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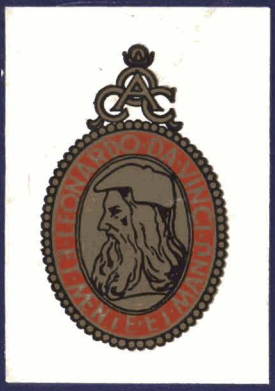

JOCCA

JOURNAL OF THE OIL & COLOUR CHEMISTS' ASSOCIATION

ANNUAL GENERAL MEETING Notice of adjournment: see page 308

Industrial Finishing Symposium. Full details of papers on page iv. Form for registration on coloured insert facing back inside cover

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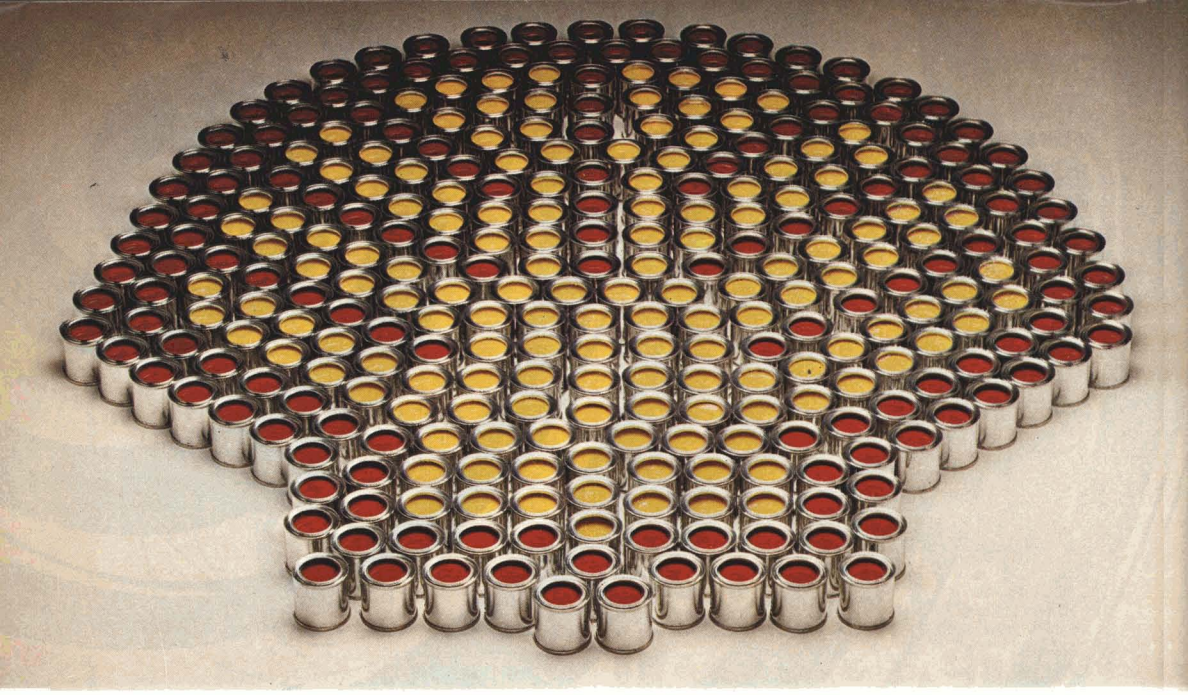

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VeoVa monomer gives improved emulsion formulations in domestic paints for both internal and external use, and the characteristics of VeoVa are now being introduced to industrial paints. A new plant in the Netherlands will help meet increasing world-wide demand.

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LTSC *Licentiate* in the Technology of Surface Coatings
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The optional Professional Grade for Ordinary Members of OCCA was instituted by Council in 1971. Since that time, over 400 candidates have been successful in their applications to join the Professional Grade and a full list was last published in the December 1975 issue of the *Journal*. The various routes to the three Grades (see above) in diagrammatic form and the full regulations for admission are published in the July 1976 issue.

