# PRESSURE-SENSITIVE ADHESIVES FOR THE ATTACHMENT OF REINFORCING CANVASES TO THE BACK OF PAINTINGS

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**Summary**—*In the conservation of paintings on canvas, the original support can be consolidated by attaching a reinforcing fabric to the back of the painting. Some of the risks inherent in traditional lining techniques can be eliminated by the use of a pressure-sensitive adhesive. Adhesives based on acrylic esters were chosen for the present study because of their long-term stability. The adhesives were subjected to thermo-oxidative aging and changes in their chemical properties and their surface and adhesive properties were studied using Fourier transform infrared (FTIR) spectrophotometry, goniometry and peel tests at 180°. The results indicate that thermo-oxidative aging causes three types of alteration in the adhesives: dehydration, oxidation and cross-linking. Although the extent of these phenomena is small, the loss of adhesive properties is significant, due to changes in the viscoelastic properties of the glues. However, some of the adhesives retain properties which satisfy the criteria required in conservation.*

## Introduction

Consolidation of a painting support is achieved by applying a reinforcing fabric to the original canvas [1–5]. Since lining is an invasive technique, it is used only when the original support is very damaged and degraded and no longer fulfils its proper function. The long-term preservation of the work of art depends on the success of this treatment. Lining must be carried out with care and using materials which best fulfil the 'règles d'éthique générales et principes déontologiques des interventions de conservation-restauration' [6] whose criteria are as follows: non-toxicity, compatibility, reversibility, stability. To avoid the introduction of moisture and heat during this operation, cold lining without moisture has been proposed since the 1980s [7–9]. The new series of pressure-sensitive adhesives which forms the object of this study must fulfil the same criteria. This must be demonstrated by proving the chemical stability of the materials and the mechanical stability of the assemblies made with them. The present study covers both chemical changes and changes in the surface and sticking properties of the adhesives after aging. In addition, it is interesting to examine the influence of chemical change in an adhesive on its surface properties and its adhesive properties. To this end a variety of analytical methods has been used: Fourier transform infrared (FTIR) spectrophotometry, goniometry and peeling at 180°. Chemical change was induced by thermo-oxidative aging.

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### *Pressure-sensitive adhesives based on acrylic esters*

Pressure-sensitive adhesives (PSAs), known in French as 'colles auto-adhésives', are generally synthetic polymers. Contact glues are distinguished not only by their chemical diversity but, more importantly, by specific characteristics. They must have a low average molecular weight and a low glass transition temperature ($T_g$). Their viscoelastic rheological behaviour gives them the property of being 'tacky' in the solid state. 'Tack' refers to an adhesive surface capable of adhering strongly to another surface solely by contact and under gentle pressure.

The majority of the pressure-sensitive glues are based on synthetic rubbers, styrene/butadiene copolymers and acrylic homopolymers or copolymers. Some of these polymers can be combined with a tackifying resin, liquid or solid, an ingredient which modifies the rheological properties, an antioxidant and, in certain cases, cross-linking agents. This study is concerned more particularly with PSAs based on acrylic esters because these polymers are recognized to have good stability [10–13].

The products chosen were five emulsions (for their non-toxicity) and one solution. The composition of each of these products was identified by FTIR spectrophotometry, complemented by information from the manufacturers (Table 1).

### *Thermo-oxidative aging*

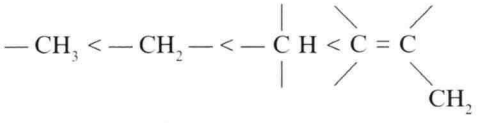
The resistance to oxidation of a polymer is particularly dependent on the reactivity of its hydrogens

*Table 1*

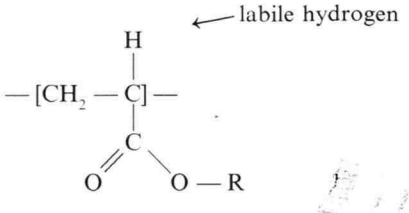
| *Adhesives* | *Type of polymer* | *pH* | *Surfactive agents or protective colloids* |
|---|---|---|---|
| | **Emulsions** | | |
| 1 Mowilith 491 | Butyl acrylate/vinyl acetate | 5 | Poly(vinyl alcohol) |
| 2 Mowilith DM 56 | 2-ethylhexyl acrylate/vinyl acetate/acrylic acid | 3–5 | Anionic |
| 3 Mowilith DM 45 | Vinyl acetate/vinyl maleate | 4–5 | Poly(vinyl alcohol) |
| 4 Acronal V 205 | 2-ethylhexyl acrylate/vinyl acetate/styrene | 3·5–4·5 | Anionic |
| 5 Acronal 85 D | 2-ethylhexyl acrylate/vinyl acetate/acylonitrile/methyl methacrylate | 2–3 | Anionic |
| | **Solution** | **Nature of the solvents** | |
| 6 Acronal 101 L | 2-ethylhexyl acrylate/vinyl formaldehyde (methanal) | acetone (propanone)/ benzene 25:75 | |

