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JOURNAL OF THE IL & COLOUR CHEMISTS' ASSOCIATION

Retention properties of a phenoxy resin in the region of glass transition and softening temperatures

P. Alessi, I. Kikic, R. Lapasin, A. Papo and G. Torriano

The cracking of finishes on birch plywood materials *A. J. Sparkes*

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Corrosion tests for organic coatings—A review of their usefulness and limitations *W. Funke*

Resource problems in the downstream chemical industry
D. S. Davies and I. J. Lawrenson

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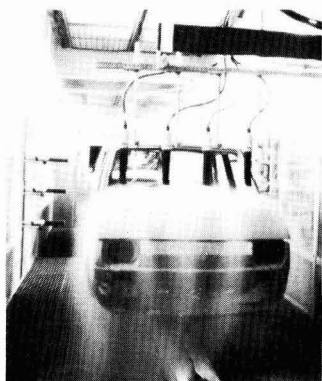
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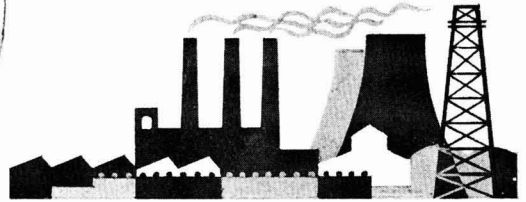
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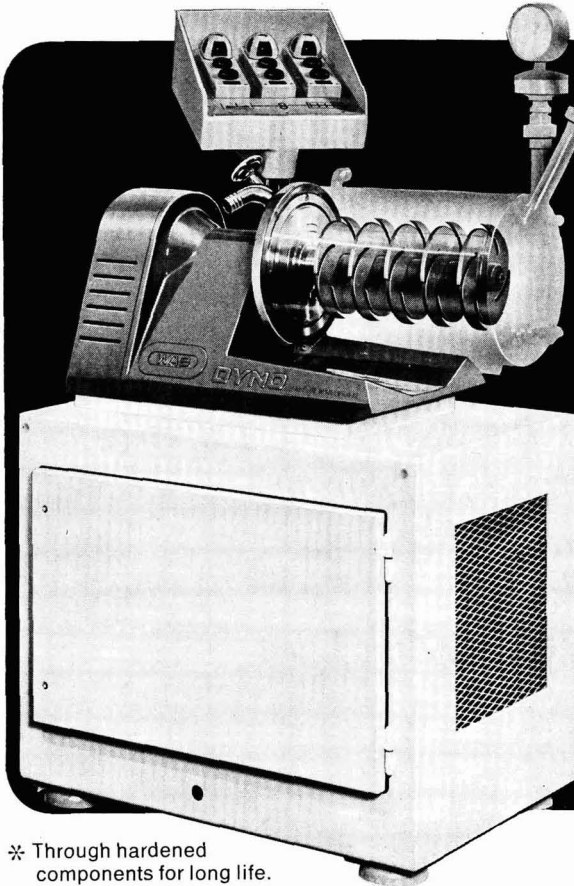
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Transactions and Communications

Retention properties of a phenoxy resin in the regions of glass transition and softening temperatures*

By P. Alessi, I. Kikic, R. Lapasin, A. Papo† and G. Torriano

Istituto di Chimica Applicata e Industriale dell'Università degli Studi di Trieste, 34127 Trieste, Italy

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Summary

Primary and secondary transition temperatures of a commercially available phenoxy resin were evaluated by gas chromatography.

The influence of thermal cycles on gas chromatographic retention properties was investigated.

Keywords

Raw materials for coatings binders (resins, etc)

phenoxy resin

Processes and methods primarily associated with analysis, measurement or testing

gas chromatography

Properties, characteristics and conditions primarily associated with materials in general

glass transition point

softening point

temperature

Les propriétés de rétention d'une résine phénoxydique entre les températures de transition vitreuse et de ramollissement

Résumé

La technique gas-chromatographique a été employée pour la détermination des températures de transition primaire et secondaire d'une résine phénoxydique de type commercial. On a étudié encore

l'influence des cycles thermiques sur les propriétés de rétention en gas-chromatographie.

Retentionseigenschaften eines Phenoxyharzes in dem Intervall von primären und sekundären Transitionstemperaturen

Zusammenfassung

Primäre und sekundäre Transitionstemperaturenintervalle für ein handelsübliches Phenoxyharz wurden mittels gaschromatographischen Verfahrens bestimmt. Die Wirkung von thermischen Zyklen

auf die gaschromatographischen Retentionseigenschaften wurde untersucht.

Introduction

Refs. 1-3

In recent years high molecular epoxy and phenoxy resins have grown in importance as binders for high quality protective and special-purpose coatings. The excellent performance of these polymers is connected with some of their particular features, such as high molecular weight, polarity, chemical resistance, etc. These properties, on the other hand, raise problems regarding formulation and the choice of the solvents and plasticisers.

Various physico-chemical techniques can help the paint formulator in solving these problems¹⁻³. In particular, they can give information on solvency, solvent release from, and retention in films, binder-solvent-plasticiser interactions, and compatibility, binder transition temperature, etc.

In this work the determination of the glass transition temperature, T_g , and the softening temperature, T_s , for a commercial phenoxy resin is reported and an approach to the determination of solvency, solvent retention and release from resin film is presented.

In evaluating T_g and T_s , phenomena connected with the thermal cycle were studied, and are reported and discussed.

Experimental

Materials and apparatus

Phenoxy resin Bakelite PKHH (Union Carbide Co.) was employed as the stationary phase. It was dried to a constant weight in a vacuum oven (the temperature was kept less than 50°C), as it was received as a 40 per cent solution in methyl ethyl ketone. The solutes injected were: tetrahydrofuran, methyl ethyl ketone, and *n*-butyl acetate (Fluka).

The GLC apparatus employed was a thermal conductivity chromatograph, Fractovap Mod. B (Carlo Erba).

Column preparation

Columns were prepared by stirring a solution obtained by dissolving a weighed amount of the dried resin in tetrahydrofuran with a weighed amount of solid support (60-80 mesh

*Paper presented at the 6th CHISA Congress, Prague, August 1978.

Chromosorb W by Carlo Erba, acid washed and silanised). The mixture was dried to a constant weight at 50°C. The coated support was packed into a copper column (1 meter length, 4mm internal diameter).

The loading of stationary phase was 25 per cent, 15 per cent and 5 per cent (the columns obtained are identified as column 25, column 15, and column 5, respectively).

Operating conditions and data reduction

Ref. 4

GLC investigations were carried out by means of a cyclic sequence of temperatures, starting from 50°C up to 150°C and vice versa. Temperature was measured with an electronic thermometer (Avo Comark) and controlled to within $\pm 0.1^\circ\text{C}$. For each temperature, tests were carried out at three different carrier gas flow rates (about 30, 60 and 90 cc/min). The carrier gas was pure hydrogen. Carrier gas flow rate was measured with a soap-film flowmeter. The quantities of the solute injected were normally 0.2 μl .

Specific retention volumes, V_g° , were evaluated according to reference 4.

Results and discussion

Refs. 5-7

Retention volumes obtained for methyl ethyl ketone in column 25 at three different carrier gas flow rates are recorded for a heating and cooling sequence in Figures 1 and 2, respectively. Typical Z-shaped curves were obtained⁵.

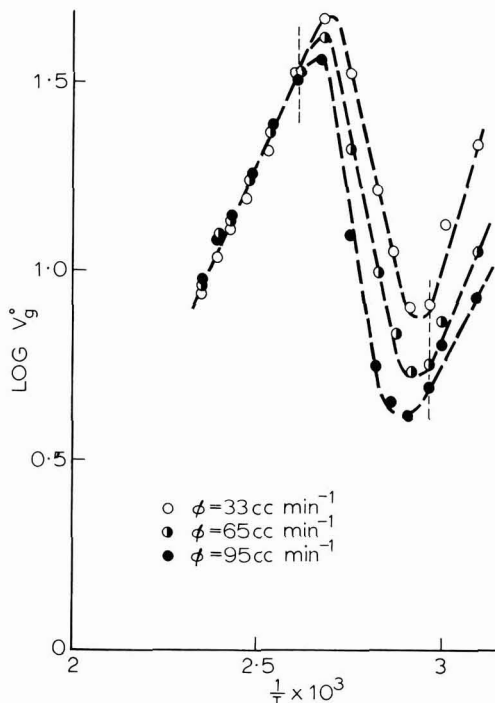


Fig. 1. Retention volumes of methyl ethyl ketone. Heating sequence

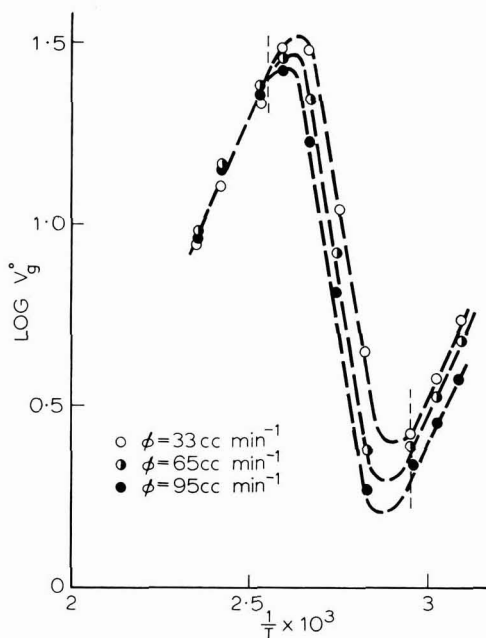


Fig. 2. Retention volumes of methyl ethyl ketone. Cooling sequence

T_g and T_s are evaluated as the points where deviations from linearity are observed, as it is shown⁵ in Figures 1 and 2.

The same values for T_g and T_s were obtained with all the solutes tested; they are $65 \pm 2^\circ\text{C}$ and $117 \pm 3^\circ\text{C}$, respectively.

The influence of the flow rate appears to be remarkable, as was found by Guillet⁶, in the non-equilibrium T_g - T_s interval; lower V_g° values were obtained at higher flow rates.

A comparison of Figures 1 and 2 plots, i.e. heating and cooling curves of the thermal cycle, makes it evident that V_g° obtained in the heating sequence are higher than the corresponding ones of the subsequent cooling sequence from T_s downwards. If the heating and cooling cycle is repeated, the lower values of the first cooling sequence are also reproduced in heating sequences. Differences of values between the first heating sequence and subsequent cooling sequence are made particularly evident in Figures 3 and 4, where the V_g° of tetrahydrofuran and *n*-butyl acetate obtained by zero-flow rate extrapolation are recorded.

Below T_g , the slopes of the curves in the first heating and cooling sequence are different; above T_s they have the same value. In $\log V_g^\circ$ versus $1/T$ plots, slopes of the curves below T_g and above T_s are related to the heats of adsorption and solution, respectively. Accordingly:

$$\text{Slope} = - \frac{\Delta H_v - \Delta h^*}{2.3R}$$

where Δh^* is Δh_m and Δh_a above T_s and below T_g , respectively. (For notation, see after references).

Only slight differences were found between Δh_a values obtained in the heating and cooling sequences below T_g in

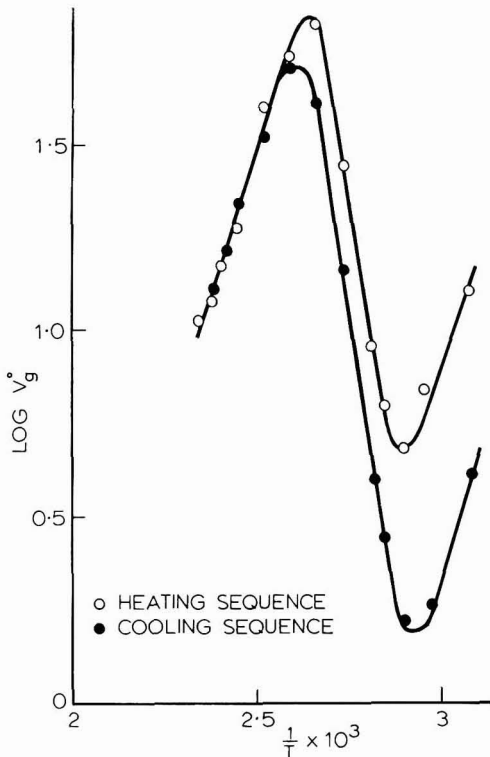


Fig. 3. Retention volumes of tetrahydrofurane

the first thermal cycle. V_g^o differences for the same procedure are, on the other hand, rather large. Since Δh_a is related to K_a , the partition coefficient⁶, it is suggested that the K_a variations are small also under different operating conditions. Keeping in mind that, below the T_g , V_g^o is given by the $V_g^o = K_a A_1$, it follows that V_g^o variations are associated mainly with A_1 variations; this means that the thermal cycle brings about smoothing of surface irregularities and, accordingly, an A_1 reduction.

The phenomena described above were also observed when the first thermal cycle was restricted to a temperature only slightly above T_g . This means that just above T_g molecular mobility is sufficient to allow substantial surface rearrangements.

From an examination of the diffuse side of the elution peaks it was possible to obtain information on desorption phenomena⁷. Tetrahydrofurane/column 25 results are given as an example in Figure 5, where the percentage of adsorbed solute is plotted versus time.

The influence of the flow rate is evident, particularly in the heating sequence; desorption is faster in the cooling sequence than in the previous heating sequence. The latter phenomenon is in agreement with what was previously observed for V_g^o .

Desorption phenomena show the influence of the stationary phase/solid support ratio, when the results obtained with columns 25, 15 and 5 are compared; at the same time, they

give an insight into the phenomena connected with thermal cycle.

In Figure 6 (heating sequence) the position of the curves as well as the shape of their initial part suggests that there is a strong influence of the area and, possibly, of the surface condition of the stationary phase on the solid support.

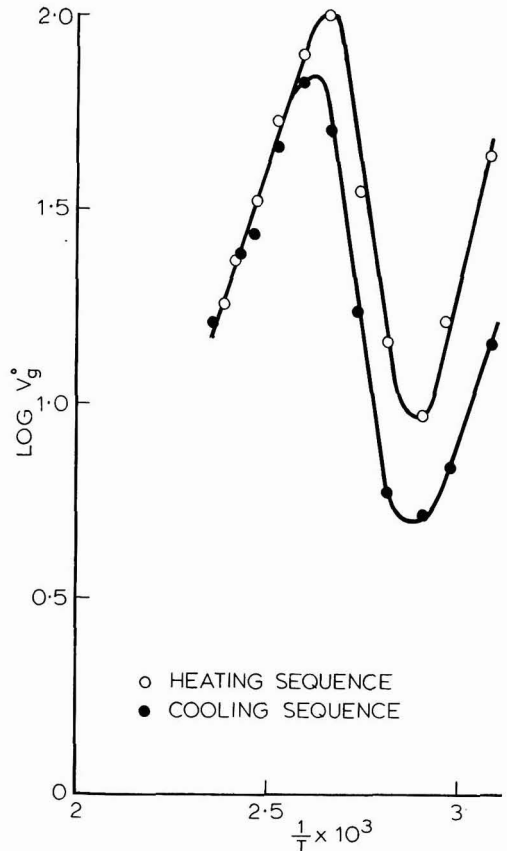


Fig. 4. Retention volumes of n-butyl acetate

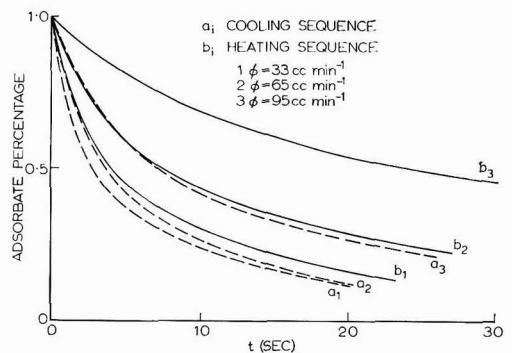


Fig. 5. Desorption curves for tetrahydrofurane (Column 25, at 50.5°C)

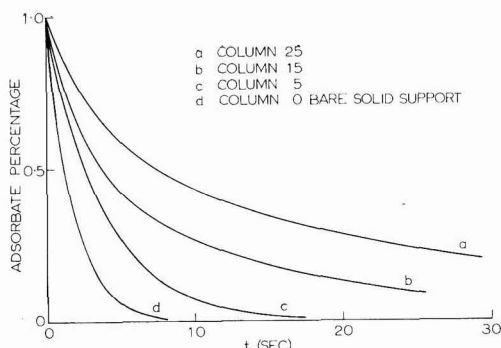


Fig. 6. Desorption curves for tetrahydrofurane. Heating sequence ($\phi = 65 \text{ cc min}^{-1}$ at 50.5°C)

It should be pointed out that the curves refer to the situation caused by letting down the stationary phase on the solid support, before the thermal treatment.

In Figure 7 the position of the curves shows that for columns 15 and 5 desorption is faster in the heating sequence; this fact is opposite to that noted for column 25 (see Figure 5).

In Figure 8 (cooling sequence) the position of the curves clearly shows the effect of the previous heating treatment up to and above T_g ; the order of location of the curves changes

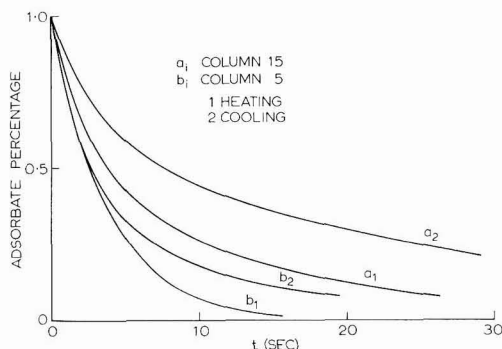


Fig. 7. Desorption curves for tetrahydrofurane. ($\phi = 65 \text{ cc min}^{-1}$ at 50.5°C)

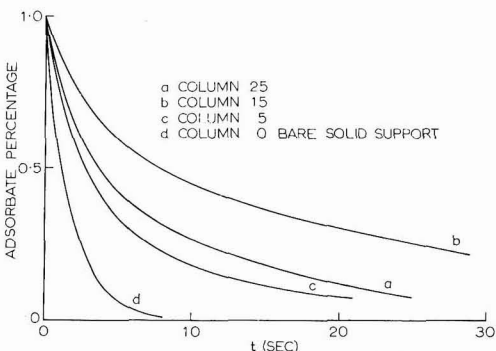


Fig. 8. Desorption curves for tetrahydrofurane. Cooling sequence. ($\phi = 65 \text{ cc min}^{-1}$ at 50.5°C)

with respect to that of Figure 6, where the increasing desorption time corresponds to an increasing percentage of stationary phase. In this case the slowest desorption is exhibited by column 15.

Increasing the stationary phase/solid support ratio (columns 5–15–25) causes increasing percentages of solid support area to become covered with stationary phase, whose adsorption power is much higher than that of the bare solid support. This explains the order of location of desorption curves of Figure 6. The steep initial part of curve 5 and, possibly, of curve 15 may be connected with fast desorption from uncovered areas of solid support.

Heating at temperatures above T_g (and even above T_g) causes a more regular distribution of stationary phase on the solid support corresponding to higher areas of solid support covered by the stationary phase. This explains the location of desorption curves of columns 15 and 5 in the cooling sequence (Figure 7).

When the stationary phase is sufficient to cover the solid support completely in column preparation, heating above T_g results in a rearrangement of the surface that makes it smooth, by cancelling irregularities, filling support pores, etc. Stationary phase area is diminished and the effect of carrier gas flow rate is less marked; this explains the lower desorption curves of column 25 (Figure 5).

The fact that, in the cooling sequence, curve 15 is placed higher than curve 25 suggests that in column 25 the quantity of stationary phase is so high that it can give a quite even regular surface where all pores and irregularities of solid support are thoroughly filled and eliminated, whereas for column 15 coverage of solid support is attained with such a thin layer of stationary phase that solid support irregularities are not completely cancelled, so that the total area happens to be more extended than in the case of column 25.