A reprint of the full regulations for admission to the Professional Grade and application form may be obtained by sending a stamped, self-addressed envelope, marked "Professional Grade leaflet" in the top left-hand corner, to the Association's offices at the address on the Contents page of this issue. **It is felt that some overseas Members, in particular, might encounter difficulties contacting the required number of sponsors and any applicant who finds himself in this position is advised to write to the Director & Secretary of the Association in the first instance.**

OCCA-29 Exhibition

The Association's twenty-ninth Technical Exhibition will be held at Alexandra Palace, London N22, from 22 to 25 March 1977. Further details regarding the arrangements for OCCA-29 and the many facilities offered at Alexandra Palace appear on page 311 of this issue of the *Journal*.

The Exhibition Committee emphasises on this occasion the quality of the OCCA Exhibitions in providing a *focus* for all those connected (either as suppliers of raw materials and equipment, or as buyers or in some other capacity) with the many and varied coatings markets throughout the world. The exhibition has long been known as the annual international forum for display and discussion in the surface coatings industries, and the motif for 1977 draws attention to the concept of the annual "focal point" for the industries (see advertisement on back outside cover of this issue).

Intending exhibitors are reminded that their completed application forms and remittance for stand space must be returned to the Director & Secretary of the Association not later than **Friday 1 October 1976.**

Any organisation which has not previously exhibited and wishes to obtain an Invitation to Exhibit should contact the Association's offices immediately. The address is given on the Contents page of this issue.

"Official Guide"

The Exhibition Committee offers advertising space in the "Official Guide" to the Exhibition, which has proved to be a very popular advertising medium, not only for exhibitors but also for companies who were not showing at a particular Exhibition.

For details of advertising in this and other Association publications, write to the Assistant Editor at the address on the Contents page of this issue.

Current Trends in Industrial Finishing

A joint symposium organised by:

OCCA
London Section

IMF
Organic Finishing Group

To be held at the University of Warwick, Coventry, England from Monday 20 to Wednesday 22 September 1976

Lecturer	*Company*	*Title*
The requirements of the Users		
Mr F. D. Timmins	British Rail, Derby	"Selecting a system and why"
Mr H. L. Quick	Chrysler UK Ltd	"Automotive finishing—the next steps"
Pretreatment		
Mr M. N. Ness Dr B. A. Cooke	ICI Ltd, Paints Division	"A new zinc phosphating process designed for automatic control of composition"
The Substrate		
Mr C. Ryall	British Aluminium (Research Division)	"Finishing of aluminium in vehicle body applications"
Mr F. E. Bassford	Cray Valley Products	"DMC and SMC moulding as substrate for painting"
Mr S. E. Fennah	British Steel Corporation	"Development in pre-finished steel coil products"
Mr E. R. Miller	Dept. of Environment, Aylesbury, Bucks	"The finishing of timber building components"
Curing		
Mr W. C. Hankins	The Electricity Council	"Electrical aspects of radiation curing"
Application		
Mr J. Muirhead	The DeVilbiss Co	"Modern application methods for surface coatings"
Mr R. J. King	Blundell-Permoglaze Ltd	"High speed drying of wood finishes"
Ecological considerations		
Mr R. A. Fish	Greater London Council Scientific Branch	"Disposal methods for hazardous wastes"
Mr G. Hicks	Esso Chemical Co Ltd	"The impact of legislation and environmental pressure on the future of solvents in coatings"
Dr R. Denney	Thames Polytechnic	"Analytical methods for the study and investigation of industrial atmosphere"
Materials		
Dr H. Hönig	Vianova Kunstharz, Atkiengesellschaft	"New methods of determining the throwing power of EC paints"
Mr D. J. Wigglesworth	Pinchin Johnson International	"Automotive top coats"
Mr H. J. Berwanger	Bee Chemicals	"Painting of plastics"
Mr D. Brooker	Arthur Holden & Sons	"Powder coatings—present and future"

To register for this symposium, complete the registration form on the blue coloured leaflet facing the front inside cover of this issue.

JOURNAL of the OIL AND COLOUR CHEMISTS' ASSOCIATION

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Telegrams: OCCA Wembley Telex

Assistant Editor: C. A. Tayler, BSc

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Journal of the Oil and Colour Chemists' Association

Vol. 59 No. 8 August 1976

Oil and Colour Chemists' Association

(Founded 1918, incorporating the Paint & Varnish Society 1924)

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Transactions and Communications

A fracture mechanics approach to lacquer cracking

By J. C. Reid

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Summary

Measurements have been made on unsupported lacquer films to help in the understanding of lacquer cracking and eventually to develop suitable test procedures for the assessment of lacquer durability. In order to obtain a parameter which would be a true material property, the concepts of fracture mechanics have been employed and these are, briefly introduced. The experimental techniques are discussed and the cold-check test as a test of durability critically examined.