These adhesives, which are commercial products, also contain additives whose precise nature could not be ascertained.

with free radicals. The reactivity of the hydrogens normally follows the sequence [14]:



Thus it is possible to anticipate the oxidation behaviour of a given polymer and to predict the sites in the structure most sensitive to oxidation. In an alkyl acrylate, for example, there is a high probability of attack on the tertiary carbon.




The exposure of the adhesives to heat accelerates the oxidation mechanisms. The technique of thermo-oxidative aging consists in heating the samples in a ventilated oven at a given temperature.

## *Chemical change in the adhesives during aging*

### *Method of analysis*

For FTIR analysis, the adhesives in emulsion form were spread on KBr discs. The Acronal 101 L solution was diluted to 10% in methyl ethyl ketone (butanone) and applied to a KBr disc. The thickness of the film after drying was about 50$\mu$m. The films were dried for two days and held in a desiccator before being placed in the oven. Then the samples were introduced into a ventilated oven regulated at 60 ± 1°C where they would remain for 4500 hours of aging. To record the spectra, they were removed from the oven and placed in a desiccator before being analyzed. The spectra were recorded on a Nicolet 510 FTIR spectrophotometer.

### *Analysis of the FTIR spectra*

Following the aging of adhesives by FTIR allows chemical change in the products to be identified. This method is very effective when one recognizes the mechanism which is responsible for chemical modifications [15]. For complex mixtures containing additives, such as the emulsions, the presence of certain groups will influence the appearance of the IR spectrum. One then has the problem of correctly attributing the absorption bands and it is difficult, at a first attempt, to identify all the products which result from the chemical events. Detailed analysis may prove elusive but it is always possible to deduce from the results an overall picture of the chemical change in the PSAs.

By linking the aging behaviour of the polymer to its chemical structure, we are in a position to suggest certain reaction mechanisms. The oxidation of an acrylate according to the standard reaction sequence must give rise to hydroperoxides (ROOH), to carbonyl groups (C = O), to carboxyl groups (COOH), and possibly to the appearance of double bonds (C = C).

These initial hypotheses lead us to examine changes in the spectra in the regions of specific vibrations, such as:

— the bond vibrations of the hydroxyl groups (4000 to 3000cm$^{-1}$)
— the bond vibrations of the carbonyl groups (1700 to 1800cm$^{-1}$)
— the bond vibrations of the C = C bonds (1640 to 1650cm$^{-1}$).

Comparison of the absorption spectra recorded during aging allows their development to be followed. The appearance or disappearance of a group manifests itself in the infrared by the respective increase or decrease of the characteristic absorption bands. For the carbonyl groups, an enlargement of the vibration band towards the higher frequencies is observed. In the case of oxidation there should be an increase in the absorption bands for the hydroxyl groups with a simultaneous enlargement in the band for the carbonyl groups.

## *FTIR examination*

### *Mowilith 491, Mowilith DM 56, Mowilith DM 45*

In the region of vibrations for the ν(OH) groups (4000–3000cm$^{-1}$) an overall diminution of the absorption bands of Mowilith 491 (Figure 1), Mowilith DM 56 (Figure 2) and Mowilith DM 45 (Figure 3) is observed.

The existence of absorption bands in the ν(OH) region is probably caused by the presence of hydroxyl groups of the protective colloids and particularly polyvinyl alcohol. The decrease in this absorption band could be caused by a *dehydration* reaction between two hydroxyls during thermo-oxidative aging, leading to the formation of an ether [16].