[Received 10 November 1978]

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Notation

- A_i — surface area of stationary phase
 Δh_a — heat of adsorption
 Δh_m — heat of mixing
 ΔH_v — heat of vaporization
 K_a — partition coefficient for surface adsorption
 T_g — glass transition temperature
 T_s — softening temperature
 V_g° — specific retention volume
 ϕ — carrier gas flow rate

The cracking of finishes on birch plywood materials*

By A. J. Sparkes

FIRA Research Department, Maxwell Road, Stevenage, Hertfordshire SG1 2EW

Summary

The various factors which cause the cracking of finishes applied to birch plywood and blockboard materials are discussed in order to show how the adoption of certain procedures regarding the selection, conditioning and finishing of these materials can eliminate or, at least, minimise cracking. The main points of the discussion are summarised in the following set of recommendations for the prevention of cracking of lacquers applied to plywood or blockboard substrates for use in interior situations.

1. Apply finishing treatments when plywood has a moisture content in the approximate range 8-10 per cent.
2. Use plywood or 5 ply crossed veneer blockboard but not 5 ply parallel veneer blockboard.

Keywords

Types and classes of coatings or allied products

furniture finish

Types and classes of structures or surfaces to be coated

plywood

birch

particle board

3. Select a grade of surface veneer appropriate to the class of work and avoid using boards with repaired defects in prominent positions. Boards with heavily sanded surface veneers are more likely to crack than those with normal thickness veneers.
4. Consult the lacquer manufacturer regarding the type of finish. Nitrocellulose and melamine based finishes tend to be more brittle and, consequently, more likely to crack than polyester or polyurethane based finishes.
5. If any of the previous recommendations are difficult to apply or as an additional safeguard, use plywood or blockboard overlaid with a resin impregnated paper. Check the compatibility of the selected lacquer with the paper surface.

Properties, characteristics and conditions primarily associated with materials in general

moisture content

dried or cured films

cracking

Le craquelage des finitions appliquées au contreplaqué de bouleau

Résumé

On discute les divers facteurs qui provoquent le craquelage des finitions appliquées au contreplaqué et aux panneaux en bloc de bouleau, afin de mettre en évidence la manière par laquelle l'emploi de certaines techniques à l'égard de la sélection, du conditionnement et de la finition de ces matériaux peut éliminer, ou, au moins, réduire au minimum le craquelage. On peut résumer les points principaux de la discussion par la série suivante de recommandations pour prévenir le craquelage de vernis clair appliqué au contreplaqué ou aux panneaux en bloc destinés à être utilisés à l'intérieur.

1. Appliquer les traitements de finition lorsque la teneur en humidité du contreplaqué se trouve entre 8 et 10% ou à peu près.
2. Utiliser des panneaux en bloc à cinq plis en biais, mais non pas des panneaux en bloc à cinq plis en parallèle.
3. Choisir un placage supérieur de qualité appropriée à celle du

produit à être fabriqué, et éviter l'emploi des panneaux ayant des défauts racommodés fort apparents. Les panneaux dont les placages supérieurs ont été fort poncés sont plus susceptibles à se craqueler que ceux où l'épaisseur du placage est normale.

4. Consulter le fabricant de vernis à l'égard du type de finition conseillé. Les finitions à base de nitrate de cellulose ou de mélamine ont tendance à être plus friables, et par conséquent, plus susceptibles à se craqueler que les finitions à base de polyester ou de polyuréthane.
5. En tant que précaution supplémentaire, ou dans le cas où quelque recommandation précédente soit difficile à respecter, utiliser le contreplaqué ou le panneau en bloc revêtu d'une feuille de papier imprégnée de résine. Vérifier que le vernis choisi est compatible avec la surface du papier.

Rissbildung in Lacken auf Birkenfurnieren

Zusammenfassung

Die verschiedenen Faktoren, welche das Reißen von Lackfilmen auf Birkenfurnier und Sperrholz-Material verursachen, werden besprochen um zu zeigen, wie dies durch gewisse Massnahmen bezüglich Auswahl, Konditionierung und Lackierung solcher Materials ausgeschaltet oder zumindest reduziert werden kann. Die wesentlichsten Punkte dieser Besprechung werden in den folgenden Empfehlungen zur Verhütung von Rissbildung in Lackfilmen auf Furnier- oder Sperrholzsubstraten für Innenverwendung zusammengefasst.

1. Lackiere nur, wenn der Feuchtigkeitsgehalt des Furniers etwa 5-10% ist.
2. Benutze Furnier oder fünffach überkreuztes Sperrholz, nicht aber fünffach parallele Furniersperrholzbretter.

3. Eine Qualität Oberflächenfurnier aussuchen, die sich für die Art der Arbeit eignet und die Verweudung von Brettern mit reparierten Fehlern an auffallenden Stellen vermeiden. Bretter mit stark gesandeten Oberflächenfurnieren sind gegen Reißen empfindlicher, als solche normaler Dicke.

4. Den Rat des Lackerzeugers hinsichtlich der Lacksorte einholen. Nitrozellulose und auf Melamin basierende Lacke neigen mehr zur Brüchigkeit und infolgedessen mehr zum Reißen als Polyester- oder Polyuriethanlacke.
5. Sollte es schwierig sein, einen der vorstehenden Ratschläge zu befolgen oder als zusätzliche Vorsichtsmaßnahme, so verwende man Furnier oder Sperrholz, das mit harzimpregniertem Papier beschichtet ist. Prüfe aber die Verträglichkeit des ausgesuchten Lackes mit der Papieroberfläche.

*Paper presented at the Thames Valley Section one-day meeting on "Coatings for wood" held at Princes Risborough Laboratory on 12 October 1978.

Large quantities of plywood and blockboard are still used to make kitchen and storage units, various items of built-in furniture and furniture components. One of the main advantages of plywood is that furniture panels can be prepared easily and finished without the need for sophisticated lamination equipment. Birch plywood materials can be finished directly with clear lacquer making a feature of the grain effects within the surface veneers or with pigmented lacquer to meet the demand for a high quality white or plain colour finish.

The close grain of birch veneer provides a good substrate for painting but, under some conditions, finishes applied directly to plywood or blockboard can crack as a result of exposure to some service conditions. If, for instance, moisture content of a sheet of plywood in the factory prior to painting is substantially higher than the average moisture content in service, cracks developing as a result of shrinkage within the surface veneers of the plywood may produce corresponding cracks in the applied paint films.

Cracks due to shrinkage of the paint film independent of substrate can also occur. However, these lacquer shrinkage cracks generally follow random directions whereas cracks due to veneer shrinkage follow the grain direction of the veneer.

When plywood cracks, the severity of cracking probably depends upon factors such as type of substrate, veneer peeling conditions and type of finish as well as upon the actual change in moisture content of the board. Some of these factors are outside the control of the user of plywood materials but others can sometimes be selected or controlled to minimise the risk of subsequent cracking.

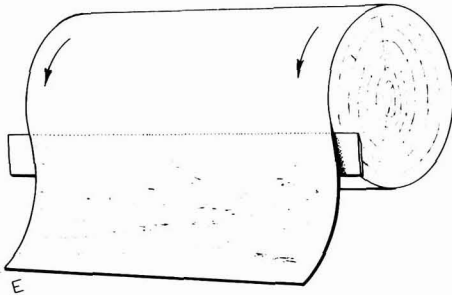


Fig. 1. Rotary cut veneers used for plywood construction

Two investigations have been carried out at FIRA with the co-operation of the Finnish Plywood Development Association to examine the effect of various factors such as substrate material, finishing treatment and exposure conditions on the cracking characteristics of birch plywood materials. Briefly, the investigations consisted of a pre-finishing conditioning treatment of panels cut from different types of plywoods and blockboards, finishing with one of nine different pigmented lacquer systems and finally a post-finishing conditioning treatment. The amount of cracking due to an initial drying out after painting and also to seasonal changes in moisture content of the plywood materials was determined by examining the surfaces of the panels at intervals throughout a one year post-finishing conditioning period.

The following four conditioning treatments were applied:

- (a) 65 per cent rh before painting—65 per cent rh after painting.

- (b) 85 per cent rh before painting—35 per cent rh after painting.

- (c) 65 per cent rh before painting—35 per cent rh after painting.

- (d) 35 per cent rh before painting—8 week cycles at 35 per cent rh, 85 per cent rh after painting.

The following nine finishing treatments were applied:

- (1) Conventional cellulose primer and finishing coat.
- (2) High quality cellulose primer and finishing coat.
- (3) Water based acrylic primer and cellulose finishing coat.
- (4) Polyurethane primer and finishing coat.
- (5) Polyurethane primer and cellulose finishing coat.
- (6) Polyester primer and finishing coat.
- (7) UV cured polyester primer and melamine finishing coat.
- (8) Melamine, precatalysed primer and finishing coat.
- (9) Melamine, 2-pack primer and finishing coat.

Table 1 refers to the results of the examination of the blockboard panels after 60 weeks conditioning treatment and Table 2 refers to the corresponding results for the plywood panels.

Table 1
60 weeks exposure blockboard panels

	a	b	c	d
	65/65	85/35	65/35	35/35-85
1 NC + NC	O	XXXW	XW	XH
2 NC + NC	O	XXXH/W	XW	XXH
3 acrylic + NC	O	XXW	XW	XH
4 PU + PU	O	XW	O	O
5 PU + NC	O	XXW	O	XXW
6 PE + PE	O	O	O	O
7 PE + melamine	O	XXXW	XXW	XW
8 precat + precat	O	XXXH/W	XXH/W	XXH
9 AC + AC	O	XXXW	XXW	XXXW

O No cracks

X 1-5 cracks

XX 6-50 cracks

XXX more than 50 cracks

W wide cracks

H hairline cracks

Table 2
60 weeks exposure plywood panels

	a	b	c	d
	65/65	85/35	65/35	35/35-85
1 NC + NC	O	XXXW	XXH	XXXH
2 NC + NC	O	XXXW	XXH	XXXH
3 acrylic + NC	O	O	O	O
4 PU + PU	O	O	O	O
5 PU + NC	O	XH	O	O
6 PE + PE	O	O	O	O
7 PE + melamine	O	XXH	XXH	XXH
8 precat + precat	O	XXH/W	XXH	XXXH
9 AC + AC	O	XXXW	XXXH/W	XH

O No cracks

X 1-5 cracks

XX 6-50 cracks

XXX more than 50 cracks

W wide cracks

H hairline cracks

A report on the first investigation in *FIRA Research Journal* No. 2, February 1973, was concerned with experimental techniques and detailed results but now that the second investigation has been completed, sufficient information is available to justify the publication of the following set of general recommendations which should help to reduce the risk of cracking of finishes applied to birch plywood and blockboard materials.

Moisture content

Control of substrate moisture content is perhaps the most obvious method of reducing the risk of cracking of finishes applied to plywood materials, but this method is difficult to apply in practice as few users have the space or time available for conditioning sheet materials to the optimum moisture content before finishing. Ideally the moisture content of the materials before finishing should be midway between the extremes of moisture content expected in service. In most interior situations a yearly average relative humidity of about 50 per cent rh is considered to be representative and this is equivalent to an average moisture content of about 10 per cent for plywood materials. Boards should therefore be delivered to the user at about 10 per cent moisture content and they should be stored under reasonably dry conditions to maintain this moisture content up to the time of finishing.

The risk of development of cracks in finishes applied to plywood materials is determined by the difference between the moisture content existing at the time of finishing and the moisture content at any time after finishing. Although the pre-finishing conditions may be ideal, cracks can develop subsequently if the plywood is exposed to extremely low relative humidity for a long period of time or to wide seasonal fluctuations in relative humidity.

If control of moisture content before finishing is difficult or if exposure to extreme conditions in service is expected, the risk of cracking can be reduced by careful choice of substrate or finishing system.

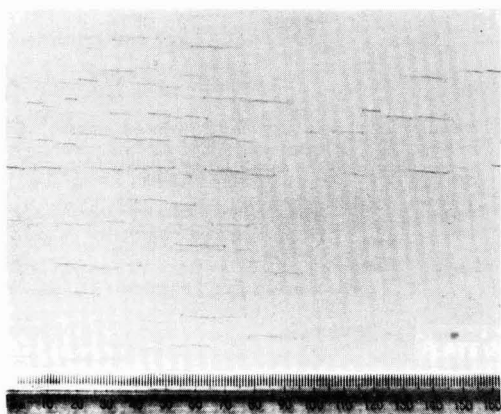


Fig. 2. Wide crack pattern developing on blockboard substrate exposed to severe conditioning treatment.

Substrate

The severity of cracking of a finish due to a given change in moisture content within a plywood substrate depends upon the construction and quality of the substrate. With normal

plywood construction, alternate veneers are crossed and under these conditions, the cracking characteristics of a board are determined by the surface veneers alone. 5 ply blockboard with the two veneers on each side of the core blocks laid perpendicular to each other is similar to plywood in this respect, but 5 ply blockboard with parallel veneers is more likely to crack than plywood exposed to the same environmental conditions. The transverse movement within the surface veneers on either side of plywood and 5 ply blockboard with crossed veneers is restrained by the underlying veneers, whereas the movement within the surface veneers of 5 ply blockboard with parallel veneers is emphasised by the corresponding movement within the underlying veneers. Fortunately, as far as the cracking of finishes is concerned, 5 ply birch blockboard with parallel veneers has been largely displaced by 5 ply birch faced blockboard which is constructed with crossed veneers.

Plywood and crossed veneer blockboard panels are likely to develop fine hairline cracks as a result of loss of moisture, but wide cracks are more characteristic of parallel veneer blockboard (Fig. 2).

The use of intermediate softwood veneers apparently has little effect on the cracking characteristics of plywoods as birch and birch faced plywood panels developed similar crack patterns when exposed to the same conditioning treatments. Surface veneer peeling conditions and, in particular, log diameters are likely to affect veneer cracking characteristics more than the type of wood used for the core veneers. As these factors are outside the control of the user, other methods of controlling cracking must sometimes be considered.

Defects in the plywood surface, such as plugged knots, patched splits and even veneer joints can lead to localised cracking as a result of loss of moisture from the board as a whole. The user is advised to select the higher grades of plywood for the more critical applications but, even within those grades which permit some defects under the grading rules, cracking problems can be minimised by selection of boards and by selection of surfaces on each board.

Finish

Cracks in finishes applied to plywood materials may be caused by shrinkage and the consequent opening of cracks within the surface veneers or by shrinkage within the lacquer film itself. Cracks due to veneer shrinkage closely follow the grain direction of the surface veneers, but cracks resulting from lacquer shrinkage generally occur in random directions. Clearly, a badly formulated lacquer is liable to shrink and crack as it ages even though the plywood substrate remains at the same moisture content. Among well formulated lacquers, however, some types are apparently more effective than others in minimising the visual effect of cracking resulting from shrinkage of plywood substrates.

Pigmented lacquers are generally more brittle than the equivalent clear lacquers and they are consequently more likely to crack as a result of movement within plywood substrates. In so far as it is possible to describe lacquers by chemical type, nitrocellulose and melamine based lacquers are relatively brittle and they will follow the opening of any cracks within the surface veneers of plywood substrates. Polyester lacquers normally applied as thick films are, by contrast, strong enough to restrain the movement and prevent the development of cracks within the surface veneers.

At the other extreme, some polyurethane based lacquers retain sufficient flexibility to bridge over fine cracks that develop in the surface veneers when plywood or crossed veneer blockboard panels dry out. Nevertheless these lacquers have their limitations with regard to the wider cracks that are likely to develop when parallel veneer blockboard dries out.

Although the relative merits of different types of finish for reducing the risk of cracking have been discussed in general terms, finishes vary considerably even within one chemical type. Information on the performance of particular finishes on plywood or blockboard substrates should always be obtained from the lacquer manufacturer.

Paper overlay

In situations where control of substrate moisture content is impracticable and where relatively simple pigmented

systems are required, the use of a paper overlay on plywood or blockboard is an effective method of reducing the risk of cracking. Boards to be finished with clear lacquer cannot be surfaced with paper overlay without masking the wood grain effect of the birch veneers, but paper provides a good substrate for pigmented lacquers providing there are no problems of lacquer adhesion. A resin impregnated paper overlay can be bonded to each side of the panels as part of the finishing treatment in the factory where the plywood is fabricated. Alternatively, a paper overlay can be applied as part of the plywood or blockboard manufacturing process. The increased cost of the paper overlay boards would be partially off-set by a probable reduction in the cost of finishing and by a considerably reduced risk of cracking. As with the polyurethane finishes, paper overlays are not completely effective in eliminating the relatively wide cracks that occur with parallel veneer blockboard exposed to large moisture content changes.

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UV cured acrylic coatings for wood*

By P. Dufour

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Summary

The development of modern finishing systems for furniture is reviewed. The advantages of the UV cured unsaturated acrylic systems are discussed.

Keywords

Types and classes of coatings or allied products
furniture finish

Raw materials for coatings binders (resins, etc.)

acrylic resin
polyester resin

Processes and methods primarily associated with drying or curing of coatings

ultraviolet curing

Miscellaneous terms

cost
investment cost
raw material cost
energy requirement

Revêtements pour bois à base de résines acryliques durcissables par rayons ultra violets

Résumé

On passe en revue le développement des systèmes de finition pour meubles. On discute les avantages des systèmes à base des résines acryliques non saturées et durcissables par rayons ultra violets.

UV gehärtete Akrylharzlacke für Holz

Zusammenfassung

Eine Übersicht von modernen Lackierungssystemen für Möbel. Die von UV gehärteten, ungesättigten Akryllacksystemen gebotenen Vorteile werden besprochen.

Introduction

Refs. 1-3.

The purpose of wood finishing is to improve its aesthetic appearance and the mechanical properties of the surface. This can be achieved by two main processes:

Wet finishing: by direct application of paint and varnishes to the substrate.

Dry finishing: by bonding to the substrate a prefinished sheet of plastic or treated paper.

The wood finishing industry is subject to the same pressures (marketing and environmental) as other industries. In times of economic crisis, high productivity is the only guarantee of a company's success.

In the future, processes will have to achieve the following:

high productivity: compensating for the ever increasing labour costs

elimination of pollution: the emission of solvents into the atmosphere is no longer accepted.

reduction in power consumption: to meet shortage of primary energy sources.

The best techniques for meeting these criteria are in decreasing order of importance:

- (1) Electron beam curing (EBC): working only with acrylic unsaturated systems.
- (2) Acrylic/UV: varnishes based on unsaturated acrylic resins.
- (3) Polyester/UV: varnishes based on polyesters in styrene.

The other systems used in wood finishing all require long drying times which consume a lot of energy for curing purposes or for the removal of solvent. For example:

Aqueous systems^{1,2}: evaporating water necessitates four times more energy than organic solvents

*Paper presented at the Thames Valley Section one-day meeting on "Coatings for wood" held at the Princes Risborough Laboratory of BRE on 12 October 1978

Systems based on nitrocellulose: contain as high as 80 per cent volatile solvents

Systems based on polyurethane: may introduce pot life problems and still contain up to 60 per cent volatiles

Acid curing systems³: contain up to 50 per cent solvent and formaldehyde is evolved during the curing and can continue for a long time after fabrication.

Market situation

Refs. 4-6

According to the results of a recent market study⁴ the improvement of the surfaces of furniture, made principally from chipboard, is divided into the three following categories:

- with paper sheets (34 per cent)
- with veneered wood sheets (20 per cent)
- with PVC sheets (12 per cent)

It is likely that for some years to come, veneered wood and PVC sheets will continue to increase, but paper sheets will retain the major share of the market.

There already exist, in different European countries, modern production lines for the finishing of paper and PVC sheets (EBC and UV used solely with acrylic unsaturated systems).

For the direct "wet finishing", EBC and UV lines have also been operated on the Continent for some years.

As far as the author is aware, in Great Britain, there are only two UV lines but they are working with the slowest system, namely, with polyester in styrene. There are no lines working with the only two systems which encompass all the three criteria cited above, namely, EBC and acrylic UV.

This is surprising because in offset inks and in overprint varnishes for the packaging industry, Great Britain has been the first in Europe to utilise UV curing of acrylates.

A logical explanation has recently been published⁵.

Binders based on acrylic unsaturates for wood

The requirements of a good varnish for wood are:

- Good wetting of the pores with a minimum of the product.
- A good flow by roller application.
- No micro-airbubbling during the curing.
- Rapid UV curing in depth and at the surface.
- Good adhesion.
- Good hardness and scratch resistance but having sufficient flexibility to withstand dimensional variations of the wood, namely, "cold check" resistance.
- Good resistance towards solvents, abrasions and stains.

The general composition of a UV varnish is:

Prepolymer: which determines principally the mechanical properties after curing.