Keywords

Types and classes of coatings and allied products

catalysed coating
cellulosic coating
clear coating

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

cold check resistance
cracking
tensile strength

Miscellaneous terms

free film

Une tentative faisant appel à la mécanique de fracture pour élucider la formation de craquelures en vernis clairs

Résumé

On a effectué les mesures sur des feuils de vernis clairs qui ont été détachés de leur support afin de contribuer à la compréhension de la formation de craquelures en vernis clairs, et ensuite de perfectionner des méthodes d'essais pour apprécier la durabilité de vernis clairs. Afin d'établir un paramètre qui serait une vraie caractéristique de la matière en question, on a fait appel aux concepts de la mécanique de fracture, auxquels on donne une briève introduction. On discute les techniques expérimentales et l'on considère en critique le "cold-check test" au point de vue d'une méthode d'essai de durabilité.

Prüfung auf Rissbildung von Lacken durch eine "Fracture Mechanics" Methode

Zusammenfassung

An nichtgetragenen (freien) Lackfilmen wurden Messungen vorgenommen, um zum Verständnis der Rissbildung in Lacken beizutragen und geeignete Prüfverfahren für die Bewertung von deren Dauerhaftigkeit zu entwickeln. Um einen Parameter zu erhalten, welcher die Eigenschaften des Materials getreulich wiedergibt, wurden die Begriffe "fracture mechanics" benutzt, und diese werden kurz einführend erklärt.

Die experimentellen Techniken werden besprochen, und die Cold-Check (Reissen in der Kälte) Methode zur Prüfung auf Dauerhaftigkeit kritisch betrachtet.

Introduction

The statistical approach

Refs. 1-5

Recently, in attempting to provide a rational framework for the tensile testing of coating materials, Hill and Adams[1] have suggested the use of the Weibull distribution function as a means of characterising the scatter in the ultimate property data. In this approach, a large number of specimens is tested and the tensile strength and elongation to break are fitted to the equation:

$$F(x) = 1 - \exp((x - \delta)^{\beta}/\alpha)$$

in which x is the tensile strength or elongation to break, $F(x)$ is the cumulative probability of failure (the proportion of x values less than or equal to x), α and β and δ are parameters which determine the shape and position of the distribution of ultimate property values. In addition, values of ultimate property below which a given proportion of samples will fail can be calculated.

It was suggested that the provision of this kind of information would allow coatings to be characterised in terms of these fitting constants. When compared with other practices[1], for example the rejection of a percentage of the sample data, the statistical technique certainly provided a closer material specification.

In the FIRA laboratories, the author is concerned in many cases with brittle wood finishes and for these this approach has limitations. Apart from the complexity of the fitting procedure, the major difficulty is one of sample preparation and involves a consideration of the tensile test itself.

It has been found in the tensile testing of a diverse range of materials, including plastics[2], adhesives[3], reinforced plastics[4], and rubbers[5], that the ultimate properties of the specimens are largely determined by the occurrence of flaws either within the body of the specimen or at its edges. The type of flaw which determines the ultimate rupture point will depend mainly on the amount of damage caused during preparation of the specimen. Coating materials are, generally, cut into strips for tensile testing. In the case of furniture lacquers, which are often brittle, it has been observed that in the

normal type of test procedure, fracture is almost invariably initiated from a cut edge. Thus, a consideration of preparation procedures and incidental damage is of prime importance.

Whilst the author's work has so far been confined to these brittle films, it is believed important to try to observe during this test the location of the point of initiation of the fracture. This would be important even in the case of initially flexible films if, for instance, embrittlement were to be observed on natural or accelerated ageing. In such a circumstance, the distribution in ultimate properties may move at some point from an intrinsic flaw-controlled regime (fracture initiated from within the body of the specimen) to an edge flaw-controlled regime. Interpretation of the Weibull parameters as distinctly material properties would not be possible beyond such a point. There is a possibility that this situation will arise because a coating material as applied to a substrate is unlikely to experience the effect of a cut edge, so it is necessary to ensure that the distribution in ultimate properties be controlled by flaws within the bulk of the material.