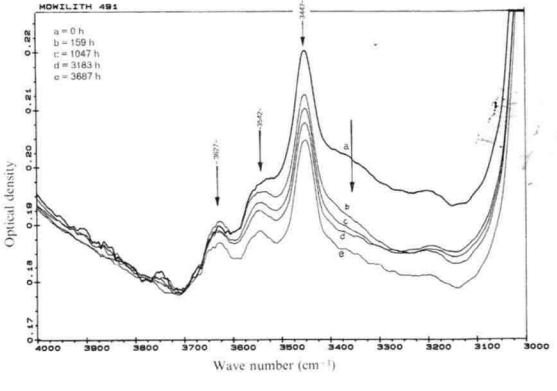



*Figure 1 Evolution of the spectrum of Mowilith 491 subjected to thermo-oxidative aging in the ν(OH) region of vibrations.*

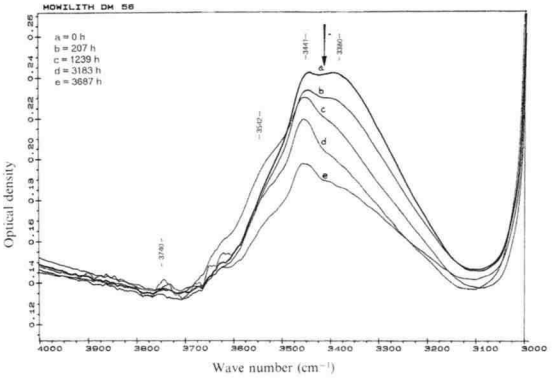



*Figure 2 Evolution of the spectrum of Mowilith DM 56 subjected to thermo-oxidative aging in the ν(OH) region of vibrations.*

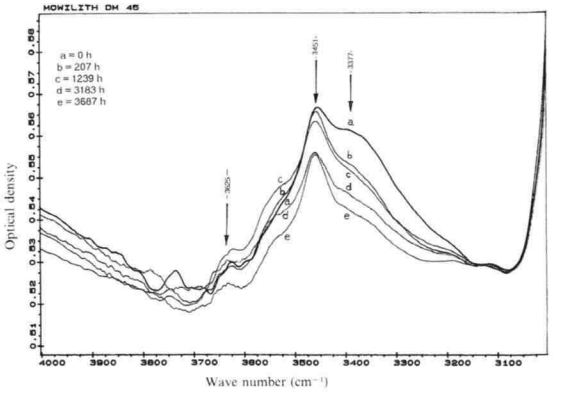



*Figure 3 Evolution of the spectrum of Mowilith DM 45 subjected to thermo-oxidative aging in the ν(OH) region of vibrations.*

In the region of vibrations for the carbonyl groups, none of these three products shows any enlargement of the absorption band in the higher frequencies.

### *Acronal V 205, Acronal 101 L*

In the region of vibrations for the carbonyl groups, an enlargement in the absorption band at higher frequencies is observed for these two products. In the ν(C = C) region we see the growth of an absorption band around 1640cm$^{-1}$ and the disappearance of a band around 1560cm$^{-1}$ for Acronal V 205 (Figure 4) and Acronal 101 L (Figure 5). Moreover, in the ν(OH) region, Acronal 101 L shows a slight increase in the bands situated between 3500 and 3200m$^{-1}$ (Figure 6).

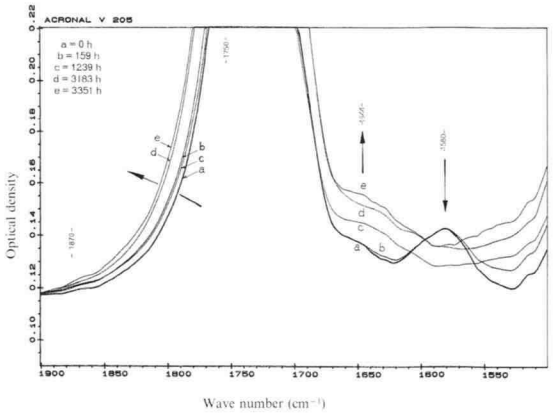



*Figure 4 Evolution of the spectrum of Acronal V 205 subjected to thermo-oxidative aging in the ν(C=C) region of vibration.*

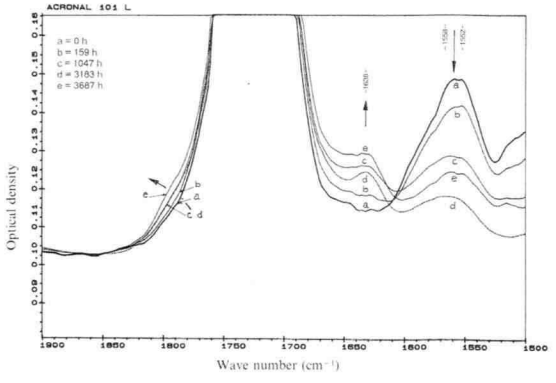



*Figure 5 Evolution of the spectrum of Acronal 101 L subjected to thermo-oxidative aging in the ν(C=C) region of vibration.*

