Vol. 63 No. 1 JOCCAB 63(1) 1–52 (1980) **January 1980**

OCCA-32 EXHIBITION
13-15 MAY 1980
Cunard International Hotel

FIRST LIST OF
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CUNARD INTERNATIONAL HOTEL LONDON—13-15 MAY 1980

JOURNAL OF THE OIL & COLOUR CHEMISTS' ASSOCIATION

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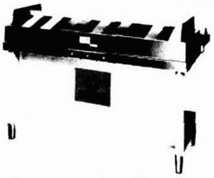

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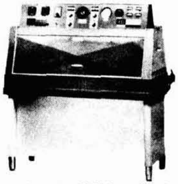

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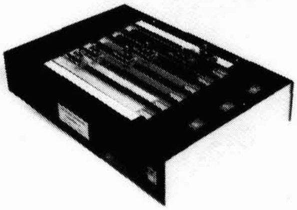

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Transactions and Communications

Rheological properties of high-build paints containing castor oil derivatives

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Summary

A comparative evaluation was carried out on the sag resistance displayed by the members of two families of high-build chlorinated rubber paints, formulated with two brands of castor oil derivatives at different concentrations. The investigation was carried out using rheological techniques according to a procedure proposed by the authors in a previous paper. Differences were observed in the rheological behaviour of the two families of paints. Good agreement was found between rheological parameters evaluated from both equilibrium and non-equilibrium data and from the results of sag resistance tests.

Keywords

Types and classes of coatings and allied products

high build coating

Raw materials for coatings
binders (resins, etc.)

chlorinated rubber

surface active and rheological agents

rheological agent
flow control agent

Properties, characteristics and conditions primarily associated with

materials in general

rheological property
thixotropy
viscosity

Processes and methods primarily associated with application of coatings and allied products

sagging

Les caracteristiques rhéologiques des peintures "high-build" contenant des dérivés de l'huile de ricin

Résumé

On a effectué une évaluation comparative sur la résistance à la formation de festons mise en évidence par deux variétés de peintures "high-build" à base de caoutchouc chloré, et deux types des dérivés de l'huile de ricin de commerce à diverses concentrations. On a effectué l'investigation en utilisant des techniques rhéologiques selon une méthode proposée par les auteurs dans une autre exposé dans le passé. On a noté des différences en ce qui concerne le comportement rhéologique des deux variétés de peinture. On a obtenu un bon accord entre les paramètres rhéologiques dérivés à partir des données de l'équilibre et au contraire, et aussi à partir des résultats des essais de résistance à la formation de festons.

Rheologische Eigenschaften von Dickschichtfarben, die Derivaten des dehydrierten Rizinusöls enthalten

Zusammenfassung

Die Widerstandsfähigkeit gegen Ablaufen von verschiedenen Dickschichtchlorkautschuckfarben wurde getestet. Diese sind in zwei Gruppen, auf Grund der in der Formel verwendeten Derivate des dehydrierten Rizinusöls, von denen zwei verschiedene Firmenprodukte benutzt wurden, eingeteilt. Die Untesuchung wurde mittels rheologischer Techniken nach einem von den Verfassern in einer früheren Veröffentlichung vorgeschlagenen Verfahren durchgeführt. Es wurden Unterschiede im rheologischen Verhalten der geprüften Farbengruppen festgestellt. Man stellte eine gute Übereinstimmung zwischen den von Gleichgewichts- und Nicht-gleichgewichtsdaten erhaltenen rheologischen Parametern und den technologischen Ablaufproben erhaltenen Ergebnissen fest.

Introduction

Refs. 1, 2

The use of high-build paints in the marine and industrial field is showing a rapid growth, since these materials allow dry films 100–200 microns thick to be laid down in a single coat without sagging on vertical surfaces.

To prevent sagging on vertical surfaces, high viscosity or the presence of an adequate yield stress is required at the very low shear rates involved in film formation. On the other hand, high-build paints must be easily applicable with the normal spraying equipment, for which a low viscosity at a high shear rate is necessary.

Usually, the addition of thixotropic agents imparts the above mentioned properties to the paint.

The objective of the present work is a comparative examination of the rheological properties of two families of high-build chlorinated rubber paints, formulated with two different castor oil derivatives.

The investigation was carried out by means of a procedure proposed by the authors in previous work[1,2]. Additional sag resistance tests were performed to confirm the validity of the rheological results.

Experimental

(a) Rheological tests

Apparatus

A commercial coaxial cylinder viscometer, Rotovisko-Haake No. 11, was used; measuring device MVI, 0.96 mm clearance.

Shear rates applied were within the range 0.7–1142 s^{-1}.

Tests were carried out at 25°C.

Materials

The materials tested were chlorinated rubber paints formulated with inert pigments and extenders, and at different levels of castor oil derivatives. These are commercially available products designated as agent *A* and agent *B*.

The characteristics of the paints are given in Table 1.

The paints 2 and 4 of both families were thinned with 10 per cent xylene and subjected again to rheological and technological tests. Ten per cent dilution was selected, since it allows a η_∞ value in the range of 1 poise to be obtained for all paints considered.

Procedure

Refs. 3–8

To determine the rheological properties of the paints tested the following procedure was used:

(1) Shear stress equilibrium data were obtained according to Pawlowsky[3] within a wide range of shear rates;

(2) Shear rates were corrected according to Krieger and Elrod[4];

(3) Shear stress steady values were correlated both with the Casson equation[5]

$$\tau^{0.5} = \tau^{0.5} + \eta^{0.5}\dot{\gamma}^{0.5}$$

and the Asbeck equation[6]

$$\ln \frac{\eta}{\eta_\infty} = \frac{S}{\dot{\gamma}^{0.5}}$$

(4) A compact representation of the equilibrium flow behaviour of all members for each paint family was obtained by a master-curve procedure;

(5) Thixotropic build-up was studied on the basis of procedures proposed by Trapeznikov[7] and Ferguson-Bradley-Beresford[8].

(b) Technological tests

Sagging tests were carried out by means of a sag index applicator. Dry film thickness was controlled over the whole strip width.

Δ_L limit thickness values correspond to the highest applicator clearance considered without sagging, curtaining or thickness variations.

Results and discussion

(a) Rheological tests

All the paints display a pseudoplastic behaviour.

Figure 1 shows the η versus τ plot for the individual members of paint family *A*. Flow curves for individual members of family *B* are of the same type. A yield value is evident with paints formulated at high content of thixotropic agent.

Table 1
Paint characteristics

Paint family	Pigment	Binder	Extender	Thixotropic agent	PVC	η at $10^4 s^{-1}$ (poise)
A	Cr_2O_3	Low viscosity chlorinated rubber +chloroparaffin	Talc	Castor oil derivative *A*	35	2.40
B	Cr_2O_3	Low viscosity chlorinated rubber +chloroparaffin	Talc	Castor oil derivative *B*	35	2.40

Paint	0	1	2	3	4
Thixotropic agent concentration (% by weight)	0	0.4	0.8	1.2	1.6

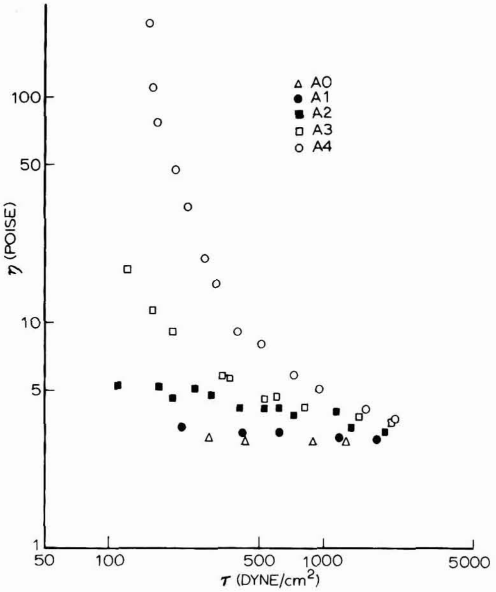

Figure 1. Viscosity versus shear stress for individual members of paint family *A*

Correlation of the $\tau - \dot{\gamma}$ data with the Casson equation[5] was satisfactory within the whole $\dot{\gamma}$ range tested. τ_0 and η_∞ values are reported in Table 2. τ_0 increases with increasing amounts of thixotropic agent within each paint family.

Experimental data were also correlated with the Asbeck equation[6]. Good results were obtained by fitting data at $\dot{\gamma}$ higher than 42 s^{-1}. The parameters of the Asbeck equation are given in Table 3. The Asbeck parameter S increases with increasing thixotropic agent concentration within each paint family.

Differences between Casson η_∞ and Asbeck η_∞ were within 8 per cent.

Casson η_∞ decreases with the thixotropic agent concentration more markedly than does Asbeck η_∞.

Table 2
Parameters of the Casson equation

Paint	τ_0(dyne/cm^2)	η_∞ (poise)
*A*0	0.23	2.87
*A*1	1.84	2.88
*A*2	11.8	2.95
*A*3	38.8	2.64
*A*4	118	2.16
*A*2+10% Xylene	0.83	0.81
*A*4+10% Xylene	28.0	1.09
*B*0	0.23	2.87
B1	9.73	2.80
*B*2	28.4	2.67
*B*3	52.3	2.62
*B*4	78.2	2.40
*B*2+10% Xylene	0.03	0.91
*B*4+10% Xylene	27.2	0.99

Table 3
Parameters of the Asbeck equation

Paint	S(s$^{-1/2}$)	η_∞ (Poise)
*A*0	0.56	2.85
*A*1	1.39	2.89
*A*2	4.12	2.84
*A*3	5.25	2.91
*A*4	9.53	2.52
*A*2+10% Xylene	1.12	0.82
*A*4+10% Xylene	7.26	1.14
*B*0	0.56	2.85
*B*1	3.35	2.78
*B*2	4.58	2.88
*B*3	5.91	2.90
*B*4	6.73	2.86
*B*2+10% Xylene	0.26	0.91
*B*4+10% Xylene	7.88	1.03

Diluted paints *A*2–*B*2 and *A*4–*B*4 show, in general, similar behaviour with the only exception of τ_0 and S values for paints 2.

Figure 2 shows τ_0 vs. c and S vs. c plots.

τ_0 and S values are higher for the members of family B at lower thixotropic agent concentration; the opposite is true at higher thixotropic agent concentration. There is an inversion for both τ_0 and S in the two families around the same thixotropic agent concentration of about 1.2 (see Figure 2).

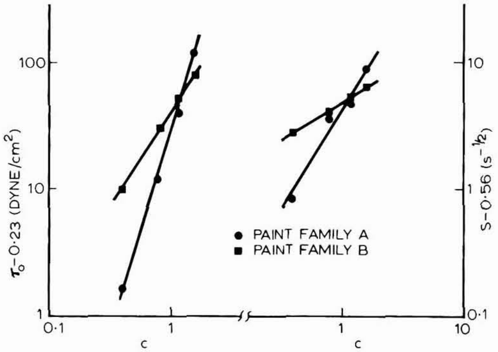

Figure 2. Casson τ_0 and Asbeck S versus thixotropic agent concentration

As far as non-equilibrium data are concerned, ln (τ_p/τ_e) was plotted versus ln t_r (rest time) for various shear rates applied. Straight lines were obtained for rest times higher than 60 s. The slope S^* of ln (τ_p/τ_e) vs. ln t_r was taken as the build-up kinetics parameter according to reference 8.

Figures 3 and 4 show ln S^* vs $\dot{\gamma}$ plots for paint pairs *A*4–*B*4 and *A*2–*B*2.

Non-equilibrium behaviour shows that paints of family *A* have faster build-up kinetics at high thixotropic agent concentration (paints *A*4–*B*4). For low thixotropic agent concentration (paints *A*2–*B*2), build-up is faster for family *B* at high shear rates and lower at low shear rates. There is again

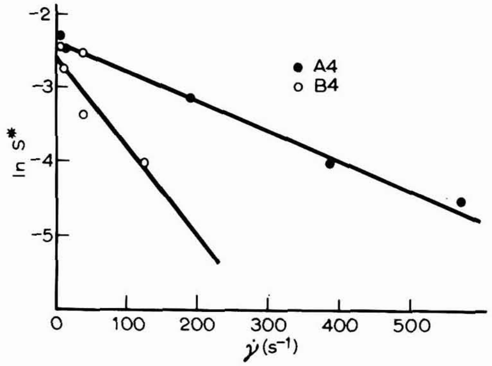

Figure 3. Natural logarithm of build-up kinetics parameter versus shear rate for paint pairs *A*4–*B*4

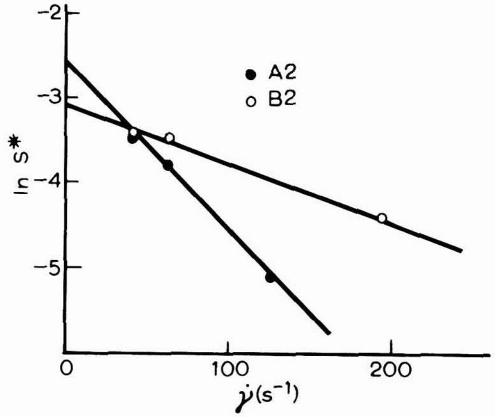

Figure 4. Natural logarithm of build-up kinetics parameter versus shear rate for paint pairs *A*2–*B*2

a reversal in the rheological behaviour, which can be accounted for in order to explain why paint *A*2 with lower τ_0 and *S* shows higher sag resistance than paint *B*2 with higher τ_0 and *S*.

In order to give a compact representation of the flow behaviour of the individual members for each paint family a master-curve was traced. The master-curve of reduced viscosity, η_R, versus reduced shear stress, τ_R, for family *A* is shown in Figure 5. For each family the flow curve at $c=0$ was assumed as reference curve; consequently, each family is represented by the same master curve.

Reduced variables are defined as:

$$\eta_R = a_\eta \eta \; ; \; \tau_R = a_\tau \tau$$

Shift factors a_η and a_τ were evaluated starting from the τ_0 and η_∞ values determined by fitting the experimental data with the Casson equation.

So, they are defined as:

$$a = \frac{\eta_{\infty,0}}{\eta_{\infty,c}} \; ; \; a = \frac{\tau_{0,0}}{\tau_{0,c}}$$

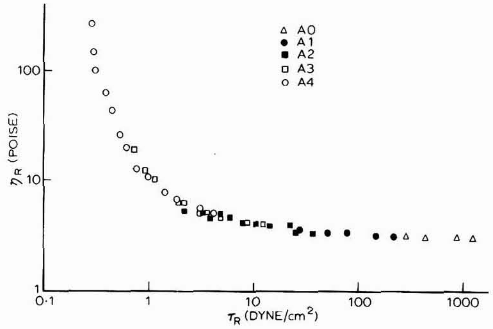

Figure 5. Master curve of reduced viscosity versus reduced shear stress for paint family *A*

where $\eta_{\infty,0}$ and $\tau_{0,0}$ are the Casson parameters of the paint with no thixotropic agent (reference paint at $c=0$), and $\eta_{\infty,c}$ and $\tau_{0,c}$ are the corresponding parameters of the paint at *c* thixotropic agent concentration.

(b) Technological tests

Technological tests show that both thixotropic agents tested are able to impart outstanding sag resistance (see Table 4).

Table 4
Sag resistance results

Paint	Δ_L(microns)
*A*0	150
*A*1	250
*A*2	>800
*A*3	>800
*A*4	>800
*A*2+10% Xylene	150
*A*4+10% Xylene	>800
*B*0	150
*B*1	200
*B*2	>800
*B*3	>800
*B*4	>800
*B*2+10% Xylene	100
*B*4+10% Xylene	>800

Paints 2, 3, and 4 showed no sagging, even when applied at an applicator clearance of 800 microns. Slight differences in sag resistance became evident in paints 1 and paints 2 when diluted with 10 per cent xylene. Family *A* displays, in this case, a slightly higher sag resistance.

General comment

A comparison between rheological and technological tests shows:

(1) At high thixotropic agent concentration, paints *A* have more favourable rheological properties than paints *B* as far as sagging is concerned; this could not be confirmed by technological tests, because both the paint families concerned have an outstanding sag resistance and a sag index applicator with a clearance higher than 800 microns was not available.

(2) At low thixotropic agent concentration (less than about 1.2) paints *A* have a higher sag resistance than the corresponding members of family *B*, although the latter have a higher τ_0 and *S*. This means that τ_0 and *S* are not sufficient to define paint sag resistance and that to this end a parameter describing the build-up rate characteristics must be taken into account; this allows a more comprehensive picture of the rheological behaviour to be obtained. A high build-up rate is able, at least in some instances, to compensate for a low τ_0 or *S* in preventing sag phenomena.

In the present case, the members of family *A* have a higher *S** than the corresponding members of family *B* after the application of a low shear rate; these conditions are encountered in laying down paints by means of a sag index applicator. Rheological properties give indications of an opposite behaviour for paints *A* and *B* after application at high shear rates; obviously, this cannot be checked by means of a sag index applicator.

Conclusion

Both the thixotropic agents tested were found to be very effective in imparting sag resistance to high-build paints. Only slight differences could be detected between the two products tested.

Full agreement was found between the results given by technological and rheological tests.

Moreover, rheological tests have been shown able to account for the small behaviour differences made evident by technological tests between corresponding members of the families of paints formulated with the thixotropic agents considered.

It is pointed out that τ_0 value or *S* value must be coupled with a build-up kinetics parameter to obtain a reliable and comprehensive appraisal of the sag resistance characteristics of a paint.

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Notation

a_η	viscosity shift factor
a_τ	shear stress shift factor
c	thixotropic agent concentration
S	parameter of the Asbeck equation
S^*	build-up kinetics parameter
t_r	rest time
$\dot{\gamma}$	shear rate
Δ_L	limit thickness of sagging
η	apparent viscosity
η_R	reduced viscosity
η_∞	viscosity at infinite shear rate
τ	shear stress
τ_0	yield value
τ_e	equilibrium shear stress
τ_p	maximum shear stress obtainable after rest time
τ_R	reduced shear stress

References

1. Kikic, I., Lapasin, R. and Torriano, G., *VII Int. Congress on Rheology, Proc.*, Gothenburg, 1976, 584.
2. Lapasin, R., Kikic, I. and Torriano, G., *Ind. Vernice*, 1977, **31** (7), 3.
3. Pawlowsky, J., *Chem. Ing. Techn.*, 1956, **28**, 791.
4. Krieger, I. M. and Elrod, H., *J. Appl. Phys.*, 1935, **24**, 134.
5. Casson, N., "Rheology of Disperse Systems", C. C. Mill, *Pergamon Press*, 1959, London.
6. Asbeck, W. K. and Van Loo, M., *Ind. Eng. Chem.*, 1954, **46**, 1291.
7. Trapeznikov, A. A. and Fedotova, V. A., *Dokl. Akad. Nauk S.S.S.R.*, 1954, **95** (3), 595.
8. Ferguson, J., Bradley, G. F. and Beresford, J., *Rheol. Acta*, 1971, **10**, 479.

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Modification of shellac. Part I: Using ethylene glycol and dicarboxylic acids

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Summary

Shellac has been modified under various conditions with ethylene glycol and dicarboxylic acids to give ethers and esters respectively; their properties and those of their varnishes and paints were studied. The baked films have been found to be extraordinarily flexible and also resistant to impact, water, acid, solvents and oils. Their possible uses in the fields of metal lacquering, surface coatings, the electrical industry, adhesives, plasticisers and indoor painting have been suggested.

Keywords

Raw materials for coatings
binders (resins, etc.)

shellac

Processes and methods primarily associated with
manufacturing or synthesis

esterification

Properties, characteristics and conditions primarily
associated with

dried or cured films

impact resistance
water resistance
solvent resistance
flexibility

La modification de la gomme-laque 1ère. Partie. En utilisant l'ethylène glycol et des acides dicarboxyliques

Résumé

On a modifié la gomme-laque sous diverses conditions avec l'ethylène glycol et des acides dicarboxyliques afin de rendre des éthers et des esters respectivement. On a étudié leurs caractéristiques et celles de leurs vernis et peintures. On a trouvé que les films après séchage au four sont exceptionnellement souples et résistants au choc, à l'eau, aux acides, aux solvants et aux huiles. On a suggéré leurs emplois eventuels dans les domaines des vernis clairs pour métaux, des revêtements de surface, des adhésifs, des plastifiants, des peintures exterieures et aussi dans l'industrie éléctrique.

Modifizierung von Schellack. Teil I. Verwendung von Äthylenglykol und Dikarbonsäuren

Zusammenfassung

Schellack wurde under verschiedenen Bedingungen mit Äthylenglykol und Dikarbonsäuren modifiziert um Ester und Äther zu erzeugen; deren Eigenschaften und die daraus hergestellten Lacke und Farben wurden geprüft. Es wurde beobachtet, dass deren ofengetrocknete Filme ungewöhnlich biegsam und schlagfest waren, sowie beständig gegen Wasser, Säure Lösungsmittel und Öle. Es werden Verwendungsmöglichkeiten auf Gebieten der Metallackierung, Anstrich mittel, Elektroindustrie, Klebstoffe, Weichmacher und für den Innenanstrich vorgeschlagen.

Introduction

Refs. 1–4

Lac resin possesses a rare combination of very desirable properties, as a result of which it has long enjoyed its superiority over all other resins, natural or synthetic. But in recent years it has faced serious competition from the tailor-made special purpose synthetic resins and has yielded in one field after another. This is obviously due to its well known limitations, namely, low softening and melting points, poor water and solvent resistance, brittleness and lack of much specified performance required by modern technology. To keep pace with the modern technological and exacting demands and also to stabilise its position vis-a-vis the competition from the ever increasing synthetic rivals, shellac should be suitably modified to upgrade its performance in specified directions. With this objective, the present investigation has been undertaken.

Various attempts were, and are being, made to modify shellac for producing special purpose products of improved performances[1]. Amongst them, one was the modification of lac with ethylene glycol to give an ether, which was further modified with saturated and/or unsaturated monobasic acids[2]. The products were claimed to be useful as plasticisers, protective coatings for metals, fabrics and papers, and stoving enamels. Though some work on the preparation of polyesters by reacting shellac with polyglycols, including ethylene glycol and saturated dicarboxylic acids[3,4], has been carried out, detailed information as regards the properties of the ethers or the polyesters and their possible utilisation (except for the preparation of rigid polyurethane foams[4]) has not been reported.

The present paper describes a study on the modification of shellac with ethylene glycol, followed by further modification with saturated and unsaturated dicarboxylic acids, and the properties of the ethers and the esters and their possible utilisation in various fields.

Experimental

Ref. 5

Materials

Shellac: Dewaxed or waxy

Chemicals: All reagents used throughout the investigation were of pure grade.

Methods and techniques

Preparation of shellac–ethylene glycol ether

The reaction between shellac and ethylene glycol was carried out according to the following methods:

(a) Shellac (100 parts) and ethylene glycol (37.2 parts) were placed in a two-necked flask and heated on an oil bath at 100–120°C until a uniform solution resulted. The mixture was then cooled to 80°C and sulfuric acid (sp.gr.1.84; 0.37 g per 100 g lac dissolved in a small amount of ethylene glycol) added. A long air condenser was attached in one of the necks and a sealed stirrer in another, the temperature of the bath raised to 180–190°C and the reaction allowed to proceed at this temperature for a period of 2.5 hr with stirring. The contents were then poured into water and the product washed repeatedly with hot water until free from sulfuric acid and unreacted ethylene glycol. The product was then heated on the oil bath at 120°C to remove the last traces of water.