Monomer: to regulate the viscosity

Photoinitiator system: initiate the curing under UV light

Additives: various agents to improve flow, gloss and so on.

UCB have developed prepolymers meeting these requirements; they are of different chemical classes, for example: polyester/acrylates, urethane/acrylates and epoxy/acrylates.

Epoxy/acrylates have progressively taken the major share of the market, because they offer a better compromise between hardness and flexibility requirements in the wood field. Coatings of application weights varying from 5 to 100 g/m² pass the "cold check" tests without difficulty.

Nevertheless, polyester/acrylates are still applied to meet specific requirements, where a low viscosity combined with a high reactivity is needed to give good solvent resistance to thin films.

The diluting monomers play an important role in the formulation influencing the following: viscosity, hardness-flexibility, reactivity, price and physiological effects, such as irritation.

Generally, the cheapest monomers have the best diluting power and are the most irritant. Nevertheless, they are still used in EBC and UV formulations because the lines utilising them are necessarily automated (to meet high production requirements) and the operators are not often in direct contact with the products. Normally, the machines are cleaned once a week or even less frequently.

Conscious of this irritancy and safety problem, UCB has put on the market, monomers with a low irritation index and which adequately meeting the requirements of the wood finishing industry.

The photo-initiator system is preferably composed of: benzophenone (the cheapest initiator), a benzil derivative (such as Irgacure 651) to improve the curing in depth, and an amino/acrylate (such as Uvecryl P104), an activator improving surface cure.

The reactivity is determined by the concentration of the photoinitiator system and also by the nature and concentration of the prepolymer. In practice, the photoinitiator concentration is adjusted to obtain a reactivity of 20 m/min with one UV lamp of 80 W/cm on a non-porous substrate. This reactivity ensures a good cure at 10 m/min.

The curing mechanisms and the influence of each of the components of the acrylic UV varnishes will not be discussed here because this data has been previously published⁶.

Historical development of UV wood finishing in Europe

Varnishes based on polyester in styrene

Polyester/UV systems were developed in the mid-sixties. They are still used mainly as sealers for chipboard and for thick layer finishing. The curing takes place using a combination of weak actinic power lamps TL and 30 W/cm HTQ lamps.

The development of the more powerful 80 W/cm UV lamps in the beginning of the "seventies" allowed the air curing of the polyester in styrene without the use of paraffin wax. At the same time the trend was towards open pore

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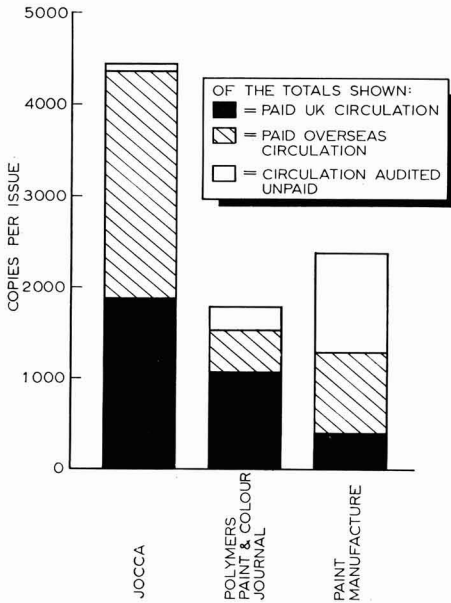
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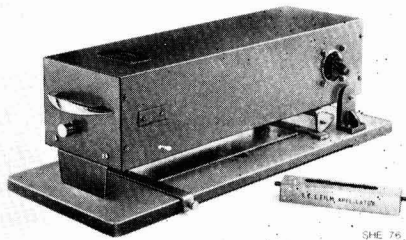
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finishing and this market witnessed a substantial growth in Germany and Italy. It necessitated the replacement of the old UV lamps by modern units operating at 80 W/cm. This replacement of dryer and the installation of new lines appeared at a period when acrylic/UV varnishes were not yet operational, and explains why polyester/UV films made such progress.

Varnishes based on unsaturated acrylic

Around 1975–76, a French furniture manufacturer wanted to increase productivity using only a limited area and, of course, with minimal investment. French formulators met that challenge by developing acrylic/UV varnishes which were applied industrially at the end of 1976.

The excellent results obtained and the skill of the formulators caused the acrylic/UV market to go from strength to strength, especially during this current year.

By the end of 1978 it is expected that, in France alone, about 30 UV dryers (each with 2 or 3 lamps) will be installed by about 20 users resulting in a total consumption of 25 tonnes per month of varnish.

According to a recent study made by a UV oven manufacturer in France, there is a potential market of 40 UV dryers in the "furniture sector" alone.

Application fields for acrylic/UV varnishes

These varnishes are used for:

Open pore finishing in coatings of 8 to 12 g/m², applied mainly by rollers, but in one specific application by spraying.

Closed pore finishing in coatings of 80 to 100 g/m² applied by curtain coaters.

The most favourable opportunity to install these new processes is when investing in a new line, because the investment is then justified as it involves a lower outlay for higher productivity than can be achieved by any other existing finishing process.

The first line installed in France applies two coats on the inside and three on the outside, curing with two lamps for the base coat and three lamps for the top coat at 20 to 25 m/min. Both sides are treated simultaneously and the panels are slightly sanded and any dust removed before each coat is applied. The total length of the line is about 60 m, but only 25 m is allowed for the application and thermal drying.

The acrylic/UV varnishes have also interested furniture manufacturers who already have thermal ovens. Two or three long thermal ovens in line would take too much space, and therefore, most of the manufacturers work with one oven and use two passes, stacking between the coats to let the panels cool. This process is time consuming and increases the risk of damage.

Hence, the furniture manufacturers have the choice of finishing their panels in one pass by installing an application machine and a UV oven, either before or after the thermal tunnel.

As production areas are generally limited with regard to space, the only real solution is to use acrylic/UV. In this way

productivity is more than doubled and rejection due to damage is avoided. Some manufacturers prefer to apply the UV varnish as a base coat and they retain the surface features which their customers expect; others apply the UV varnish as a top-coat and thus obtain a new surface with improved properties.

Comparison of polyester and acrylic/UV varnishes

Varnishes based on polyester in styrene

Wetting is not perfect because the varnish "humps" on the pores, and therefore, it is necessary to apply a layer of 15 to 20 g/m² and sand in order to obtain a flat surface, thus losing a lot of cured varnish.

Reactivity: For a speed of 10 m/min, three lamps are necessary for the base coat and five lamps for the top coat. This extended irradiation (three times longer than with acrylic/UV) warms up the substrate and causes "micro-bubbling". To minimise the *adverse effects* of wetting and "micro-bubbling", fillers are added to the varnish resulting in a dull finish.

Styrene is a relatively volatile monomer causing viscosity variations and necessitating regular inspection of the rollers and cleaning at least once a day. Furthermore, an efficient ventilation system is necessary around the rollers to avoid a high level of styrene in the workshop.

Selling price: £1.45 to £1.55 per kilo.

Varnishes based on unsaturated acrylic

Wetting: Pores are very well wetted even on tinted panels; the varnish does not "hump" and thin layers of 8 to 12 g/m² can be applied (that is to say, about half the quantity of polyester/UV); only a slight sanding is required with very little product loss.

Reactivity: For a speed of 10 m/min, one lamp is sufficient for the base coat and 1.3 to 1.5 lamps for the top coat; this is three times less than with the polyester UV varnish. Because of the short curing time, the substrate does not heat up and no "micro-bubbling" occurs.

All *acrylic binders* and monomers have an extremely low volatility giving a stable viscosity, and therefore, supervision of the rollers is reduced to a minimum and the machines are only cleaned once a week.

Selling price: £2.80 to £3.20 per kilo, i.e. twice the price of the polyester/UV varnish.

At that time it was very easy to say that the acrylic/UV varnishes are "too expensive". This is like the adversaries of the UV technology comparing only the price per kilo of a nitrocellulosic varnish and omitting to take into account that it contains only 20 per cent dry material.

When the finished prices per m² are compared the situation is completely changed. Because of the better wetting only half the quantity of acrylic/UV varnish is needed and the product lost by sanding is negligible. In that way the price difference is eliminated, but in addition, curing the acrylic/UV needs only 1/3 of the electric power necessary for the curing of polyester/UV varnishes, and daily cleaning with acrylic/UV is no longer required; this represents a substantial saving in

time and furthermore there is no wastage of products. The simultaneous varnishing of both sides can be done only with the acrylic/UV.

Market acceptance of the acrylic/UV varnishes

The advantages for a furniture manufacturer in using the acrylic/UV varnishes have been demonstrated. It is surprising that they are not used in the European countries other than France (note that in the U.S.A. these varnishes are widely used).

There are several reasons for this, for instance:

Formulators who have made no effort to develop acrylic/UV systems are against this new technology and this is quite understandable.

The large manufacturers of polyesters in styrene defend their own market and are not willing to replace their products by new ones at lower tonnages.

Some users are rather against the acrylic/UV because its use means a decrease in volume; even the French formulators complained about the decrease during one of their Federation meetings.

UV oven manufacturers prefer to install three times more lamps to cure the polyester/UV varnishes.

Each of these adversaries of the acrylic/UV will mention only the price per kilo and minimise the other advantages.

The acrylic/UV varnishes have only two years industrial experience. The furniture manufacturers, outside France, learn only the price per kilo and negative aspects about the acrylic/UV varnishes. Therefore, it is not surprising that there are difficulties to be overcome before this system is accepted.

Conclusion

The price per kilo of acrylic/UV varnishes is high, but their advantages easily compensate for this drawback, namely: the low quantity required per m², good coating quality, freedom from pollution and substantial reduction in power consumption, a reduction in working area required and a low investment for high production rates.

These varnishes will not take the whole market, but the author is convinced that their advantages are becoming increasingly evident to end users. Evidence for this has appeared in France this year and for several years in the U.S.A., where their utilisation is a known success.

[Received 31 October 1978]

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Corrosion tests for organic coatings—A review of their usefulness and limitations*

By W. Funke

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Summary

Various exposure tests and methods for classifying the performance of protective organic coatings are reviewed. It is proposed to use permeability to water and oxygen, together with the adhesion on exposure to high humidity, as primary criteria for evaluating the

corrosion protection and to explain differences between coatings subjected to conventional corrosion tests and during outdoor exposure. Finally, some special and some still unsolved problems are considered.

Keywords

Types and classes of structures or surfaces to be coated
steel

Processes and methods primarily associated with analysis, measurement or testing

corrosion testing
accelerated corrosion testing
immersion testing
salt spray testing
absorption

Properties, characteristics and conditions primarily associated with dried or cured films

humidity resistance
permeability
adhesion

Les essais de corrosion pour revêtements organiques—Un examen de leur utilité et de leurs limitations

Résumé

On passe en revue de divers essais de résistance aux intempéries et également de diverses méthodes pour classer le rendement de revêtements protecteurs organiques. On propose d'utiliser la perméabilité à l'eau et à l'oxygène, ainsi que l'adhérence après l'exposition à l'humidité élevée, en tant que critères primaires pour

évaluer la protection anti corrosion et aussi pour expliquer les différences mises en évidence par les revêtements subis d'un part aux essais de corrosion conventionnels, et d'autre part aux essais de résistance aux intempéries. Enfin on considère certains problèmes exceptionnels et aussi d'autres qui restent encore non résolus.

Korrosionsprüfungen organischer Beschichtungsmittel-Zweckmässigkeit und Begrenzung

Zusammenfassung

Es werden verschiedene Bewitterungsprüfungen und -Methoden zur Klassifizierung der Schutzwirkung organischer Beschichtungsmittel betrachtet. Als wesentlichste Kriterien zur Bewertung des Korrosionsschutzes und zur Erklärung der Unterschiede zwischen Beschichtungsmitteln dienen die gebräuchlichen

Korrosionsprüfungen und denen die Aussenbewitterungsprüfungen unterworfen worden waren, wird die Verwendung von Prüfungen auf Wasser- und Sauerstoffdurchlässigkeit, sowie Haftung unter Bedingungen hoher Feuchtigkeit vorgeschlagen. Schliesslich werden einige spezielle und einige noch ungelöste Probleme betrachtet.

Introduction

As organic coatings are usually applied for decorative and protective purposes, quality requirements are predominantly concentrated on gloss and colour retention during corrosion tests. In the past two decades, testing methods to classify coatings according to these optical properties have been brought to a remarkably high accuracy and reliability, in contrast to classification of their protective quality. Despite manifold efforts to evaluate corrosion protection quantitatively by electrical and electrochemical measurements or to correlate it with properties involved in the barrier function of paint films, the final decision on the application of protective coatings is still based on the classical corrosion tests and results of outdoor exposure. These corrosion tests are essentially the only ones which have been standardised in many industrial countries.

Exposure tests and classification of corrosion protection by coatings

Refs. 1, 2

Amongst all the possible exposure tests for organic coatings (Table 1), the salt spray test probably is the most common for testing corrosion resistance of coatings. After various times of exposure to salt spray at a moderately elevated temperature, coating samples may be classified qualitatively by visual inspection or semiquantitatively by measuring the width of undercutting started from a scratch deliberately applied before exposure.

There is little doubt that the testing conditions used in salt spray tests accord well with practical exposure of painted steel, as regards salt water on the roads during the winter, and

*Shortened version of lectures presented at the AGM of the London Section on 16 February 1978 and at the Corrosion Conference at Lehigh University, Bethlehem, USA on 13-16 November 1978.

Table 1

Conventional corrosion tests and classification for the protective quality of coatings

Exposure test	Classification
Salt spray test	Qualitative—by visual inspection of underfilm corrosion and blistering.
Humidity cabinet	
Condensation test	
Outdoor exposure	
Sulfur dioxide	Semiquantitative—scratch test (width of blistering).
Immersion tests (salt water, seawater, deionised water)	Quantitative—electrical measurements: resistance, capacitance, polarisation curves, potential.

also with a good approximation to sea water exposure. However, it is common practice to consider the salt spray test as a method to evaluate generally the ability of a coating system to resist corrosion. The salt used, as well as the elevated temperature, are used only to accelerate corrosion and undercutting. As salt spray tests commonly are carried out at 35 or 40° C, it is questionable whether the results obtained are also representative of exposure temperatures around the freezing point. Many paint films have the glass transition just within this temperature range, and it is well known that permeability to water and gases change significantly at the glass transition of the film.

Moreover, some doubts exist as to whether the salt spray test is still adequate when exposure to rain or condensed water is considered. It is well known that for osmotic reasons, water uptake of coatings is significantly higher in pure, deionised water than in sea water or salt water.

When comparing the conditions of the humidity cabinet and condensation tests, the same reasoning regarding the glass transition temperature applies as in the salt spray test.

Exposure to humid air containing SO₂ has long been controversial and the argument about it still has not been settled. The permeation rate of SO₂ through paint films may be easily determined by titration of the water leaving the film at the downstream part of a permeation cell. It is observed that the pH-value remains constant until SO₂ has passed the membrane and enters the water, which is indicated by a rapid drop in the pH (Fig. 1). The time of pH-change as well

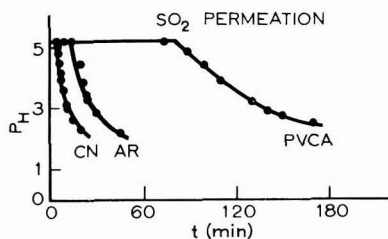


Fig. 1. Drop in pH value due to SO₂ permeation, Temp. 23°C

as the slope of the decreasing pH are related to the SO₂-permeability of the film. When pure SO₂ at atmospheric pressure is present in the upstream part of the permeation cell, rather high rates are observed (Table 2). It may be supposed, therefore, that sulfate ions may easily be formed at the coating/metal interface and stimulate corrosion without any permeation of sulfate anions being necessary. However, some

Table 2

Rate of permeation of SO₂ through paint films, Temp. 23°C

Rate of permeation	
SO ₂ (g.cm ⁻² .d ⁻¹)	
EC No. 6	1.01 · 10 ⁻² (36μm)
CN	4.05 · 10 ⁻² (100μm)
AR	2.0 · 10 ⁻² (88μm)
PVCA	1.1 · 10 ⁻³ (77μm)
Rate of permeation*	
SO ₂ (g.cm ⁻² .d ⁻¹)	5.10 ⁻² – 0.3 · 10 ⁻⁶

*Reference: Polymer Handbook, 2nd Edition

evidence exists that a too high concentration of SO₂ not only accelerates corrosion, but in some cases may also destroy the binder chemically. Therefore, data are needed with reasonably lower upstream concentrations of SO₂. Originally SO₂ exposure has been considered to be typical for an industrial atmosphere, but with the great increase of SO₂ emission from oil burners for heating purposes, relatively high concentration of SO₂, at least locally, may also be met in urban or even rural areas. Similar arguments are also pertinent when considering immersion tests.

As well as the qualitative classification based on visual inspection, semiquantitative means of evaluating corrosion protective properties of coatings, such as the scratch test, are very common. When a scratch is applied to the test samples before exposure, information is required on how easily a film is undercut and detached by corrosion, which starts from the exposed steel at the scratch. There is considerable agreement amongst paint technologists that corrosion resulting from mechanical paint defects is by far more important than any other types of corrosion encountered in organic coating systems. On the other hand, despite standardisation, the scratch test is very liable to experimental errors, e.g. due to different pressures and velocity of scratching the coated panels, abrasion of the scratching tool, lifting the coating far beyond the area of the scratch, which again depends on viscoelastic properties and thickness of the coating¹. To conclude the discussion of the scratch test combined with exposure to some corrosive medium, it may be stated that this method is useful for roughly classifying coating systems differing considerably in their corrosion protection, but it usually fails to discriminate smaller differences with sufficient reliability.

For quantitative classification, electrical and electrochemical methods are often reported. Much literature exists on the measurement of resistance, capacitance, polarisation and potential to evaluate the corrosion protective property of organic coatings. An excellent survey by H. Leidheiser critically describes the present state of these methods². Despite manifold efforts in this field of corrosion testing, none of these methods has found unequivocal approval, in spite of having been standardised to some extent.

Whatever may be said about the conventional and newer methods for classifying the corrosion protective quality of coatings, with these tests coatings can only be compared. All further conclusions and explanations of the differences found are arguments by analogy or, bluntly expressed, rather more than less speculative. The optical appearance of a coating sample after exposure to corrosive environments is always a complex result of the influence and action of a number of primary film properties, which will be discussed below.

Measurement and significance of primary properties involved in the protective function of organic coatings

Refs. 3, 4

The most important requirement for corrosion protection by organic coatings is adhesion to the metallic substrate. (Table 3)

Table 3

Primary properties of coatings involved in corrosion protection by coatings

Primary properties involved in corrosion protection	Action	Measuring methods
Adhesion on exposure to water	prerequisite for protection	Comparative absorption, mechanical adhesion measurement, sound absorption
Water permeability	Directly involved in the cathodic reaction and solvent for electrolyte	Volumetric, gravimetric, capacitance
Oxygen permeability	Directly involved in the cathodic reaction: $H_2O + \frac{1}{2}O_2 \rightarrow 2OH^-$	Volumetric, barometric, oxygen electrode
Ion permeability	Stimulating agent and electrolyte for local corrosion element	Radioactive tracing, conductivity, ion sensitive electrodes (Cl ⁻)
SO ₂ permeability	Stimulating agent and electrolyte for local corrosion cells	Titration, pH measurements

Normally, adhesion is roughly classified by the cross-cut test or measured quantitatively by the vertical tear-off method. However, both methods have drawbacks, especially if coating samples are to be measured when exposed to water or at high humidity. As the presence of water is critical for maintaining adhesion on exposure, some other method of determining the loss of adhesion on exposure to high humidity has been investigated by measuring the difference between water absorption of free and supported films³. Loss of adhesion on exposure to high humidity is indicated by a crossing of the water absorption curve for the supported film over that of the corresponding free film (Fig. 2). The "cross-over" time thus indicates the time after which the loss of adhesion becomes significant by the accumulation of water in the coating/substrate interface. As this method requires some skill, there is a need to simplify it or to find other methods for

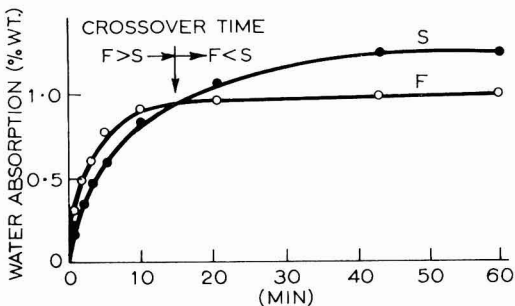


Fig. 2a. Water absorption/time relationship of free (F) and supported (S) electrodeposited films at $p/p_0 = 0.9$ at 23°C (Paint sample 4)

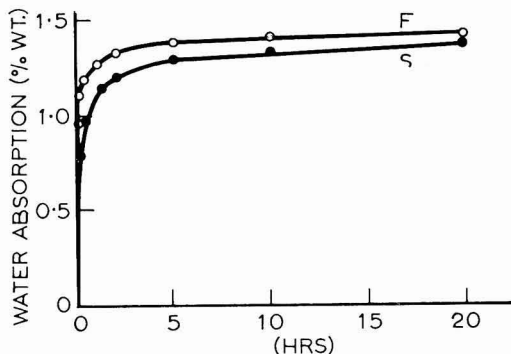


Fig. 2b. Water absorption/time relationship of free (F) and supported (S) electrodeposited films at $p/p_0 = 0.9$ at 23°C (Paint sample 1)

measuring adhesion of coatings on exposure to high humidity or water.