An alternative approach to this problem of fracture, and one which is particularly useful for brittle coatings, involves the more complete use of the concepts of fracture mechanics.

Fracture mechanics approach

Refs. 6-8

The concepts of fracture mechanics originated with Griffith[6], who suggests that a crack will grow in a body under tension when its growth through unit area releases strain energy at more than a critical rate with respect to the crack dimensions, this rate of strain energy release being that required for the creation of the new surface. For an infinite plate of elastic material containing a *sharp* central crack of length $2a$ lying in a plane perpendicular to the stress, his equation was of the form:

$$\sigma = (2E\gamma')^{\frac{1}{2}}/(\pi a)^{\frac{1}{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where E = Young's modulus

γ' is the specific surface energy

σ is the tensile strength

In this case, the strain energy density W (that is, the area under the stress-strain curve) is given by:

$$W = 0.5\ \sigma^2/E$$

For specimens of finite width and with a flaw in one edge, the stress field at the crack-tip can be influenced by the proximity of the free edges, so that a modification of this equation is required[7].

$$\sigma = (2E\gamma)^{\frac{1}{2}}/(ay^2)^{\frac{1}{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where $y = 1.99 - 0.41\ (a/w) + 18.70\ (a/w)^2 - 38.48\ (a/w)^3 + 53.85\ (a/w)^4$

where w = specimen width.

This modification for "finite width" effects holds good over a range $0 < (a/w) < 0.6$. Thus, for elastic materials, a plot of σ against $(ay^2)^{-\frac{1}{2}}$ should be linear and of slope $(2E\gamma)^{\frac{1}{2}}$, and by preparing specimens of varying flaw size, γ can be obtained. The parameter γ is basically the energy required to create unit area of new surface in a body and, as such, is a property of the material alone. This argument holds for bodies containing sharp flaws (flaws where the tip radius is of atomic dimensions). Where the flaw tip radius is larger, the stress concentrating effect of the flaw will be lessened. Therefore, in practice it is desirable to obtain as sharp a flaw as possible.

In the fracture toughness testing of thick (> 1mm) plastic sheet, a technique of crack production is sought, which will result in a "natural" crack of known length. For instance, a saw cut of suitable depth can be made in the edge of a sheet specimen and then a razor blade pushed slowly into the base of this cut[8]. A natural crack tends to propagate immediately ahead of the blade and a crack of controlled depth can be produced. For thin films, the flexing of the film makes this technique difficult. Instead, in the work reported here, the blade was forced into the film in a direction normal to its major surfaces. This method produced notches with tip radii greater than for a natural crack. As the stress concentrating effect of a flaw is dependent on its tip radius, this meant that these specimens broke at applied stresses rather higher than would have been attained had the notch been a truly natural crack. Nevertheless, as long as the specimens can be notched in a reproducible manner and as long as the fracture is initiated at the notch over the whole range of notch depths experimentally attainable, the value of γ measured by this method should be proportional to the value of γ pertaining under "natural crack" conditions.

It is the author's purpose in the present paper to illustrate the use of these concepts in the testing of brittle coatings. Consequently, in what follows he has chosen to describe particular examples taken from his own work in order to highlight areas in which this approach has proved useful, rather than to discuss a single piece of long-term research.

Experimental

Specimen preparation

Glass plates 23 × 10cm (9 × 4 inches) were covered with a layer of 0.00254cm (0.001 inch) Melinex film, a thin film of water being used to exclude air bubbles. Lacquer was then spread on the Melinex film using bar spreaders or draw-down blades. The plates were allowed to dry in a dust-free enclosure for four days prior to conditioning. Before being tested, the films were maintained overnight at 65 per cent relative humidity (RH) and 24°C.

Test strips were cut (6 × 1cm) using a fresh scalpel blade for each plate. Each strip was placed on a glass surface lacquer-side down, a ruler was placed on top, and the Melinex film peeled from the lacquer by drawing it back over the ruler. Using this technique specimen strips of very brittle lacquers (extension-to-break around 1 per cent) could be obtained without further damage.