(b) The above etherification reaction was carried out at 180–190°C in a beaker with stirring for 2.5 hr. The product was washed with hot water and dried as before.

(c) The etherification reaction was carried out at 145–150°C either in a flask or a beaker, for 4 hr and the finished product recovered as before.

(d) In a similar manner shellac (100 parts) and ethylene glycol (43.4 pts) in presence of sulfuric acid were reacted at 145–150°C for 4 hr in a flask or a beaker respectively.

Preparation of esters

(a) Lac-glycol ether and the required dicarboxylic acid were placed in a beaker in the proportion of 2:1 by weight and heated on an oil bath with stirring at 145–150°C for a period just short of their gelation time. At the end of the reaction, the product was washed repeatedly with hot water and then dried at 120°C on an oil bath.

(b) The mixture of shellac and ethylene glycol (with sulfuric acid catalyst) was reacted as before for 4 hr at 145–150°C in a 3-necked flask fitted with air condenser and stirrer. Then through the other neck the dicarboxylic acid was added gradually and the heating continued for a further period of 4 hr. The product was then washed repeatedly with hot water and dried at 120°C.

Preparation of varnish, paint and film

(a) The ether/ester was dissolved in 95 per cent alcohol by slightly warming to give a 25 per cent solution (w/v) and the solution filtered to remove any insoluble matter present. Wax from waxy lac compositions was also removed during this filtration.

(b) The ether/ester (25 g) was dissolved in dilute ammonia solution (10 ml ammonia, sp.gr. 0.88, diluted to 75 ml), by warming and agitation. The solution was filtered.

(c) The aqueous varnish was mixed with titanium dioxide pigment (resin to pigment ratio being 75:25 and 60:40) and ground in a ball mill for 48 hr. The paint was then filtered through fine muslin cloth.

Films on glass slides (2.5 x 7.5 cm) and on tin, aluminium and/or mild steel panels (7.5 x 15 cm; 20 x 30 cm) were prepared by a flowing method with varnishes and by brushing with paints. After overnight standing one set of each of the films was baked at 150°C for one hour and another set allowed to air dry for 7 days at room temperature.

Methods of analysis and evaluation

The acid values, hydroxyl values and life* at 150°C of the various ethers and esters were determined according to the standard methods adopted for shellac[5]. The solubilities of these in various solvents were also noted.

Resistance of the films on glass slides to water, 1 per cent hydrochloric acid and 1 per cent sodium hydroxide solutions were tested by dipping them for 48 hr at room temperature and the extent of damage, such as blushing or film failure, noted. The scratch hardness, flexibility and impact resistance of the films on tin and aluminium panels were tested by an automatic scratch hardness tester (1 mm steel ball), a 3 mm conical mandrel and a falling block instrument respectively.

The weathering tests of the paints were carried out for the tin and mild steel panels by exposing them at an angle of 45° and facing south on the roof of the laboratory.

The properties of the ethers, esters and films are recorded in Tables 2, 3, 4 and 5.

Results and discussion

Refs. 2, 6–8

The shellac molecule (average mol.wt.1000) is believed to have 5 hydroxyl groups and 1 carboxyl group in the free state[6] and a partly masked aldehyde group[7]. The hydroxyl groups can be easily esterified with acids and the carboxyl group with alcohol. It has also been observed that these hydroxyl groups react with various monohydric alcohols, such as ethyl, butyl and allyl alcohols and specially with dihydric alcohols to form ethers[2,8]. This etherification reaction has currently been investigated by reacting shellac with ethylene glycol under different conditions.

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*Polymerisation time in minutes to reach the insoluble, infusible state.

Table 1
Progressive fall in acid value with time during the etherification of shellac with ethylene glycol

Reaction temp. (°C)	180–190 (flask)					145–150 (flask)					145–150 (beaker)				
Reaction time (hr)	1	2	2.5	3	4	1	2	3	4	5	1	2	3	4	5
Acid value	30.6	25.3	21.3	21.3	21.1	53.9	44.8	21.5	21.3	21.3	34.7	30.3	21.0	20.8	20.8

Initially the etherification reaction was carried out according to the method of Gidvani[2] by reacting shellac and ethylene glycol in the molar proportion of 1:6 in a flask at 180–190°C. Samples were drawn at timed intervals and the acid values of the washed samples determined. The acid value became constant after carrying out the reaction for 2.5 hr (see Table 1). It was later found that a product having a similar acid value was obtained by carrying out the reaction in an open vessel, e.g. a stainless steel beaker. The only difference between the products was in the consistency, the former being soft whilst the latter was semi-solid. Obviously, this may be due to the fact that in the latter case the water of reaction is removed continuously resulting in a semi-solid product, whilst in the former case the water remains in the reaction medium which, surprisingly, does not reverse the etherification process.

When the reaction was carried out either in a closed or an open system at a lower temperature, 145–150°C, products having almost the same acid values were obtained after continuing the reaction for 4 hr (see Table 1). It will be seen from Table 2 that there is hardly any appreciable difference in the chemical constants of the ethers obtained under various conditions, such as at 180–190°C or 145–150°C in a flask or a beaker, or when using waxy or dewaxed lac in the molar proportion of 1:6 or 1:7. The number of free hydroxyl groups present in the ethers as calculated from the hydroxyl and acid values, is also in good agreement, at about 9. In a flask or closed system a soft, sticky and tacky product was always obtained having a higher life, whilst in an open system the product was semi-solid, less sticky and less tacky having a shorter life. The only significant difference in appearance was in the products (comps. 7 and 14) which were semi-solid, tough and non-tacky and obtained in an open system using lac and ethylene glycol in the molar proportion of 1:7.

It will also be evident from the chemical constants that the acid and hydroxyl values decrease during the reaction of shellac with ethylene glycol. The following types of reactions are likely to occur during the process:

(i) Esterification of the carboxyl group of shellac with ethylene glycol.

(ii) Etherification of hydroxyl groups of shellac with ethylene glycol.

(iii) Hemiacetal or acetal formation of the carbonyl group of shellac with ethylene glycol.

In reactions of type (i), one ethylene glycol molecule may react either with one carboxyl group of one lac molecule forming a monoester, or with two carboxyl groups of two lac molecules forming a diester, affording neutral products in each case. Theoretically, the monoester will have a molecular weight of 1044, a hydroxyl value of 322.4 and 6 hydroxyls free, whilst the values for diester will be 2026, 276.4 and 10 respectively. Since the actual hydroxyl values of the products are much lower and the acid values sufficiently higher than those expected in the above esters, this type of reaction may be ruled out as the principal one.

The etherification of one or two molecules of lac can take place with 1, 2, 3, 4 or 5 molecules of ethylene glycol. In the first case, the products will have one carboxyl and five hydroxyls free having acid values, hydroxyl values and molecular weights lying between 54–46, 269–230 and 1044–1220 respectively. In the second case the products will have two carboxyls free in each and 8, 6, 4, 2 and 0 hydroxyls free respectively. Their acid values, hydroxyl values and molecular weights will lie between 55–53, 221–0 and 2026–2130 respectively. These theoretical values, however, do not agree well with the observed values. Taking all the probabilities into consideration, it would appear from the observed and the calculated values that one hydroxyl of each of five ethylene glycol molecules reacts with five hydroxyl of shellac leaving one hydroxyl of each ethylene glycol free, and that most probably two such ether molecules form a dimer by auto-condensation, a carboxyl of one esterifying with a hydroxyl of another (see columns 2 and 4, Table 3).

It is believed that the masked aldehyde is present in lac as an acylal linkage which is likely to open up in presence of sulfuric acid catalyst[7]. Since the ethers showed the absence of any free aldehydic function, it can be assumed that along with the etherification reaction, hemiacetal, diacetal or cyclic acetal formation has also occurred simultaneously. In cases of dimeric hemiacetal or diacetal, the theoretical hydroxyl values and the number of free hydroxyl groups are higher than the observed values (see cols. 7 and 10, Table 3), whilst for cyclic acetal the values agree closely with the observed values (col. 13, Table 3). Thus, it may be presumed that the lac-glycol ethers are in fact dimers which have been formed through: (a) etherification of the five hydroxyls of shellac with one hydroxyl of each of 5 molecules of ethylene glycol; (b) cyclic acetal formation of the aldehydic group of lac with ethylene glycol; and (c) simultaneous esterification of carboxyl of one monomeric ether with a hydroxyl of another monomeric ether. Of course, it cannot be said with certainty that only dimers are present; minor proportions of trimers and monomers may also be present.

The ethers are dark, sticky, tacky and soft to semi-solid masses which very slowly change in consistency on prolonged storage. They are completely soluble in rectified spirit, butyl alcohol, ethylacetate, acetone, methyl ethyl ketone and methyl isobutyl ketone, partially in methanol and insoluble in petroleum hydrocarbons, ether, benzene, toluene and xylene. They are also soluble in aqueous bases,

Table 2
Preparation and properties of lac-ether and lac-ether-esters

	Reactants in parts							Reaction		Properties				
Composition No.	Shellac	Ethylene glycol	Sebacic acid	Adipic acid	Maleic acid	Maleic anhydride	Phthalic anhydride	Temp. (°C)	Time (hr)	Acid value	Hydroxyl value	Life at 150°C (min.)	No. of OH groups	Appearance of products
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Waxy	–	–	–	–	–	–	–	–	66.5	266.3	64	*Ca.*5	Hard and brittle
2	Waxy 100	37.2	–	–	–	–	–	180–190(F)	2.5	21.5	201.8	200	9.4	Soft, sticky and tacky
3	Waxy 100	37.2	–	–	–	–	–	180–190(B)	2.5	21.9	200.5	80	9.2	Semi-solid, sticky and tacky
4	Waxy 100	37.2	–	–	–	–	–	145–150(F)	4.0	21.3	194.0	200	9.2	Soft, sticky and tacky
5	Waxy 100	37.2	–	–	–	–	–	145–150(B)	4.0	20.9	180.0	130	8.6	Semi-solid, sticky and tacky
6	Waxy 100	43.4	–	–	–	–	–	145–150(F)	4.0	21.7	193.7	225	8.9	Soft, sticky and tacky
7	Waxy 100	43.4	–	–	–	–	–	145–150(B)	4.0	18.8	179.5	70	9.5	Semi-solid, tough and non-tacky
8	Dewaxed	–	–	–	–	–	–	–	–	69.0	270.0	30	*Ca.*5	Hard and brittle
9	Dewaxed 100	37.2	–	–	–	–	–	180–190(F)	2.5	21.3	200.4	150	9.4	Soft, sticky and tacky
10	Dewaxed 100	37.2	–	–	–	–	–	180–190(B)	2.5	21.1	194.6	80	9.2	Semi-solid, sticky and tacky
11	Dewaxed 100	37.2	–	–	–	–	–	145–150(F)	4.0	21.1	182.8	135	8.7	Soft, sticky and tacky
12	Dewaxed 100	37.2	–	–	–	–	–	145–150(B)	4.0	22.0	194.0	90	8.9	Semi-solid, sticky and tacky
13	Dewaxed 100	43.4	–	–	–	–	–	145–150(F)	4.0	19.4	173.9	150	9.0	Soft, sticky and tacky
14	Dewaxed 100	43.4	–	–	–	–	–	145–150(B)	4.0	20.6	185.1	60	9.0	Semi-solid, tough and less tacky
15	Dewaxed 100	37.2	50	–	–	–	–	145–150(F)	4+4	22.1	176.5	46	8.0	Soft, sticky and tacky
16	Dewaxed 100	37.2	–	50	–	–	–	145–150(F)	4+4	21.4	179.8	54	8.4	Soft, sticky and tacky
17	Dewaxed 100	37.2	–	–	50	–	–	145–150(F)	4+4	21.8	174.0	50	8.0	Soft, sticky and tacky
18	Dewaxed 100	37.2	–	–	–	50	–	145–150(F)	4+4	21.7	169.6	45	7.8	Soft, sticky and tacky
19	Dewaxed 100	37.2	–	–	–	–	50	145–150(F)	4+4	22.8	177.1	51	7.8	Soft, sticky and tacky
20	Comp. 9–100	–	50	–	–	–	–	145–150(B)	4.0	30.7	152.0	65	5.0	Soft, sticky and tacky
21	Comp. 10–100	–	50	–	–	–	–	145–150(B)	3.75	28.1	143.2	50	5.1	Semi-solid and less tacky
22	Comp. 11–100	–	50	–	–	–	–	145–150(B)	4.75	29.0	149.1	70	5.1	Soft, sticky and tacky
23	Comp. 12–100	–	50	–	–	–	–	145–150(B)	4.0	28.8	142.7	50	5.0	Semi-solid and less tacky
24	Comp. 5–100	–	50	–	–	–	–	145–150(B)	3.5	27.9	142.8	30	5.1	Semi-solid and less tacky
25	Comp. 13–100	–	50	–	–	–	–	145–150(B)	4.0	28.8	152.6	45	5.3	Semi-solid and less tacky
26	Comp. 14–100	–	50	–	–	–	–	145–150(B)	0.83	27.2	170.8	45	6.3	Hard, tough and flexible
27	Comp. 14–100	–	–	50	–	–	–	145–150(B)	0.75	32.1	208.9	40	6.4	Hard, tough and flexible
28	Comp. 10–100	–	–	50	–	–	–	145–150(B)	4.0	34.8	160.5	60	4.6	Semi-solid and less tacky
29	Comp. 12–100	–	–	50	–	–	–	145–150(B)	4.0	31.2	156.3	60	5.0	Semi-solid and less tacky
30	Comp. 12–100	–	–	–	50	–	–	145–150(B)	2.0	29.3	156.5	50	5.3	Semi-solid and less tacky
31	Comp. 12–100	–	–	–	–	50	–	145–150(B)	4.5	29.9	157.2	40	5.3	Semi-solid and less tacky
32	Comp. 12–100	–	–	–	–	–	50	145–150(B)	2.5	30.9	160.0	45	5.2	Hard, tough and flexible
33	Comp. 11–100	–	–	–	–	–	50	145–150(B)	4.0	30.1	153.5	50	5.1	Hard, tough and flexible
34	Comp. 5–100	–	–	–	–	–	50	145–150(B)	3.0	32.9	172.3	40	5.2	Hard, tough and flexible

F = flask; B = stainless steel beaker

Table 3
Chemical constants observed and calculated for the ethers

Constants	Values observed	Values calculated for*											
		Etherification only (a)			Etherification and hemiacetal formation (b)			Etherification and diacetal formation (c)			Etherification and cyclic acetal formation (d)		
1	2	Monomer 3	dimer 4	Trimer 5	Monomer 6	dimer 7	trimer 8	Monomer 9	dimer 10	trimer 11	Monomer 12	dimer 13	trimer 14
1. Acid value	19–22	46.0	23.1	15.5	43.8	22.0	14.7	42.3	21.1	14.3	44.4	22.4	14.9
2. Hydroxyl value	174–202	230.0	207.9	201.5	306.6	286.0	279.3	296.1	274.3	271.7	222.0	201.6	193.7
3. Molecular weight	2609–2795 (end point method)	1220	2422	3624	1282	2546	3810	1326	2634	3942	1264	2510	3756
4. No. of free OH groups	9	5	9	13	7	13	19	7	13	19	5	9	13

*Basis of calculation: (a) 5 moles of glycol have reacted with 5 OH of lac molecule with the elimination of 5 H_2O leaving 5 OH of the glycol and the COOH of lac free to give the monomer; 1 OH of a monomer has reacted with the COOH of another monomer to give the dimer leaving 9 OH and 1 COOH free; 1 OH of the dimer has reacted with the COOH of another monomer to give the trimer leaving 13 OH and 1 COOH free.

(b) 6 moles of glycol have reacted with 5 OH and 1 CHO of lac forming ether and hemiacetal with the elimination of 5 H_2O leaving 7 OH and 1 COOH free to give the monomer; for dimer and trimer similar to (a) leaving 13 and 19 OH and 1 COOH free respectively.

(c) 7 moles of glycol have reacted with 5 OH and 1 CHO of lac forming ether and diacetal with the elimination of 6 H_2O leaving 7 OH and 1 COOH free to give the monomer; for dimer and trimer similar to (b).

(d) 6 moles of glycol have reacted with 5 OH and 1 CHO of lac forming ether and cyclic acetal with the elimination of 6 H_2O leaving 5 OH and 1 COOH free to give the monomer; for dimer and trimer similar to (a).

Table 4
Chemical constants observed and calculated for various lac-ether esters under different conditions

Ester composition		Acid value		Hydroxyl value		Molecular weight		No. of OH present		
(see Table 2) 1		Observed 2	Calculated 3	Observed 4	Calculated 5	Observed 6	Calculated 7	Observed 8	Calculated 9	Remarks 10
1	23	28.8	26.1	142.7	130.5	5843	6200	5.0	5.0	Calculated on the basis of 7 moles of acid have reacted with 13 hydroxyls of 2 dimeric ethers (Column 13, Table 3) leaving 5 hydroxyls and 3 carboxyls free.
2	29	31.2	29.0	156.3	145.0	5394	5808	5.0	5.0	
3	30	29.3	30.1	156.5	150.5	5744	5598	5.3	5.0	
4	31	29.9	30.8	157.2	154.0	5629	5472	5.3	5.0	
5	32	30.9	28.9	160.0	144.5	5447	5822	5.2	5.0	
6	15	21.4	20.1	179.8	160.8	5243	5570	8.4	8.0	Calculated on the basis of 5 moles of acid have reacted with 5 pairs of hydroxyls of 2 dimeric ethers (column 13, Table 3) leaving 8 hydroxyls and 2 carboxyls free.
7	16	22.1	19.2	176.5	153.6	5077	5870	8.0	8.0	
8	17	21.8	21.1	174.0	168.8	5147	5420	8.0	8.0	
9	18	21.7	21.1	169.6	168.8	5171	5330	7.8	8.0	
10	19	22.8	20.1	177.1	160.8	4921	5580	7.8	8.0	

Table 5
Film properties of lac-ether and lac-ether ester compositions

Composition No.	Film appearance (air dried)	Water resistance (48 hr)		Acid resistance (48 hr)		Scratch hardness (g)		Flexibility		Elasticity	
		A.D.	Baked	A.D.	Baked	A.D.	Baked	A.D.	Baked	A.D.	Baked
1	2	3	4	5	6	7	8	9	10	11	12
1	Smooth, glossy and non-tacky	B	NB	B	NB	500	600	P	P	P	P
2	Smooth, glossy and slightly tacky	B	NB	B	NB	300	400	P	P	P	P
3	Smooth, glossy and slightly tacky	B	NB	B	NB	200	300	P	P	P	P
4	Smooth, glossy and slightly tacky	B	NB	B	NB	200	300	P	P	P	P
5	Smooth, glossy and slightly tacky	B	NB	B	NB	200	300	P	P	P	P
6	Smooth, glossy and slightly tacky	B	NB	B	NB	400	500	P	P	P	P
7	Smooth, glossy and non-tacky	B	NB	B	NB	400	500	P	P	P	P
8	Smooth, glossy and non-tacky	B	NB	B	NB	500	600	F	P	F	P
9	Smooth, glossy and slightly tacky	B	NB	B	NB	200	300	P	P	P	P
10	Smooth, glossy and slightly tacky	B	NB	B	NB	300	400	P	P	P	P
11	Smooth, glossy and slightly tacky	B	NB	B	NB	300	400	P	P	P	P
12	Smooth, glossy and slightly tacky	B	NB	B	NB	300	400	P	P	P	P
13	Smooth, glossy and slightly tacky	B	NB	B	NB	400	500	P	P	P	P
14	Smooth, glossy and very slightly tacky	B	NB	B	NB	400	500	P	P	P	P
15	Smooth, semi-glossy and highly tacky	B	NB	B	NB	–	–	P	P	P	P
16	Smooth, semi-glossy and highly tacky	B	NB	B	NB	–	–	P	P	P	P
17	Smooth, semi-glossy and highly tacky	B	NB	B	NB	–	–	P	P	P	P
18	Smooth, semi-glossy and highly tacky	B	NB	B	NB	–	–	P	P	P	P
19	Smooth, semi-glossy and highly tacky	B	NB	B	NB	–	–	P	P	P	P
20	Smooth, semi-glossy and highly tacky	B	NB	B	NB	700	800	P	P	P	P
21	Smooth, glossy and slightly tacky	B	NB	B	NB	600	700	P	P	P	P
22	Smooth, semi-glossy and highly tacky	B	NB	B	NB	600	700	P	P	P	P
23	Smooth, glossy and slightly tacky	B	NB	B	NB	600	700	P	P	P	P
24	Smooth, glossy and slightly tacky	B	NB	B	NB	600	700	P	P	P	P
25	Smooth, glossy and slightly tacky	B	NB	B	NB	600	700	P	P	P	P
26	Smooth, glossy and non-tacky	B	VSB	B	VSB	400	500	P	P	P	P
27	Smooth, glossy and non-tacky	B	VSB	B	VSB	300	400	P	P	P	P
28	Smooth, glossy and slightly tacky	B	NB	B	NB	500	600	P	P	P	P
29	Smooth, glossy and slightly tacky	B	NB	B	NB	500	600	P	P	P	P
30	Smooth, glossy and slightly tacky	B	NB	B	NB	500	600	P	P	P	P
31	Smooth, glossy and slightly tacky	B	NB	B	NB	600	700	P	P	P	P
32	Smooth, highly glossy and non-tacky	B	NB	B	NB	600	700	P	P	P	P
33	Smooth, highly glossy and non-tacky	B	NB	B	NB	800	900	P	P	P	P
34	Smooth, highly glossy and non-tacky	B	NB	B	NB	700	800	P	P	P	P

B = blush; NB = no blush; VSB = very slight blush; P = passed; F = failed; A.D. = air dried; Baked = baked at 150° for 1 hr.

both inorganic and organic. On heating they are converted to tough, flexible and rubbery products which are insoluble in all the above organic solvents.

Attempts have been made to modify further the soft, sticky and tacky ethers. It has been observed that in dimers at least nine hydroxyl groups are present in the free condition. Such types of compounds may be expected to react very easily with a suitable acid to give esters. Monobasic acids will give esters having practically no centre for further reaction and hence there will be no scope of their condensation/polymerisation leading to hard and tough masses. Esters have, therefore, been prepared from dibasic acids such as sebacic, adipic, maleic, maleic and phthalic anhydrides.

At the outset, the lives with various proportions of acids were determined and it was observed that with lower proportions of acid the life was not high enough. With 33.3 per cent acid (2:1 proportion, w/w), however, the life was high enough (4 to 5 hr) to give sufficient time for esterification to proceed and, thereby, resulting in desired polyester type of products.

The ethers were reacted with the acids at 145–150°C in a beaker without any catalyst for a period less than their gelation time. The unreacted acid was removed by washing repeatedly with hot water until the acid value of the esters became constant. The conditions of esterification and the chemical constants are shown in Table 2. In a few cases (compounds 15 to 19) the etherification was carried out for 4 hr, the dicarboxylic acid added and esterification carried out for a further period of 4 hr. These latter compositions and those esters prepared from closed system ethers were soft, highly sticky and highly tacky, but those prepared from open condition ethers were less tacky and sticky, semisolid to hard and tough masses. Normally the esters have higher acid values (27–35), lower hydroxyl values (143 to 172) and lower lives (30–70) in comparison with the corresponding ethers, except for compounds 15 to 19 where the acid values were of the same order as those of the ethers.