As both water and oxygen are required for the anodic reaction in the corrosion of steel, the permeabilities of these agents directly relate to the barrier properties of coatings in suppressing the corrosion. Moreover, water serves as solvent for the electrolytes needed in the local corrosion cells. A series of methods are available for measuring both water and oxygen permeabilities of organic coatings (Table 3). It is now generally agreed, that usually the permeability of coatings for water is relatively high and sufficient to provide an adequate supply for the corrosion reaction⁴. On the other hand, oxygen permeability of organic coatings may be in about the same range or even below that needed for the corrosion reaction to proceed with normal rate.

Electrolytes, especially chloride and sulfate ions, which are already present at the coating/metal interface or enter this area by diffusion, are also important as stimulating agents of the corrosion of steel (Fig. 3). It is, therefore, important to

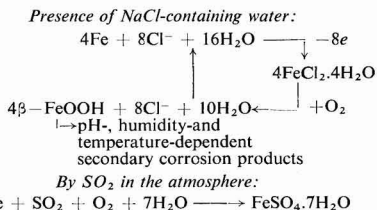


Fig. 3. Mechanism of corrosion stimulation by chloride and sulfate anions

know the permeability of coatings for these ions. Methods to measure ion permeability of free films are indicated in Table 3. The more reliable data published in literature, however, show that protective coatings used in practical thickness have extremely low anion permeabilities if no external electrical voltage, as in cathodic protection, is applied (Table 4). It may therefore be assumed that stimulation of the corrosion on exposure to salt solutions takes place mainly at damaged or imperfect parts or spots of the film and that the stimulation below a perfect film which completely covers the substrate with a reasonable thickness, must be due to impurities, possibly of the same kind, but already present on the metal surface before the coating was applied.

Table 4

Chloride ion permeability calculated according to data of Glass and Smith⁹ and Svoboda⁸

Binder	Permeation rate (mg.cm ⁻² .d ⁻¹).10 ⁻³	Concentration gradient (NaCl-n)	Film thickness (μm)	Reference
Cellulose nitrate/alkyd resin	0.35	0.053	50	⁹
Neoprene	0.85	0.053	50	
Epoxy resin	0.71	0.053	50	
Cellulose acetate	22.0	0.053	50	
Pentaerythritol alkyd resin modified with linseed oil	0.13 to 0.16	0.53	75	⁸

That normal perfect coatings are very slightly permeable to ions is also emphasised by the osmotic origin of blistering on exposure of coatings to high humidity or liquid water. For this mechanism to operate, soluble material such as chlorides or sulfates must be present at the metal surface, which is usually the case, and the coating film must be impermeable or very slightly permeable to these impurities.

Finally, it should be considered that sulfate ions may be formed in situ after permeation of SO₂ through the film to the metal substrate. According to the author's results, SO₂ permeability is very high if coatings are exposed to the pure gas at atmospheric pressure. However, it cannot be ruled out that some chemical reaction with the binder takes place under these conditions.

Primary film properties and attempted classification

Refs. 5, 6

It has frequently been attempted in the past to correlate water permeability data with the practical corrosion protective efficiency of organic coatings without being able to offer unequivocal and convincing statements. It was an improvement to include in these consideration the permeability to oxygen⁵, which formerly, due to lack of data, was almost neglected in discussions about corrosion protection by coatings. However, on comparing permeabilities with the protective behaviour of coatings both in corrosion tests and in practical performance, it soon became apparent that adhesion of a paint film when exposed to high humidity plays a decisive role in the evaluation of corrosion protection by the primary film properties involved. It is well known, that the adhesion of many paint films decreases significantly and is even lost on prolonged exposure to high humidity or liquid water⁶. As long as adhesion persists, there is no possibility of corrosion. If water not only enters the coating but also displaces the film from its substrate, how rapidly corrosion proceeds depends on the rate of oxygen diffusing to the interface (Fig. 4).

Therefore, the rate determining step for the loss of adhesion will be related to water permeabilities, provided that water can disturb the film/substrate interaction. Once adhesion is lost the rate of corrosion should depend on the oxygen permeability. If corrosion stimulators are present in the interface,

the need for oxygen supply increases and oxygen permeability even more significantly governs the rate of underfilm corrosion, whilst the supply of water is still sufficient.

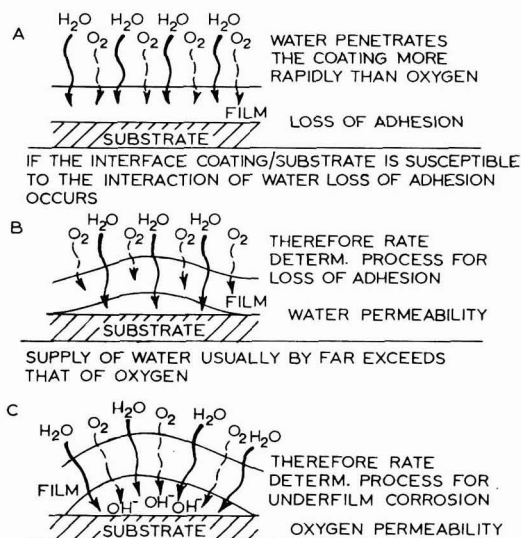


Fig. 4. Consecutive steps in underfilm corrosion

If this approach to the problem of evaluating the practical protective performance of organic coatings is correct, it should be possible to explain differing corrosion protection of various coating systems by the primary parameters "wet" adhesion, oxygen and water permeability. Results of some first experiments with a series of electrodeposited coatings were encouraging.

As may be seen from Table 5, EC-systems No. 7 and 3 have lowest values for water and oxygen permeability but are rated as only medium for adhesion under influence of high humidity (*Cross-over time*). Because of the low permeability for water it takes a relatively long time for these systems before adhesion is reduced. Then corrosion may occur, but only slowly, due to the low oxygen permeability.

Table 5

Classification of electrocoating systems according to water and oxygen permeabilities and cross-over time compared with the classification according the salt spray test

Method	EC-system number
Water permeation rate	7 < 3 < 4 < 5 < 6 < 1 < 2
Oxygen permeation rate	3 < 7 < 6 < 5 < 4 < 1 < 2
Cross-over time	6 ≈ 1 > 2 ≈ 7 > 3 > 4 ≈ 5
Salt spray test (DIN ₅₃₁₆₇)	3 ≈ 6 ≈ 7 > 1 > 4 > 2 ≈ 5

On the other hand, in the EC-system No. 6 it is obvious that the adhesion strongly resists the attack of water. Therefore, despite of the relatively poor rating of its water permeability and its moderate oxygen permeability, the good protective properties of this system are not impaired, which is also confirmed by its rating in the salt spray test. In this connection, it should be remembered that according to the permeability equation $P = D \cdot S$, a high water uptake may,

at least partly, be compensated by a low diffusion coefficient because both coefficients do not always correspond to each other (Fig. 5).

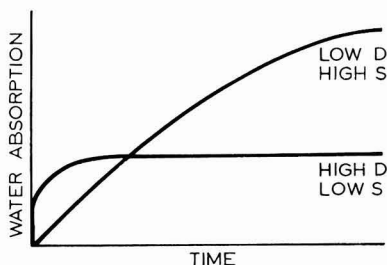


Fig. 5. Water absorption rates of coatings depending on diffusion coefficient (D) and solubility coefficient (S)

Besides improving the experimental technique of measuring the primary properties involved in the protective mechanism, these results have to be confirmed by more extended studies with other coating systems. Nevertheless, the big advantage of this approach is that it can explain why a coating protects well or poorly, whereas conventional testing methods at best only tell how to classify coatings according to their corrosion protective quality.

Special and unsolved problems

Refs. 2, 7

Considering the three-parameter approach to estimate the corrosion protection of coatings, it should be mentioned that in the case of coatings systems containing anticorrosive pigments, water and oxygen permeability lose much of their relevance, but adhesion on exposure to high humidity still remains important. For anticorrosive pigments to act, a certain amount of water is required and the vehicle should be able to absorb some water. On the other hand, by their oxidative character most of the anticorrosive pigments probably dominate the effect of molecular oxygen in inhibiting, as well as in consecutive reactions of the corrosion process.

Some doubt still exists as to whether permeability data obtained with free films are also representative for supported ones, especially when film formation and drying depends on the access of oxygen and the release of residual solvent from lower regions is retarded. Properties such as the permeability of supported films may differ significantly from those of free ones.

Attention should also be paid to the temperature dependence of permeabilities, which is often quite significant. If, as in common practice, permeabilities are measured at room temperature, the use of these values to explain corrosion protective performance of coatings in the salt spray test at

35–40°C or in practical performance in winter time at temperatures little above the freezing point may be unjustified and misleading the more so as the glass transition temperature of the coating frequently lies within the range of practical performance.

As oxygen permeability is important only when the coating is exposed to high humidity, it also has to be asked how it is influenced by the water uptake of the coating. Some data now available⁷ indicate that in practical coating systems oxygen permeability is not much influenced by the degree of absorbed water². Another point to which attention should be paid, is the change of film composition on exposure to liquid water or even to water vapour. The leaching of soluble coating components and residual solvents may result in considerable changes of permeabilities.

Despite much interesting work on the ion exchange properties, electrical charge and the influence of electrical resistance of coatings on their protective behaviour, e.g. by Mayne and his co-workers⁷, these relationships have still received only little attention in the practical world of protective coatings. It is expected that further research in this field may help to clarify some still unsolved questions concerning the affect of electrical charges on the protective action of paint films.

Finally, it must be stressed that all experiments and methods used in testing the corrosion protective quality of coatings are greatly dependent on the perfection of the coating. The problem of obtaining or preparing free as well as supported films without defects, especially in the range of lower film thickness is always difficult. Results reported without adequate information on the number of parallel runs or, better, on the reliability of the tests, based on a statistical treatment, should be always considered with reservation.

A far as the three-parameter approach for evaluating the corrosion resistance of coatings is concerned, it certainly may be expected that it will provide a more sound and scientific basis for this very old testing problem. However, it seems realistic to say that it will never be possible to eliminate practical tests for a quick assessment of the corrosion protective quality of coatings. Being able to tell why they differ, means some progress even when using these conventional testing methods.

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Resource problems in the downstream chemicals Industry*

By D. S. Davies and I. J. Lawrenson

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Introduction

I am well aware that everyone in the oil and colour chemicals businesses faces greater problems than ever; slowly growing markets, intense international competition, inflation, high taxation, complex industrial relations problems, and high costs for the innovation that traditionally underlies competitiveness. And I also know that governments, in trying to help, often seem to hinder. I have spent most of my life working in your industry or relative ones, and greatly enjoy discussion of the whole range of your technological problems and opportunities. So I am delighted and honoured to be here.

When I began working in the industry, just after the war, one could be confident that raw materials shortages would be solved by the postwar reconstruction of the coal tar chemicals businesses that supplied anthracene, naphthalene, and phenols; only the visionaries saw the petrochemical future. Markets were hungry. Competition would intensify, but the way ahead was simple: do ingenious chemistry, and fit it to customer needs. The new or expanded plants would be tidier and cleaner than the old, but no one really took engineering very seriously. The products were applied by skilled men with brushes, sprayguns, and dyebaths.

A lecture under this title, by the conventions of that time, but concerning our present problems, would be expected to cover the merits of the naphthaquinone/butadiene or benzoyl/benzoic routes to anthraquinone, chlorbenzene or cumene routes to phenol, isomer ratio problems, and perhaps give some sagacious observations based on the hallowed views of Robinson and Ingold. Fairly obviously, I am not going to follow this line, but going to talk as a self-styled economist and engineer, and will endeavour to be faithful to the chemical tradition and not betray or forget it. The resource problems in question are those of materials, cash, people and skills. They all interact and, therefore, there is a fifth problem of awareness and breadth of view. We cannot elect to take a narrow, specialised view, because our US, European, and Japanese competitors do not do so, and again and again it has been shown that obstacles are best dealt with by beginning with a broad view that discloses a way round rather than through problems.

Materials

Although materials pose the most obvious problem, and it is a worrying one, it is possible to be confident about longer term solutions. The variety of chemical options is now immense, and if, tomorrow, a law were passed banning the use of naphthalene, anthracene, or phenols in five years' time, there would be no disaster. Everything—resins, colours, auxiliaries—could be made on a BTX or aliphatic base, and oil crises, although also worrying, would create no long-term problems because the production volumes are relatively so small and the added value so large: stockpiling would be feasible. We use our present base chemicals largely because, at one time, they were unwanted by-products, there for the asking and the extraction. We stick to them because the

market is accustomed to the products made from them and, like ourselves, it is conservative. The process of changing to new, but technically acceptable products is one requiring time, effort, and persuasion—and, therefore, cash and skill. Both of these are scarce.

Even if one turns to the more direct solutions of finding acceptable means of supplying all the present intermediates, it is still only cash and skill that matter. Either, we have to find new strategies for linking our production with those of other industries so as to get volume needed to pay for new plants and technologies or, we have to find means of building small plants cheaply. We can see, in retrospect, that the anthracene problem was totally predictable from the inevitable reaction of a mature steel industry to much dearer coke, which itself resulted from the abandonment of gas making by low temperature coal carbonisation. So we must not get caught that way again. There may be a very good medium term option for sharing big anthraquinone plants with the pulp and paper industry, who may want the product to improve bleaching efficiency. But if newspapers are replaced by electronic methods, such as Viewdata (and rising energy prices will encourage this) what then? Might it not be prudent to make sure that we can afford to make all our intermediates ourselves, on the appropriate scale and at an acceptable cost, from a wide range of starting materials of common utility?

Cash

Throughout the industry large injections of cash will be needed to reduce costs (associated with improvement of the market share), for the introduction of new products, for the safeguarding of materials supply or for improvement of the technology of the various processes. Present day costs for the introduction of new products are immense: it is reckoned that the cost for the introduction of a major new polymer could be \$10⁹. For new processes, the amount is smaller but still sizeable. So we have to be selective and must be very careful where we put our money: we must have a really good strategy for our cash policy. Such selectivity—perhaps laying a lot of emphasis on design, quality control, and process improvement—offers plenty of scope for the energy and enthusiasm without which industry cannot function. There is also the chicken-and-egg situation here. Costs and cash are linked, so as to lead to upward or downward spirals: lower costs lead to higher profits, which in turn mean more cash available for investment in techniques and equipment, and so on.

People

Your industry, like all others, will be greatly affected by the moves towards increased automation, resulting largely from the ready availability of cheap microelectronic devices. There will be less need for human intervention in the more unpleasant, dangerous operations, and hopefully efficiency will improve and the invested capital will be utilised more effectively. People will have to be more highly-trained than hitherto, and have a wider range of skills. For too long technologists

*Lecture presented by Dr D. S. Davies, Chief Scientist and Engineer of the Department of Industry prior to the Association AGM on 21 June 1978

have sheltered behind the barriers of specialisation. These are beneficial when new skills are burgeoning, because they do help everyone to press ahead quickly and independently. But as an industry, like yours, matures, it becomes more important to have rationalisation and unification. Chemistry alone is insufficient without the other skills needed to deal with contemporary problems: the skills of toxicology, of micro-electronics, of mechanical and other engineering, or computer systems.

The overall task

The overall task of managing materials, cash and people must be an integral one, and should probably be international. We

are far too dependent on the actions of our international competitors to be able to adopt a "little England" stance. The high costs and the magnitude of the problems mean that perhaps only the large international firms can cope alone with some of the major developments. Others may need help. Government can give attention to the availability of cash and manpower, by assistance with subventions of money to get things going, or by training when new skills are needed. For example, the Department of Industry is at present mounting courses at all levels to help industry make the best use of micro-processors and has its Requirements Boards and Process and Product Development Scheme for other purposes. We must ensure that relations between the private and public sectors are good: together we can move towards a really good strategy, which is crucial if we are to progress.

Next month's issue

The Honorary Editor has accepted the following papers for publication, and they are expected to appear in the March issue of the *Journal*:

Quantitative estimation of aldehydic acids in lac resin and its fractions by *S. C. Sengupta, S. C. Agarwal and N. Prasad*

Polarisation resistance—Its meaning when applied to a coated substrate by *J. D. Scantlebury and K. N. Ho*

Electrochemical testing of the protective power of zinc rich paints by *R. Fernandez Prini and S. Kapusta*

Regulatory legislation—Effect on preservative choice by *A. J. Hinton*

Electrical resistance of electrodeposited rubber per unit coulomb

Sir—I refer to the details of the data analysis shown in Tables 2 and 3 of my paper published in *JOCCA*, 1978, 61, 427. Errors of a minor nature crept into the numerical calculations, mainly on account of negative values of $(x_n - x_0)$. Since my publication (Ref. 6 of the paper), I have further developed the techniques of numerical analysis by restricting the analysis to cases where $x_n > x_0 > 0$, so that $(x_n - x_0)$ will always be a positive quantity. Further, in order to compare results that cover different ranges of x values, two values of d corresponding to x_0 and $(x_n - x_0)$ are evaluated, and a parameter D calculated which is the geometric mean of the two d values, and is more useful for comparative purposes. Full details of this improved technique are awaiting publication¹.

$$D \text{ is defined as } = \frac{\Sigma A - A_0}{\sqrt{2x_0(x_n - x_0)}} \text{ where } A = \frac{1}{2} [(x_n - x_{n-1})(y_n + y_{n-1})]$$

and $A_0 = \frac{1}{2} [(x_n)^2 - (x_0)^2]$ where $(x_0, y_0), (x_1, y_1) \dots (x_n, y_n)$ are the individual data points, under conditions $x_n > x_0 > 0$.

In Table A the calculations are shown according to the earlier procedure (d values) and the improved procedure (D values) for the comparative study of $p.60$ and $p.180$ data of the paper. The two values agree since the range of x is the same in the two cases. Nevertheless, the improved procedure is helpful, in this case, to eliminate possible errors in the routine handling of negative values of $(x_n - x_{n-1})$ and $(x_n - x_0)$ in numerical evaluation work.

The relative D values for R_{60} and R_{180} data calculated by the improved procedure is 1.50 instead of the erroneous value of 1.06 as estimated earlier. The details of this calculation are shown in Table B.

The relative values of D for the charge of rubber latex particles is calculated to be the same as found earlier in Table 3 of the paper.

From the relative values of D for data on concentration vs p and the concentration vs R , it is concluded that $p.180$ values are 7 per cent more than $p.60$ (Table A) and that R_{180} values are 50 per cent more than R_{60} (Table B). Using the above information, the p and R values re-estimated from the entire set of results are found to be 237 and 7.7. On the basis of unit electrode area (cm^2), the new figures give resistance per coulomb as 25.3 and 698 ohms/gm. Using these new figures, the charge on the individual particle of latex is estimated to 2.28×10^{-13} coulombs.

The following conclusions are drawn from the investigations:

- (1) One coulomb yields a deposit of electrical resistance 25.3 Ω .
- (2) One gram of electrodeposited rubber has a resistance of 698 Ω .
- (3) The individual rubber latex particle carries a charge of 2.73×10^{-13} coulombs (average of 2.28 and 3.17).