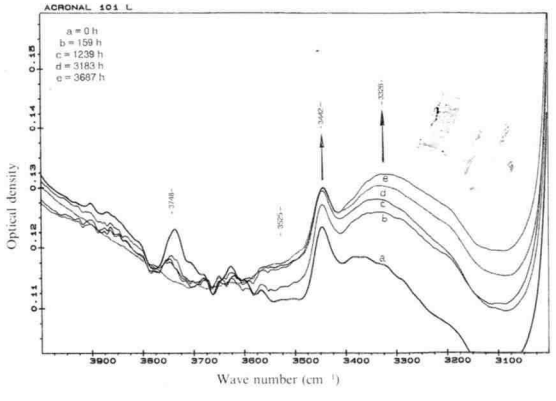



*Figure 6 Evolution of the spectrum of Acronal 101 L subjected to thermo-oxidative aging in the ν(OH) region of vibration.*

The changes in the spectra of Acronal V 205 and Acronal 101 L correspond to oxidation. The spectrum of Acronal 85 D shows no significant alteration during this thermo-oxidative aging.

The variations in optical density are of the order of 1/100 or less for the spectra obtained during thermo-oxidative aging. These variations are thus very small and show that the chemical change in these adhesives remains very limited in the experimental conditions of thermo-oxidative aging at 60°C for 4500 hours. In view of the objectives of this study, the interpretation of these results was not pursued further.

## Changes in surface properties during thermo-oxidative aging

The surface properties of solid polymers are characterized by their structure. Zisman shows that the surface properties of a solid are sensitive to alterations in the structure [17]. When a polymer is oxidized, the formation of the carbonyl groups brings with it an increase in the polarization of the surface [18, 19]. Thus measuring the surface energy of aged polymers is a sufficiently sensitive method to reveal certain alterations in the surface.

### *Method*

Starting by measuring the contact angles of three reference liquids—distilled water, di-iodomethane, alpha-bromonaphthalene—on the surface of dry adhesives, the surface energy of each adhesive before and after thermo-oxidative aging was calculated by means of a goniometer, using the method of Owens and Wendt [20].

*Table 2 Variation in the surface energy of the six adhesives before and after thermo-oxidative aging*

| | *Before aging* $\gamma_s mJm^{-2}$ | *After 4239 hours of aging* $\gamma_s mJm^{-2}$ |
|---|---|---|
| Mowilith 491 | 31 ± 1·5 | 24 ± 1·5 |
| Mowilith DM 56 | 40 ± 1·5 | 45 ± 1·5 |
| Mowilith DM 45 | 22 ± 1·5 | 32 ± 1·5 |
| Acronal V 205 | 16 ± 1·5 | 24 ± 1·5 |
| Acronal 85 D | 17 ± 1·5 | 27 ± 1·5 |
| Acronal 101 L | 20 ± 1·5 | 27 ± 1·5 |

### *Results*

The surface energies of solids depend on the nature of the polymers or copolymers and their additive

content—tensio-active agent, protective colloid, etc. During thermo-oxidative aging, the alterations in the chemical structure at the level of the polymers and the additives give rise to considerable variations in the surface energy of the adhesives. For the series of pressure-sensitive adhesives studied here, the value of the surface energy of each adhesive tends to increase, except for Mowilith 491 (Table 2).

## Change in adhesive properties during thermo-oxidative aging

The object was to assess the sticking properties of the six adhesives during the 4500 hours of thermo-oxidative aging. To achieve this objective it was decided to verify the alterations in the adhesive properties of the PSAs while their surfaces were directly exposed to aging, and the changes in the adhesive forces which join the two canvases.

### *Methods*

The adhesive properties can be determined by means of the peel test based on standards ASTM D 903–49 [21] and NF T 76112 [22]. This destructive method permits the quantitative evaluation of the state of adhesion of a system.

#### *The test samples*

The test samples comprised a flexible part, partially coated with glue (a) and a rigid part (b).

To verify the influence of thermo-oxidative aging on the adhesive, a series of Mylar/adhesive/steel (MAS) test samples was constructed. Part (a) consisted of a layer of adhesive applied on a 50$\mu$m-thick film of Mylar. The dimensions of the strip were 25mm wide by 330mm long. The adhesive was spread over an area 152mm long and 25mm wide. The thickness of the glue was in the order of 0·8mm for the emulsions and 0·3mm for the solution. This part of the test sample was aged in the oven. Part (b) consisted of a degreased polished steel plate (GOST 1050–60), 3mm thick, 25mm wide, 200mm long (Figure 7).