The esters are soluble in rectified spirit, ethyl acetate, acetone, ethyl methyl ketone, ethyl isobutyl ketone, warm methanol and insoluble in ether, petroleum ether, benzene, toluene and xylene. They are also easily soluble in alkaline solutions. As expected, they are converted on heating to tough, flexible and rubbery materials which, though insoluble in all the above solvents, dissolved easily in ammoniacal solutions.

Although the dicarboxylic acids were taken in sufficient excess, five hydroxyls remained free in the esters; however, in compounds 15 to 19 eight remained free. The observed and calculated acid values, hydroxyl values, molecular weights and number of free hydroxyls for a few specific esters (Table 4) were found to be in very good agreement. It would appear from this data that probably seven acid molecules have reacted with two dimeric ethers (which have 9 pairs of hydroxyls); six acid molecules with 6 pairs of hydroxyls and one molecule with one of the remaining 3 pairs of hydroxyls, leaving five hydroxyls, one carboxyl of the dibasic acid and two carboxyls of the dimeric ethers free. Similarly in compounds 15 to 19, it would appear that five molecules of acid have reacted with 5 pairs of hydroxyls leaving eight hydroxyls and two carboxyls of the dimeric ethers free. It seems evident that better esterification resulted when it was carried out with washed ether in the absence of catalyst and with a large excess of dicarboxylic acid.

Esterification of compound 14 did not proceed to the desired extent as the reaction period was short and resulted in products having higher hydroxyl values and at least six free hydroxyls (see compounds 26 and 27), whilst compound 13 gave usual esters (see compound 25). This indicates that ethers obtained by taking lac and glycol in the proportion of 1:6 either in open or closed condition are quite suitable for the preparation of esters from dibasic acids.

Film properties

The properties of the films from ethers and esters are shown in Table 5.

Finish: The air dried and baked (1 hr at 150°C) films of the ethers on glass, tin and aluminium surfaces were smooth and glossy. The air dried films from the esters though were usually smooth, compounds 15 to 20, and 22 gave semi-glossy and highly tacky films, compounds 32 to 34 highly glossy and non-tacky films, whilst the remainder gave glossy and slightly tacky films. The slight tackiness of the films could, however, be completely removed by baking at 150°C for 1 hr, but the highly tacky ones required at least 5–12 hr baking. The gloss of the films was retained even after baking. The slight tackiness of the air dried films improved sufficiently with the addition of a little ammonia to the varnish.

Hardness: There was no improvement over untreated lac in the cases of ether films; in fact the values were almost half that of lac. With the ester films, there was appreciable improvement in hardness, except for compounds 26 and 27. The greatest hardness was given by the phthalic anhydride esters which were also highly glossy and non-tacky.

Flexibility: All the air dried and baked films showed satisfactory performance, even when the panels were folded double; the only exception was air dried films from dewaxed lac.

Impact resistance: All the air dried and baked films passed the test, with the exception of air dried films from dewaxed lac.

Water and acid resistance: All the air dried films blushed within half an hour and the recovery time was within 30–60 min. All the baked films were resistant to water (7 days) and acid, except for compounds 26 and 27 which showed very slight blushing.

Alkali resistance: All the air dried, as well as baked, films dissolved very easily in alkali solution within a very short period.

Weather resistance of paint films

Since films from lac ether and its phthalic ester showed good performance, these were used for the preparation of aqueous paints. The paints, when applied on tin and mild steel panels (20 x 30 cm) gave uniform, smooth and hard films; the lower percentage of pigments resulting in a glossy finish. The touch dry time of the lac ether films was 2–7 days and that of ester within 24 hr. One hour's baking at 150°C resulted in a semi-glossy, non-tacky finish. The air dried films blushed easily whilst the baked ones only slightly when kept in water for 48 hr.

One set of the baked films was tested for weather resistance on the roof of the laboratory and another set within the laboratory. The former lost their gloss within three weeks with on-set of chalking. There was no tendency of rusting in any of the panels up to six month's standing, but this gradually developed afterwards. Indoors, the films kept well for over one year and a half, without any chalking, rusting or loss of gloss. The behaviour of other paints based on chrome yellow, lamp black and Brunswick green was almost similar. Top coats on these normally gave a glossy and adherent finish.

The esters from compound 14 did give glossy and non-tacky films which after baking blushed very slightly in water, but the hardness was poor. This may be due to the fact that esterification did not proceed to the desired extent because of shorter life of the reactants.

Compounds 15 to 20 and 22 were soft, highly tacky and sticky. Their tackiness could be removed only by prolonged baking at 150°C. Addition of ammonia did not help. Curing agents, such as p-toluene sulfonic acid, tartaric acid and oxalic acid were tried. Only 2 per cent of the first acid was found to reduce the baking time to 2–3 hr to give a tack-free finish. Addition of lac was also found to improve the tackiness, and with 50:50 proportion, a complete tack-free finish was obtained after 2 hr baking. The tackiness of the above esters, as well as of the ethers could, however, be completely removed by baking at 200°C for 1 hr. Films baked in this way surprisingly retained their gloss, hardness and flexibility (folded double), and were resistant to impact, water, acid, 90 per cent alcohol, oils and solvents like esters, ketones and hydrocarbons, but not alkali.

Air dried films on paper or cloth from the alcoholic solution of the highly tacky and sticky esters, particularly from compound 20, adhered with slight pressure to paper, cloth, metal, wood and glass surfaces and could be lifted very easily by pulling, without losing their adhesive property. Thus, it could be used a good number of times.

The electrical breakdown strength (BDS) of the films, specially those from the ethers, were of the order of 0.700 kV/mil, which is equal to that of the untreated lac used for modification.

It has been mentioned earlier that on polymerisation, the ethers and esters were converted to tough rubbery materials which were insoluble in almost all solvents. However, the ester polymers only were found easily soluble in ammonia. A 25 per cent solution (ammoniacal) of these polymers gave tack-free and glossy films on air drying. The touch dry time was within 5–10 min. However, they blushed very easily in water. But baking at 150°C for 1 hr resulted in highly flexible, hard and glossy films resistant to impact, water, acid, 90 per cent alcohol, oils and other solvents for days together, but as usual, not to alkali.

It has been found that the air dried as well as baked films dissolved very easily in the presence of alkali. Some preliminary work showed that the coatings may be made alkali resistant when modified with polyisocyanates.

Taking into consideration the properties and performances as far as surface coating is concerned, the behaviour of esters prepared from open system ethers by method (a) was superior to those prepared by method (b).

Possible uses

(1) In general, it was found that the baked films were remarkably adherent to any substrate, as there was no tendency towards lifting, even after dipping in water for 7 days. At the same time their flexibility, resistance to impact, water, acid and solvents were far superior and the BDS equal to lac. Moreover, films prepared three years before on glass and metal panels have so far kept all the properties intact. These properties suggest their uses in the fields of plasticisers, metal lacquers, surface coatings, electrical insulation, impregnating agents etc.

(2) The highly tacky and sticky nature of some esters indicate their uses as an anti-skid material, rust inhibitors for steel structures during storage, insulating tape, cements and adhesives.

(3) The paints based on the ethers and esters can only be used indoors for painting steel and wooden structures or other decorative structural painting. The paints have not gelled during storage for over two years so far and the settled pigments may be dispersed by agitation.

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References

1. Bose, P. K., Sankaranarayanan, Y. and Sengupta, S. C., "Chemistry of Lac", *Indian Lac Research Inst.*, 1963, Chap X, 182–190.
2. (a) Bhattacharya, R. and Gidvani, B. S., *J. Soc. Chem Ind.*, 1938, **57**, 285;
   (b) Gidvani, B. S., *Chem & Ind.*, 1939, **58**, 10; *London Shellac Res. Bur.*, Tech. Paper No. 17, 1939;
   (c) Gidvani, B. S. and Kamath, N. R., *ibid*, Tech. Paper Nos. 23, 1944 and 28, 1945.
3. Bhattacharya, P. R. and Venugopalan, M., Annual Report, *Indian Lac Research Inst.*, 1950–51, 21 and 1951–52, 22.
4. Ghatge, N. D. and Gujar, K. B., *IndJ.Tech.*, 1972, **10**, 148.
5. "A Handbook of Shellac Analysis", *Indian Lac Research Inst.*, 2nd Edition, 1952.
6. Ref. 1, p 43.
7. Sengupta, S. C., Agarwal, S. C. and Prasad, N., *JOCCA*, 1979, **62**, 85.
8. Sankaranarayanan, Y., Annual Report, *Indian Lac Research Inst.*, 1949–50, 18; 1950–51, 17; Gupta, P. C., Mukherjee, M. and Sankaranarayanan, Y., *Paintindia*, 1969, **19** (9), 26.

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Epoxy-chromate coatings: Electric and membrane results

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Summary

Measurements of potential and resistance for an epoxy-chromate paint show that there is no protection for long immersion periods in water with a chloride ion content higher than 100 ppm, when the metal base is steel.

Measurements of water absorption and chloride content in free films and films attached to steel and glass indicate that there is a special interaction between metal and both ion species (water and chloride ions). This interaction is not present in the case of films attached to glass or the free films.

Keywords

Types and classes of coatings and allied products
anticorrosive coating

Types and classes of structures or surfaces to be coated
steel

Properties, characteristics and conditions primarily associated with materials in general
electrical resistivity

Raw materials for coatings
binders (resins, etc.)
epoxy resin

chemically active pigments
zinc chromate

Processes and methods primarily associated with analysis, measurement or testing
absorption

Revêtements époxyde/chromate: les résultats électriques et absorptiométriques

Résumé

Les mesures du potentiel et de la résistance électrique d'une peinture époxyde/chromate indiquent, où il s'agit d'un support en acier, qu'il n'y a pas de protection pendant de longues périodes d'immersion en eau ayant une teneur en ions de chlorure au delà de 100 ppm.

Les mesures de l'absorption de l'eau et de la teneur en chlorure sur les films sans support et aussi sur ceux déposés soit sur acier ou sur verre indiquent qu'il y a une interaction particulière du métal et toutes les deux espèces ioniques (les ions de chlorure et d'eau). Cette interaction ne se présente pas dans le cas des films sur verre ou sans support.

Epoxy-Chromatanstriche: Elektrische und membran-Resultate

Zusammenfassung

Messungen des Potentials und Widerstands an einem Epoxy-Chromate Aufstrich zeigen, dass Metallsubstrate aus Stahl in Gewässern mit einem über 100 ppm liegenden Chloridionengehalt von diesem während langer Eintauchperioden nicht geschützt werden.

Messungen von Wasserabsorption und Chloridgehalt an freien Filmen und an Stahl und Glas haftenden Filmen deuten an, dass eine besondere Reaktion zwischen Metall und beiden Ionen Spezies (Wasser- und Chloridionen) stattfindet. Diese Zwischenreaktion findet nicht statt, wenn der Film sich auf Glas befindet oder frei ist.

Introduction

Refs. 1–3

In a previous work[1] the authors analysed the capacity of chromate to passivate the steel in a chloride solution. It was demonstrated that in the range from 10^{-4} to 10^{-1} molar concentration of the chromate ion (which corresponds to the solubility products of the most common pigments), the chromate ion is not able to passivate the steel in the presence of chloride ion concentrations from 100 to 50 000 ppm in the same solution.

These experiments were carried out in such a manner as to reproduce the paint process: immersion for twenty days in chromate solution of various concentrations, followed by the immersion of the same specimens in the same chromate solution concentrations, but in the presence of different amounts of chloride ion (from 0 to 50 000 ppm).

The choice of the first twenty days was made on the basis that the chromium content on the surface of the metal reaches the equilibrium, at the passified film, after about 15 days[2].

To translate these results from the metal/solution environment to a metal/paint/solution one, it was necessary to determine the water and chloride content in the film, on the assumption that the chloride concentration could be expressed with physical significance, in terms of the ppm of the water content inside the film. The present work has been done to obtain these results for a chromate epoxy paint.

It is well known that epoxy/chromate is commonly used as an anticorrosive primer for ships. This work demonstrates that it must be used with care when used on structures which cannot be easily repainted and will be immersed in water containing chloride.

The results also show that the amount of water absorbed in attached films is quite different from that of free films, as pointed out by Funke[3] in relation to the accumulation of water in the metal/film interphase, but also due to some possible special influence of the metal itself, as shown by the different results on films applied to metal and to glass.

These experiments introduce serious doubts about the extrapolation of the free film results to films applied, in actual practice.

Experimental

Ref. 4

Paint characterisation

The monomer of the epoxy resin was the diglycidyl ether of the bisphenol A. The curing agent was a polyamide-amine derived from fatty acids. The pigment used was the zinc basic chromate ($2ZnO.CrO_3.H_2O$) and zinc oxide (ZnO). Hematite (Fe_2O_3) and talc ($Mg_3H_2(SiO_3)_4$) were also present. The composition of the paint when mixed with the curing agent was: 30 per cent solvent, 57 per cent solids and 13 per cent vehicle.

The proportions in the dry film were: hematite 33 per cent (Fe_2O_3, 80 per cent), zinc basic chromate 28 per cent, zinc oxide 11 per cent (82 per cent rich) and talc 28 per cent.

The surface treatment was by sand blasting and the specimens were kept in water-free xylene until required for painting. The surface roughness was between 20 and 30μm (R_t), and the thickness of the films was up to 200μm.

The paint was applied by brushing and the curing time was two months at room temperature.

The adhesion was very good and the chipping test was negative[4]. There was no porosity[4] for thicknesses greater than 50μm and it was possible to detect some porosity in thinner films.

The indentation test[4] shows high hardness of the film. The tests did not penetrate to the metal surface even with a 4 Kg load. Figure 1 shows the profile of indentation depth for different loads.

Measurements

The electrical potential measurements of the metal/film/solution interface were made against a normal calomel electrode (NCE) with Keithley electrometer (impedance in the order of $10^{14}\,\Omega$).

The resistances of the applied films against the direct current were measured with a dry cell as current source and a Keithley instrument as current detector in series with the film and the dry cell. In these measurements the other electrode was platinum to avoid polarisation.

An isopiestic method was used for the equilibration of the water contents in the films. This equilibration was done for 1.00, 0.902 and 0.807 water activities. The films were dried in the presence of phosphorus pentoxide. The amount of water, as a percentage of the dry film weight, was followed by weighing because the absorption and desorption rates of water in these membranes are so slow, that it is possible to perform these measurements without significant errors.

The determination of chloride ion concentration in ppm of the water content, was made after complete removal of this ion by several exchange experiments against distilled water, by means of a chloride calibrated selective electrode. The samples were first washed with distilled water.

Results and discussions

Refs. 1–9

The potential and resistance measurements

The ageing of the films were made at different chloride concentrations (from 0 to 50 000 ppm) and at two temperatures (room temperature and 50°C). The higher one was made to accelerate the phenomena.

The progress in these experiments was followed by potential and DC resistance measurements.

In Figure 2 typical changes in resistance are shown. It can be seen that the rate of decrease at the beginning of the run is much greater at 50°C than at 20°C and the hydration time could be estimated in less than one day.

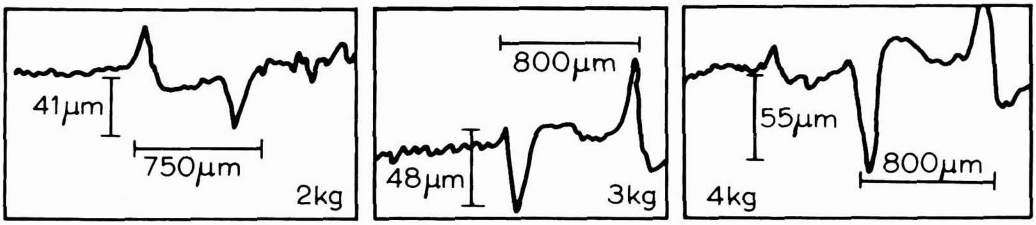

Figure 1. Indentation profile for various loads on an epoxy chromate paint sample.

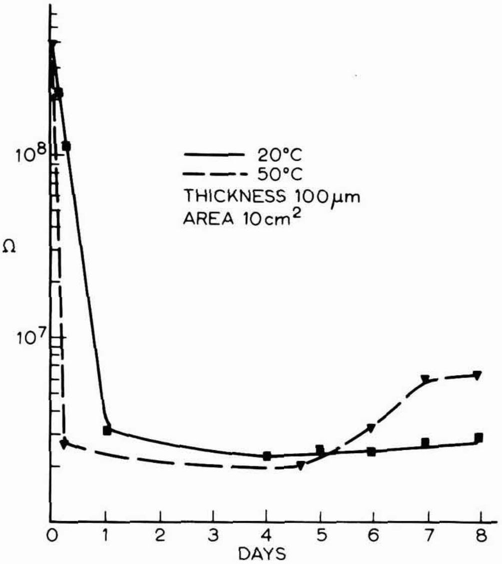

Figure 2. Change in resistance versus time for 20 and 50 °C. Film thickness 100 μm. Area 10 cm².

Continuous potential measurements at room temperature were followed for up to eight days immersion.

For chloride ions at up to 500 ppm in the external solution, the potentials were higher than –300 mV (NCE). At higher chloride concentrations they were lower than –500 mV (NCE). If it is taken into account that the Flade potential for iron at a pH of 7 can be taken as –110 mV (NCE)[5] and that the paint film can act as an ohmic barrier between anodic and cathodic areas, it is possible to consider potentials of –300 mV (NCE) for steel, as the passivation region. This idea agrees with earlier results[6] and means that at up to 500 ppm of chloride content in the external solution there is a real protection of the steel by the epoxy chromate paint at room temperature for this period of time.

Nevertheless, the fact that the experiments at 50 °C have shown that for the same period of time and for even lower chloride concentration (100 ppm), potentials of between –650 and –710 mV (NCE) are found which could be attributed to free corrosion potentials, shows that even for thickness higher than 100 μm there is no protection for longer exposure times at room temperatures.

Later experiments at room temperature which measured potential during a period of one year have proven this conclusion, even for 100 ppm of chloride. The application of a coal tar epoxy top paint will only postpone the damage allowing longer immersion times useful for ships, but not, for instance, for pressure tubes of a hydroelectric power station.

Water content of attached and free films

The comparison between the amount of water in a free film and in an attached one can be seen in Figure 3, for 0.902 water activity and at the beginning of absorption. The crossing point gives a time order of two hundred minutes for the quasi-equilibrium water content. This value is, of course, less than that obtained from resistance measurements for the equilibrium absorption time.

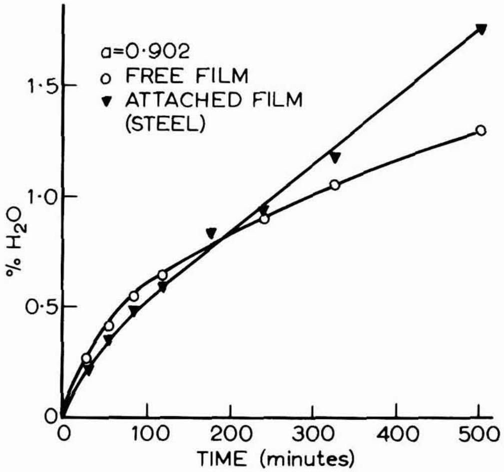

Figure 3. Absorption of water versus time for 0.902 external water activity for free and attached (to steel) films 20 °C.

Figure 4 shows the water content increase over long periods of time for free films and different water activities. The values are lower than 3 per cent and they increased with the water activity; the time of equilibration from these measurements could be estimated in sixty hours.

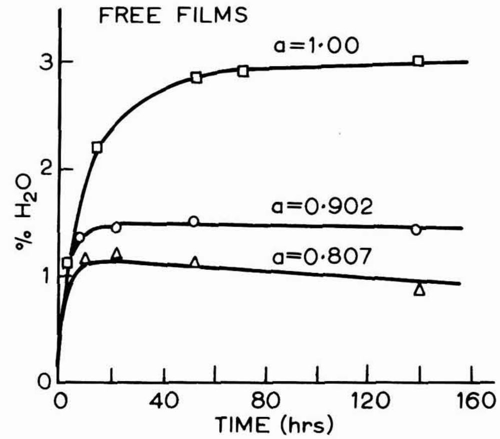

Figure 4. Absorption of water versus time for various water activities with free films at 20 °C.

Figure 5 shows the same results, but for films attached to steel. The water content goes from 3 to 13 per cent when the water activity is increased. The results show clearly that the applied films have a higher water content than the free films of the same thickness. The presence of the solid surface and/or the fact that this surface is a metal, could be the reason for this phenomenon. Funke[3] has proposed that there is water accumulation in the metal/film interface.

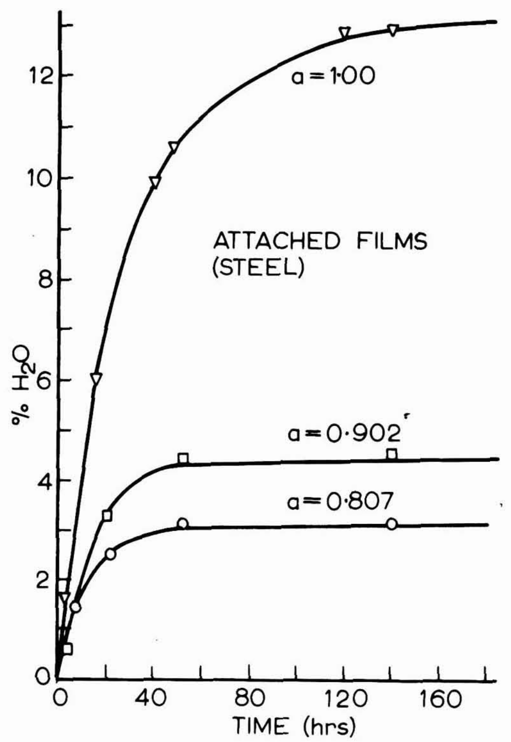

Figure 5. Absorption of water versus time for various water activities with films attached to steel, at 20°C.

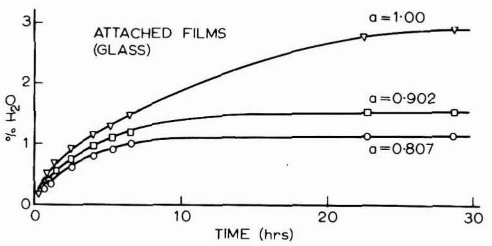

Figure 6. Absorption of water versus time for various water activities with films attached to glass, at 20°C.

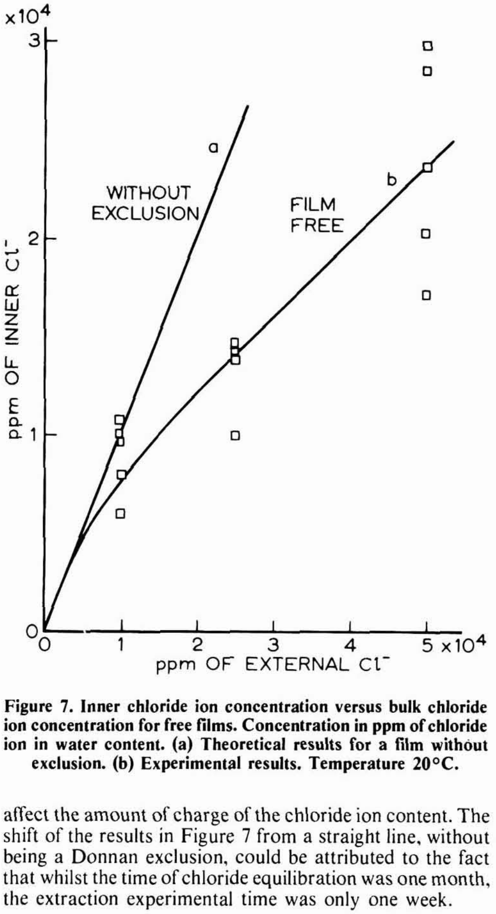

Figure 7. Inner chloride ion concentration versus bulk chloride ion concentration for free films. Concentration in ppm of chloride ion in water content. (a) Theoretical results for a film without exclusion. (b) Experimental results. Temperature 20°C.