Yours faithfully,
S. GURUSWAMY

Central Electrochemical Research Institute,
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28 November 1978

- (1) Guruswamy, S., Comparative study of numerical data, *awaiting publication*.
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Table A

Comparison of d and D values for x - y plot of the data. (Data source: Table 1, P_{60} & P_{180} values—ref 2)

when x is arranged in numerically decreasing order								Ref (n)	when x is arranged in numerically increasing order							
% con- centration of latex (x)	$(x_n - x_{n-1})$	y values correspond to p values of table 1, ref 2							% con- centration of latex (x)	y values correspond to p values of table 1, ref 2						
		60 sec- onds	180 sec- onds	$(y_n + y_{n-1})$		A				60 sec.	180 sec.	$(y_n + y_{n-1})$		A		
		60 sec. sec.	180 sec. sec.	60 sec.	180 sec.	60 sec.	180 sec.			60 sec.	180 sec.	60 sec.	180 sec.	60 sec.	180 sec.	
20	-8	198	112	472	372	-1888	-1488	0	1.5	1.5	17	18	305	687	229	515
12	-6	274	260	554	512	-1662	-1536	1	3	3	288	669	568	921	852	1382
6	-3	280	252	568	921	-852	-1382	2	6	6	280	252	554	512	1662	1536
3	-1.5	288	669	305	687	-229	-515	3	12	8	274	260	472	372	1888	1488
1.5	—	17	18	—	—	—	—	4	20	—	198	112	—	—	—	—
ΣA -4631 -4921								ΣA 4631 4921								
$\frac{1}{2} [(1.5)^2 - (20)^2]$ -199								A_0 199								
$d = \left[\frac{\Sigma A - A_0}{\sqrt{2(x_n - x_0)}} \right]$								$D = \left\{ \frac{\Sigma A - A_0}{\sqrt{2(x_0)(x_n - x_0)}} \right\}$								
Relative value of d								Relative value of D								
1.00 1.07								1.00 1.07								

Table B
Evaluation of R_{60} and R_{180} data (Table 1—reference 2)

% Con- cen- (x)	$(x_n - x_{n-1})$	y corresponds to R values (taken from table 1—reference 2)						Ref (n)	% Con- cen- (x)	$(x_n - x_{n-1})$	y corresponds to R values (taken from table 1—reference 2)							
		60 sec.		180 sec.		$(y_n + y_{n-1})$					A		60 sec.		180 sec.		A	
		60 sec.	180 sec.	60 sec.	180 sec.	60 sec.	180 sec.				60 sec.	180 sec.	60 sec.	180 sec.	60 sec.	180 sec.	60 sec.	180 sec.
20	-8	13.0	11.7	21.4	20.2	-85.6	-80.8	0	1.5	1.5	0.51	0.54	7.3	16.3	5.5	12.2		
12	-6	8.4	8.5	14.3	14.3	-42.9	-42.9	1	3	3	6.8	15.8	12.7	21.6	19.1	32.4		
6	-3	5.9	5.8	12.7	21.6	-19.1	-32.4	2	6	6	5.9	5.8	14.3	14.3	42.9	42.9		
3	-1.5	6.8	15.8	7.3	16.3	-5.5	-12.2	3	12	8	8.4	8.5	21.4	20.2	85.6	80.8		
1.5	—	0.51	0.54	—	—	—	—	4	20	—	13.0	11.7	—	—	—	—		
ΣA -153.1 -168.3								ΣA 153.1 168.3										
$A_o = \frac{1}{2} [(1.5)^2 - (20)^2]$								$A_o = \frac{1}{2} \{(20)^2 - (1.5)^2\}$										
$d = \left\{ \frac{\Sigma A - A_o}{\sqrt{2(x_n - x_o)}} \right\}$								$D = \left\{ \frac{\Sigma A - A_o}{\sqrt{2x_o(x_n - x_o)}} \right\}$										
Relative value of d								Relative value of D										
1.00 1.50								1.00 1.50										

Section Proceedings

Bristol

The first two meetings of the Section under the Chairmanship of Mrs Harper were better attended after the circulation of a memorandum to members requesting Section support at the Meetings.

The development of horizontal milling

Mr Kerr of Glen Creston Machinery Ltd, spoke to the Section on 29 September on the development of horizontal milling with particular reference to the Dyno Mill and gave references to several papers written on the subject. He outlined the history of dispersion in the paint industry and the development of modern means of rapid dispersion by the Dyno Mill.

Initially this mill had been used in the pharmaceutical industry to break down the cell walls of algae to obtain protein. Research work had given a 3 to 10 fold improvement in efficiency. The advantages of the horizontal form of the mill were described. The various sizes of the mill now available was discussed including 0.3 and 1.4 litre sizes.

The lecture was well received and many questions on the performance of the mills from the audience, which included members from the paint and printing ink industries, demonstrated the interest in the subject.

The discussion was opened by Mr L. J. Brooke and the vote of thanks was proposed by Mrs B. Cryer.

The refinishing of motor vehicles

The second lecture of the session was presented by Mr Sellen of Berger Paints on 27 October on the subject of the refinishing of motor cars. Mr Sellen introduced his subject by the use of a training film demonstrating the pitfalls of using incorrect procedures when applying paint to motor vehicles.

The speaker outlined the changes which had occurred in the type of paints used since the first world war. He emphasised that modern refinishes gave excellent performance, in particular the two-pack isocyanate cured enamels based on hydroxylated acrylic resins. These enamels, cured at room temperature or by very low temperature bake, gave a performance very similar to the original finish applied by the motor manufacturer especially for metallic finishes. The use of computers was needed to keep colour control of the 8000 colours often necessary to be matched, as often there were 450 new colours introduced in a year. This close colour control of the tinters and bases allowed for accurate matching of the customer's car by the refinisher.

The methods of ensuring the safety of the operatives in garages who were using the newer products was discussed and the need for good housekeeping and efficient air extraction was stressed.

At question time the audience showed their interest in the subject, since all were car owners and in many cases had had to call on the services of the refinisher after damage to their cars.

J.R.T.

Irish

Dispersion techniques

A Meeting was held at the Clarence Hotel, Dublin on Friday 8 December 1978. Mr R. Ward of Torrance and Sons gave a lecture on "Dispersion techniques".

Mr Ward dealt with two types of dispersing equipment, the well established high speed cavitation disperser and the new horizontal dispersing mill.

Dealing with the high speed disperser. Mr Ward re-emphasised the operating parameters, such as, the ratio of impeller

diameter to tank size, depth of mill base, etc. He then went on to discuss the geometry of impellers, together with peripheral speeds, and finally in this section of the lecture, he described the ideal mill base for optimum milling conditions, pointing out that weak dilatancy is most beneficial for machines of this type.

Mr Ward then continued with an illustrated description of a horizontal bead mill. He explained the mechanical workings in great detail, with particular attention to the sealing arrangements and the separation of the grinding media. The properties of various grinding media were described before passing on to the premix techniques, where Mr Ward recommended a high speed mixer premix as being the most suitable for this type of machine. Finally, the properties of the ideal mill base were discussed in detail and examples of expected throughput given.

The lecture produced a lively discussion, particularly concerning the horizontal bead mill and several salient points were raised, which Mr Ward dealt with most competently.

The Meeting closed with a vote of thanks by Mr D. Pountain.

D.P.

London

Visit to the Metropolitan Police Forensic Science Laboratory

On Tuesday 17 October, twenty London Section members had a very successful tour of the Forensic Science Laboratories in Lambeth Road.

The group was first welcomed by Dr Berrett who explained the role of the forensic scientist within the Metropolitan Police organisation. The group was then split in half for visits to both the general chemistry and biology laboratories.

In the chemistry section an interesting talk was given on how paint and glass fragments could be used as court evidence with particular reference to burglary cases. Paint fragments could be usefully characterised by their cross-sectional layer structure and glass fragments by their refractive index.

During the tour of the biology laboratory, a talk on the evidential value of blood and fibres was given. It was demonstrated how the distribution pattern of blood stains on clothing could be of use, and also the importance of blood grouping. Fibres were first identified by their type, i.e. whether natural or synthetic and then in the cases where dye could be extracted, this was also analysed.

During the visit members were able to appreciate this well designed laboratory complex, which houses some two hundred and eighty staff and a vast wealth of analytical equipment. It is hoped that a second visit may be arranged in the near future for those members who were unable to attend this visit due to the imposed restriction on numbers.

D.T.K.

Finishes and materials for window frames

The second evening meeting of the 1978-79 session was held on Wednesday 18 October 1978 at the Rubens Hotel, SW1 when Mr P. Whiteley of the Building Research Establishment presented a lecture on "Finishes and materials for window frames" to 30 members and guests.

In his lecture Mr Whiteley discussed and illustrated some of the results of an extensive and ongoing project at the BRE comparing construction materials and finishes for window frames. The project was set up as a result of the extensive failures and general dissatisfaction with painted softwood frames in the 1950-60's. The factors affecting exterior performance were complex, but included poor design of joints and frames, poor quality of paint and even the increase in moisture content within some types of houses.

The conventional paint system of primer, undercoat and topcoat used on wooden windows had been examined by BRE. All three affected the overall durability. A high proportion of failures resulted from the use of quick drying brittle primers. The poor performance of brittle primers was still manifest even when overcoated with durable undercoats and topcoats. The primers themselves should have at least six months exterior durability to cover the installation period prior to painting with finishing coats. Lead based primers have been considered the most durable, but were unacceptable for health and safety reasons and often for high cost. In BRE's evaluation, some equally good non-lead primers were found. Reference was made to the two British Standards for solvent borne and water borne primers, BS 3538 and BS 5082 respectively, which used different test panels, thus making comparisons difficult.

The durability of undercoats and topcoats was not always acceptable. Undercoats were usually too hard and topcoats frequently general purpose types which did not have maximum durability. Mr Whiteley felt there was a market for an exterior durable, decorative system, possibly a semi-gloss paint, eliminating the need for a separate undercoat.

The paint film tended to keep water in the timber, either water already in the wood prior to painting, or water entering through the film, open joints or cracked putty. Scandinavian and American work had shown that, for good exterior durability, permeability of the film was required. BRE/PRA studies had indicated that little blistering occurred in British winter conditions; the failures usually being substrate adhesion loss and cracking. Bottom rail failure occurred rapidly with site-applied commercially-available paint systems. Two different factory applied finishes were very much better, exhibiting good durability after 6 years.

The effect of moisture content on paint film durability was shown to be at least as important as sunlight, as similar results were obtained on both north and south-facing windows.

Mr Whiteley went on to discuss the performance of exterior stains (also known as penetrating or water repellent stains) which had good vapour permeability and an aesthetic appeal, particularly to architects. A development of the original Madison preservative, the closer they became to paint formulations, the better their performance. Whilst the darker colour stains resulted in better UV light resistance, the increased wood temperatures could lead to a greater tendency to timber cracking. The life of these stains was less than that of paints, needing recoating every 2-3 years. Maintenance costs should be lower as existing coats could be simply overcoated without the need to strip back to bare timber as with failed paint.

A deficiency of stains was their inability to protect face putty and glazing beads had to be used for this purpose.

Mr Whiteley then discussed alternative construction materials to softwood timber which were used or available for window frame construction, and listed the advantages and disadvantages of the material, the coatings used on it and discussed the capital and maintenance costs, softwood being about the lowest in overall cost in spite of the apparently high maintenance costs.

Hardwood windows were cost competitive with aluminium windows; they were rarely painted, but often stained to maintain a natural colour, and this lessened dirt pick-up and bleaching.

Galvanised steel was widely used and produced lowest overall costs, but unless the zinc was clean and properly primed with recommended primers, adhesion failure of topcoats resulted.

Aluminium window frames were available unpainted for mild environments, anodised (with a 15 year life) or painted in factory conditions with acrylics, silicone polyesters, polyvinylidene fluoride coatings or polyester powders. The choice depended on initial costs versus durability, with maintenance costs very low in the early years.

Unplasticised PVC was widely used in Germany for window frame construction, but because they were of heavy section, petroleum feedstock price rises had put them out of contention in the UK. They exhibited good durability but could show dirt pick-up.

In closing his lecture, Mr Whiteley showed how, in selecting the most economical combination of construction material and finish for a durable window frame, it was necessary to predict the durability and maintenance requirements in order to forecast the net present value of maintenance. Nevertheless, for many windows the capital cost was still the overriding factor. What was certain was that many different types of frames and coatings would continue to be used for a number of years into the future.

After an extensive question time, a vote of thanks was proposed by Mr R. Faulkner.

A.J.N.

Manchester

Quality assurance and batch liquid products with particular reference to paint

The Woodcourt Hotel, Sale, was the venue on Monday 6 November 1978 for the above lecture presented by Mr D. J. Murray of Crown Decorative Products Ltd, speaking to an audience of 60 members and visitors. Mr Murray defined various aspects of Quality Assurance as follows:

Quality

The totality of features and characteristics of a product that bear on its ability to satisfy a given need.

Quality control

The "machinery" in operation throughout an organisation to implement quality assurance.

Quality assurance

The design, construction, monitoring and continual adaptation of the quality control "machinery". Thus ensuring

that the required level of quality is, and will continue to be, achieved at an economic level.

Resulting from the above precise definitions, horology was encountered in the shape of the Crown Paints Quality Clock 1975 and quality determinants based on it.

Plant design, training for managers and manuals all related to Quality Assurance were fully discussed, the final words being reserved for the subject of independent audit systems. A full discussion period was concluded by a vote of thanks proposed by Mr R. Stott which was enthusiastically received.

Additives improve emulsion paints

Fifty members and visitors were present at the Manchester Literary and Philosophical Society on Wednesday 15 November 1978 at 4.30 p.m. to hear Mr J. Clarke of Allied Colloids Ltd present his lecture to a student meeting.

The sudden death of the Chairman, Tony McWilliam, on 13 November, was acknowledged by a period of silent tribute in the presence of the acting Chairman, Mr A. C. Jolly.

John Clarke commenced his lecture by describing the main prerequisites of a good emulsion paint formulation. They were: good flow, levelling, long term stability, washability, scrub resistance, sheen/gloss, etc. The different types of water soluble polymers used were described, and the influence of their individual molecular weights noted.

The subjects of pigment dispersion, thickening/rheology control were fully discussed.

The lecturer concluded by emphasising that his paper had dealt with alkali soluble and alkali activated thickening agents only.

Following a question period, Mr G. T. Flood proposed a vote of thanks.

F.B.W.

Scottish

Eastern Branch

Reactive hydrocarbon resins

A lecture was presented on Wednesday 22 November at the Murrayfield Hotel by Dr Alberto Malatesta of Essochem Europe Inc., on reactive hydrocarbon resins, principally the 8000 series.

Escorez 8000 reactive hydrocarbon resins which have been sold on the world market since the early 1970's have a number of physical and chemical properties which make them especially useful as a raw material for specific end uses. Moreover, their price stability in relation to natural products gives advantages in production cost, planning and forecasting to the users.

The Escorez 8000 series of resins are sold as two grades, 8190 and 8100, which differ essentially in their softening points, and are a chemically complex mixture of cyclopentadiene polymers. The absence of a definite melting point, characteristic of cyclopentadiene Diels-Alder oligomers, indicates a loss of regularity at the molecular level. This can be rationalised by the existence of a concurring vinyl polymerisation introducing such an irregularity.

The evidence of a wide molecular weight spread, characteristic of Escorez 8000 resins, can be gathered from molecular weight distribution work using gel permeation chromatography. Such distribution imparts the physical properties peculiar to these reactive resins.

The chemical reactivity of Escorez 8000 resins is essentially derived from its highly olefinic character. Cyclopentene and bicycloheptene double bond concentrations are readily determined by NMR spectroscopy. With the traditional chemical methods to determine the unsaturation level, the total olefinic content may also be found.

Rotogravure ink resins based on Escorez 8000 are produced using the unsaturation described. The addition of maleic anhydride followed by reaction with preformed, protected resols gives a phenolic modified acid resin capable of being finalised into an ink resin with polyfunctional alcohols.

Other products based on Escorez 8000 are being developed. They will find application in the following fields: off-set ink resins, paints, emulsifiers and rubber chemicals.

A vote of thanks to Dr Malatesta was proposed for his excellent lecture to which the company indicated their appreciation in the usual manner.

Carton printing

A lecture was presented on 4 December at the Murrayfield Hotel by Mr D. Lawson of William Thynes on the scientific aspects of carton printing.

This lecture covered newer applications of cartons such as "bake-in-the-pack". This consists of a cake mix in a printed carton where water is added and the mixture baked in the carton at oven temperatures of 230°, developing a board temperature of 160°; it is certainly "food" for thought for board and ink requirements.

Product coding was the next topic covered, enabling supermarkets using a computer to identify and record prices at the checkout. The code on the packet consists of lines of varying thickness and spacing which is recorded using a laser scanner.

On the subject of lasers, William Thynes had developed a laser cutter for the making of cutting and creasing formes where, after cutting, the rules are then inserted, which is a considerable saving in time over the old method of jig-sawing the formes.

This was a very enjoyable lecture with a lively discussion following.

A vote of thanks was given by G. H. Hutchinson at the conclusion of this meeting.

T.M.

West Riding

The testing of hazardous chemicals with particular reference to the requirements of the Health & Safety at Work Act

A meeting of the West Riding Section was held on Tuesday 7 November 1978, at the Mansion Hotel, Leeds. On this occasion the talk was presented by Mr D. H. Pullinger of the Hazelton Laboratories Europe Ltd.

Mr Pullinger outlined the salient features of existing or proposed legislation in the UK or EEC. He discussed the guidelines for the selection of chemicals for testing under the Health and Safety at Work Act. They apply to new substances made or imported and products containing new substances if production exceeds 1 tonne per annum. It is anticipated that about 200-300 test articles per annum will arise in consequence.

The information required relating to these articles includes a number of physical properties such as melting point, boiling point, vapour pressure, solubility in water, partition coefficients, physical form, respirable fraction, bulk density, and hazardous thermal decomposition products.

Where appropriate, data on toxicity may be required, such as Oral LD₅₀, Dermal LD₅₀, LC₅₀ and where appropriate, skin irritation, eye irritation, sub-acute toxicity and mutagenicity.

An outline of the biological testing methods was presented and the difficulty of precisely interpreting the results mentioned. Other possible requirements and some more general issues were also touched upon.

The Chairman, Mr M. J. Cochrane, proposed a vote of thanks.

The pencil story

A meeting of the West Riding Section was held on Tuesday 5 December at the Mansion Hotel, Leeds. Mr D. W. Tee of the Cumberland Pencil Co Ltd presented the talk on this occasion.

He began by describing the historical background which is unique to this country. Graphite is a pure form of carbon of which there are many deposits throughout the world. About 1500 deposits of graphite were found in Borrowdale in the Lake District. These deposits were unique in that the graphite had been formed under immense pressure and some heat which resulted in its particular marking characteristics, and its physical form.

Shepherds found it useful for marking sheep but when its value was realised the mines were taken over by the Government. The graphite was transported from Keswick to London by armed stagecoach and, in the reign of Elizabeth I, its chief use was as a mould for the manufacture of cannonballs. The graphite was highly valued and was in great demand from other European countries since no other source existed.

The first pencils ever made were produced in Keswick and a cottage industry rapidly developed, since Cumberland graphite is the only graphite which could be used in its natural state, owing to its unique volcanic origin.

In 1795 Conté, a Frenchman, discovered that amorphous graphite could be mixed with clay and fired in a furnace to give a substitute for Borrowdale material. This principle is still used in manufacture to produce pencils in varying hardness. The mining of Cumberland graphite finally ceased in the late 19th century.

Mr Tee then showed a film which demonstrated the pencil manufacturing process. The graphite and clay are mixed in a ball mill with water, filtered and a cake produced which is compressed. The solid is extruded into strips and dried. In the case of "lead" pencils they are then cut into

lengths and fired at 1000°C for 8 hours. The lead is then impregnated with stearin to enable it to write.

The wood used is incense cedar which is imported from America. It is cut into slats and grooved to take nine of the graphite strips. When the graphite strips have been bonded into the groove, another slat is bonded to the top giving a board with nine graphite strips encased in it. This "sandwich" is then divided and shaped into separate pencils and between 4 and 14 coats of nitrocellulose lacquer are applied to give a perfect finish.

The different hardness of pencils is dependent upon the

ratio of clay to graphite. Every company has its own grades of pencils and attempts to define a BS grade have proved unattainable.