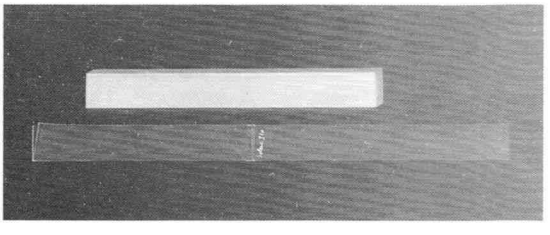


*Figure 7 MAS test piece.*

The change in the bonding of the assembly was determined starting with trials made on a series of polyester/adhesive/linen (PAL) test samples. Part (a) was composed of a strip of polyester fabric, 320mm by 25mm, sized with a layer of Plextol B 500 before receiving the layer of adhesive. The layer of adhesive was applied over 152mm of the length and 25mm of the width. Part (b) consisted of a linen fabric sized with rabbitskin glue, adhered with Araldite (AWB/HY994) to an aluminium plate, 200mm by 25mm, to form the rigid part of the test sample (Figure 8).

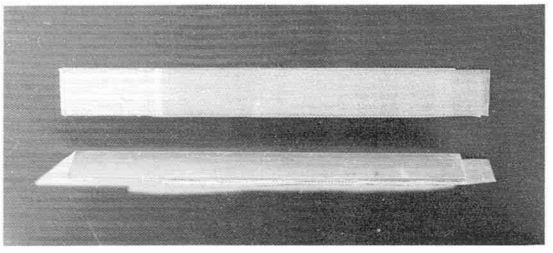


*Figure 8 PAL test piece.*

Seven series of MAS test samples and three series of five PAL test samples were made for each adhesive to follow the change in peel strength during 4500 hours of thermo-oxidative aging. In the case of the MAS test samples, parts (a) were removed from the aging oven and left for one hour at 23 ± 2°C and 55 ± 3% RH. Then parts (a) and (b) were stuck together. The positioning and the pressure were determined by a gauge specially made for the study. The pressure was 26·3gcm$^{-2}$. The trials took place two hours after the bonding of the two parts. The PAL test samples were removed from the oven two hours before the trials.

### *Material*

The peel tests were done on an Instron 4507 dynamometer. The apparatus is designed to be driven by an information system. The Series IX.1.11 computer permits data to be recorded and processed. The traction speed was programmed at 100mm/min, as required by standard NF T 76112. The temperature was maintained at 23 ± 2°C and the relative humidity stood at 55 ± 3%. The calculating programme of the Series IX computer allows the mean load to be calculated starting from the peel energy. The peel energy ($E_p$) is determined by integrating the area below the charge/displacement curve. According to standard NF T 76112, the 25mm of peel at the beginning and end of the trial should be ignored. Series IX provides for calculating the energy between two given limits and the dis-

placement D is fixed at 100mm. The mean load ($F_p$) is obtained by dividing the value of the peel energy by the displacement D.

## *Results*

### *MAS test samples*

The Mowiliths 491 and DM 45 show a fairly rapid drop in peel force during the first 1000 hours of thermo-oxidative aging. This stabilizes at the end of about 2000 hours. In contrast, the peel force of Mowilith DM 56 decreases progressively during aging (Figure 9). For these three pressure-sensitive adhesives, the peel shear is adhesive, no glue residue remaining on the metal part of the test sample.

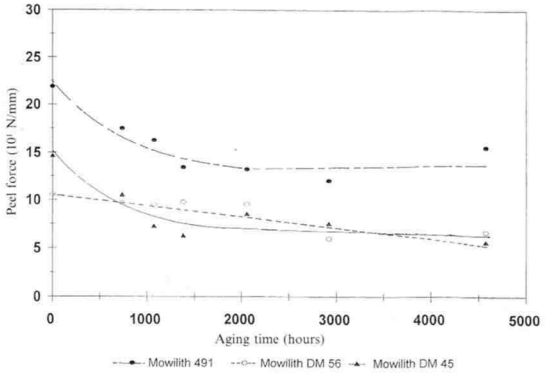



*Figure 9 Evolution of the mean peel force for the Mowiliths 491, DM 56, DM 45 during aging (MAS test pieces).*