Notches were introduced from one edge using a razor blade set in a holder. A fresh blade was used for each plate. The lengths of the cracks were measured using a travelling microscope, and any specimens in which a natural crack had propagated from the notch tip were rejected at this stage.

Usually, 20 specimen strips were obtained from each plate and half of these left unnotched for the measurement of Young's modulus. Tests were performed on an Instron testing machine at a crosshead speed of 1mm per minute.

Lacquers employed

Three lacquers were employed in this work. Lacquer *A* (*1*) was a precatalysed lacquer, which had spent some four years in the can. When fresh, it was found to perform satisfactorily in the cold-check test (described below), but poorly in service. Lacquer *A* (*2*) was a freshly prepared version of *A* (*1*), made

up in the laboratory as nearly as possible to the same formulation. Lacquer *C* was a nitrocellulose lacquer formulated in the laboratory.

Results

Refs. 9-11

Preliminary tests on unnotched specimens—Lacquer A (1)

That fracture had been initiated in unnotched specimens from a cut edge was obvious from the shape of the broken specimens. When the two specimen halves were reassembled, a gap often occurred, reminiscent of a river delta, with its root at one edge; this had been formed as the fracture had branched and re-branched as it progressed across the specimen. The same conclusion as to fracture origin was reached by testing specimens cut rather wider (4cm) than the grips used for testing (2.5cm), so that the cut edges remained relatively unstressed. The tensile strength of the wide specimens (based on the grip width) were significantly higher than those of the narrow specimens. This is shown in Table 1,

Table 1

Variation in average tensile strength with specimen width

Specimen width (cm)	Average tensile strength* MN/m^2	Ratio of tensile strength to modulus*
1	13.3 (9)	1.9×10^{-2} (8)
4	18.2 (7)	2.9×10^{-2} (7)
(Grip width = 2.5cm)		

*Numbers in parentheses are the number of specimens used in averaging.

where the numbers in parentheses are the number of specimens used in averaging. Since the actual area stressed is less well-defined in the wide specimens, the ratio of tensile strength to Young's modulus (from the slope of the linear portion of the curve shown in Fig. 1) is also shown. As both measurements were based on the same (ill-defined) cross-sectional area, the ratio should have been independent of this area. Again, this ratio is higher for the wide specimens. Fracture in these specimens invariably took place within the gripped portion, usually close to the grips.

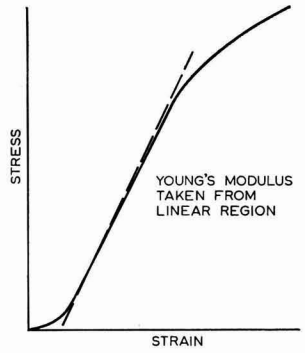

Fig. 1. Typical stress-strain curve for a brittle lacquer (schematic)

Examples of the use of the fracture mechanics approach

Example A Fig. 2 shows the results obtained on precatalysed lacquer *A(1)*. The tensile strength is plotted in accordance with equation (2). Various thicknesses of lacquer were employed by using different spreaders and multiple coats. Instead of a linear relationship between tensile strength and the parameter $(ay^2)^{-\frac{1}{2}}$, the plots curve away from the stress axis at high stresses. It is believed that much of this curvature

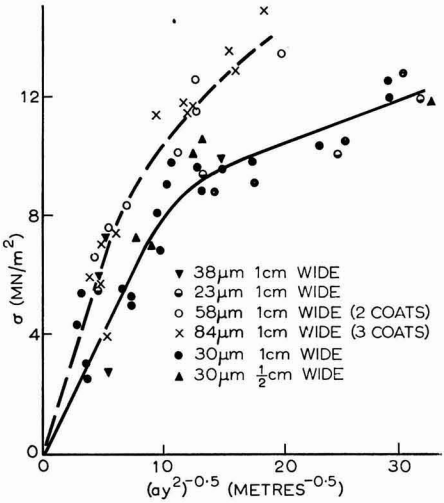

Fig. 2. Tensile strength (σ) as a function of notch depth parameter ($a\,y^2$) for lacquer *A(1)* unheated

can be attributed to non-linearity in the stress-strain curve for the material, and this point is discussed fully in the appendix. The slope in the low stress region has been taken here and the Young's modulus from the same region used to calculate γ (Table 2).