Figure 6 shows the water content obtained for different water activities, but for films attached to a glass surface. The comparison of these results with those of the earlier figures shows that the greater amount of water for attached films on metals could not be attributed to the presence of the solid surface in itself. The water content of attached films on glass is practically the same as that of the free films. Thus, it is necessary to consider that there must be some special interaction between the metal and the water in films attached to metal. Perhaps a charge-dipole interaction and/or an interaction with the corrosion products of the metal surface should be considered.

Chloride content

All the results are based on the hypothesis that the presence of chloride ions does not change the percentage water content between the free and attached films.

Figure 7 shows the chloride ion concentration in the film versus the bulk one (the concentrations are given in ppm of chloride ion, in water content).

To compare these results with those of a membrane without exclusion, a straight line representing the latter has been added.

The fact that the partition coeficient ($K=\bar{c}/c$, $\bar{c}$ inside the membrane and c outside the membrane) falls between 0.1 and 1.0 is a clear evidence that there is no Donnan exclusion. This means the amount of the fixed charge does not affect the amount of charge of the chloride ion content. The shift of the results in Figure 7 from a straight line, without being a Donnan exclusion, could be attributed to the fact that whilst the time of chloride equilibration was one month, the extraction experimental time was only one week.

In Figure 8 the same results are presented, but for films attached to steel. In this case the figure shows a strong exclusion. It seems that the inner chloride concentration reaches a maximum value of 400 ppm, which must be compared to the value of 9000 ppm for free film lower contents.

This exclusion must be related to the presence of the metal surface. It could be considered that the charge on the metal surface produces an extended double layer inside the

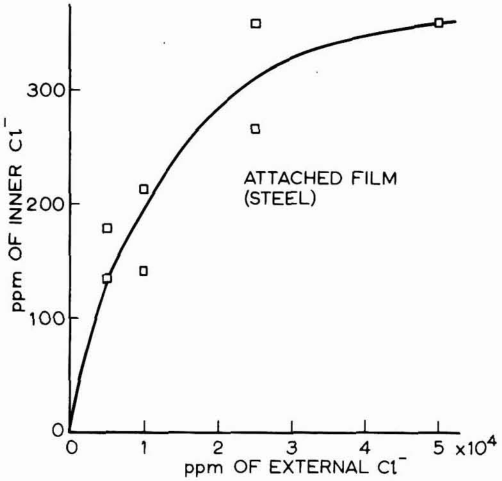

Figure 8. Inner chloride ion concentration versus bulk chloride ion concentration for films attached to steel. Concentration in ppm of chloride ion in water content. Temperature 20°C.

film (due to a very low charge density in the film side). In this case, if $\overline{c} = c \exp -F\Phi/RT$ is considered, an exclusion average potential (Φ) of about 100 mV is needed, with the negative side to the metal. Nevertheless, the rest potential found corresponds to a positive charge region on the metal (the zero charge potential for iron is about −650 mV vs NCE[7]). Perhaps this fact can be explained by the idea that the chromate ion absorption[5,8,9] shifts the potential of zero charge to more positive values and/or it is possible that the value for iron cannot be used for steel.

Another explanation of this exclusion could be related to the presence of the corrosion products of the steel inside the film, which might retain the chloride ions.

Conclusions

1. Over long periods of time, for steel structures which are not easy to repaint, it must be considered that the epoxy chromate paint does not protect the steel adequately in waters with a chloride ion content higher than 100 ppm.

2. The water content of attached films studied on steel are higher than those of the free films. As the water content of attached films on glass are of the same order of magnitude as the free films, the excess of water content on the films attached to steel, must be attributed to a special metal/water interaction.

3. The exclusion of chloride ions on the films attached to the steel, but not in the free film, also indicates a special interaction which perhaps could be attributed to a potential gradient inside the film, or must be seen as a consequence of the presence of corrosion products inside the film.

4. In any case these results introduce some doubts about the extrapolation of free film results to the real paint situations.

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References

1. D'Alkaine, C. V., Corti, H., Garcia, C. and Gomez, D., 3rd Electrochem. & Corrosion Latinoamerican Meet., p. 201, 1977, *INIFTA*, La Plata, Argentine.
2. Brasher, D. M. and Kingsbury, A. H., *Trans. Far. Soc.*, 1958, **54,** 1214.
3. Funke, W., *JOCCA,* 1976, **59,** 398.
4. Corti, H., D'Alkaine, C. V., Fernandez Prini, R., Garcia, C., Gomez, D. and Kapusta, S. Corrosion Meeting, *Chem. Eng. Assoc.,* 1977, Rosario, Argentine.
5. Cartledge, G. H., *Z. Elektrokem,* 1958, **62,** 648.
6. D'Alkaine, C. V. and Garcia, C. *Nat. Inst. Techn.,* Electrochemical Sector. Contract No. 2814804-1977. Buenos Aires, Argentine.
7. Vetter, K. J., "Electrochemical Kinetics. Theoretical and experimental aspects", *Academic Press,* 1967.
8. Evans, U. R., *Electrochem. Acta,* 1971, **16,** 1825.
9. Cartledge, G. H. and Simpson, R. F., *J. Physical Chem.,* 1975, **61,** 973.

J. Oil Col. Chem. Assoc. 1980, **63**, 28–33

The coating of external plywood cladding panels

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Summary

Factors affecting the external durability of coated plywood are discussed and the requirements of the coating are deduced. A preference for emulsion bound, heavy textured coatings is indicated on the basis of requirements for low water vapour resistance, i.e. ca. 10 MNsg^{-1}, and high film thickness, >1 mm, in addition to the more obvious properties of flexibility, adhesion, stability, opacity etc.

Methods for improving the "check" resistance of such coatings are discussed. Conclusions and recommendations are given for the coating, the plywood and for design.

Keywords

Types and classes of structures or surfaces to be coated
plywood

Types and classes of coatings and allied products
water based paint

Properties, characteristics and conditions primarily associated with dried or cured films
checking
water resistance
water vapour permeability

Le peinturage des panneaux de contreplaqué pour revêtir les façades de bâtiments

Résumé

On discute les facteurs ayant une influence sur la résistance aux intempéries de contreplaqué peint et l'on déduit les exigences auxquelles le revêtement devrait répondre. On indique une préférence pour les revêtements ayant une forte concentration d'agrégats minéraux et basés sur une émulsion, compte tenu des exigences pour une faible résistance à la vapeur d'eau c'est-à-dire de 10MNsg^{-1} à peu près, et pour une épaisseur de film élevée, >1mm, aussi bien que les caractéristiques plus évidentes, telles que la souplesse, l'adhérence, la stabilité, l'opacité etc.

On discute certaines méthodes pour améliorer la résistance a la formation de fines craquelures superficielles de tels revêtements. On donne les conclusions et les recommandations à l'égard du type de revêtement choisi, du contreplaqué, et d'ailleurs de la mise au point de la construction.

Die Beschichtung von Sperrholz-Verkleidungstafeln für Aussen

Zusammenfassung

Die die Wetterbeständigkeit gestrichenen Sperrholzes beeinflussenden Faktoren werden besprochen, und daraus die an die Anstrichmittel zu stellenden Anforderungen festgestellt. Vom Gesichtspunkt der Erfordernis, geringen Widerstandes gegen Wasserdampf, d.h. approx. 10 MNsg^{-1} wird der Vorzug stark texturierten Dispersionsfarben hoher Filmdicke>1 mm gegeben, dazu gehören ausserdem solche naheliegenden Eigenschaften, wie Biegsamkeit, Haftvermögen, Stabilität. Opazität etc.

Es werden auch Methoden besprochen zur Verbesserung des Widerstandes solcher Anstriche gegen Haarrissbildung. Schlussfolgerungen werden gezogen und Vorschläge gemacht mit Bezug auf Anstrichmittel, Sperrholz und Bauart.

Introduction

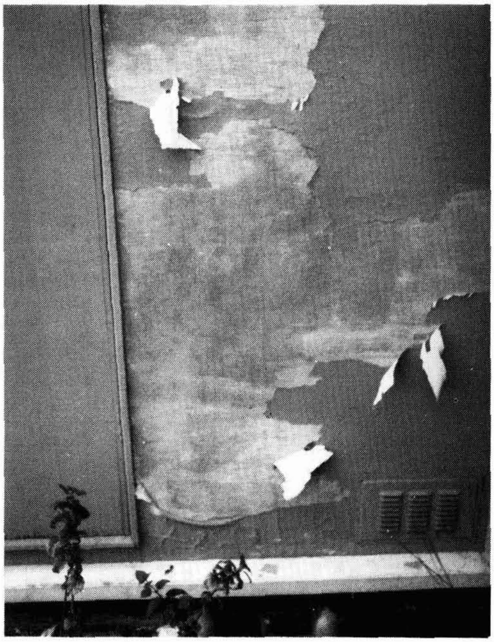
Ref. 1

Plywood has been used extensively as an external cladding, often with coatings intended to give the impression of the solidity of masonry.

The attractions of plywood for this application are very broadly based. Commercial factors, i.e. price and availability are favourable. High strength at low weight, in a sheet material, finds use where a contribution to structural strength is required and where the weight contribution of a pure cladding must be minimised. Good resistance to impact damage is a significant advantage at all stages of handling and fixing, the techniques for which are well established and uncomplicated, as well as in service conditions. Overall dimensional stability is good, thermal movement is so small as to be of only academic interest – of the order of 10^{-6} °C^{-1}, i.e. 10^{-6} metres per metre per °C. Movement due to moisture content variation is far more predictable than in equivalent unlaminated timber. The "crossed grain" orientation of alternate veneers restrains lateral movement. In timber longitudinal changes are around 4–5 per cent of corresponding lateral (across grain) dimensional change, due to varying moisture content.

These considerations alone are sufficient to ensure the continuing use of plywoods, even with the availability of an increasing number of alternatives, for example, wood based fibre and particle boards, fibre reinforcement cement, fibre reinforced polyesters and profiled plastics and metals.

One outstanding consideration is that of durability in combination with a decorative coating. Superficially the answers are reassuring, timber having enjoyed a long and generally successful history in the building industry. A basic assumption has been that, as plywoods are made from wood, the technology applicable to the coating of wood is equally applicable to plywood! To a certain extent this is true, but there are factors peculiar to plywoods and their evolved modes of use which do create problems and these may lead to aesthetically undesirable, and always costly, failures[1].



Catastrophic coating failure over plywood caused by the use of an inappropriate system, initiated by checking.

The results of overlooking or underestimating such problems can be seen almost anywhere in the UK.

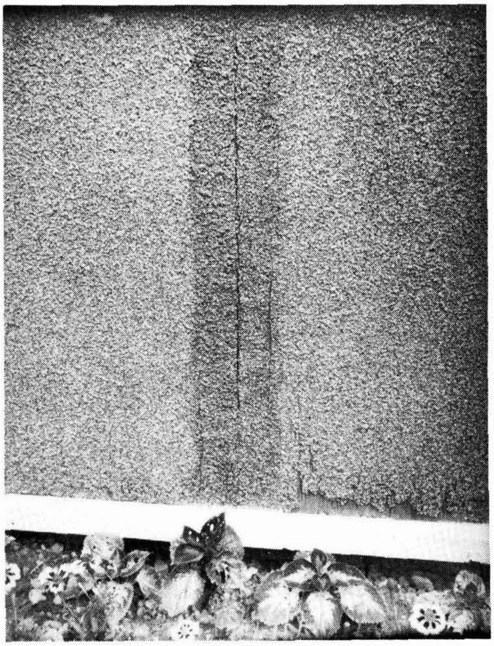
Usage and supply

Factors relevant to producing a durable plywood/coating combination are universal. In terms of evolution there may be a distinction between:

(1) The pure cladding, where plywood plus a surface coating forms a non-structural skin, perhaps replacing an external brick leaf, internal structure being unmodified.

(2) The sheathing/cladding combined function where the plywood is structural, as in current timber framed construction and in which the coating, applied directly to the plywood, replaces the outer brick skin and breather paper. This is a demanding specification for a paint film.

(3) The cladding application, where the basic design of the building depends upon the availability of a suitable sheet material which is installed in a structural frame like a window pane.

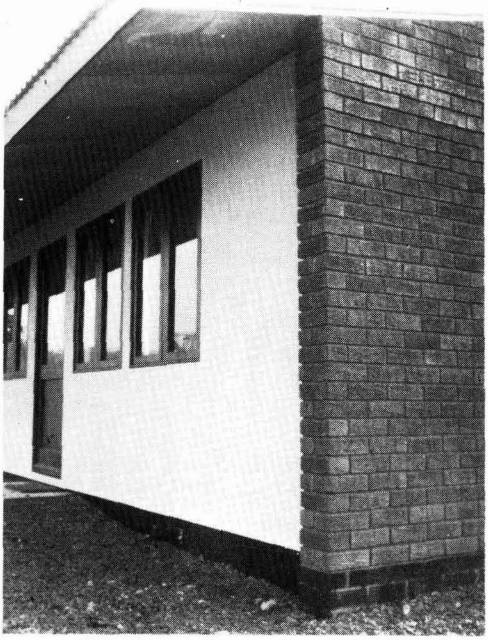


Catastrophic failure: over "checks"; at butt joints; at the poorly detailed bottom edges.

There are, of course, many applications of combined function, in the very wide field of use. This covers housing, both private and public, industrial and public buildings and temporary and relocatable buildings.

The above gives an indication of the implied demands made upon the plywood/coating combination and a qualitative appreciation of the scale of use. There are no relevant statistics for end use, but import figures give a reasonable picture of those types readily available, this being important when considering the "check" stability of those plywoods most likely to be encountered. During the period 1972–1978, European and North American (e.g.

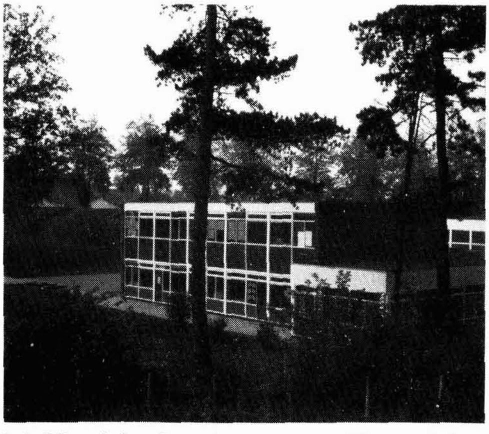
Coated plywood as a cladding, complimenting tiles and providing ground level impact resistance.



A modern timber framed building in which a textured coating replaces the outer brick skin. Note the wide eaves.

Finland, USSR and Canada) plywoods accounted for between 65 and 70 per cent of total UK plywood imports. Plywoods from these sources are made principally from Douglas Fir, Spruce and Birch. The only other consistently significant source was the Far East (e.g. Malaysia, Singapore, Taiwan) representing 20–30 per cent of total from whence the timber species used are generally undefined and very variable.

During the same period there was a substantial decrease in plywoods of African origin to virtually insignificant proportions, these being made mainly from mahogany.

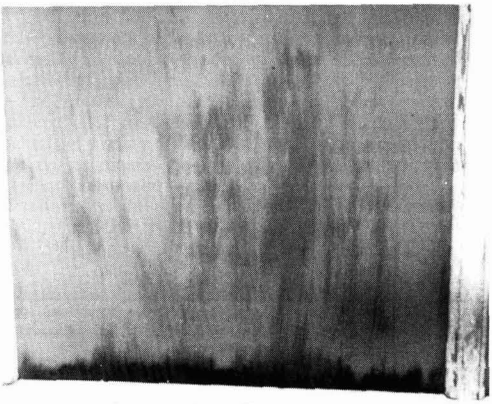


A building design for which a sheet cladding panel is a prerequisite.

Checking

Ref. 2

The major peculiarity of plywoods with which a coating must contend is that of its propensity for "checking". That is, the cracking of the exposed surface veneer along the line of the grain. This phenomenon is common to all plywoods, although the severity varies with the species of timber[2] used, manufacturing procedures and the conditions of use. Plywoods manufactured from a common timber may show great variations in this respect. Some splits are created by the flattening of the rotary cut veneers during manufacture. These "lathe checks" are not necessarily evident at the outer surface, initially, but lead to surface rupture during the subsequent life of the board. It is possible that "lathe checks" originally present, are the initiators of all subsequently visible "checks" on plywood surfaces.



A paint film cracking because of "checking" in the underlying plywood. Incidence is higher at the bottom edge.

"Checking" can be demonstrated, quite dramatically in some species (e.g. Douglas Fir, Spruce) by subjecting a plywood panel to just one severe wet to dry cycle. As the outer veneer dries it shrinks, predominantly in the across grain direction (see above). Under the influence of the strong mechanical restraint of the internal glue line and differential drying rates through the veneer, the shrinkage tends to be lateral rather than in thickness. Hence the "checks" appear. Sensitivity to varying external moisture content will be increased following initial checking, as a result of the increased effective surface area. Thus, initially, an acceleration of the degree and extent of checking is to be expected during exposure.

It is worth noting that producing plywood with timber at a moisture content below the average expected in service will not necessarily prevent checking, e.g. if a panel originally at 10 per cent moisture content has this raised to 18 per cent and then reduced to 15 per cent, checks may occur during the fall from 18 to 15 per cent even although, at all times, this is above the original 10 per cent.

The atmospheric conditions relevant to the checking phenomenon are:

(1) The number of wet/dry cycles.

(2) The difference in moisture content of the external veneer at the extremes of each cycle.

(3) The temperature, from the purely thermodynamic consideration that the rate of change of moisture content will be higher at higher temperature.

There are three basic means by which a surface treatment may overcome the checking problem. The surface treatment may be:

(1) of such mechanical strength that the movement of the veneer is physically restrained as at the internal glue line.

(2) a barrier to both water and water vapour, so that the underlying veneer experiences no moisture content change and, therefore, negligible dimensional change.

(3) of such flexibility and cohesion that any surface checks are bridged by the system.

Accepting that there is some overlapping, it is nevertheless relevant to examine the principles involved individually.

Overlaid plywood

Refs. 1–4

The first option, that of mechanical restraint is not feasible within a paint system alone, but has been practised within the plywood industry. During the second world war, phenolic resin treated papers were developed which could be consolidated and bonded to plywood at the temperatures and pressures employed in plywood manufacture. Currently, some manufacturers offer plywood with overlays which provide a good substrate for decorative paints. The evidence provided by the author's work, and that of others is that such paint coated overlays perform extremely well so far as checking is concerned[1-4]. Generally, a suitably overlaid softwood plywood will perform better than an unsurfaced plywood of inherently good check stability, such as mahogany. Coated, check free lives of twenty years for overlaid Douglas Fir plywood have been reported in North America.

At the manufacturing stage, the application of a painting grade paper overlay adds about 10 per cent to the cost of the plywood. This extra cost can be offest against the reduced cost of preparation for painting, e.g. it may be possible to omit a priming coat.

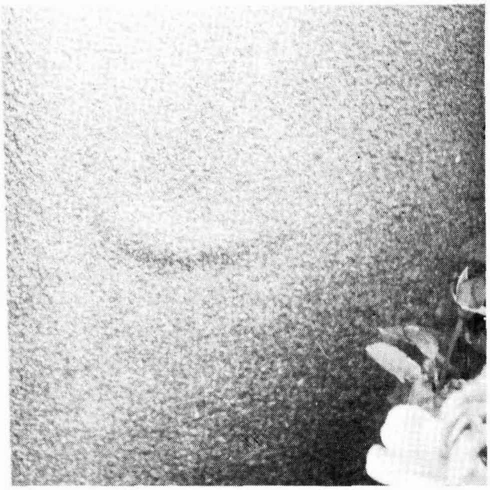
Currently, the on-cost of overlaying is magnified by commercial factors. Unfaced plywoods are relatively low priced due to the downturn in the UK building industry, and the relevant, paper-faced plywoods remain a low turnover speciality. It may be supposed that the low demand for such boards arises from an ignorance of both their existence and the problems which they seek to overcome.

Although overlays offer a solution to the checking problem, they cannot be involved as part of the finishing process. They must be specified as part of the fabric of the building. Further, such overlays do vary in physical characteristics. A brittle overlay may crack when pierced. An overlay of high vapour resistance necessitates the added expense of a balancing overlay on the reverse side of the board. Also, the use of an overlaid plywood does not, in itself, obviate the need for care in detailing and the discontinuities produced by fixings, and joints in the substrate are not covered by the factory applied overlay.

Substrate isolation

Refs. 3, 5

The second option, that of a virtual isolation of the plywood from external moisture content variation, has been pursued by both plywood and paint manufacturers. The factory finished board has shown good performance. A relatively thick film based upon an internally cross linked resin system, e.g. epoxy/polyamide, is used. Normally this is combined with a coarse, coloured aggregate which is spread over the uncured resin system. Any loose aggregate is removed after curing[3]. Good performance relies mainly upon controlled conditions during application, in particular the low moisture content of the base board (8–10 per cent). Such boards are, however, expensive in themselves and in terms of the requirements for subsequent handling and fixing, they are unsuited to cutting and applications where monolithic appearance is required of an elevation made up with many butt jointed panels. The extension of this principle to coatings suitable for on-site application has met with very much less success. This is due to the lack of control possible over application conditions and the difficulties involved in ensuring the complete isolation of the plywood substrate, particularly on the rear and edges. A low permeability coating will prevent a damp substrate from drying; leading to premature decay, especially in softwoods, and to weakened adhesion generally followed by blistering and failure of the coating[5].



Large scale blister forming over plywood in a coating of obvious flexibility but low adhesion and permeability.

This type of coating, whether factory or site applied, is therefore, extremely vulnerable to a discontinuity in the isolating envelope. Should the exposed face be holed, then water may enter, as liquid, far more quickly than it can leave. An unsealed internal face, exposed to interstitial condensation, may lead to failure of cladding, coating and possibly other elements of construction.

Figure 1, shows temperature/dewpoint profiles for a typical plyclad wall section. The assumed internal and external atmospheric conditions are as normally used to assess condensation risk for a temperate climate. A steady state is assumed. These profiles illustrate the condensation risk, inherent in the use of low permeability external coating system.