Coloured pencils use organic binders and account for about 50 per cent of the market. The market for pencils has remained stable and Mr Tee suggested that alternatives, such as ball pens and felt pens, have taken up the market growth.

A vote of thanks for a most interesting lecture was proposed by Mr David Maltman.

R.A.C.C.

Information Received

New company formed

A new company called Pollution Solutions Ltd has recently been formed to advise and implement schemes which overcome pollution hazards resulting from general industrial slurries. The services offered include design and installation of comprehensive systems often incorporating underground and above ground storage tanks, mixing and aeration equipment, primary and secondary settlement vessels as well as the construction of lagoons for holding treated liquids prior to safe disposal.

Bayer acquisition

Bayer UK Ltd and Uniroyal Ltd have announced the transfer of Uniroyal's Bromsgrove latex plant to Bayer UK Ltd. The agreement gives Bayer its first major rubber plant in the UK.

New products

Wet film thickness gauge

Paul N. Gardner Co. of Florida have available the new Gardco wet film thickness gauge with a range of 1 to 80 mil and 25 to 2032 microns.



The new wet film thickness gauge from Paul N. Gardner Co.

New pigment

BASF have introduced a transparent iron oxide pigment named Sicotrans Red 2520. The special feature of this new pigment is that it combines good dispersibility with high transparency, and is particularly suitable for metallic automotive finishes.

New emulsifiers

A range of new and polymeric emulsifiers has been developed by ICI to solve the more difficult and specialised problems of emulsions used in industries such as speciality oils, paper and printing. They

are suitable for a wide range of two-phase systems and provide good emulsion stability, high efficiency, good oil solubility.

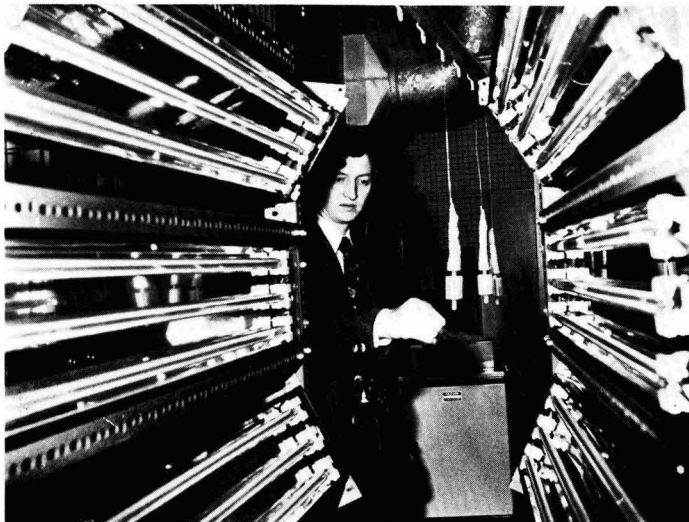
Infrared powder curing system

A dramatic reduction in the time taken to stove powder coatings is claimed for the new Wallace Knight electrical medium wave infrared curing system. According to initial tests, medium wave infrared electric heating reduces stoving time when compared with either short- or long-wave electric heating by as much as 40 per cent, and offers significant savings in terms of stoving time and oven lengths.

Data Station, which is a compact desk top computer which can be directly connected to most of the company's high performance infrared instruments to provide routine use of computer aided infrared spectroscopy.

Laser particle counter

Gelman Hawksley Ltd has introduced the Model 226 Laser Illuminated Aerosol Particle Counter and Sizing System which has been designed to function as a 16 channel high concentration/high sensitivity counting system.



The Wallace Knight electrical medium wave infrared heating elements in a stoving oven

New plastisol coating

Plastic Coating Systems Ltd has available a new PVC plastisol especially developed for application to plating jigs for the plate industry. The new coating, called Vylastic EP80 pvc, is tough, resilient and available in a wide range of colours.

Infrared spectrophotometry computer

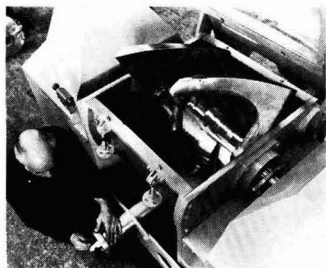
Perkin-Elmer Ltd have claimed a major advance in infrared spectrophotometry with the introduction of their Infrared

Safety valve for pumps

A new compact control valve to safeguard air-powered pumps has been introduced by Steetly Industrial Distribution Ltd, called the Steetly Pump-Protecta Valve. The control valve can be used with any air-driven pump, mounted between the pump and its air supply, and is designed to sense when a pump is cavitating or cycling at an excessive rate. It then shuts off the air supply to prevent unnecessary damage to the pump and premature mechanical failure.

Bottom discharge mixers

Winkworth Machinery Ltd has recently launched a new range of chemical, food and process mixers named Pacemix which are claimed to virtually eliminate the problem of discharge traditionally associated with mixing stiff substances. There are six basic models in the range which covers capacities from 20 litres to 700 litres and all are suitable for mixing substances such as viscous pastes, hot melt adhesives etc. The efficient mixing action is generated by two contra-rotating blades in a steel cylindrical pan which revolve at slightly different speeds.



The bottom discharge mixer from Winkworth Machinery

New in-can preservative

Sterling Industrial has introduced a new broad spectrum biocide which is free from phenol and contains no heavy metals. The new product is known as Parmetol DF12 and is designed as an in-can and film preservative for use with water based paints and similar types of products. It is effective against aerobic and anaerobic bacteria, yeasts and moulds.

New spray gun

Kremlin Spray Painting Equipment Ltd has introduced the new model M5 spray gun to its range of conventional air spray

guns. The new model gives a high quality finish with a fineness of spray equal to that of the M18 at the top of the range but with a lower output. It is especially recommended for car body refinishing, light industry etc.

Courses conferences, etc.**Measuring colour**

Toxide International Ltd has republished its booklet "Measuring Colour" which was first published in 1970 covering the whole range of colour measuring and colour measuring instruments. The new edition incorporates the recent activities of the CIE in its search for a universal chromaticity system.

Paint industry survey

Key Note Publications Ltd has recently published a business survey of the British paint and varnish industry. It includes a concise overview of the industry's structure, market background, recent developments and prospects.

Polymerisable half esters

R. H. Chandler Ltd has published a book entitled "The polymerisable half esters: Their polymers and applications" by Dr H. Warson which comprehensively covers this interesting group of compounds. Sections are devoted to the preparation of half esters, their physical properties, their polymerisation and copolymerisation, both aqueous and non-aqueous.

Organic coatings conference

The State University of New York will be holding its fifth international conference in Organic Coatings Technology in Athens, Greece from 16-20 July 1979. The conference is designed for chemists or other professionals who want to understand the principles involved in the science and

technology of organic coatings, their manufacture, applications to surfaces and properties.

NMR spectrometer data sheet

A data sheet illustrating and describing the new Model R-600 Fourier Transform Nuclear Magnetic Resonance Spectrometer is now available from Perkin-Elmer Ltd. Specifications and instrument features of the model R-600 are included.

Year Book

The 1979 edition of the Polymers Paint & Colour Year Book is now available containing an up-to-date guide to suppliers of raw materials, plant and equipment used in the paint and allied industries.

Steel corrosion symposium

A symposium concerned with the protection of structural steelwork against corrosion and the new Code of Practice BS 5493, 1977 is to be held at the Derby Lonsdale College of Higher Education on Tuesday, 10 April 1979 under the title "BS 5493, 1977: An appraisal".

Pollution equipment catalogue

Techmation Ltd have available a 16-page catalogue describing the range of pollution monitoring instrumentation available through them.

Hand care

Industry's best deal for your hands is a new leaflet which has been produced by Sterling Industrial, a leading manufacturer of hand care products including barrier creams, skin reconditioners, hand cleansers etc.

British Standard

The British Standards Institution now has available the new BS 4325 Parts 1, 2, 3 and 5, 1978: Methods for analysis of oilseed residues.

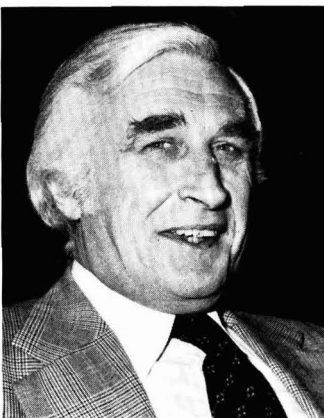
Notes and News**London Section****Ladies' Night**

A complete change of venue marked the London Section's 1978 Ladies' Night. For the first time it was held outside the centre of London at the Selsdon Park Hotel, Sunterstead, Surrey, on Friday 27 October 1978.

The occasion was a sell-out three weeks before the event with 210 members and guests attending. The principal guest was Miss Sally Gaetsky, who for many years has been closely associated with the surface coatings and ink industries through Corneliuss Chemicals Ltd. In her speech Miss Gaetsky brought the elements of femininity, technology, OCCA and surface coatings together in her own inimitable style.

Mr D. Bayliss, Chairman of London Section, proposed the toast to the Ladies and guests.

Present as top table guests were the Director and Secretary, Mr R. H. Hamblin,



Mr P. J. Whitaker

and the Chairmen of Thames Valley, Manchester and West Riding Sections, Mr G. Hill, Mr A. McWilliam and Mr M. Cochrane respectively, with their wives.

After an excellent four course meal, dancing continued until 1 am. A most successful and enjoyable evening was had by all present and this change of venue is likely to continue in future years.

A.J.N.

News of Members

Mr C. D. Smith, an ordinary Member and former Chairman of the Scottish Section, has retired from his position as Managing Director of Henderson, Hogg & Co. Ltd after 50 years with the Company.

Mr P. J. Whitaker, an Ordinary Member attached to the Ontario Section, has been appointed Head of the Plastics and Additives Division of Ciba-Geigy in Canada. Mr Whitaker was formally Head of Marketing for Pigments worldwide, based in Switzerland.

**New fourth
edition now
available**



The Introduction to Paint Technology, of which 18,000 copies have already been sold, forms an excellent introduction to the whole field of surface coatings and related technologies. The fourth edition contains the important addition of a glossary of the terms used in the book together with explanations of their derivations, as well as the completely revised and updated text.

Price £5.00 (Registered Students of the Association £2.50) **Prepayment only.**

OIL AND COLOUR CHEMISTS' ASSOCIATION
Priory House, 957 Harrow Rd., Wembley HA0 2SF

Paint Technology Manuals Works Practice

This publication, which is of great use both to the practical man within the industry and the student entering the industry, is concerned with the practical aspects of making paints. As very little has been published on this subject, a fairly broad coverage is attempted including factory layout and organisation, paint and media manufacturing processes, legal aspects and safety precautions.

Price: £3.00

UV2

The eleven papers in this volume, bound in limp covers, are based on the lectures presented at the second symposium of the Newcastle Section with the title 'Ultraviolet polymerisation and the Surface Coatings Industry' held in September 1977, and cover new work in this expanding field.

Price: £7.50

Special offer

Ultraviolet Polymerisation and the Surface Coatings Industry

The two volumes of the papers presented at the Newcastle Section Symposia on this subject held in 1975 and 1977 are offered at a special price of £10.00 for both volumes purchased together.

Normal price: *Ultraviolet polymerisation (1975)* £5.00; *Ultraviolet polymerisation 2 (1977)* £7.50.

UV2

UV2

The eleven papers in this volume were originally published in the *Journal* earlier in 1978. They are based on lectures given at the Second International Symposium of the Newcastle Section of the Association held at Durham University on 14 and 15 September 1977 with the theme "Ultraviolet polymerisation and the surface coatings industry". Titles and authors are listed below:

Exciplex interactions in photoinitiation of polymerisation by fluorenone amine systems by *A. Ledwith, J. A. Bosley and M. D. Purbrick*

Recent developments in photoinitiators by *G. Berner, R. Kirchmayr and G. Rist*

Present status of ultraviolet curable coatings technology in the United States by *J. Pelgrims*

The design and construction of ultraviolet lamp systems for the curing of coatings and inks by *R. E. Knight*

New developments in ultraviolet curable coatings technology by *C. B. Rybny and J. A. Vona*

Cure behaviour of photopolymer coatings by *R. Holman and H. Rubin*

Photoinitiator problems in clear coatings by *M. De Poortere, A. Ducarme, P. Dufour and Y. Merck*

The UV curing of acrylate materials with high intensity flash by *R. Phillips*

Parameters in UV curable materials which influence cure speed by *A. van Neerbos*

The use of differential scanning calorimetry in photocuring studies by *A. C. Evans, C. Armstrong and R. J. Tolman*

The UV curing behaviour of some photoinitiators and photoactivators by *M. J. Davis, J. Doherty, A. A. Godfrey, P. N. Green, J. R. A. Young and M. A. Parrish*

To obtain this book, complete the order form and send with the necessary remittance to the Association's offices. Price: £7.50 (US \$15) each.

[See order form on page viii]

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See page xix



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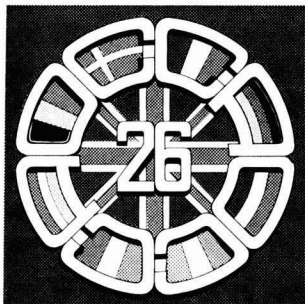
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"The OCCA"

The annual technical exhibition of the Oil and Colour Chemists' Association (known to many simply as "The OCCA") has become the world's most important event for all those connected with the paint, printing ink, polymer, adhesive, colour and allied manufacturing industries. The OCCA exhibition is held every year in London, England. The symbols for the 1974-79 exhibitions were specially designed by Robert Hamblin, Director and Secretary of the Association, to emphasise the very wide coverage which all the Association's activities attract:

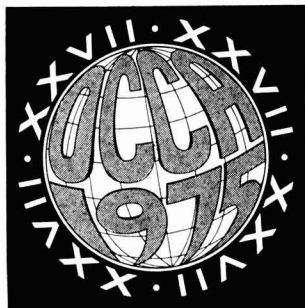


The motif for OCCA-26 used the flags of the enlarged EEC converging on the British flag to symbolise the welcome extended to visitors from overseas to the Exhibitions for more than 25 years. (1974)

The INTERNATIONAL Focal Point for the Surface Coatings Industries



The motif for OCCA-31 emphasises the unique aspect of the OCCA Exhibitions, which annually provide an international focal point for the surface coatings industries.



The 1974 theme continued at OCCA-27 by showing the world-wide interest aroused by the Association's annual Exhibitions in London which attract visitors from all parts of the globe.

The OCCA Exhibitions provide a unique annual focal point for the surface coatings industries, and bring together technical personnel to meet in an informal atmosphere allowing a free interchange of ideas and the rapid dissemination of knowledge of new products and new developments of existing products.

In recent years, visitors to the OCCA Exhibitions have regularly come from over fifty overseas countries and at the 1978 Exhibition, admissions by season ticket of over 10,000 were recorded at the turnstiles in the hall.



The motif for OCCA-30 used the symbol of a moving indicator on a calendar to emphasise the importance of the continuous dialogue year by year between suppliers and manufacturers.

The Exhibition provides an ideal opportunity for organisations to display and discuss their products and services to a wide spectrum of visitors from all over the world.

Organisations wishing to receive further details should contact the Director & Secretary, Mr R. H. Hamblin, Oil & Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF, England (Tel: 01-908 1086, Telex: 922670 OCCA G).



The motif for OCCA-28 emphasised that the target for 1976 was London where all the Exhibitions have been held, and continued the theme of its international aspect.



In 1977 the motif for OCCA-29 used inward pointing arrows to show the many places from which people came to the Exhibition, and these arrows formed outward pointing arrows to show the subsequent spreading of knowledge.



OCCA-31 Exhibition

Alexandra Palace, London, 3-6 April 1979

**Australia★Belgium★Denmark★Finland★France★
East Germany★West Germany★Holland★Hungary
★Italy★Poland★Singapore★Spain★Switzerland★
UK★USA**

The international focal point for the surface coatings industries

New Exhibitors

The Exhibition Committee is pleased to report a number of additions to the list of exhibitors published in the January issue of the *Journal* and these organisations are mentioned below.

Any company still wishing to apply for exhibition space should contact the Director & Secretary immediately, since there is only a limited amount of stand space available in the hall.

The OCCA Exhibition, which is known as the international focal point for technical and commercial display and discussion in the surface coatings industries, is the most important annual event of its kind in the industries, and it offers an unparalleled opportunity for personnel in the manufacturing industries to meet and discuss their requirements with their counterparts in the supplying industries.

Many young technologists and scientists who visited earlier Exhibitions have now risen to high positions within their organisations, and the advantage to exhibitors of keeping in constant contact with them needs hardly be stressed.

At present there will be participation by organisations in the following 16 countries:

Australia, Belgium, Denmark, Finland, France, East Germany, West Germany, Holland, Hungary, Italy, Poland, Singapore, Spain, Switzerland, UK and USA.

Theme of the Exhibition

The aim of the Exhibition is the presentation of technical and commercial information relating to advances in the surface coatings industries. The Committee stipulates that a technically trained person who has knowledge of the products displayed be available on the stand throughout the Exhibition.

Whilst the Committee naturally encourages the showing of new products, it does not stipulate that a new product has to be shown each year, since it fully appreciates that this is not possible. Accordingly, the Committee draws attention to the fact that new technical data on existing products is regarded as acceptable subject matter.

Dates and times

The thirty-first annual Exhibition organised by the Association, OCCA-31, will

be held at Alexandra Palace, London on the following dates:

Tuesday 3 April	..	09.30 to 17.30 hrs.
Wednesday 4 April	..	09.30 to 17.30 hrs.
Thursday 5 April	..	09.30 to 17.30 hrs.
Friday 6 April	..	09.30 to 16.00 hrs.

Since the first list of exhibitors was published in the January issue of the *Journal* the Association has been informed that the following companies' products will also be on display:

- Erichsen GmbH (*laboratory apparatus*)
- *Glychem International Ltd—Singapore (*chemical intermediates*)
- International Minerals & Chemicals Corp.—USA (*chemical intermediates*)
- Hilton-Davis—USA (*pigments*)
- Koehler, H. G., GmbH—Germany (*laboratory apparatus*)
- *Mastermix Engineering Co Ltd (*manufacturing equipment*)
- Rhoem GmbH—Germany (*resins*)
- *Torrance & Sons Ltd (*manufacturing equipment*)
- Vree, J. De—Belgium (*manufacturing equipment*)
- *Wardle, R. Jackson (*laboratory equipment*)
- *Main stand-holders

Facilities at Alexandra Palace

The Association has full use of the facilities at Alexandra Palace during the period of the Exhibition which include a restaurant, bar, a cafeteria and a private exhibitors' bar. Another facility which is of considerable benefit to those travelling to the Exhibition by car is the ample free car parking space within the Palace grounds.

For visitors travelling to the Exhibition on the underground system, the Association will once again be running a free bus shuttle service to and from the Exhibition, this year from Wood Green Station on the Piccadilly Line. The extension of the Piccadilly Underground Line to the Heathrow Central terminal was opened in late 1977, and this now provides a direct link for travellers arriving at the airport to both central London and to Wood Green Station and the bus shuttle service to the Exhibition.

Improvements at Alexandra Palace

In July 1978 work was started on a comprehensive refurbishment of the facilities at Alexandra Palace, and much of this has

now been completed. The floor of the Great Hall, in which the Exhibition is held, has been resurfaced and the walls and pillars have been redecorated. The West Corridor and the restaurants and bars have also been completely refurbished, and the work to the exterior of the building is scheduled to be completed by the time of the Exhibition next year. These improvements will add to the pleasantness of the venue, set in extensive parklands, and will provide an excellent setting for this international focal point for the surface coatings industries.

Information in foreign languages

As in previous years, the Association will be circulating information leaflets in six languages which will contain application forms for those wishing to purchase copies of the *Official Guide* and season admission tickets before the Exhibition. Interpreters will once again be in attendance at the Information Centre at the Exhibition to assist foreign exhibitors and visitors with their queries.

Official Guide

This unique publication contains descriptions of all companies and their exhibits at the Exhibition and is issued to each member of the Association at home and abroad as well as to all visitors to the Exhibition with their admission tickets. Copies are also sent to members of relevant trade associations, foreign embassies and all organisations exhibiting receive complimentary copies.

Members are asked to ensure that they bring their tickets, enclosed in their copies of the *Official Guide*, to the Exhibition since otherwise the charge for admission will be made and no refund will be applicable in these cases.