Table 2

Calculation of γ at various film thicknesses

Film treatment	Average thickness (μm)	Young's modulus E (MN/m^2)	Fracture toughness γ (MN/m)
Lacquer *A(1)* 1 coat (7 days after spreading)	23	6.2×10^2	5×10^{-4}
	30	6.3×10^2	
	38	6.6×10^2	
2 coats	58	7.1×10^2	8×10^{-4}
3 coats	84	6.9×10^2	

The value of γ in Table 2 is only weakly dependent on the thickness of the film, and this has been found common to all the six lacquers so far tested.

A popular test for the durability of lacquers is the cold-check test, in which a suitable substrate is spread with lacquer, which is allowed to dry, and the specimen then put through a temperature cycling programme. Typical conditions are one hour at 60°C, one hour at −20°C and one hour at the ambient air temperature. The number of cycles required to

cause cracking of the lacquer is taken as an indication of durability. It is often found in this test that the thickness of the lacquer film has an influence on the results obtained. Fig. 3 shows cold-check results obtained by French[9], plotted as a function of film thickness. Similar data have been reported by Miller & Clare[10].

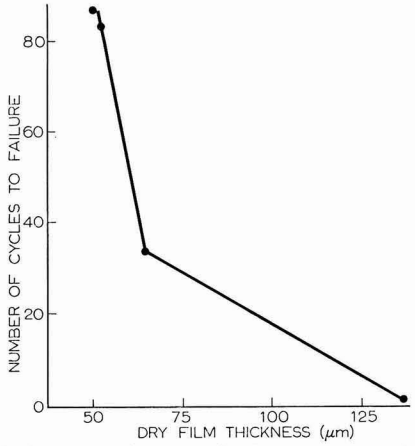

Fig. 3. Cold-check resistance as a function of lacquer film thickness

The results reported here indicate that the tendency to crack in thicker films is not necessarily associated with a lowering of fracture toughness in the material. Further experimentation is underway to examine this aspect of lacquer cracking more fully.

Example B The effect on fracture toughness of varying the lacquer composition is illustrated in Fig. 4 and Table 3.

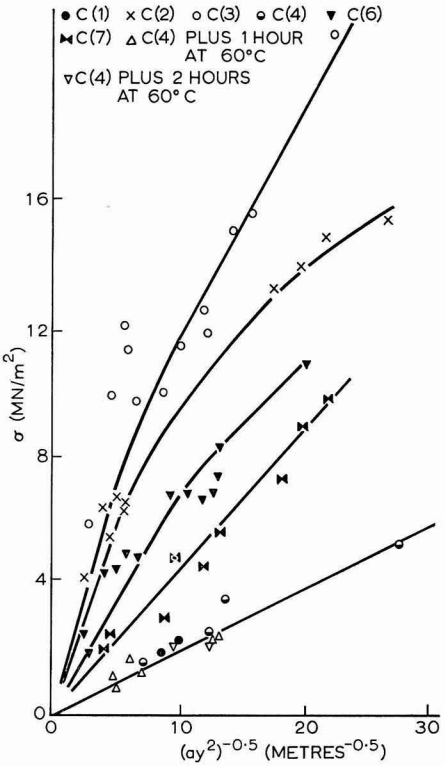

Fig. 4. Tensile strength (σ) as a function of notch depth parameter $(a\,y^2)^{-0\cdot5}$ for lacquers $C(1)$ to $C(7)$ (see Table 3 for compositions)

Table 3
Effect of lacquer composition on fracture toughness

Components	Lacquer							Remarks
	C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	
Nitrocellulose DHX 3/5	14.3	7.15	0	12.9	12.9	12.9	12.9	Low viscosity
Nitrocellulose DHX 30/50	0	7.15	14.3	1.4	1.4	1.4	1.4	High viscosity
Non-drying alkyd	6.2	6.2	6.2	6.2	0	12.3	6.2	"Soft" resin
Rosin-maleic ester	6.1	6.1	6.1	6.1	12.3	0	6.1	"Hard" resin
"Bisoflex"	5.2	5.2	5.2	5.2	5.2	5.2	4.6	Plasticiser
Blown castor oil	0	0	0	0	0	0	0.6	
Butyl acetate	13.0	13.0	13.0	13.0	13.0	13.0	13.0	
Toluene	49.0	49.0	49.0	49.0	49.0	49.0	49.0	
Butanol	5.2	5.2	5.2	5.2	5.2	5.2	5.2	
1% silicone solution in toluene	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Young's modulus ($MN/m^2 \times 10^{-2}$)	6.4	6.5	7.3	7.0	Too brittle to test	5.9	6.5	
γ ($MN/m \times 10^4$)	0.3	8.5	10.0	0.3		4.1	1.5	