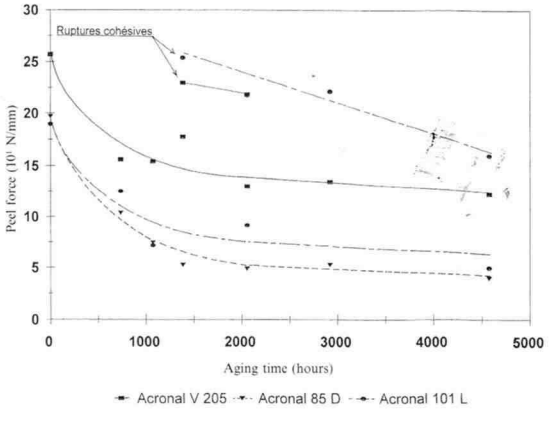



*Figure 10 Evolution of the mean peel force for the Acronals V 205, 85 D, 101 L during thermo-oxidative aging (MAS test pieces).*

As far as the Acronals are concerned, two interesting facts emerge. The drop in the peel force is very pronounced during the first 1000 hours of aging. For Acronal 85 D the peel shear is exclusively adhesive. For the Acronals V 205 and 101 L, starting from around 1200 hours the rupture is no longer only adhesive but also cohesive. To put it another way, glue residues are found both on part (a) (Mylar) and part (b) (steel) of the test sample. The two phenomena are superimposed because these two types of rupture are observed on the same test sample and on the totality of samples (Figure 10).

### *PAL test samples*

In these trials an increase in the peel force during thermo-oxidative aging was observed, except for Mowilith 491 (Figure 11).

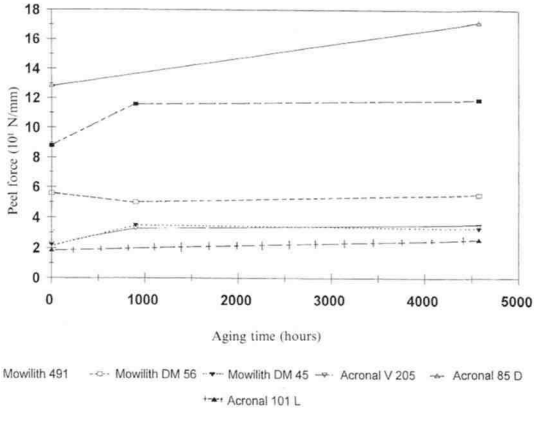



*Figure 11 Evolution of the mean peel force for the series of pressure-sensitive adhesives during thermo-oxidative aging (PAL test pieces).*

## *Solubilisation trials*

Solubilisation trials of the six adhesives were carried out with two solvents, ethyl acetate and toluene (methylbenzene). These two solvents are those normally recommended for acrylates.

Two grams of each adhesive were immersed in 10ml of solvent contained in test tubes. The solubility of the adhesive was measured at the end of one hour and after the test tube was heated over a Bunsen burner for about five minutes*. The results are summarized in Table 3.

**Editor's note.* This technique involves risk and must be carried out in a well-ventilated room or under a fume hood.

*Table 3 Solubilisation trials of the adhesives*

| | *Ethyl acetate* | | | | *Toluene* | | | |
|---|---|---|---|---|---|---|---|---|
| | *Before aging* | | *After aging* | | *Before aging* | | *After aging* | |
| | *1h* | *Hot* | *1h* | *Hot* | *1h* | *Hot* | *1h* | *Hot* |
| Mowilith 491 | PS | PS | PS | PS | PS | PS | PS | PS |
| Mowilith DM 56 | G | G | G | G | G | PS | G | PS |
| Mowilith DM 45 | G | G | G | G | G | PS | G | PS |
| Acronal 85 D | G | G | G | G | G | PS | G | G |
| Acronal V 205 | G | G | I | I | G | PS | G | G |
| Acronal 101 L | S | S | PS | S | PS | S | I | PS |

S: soluble, PS: partially soluble, G: swelling, I: insoluble.

## Interpretation of the results

### *Influence of thermo-oxidative aging on the sticking properties of PSAs: MAS test samples*

Various theories are advanced to explain the effect of thermo-oxidative aging on adhesive properties. Some of them show that the work of adhesion ($W_a$) is proportional to the surface energies of the adhesive and the substrate [23] and the peel force ($F_p$) [24]. Other theories point to the influence of the mechanical and viscoelastic properties of the adhesives [25, 26].

