a trace of dichromate treated polyethylene to untreated polyethylene.

From these results, the following conclusions are obtained: (1) When the polar groups formed by the dichromate treatment are so much as to be determined by infrared spectroscopy, the peel strength decreases rapidly with the increase of the polar groups. (2) When the concentration of polar groups is still so small as to be not determined by infrared spectroscopy, the peel strength increases remarkably. (3) The mode of failure in the region of increasing peel strength differs from that in the region of decreasing peel strength. In the region of the former, the site of failure is at the interface, near the interface, or in the adherend, but in the region of the latter, the site of failure is evidently at the surface layer of polyethylene. (4) The increase of peel strength may be due to the increase of adhesion of polyethylene based on the formation of polar groups. The decrease of peel strength is owing to the decrease of cohesive strength of polyethylene based on the oxidizing degradation.

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STUDIES ON ADHESION OF POLYOLEFIN

Part 7 Effect of crystallinity of polyethylene on peel strength of al plate–pe–al foil laminate

(*Received March* 14, 1969)

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Abstract

The peel strength of aluminum plate/polyethylene/aluminum foil laminate increased by rapid cooling with water, ice water, or liquid nitrogen after hot-melt bonding of polyethylene as compared with cooling in air at room temperature. It was concluded that the increase of peel strength by rapid cooling was due to the decrease of modulus based on the decrease of crystallinity of polyethylene. The microcrystallization, the decrease of modulus, density, and overall crystallinity of polyethylene by rapid cooling were shown respectively by the observation with polarizing microscope, the measurement of dynamic modulus, density, and infrared spectra.

J. ADHESION SOC. JAPAN 6 (No. 4), 291 (1970)

STUDIES ON ADHESION OF POLYOLEFIN

Part 8 Observation of surface of aluminum foil peeled off from laminate of aluminum plate–polyethylene–aluminum foil by microscope and electronmicroscope

(*Received March* 11, 1969)

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Abstract

For the discussion of bond strength, first of all, it is necessary to make clear the locus of failure as a premise. In general, the low bond strength of polyethylene is explained to be based on low adhesive property derived from its non-polarity and crystallinity. On the contrary, Bikerman concluded that the low bond strength of polyethylene was due to the failure of the "weak boundary layer" on polyethylene surface. Schonhorn also approved of the Bikerman proposal.

In our study, aluminum plate and foil were laminated with polyethylene powder by melting in a hot press. The surface of foil peeled off from the laminate was observed by optical microscope and electronmicroscope. From the results, the following were concluded: (1) The surface was covered over all the area with a thin polyethylene layer or "weak boundary layer," in spite of the conclusion of interface failure on observing with the naked eye. (2) The thickness of the failed polyethylene layer on aluminum foil increased with higher bonding temperature. (3) The lamellae structure of polyethylene crystal was observed on the surface of aluminum foil by electronmicroscope. (4) The lower peel strength of polyethylene with too high bonding temperature was proved to be based on the failure of a weak layer in polyethylene surface by the microscope and electronmicroscope observations.

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ADHESION OF POLYETHYLENE TO METALS

(*Received August* 3, 1968)

Kazuo YANAGISAWA, the late Katsuya FURUKAWA, Hideo ARAI and Nobuyuki ASHIKARI

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Abstract

This paper is concerned with the study of improving the adhesive strength of polyethylene to metals, when the hydrogenated polybutadiene (HPB) is used as an adhesive.

One method is to add an organic peroxide (DCP) into HPB as an agent for promoting the reactivity of the double bonds in the HPB, which gives high peel strength in a short time of bonding.

The other method is to use an ethylenic copolymer as an intermediate layer between polyethylene and the HPB layer. The intermediate layer relaxes the stress caused by the bonding processes. An ethylene-vinyl acetate copolymer containing 10–20% of vinyl acetate and an ethylene-ethyl acrylate copolymer are suitable for this purpose.