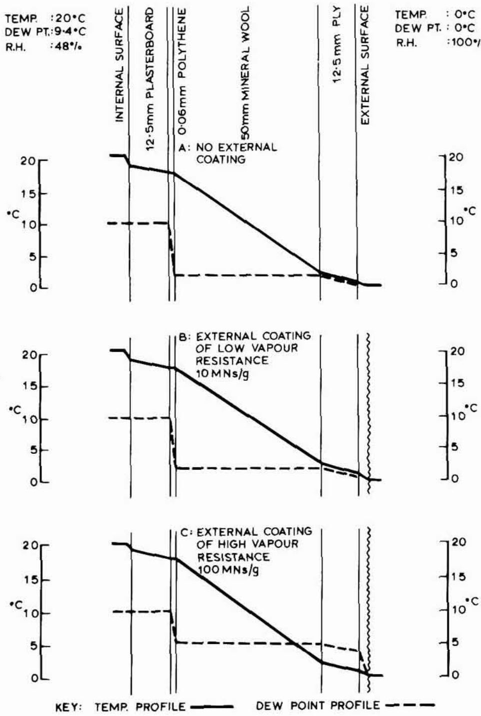


Figure 1. Temperature/dewpoint profiles for a typical plyclad wall section in standard conditions, but with various external coatings.

Figure 1A shows the profiles for the wall section, the plywood being uncoated. Throughout the section the dewpoint remains below the structural temperature indicating no condensation risk.

Figure 1B shows the profiles produced by the introduction of an external coating of low vapour resistance, i.e. 10 MN sg^{-1}, and negligible thermal resistance, i.e. assuming no effect upon the temperature profile. The dewpoints within the section are raised slightly, but still remain below structural temperatures, again indicating no condensation risk.

Figure 1C shows the profiles produced by the introduction of an external coating of high vapour resistance, i.e. 100 MN sg^{-1}, and negligible thermal resistance. The dew point is above the structural temperature in the outer regions of the insulant, in the plywood and in the coating. This indicates a condensation risk in these areas. Note that this condensation risk is not eliminated by sealing the rear of the plywood. The use of a coating system of low vapour resistance is clearly indicated.

Flexibility

The third option, involving a system that can accommodate the substrate movement concerned, shows far greater potential. Apart from flexibility and, possibly, some restriction of moisture vapour transmission, such a coating must also be capable of high film build. This is because a crack, opening beneath a coating from zero to finite width, produces an infinite extension ratio in the coating. Under these conditions irreversible changes take place within the coating which represent the initiation and onset of rupture (manifested as the Mullins Effect, i.e. the stress softening of filled elastomers). Reduction or elimination of this effect at the outer surface of the coating can be achieved by increased film thickness.

An alternative approach is to reduce the "filler" content, i.e. reduce the pigment to binder ratio. Thus, film cohesion will be increased and the number of nuclei for rupture sites reduced. However, vapour resistance will be increased, with significant dangers (see above). A thin film will not obliterate underlying defects and may be jeopardised by their presence. For example, a thin film may fail to bridge an existing crack or hole.

Increased film thickness suggests textured coatings, which also satisfy aesthetic requirements. Such coatings, based on oleoresinous media, have demonstrated check free service lives in excess of five years in favourable circumstances. Their success in this respect is due both to good flexibility and low permeability. Both properties show marked deterioration with age. Failure may occur through high substrate moisture content. A multi-coat system is necessary to obtain adequate coating thickness. This increases application costs and risks of intercoat contamination.

More recently, high quality, heavy textured coatings, based on water-borne media, particularly vinyls and acrylics, have become available in the UK. Following relatively long term (10–15 years) success in North America and on continental Europe, this coating type now enjoys use on a virtually world-wide scale. Representative of these types are the products "Wash-Perle" and "Wash-Lite".

In general terms, these coatings are ideally suited for use upon plywoods. Their durability is proven. They have low water vapour resistance (below or about 10 MN sg^{-1}), good adhesion direct to timber and high flexibility which changes little with age. Good results have been achieved on plywood. However, checking does occur beneath such coatings and depending on the circumstances, may rupture the coating. High "breathability" reduces the risk of both board decay and adhesion failure, but lends no aid to board stability. Hence, these textured coatings are not a complete solution.

At Carrs Paints, routes for the possible improvement of "check" resistance have been investigated using an accelerated test, wherever possible correlated with external exposure results in UK, USA, and the Arabian Gulf states, the latter providing a particularly severe environment for plywood stability.

Increased coat depth results in increased crack resistance, and a single wet coat application of 4–5 kg m^{-2} is now possible. This represents a 2–3 mm average coat thickness. The improved check resistance of a high coat weight may be further improved by application in two coats, the second being delayed until checking has appeared through the first coat. However, this approach is expensive in terms of both materials and, in the latter case, site costs.

Many primers, some commercially available, are virtually ineffective in improving board stability. The minor improvements possible do not justify the incorporation of a further coating.

The incorporation of loose fibres, e.g. nylon, flock, etc. has no beneficial effect at realistic levels of addition. Fairly low additions have a dramatic effect upon rheology and working properties. However, a quite remarkable improvement in check resistance is achieved by the involvement of a glass fibre mesh within a continuous matrix of the coating.

This provides a realistic way of improving cohesion without impairing any other properties of the coating. The extension of this idea has resulted in the introduction of the "Wash-Ply" system. This is the subject of a current patent application. A glass fibre mesh has been developed paying particular attention to mesh size and weave locking in relation to the components of the "Wash-Lite" coating. The resulting combination demonstrates excellent crack resistance effective in combatting checking within plywoods of very unstable timbers, e.g. Douglas Fir. Protection is also provided over all surface discontinuities, veneer imperfections, fixing points, joints, etc.

This is by far the most promising option for effective check resistance using an emulsion, texture coating. The coating should not be considered in isolation. Building design and substrate specification are also of relevance.

Design

Sympathetic design can greatly improve the stability and the durability of plywood cladding. Design factors should not be overlooked in their ability to reduce the effects of atmospheric damages.

General principles are: to avoid traps for shed water; to use generous eaves; to avoid the high solar gains of dark colours; and to avoid interstitial condensation.

Plywood

Refs. 2, 6–10

Appropriate specification of plywood is also important. An overlaid board may be considered, but when an overlay is not present the surface quality of the plywood is relevant. The frequency and size of surface imperfections should be kept to the minimum possible for the cladding application. Surface quality grades may be specified.

From the above, it will be clear that the inherent "check" stability of the plywood is very important. It is possible to specify a plywood manufactured from a timber species demonstrating a low propensity for checking[2], e.g. meranti. However, these are generally rare in the UK, and hence likely to be expensive.

Some guidance is available concerning timber durability, but this is not necessarily very relevant, giving an indication of ground contact performance only[6]. The use of timber species exhibiting, at least, reasonable durability is desirable, particularly when continuing high moisture contents in service are anticipated. However, plywoods of poor durability can give long decay free service in a well designed application, and artificial enhancement, by impregnation, is now possible[7,8].

It is interesting to note that the often accepted specification for plywood intended for exterior use, i.e. WBP (water and boilproof) defines glue performance alone[9,10]. There is no restriction upon the timber species used in the veneers.

[Received 21 March 1979

Refences

1. Smith, G. A., *Building Trades Journal,* 1977, Dec. 2.
2. Knight, R. A. G. and Domain, L. S., *J. Inst. Wood Science,* 1962, Vol. **10.**
3. Miller, E. R., *Timber Lab Papers,* No. 53, 1972.
4. Black, J. M., Lutz, J. F. and Mraz, E. A., *Forest Products Journal,* 1976, **26,** No. 4, April.
5. Miller, E. R., *Building Trades Journal,* 1977, May 3.
6. BRE (P.R.L.) – *Technical Note 40,* The natural durability classification of timber.
7. Hall, G. S., Coatings and Preservations on Timber, *B. & C. G. Interbuild Conf.* 1975, Nov. 19, TRADA.
8. *BS 3842.* 1965 – Treatment of plywood with preservatives.
9. *BS 3493.* 1962 – Information about plywood.
   BS 1203. 1963 – Synthetic resin adhesives (phenolic and amino plastic) for plywood.
10. *BS 1088 and 4079.* 1966 – Specifications for plywood for marine craft.
    BS 1455. 1972 – Plywood manufactured from tropical hardwoods.

J. Oil Col. Chem. Assoc. 1980, **63**, 34–36

A gas chromatography study of grape dipping oil

By A. R. Hendifar and M. R. Tirgan

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Introduction

Refs. 1–4

One of the products which is used for the faster drying process of the grape and its conversion to raisin, is grape dipping oil. This oil is a mixture of fatty acid esters and it is used in the form of an emulsion in potassium carbonate solution into which the bunches of grapes are dipped[1-3]. This oil penetrates into the waxy layer of the grape berries and causes a rapid evaporation of water from inside the layer under radiation of sun light; thus the conversion of grape to raisin is accelerated[4]. The purpose of this study is to find a fast method of identification of the dipping oil constituents, its synthesis and the effect on different types of grapes.

Experimental

Regents

(a) Methanol (Ethanol free)
(b) Alcoholic potash ($\frac{1}{4}$ N). 14g KOH dissolved in 1000 ml methanol (Ethanol free)
(c) Hexane G.R. or Chromatographic grade.
(d) Fatty acid methyl ester standards.
(e) Methylating agents: 5 ml concentrated sulfuric acid slowly added to 1000 ml of methanol.

Apparatus

(a) Gas Chromatograph Varian Aerograph mode 2800 equiped with two flame ionisation detector.

(b) *Chromatographic Columns:*

–Coiled stainless steel column, 6 ft × $\frac{1}{8}$ inch packed with porapak Q 100-120 mesh and conditioned at 240°C with 15 ml/min helium for 48 hours.

Operating conditions: Carrier gas flow; helium 25 ml/min, Hydrogen 30 ml/min, air flow 300 ml/min. Electrometer $10^{-10} \times 8$ Ams/mv. Temperature; column 200°C, injector 240°C, detector 250°C. Volume injected 0.5μl. Chart speed recorder 50 cm/h, recorder sensitivity 1mv.

–Coiled stainless steel column, 20 ft × $\frac{1}{16}$ inch packed with 3 per cent Apiezon L on varaport 30, 100–120 mesh and conditioned at 250°C with 10 ml/min helium for 48 h.

Operating conditions: Carrier gas flow; helium 15 ml/min, Hydrogen 30 ml/min, air flow 300 ml/min. Electrometer $10^{-9} \times 1$ Ams/mv. Temperature; column 210°C, injector 270°C, detector 260°C. Volume injected 0.5μl. Recorder chart speed 10 cm/h; recorder sensitivity 1mv.

Procedure

(a) *Ethanol and Butanol Standards*

In a 5 ml vial with a septum add with 10μl Hamilton syringes, 5μl ethanol and 5μ l n-Butanol in 2.5 ml methanol (Ethanol free).

Fatty acid methyl ester standard
Prepared by weighing the appropriate amount of methyl ester of fatty acids in hexane.

(b) *Sample*

Sample of high quality commercial grape dipping oil giving satisfactory results at grape farms.

(c) *Test method*

Oil Identification
A one gram sample of the dipping oil was weighed exactly and placed in a 100 ml volumetric flask, methanolic potassium hydroxide was added until the total volume was 100 ml. The hydrolysis which takes between the reactants is very rapid and ethanol and butanol which are the alcohols derived from the esters in the sample are released. For identification they can be studied on Porapak Q column (Figs. 1 and 2). In order to calculate the amount of residual ethanol and butanol in the original sample, under the same

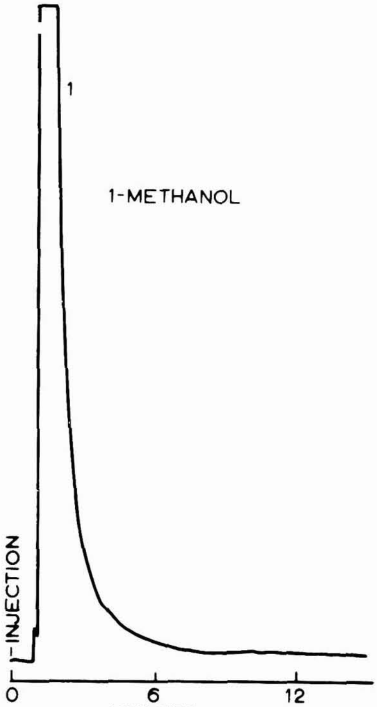


Figure 1. Chromatogram of alcoholic potash

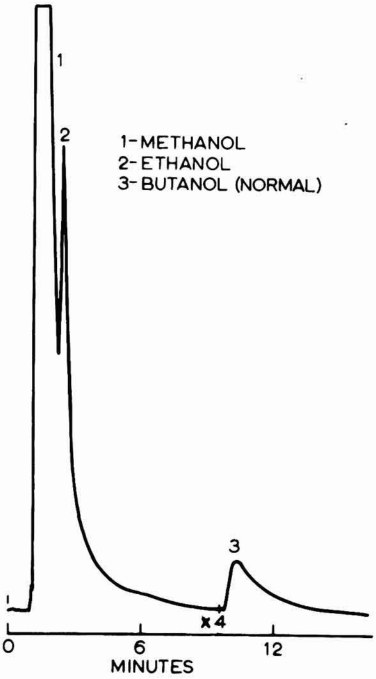


Figure 2. Chromatogram of sample in alcoholic potash

conditions, about one gram of the sample was weighed and hexane was added to give a volume of 100 ml. Since in this case hydrolysis does not take place, and only the residual alcohols enter the hexane, the chromatographic analysis can be done using Porapak Q column and the true amount of alcohols determined. To study the fatty acids in the oil, either free or in the form combined in esters, one gram of the oil with 40 ml of 0.5N methanolic potash was refluxed for two hours. This was transferred into a separating funnel containing 40 ml water and 80 ml ethyl ether. After shaking this mixture, the aqueous layer was separated and the ethereal layer washed with two portions of 10 ml water. The aqueous washings were added to the first one from the original separation. To this, 8 ml of concentrated hydrochloric acid was added and the free fatty acids were separated with 80 ml hexane. The hexane layer was washed with two 10 ml portions of water and then it was added to a pre-weighed flask. The hexane was then evaporated using a rotary evaporator, the weight of the remaining materials giving that of the fatty acids.

For chromatographic study, 20 ml of the methylating agent is added to the above sample and refluxed for 4 hours. The mixture is transferred to a separating funnel and 50 ml of water and 75 ml hexane is added. The hexane layer is separated after shaking and washed twice with 10 ml of water. It was then transferred into a 100 ml volumetric flask and enough hexane is added until the total volume is 100 ml. This sample is injected on a 3 per cent Apiezon column for the chromatographic study. The percentage of each of the fatty acids in the oil can be calculated from the amount of the methyl ester of the fatty acids. The acid number of the original oil, which is also measured to determine the amount of free fatty acid and the percentage of the sulfate ion, is determined by the standard barium sulfate method. The infrared spectroscopy was also used for identification and study of this oil.

Oil Synthesis Study

Considering that 65 to 70 per cent of the oil is an ethyl ester of fatty acids, two basic methods for the synthesis of the latter were studied. In the first, esterification of free fatty acids with two or three times more than the required amount of absolute alcohol in the presence of sulfuric acid 1.5 per cent as a catalyst was studied. The reaction mixture in this process was refluxed for at least three hours and after neutralisation of the sulfuric acid with calcium hydroxide, the ethyl esters are obtained by distillation of volatile components (eg excess of untreated ethanol and water).

The second method is based on ethanolysis of triglyceride of fatty acid with an iodine number of approximately 60 (e.g. fats and vegetable oil). In this process the triglyceride is alcoholised by using absolute ethanol (containing 1 per cent of sodium hydroxide as catalyst) in 70 per cent excess. The reaction is complete after four hours at 50°C giving a yield of more than 95 per cent of ethyl ester. The glycerine formed as a residue is accumulated at the bottom of the reaction vessel because of its higher density. This residue containing 70 per cent of glycerine can be used later for the recovery of glycerine by the standard methods. At the end of the reaction the untreated alcohol can be recovered by distilation. For butyl ester synthesis (used after sulfonation at low temperature as wetting agent) only the first method "esterification" is applicable. A sample of the dipping oil is prepared by mixing 65 per cent ethyl esters of fatty acid (second process) and 25 per cent ester sulfonate and 10 per cent of free fatty acid.

Dipping oil treatment of grape bunches

Five varieties of sultana grapes were dipped for 1 minute in dipping oil solution consisting of 2 per cent of oil, 2.5 per cent of potassium carbonate in water at normal temperature and then sun dried for 6 days. A reference dipping oil was used under the same conditions and compared for its effect on untreated sultanas.

Results and discussion

According to the results it can be concluded that grape dipping oil consists of three basic ingredients, ethyl ester of fatty acids, butyl ester of sodium sulfate and free fatty acids. The fatty acids which make up the fatty esters consist of a mixture of palmitic, oleic and stearic acids, which can be compared with fatty acids which are present in soya, cotton or sunflower seed oil that has been hydrogenated to an iodine number of 60. The interesting point in this study, is the rapid hydrolysis of oil by methanolic potash. The free fatty acids which make up 8–10 per cent of the original oil are some of the best oil emulsifying agents in potassium carbonate solution, in comparison with the usual synthetic emulsifiers. Considering that 65–70 per cent of the oil is ethyl esters of fatty acids, two basic methods for the synthesis of the latter were studied. In the first method ethylation of free fatty acids with two or three times more than the required amount of absolute alcohol, in the presence of sulfuric acid as a catalyst, was studied. In this method, because of the formation of water, at the end of esterification process, the recovered alcohol contains some water and cannot be used for further ethylation before removing water. It should also be noted that the reactant mixture in this process should be refluxed at least for three hours. The alternative process is based on ethanolysis of the triglyceride of fatty acids which does not require the reaction mixture to be refluxed. The remaining ethanol at the end of the reaction can be recovered for further usage, and the ethyl ester obtained has a paler colour than is obtained by the first process. Since in the ethanolysis process, the alcohol produced can be used again without further treatment and the reaction process takes place at a lower temperature, this method is preferred to the esterification method.

The results obtained on application of the dipping oil produced on the basis of ethyl ester (ethanolysis process) using five varieties of sultana grapes grown in the Rezayeh region, located in the north western province of Iran, is consistent with the imported oil used as a reference.

[*Received 2 November 1978*

Refences

1. Ponting, J. B. and Bean, D. M. Mc., *Food Technology*, **24** (12), 85.
2. M. Grncarevic, *Am.j. Enol, viticult*, 1963, **14,** 230–234.
3. May, P., La viticulture Australienne 1976, *CSIRO Division of Horticultural Research,* Adelaide, Australia 5001, Published Paper No. 408, p. 21.
4. Chambers, T. C. and Possingham, J. V., *Aust. J. Biol. Sci.*, 1963, **16,** 818.

Note: This paper is rather outside the scope of *JOCCA*, but the techniques used are thought to be of some interest to readers.

Next month's issue

OCCA Monograph Number 1 – Marine finishes. Part I *by T. A. Banfield*

Solubility parameter values suggested using the reported and calculated values for organic compounds *by A. Jayasri and M. Yaseen*

Zinc-rich paints *by G. W. Kapse and Km. Bela Rani*

A gas chromatography technique for the analysis of solvent mixtures based on hydrocarbons, esters, ethers etc., used in paints and lacquers *by A. R. Hendifar and M. R. Tirgan*

reviews

Further information on any of the publications reviewed may be obtained by circling the appropriate *Reader Enquiry Service* number on the form at the back of the *Journal*. Enquiries will be forwarded to the publisher.

Handbook of US colorants for foods, drugs and cosmetics

Daniel M. Marmion

Wiley-Interscience, New York 1979

Pp 350 Price: £13.25

This handbook consists of three parts. Part A provides a general background on the history, regulation, description and use of colourants; Part B is on colourant analysis; and Part C on resolution of mixtures and analysis of commercial products.

In the preface the hope is expressed that the book will serve as "a manual for those who manufacture colorants, regulate their use, incorporate them into their products, study their effects, or consume the myraid of articles in which they are found". It will perhaps be of some use as such a manual, but, the opportunity to make it much more valuable has been wasted. In the opinion of the reveiwer each category of potential reader will find it superficial and irritating because of its ramblings on generalities and its lack of in-depth treatment of specific areas.

Chapter 3, for example, states that "the regulations governing color additives are too complex and transitory to attempt an authoritative in-depth review of them here". A handbook purporting to be definitive should be the appropriate place for such a consideration, and it would have been much more valuable than parts of Chapter 2 devoted to the effects of vagaries of climate and character of the soil on the colour of the peel of Florida Valencia oranges, or, to the fact that summer milk from cows is more yellow than winter milk.

The book is also irritating in its layout, with descriptive text and associated diagrams or tables sometimes apart apparently for no reason. In one case, too, a sentence is split into two parts from the bottom of one page to the middle of another some twenty pages further on. Further minor irritations come from abbreviation inconsistencies such as m.w. and Mol. Wt. for molecular weight, and spellings such as granuals.

Colourant analysis, resolution of mixtures, and analysis of commercial products occupy two-thirds of the book. Much of this has been done better previously in books such as "The Analytical Chemistry of Synthetic Dyes" edited by Venkataraman and published also by Wiley.

Some chapters of the book have considerable bibliographies, others none. The bibliographies appear well researched. Within them the references listed vary from a brief citation to a long description of a technique. Often the latter are too long, but the shorter attached merit evaluating comments are welcome.

Altogether, however, the reviewer found the book a considerable disappointment.

Reader Enquiry Service No. 21 F. S. WRIGHT

occa meetings

Further information on any items mentioned below may be obtained by circling the appropriate *Reader Enquiry Service* number on the form at the back of the *Journal*. Enquiries will be forwarded to the Section concerned or may be forwarded to the lecturer.

Hull

Plant and machinery for processing oil seed

The first ordinary meeting of the 1979-80 session was held at the Humber Bridge Hotel, Barton, and was a joint meeting with the South Humberside Branch of the Institute of Chemical Engineers. The subject of the lecture, given by Mr. N. Lythgoe of John L. Seaton & Co., was "Plant and machinery for the processing of oil seed and vegetable oils".

Mr Lythgoe introduced his talk by stating that the raw materials for the oil industry have had, and will have, a longer life span than man himself. During many centuries the knowledge of the processing, and the understanding of the chemical nature of oils, has increased to the present day when, in the light of the limited resources of natural gas and fossil oils, he could see a resurgence of interest in replaceable feedstocks such as those used by the oil processing industries.

This talk described the development of oil processing plants and explained why particular machines and processes were introduced in order to maximise the quantity and quality of the end products. From the vast range of oils available, there are approximately twenty-four in global trade, with eight further oils acting as "back-up" substitutes when available. The estimated world trade is 45 m tonne/annum.

Oils and fats are used for edible and technical purposes. The split is about 90 per cent edible, 10 per cent technical, with all the technical oils being vegetable in origin and liquid.

Climatic conditions during sowing, growing and harvesting determine the yield and quality of the oil. The seed price is based upon estimates of the harvest and the market potential, a true "supply and demand" situation. Oil price fluctuations often generate switching from one oil market to another, such that, in a free market system there is rivalry between butter and margarine, nut oil and corn oil, soya meal, cotton meal, linseed meal and wheat.

occa meetings

Mr Lythgoe finished by outlining the types of mill that had been used over the centuries, up to modern "solvent extraction" processes. A lively question time followed, with the vote of thanks being proposed by Mr A. Scott of the Chemical Engineers Group. Fourteen members and guests were present.

Reader Enquiry Service No. 22 F.D.R.

London

Preservation, priming, putty, paint

The second evening technical meeting of the 1979-80 session was held at the Rubens Hotel, SW1, on 25 October under the chairmanship of Dr T. A. Banfield, London Section Chairman.

Mr J. J. Froggatt presented a paper on "Preservation, priming, putty and paint" based on his many years' experience in the field of finishing external fixed and opening wooden window frames.