The *Official Guide* is published several weeks in advance of the dates of the Exhibition to allow visitors the maximum opportunity to plan the itinerary of their visits. In 1978, for the first time, the *Official Guide* contained a chart classifying the products on show into the various types, and it is intended to produce a similar chart for the *Official Guide* to OCCA-31. This chart is invaluable to visitors, especially those who have only a limited amount of time available, as it provides a quick, easy reference of all the companies present who are displaying the products in which they are interested.

News of Exhibitors

Stand 30

Baird & Tatlock (London) Ltd

The *Brookfield Multi Speed Rotational Viscometers* suitable for Newtonian and non-Newtonian materials in the range 1 to 64 000 000 centipoise will be shown, as well as the complete range of accessories make the *Brookfield* adaptable for virtually any viscosity measurement.

The new *Brookfield Digital Rheolog Recording Viscometer* is a comprehensive system providing a continuous record of viscosity as a function of time and/or temperature. The new *Rheolog* incorporates a digital display with a connection for input to a laboratory strip recorder.

The *Brookfield Helipath Stand* makes it easy to measure non-flowing materials regardless of degree of thixotropy.

Viscosel Model VTA 120 Process Viscometer can be used in any process where viscosity has to be maintained at a constant level by the controlled addition of solvents to compensate for evaporation and similar losses.

Brookfield Thermosel for viscosity determination at elevated temperatures.

Wells-Brookfield Micro Viscometer can be used in any field where small samples must be accurately measured.

Baird and Tatlock have been appointed the sole UK Supplier of *Colora* thermostatic and cryostatic baths and circulators. The complete range of instruments enables liquid temperatures to be maintained in the range minus 90°C to plus 300°C with an accuracy of $\pm 0.005^\circ\text{C}$.

The *Colora Series K Compact Thermostats* comprises of five basic types with different control possibilities, temperature ranges and pumping facilities. Temperature range is up to 150°C with a device for external cooling, down to -60°C maximum.

The *Colora Ultra Thermostat Series NB* is a reliable bath/circulator offering accurate temperature control to $\pm 0.01^\circ\text{C}$ in the range +20°C to +180°C. It is ideal for use with the *Brookfield Synchro-Lectric Viscometer* since a specially adapted stand is available for clamping the viscometer directly over the bath.

The stand will also include *Dow Corning Silicone* products available from *Hopkin and Williams* for: colour retention; coating; paint additives; plastics; powder treatment and many other applications.

Stand 36

Dow Chemical Co

*Dowicil** 75 in-can preservative for water-based systems like dispersion paints, ad-

*Trademark of the *Dow Chemical Company*

hesives, lattices and metal-working fluids will be displayed.

*Dowicil** 75 is:

- very active
- low in toxicity
- biodegradable
- highly soluble in water.

*Methocel** *Cellulose Ethers* will also be shown.

In the paint industry:

- gives paint a good body
- improves storage stability
- offers incorporation flexibility.

Stand 19

Alfred Karcher GmbH & Co

The Company's manufacturing programme includes:

Cleaning equipment for the paint and chemical industries.

Surface treatment (phosphating plants) for following painting, rubber or plastics coating processes.

Heat engineering (system generators and thermal oil plants) for process heating.

Cleaning plants for the interiors of tanker trucks.

A cleaning plant for cleaning the interiors of paint vessels, compact plant and phosphating plant, or iron or zinc, will also be displayed.

Stand 65

Tiszamenti Vegyimuvek, TMV

Tiszamenti Vegyimuvek, Szolnok, will present pigments for the production of paints and lacquers, including zinc chromate, chrome yellows and chromium oxide green.

Chromium oxide green is a pigment with excellent overall properties, especially light-fastness and weathering. It is an all purpose pigment and can even be used for polished metal surfaces.

Zinc chromate is a basic zinc potassium chromate for priming paints, and is also of value as a brilliant greenish yellow, either in self shades or in admixture with blue.

The lead chromate pigments are produced by *Tiszamenti Vegyimuvek*, Szolnok, under licence from *I.C.I.* The chrome yellows are available in primrose, lemon and middle shades.

Chrome Yellow pigments manufactured by *TMV* under licence from *ICI* are exported only to Comecon countries.

The full *TMV-ICI* range of lead chrome

pigments is as follows, products of similar shade being grouped together:-

- Primrose chrome D-6G
- Lemon chrome A-3G, B-3G, C-4G, D-4G
- Middle chrome B-HG, C-HG, D-HG

Stands 17 and 18

G. J. Erlich Ltd

In association with:

Molteni (UK) Ltd

The Company will exhibit some plant from their wide range of equipment for the paint, printing ink, chemical and allied industries, such as cosmetics, pharmaceuticals, adhesives, sealants and mastics.

From *Molteni* of Italy:

High speed mixer-dispersers TM series: Rotating vessels of up to 1,000 litres capacity and laboratory type. Also designed to work under vacuum.

Planetary mixers: Laboratory sizes up to 1,000 litres capacity. The models from 500 litres capacity upwards now have fully hydraulic drive starting from 0 at full torque. The oil tank and power pack are an integral part of the machine, avoiding trailing hydraulic pipes. These can be supplied to work under vacuum and with jacketed vessels.

Butterfly mixers: Type 'H' and 'HC' hydraulic drive, also with second shaft for high speed dispersion.

Hydraulic turbo-mixers: Through-floor models, two or three positions in various executions with capacities of up to 3,000 litres.

Horizontal microsfera: The *Horizontal microsfera* will be introduced. Type *MS 05*, *MS 020*, *MS 050*, of the most advanced design with change can system and very high outputs.

Microsfera grinder-dispersers: Incorporating a patented ultrasonic grinding unit of the latest design, considerably improving output.

Triple roll mills: From laboratory size up to the *S.100* with an automatic hydraulic adjustment of the rollers.

Vibrating screens

Hydraulic feed unit 'HV': For extracting viscous and pasty products from a cylindrical container.

Vessel cleaning appliance: The latest addition to the range. Cheap and simple pneumatically assisted and remotely controlled mechanical brush for cleaning vessels without manual effort.

From *Ge-Halin* of Germany:

Hydraulic presses: For heavy pastes, mastics, sealants, etc. to work in conjunction with *Planetary mixers* for dosing and filling cartridges, cans, tubes and pails. 'H' and 'S' types. Also fully automatic rotary *KVF-I* type.

Stand 56

Ciech—Import and Export of Chemicals Ltd

Ciech-Plastofarb and the *Union of Plastics and Paints Industry*, Mikolow will present:—

Raw materials and intermediate products for the production of paints and lacquers, zinc chromate, zinc tetra-oxochromate, chrome yellow, basic lead sulfate, ultramarine, phthalic resins.

A wide assortment of lacquering products for various purposes.

Marine paints for all parts of ships and also for special-vessels, e.g. for the transport of liquefied gas.

Especially recommended are:

Chlorinated rubber, anticondensation, fire-proof paint for wet rooms; Anti-fouling paints based on organic poisons/chlorinated rubber, and vinyl/epoxy solventless paint for potable water, edible oils and foodstuffs containers, as well as for fuel and ballast tanks.

Paints for building:

Polinit emulsion paints; acrylic wall-plaster compositions; *Acentil* acrylic emulsion paints, for asbestos-cement sheets.

Lacquering products for wood and furniture industries; quick drying type for fibreboard; chemical-hardening colourless types; chemo-hardening pigmented types; polyester spattle putty hardened with ultraviolet light.

A wide assortment of anticorrosive products for steel equipment and constructions.

Ciech welcomes visitors to its Stand, where representatives and a number of brochures will be available.

Stand 26

Microscal Ltd

Microscal continues to concentrate its efforts in the development of research and test equipment. Of particular interest are the surface and other properties of powders, the fading rates of dyes and colourants on a wide variety of substrates, and the particle size analysis and random sampling of powders and granular solids.

The *Flow Microcalorimeter* facilitates the understanding of many physical and chemical interactions especially those taking place between the surface of a powder and its environment.

The properties of surfaces may be evaluated in a new way by measuring the extent to which interactions with a given surface are reversible using a variety of different solutes, solvents, gases and vapours.

The *Spinning Riffler* is used increasingly as a routine prelude to the analysis of powders, and in product and process development, where experiments on a truly representative sample are essential or where the costs of unrepresentative sampling are high. Various models have recently been restyled and developed further to facilitate the handling of cohesive powders.

In particle size analysis, particularly in the sub-sieve range, the *Wide Angle Photo-sedimentometer* continues to give exceedingly reliable and economical service for virtually any material and suspending liquid. The *X-Ray Sedimentometer* covers a wide size range for a restricted selection of materials.

The *Light Fastness Testers* and their ever widening range of accessories are used in increasingly diverse fields. These now include, in addition to textiles, carpets, plastics, paper, leather, printed goods etc, specialised application such as testing anodised aluminium used as architectural materials and degradation studies of pharmaceuticals. Testing in the presence of chosen gaseous contaminants and the wet testing of materials are recent new applications.

Stand 1

Macbeth Division of Kollmorgen (UK) Ltd

There are over ten million perceptibly different colours.

Macbeth will demonstrate the ability to identify and classify colour with an unrivalled range of products ranging from physical standards to the most advanced colour measuring instruments.

Following the introduction at OCCA in 1977, the *MS 2000 Spectrophotometer* and *MC 1010 Colorimeter* have become established as leaders in the field of colour measurement and control. Recent models have changes to satisfy current customer needs.

Unlike all other instruments, which use serial or sequential scanning of wavelength, the pulsed/Xenon light source and advanced electronics allow simultaneous measurement at multiple wavelengths. Apart from advantages for both instrument and sample stability, this unique feature can be applied 'on-line' for the measurement of moving samples. On-line versions of both *Spectrophotometer* and *Colorimeter* are now available.

For critical visual colour assessment *Macbeth Spectralite* filtered daylight provides artificial daylight without the imperfections of fluorescent fittings. The *Exanolite* range of blended fluorescent incandescent daylight will be introduced at OCCA. Both ranges are available with various lamps for checking metamerism and fluorescence. Physical standards include the Munsell colour atlas, colour tolerance sets for production specification and the 100 hue colour vision tests.

Optical densitometers, for both on- and off-line applications, complete a range of products that take colour out of the realm of opinion into objective and scientific methods.

Stand 6

Synres (UK) Ltd

Synres (UK), being a part of one of the largest resin manufacturers in Europe, is pleased to be participating in OCCA 1979.

The theme for this exhibition will be the conservation of raw material and energy, in particular in relatively low temperature curing systems, without sacrificing quality. Products from the amino range, e.g. *Synresine ME 2172 B* and *A 465 XB*, in combination with low stoving alkyds (80°C), will be shown.

Water based resins

Pursuing the theme is the range of *Synresyl* water based products for flat-board finishes, coil coating and other applications.

Acrylic resins

A feature will be made of low viscosity acrylamide *Synedol 1064 XB*, as well as *Synedol 2263 XB* for use in basecoats for basecoat clear lacquer systems.

Printing ink resins

Three new types of modified phenolic resins for offset, flexography and gravure will be shown.

A comprehensive staff of technical personnel will be available on the stand during the entire exhibition.

Stand 69

Winter Oy

Winter Oy will show the new *Wintermix Special* manually operated tinting machine, which tints the paint directly through the lid of the can. The functioning of the machine is absolutely accurate since, due the new valve structure of the colourant, the canisters cannot leak. The filling of the canisters (capacity 2.5 litres) is extremely simple as the machine is equipped with screw-in filling funnels. The machine needs no electricity for mixing the colourants as the mixers in the canisters rotate automatically when turning the selection platform. As an additional device a counter can be fitted, which announces through audible and light signals when the required number of pumpings has been reached. This counter noticeably facilitates the operation of the machine and also eliminates the possibility of errors. Further, a microfilm reading device can be fitted to the machine.

Winter Oy will also introduce the new, fully automatic machine, which has a very highly developed microprocessor. It can, amongst other things, read the formulae on the microfiche with the help of a microfilm reading device. This means that the number of shades is unlimited, because about 2000 formulae can be stored on a microfiche. The formulae can be written out directly on the microfiche with the help of normal computer techniques. As the mechanical side works by air pressure, the colourants do not dry, because they are in a vacuum. The machine measures simultaneously all the colourants needed for a formulae. The mixing ability is from 0.3 litre to 30 litres.

Also on show will be one type of the *Karuselli-mixer*. The present range of *Karuselli-mixers* is capable of mixing cans from 0.25 litre to 30 litres. The *Karuselli-mixers* are well known for their speed and good quality all over Europe and the United States.

Both tinting machines will be demonstrated using the famous *Sintermix-colourant*, which is now the most popular colourant in Europe.

Stand 67

Porter Chadburn (Plastics) Ltd

Porter Chadburn will be exhibiting the many uses for the *Portaliner* system as well as a new shaped open topped liner to be used in standard sizes of mixing pans and 40 gallon drums. This saves cleaning time and loss of material.

The *Portatank Tank* has been recently modified to accommodate the demand of the paint, chemical and printing ink trades. The modification is in the door, which incorporates a special locking device, which locks the spout to the upstand in the door. This eliminates seepage and is a very useful modification; it is fitted to both static and transportable tanks. Existing tanks can be altered to take this modification.

The other aspects of the *Portatank* are well known as a method of storing and transporting liquids, tinters, etc., in sterile air free conditions. This saves product and reduces oxidation and skinning. The tank can be emptied by air top pressure between the tank and the lining, up to the safe working limit of the tank, 30 p.s.i.

This liner is now being used extensively in open topped metal and fibre drums and in cardboard pallet boxes. Using a *Portaliner*, drums can be upgraded and exploited to make great savings, such as return loads, no cleaning or re-lacquering, protection of product, reduction of the use of bactericides, reduction of wastage.

An open topped drum can be used instead of a tight head drum and un-lacquered drums instead of lacquered drums.

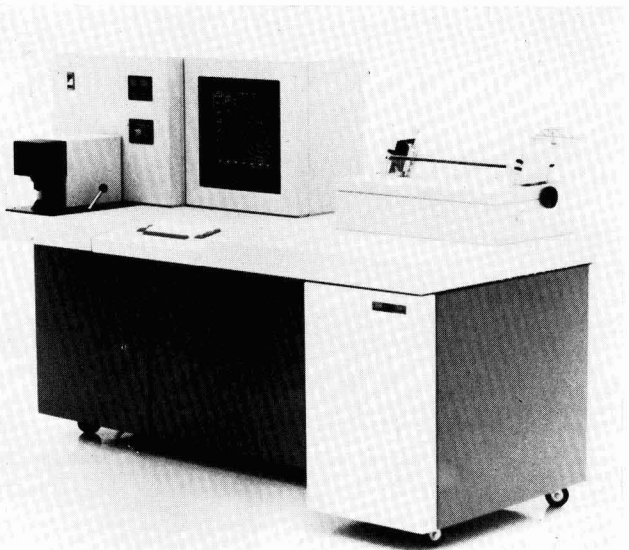
The drum filling head manufactured by *Porter Lancastrian Engineering* will also be exhibited.

Stand 20

IBM United Kingdom Ltd

Instrument Systems Group

The *Instrument System Group* of *IBM United Kingdom Ltd* will be exhibiting the *Model 7842 Colour Analyser*. This is an instrument that combines, in one integrated unit, advanced optical instrumentation and digital computing techniques. It is a powerful tool that dramatically adds to the human visual process in colour applications. The *7842* is designed for ease of use.



The Model 7842 Colour Analyser from IBM United Kingdom Ltd, which combines digital computing techniques with advanced optical instrumentation.

Step-by-step instructions appear on the display to prompt the user. A simple, typewriter-like keyboard allows the user to interact with the system. The built-in printer provides a permanent record of results obtained. Colour professionals therefore require minimum training. The *7842* has also been designed to be reliable. The spectrophotometer incorporates a dual light path, closed fibre-optics system with only one moving part. The self-levelling holder properly positions the sample. Each read cycle measure 150 data points (between 400 and 700 nanometres) 8 times and averages the results in 6 seconds. The large, easy-to-read display can then present numeric data or a graphic plot of 31 reflectance points. The *7842* uses a two-constant (K and S) colour algorithm to analyse opaque pigment applications in such industries as paints and coatings, ceramics, plastics, cosmetics, laminated paper, pigments.

The *IBM Model 7842 Colour Analyser* provides the following capabilities:

Operator-assisted colour match, automatic colour match, formula correction/batch addition, formulation, scale-up, colour analysis, cross-finish matching, pigment evaluation and opacity calculations.

Through the use of Basic (a well-known, easy-to-use programming language), information stored in the data files may be read and manipulated to produce reports in any format special to the user.

Other products in the *IBM Instrument Systems* range include the *Model 7841 Textile Colour Analyser* and the *Model 7840 Film Thickness Analyser* (both based on the same spectrophotometer as the *Model 7842* described above) and the *Model 7406 Device Coupler*, a flexible, easy-to-use interface between research and development equipment and computers or terminals.

Stand 68

Westlairs Ltd

Westlairs will present the *Uvcon (UVI)* which is the latest device manufactured by *Atlas Electric Devices Company* of Chicago, U.S.A., for exposing materials to alternate cycles of fluorescent ultraviolet light and condensation. A smaller, bench top model (*UV2*) designed primarily for customers with limited or intermittent test programmes will also be shown.

Of interest to visitors concerned with the dry/cure of coatings will be the new *Hi-Density Infra Red* dry cure system manufactured by *Research Incorporated* of Minneapolis. Also on display will be the new *Research* microprocessor based programmer *Model 73211* and various other modules from the *Research Microsystems Division*.

A selection of physical test instruments manufactured by *Gardner Laboratory Incorporated* of Bethesda, Maryland, will be shown and also the latest *Kesternich SO₂ Test Cabinet*, adapted for use also as a salt spray cabinet, manufactured by *H. G. Koehler KG* of Lippstadt, Germany.

Stand 42

Millroom Accessories & Chemicals Ltd

For over 25 years *Millroom Accessories & Chemicals Ltd* have manufactured high speed dispersers and mixers.

The *Rotamix*, which is the single headed disperser, and the *Biotomix*, the twin shafted

machine, have gained increasing popularity over the years. The *Rotamix* is produced in a standard range of five models from a small laboratory machine through to a heavy duty disperser.

Both the *Rotamix* and *Biotomix* can be supplied in mild or stainless steel and with a flameproof drive if required. A pump version is also available for two of the models, which permits the emptying of vessels without the use of an additional pump.

The popularity in recent years of the laboratory disperser—*The Whirl*—has been quite remarkable.

The manufacture of dispersers and stirrers leads naturally to the production of mixing and storage tanks. *Millroom Accessories & Chemicals Ltd* produce a wide range from simple change pans to sophisticated blending and dispersing tanks of large capacity using various means to disperse, or to keep difficult materials in suspension.

Expert staff will be available to discuss specific requirements and to offer a complete design and manufacturing service.

Millroom Accessories & Chemicals Ltd will also show their wide range of grinding media, ball mill linings and accessories as well as a new powder blender.

Stand 71

Mastermix Engineering Co. Ltd

Mastermix In-line system

Mastermix Engineering Co. Ltd announce this new concept for the production of high quality high viscosity air free pigment dispersions such as printing inks and colour concentrates.

Whilst it has been possible for some time to produce high quality dispersions of this type on continuous mills, the finished product contains finely divided air, which can normally only be removed by passing over three roll mills, therefore negating most of the advantages gained.

In the *Mastermix "In-line system"*, a *Mastermix Dispenser*, a *Mastermill* and de-aerator are directly coupled together so that raw materials loaded onto the *Mastermix Dispenser* appear as fully finished products at the outlet of the de-aerator after a completely "in-line" process. Cleaning is achieved by re-circulation of cleaning materials through the entire system. Operation requires minimal labour and can be made completely automatic.

Mastermix De-aerator

Another recent development intended originally for processing of PVC1 pastes is expected to find wide application in printing ink manufacture. Other projected uses are as part of a self-cleaning continuous solvent recovery system. Technical staff will be available to discuss these new developments as well as the well known range of *Mastermix* machines.

Mastermix Mastermill

The *Mastermix Mastermill* body structure has been redesigned to give a very much enhanced appearance to this very popular machine.