J. ADHESION SOC. JAPAN 6 (No. 4), 313 (1970)

A NOTE ON ADHESION BEHAVIOR OF CHLORINATED ISOTACTIC POLYPROPYLENE/ISOTACTIC POLYPROPYLENE SYSTEMS

(*Received January* 5, 1970)

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Abstract

Adhesion behavior of chlorinated isotactic polypropylene (adhesive)/isotactic polypropylene (adherend) system is investigated, relating to crystallinity of the adherend.

Undrawn commercial films of isotactic polypropylene were heated at desired temperatures in the unstretched state to control their crystallinities which were estimated from their infrared absorption spectra. The films were coated with chlorinated isotactic polypropylenes (chlorine contents 25–35%), pressed for bonding in an oven at various temperatures, and peel strengths of these composites were measured with a tensile tester. In addition, replicas of the film surfaces of polypropylene were observed with an electron microscope before and after bonding.

The results are summarized as follows: (1) The peel strength increases with increasing thickness of adhesive layer and the temperature of bonding. (2) The higher the degree of crystallinity of the films, the lower the peel strength. (3) If the preheating temperature for the films is lower than that in bonding, crystallization proceeds during bonding, resulting in the same degree of crystallinity as that of the film which is bonded without preheating. An interesting result is, however, that the heat-treated film gives considerably lower peel strength in adhesion compared with that of the untreated film, even though both of the films have finally the same degree of crystallinity.

The following explanation may be given for the bonding mechanism on the basis of the above results: noncrystalline regions of the film surface take an important role for adhesive joints, where mutual diffusion of the segments of chlorinated polypropylene and polypropylene molecules would be caused by microbrownian motion at elevated temperature, followed by mixed and/or epitaxial crystallization to some extent.

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WETTING AND PEEL ADHESION OF PRESSURE SENSITIVE ADHESIVE TAPES

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Abstract

The critical surface tensions for various adherends (γ_c) and for pressure sensitive adhesives ($\gamma^1{}_c$) were determined using the method reported by Zisman. The 180° peel adhesions were measured for pressure sensitive tapes composed of natural rubber/rosin, polyisobutylene with different molecular weights, and other adhesives. In every case, curves with a maximum were obtained from the plot of peel adhesion versus γ_c and the maximum occurred generally at $\gamma_{c\ \max} \approx \gamma_c$.

The straight line was found from the plot for cosine of contact angle θ of fluid polyisobutylene on various solid surfaces versus its γ_c up to $\gamma_c \approx 30$ dynes/cm. The values of γ_c and $\gamma_{c\ \max}$ for polyisobutylene were approximately 30–31 and 29 dynes/cm, respectively. Therefore, the peel adhesion must be closely connected with the wetting in the region where $\gamma_c \lesssim \gamma_{c\ \max}$. The interaction parameters (Φ) were calculated for the systems of fluid polyisobutylene and various solids, and the maximum value of Φ occurred approximately at $\gamma_c = 28$–29 dynes/cm for the solid surfaces.

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STUDIES ON THE WOOD GLUING

Part V Microscopic observation on the durability of phenol and melamine-resin adhesive in plywood-type joint

(*Received May* 6, 1969)

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Abstract

Beech and lauan plywood glued with phenol-resin adhesive or melamine-resin adhesive were exposed to boil and dry repeating cycle and to continuous boiling. Glue-joint durability of these plywoods was studied by means of the microscopic observation of glue-line and tension shear test.

The following conclusion may be drawn from the experiments:

1) Surface check and end check of plywoods occurred from the boundary of compound ray. These caused the delamination of glue-line of plywood.

2) Delamination of glue-line occurred from the end of compound ray and the latewood adjacent to the glue-line, and also from the lathe check of veneer.

3) The glue-joint strength of plywood glued with phenol-resin adhesive gradually decreased as the exposure to boil and dry repeating cycle proceeded. This phenomenon was caused mainly due to the deterioration of adherend.

4) The glue-joint strength of plywood glued with melamine-resin adhesive decreased rapidly for twelve cycles, and then it was no longer observed. The deterioration of adhesive was chiefly responsible for this phenomenon.

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