During the presentation, ably assisted by his wife, Mr Froggatt initially discussed the need for preservation related to changes in the present day quality of timber used to make frames. The trend to the use of fast growing, high porosity softwood at the expense of high density heartwood timber for economic reasons meant that wood was more prone to water ingress and subsequent rotting. Factors which affected the way in which timber could be preserved adequately and the best way of applying preservatives were mentioned.

Concerning priming, Mr Froggatt stated that the best primers were still white lead primers to BS 2521. They gave high build and excellent filling with elasticity and weatherability. Oleoresinous primers also did a good job, but better results were obtained by dipping. They also caused some problems with putty drying. In the lecturer's opinion, water-borne primers, whilst cheap, fast drying and odour free, caused problems through water take-up and subsequent putty failure due to loss of adhesion of the putty to the primer. Such primers had been found to be more permeable to liquid water than to vapour, with the result that rain and condensation will penetrate, leading to water-logged timber.

Linseed oil putty was first used in the early 1700s and since then has changed very little in composition, being a semi-flocculated dispersion of whiting (82 per cent) in raw linseed oil (12 per cent), the oil acid value being 2.5 – 4.0. Mr Froggatt contended that the only way of determining the quality of the putty was by handling it. It needed "length" so that it could be applied easily and speedily into the frame and on to the glass, good flow for knifing the chamfer, good handleability so that it stuck to the wood and not to the hand, and good hold-up for correct glass bedding. Failures of putty in use were generally due to timber movement and not to putty breakdown. Mr Froggatt cited examples where putty used in conjunction with good quality timber was still effective after over 100 years' use.

In briefly discussing paint systems, Mr Froggatt considered that the design element, with frames flush with external walls and exposed to the general weather and the general routine cleaning of windows and frames, was such that additional coats of paint should be applied to frames to protect them.

The greatest area of failure of frames was on the bottom rail joints and was due to the ingress of water through end grain, penetration occurring due to timber movement. No paint system would ever have the flexibility to cope with such movement.

In conclusion, Mr Froggatt briefly forecasted the future trends and discussed the usage of pigmented stains in place of paint systems, but felt that they would never really be accepted by the public from the choice of colours available, which are all dark and unattractive.

During the question period, Mr Froggatt was subjected to a wide range of questions including advice on ways of stopping blue tits from eating putty. The questions were both searching and provocative and did justice to a most stimulating lecture which was so poorly attended by only 15 OCCA members and guests.

The final vote of thanks was proposed by Mr P. Whiteley of the Building Research Establishment and rounded off a most interesting evening.

Reader Enquiry Service No. 23 A.J.N.

Midlands

In-line coatings

The second ordinary meeting of the Midlands Section was held on Thursday 18 October 1979 at the County Cricket Ground, Edgbaston, Birmingham.

Forty-seven members and guests were present to hear Mr G. Gooding of Mander Kidd (UK) Ltd give a talk entitled "In-line coatings – Another approach to accelerated drying in print". Mr Gooding opened his talk by defining the terms "in-line coating" and "press coating". The speaker, with the aid of a colleague, then went on to give a practical demonstration of the application of a press coating over a lithographic ink, the examples of which were passed round for the audience to examine. These press coatings are rapid, non-yellowing, water-based coatings which eliminate the use of spray powder, thus enhancing the clarity and feel of the finish. In production they are usually applied as an "in-line" operation enabling full printed stacks of boards, requiring no aerating, to be handled. From an economic aspect, with press coatings there is less waste, increased production; with the elimination of spray powder less maintenance is required and any scrap can be recycled.

The speaker continued his talk by describing, with the aid of numerous slides, the various machines and processes used to apply these coatings. He also described in detail the main advantages and disadvantages of each machine and process.

Mr Gooding concluded his talk by stating that over the next two years there would be a big increase in the use of press coatings.

The interest shown by the audience in the lecture was reflected in numerous questions that were asked. The meeting was brought to a close with a vote of thanks proposed by Mr G. A. Tabbernor and warmly endorsed by the audience. *Reader Enquiry Service No. 24*

The Midlands Section would also like to express their thanks to Mander Kidd (UK) Ltd for providing the buffet and refreshments.

Solvent system design

A technical meeting of the Midlands Section was held at the County Cricket Club, Edgbaston, Birmingham on Thursday 15 November when members and guests heard Mr J. J. Blom of Shell Chemicals, Amsterdam deliver a lecture on "Solvent system design".

Mr Blom said that since the earliest days of solvent technology, formulators had sought to develop methods for determining the solvent power of solvents. Tests such as the aniline point and the kauri-butanol number were introduced, but these were basically limited to hydrocarbon solvents. A more versatile method was derived by using solubility parameters. The idea of solubility parameters was first introduced by Hildebrand. His original theory was only intended for non-polar liquids. Other workers sought to extend this concept to polymer solutions in the entire range of organic solvents. It was found that this could be achieved if a three parameter system was used. The systems of Hanson, Nelson Hemwall and Edwards are among the best known of these.

The lecturer concluded his talk with examples of the use of these parameter systems in the production of solubility maps. From these maps it is possible to predict whether a solvent or solvent blend forms a true solvent for the polymer.

The meeting closed with a vote of thanks proposed by Mr L. P. G. Goodale.

Reader Enquiry Service No. 25 B.E.M.

Manchester

European test methods for emulsion paints

Innovation was the keyword for the first lecture of the 1979-80 session. Held at the new venue at the New Administration Building, Manchester Polytechnic, All Saints, on Friday 12 October, 55 members and their guests attended to hear Mr John C. Legg, Technical Service Manager – N.W. Europe, of Scado, Netherlands, deliver a lecture entitled "A comparison of Western European test methods for emulsion paints".

Mr Legg began the 90 minute talk by quoting export figures of 28 000 tonnes per annum of emulsion from the UK, compared with imports of only 2000 tonnes. Further comparisons in relation to market trends were building paints based on emulsions forecast to increase from 53.5 per cent to 72 per cent by 1987, whilst alkyd based products would decline from 30.5 per cent to 14.6 per cent.

He then proceeded to the title subject of test methods – why, what, how and the results – and warned the audience that what was acceptable in the UK might not be so for the rest of Europe. The various testing standards used in Europe were detailed as follows;

UK – British Standards – BS 2863A – BS 3900, BS 2782
France – Afnor
Germany – DIN 5378, DIN 55951, DIN 53495
Holland – NEN 15062, NEN 20527, NEN 21183
Scandinavia – Not specified
Italy – Uniplast/Unichem
ISO – Standards and Draft Specifications.

The various tests used in specific countries were then described in detail and included determination of the following properties by differing methods applied to emulsions and/or emulsion paints.

1. Freeze thaw stability
2. pH
3. Non volatile content
4. White point
5. M.F.T.
6. Viscosity
7. Gross particle size
8. Density
9. Coagulent content
10. Water absorption
11. Tensile properties
12. Fineness of grind
13. Surface dry
14. Hard dry
15. Hiding power
16. Gloss
17. Recoatability
18. Washability
19. Water resistance
20. Dilutability, and other tests.

Specific preference by the individual countries in relation to marketing methods and paint properties were described fully, including reference to Testing Standards for the container, a practice noticeably absent from the UK products. Finally, Mr Legg concluded the talk by stating that all countries had their own standards and methods, and that presentation of test results specific to that country's needs was very important in marketing.

A lively question period of approximately 45 minutes duration was followed by a Vote of Thanks proposed by Mr Eric Hurst, which was received with acclaim.

Reader Enquiry Service No. 26 F.B.W.

Ontario

Particle size reduction

The Ontario Section held its second technical meeting of the 1979-80 session at the Skyline Hotel, Toronto on Wednesday 17 October.

The subject was "Particle size reduction for the inks and coatings industries" given by Mr Fred Rotar of Netzsch Brothers Inc., Lyonville, Pennsylvania, USA.

Mr Rotar discussed the importance of particle size reduction in achieving optimum economies of production and the relevance of particle size to inks and coatings performance. He reviewed the many forms of mills available commercially, distinguishing between the "tried and true", the latest advances, and the outright gimmicry which this area often attracts.

occa meetings

The meeting was extremely lively, with Mr Rotar being interrupted several times during his presentation with questions from the floor.

The Section Chairman, Mr S. Patel, proposed the vote of thanks.

Reader Enquiry Service No. 27 D.S.W.

Irish

Industrial training

A meeting of the Irish Section was held at the Clarence Hotel, Dublin on Friday 19 October. The meeting was addressed by Mr Dermot Conlon, the Manager of the Chemical and Allied Products Section of AnCO – the Industry Training Authority.

Mr Conlon traced back the history of AnCO to its foundation in 1967 for the purpose of improving the efficiency of industry through training. The Chemical and Allied Products Section was founded in 1972 and now has 210 companies, including the paint and ink manufacturers, as members.

A Levy Grant Scheme is now in operation, whereby members contribute one per cent of their payroll costs towards AnCO. Ninety per cent of this Levy is repayable if the company meets certain criteria as regards training, such as producing a formal training plan and carrying out the training agreed. In addition, generous grants towards the cost of training courses are offered.

The emphasis is on operator, supervisory and management training, specialist technical training being generally organised by individual companies, but often with grant assistance from AnCO.

Mr Conlon presented his subject comprehensively and the lively discussion which followed indicated the wide interest in the training function.

Reader Enquiry Service No. 28 D.P.

news

Further information on any items mentioned below may be obtained by circling the appropriate *Reader Enquiry Service* number on the form at the back of the *Journal*. Enquiries will be forwarded to the organisation concerned.

BP-ICI plant opens

The biggest single petrochemicals project ever built in Britain, a £200 m plant at Wilton, Cleveland, has been commissioned about two years behind schedule.

The complex, a joint venture between BP Chemicals and ICI, comprises an olefin plant, a gasoline treatment plant and a butadiene extraction plant. The olefin plant has a design capacity of 500 000 tonnes a year of ethylene, the main product.

The plant, which is equally owned by ICI and BP Chemicals, is operated and maintained by ICI.

Reader Enquiry Service No. 31

Warwick Chemical growth

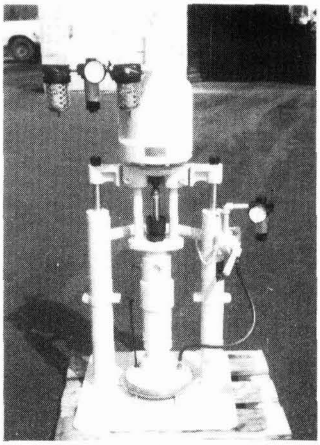
Warwick Chemical Ltd has announced that it has acquired a new 30 acre site to add to its existing factories in Surrey and Leeds. The company, which is 21 years old, manufactures a wide range of products, including alkyds, modified alkyds and hard resins for inks and paints, as well as dying auxiliaries and finishing chemicals.

Reader Enquiry Service No. 32

European distributors

Kismet Dynaflex Industrial Sales and Service Ltd have been appointed exclusive distributors, both for the UK and Europe, of the Johnstone range of heavy duty air pumps.

The standard double ball model pumps are suitable for all self-levelling or pourable liquids, with the chop and check versions handling non self-levelling items such as sealants. Stainless steel models are available for water-based, corrosive or latex based materials.



The Kismet Dynaflex Johnstone pump for sealants and mastics

Kismet Dynaflex have also recently announced a new range of hand pumps, capable of both filling and emptying drums and tanks. Three models are available to handle from paraffin through light oils up to SAE 140 gear oils as well as chemicals and additives.

Reader Enquiry Service No. 33

Change of address

G. J. Erlich Ltd has changed address to Erli House, South Cottage, Denham Place, Bucks UB9 5BL, England.

Reader Enquiry Service No. 34

Toxicology advice

An international advisory service in toxicology, named Kentox, has recently been formed to assist individuals and organisations in the areas of toxicology and product safety, with particular reference to the requirements of recent legislation in the UK and overseas for product testing.

Reader Enquiry Service No. 35

New agencies

F. T. Scientific Instruments has announced the appointment of two new distributors for their range of laboratory apparatus. Scientific and Medical Products Ltd have been appointed to cover North West England and North Wales, whilst Data Scientific Ltd have been appointed to cover central Southern England.

Reader Enquiry Service No. 36

Manufacturing arrangement

The complete range of Macbeth lighting products will be available in the UK at reduced prices as a result of the formation of Multi-Light Ltd, which will manufacture under licence to the Macbeth division of Kollmorgen.

The new arrangement will avoid the high shipping costs from the US, and in addition Multi-Light will be marketing their own colour matching products alongside the Macbeth range.

Reader Enquiry Service No. 37

New resin plant

Imperial Chemical Industries is planning to spend more than £20 million on a new paint resin manufacturing plant at Stowmarket in Suffolk. Work should begin on the resin plant during spring, subject to planning permission, and the plant is scheduled for commissioning in early 1982.

The investment represents an important step in ICI's plans to develop its share of the total European paints market. The Paints Division employs about 5100 people producing more than 100 m litres of paint a year in the UK. The plant will replace older resin plants at Stowmarket and Slough, the division's other main site.

Reader Enquiry Service No. 38

New plant for precipitated silicas

Joseph Crosfield & Sons Ltd is to construct a new £8 million plant at Warrington to produce precipitated silicas and silicates. The additional facilities will come on stream in about two years time giving Crosfield a capacity of up to 30 000 tons per annum.

Precipitated silica and the closely related aluminium and calcium silicates are used in a number of industries. As reinforcing fillers for rubber they give enhanced tensile strength and tear resistance in many formulations, including off-road tyres, and they also find use in mastics and similar products. Precipitated silicates are used as functional extenders in emulsion paints to improve opacity and whiteness.

The precipitates are part of Crosfield's established position in the whole area of silica chemistry and the new extension of capacity reflects the continuous growth of this business.

Reader Enquiry Service No. 39

Computer blending service

Scicon Computer Services has developed Scimix, a computer system aimed at producing least-cost formulations in any process where raw materials are blended together, such as pigment blends to meet a given colour specification.

The system will advise changes in the formulations, to take account of material shortages or cost increases, to produce a product of the required specification at the lowest cost.

Available as a computer service together with professional advice on the system from the Scicon bureau at Milton Keynes, the system can also be accessed by computer terminals at Scicon regional offices or on the users own premises.

The Scimix system is also capable of handling multi-blend problems, where a particular raw material in short supply is used in several different formulations, giving advice on the allocation of stocks between the alternatives to give the most cost-effective results.

Reader Enquiry Service No. 40

Skin reactions report

The Consumers' Association has published an important new report called "Reactions of the skin to cosmetic and toiletry products". This is the first time that a large scale survey – over 11 000 people – has been performed to establish the proportion of the population who may react to ingredients in these products. The survey found that 12 per cent of those interviewed *thought* they had suffered an adverse reaction to a product in the last 12 months. As a follow-up, a further sample of people who said they had suffered a reaction were patch-tested. This allowed their claims to be tested and, importantly, enabled a distinction to be made between those suffering an allergic contact dermatitis and those suffering an irritant reaction.

The results show that the majority of claims are genuine and that between 3 and 9 per cent of the adult population may suffer an adverse reaction in any year. However, in the main these reactions are of an irritant sort only and are not true allergic reactions.

Reader Enquiry Service No. 41

new products

Pliolite resin AC4

Manchem Limited, UK agents for Compagnie Francaise Goodyear, has added Pliolite Resin AC4 to the standard range. Pliolite AC4 is a styrene/acrylic resin which gives thixotropic gels in a variety of systems. Advantages of a thixotrope which is also a film former, include ease of incorporation, no seeding, gloss and flow.

Reader Enquiry Service No. 42

New diols from Degussa

As the latest result of its research and development work in the area of organic intermediates, the Chemicals Division of Degussa has introduced a series of diols into its range.

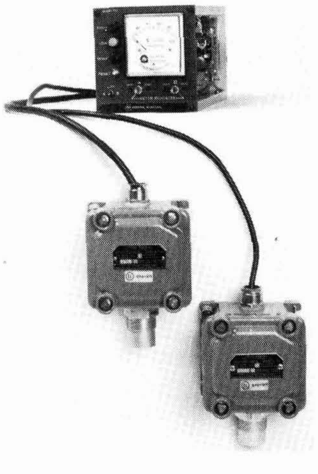
Vicinal diols such as phenyl-1,2-ethanediol, 2-phenyl-1,2-propanediol, 1,2-hexanediol, 1,2-octanediol, longer chain 1,2-alkanediols and 1,2-cycloalkanediols on the basis of corresponding olefins are now available as experimental products. Vicinal diols can be used as intermediates in the chemical, pharmaceutical, plastic, cosmetic, paint and lacquer industries.

1,3-propanediol (trimethyleneglycol), which is used in the production of polyesters, polyurethanes etc., has been in production since mid-1979.

Reader Enquiry Service No. 43

Solvent vapour monitors

Within the General Monitors range of combustible/toxic gas monitoring equipment, available from Allison Engineering Ltd, is a sensor which is extremely effective in detecting the combustible vapours given off by volatile liquids and solvents widely used in industry.



Each sensor is specially pre-calibrated to respond to the particular solvent vapour that will be generated in any given industrial application. Located in the plant or factory area, the sensor sends an electrical signal to a controller in the plant office or control room. Typical locations of the sensor include drying ovens, solvent storage areas, above process pumps where there is a possibility of gland leakage, etc.

The controller is supplied complete with its own analogue meter display, which again can be calibrated for the particular solvent being handled.

Reader Enquiry Service No. 44

news

Chemical pump

The Liquiflo range of positive displacement gear pumps, marketed in the UK by Alpha Technical Services Ltd, has recently been extended to include the Series 32, with a discharge of 4 litres per minute at differential pressures to 7 atm. This unit is ideally suited to sampling, metering and dosing applications.

A variety of construction materials are available for different applications, and shaft seals can be provided from standard stuffing box to proprietary lubricated double mechanical seals. By selecting the appropriate materials, most aggressive or viscous liquids can be handled over a temperature range from −40°C to 3000°C.

Reader Enquiry Service No. 45

Gas chromatograph accessories

Perkin-Elmer has introduced the Backflush and Cut accessory which is compatible with the complete range of Sigma Gas Chromatographs. This accessory consists of a system for automatic backflushing and "heart cutting" using a pressure balancing system with two columns.

In the backflush mode, analysis time is shortened by removing slow moving components that elute after the components of interest. "Heart cutting" involves venting major components, such as solvents, to the atmosphere, thereby preventing minor peaks from being obscured and detector overloading.

Reader Enquiry Service No. 46

Dielectric constant measurement

ChemLab Instruments Ltd have added WTW Dekameters and Dipolmeters to the range of WTW equipment they market in the UK.

The WTW Dekameter is an effective tool for the rapid measurement of dielectric constant and dielectric loss factor of liquids, emulsions, oils, powders, grains, granulates, lacquers, films, foils, etc., which can, in particular, be related to the water content.

It can be used for single sample measuring in the laboratory, or for continuous measuring in the factory as part of a process control unit.

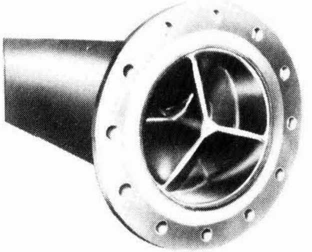
The WTW Dipolmeter is a compact, versatile and easy to operate instrument designed for the accurate measurement of the electric dipole moment in molecular structures. It can also be used to measure accurately the dielectric constant of materials and for the fast quantitative analysis of substances such as volatile oils. A range of measuring cells is available for use with these instruments.

Reader Enquiry Service No. 47

Motionless mixers

Lightnin Mixers Ltd are now able to offer the Lightnin Series 50 In-line Blender motionless mixers in a range from 25 mm to 1829 mm.

25 mm to 254 mm Standard Modules can, without the need for special tools, be adjusted to laminar or turbulent flow configuration. Invididual three bladed elements are removed from the non-rotating shaft and indexed by hand. Elements can be individually aligned within each flight so that the mixing motion can meet the process requirement. Heating and cooling jackets can also be fitted.



A Lightnin non-standard In-line blender module

300 mm to 1829 mm Non-standard Modules have the same configuration as the Standard modules, but are not adjustable from laminar to turbulent flow. They are initially aligned for either laminar or turbulent performance (single or dual).

Reader Enquiry Service No. 48

New glossmeter

Gardner Laboratory, through their UK agents Elcometer Instruments Ltd, has introduced the new Gardner Glossgard II, a fully portable instrument which makes good use of modern electronic components. The optical system, digital display, electronic circuitry and rechargeable battery are all contained in one single hand-held instrument weighing only 900 grammes.

Glossgard II instruments are available in all more popular geometries – 20°, 45°, 60°, 75°, and 85° to cater for all requirements from matt to high gloss, testing to international standards.

Two novel features are a hold button which when depressed holds the last reading, and a small light which comes on when the battery needs recharging. The hold facility is particularly useful when readings must be obtained in a difficult location.

Reader Enquiry Service No. 49

Fountain drier additive

Economy and improved effectiveness are the main advantages claimed for a new, more concentrated fountain drier additive for litho printers which has been developed by Coates Brothers Inks.

Designed to be added to sheet-fed and web fount solutions, GEM Fountain Drier Additive increases ink drying potential without possible press stability effects. The additive is also claimed to increase adhesion and rub resistance.

Reader Enquiry Service No. 50

Concool water baths

Baird & Tatlock (London) Ltd have recently introduced a new static water bath system to their range of laboratory apparatus. Known as the Concool system, it consists of a static water bath and contact cooling attachment.

The main difference between the static water bath system and the circulatory systems is the low wattage density heater covering the base of the bath below a perforated stainless steel false bottom. The heated water circulates on a convection principle and the heating element is such that it allows any water level to be used, up to 10 mm below the top of the bath.

Two inlet tubes with screw-in plugs can be connected to a small constant level device which is available, or alternatively, the inlets can be connected to a cooling coil which can be immersed in the water.

Reader Enquiry Service No. 51

Non-yellowing varnish

Swale Chemicals Ltd has announced the launch of a new overprint varnish for lithographic application, Swale LV 5967, which has been formulated to overcome the gradual yellowing common to most other overprint varnishes. It also exhibits good gloss and printability combined with stability on the press. LV 5967 requires only the lightest application of anti set-off spray and may be used with traditional plates and rollers.

Reader Enquiry Service No. 52

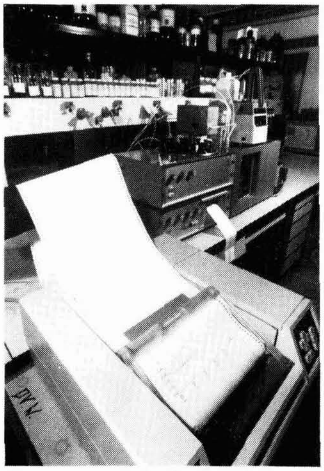
The new portable glossmeter from Gardner Laboratory

Computerised diluting viscometer

Complete diagrams or tables for the determination of critical viscosity figures from dilution series can be obtained from a new computerised diluting viscometer developed by Schott-Geräte GmbH, particularly in order to meet the demands in polymer research.

Dilution sequences of synthetic product solutions are prepared, and their results printed out, in a fully automatic process, economically and with high precision. The instrument replaces the complicated procedure of manual dilution, automates the entire measuring process, whilst also calculating the viscosity figures and determining the critical viscosity figures. These are then tabulated, or a complete digram is drawn.