Some adhesives are very sensitive to thermo-oxidative aging while others are more resistant (Table 4).

*Table 4 Resistance to peel of the six adhesives*

| | *Loss of peel strength* |
|---|---|
| Mowilith 491 | 40% |
| Mowilith DM 56 | 43% |
| Mowilith DM 45 | 50% |
| Acronal V 205 | 52% |
| Acronal 101 L | 65% |
| Acronal 85 D | 80% |

During thermo-oxidative aging, IR analysis revealed small modifications in the chemical structure of the PSAs: the dehydration of the Mowiliths 491, DM 56 and DM 45, and the oxidation of the Acronals V 205 and 101 L have been noted. Moreover, thanks to the evolution of the spectra, certain phenomena have been observed which are not capable of interpretation. Thus the accumulation of recognized events (dehydration and oxidation) and unrecognized ones is partly responsible for the modification of the surface and viscoelastic properties of the PSAs. After 4500 hours of thermo-oxidative aging, a study of the chemical evolution of the adhesives by infrared reveals little change. The phenomena observed are slight and the concentration of oxidized groups resulting from the oxidation is small. *A priori* the appearance of oxidized groups does not seem to be directly responsible for the large variations in the physical properties of some adhesives. However, in the course of free-radical oxidation, the insolubilisation of some adhesives is probably due to cross-linking by the recombination of the macroradicals formed. Moreover a temperature of 60°C is sufficient to bring about the dehydration of the polymer or its additives. It is these modifications in the structure of the adhesives brought about by oxidation and dehydration which are responsible for the variations in the viscoelastic properties and, consequently, the adhesive properties.

### *Influence of thermo-oxidative aging on the peel strength of the PAL test pieces*

Since assembly was effected before introduction into the oven, the whole of the test piece was aged and all the materials in the system were affected. The adhesive is no longer in contact with the air but with the linen fabric sized with skin glue. This fabric has a textured and porous surface. Analysis of the results is complex because to the adhesive forces is added the mechanical bond resulting from the penetration of the glue into the textile fibres.

The interfaces of the adhesive within the glued assembly are isolated from external attack and from chemical alteration. The only factors which can explain the variations in the peel strength in the present case are the wetting of the support by the adhesive at the moment of sticking, the diffusion of the adhesive in the support, and the dehydration of

the adhesive. As a general rule, all the adhesives whose surface energy before aging is lower than that of the support ($35 mJm^{-2}$) show an increase in peel strength after aging. On the other hand Mowilith DM 56, which has a surface energy greater than that of the support, behaves differently. It may be assumed that at 60°C a pressure-sensitive adhesive which thoroughly wets the support is going to migrate slightly into the textile and improve the mechanical bond.

Whatever the value of the peel strength, the shear is adhesive: the glue remains wholly on the polyester fabric to which it was applied. No residue adheres to the linen fabric. In other words, the lining of a painting carried out with such adhesives is reversible on non-friable canvases provided that the peel strength at 180° is of the order of $500 Nm^{-1}$ [27, 28]. The Acronals V 205 and 85 D as well as the Mowiliths DM 45 and DM 56 respect this value while the peel strength of Acronal 85 D and Mowilith 491 is too high for the reversibility of the lining to be assured.

## Conclusion

In the field of conservation where the selection criteria for treatment materials are subject to the 'règles d'éthique générales et aux principes déontologiques des interventions' the series of pressure-sensitive adhesives studied here is not without interest. From a chemical point of view, analysis of the spectra reveals a very slight oxidation of the Acronals V 205 and 101 L and the dehydration of the Mowiliths 491, DM 56 and DM 45. The behaviour of the Mowiliths under thermo-oxidation indicates good stability. In addition it was observed that minor chemical changes, such as dehydration, oxidation and cross-linking, are at the root of the variations in the sticking properties. The weakening of adhesion observed in assemblies of the MAS type contributes in the long term to the reversibility of this kind of lining. Taking into account the selection criteria—non-toxicity, stability, reversibility—it can be concluded that products with characteristics similar to those of the Mowiliths DM 56 and DM 45 best answer the requirements of conservation.