Mastermix Autoraise

In its latest form, the *Mastermix Autoraise* which, when fitted to a *Mastermix PMD*, controls the position of the high speed blade in the vessel, is becoming increasingly popular. The *Autoraise* is specified for nearly all new *PMD* machines and a neat self contained unit is available for fitting to existing machines. The *Autoraise* continuously monitors the position of the high speed blade during loading and dispersion, so that the machine is working at optimum performance all the time without the need for attendance by the operator.

OCCA Biennial Conference 1979



20-23 JUNE 1979 STRATFORD HILTON HOTEL

The challenge to coatings in a changing world

The next OCCA biennial Conference will be held at the Stratford Hilton Hotel, Stratford-upon-Avon, Warwickshire from 20-23 June 1979. The theme for the Conference will be all aspects of the challenge of new materials and the substitution of traditional ones, new methods of construction and the problems of application and the effects of new legislation on coatings during the last quarter of the twentieth century.

A list of the papers to be presented together with their summaries and biographies of the lecturers was published in the December 1978 issue of the *Journal* and copies of the Conference brochure and registration form were enclosed in all copies of the *Journal* sent to Members attached to the General Overseas Section and non-member subscribers to the *Journal*.

The brochures are being sent to all Members attached to the UK and Irish Sections with Section circulars. Any non-member who has not yet received a copy of the brochure and wishes to register for this important Conference should apply for the necessary form to the Association's offices. Non-members wishing to avail themselves

of the preferential Conference fee for Members may do so by sending in a membership application form at the same time as they submit their Conference registration form and the fee enclosed should cover both the membership entrance fee, 1979 subscription and the Conference registration fee. Membership application forms can be obtained from the Association's offices. The registration fees for the Stratford Conference will be £60 (plus value added tax at the standard rate) for Members, £80 (plus VAT) for non-members and £20 (plus VAT) for wives. A daily registration fee for Members of the Association of £35 (plus VAT) and of £20 (plus VAT) for Registered Students of the Association has been set.

Preprints of the papers are now being prepared and it is expected that these, together with details of accommodation, badges, programmes etc. will be sent to those who have registered in May 1979. It is a feature of the Association's Conferences that preprints are sent well in advance of the function in order to enable delegates to read them before the Conference, at which the lecturers illustrate

their topics but do not read their papers in their entirety. This allows for a much longer discussion period than at many other conferences and has proved of immense value to those attending previous Association Conferences.

Stratford-upon-Avon new is a venue for the OCCA Conference and it is expected that it will prove popular and interesting to delegates. A full social programme has been arranged for the benefit of those attending the Conference including delegates' wives and this includes coach parties to local places of interest including Shakespeare's birthplace, Warwick Castle and Oxford, and also a golf tournament and theatre party to the Royal Shakespeare theatre.

Further information may be obtained from the Director & Secretary at the address on the Contents page of this issue (Tel: 01-908 1086; Telex 922670).

Irish Section

Annual Dinner Dance

The Annual Dinner Dance of the Irish Section took place on Friday 24 November 1978 at the Clarence Hotel, Dublin.

Over 100 members and their guests sat down to an excellent dinner, the guests of honour being Mr I. R. McCallum, Chairman of the Scottish Section, with Mrs McCallum, and Mr D. Moore, President of the Irish Paint Manufacturers' Federation, with Mrs Moore.

The meal was followed by some witty speechmaking, the mood being set by Mr McCallum proposing the toast to the Irish Section. The response was given by Mr K. Callaghan, Chairman of the Irish Section, and the toasts to the guests was proposed by Mr R. Rea. The speeches

ended with a fine response by Mr Moore and the rest of the evening was devoted to dancing, which was ably catered for by the resident band.

D.P.

West Riding Section

Ladies' Night

The annual Dinner Dance of the West Riding Section was held on Friday 24 November at the Crown Hotel, Harrogate.

Some 245 sat down to dinner after which the Chairman, Mike Cochrane, welcomed the top table guests. They were the President and his wife, Mr and Mrs F. Hellens (Newcastle), Mr and Mrs D. Bayliss (London), Mr and Mrs J. Burns (Midlands), and Mr R. Brooks (Hull). Mr Cochrane also expressed the sadness of all present at the untimely death of Mr McWilliam, who had been a member of the West Riding Section before moving to Manchester and had intended to be present on this occasion.

After presenting the West Riding Golf Trophy to Mr T. Wright, the Chairman invited members of the West Riding Section to drink a toast to the ladies and guests. The President responded in his inimitable way with some well chosen words about the Association interspersed with a selection of Scottish humour.

Following Dinner the party rapidly got under way with dancing to the Peter Edwards Sextet. This popular occasion proved to be its usual success due in no



Shown at the West Riding Section Ladies' Night (left—right): Mr D. Brooks (Chairman Hull Section), Mrs Burns, Mr J. Burns (Chairman Midlands Section), Mrs Cochrane, Mr M. Cochrane (Chairman West Riding Section), Mrs McLean, Mr A. McLean (President), Mrs Bayliss, Mr D. Bayliss (Chairman London Section), Mrs Hellens, Mr F. Hellens (Chairman Newcastle Section)

small measure to the efforts of the Social Secretary, Norman Cochrane.

R.A.C.C.

Scottish Section

Eastern Branch

Annual Skittles Match

The Annual Skittles Match between the Scottish Section and its Eastern Branch was held on Friday 27 October at the Civil Service Club.

This is an annual match between the "East" and "West" parts of the Scottish Section for the coveted Newton Cup.

After an enjoyable evening the "West" managed to beat the "East" 1142 to 933 points. It is rumoured that the "West" had gone into training for this event, which possibly explains their success.

The individual winners were:—

Men: T. Kirkwood (Visitor) 155 points

Ladies: A. Docherty (Visitor) 76 points

Thanks are due to all who donated prizes.

T.M.

Register of Members

The following elections to membership have been approved by Council. The Section to which each new Member is attached is given in italics.

Ordinary Members

ABDUL-KARIM, AFAF ABDULWAHAB, BSc, Modern Paint Industries, PO Box 2436, Alwiya, Baghdad, Iraq. (*General Overseas*)

CLOTHIER, ANTHONY, H H Robertson (Africa) (Pty) Ltd, 154 Monteer Road, Isando, South Africa. (*Transvaal*)

COLDWELL, PETER, 36 Nabwood Crescent, Shipley, West Yorkshire. (*West Riding*)

CRITCHLEY, ROBERT PETER, BSc, 121 Factory Lane, Blackley, Manchester. (*Manchester*)

DRANSFIELD, ROGER HOWARTH, BSc, 24 Hillbrow Place, Walmer 6065, South Africa. (*Cape*)

EGERTON, TERENCE ARTHUR, MSc, PhD, Tioxide International, Portrack Lane, Stockton on Tees, TS18 2NQ. (*Newcastle*)

GRUNDMANN, HANS, PhD, 12 Grangeway, Handforth, Wilmslow, Cheshire, SK9 3HZ. (*Manchester*)

HEMMINGS, JAMES, LRIC, 4 Netherfield Close, Riley Lane, Kirkburton, Nr. Huddersfield, West Yorkshire. (*West Riding*)

HOWARD, PETER PATRICK, BSc, 22 Ruarangi Road, Mt Albert, Auckland, New Zealand. (*Auckland*)

JARVIS, JAMES EDWARD, BSc, Torrance & Sons Ltd, Bitton, Bristol. (*Bristol*)

KING, CAROLINE JANE, BSc, Tioxide International, Portrack Lane, Stockton on Tees, TS18 2NQ. (*Newcastle*)

LAMB, KEVIN MERVYN, BSc, Berger Paints, Petherthon Road, Hen-grove, Bristol. (*Bristol*)

MAJID, QUSAI, BSc, Modern Paint Industries, PO Box 2436, Alwiya, Baghdad, Iraq. (*General Overseas*)

NASH, DAVID JOHN, Plascon Evans Co. (Pty) Ltd, PO Box 1594, Port Elizabeth, South Africa. (*Cape*)

PEDDIE, DOUGLAS CLIVE, 28 A G Visser Street, Brackenhurst, Alberton, South Africa. (*Transvaal*)

POWELL, WILLIAM JAMES, BSc, 18 Nevendon Drive, Manchester M23 8RR. (*Manchester*)

VAN DER MERWE, ALFERD ADRIAAN, Plascon Evans (EC) Ltd, PO Box 1594, Port Elizabeth, South Africa. (*Cape*)

WATSON, PETER LEONARD, BSc, Croda (SA) Ltd, PO Box 615, Kempton Park 1620, South Africa. (*Transvaal*)

Associate Members

DORUYTER, JACOBUS, Hoechst SA (Pty) Ltd, PO Box 8692, Johannesburg 2000, South Africa. (*Transvaal*)

FRANCIS, KEVIN, Sigma Coatings Ltd, Castle Mills, Buckingham. (*Thames Valley*)

HUNT, PHILIP ANDREW, John Hill Road, RD3, Papakura, New Zealand. (*Auckland*)

NIENABER, JAN JOHAN, 13 Tarina Park, 401 Cape Road, Cotswold, Port Elizabeth, South Africa. (*Cape*)

NORRIS, JUDITH ANGELA, 4 Greengate, Hale Barns, Altrincham, Cheshire. (*Manchester*)

SANDILANDS, GRAHAM, Bayer SA (Pty) Ltd, Box 1366, Johannesburg 2000, South Africa. (*Transvaal*)

WADHAM, JOHN HENRY, Torrance & Sons Ltd, Bath Road, Bitton, Bristol. (*Bristol*)

WARD, RAYMOND, Avonleigh, Martins Road, Keevil, Wilts. (*Bristol*)

Registered Students

HOLMES, DALE LEE, 25 Hollybank Close, Old Trafford, Manchester 16. (*Manchester*)

RAJ, MULAKH, Astley Paints, Gosford Street, Coventry. (*Midlands*)

Forthcoming Events

Details are given of Association meetings in the United Kingdom and Ireland up to the end of the month following publication and in other parts of the world up to the end of the second following publication.

February

Thursday 1 February

Newcastle Section: Joint meeting with the Plastics and Rubber Institute. "Glass fibre polyester as a substrate for painting" by Mr F. E. Bassford of Cray Valley Products Ltd, at St Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m.

Friday 2 February

Scottish Section—Eastern Branch: Burns Supper to be held at the Commodore Hotel, Marine Drive, Edinburgh.

Monday 5 February

Hull Section: "Developments in milling and dispersing equipment" by a speaker from Herbert Smith & Co Ltd. *Details to be announced.*

Manchester Section: "Inks for packaging" by Mr Duffin of Irlam Inks. Joint lecture with Institute of Printing Inks at Woodcourt Hotel, Sale, commencing at 6.30 p.m.

Tuesday 6 February

West Riding Section: "Some aspects of corrosion in CEBG installations" by Mr R. Umpleby of CEBG Scientific Services Department at the Mansion Hotel, Roundhay Park, Leeds 8, commencing at 7.30 p.m.

Thursday 8 February

Scottish Section: "Fundamentals of modern emulsion paint formulation" by J. Clark of BTP Ltd. Student invitation lecture at the Albany Hotel, Glasgow, commencing at 6.00 p.m.

Friday 9 February

Thames Valley Section: Buffet dance at Great Fosters, Egham. *Details to be announced.*

Wednesday 14 February

Ontario Section: TBP by Mr L. Horn of Lawter to be held at the Saturn Room, Constellation Hotel, Toronto, commencing at 6.00 p.m.

Thursday 15 February

Midlands Section: "The case for lead chromes" by Mr F. A. Chapman and Mr A. C. D. Cowley of ICI Organics Division, at the Calthorpe Suite, County Ground, Birmingham, commencing at 6.30 p.m.

Friday 16 February

Irish Section: "Solvent recovery in the paint industry" by Mr I. Smallwood of Frazer McNaughton Ltd, at the Clarence Hotel, Dublin, at 8.00 p.m.

Newcastle Section: Ladies' Night to be held at Five Bridges Hotel, Gateshead. *Details to be announced.*

Wednesday 21 February

London Section: "Novel ink systems" by P. G. Richardson, Fishburn Printing Ink Co Ltd, at Rubens Hotel, Buckingham Palace Road, SW1, at 7.00 p.m.

Manchester Section: Student Lecture "Powder versus water based paints, a comparison of properties" by K. H. Dodd of Carrs Paints at Manchester Literary & Philosophical Society, George Street, Manchester, commencing at 4.30 p.m.

Thursday 22 February

Thames Valley Section: "Aqueous based printing inks" by Mr Mullard of Harlow Chemicals, at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing at 6.30 p.m. for 7.00 p.m.

Friday 23 February

Bristol Section: "Surface active agents in surface coatings" by Dr A. Pryce of ABM Chemicals Ltd. Joint meeting with the Birmingham Paint Varnish and Lacquer Club at the Royal Hotel, College Green, Bristol, at 7.15 p.m.

Wednesday 28 February

Scottish Section—Eastern Branch: "Acrylic emulsions in and on paper" by J. B. Tait of Rohm & Hass. Joint meeting with the B.P.B.M.F., in the Maybury Hotel, Maybury Road, Edinburgh, at 7.30 p.m.

March

March

Auckland Section: Annual General Meeting, *details to be announced.*

Monday 5 March

Hull Section: Ladies' evening. "Drug abuse", lecture and film to be given by a member of the Drug Squad of the Humber-side Police at the George Hotel, Land of Green Ginger, Hull at 6.30 p.m.

Tuesday 6 March

West Riding Section: "Water borne paints as industrial coatings" by Dr H. Rauch-Puntigam of Vianova Kunstharz AG at the Mansion Hotel, Roundhay Park, Leeds 8 at 7.30 pm.

Thursday 8 March

Midlands Section—Trent Valley Branch: "Latest developments in driers" by Mr J. H. W. Turner of Manchem Ltd at the Crest Hotel, Pastures Hill, Littleover, Derby at 7.15 p.m.

Newcastle Section: "Water borne paints in industrial coatings" by Dr H. Rauch-Puntigam of Vianova Kunstharz AG at St. Mary's College, Elvet Hill Road, Durham at 6.30 p.m.

Scottish Section: "Calcium and zinc ferrites—Two new anticorrosive pigments" by a lecturer from Bayer Ltd at the Albany Hotel, Glasgow at 6.00 p.m.

Friday 9 March

Manchester Section: Informal Buffet Dance at the RAFA Club, Sale, *details to be announced.*

Wednesday 14 March

Manchester Section: Student works visit, *details to be announced.*

Ontario Section: "Problems in flexo/gravure packaging" by S. Tesainer of Lawson Packaging at the Constellation Hotel, Toronto at 6.00 p.m.

Thursday 15 March

Thames Valley Section: "Recent developments in pigment dispersion and dispersion equipment" by a speaker from Mastermix Engineering, at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks at 7.00 p.m.

Friday 16 March

London Section: "Maintenance painting of structural steel". Day meeting with Institute of Corrosion Science at Thames Polytechnic, Woolwich at 10.00 a.m.

Manchester Section: "North Sea oil" by lecturer from Esso Ltd at Manchester Literary & Philosophical Society, George Street, Manchester at 6.30 p.m.

Wednesday 21 March

Scottish Section—Eastern Branch: Annual General Meeting, at the Murrayfield Hotel, 18 Corstorphine Road, Edinburgh at 7.30 p.m., followed by *Ladies' Evening*. "Language of colour" by Mr J. Knightly, Scottish College of Textiles.

Manchester Section: "North Sea oil" by lecturer from Esso Ltd at Manchester Literary & Philosophical Society, George Street, Manchester at 6.30 p.m.

Friday 23 March

Bristol Section: Annual Dinner Dance at the Mayfair Suite, New Bristol Centre.

Irish Section: "Fire prevention in factory/home" by Dublin Fire Department at the Clarence Hotel, Dublin at 8.00 p.m.

Midlands Section: J. Newton Friend lecture and Ladies' Invitation and Buffet. "Mountain rescue" by Dr D. Bunting at Chamber of Commerce and Industry Ltd, Harborne Road, Birmingham, *details to be announced.*

Friday 30 March

Bristol Section: "Prohesion, methods of test and prediction of performance" by Mr F. Timmins of British Rail, Derby, at the Royal Hotel, College Green, Bristol at 7.15 p.m.

April

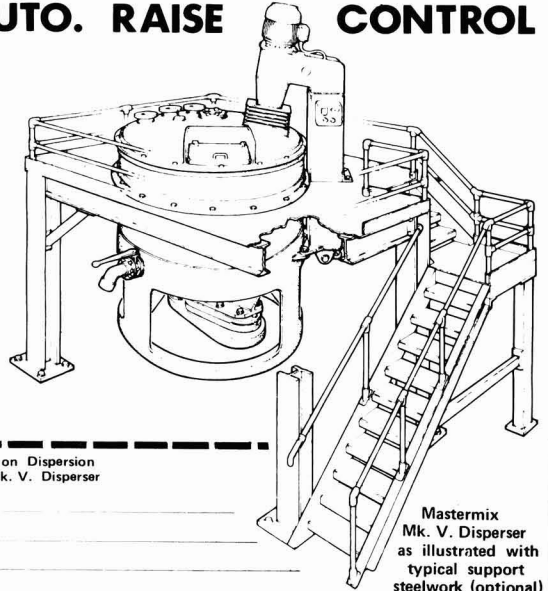
Sunday 15 April

Ontario Section: Annual General Meeting, *details to be announced.*

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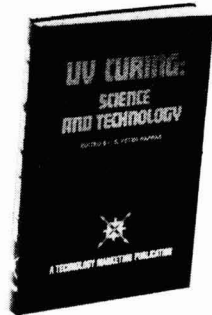
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UVCS&T

Editor: DR. S. PETER PAPPAS

Technology Marketing Corporation, the original and leading publishers of radiation curing and processing technology news proudly announces a *NEW SCIENTIFIC BOOK*: "UV Curing: Science and Technology."

This authoritative and highly regarded scientific book has just come off the press and is ready for delivery. Co-authored by leading scientists and professionals from both industry and academic ranks, the book describes the basic principles of the science and technology of uv curing. The integration of scientific and technological aspects of these areas enhances the usefulness of this book to a diverse readership, spanning the gamut from research scientists to sales personnel.

The unique balance between theoretical and practical presentations, makes this book a vital part of any research and development organization currently involved (or desiring to get involved) in the rapidly growing technology of uv curing. Contents of this book are not found in any other publication.

ABOUT THE EDITOR

Dr. S. Peter Pappas, Professor of Chemistry at North Dakota State University, received his B.A. degree from Dartmouth College in 1958 and his Ph.D. degree in Chemistry from the University of Wisconsin in 1962.

Dr. Pappas has authored (or co-authored) over 30 journal articles on synthesis, reaction mechanisms, photochemistry, and coatings technology, including a recent review paper on photochemical aspects of ultraviolet curing. His papers on the photochemistry of pigments as related to chalking and uv curing, received first prize in the Roon Award Competition, sponsored by the Federation of Societies of Coatings Technology in 1974, 1975 and 1976.

ABOUT CO-AUTHORS

In preparation of "Ultraviolet Curing: Science and Technology" Dr. Pappas has been assisted by several internationally recognized authorities from major industrial firms. The editor and each co-author have contributed at least one chapter, in their respective field of specialty, to "UV Curing: Science and Technology." Co-authors and their affiliations are listed below.

Robert W. Bassemir, Sun Chemical Corporation
Graphic Arts Laboratories

Anthony J. Bean, Sun Chemical Corporation
Graphic Arts Laboratories

Dr. James V. Crivello, General Electric Company
Research and Development Center

Dr. Eugene D. Feit, Bell Laboratories

(cont.)

Dr. Gerald W. Gruber, PPG Industries
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Dr. Vincent D. McGinniss, Battelle Columbus Laboratories
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Research and Development Center
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North Dakota State University
Dr. Zeno W. Wicks, Jr., Polymers and Coatings Department
North Dakota State University

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11. SOME RELATED PUBLICATIONS

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Write in confidence to: **Dr Wallace Rubin, Kelsey Industries Limited, Kelsey House, Wood Lane End, Hemel Hempstead, Herts.**

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OCCA-31 Exhibition



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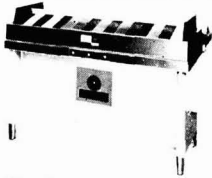
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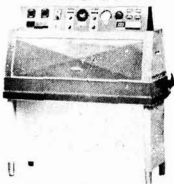
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