Reader Enquiry Service No. 53



The computerised diluting viscometer developed by Schott-Geräte

New from BASF

BASF has introduced Auramine FA-NS and Auramine FWA-NS, two low-dusting grades of the well established basic dyes Auramine FA and FWA. The two new grades simplify handling and eliminate problems in the manufacture of alcohol based flexographic inks.

Basoflex Blue 6380 is a new addition to the BASF range of aqueous pigment preparations for packaging inks and similar fields of application. It is based on Fanal Blue CF6380, and is distinguished by its pure reddish tone, high tinctorial strength and good transparency; it also has extremely good flow properties.

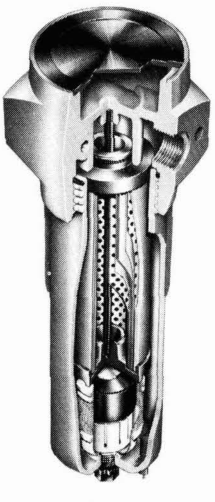
The Euthylen range for colouring polyethylene films has been expanded with the introduction of six new types with very good opacity: Euthylen Black 00-6015, Euthylen Green 87-0015, Euthylen Grey 00-7125, Euthylen Grey 00-5135, Euthylen Yellow 16-0015 and Euthylen Blue 69-0015.

Reader Enquiry Service No. 54

New filter range

A new compressed air filter range has been announced by Domnick Hunter Filters Ltd. The filters have a bolt together feature, which allows different grades of filters to be joined together without the need for connecting pipes. The working pressure is 16 bar with the standard automatic drain and 20 bar with the optional manual drain.

Reader Enquiry Service No. 55



A cut-away showing the new Domnick Hunter filter

Water thinnable finishes

As an extension to their current range of water-based products, Sonneborn & Rieck Ltd have developed two acid catalysed water thinnable finishes that can be used for conventional applications.

The materials are comparable with solvent based acid catalysed finishes, and the finishes have been formulated to give excellent timber wetting properties. The two lacquers, names Jaxamel Acid Catalysed Lacquer 47:01 range – for spray application, and Jaxamel Acid Catalysed Lacquer 47:02 range – for application by curtain coater, are both available in satin, semi-matt and matt sheen.

Reader Enquiry Service No. 56

Portable pH/Redox instrument

Thermographics Measurements Ltd has available a new portable pH/Redox measuring instrument Model GD1 from Seibold Messgerätefabrik, which has a large 13 mm LCD. The pH range of 0 to 14 is given with an accuracy of 0.02 pH, and the mV range is from −1500 to 1500 ± 1mV. The instrument also has an option for an analogue output.

Reader Enquiry Service No. 57

Automatic viscosity measurement

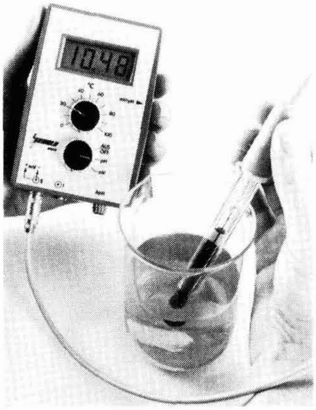
Techmation have available the Wescan Model 221 Viscosity Timer for the precision automatic measurement of oil viscosity, and determination of intrinsic viscosity of polymers and proteins. Together with a choice of Wescan Optical Viscometer Assemblies for three styles of glass capillary viscometer, complete systems can be chosen for the determination of liquid viscosities from 0.5 to 100 000 centistokes at temperatures from −75 °C to 150 °C.

The timer has an integral 100 Hz oscillator, and a five digit counter with a readout in seconds to the nearest 0.01 seconds.

Optical systems sense the change in the intensity of light reflected from the inside of a glass tube as the liquid meniscus moves past the timing point. A holder to which a miniature light bulb and two phototransistors are attached is mounted to the top of the viscometer. Light from the bulb is conducted to the viscometer's two timing points by fibre optics and directed at the centre of the tube. Reflected light is conducted by a second set of fibre optics to the phototransistors, which form part of the circuit which operates the timer.

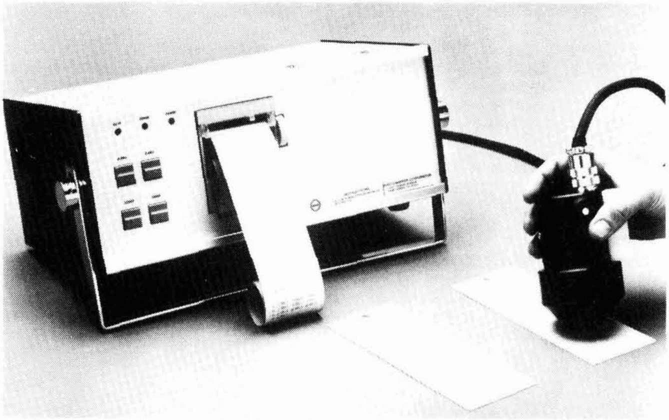
As the lamp and phototransistors are mounted near the top of the viscometer rather than at the timing points, the viscometer can be immersed in a bath for close temperature control without affecting the performance of the timing system.

Reader Enquiry Service No. 58



The portable pH/Redox measuring instrument

news


The Photomarker PM-400 automated portable colorimeter from Engelmann & Buckman Ancillaries Ltd

Colour analysis systems

Engelmann & Buckman Ancillaries Ltd has been appointed UK distributor for Photomarker Colour Analysis Systems for non-textile applications. Photomarker products are suitable for evaluating specimens in stationary, on-line or in-process modes over a wide range of applications.

The Photomatch PM-300 is specifically designed for shade and colour matching. A lightweight, portable sensing head can be used under any lighting conditions. A push button is used to record the reference colour measurements as a standard, and sensor signals are measured 500 times a second by an internal microprocessor.

The Photomatch PM-400 is a fully automatic, portable colorimeter which provides extremely accurate and rapid data printout in a variety of measurement scales.

Reader Enquiry Service No. 59

Thin film coating unit

Ion Tech have announced the introduction of the new Microvac ion techniques thin film coating unit.

The Microvac can be equipped with various Saddle Field Ion Sources and the new Plasmax high rate splutter gun. Techniques such as reactive ion beam spluttering, high vacuum ion plating, thermal evaporation etc. can be investigated and deposition rates from a few Angstroms per minute to 13 000 Angstroms per minute can be achieved.

Reader Enquiry Service No. 60

Regenerative pumps

Following the success of their "no maintenance" RG50 regenerative pump set, Stuart Turner Ltd has introduced two new RG models with increased output. The types RG150 and RG200 are suitable for a wide variety of applications within the paint manufacturing industry and are also available in special automatic pressure boosting form for boosting and maintaining water pressure in areas where the mains supply is inadequate.

The pumps are fitted with induction motors for continuous operation and once installed require no routine maintenance during the course of a normal working life. The RG150 is equipped with a 1.5 hp motor giving a flow rate of 680 gallons per hour at 40 psi, with a maximum output pressure of 65 psi; the RG200 is fitted with a 2 hp motor giving a maximum output pressure of 100 psi and a flow rate of 350 gallons per hour.

Reader Enquiry Service No. 61

literature

Gradient over leaflet

The Paint Research Institute TNO, Holland, has available a leaflet describing the gradient oven which they have developed. The oven can be used in the laboratory to heat cure or harden coatings and similar materials applied in relatively thin coats on flat metal substrates such as tin plate.

Advantages claimed for the oven are greatly improved temperature control, short heating times, and the ability to specify a temperature for each part of a test panel.

Reader Enquiry Service No. 62

Data sheet

ECC International has available a new data sheet from the Paint and Polymer Division of the company which gives details about the clays available for emulsion paints and similar products.

Reader Enquiry Service No. 63

New protective coatings report

The Steel Structures Painting Council, USA, has available a report of the SSPC Project PACE (performance of alternate coatings in the environment), which gives the results of a complete evaluation of new coating products, developed by the paint and raw material suppliers in the past few years in response to environmental regulations regarding pollution, health and safety.

Reader Enquiry Service No. 64

Phenolic Resins guide

Synthetic Resins Ltd has published a guide to their range of Uravar phenolic resins, which contains the latest amendments to SRL's established range of phenolics. It comprises separate documentation for solid and liquid resins, including aqueous types, and those in spirit solution, and gives a tabulated breakdown of properties and recommended applications.

Reader Enquiry Service No. 65

Advances in crosslinking

R. H. Chandler Ltd has recently published a bulletin from Solihull Chemical Services entitled "Recent advances in crosslinking and curing", which reviews recent articles and patents. Regular publication of the bulletin will commence in February 1980.

Reader Enquiry Service No. 66

Sprayed insulation

A new brochure from Baxenden Chemicals shows how energy may be saved using sprayed urethane insulation. Information on performance and specific properties is given, together with technical advice and an approved contractors list.

Reader Enquiry Service No. 67

Organotin antifoulings

A new information leaflet is now available from the International Tin Research Institute, designated L.69: Organotin-based Antifouling Coatings, which describes the advantages of using organotin compounds in antifouling compositions.

The leaflet also contains a list of manufacturers of organotin-based antifouling coatings and their ranges of products.

Reader Enquiry Service No. 68

appointments

Mr Alan Routs has been appointed Managing Director of Sheen Instruments Ltd. The company plans to extend its range of specialised test equipment supplied to manufacturers of paints, varnishes and inks.

Mr George D. Campbell has been appointed managing director and chief executive of the Walpamur Company (Ireland). For the past six years he has been marketing director of Crown Paints, Darwen, Lancs. Walpamur Ireland is an associated company of Crown Paints. **Mr Gordon Fearnley** has been appointed sales and marketing director of Crown Paints.

Mr Bob Platts has joined Instrumental Colour Systems Ltd as technical sales executive covering the Midlands and Southern England. Mr Platts was formerly a pigment sales manager, with wide expertise in colour and colour compounds.

Mr K. J. Minton has been appointed Managing Director of Laporte Industries (Holdings) Ltd. Mr Minton was formerly Operations Director.

Mr D. H. Henderson, chairman of ICI Paints Division, has been appointed an ICI Director. Denys Henderson has been the Paints Division chairman since May 1977.

Mr J. M. Raisman has become chairman of Shell Chemicals UK. He is deputy chairman and chief executive of Shell UK and succeeds Mr W. C. Thomson who has recently become a group managing director of the Royal Dutch/Shell Group of Companies. Appointed to the board of Shell Chemicals UK is **Mr M. J. Waale**, who has succeeded Mr Thomson as chemical co-ordinator, London, in Shell International Chemical Company.

Dr Ralph Iley, Chairman of Anzon Ltd and a Director of Lead Industries Group Ltd, has joined the Board of Tioxide Group Ltd. **Mr Maurice Dumbrell** has been appointed as Technical Director of Tioxide Group Ltd.

Dr Michael Fairey has been appointed Production Director of Camrex Ltd.

Further information on any items below may be obtained by circling the appropriate *Reader Enquiry Service* number on the form at the back of the *Journal*.

occa news

ICCATCI Meeting

Representatives of the International Committee to Coordinate Activities of Technical Groups in the Coatings Industries (ICCATCI) held a meeting on 4 October during the Federation of Societies for Coatings Technology Annual Meeting and Paint Industries' Show in St. Louis, USA.

The principal business of the St. Louis meeting was to review current activities of ICC members and to discuss possibilities for future cooperative efforts.

One programme the committee will undertake is the preparation of a bibliography of literature available on "Technical uses of computers in the coatings industry".

The next meeting of the ICC has been scheduled to be held in Amsterdam during the next FATIPEC Congress in June 1980.

Some of the representatives at the International Coordinating Committee meeting held in St. Louis on 4 October. *From left to right;* **James A. McCormick, President of Federation of Societies for Coatings Technology, M. F. Kooistra, President of FATIPEC, Borje Andersson, President of Scandinavian Federation of Paint and Varnish Technologists, and Dr F. M. Smith, President of OCCA.**

Jordan Award

This award was instituted by the late Mrs M. R. Jordan in memory of her husband Dr L. A. Jordan, who was President of the Association 1947-49 and an Honorary Member, and who died in December 1964. The Committee invites applications for the sixth award of £100.

The rules of the Award are:

1. The Award will be made for the best contribution to the science or technology of surface coating by a Member of any nationality working in either the academic or industrial field who is under the age of 35 at the date of application.

2. The final date for submission of applications will on this occasion be 31 December 1980 and it is hoped to present the award at the Association's conference in the following year.

3. The selection of the recipient of the Award will be made by a Committee under the chairmanship of the Association's Hon. Research and Development Officer.

4. There will be two methods of application. First, by the submission of a paper describing original work by the candidate which is offered for publication in the *Journal* or has been so published during application. The alternative method will be by recommendation by a superior for work which for reasons of commercial secrecy cannot be published; in this case the candidate will be expected to submit a dissertation on a topic relating to his work and demonstrating his superior knowledge of the principles thereof. The Award is for individual merit and clear evidence of the candidate's own contribution will be required if a paper is offered under joint authorship.

5. Applications should be addressed to the Director and Secretary at the Association's offices.

Reader Enquiry Service No. 72

occa news

OCCA-32 Exhibition

13-15 May 1980

Cunard International Hotel
Hammersmith, London W6

The international focal point

Allocation of space

The Exhibition Committee of the Oil and Colour Chemists' Association announces that the first allocation of space for the OCCA-32 Exhibition has now taken place.

Many companies who have participated in the OCCA Exhibition in recent years have been allocated space for OCCA-32, and it is particularly pleasing to note the return to the Exhibition of several companies who have not been able to participate for a number of years, as well as companies new to this Exhibition.

Organisations intending to participate at the Exhibition who have not yet submitted their applications are reminded that space at the Cunard International Hotel is strictly limited. Applications received will now be allocated any space remaining around those stands already allocated on a strictly first-come, first-served basis. Details of the space remaining may be obtained by contacting the Director and Secretary at the address on the Contents page.

The Cunard International Hotel

First list of Exhibitors

The following organisations have been allocated space to participate at the OCCA-32 Exhibition; product classifications are given in parentheses.

Baird & Tatlock Ltd
  (laboratory apparatus)
Blagden Campbell Chemicals Ltd
  (resins, pigments, additives)
British Industrial Plastics Ltd *(resins)*
C & W Specialist Equipment
  (manufacturing equipment)
Chemolimpex *(resins, additives)*
Ciba-Geigy Plastics & Additives Company *(resins)*
Ciech – Import & Export of Chemicals Ltd
  (pigments, chemical intermediates)
Contraves Industrial Products Ltd
  (laboratory apparatus)
Coulter Electronics Ltd
  (laboratory apparatus)
Cray Valley Products Ltd *(resins)*
Croda International *(resins)*
Dresser-Europe SA
  (manufacturing equipment)
Durham Chemicals Ltd *(additives)*
Eiger Engineering Ltd
  (manufacturing equipment)
Elcometer Instruments Ltd
  (laboratory apparatus)
Fillworth Ltd *(manufacturing equipment)*
Floridienne *(pigments, resins)*
Fortschritt Landmaschinen
  (manufacturing equipment)
Foscolor Ltd *(pigments)*
Glen Creston Machinery Ltd
  (manufacturing equipment)
H. Haeffner & Co. Ltd *(pigments)*
Harlow Chemical Company *(resins)*
Hercules Powder Company
  (resins, pigments, additives)
IBM United Kingdom Ltd
  (laboratory apparatus)
Industrial Dispersions Ltd
  (pigments, additives)
International Tin Research Institute
  (information)
John Godrich *(manufacturing equipment, laboratory apparatus)*
K & K Greeff Industrial Chemicals Ltd
  (resins, pigments, additives)
Laporte Industries Ltd
  (pigments, chemical intermediates)
Lawrence Industries Ltd
  (extenders, additives)
M & M Process Equipment Ltd
  (manufacturing equipment)
MSE Scientific Instruments Ltd
  (laboratory apparatus)
Macbeth Division of Kollmorgen
  (laboratory apparatus)
Marchant Brothers Ltd
  (manufacturing equipment)
Mastermix Engineering Co. Ltd
  (manufacturing equipment)
Microseal *(laboratory apparatus)*
Morris Ashby Ltd *(additives)*
NL Chemicals *(pigments)*
Netzsch Brothers
  (manufacturing equipment)
Paintmakers Association *(information)*
Paint Research Association
  (information, services)
Polymers Paint & Colour Journal
  (journal)
Q-Panel Company
  (laboratory apparatus)
Resinous Chemicals Ltd *(resins)*
Sanyo-Kokusaku Pulp Co. Ltd
  (additives, resins)
Scott Bader *(resins)*
Sheen Instruments Ltd
  (laboratory apparatus)
Shell Chemical Company *(resins)*
Silberline Ltd *(pigments)*
SOAB *(resins)*
Society of Dyers & Colourists
  (information)
Synthetic Resins Ltd *(resins)*
Tioxide International *(pigments)*

Reader Enquiry Service No. 71

occa news

A view of part of the Queen Mary Suite at the Cunard International Hotel

UCB Chemical Division *(resins)*
Victor Wolf Ltd *(additives)*
Vinyl Products Ltd *(resins)*
Werner & Pfleiderer Ltd
(manufacturing equipment)

Extracts from the editorial entries for the Exhibition *Official Guide* will be published, together with the names of other companies which will be having their products displayed on the above stands, in the February and March issues of the *Journal*, leading up to the Exhibition Preview in the April issue.

The OCCA Exhibition, which is known as the international focal point for 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.

In recent years, the OCCA Exhibition has regularly attracted thousands of visitors from 50 countries, who travel to London each year to view the latest developments affecting the industry and to contact leading companies for their needs.

Theme for the Exhibition

Motif: The motif, designed by Robert Hamblin, uses the compass to symbolize the unique attraction of the OCCA exhibitions which annually draw exhibitors and visitors from numerous countries.

The aim of the Exhibition is the presentation of technical and commercial information relating to raw materials, plant and equipment used in the paint, polymer, printing ink, colour, adhesive and allied industries, both in manufacture, processing and application.

Dates and times

The thirty-second annual OCCA Exhibition, a three day event, will be open as follows:

Tuesday 13 May 1980..... 09.30 to 17.30
Wednesday 14 May 1980. 09.30 to 17.30
Thursday 15 May 1980.... 09.30 to 17.30

The Cunard International Hotel

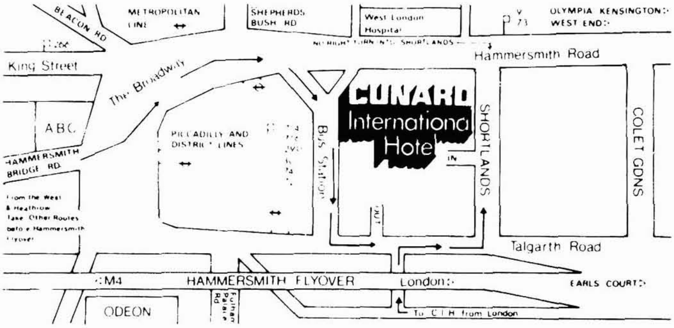
The new venue for the 1980 Exhibition will be the Cunard International Hotel, Hammersmith, London W6, and the main part of the Exhibition will be in two sections: on the ground floor, forming the entrance to the Exhibition, traditional style stands will be accommodated in the New Exhibition Hall where exhibitors of heavy machinery, plant and equipment will be located; on the first floor of the hotel, in the Queen Mary Suite, the stands will be of a simplified nature with the objective of allowing exhibitors to use modular display systems. These stands will have no platform, being erected directly on to the carpeted Suite floor, and so it will not be possible for heavy equipment to be displayed in this section.

Access between these two areas will be through the intermediate Mezzanine floor, where there are a number of rooms in the Armada Suite for companies to display free standing exhibits together with an Exhibitors' lounge.

In addition there will be several suites and syndicate rooms on the third floor of the hotel, either for companies who wish to use this type of facility to exhibit, or for those who wish to have somewhere convenient to entertain their visitors in addition to their main stands elsewhere in the Exhibition. Already, several organisations have taken advantage of this opportunity to have a main stand for general enquiries, and the more private room for detailed discussions.

A view of part of the New Exhibition Hall at the Cunard

OCCA news



Travel arrangements

The Exhibition Committee has decided to move the venue of the 1980 Exhibition to the Cunard International Hotel, as it is felt that the more central site and greater range of types of exhibiting facilities it offers will be welcomed both by exhibitors and visitors to the Exhibition.

The Hotel has a selection of restaurants, shopping facilities and bars. There is a coffee shop close to the Queen Mary Suite (which itself contains a bar), an Exhibitors' Lounge on the Mezzanine floor, and there are plans for a coffee bar to be erected in the New Exhibition Hall for the Exhibition.

The Hotel is situated near Hammersmith Station on the Piccadilly Underground Line between Heathrow Airport and the centre of London. Visitors from overseas may board the Piccadilly Line in the Airport complex, which will take them direct to Hammersmith Station or to central London where they may be staying. Hammersmith Station is also served by the Metropolitan and District Underground Lines (the latter of which connects to Victoria Station for those arriving at Gatwick Airport). The Hotel is adjacent to the Hammersmith flyover on the M4 Motorway which links Heathrow Airport by road. Car parking at the Hotel is limited, but there is a large NCP car park close by in King's Mall off King Street.

Admission to the Exhibition will be free, and visitors will be asked to complete registration cards which will be available from the Association with copies of the *Official Guide* in advance. Copies of the *Official Guide* will be charged at £1.50 each, and both registration cards and copies of the *Official Guide* will also be available at the entrance to the Exhibition.

Official Guide

It is intended, as in previous years, to publish the *Official Guide* to the Exhibition several weeks in advance so that it may be sent to visitors to enable them to plan the itinerary for their visits. The *Official Guide* will contain descriptions of all the exhibits together with much other useful information for visitors, such as maps of the exhibition areas, details of facilities, travel information and an analysis of the exhibits.

Many thousand copies of the *Official Guide* will be printed and distributed on a world-wide basis. Advertising space will be available in this publication, and details of availability, rates, special positions etc., may be obtained from the Assistant Editor at the address on the Contents page.

Honorary Membership

As mentioned in the December issue of the *Journal*, Council has decided to confer Honorary Membership of the Association upon the Hon. Editor, Mr S. R. Finn. A scroll conferring Honorary Membership was presented to Mr Finn at his home on 1 December by the President, Dr F. M. Smith and the Director and Secretary, Mr R. H. Hamblin. The wording of the scroll was as follows:

> "It was unanimously agreed this day (*24 October 1979*) by the Council of the Association to confer Honorary Membership upon Stanley Russell Finn Esq., Honorary Editor since 1969 and currently a Vice President, in order to express the admiration of the Members for the way in which he has at all times discharged his duties as Honorary Editor and raised the prestige of the Association's publications, and in particular its *Journal*, to its present eminent position in the surface coatings industries."

Hull Section

Dinner Dance

The annual Dinner and Dance of the Hull Section of the Association was held on Friday 5 October, 1979 at the Willerby Manor Hotel, near Hull.

The actual numbers were down on previous years, but in addition to the Chairman of the Hull Section, Mr R. Brooks, the Chairmen of the Midlands and West Riding Sections were also present.

Mr Angus McLean deputised for the President, who was away in America on OCCA business.

The ladies as usual received their pot plants – a feature of the Hull Section event. In addition, a "piggy bank" was kindly donated to each lady by Williams and Glyn's Bank.

A 12 piece coffee set was also donated by Hornsea Pottery as a raffle prize.

Dancing continued until the early hours of the morning to the music of the Frank Cleveland Orchestra with Rosemarie.