## Acknowledgements

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## Products, suppliers and equipment

Mowilith: Société Française Hoechst, Tour Roussel, La Défense, 92800 Paris Cedex 3, France.
Acronal: BASF France, 140 rue Jule Guesde, 92303 Levallois Perret, France.
Araldite: S.A. Ciba-Geigy, 92506 Rueil-Malmaison, France.
Nicolet 510 FTIR: Nicolet France, Zone Industrielle Pissaloup, 78192 Trappe, France.
Goniometer: Kruss France, 38/40 Avenue Jean Jaurès, 91120 Palaiseau, France.
Instron 4507: Instron France, 11 Parc Ariane, 78284 Guyancourt, France.
Steel (GOST 1050–60): Weber Métaux et Plastiques, 3 rue de Poitou, 75003 Paris, France.
Polyester fabric: Marin, 70 Avenue Gabriel Péri, BP 51, 94115 Arcueil Cedex, France.
Linen fabric: Libeco, Tielstraat 98, 8860 Meulebeke, Belgium.
Skin glue: Adam-Montparnasse, 11 Bd Edgar-Quinet 75014 Paris, France.

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**Résumé**—*Dans le domaine de la conservation-restauration des peintures sur toile, la consolidation de la toile originale se fait par l'intermédiaire du contre-collage au revers de la peinture d'une toile de renfort. L'utilisation d'un auto-adhésif permet d'éliminer une partie des risques d'altération inhérente aux techniques de doublage traditionnel. Les matériaux utilisés en conservation-restauration doivent être stables à long terme. Notre choix s'est porté vers des adhésifs à base d'esters acryliques. Les adhésifs ont été soumis à un vieillisse-*

*ment thermo-oxydatif. Nous avons suivi l'évolution de leurs propriétés chimiques, de surface et de collage à l'aide de la spectrophotométrie IRTF, de la goniométrie et des essais de pelage à 180°. D'après l'analyse des résultats le vieillissement thermo-oxydatif provoque trois types de modification au sein des adhésifs: la déshydratation, l'oxydation et la réticulation. Malgré la faible amplitude des phénomènes observés, la perte des propriétés de collage des adhésifs est importante. Elle est due aux changements des propriétés viscoélastiques des colles. Dans la gamme de produits choisis, certains adhésifs vieillis conservent des propriétés qui correspondent encore aux critères de sélection exigés en conservation-restauration.*

**Zusammenfassung**—*Bei der Konservierung von Leinwandgemälden besteht eine Möglichkeit, den originalen Bildträger zu stützen, in der Befestigung eines Verstärkungsgewebes auf der Rückseite der Originalleinwand. Einige der bei den klassischen Doublierungsmethoden auftretenden Gefahren können durch den Gebrauch besonderer Kontaktklebstoffe ausgeschlossen werden. Wegen ihrer Langzeitstabilität kamen in der vorliegenden Studie Klebstoffe auf der Basis von Acrylestern zur Untersuchung. Einer Thermooxidationsalterung folgten Untersuchungen mit Hilfe der FTIR Spektroskopie, der Goniometrie und von Abschältests bei 180°C, um zu Aussagen über Veränderungen der chemischen Eigenschaften, der Oberflächen- und der Klebeeigenschaften zu gelangen. Die Ergebnisse zeigen, daß die Thermooxidation drei Arten der Veränderung in den Klebstoffen auslost: Trocknung, Oxidation und Vernetzung. Trotz des geringen Ausmaßes dieser Phänomene ist der Verlust an Klebeeigenschaften signifikant. Dies ist auf Anderungen der viskoelastischen Eigenschaften des Klebstoffes zurückzuführen. Dennoch behalten einige der Klebstoffe die für die Konservierung benötigten Eigenschaften.*

**Resumen**—*En la conservación de pintura sobre lienzo, se puede consolidar el soporte original añadiendo una tela a la parte posterior del cuadro para reforzarlo. Se pueden eliminar algunos de los riesgos inherentes en las tradicionales técnicas del forrado al utilizar un adhesivo sensible a la presión. Para este estudio se escogieron adhesivos basados en ésteres acrílicos por su estabilidad a largo plazo. Se sometieron los adhesivos a envejecimiento termo-oxidante y se estudiaron los cambios en sus propiedades químicas y sus propiedades adhesivas y de superficie con espectrofotometría FTIR, goniometría y pruebas de desprendimiento a 180°. Los resultados indican que el envejecimiento termo-oxidante causa tres tipos de alteraciones en los adhesivos: deshidratación, oxidación y entrecruzamiento. Aunque el alcance de estos fenómenos es pequeño, la pérdida de propiedades adhesivas es importante, debido a cambios en las propiedades viscoelásticas de los pegamentos. Sin embargo, algunos de los adhesivos retienen propiedades que satisfacen los criterios necesarios en la conservación.*