A.R.V.S.

Shown at the annual Dinner and Dance of the Hull Section: *Back row (l – r)* **Mr T. W. Wilkinson, Mr A. McLean, Mr M. G. Bentley, Mr J. Burns, Mr R. Brooks (Chairman, Hull Section), Mr A. R. Van Spall (Social Secretary), Mr P. W. Munn (Vice Chairman, Hull Section) and Mr R. H. Hamblin (Director and Secretary);** *Front row (l – r)* **Mrs T. W. Wilkinson, Mrs A. McLean, Mrs M. G. Bentley, Mrs J. Burns, Mrs A. Van Spall, Mrs P. W. Munn.**

London Section

Ladies' Night

Once again a most successful London Section Ladies' Night was held at the Selsdon Park Hotel, Sanderstead, Surrey on Friday 19 October. The principal guest of the evening was Dr George de Winter Anderson, Managing Director of the Paint Research Association, and his wife. The top table guests included the Chairmen of the Midlands, Thames Valley, Newcastle and West Riding Sections with their wives, and the Director and Secretary of the Association, Mr R. H. Hamblin.

The toast to the ladies and guests was proposed by the Chairman of the London Section, Dr T. A. Banfield. In responding, Dr Anderson succinctly reviewed the previous ten years, particularly with reference to the surface coatings industries and the continued successful relationship between OCCA and the PRA.

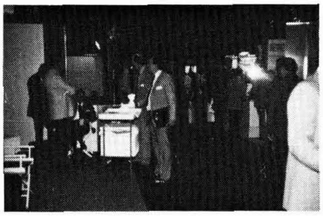
Following the meal in the Tudor Room, dancing continued in the Ballroom until 1.00 a.m.

A.J.N.

The President's Page

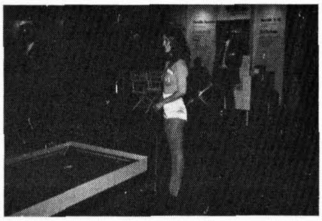
Official engagements have taken a good deal of my OCCA time during my first six months. Within hours of taking office at the end of the successful Conference at Stratford in June, I was flying to Paris for the inauguration of the International Committee to Co-ordinate Activities of Technical Groups in the Coatings Industires already reported (*JOCCA*, 1979, **62**, 366).

October saw my wife and I as official guests of the Federation of Societies for Coatings Technology at their Convention and Paint Show at St. Louis, Missouri, USA. The combination of a conference with an exhibition has an interesting consequence for both. A little under 5000 people registered and although the exhibition was busy and obviously thriving, the lectures were often attended by no more than 50. This did not apply to the Keynote Address by Howard K. Smith, television commentator and self-appointed diagnostician of the American economic, political and social malaise, which was attended by over 1000, but it was not technical. The Mattiello Lecture brought in over 200, but at no lecture was there any attempt to encourage the discussion which is the main plus-value offered by the OCCA Conferences.



One or two pictures of the Paint Show witnessing the presence of Mr Graham North and the writer clearly demonstrate the similarities with, and differences from, our own exhibition. American hospitality was as usual uninhibited as the pictures taken at some of the receptions lay witness.

Having taken advantage of the Cray Valley Products Ltd inclusive trip to the Convention, we were able to take part in some of the well organised visits and complete some business in New York.



After literally 15 hours at home, we set off for the Scandinavian three-yearly conference organised by the Scandinavian Paint and Varnish Technologists and this year held in Stockholm where they celebrated 25 years and international recognition by the International Alliance. A very successful conference and series of events was almost exclusively supported by the Scandinavian members together with official guests and overseas lecturers. The untiring efforts by the Chairman, Dr Borje Andersson, were crowned by a magnificent concluding banquet in the Stockholm Civic Hall where Nobel prizes are presented. Your President had the honour of presenting congratulations on behalf of OCCA, FATIPEC and the FSCT (the original members of the International Alliance). The absence of photographic evidence is partly due to the President's bad luck with his camera (!) and partly due to postal delays from Stockholm.

In the succeeding months there have been many opportunities to visit the Sections and to meet the hard working officials who are the very life-blood of OCCA. In the Midlands and in Manchester I was able to accompany the Director and Secretary in a presentation and discussion of OCCA affairs. It is very apparent from these events that the average locally active member is far from well-informed about OCCA on a national or international level. More exchanges of this sort would be welcome.

The social activities of the Sections and Branches continue to thrive and my wife and I have been happy to be in Birmingham, Manchester and Harrogate and myself only in Dublin. Other engagements prevented us being at the London and Hull Ladies' Nights. We have, however, represented OCCA at the Annual Conference of the Society of Dyers and Colourists in Sheffield in September when I was able to speak at their dinner and at the annual Dinner Dance of their London Section in November.

In December I was invited to propose the toast to the Institute of Metal Finishing at their Annual Luncheon at the Cafe Royal in London. For an organisation with just less than 2000 members, an attendance of 120 was very encouraging and we wish them every success in the future. One must, however, consider whether inflationary and economic trends, not to mention "limits to growth", toxicology and the maturing of our industries, will not eventually push all our associations into a survival grouping of some sort. Not that we don't all value our uniqueness and our independence of action.

One final thought in this informal Presidential report. Many of our Committees meet very infrequently and when they do are not well attended. This is an observation of fact; the reasons are not entirely clear but are undoubtedly many. The

occa news

conclusion is that, whatever the cause, perhaps the current state of affairs needs an overhaul. We have a forward thinking group consisting of the Immediate Past President, Mr Angus McLean, Mr John Bourne, Mr Ian McCallum, the Director and Secretary and myself, which is considering this and other aspects. Please write to me with any views you have or feed them through your Section or Branch Committees, who have been asked to involve themselves.

Francis Smith
January 1980 *President*

South African Division

Symposium Call for Papers

The next South African Division National Technical Symposium is to be held in Durban during November 1980. The theme for the Symposium will be "Coatings for the Eighties – Looking ahead", and it will be held from 6-7 November 1980 at the Elangeni Hotel, Durban, Natal.

Any persons wishing to present a paper at this Symposium are asked to send a 300 word summary and title by the end of March 1980 to Professor D. E. A. Williams-Wynn, c/o Department of Applied Chemistry, University of Natal, King George V Avenue, Durban 4001.

Reader Enquiry Service No. 73

Midlands Section

Trent Valley Branch

Buffet Dance

Once again the Trent Valley Branch of the Midlands Section enjoyed a social buffet dance at the Cross Keys Inn, Turnditch near Derby.

Approximately fifty members and their guests enjoyed the event which was held on the evening of 26 October.

The facilities at the Cross Keys Inn have already been reserved for the Branch AGM, when it is anticipated that several more members from the Section will be present. Details will be released nearer to the time.

Nottingham Evening Post visit

Thanks to the joint efforts of the Chairman of the Midlands Section, Mr John Burns and Mr Cyril White, the Hon. Social Secretary, members and guests of the Trent Valley Branch were fortunate to be accepted as guests of the *Nottingham Evening Post* on the afternoon of Thursday 1 November.

The editor of the *Evening Post*, Mr Bill Snaith, hosted the memorable occasion, which included a short film outlining the history of the paper, which was traced from as early as the year 1710 for an earlier "Post", through to 1 May, 1878, when the present *Evening Post* had been founded, and to the present day, in which the *Nottingham Evening Post* can lay fair claim to being the most technically advanced newspaper in Europe.

The film was followed by a conducted tour of the press, where at first-hand, the word processors and computerised mechanics of the single "keyboard" consoles were observed. With a handling capacity of 1000 lines per minute, these machines, if that is the correct description, can turn news into print within the space of twenty minutes.

The party saw the huge rolls of empty newspaper, weighing three quarters of a tonne each, feeding printing presses which handle 10 tonnes per day and produce 52 000 copies of the paper per hour.

The tour was concluded with tea, after which Mr Snaith arranged for the group to be photographed.

The Chairman of the Trent Valley Branch, Mr Joe Tomlinson, gave a vote of thanks to Mr Snaith and his staff.

J.R.K.

Members and guests of the Trent Valley Branch during their visit to the Nottingham Evening Post

Photograph: Nottingham Evening Post

new 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

BEADLE, ROY WILLIAM, 3 Oreston Road, Rainham, Essex RM13 9XS. *(London)*

CONWAY, JOSEPH WILLIAM, Whitford Plastics, 86 Brindley, Astmoor, Runcorn, Cheshire. *(Manchester)*

DARGAN, DOUGLAS STUART WILLIAM, BA, Kirklees Chemicals Ltd, George Street, Batley, West Yorkshire. *(West Riding)*

FREEMAN, KEITH WILTON, ARIC, J. L. Seaton & Co Ltd, 2 Air Street, Hull. *(Hull)*

HERSEY, MARTIN, JOHN, BSc, 124 Felbrigge Road, Goodmayes, Ilford, Essex. *(London)*

JOHN, IAN LENNOX, MSc, 329/4 South Gyle Road, Edinburgh EH12 9EE. *(Scottish)*

LINDLEY, PAUL NICHOLAS, BSc, 275 Ley Street, Ilford, Essex. *(London)*

McCOLL, NIALL HAMILTON, 257 Lake Road, Lakepuna, Auckland 9, New Zealand. *(Auckland)*

PAYNE, IVAN SHANNON, PO Box 12080, Jacobs 4026, South Africa. *(Natal)*

PLAISTOWE, JOHN, BSc, 107 Norwood Grove, Beverley, North Humberside. *(Hull)*

new members

POWELL, JOHN, BSc, 3 Hall Bank South, Mobberley, Knutsford, Cheshire. *(Manchester)*

SCHEEPERS, WILLIAM HENDRIK, BSc, PO Box 78, New Germany 3620, South Africa. *(Natal)*

SCOTT, DAVID GEORGE, Whitford Plastics, 86 Brindley, Astmoor, Runcorn, Cheshire. *(Manchester)*

SHORE, NORMAN, APRI, Oaklea, Willington Lane, Oscroft, Tarvin, Chester. *(Manchester)*

SWINBURNE, RAYMOND, LRIC, 4 Trevarren Drive, Leechmore Grange Estate, Sunderland, Tyne & Wear. *(Newcastle)*

VINCENT-BARWOOD, ANTHONY EDWARD, Whitford Plastics, 86 Brindley, Astmoor, Runcorn, Cheshire. *(Manchester)*

WILSON, HUGH CAMPBELL, BSc, 222 Caernavon Close, Castlefields, Runcorn, Cheshire. *(Manchester)*

Associate Members

FLETCHER, ROGER FRANK, Ciba-Geigy NZ Ltd, 9 Hutt Road, Petone, New Zealand. *(Wellington)*

GABB, ALAN JOHN, 30 Queens Crescent, Forest Hills, Kloof, Natal, South Africa. *(Natal)*

GREEN, LINDA ELLEN, PO Box 369, Pinetown 3600, South Africa. *(Natal)*

WARNE, MALCOLM JOHN, 22 Herbert Andrews Road, Beighton Beach, Natal, South Africa. *(Natal)*

Registered Students

BARRETT, LESLIE GERALD, Whitford Plastics, 86 Brindley, Astmoor, Runcorn, Cheshire. *(Manchester)*

BOURNE, ADRIAN JOHN, 24 Landor Road, Knowle, Solihull, West Midlands B93 9HZ. *(Midlands)*

DEVALL, GEOFFREY STEPHEN, 31 Ash Hill Road, Ash, Aldershot, Hants GU12 6AD. *(Thames Valley)*

MULJI, AJAI, 83 Tavistock Avenue, Perivale, Middlesex. *(London)*

TIMBRELL, JOHN ARTHUR, 5 Primrose Drive, Palace Road, Ripon, North Yorkshire HG4 1EY. *(West Riding)*

occa diary

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

January 1980

Thursday 3 January

Newcastle Section: Chairman's lecture, by J. Clark of BTP Tioxide Ltd, at the Students Common Room, St. Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m. *Details to be announced.*

Monday 7 January

Hull Section: "Synthetic clays" by F. D. Robinson and B. J. Mayes, Laporte Industries, at the George Hotel, Land of Green Ginger, Hull, commencing at 6.30 p.m.

Thursday 10 January

Bristol Section: "Coal as a replacement for oil in the chemical industry". Joint meeting with the Birmingham Paint Varnish & Lacquer Club, to be held in Birmingham. *Details to be announced.*

Friday 11 January

Scottish Section: Annual Dinner Dance, details to be announced.

Monday 14 January

Manchester Section: "Powder, high solids, water" by M. Bus, L. C. Kwakman and A. J. Van Der Werff of Scado BV, at the Crest Motel, Bolton, commencing at 6.30 p.m.

Thursday 17 January

London Section: "International standardisation of methods of test for paints" by H. A. Hipwood, MQAD, at the Princess Alice, Romford Road, Forest Gate E7, commencing at 6.15 p.m. To be followed by a buffet supper.

Scottish Section: "Applied colour measurement in surface coatings" by D. A. Plant, at the Albany Hotel, Glasgow, commencing at 6.15 p.m.

Friday 18 January

Irish Section: Ladies' Evening. Travel film and Cheese and Wine evening, at the Clarence Hotel, Dublin, commencing at 8.00 p.m.

Midlands Section: "The role of the technologist in marketing" by R. Fidler of International Paint Ltd, at the Birmingham Chamber of Commerce & Industry, commencing at 6.30 p.m.

Wednesday 23 January

Manchester Section: Student Lecture "Physical testing of paints and coatings" by R. H. Wallington of MQAD, MOD, at the Manchester Polytechnic, New Administration Building, All Saints, commencing at 4.30 p.m.

Scottish Section–Eastern Branch: At the Murrayfield Hotel, 18 Corstorphine Road, Edinburgh, commencing at 7.30 p.m. *Details to be announced.*

Thursday 24 January

Thames Valley Section: Works visit to Rondec Ltd, Egham, Surrey at 7.00 p.m. Demonstration of screen printing for labelling.

Friday 25 January

Bristol Section: "Inks for packaging" by H. J. Duffin of Irlam Inks Ltd, at the Royal Hotel, Bristol, commencing at 7.15 p.m.

February

Monday 4 February

Hull Section: "China clays as opacifying extenders in paint" by R. McGuffog, Research & Development Department, ECC International, at the George Hotel, Land of Green Ginger, Hull, commencing at 6.30 p.m.

occa diary

Tuesday 5 February

West Riding Section: "An integrated approach to dispersion applications using new technology" by R. W. English and J. Perkins of Mastermix Engineering Co., at the Mansion Hotel, Roundhay Park, Leeds 8, commencing at 7.30 p.m.

Thursday 7 February

Newcastle Section: "Packaging" by a speaker from Metal Box Ltd, at the Students Common Room, St. Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m.

Friday 8 February

Manchester Section: "Transportation and labelling of hazardous materials" by a speaker from Esso Chemical Co. Ltd, at the Manchester Polytechnic, New Administration Building, All Saints, commencing at 6.30 p.m.

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

Thursday 14 February

Midlands Section – Trent Valley Branch: "Pipeline protection" by D. Polkinhorne of Delpic Engineering Services Ltd, at the Derby Crest Motel, Pastures Hill, Littleover, Derby, commencing at 7.15 p.m.

Friday 15 February

Irish Section: "Waste is money – What are we doing about it?" by Irene Daly, Industrial Chemist, Irish Dunlop Ltd, at the Clarence Hotel, Dublin, commencing at 8.00 p.m.

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

Saturday/Sunday 16/17 February

London Section: Weekend conference on "Home decoration", to be held at the Queens Hotel, Hastings, Sussex. *Details to be announced.*

Wednesday 20 February

London Section: "Pollution analysis" by N. A. R. Falla, Paint Research Association, to be held at the Rubens Hotel, Buckingham Palace Road, SW1, commencing at 7.00 p.m.

Thursday 21 February

Midlands Section: Lecture to be presented on behalf of the Paint Research Association, at the Calthorpe Suite County Cricket Ground, Edgbaston, Birmingham, commencing at 6.30 p.m. *Details to be announced.*

Scottish Section: "Chemistry of crime" by W. J. Rodger, Strathclyde Police Department, at the Albany Hotel, Glasgow, commencing at 6.15 p.m.

Thames Valley Section: "The restoration of paintings" by a speaker from the National Maritime Museum, at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing at 6.30 p.m. for 7.00 p.m.

Friday 22 February

Scottish Section – Eastern Branch: "Burns Supper" at the Commodore Hotel, Marine Drive, Edinburgh at 7.30 p.m. for 8.00 p.m. *Details to be announced.*

Wednesday 27 February

Scottish Section – Eastern Branch: "The thermoluminescence dating technique applied to the authentification or otherwise of Chinese ceramics" by J. Tate of the National Museum of Antiquities of Scotland, at the Murrayfield Hotel, 18 Corstorphine Road, Edinburgh, commencing at 7.30 p.m.

Friday 29 February

Bristol Section: "The manufacture and uses of pigment chips" by F. J. Morpeth of Foscolor Ltd, at the Royal Hotel, Bristol, commencing at 7.15 p.m.

March

March

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

Manchester Section: Informal Buffet Dance, *details to be announced.*

Monday 3 March

Hull Section: Ladies' Evening, *details to be announced.*

Tuesday 4 March

West Riding Section: "Industrial nitrocellulose – Manufacture and use" by A. W. E. Staddon of ICI Ltd, Organics Division, at the Mansion Hotel, Roundhay Park, Leeds 8 commencing at 7.30 p.m.

Thursday 6 March

Newcastle Section: "The manufacture and uses of pigment chips for the printing ink and paint industry" by F. Morpeth of Foscolor Ltd, at the Students Common Room, St. Mary's College, Elvet Hill Road, Durham commencing at 6.30 p.m.

Monday 10 March

Manchester Section: "Electrodeposition – Anodic versus cathodic" by H. V. Schenk of BASF Ludwigshafen, at the Woodcourt Hotel, Sale commencing at 6.30 p.m.

Thursday 13 March

Midlands Section – Trent Valley Branch: "Fire precautions" by an officer of the Derbyshire Fire Service, at the Derby Crest Motel, Pastures Hill, Littleover, Derby commencing at 7.15 p.m.

Scottish Section: Student Invitation Lectures: "The practical aspects of colour in surface coatings" by T. Grieve of Isaac Spencer Ltd, and "The practical aspects of colour in printing inks" by G. Hutchinson of Croda Inks Ltd, at the Albany Hotel, Glasgow commencing at 6.15 p.m.

Wednesday 19 March

London Section: "Resins". Day meeting at Thames Polytechnic, Woolwich SE18, commencing at 10.00 a.m.

Thursday 20 March

Thames Valley Section: "Cathodic electrodeposition" by R. L. Bayliss of ICI (Paints) Ltd, at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks commencing at 6.30 p.m. for 7.00 p.m.

Friday 21 March

Irish Section: "Paint lecture", at the Clarence Hotel, Dublin commencing at 8.00 p.m. *Details to be announced.*

Midlands Section: Newton Friend Ladies' Invitation Lecture: "Greeting cards through the ages" by A. Genmes of Webb Ivory Ltd, at the Birmingham Chamber of Commerce and Industry.

Wednesday 26 March

Scottish Section – Eastern Branch: Works visit to Lorimers Brewery, St. Leonards Street, Edinburgh at 7.15 p.m. for 7.30 p.m.

Friday 28 March

Bristol Section: "Low odour solvents" by A. Cumbers of Carless Solvents Ltd, at the Royal Hotel, Bristol commencing at 7.15 p.m.

Monday 31 March

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


ΘΕΟC

UV CURING: SCIENCE AND TECHNOLOGY

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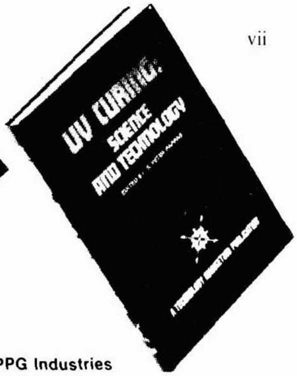

PUBLICATION CODE UVCS&T

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
Research and Development Center
Dr.Vincent D. McGinniss, Battelle Columbus Laboratories
Dr. James E. Moore, General Electric Company
Research and Development Center
Dr. S. Peter Pappas, Polymers and Coatings Department
North Dakota State University
Dr. Zeno W. Wicks, Jr., Polymers and Coatings Department
North Dakota State University

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Scottish Section

Eastern Branch

BURNS SUPPER

The Burns Supper, organised annually by the Eastern Branch of the Scottish Section, which is by tradition an all male event, is being held in the Marine Suite, Commodore Hotel, Marine Drive, Edinburgh EH4, on Friday, 22 February 1980.

The reception will commence at 7.30 p.m. for 8.00 p.m. with the traditional "Piping of the Haggis" to follow.

A full traditional five course Scottish meal will be served during the evening, which it is believed will satisfy any appetite. Appropriate music, songs and verse will be rendered by various artistes throughout the evening.

Tickets, priced at £9.50 each (inclusive of VAT) can be obtained from:

A. McKendrick
Acting Chairman/Secretary
Craig & Rose Ltd
172 Leith Walk
Edinburgh EH6 5EB
Tel: 031-554 1131

Overnight accommodation will be available at the Commodore Hotel at 50% off normal rates (including full breakfast), i.e. Single £9.00, Twin £14.50. Reservations should be made direct to the Commodore Hotel (031-336 1700) mentioning attendance at this function.

Other hotels within reasonable distance of the venue are the Eurocrest Hotel (031-332 2442), the Barnton Hotel (031-339 1144) and the Fox Covert Hotel (031-334 3391).

London Section

Weekend Conference

DECORATION

London Section is organising a weekend conference on 17 and 18 February 1980, to be held at the Queens Hotel, Hastings. The subject of the conference will be "Decoration". As some of the lectures will be of interest to the ladies, special facilities will be arranged for children, such as entertainments which will coincide with these lectures.

The papers presented at the conference will be:

"Modern decorative emulsion paints" by Mr G R Brown of Harlow Chemical Co. Ltd.

"Appraisal of products for local authority use" by Mr R. T. Kelly, Chief Scientific Adviser, Greater London Council.

"Paint application" by a speaker from Berger Paints. (This paper is intended to be of interest to the ladies.)

"Technical developments in wall coverings" by Mr S. Duckworth of Crown Decorative Products Ltd.

"The role of the professional decorator" by Mr E. G. Sangster, Director, National Federation of Painting Contractors.

"Colour in decoration" by Mr D. C. Mason, Chief Colour Consultant, ICI Ltd, Paints Division. (This paper is intended to be of interest to the ladies.)

"Modern decorative paints – Solvent based" by Mr R. H. Munn of Cray Valley Products Ltd.

In addition, there will be periods for general discussion during each session, and the conference will be finished by a Forum discussion.

A reception, followed by dinner and dancing will be held for delegates on the Saturday night.

The prices for the conference (including meals) will be as follows:

Members and wives £28.50 each; Non-members and wives £38.50 each. Children in separate rooms £24.00; Children in parents' room £12.00 (under 10 years) or £15.00 (10 – 14 years).

All prices are subject to VAT at 15 per cent.

Accommodation on the Friday night before the conference is also available (bed and breakfast) at £20.00 plus VAT (double room) or £11.00 plus VAT (single room). Bookings for accommodation on Friday 16 February should be made direct to the hotel.

Further information may be obtained from, and applications should be made to: **Mr H. C. Worsdall, Clydebridge Chemicals Ltd, P.O. Box 2, Sevenoaks, Kent.**

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