The original lacquer (*C4*), on which these modifications were based, contained nitrocellulose of two average molecular weights, as indicated by their viscosity ranges on the ICI system[11]. The original formulation (*C4*) was found to have only slightly better resistance to fracture than a formulation (*C1*) based on the low viscosity (low molecular weight) nitrocellulose alone. A very fracture-resistant film (*C3*) was produced by using only the high viscosity nitrocellulose, but a considerable improvement in fracture resistance was still obtained using a 1:1 mixture (by weight) of the two grades (*C2*).

It was noted that rupture in lacquer *C3* occurred more slowly than in the other lacquers (especially in specimens containing long notches), and the load on the specimen fell as the crack proceeded across it. This may have been due to a greater degree of ductility at the crack tip, resulting in a higher tip radius and hence a reduction in the stress concentration at the tip.

The original lacquer contained proportions of a "hard" (maleic ester) resin and a "soft" resin (non-drying alkyd), and in lacquers *C4*, *C5* and *C6* the proportions of these were varied. The sample containing no "soft" resin was found to be too brittle to test, whereas that containing no "hard" resin had an improved fracture resistance over the original.

In lacquer *C7*, a proportion of blown castor oil was introduced, and this was found to result in a considerable improvement in fracture resistance.

This example is important in that it demonstrates that the fracture toughness parameter γ is capable of providing a quantitative description of formulation changes in accordance with that which would be expected qualitatively by experience, and it supports the expectation derived from theory that γ is indeed a measure of the tendency to fracture.

Example C As the cold-check test for lacquer durability involves heating the lacquer film at 60°C, the effect of this treatment on lacquers *A(1)* and *A(2)* was explored. The films spread on Melinex were heated at 60°C for varying periods and tested at room temperature, after being conditioned overnight at 65 per cent RH.

In one case, a film of lacquer *A(1)* was put through a series of 13 cold-check cycles before being cut and tested. The value of γ found for this film is shown in Fig. 5 as an open point, together with the data for the other heated films.

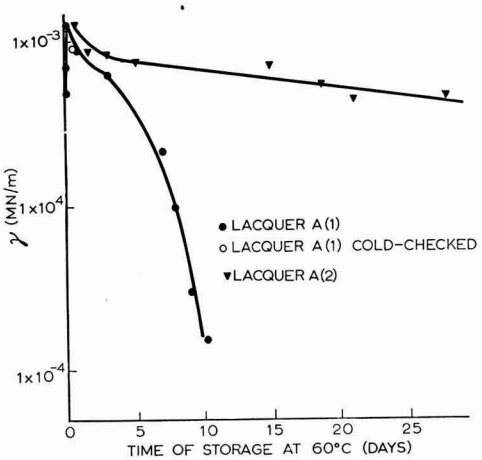

Fig. 5. The effect of prolonged heating on the fracture resistance of lacquers *A(1)* and *A(2)*

Lacquer *A(1)* was found to increase its fracture resistance during the first two hours of heating, but subsequently became very brittle. The freshly prepared lacquer *A(2)* showed rather different behaviour. The unheated material (seven days'

Table 4

Effect of heating on lacquer durability and γ

Film treatment	Average thickness (μm)	Average modulus ($MN/m^2 \times 10^{-2}$)	Fracture toughness (MN/m)
Lacquer *A(1)* heated at 60°C for:			
1 hour	30	7.8	6.4×10^{-4}
2 hours	30	8,0	1.2×10^{-3}
2 hours (repeat)	30	8.9	1.1×10^{-3}
17 hours	30	7.3	8.2×10^{-4}
3 days	30	8.0	6.3×10^{-4}
7 days	30	8.3	2.2×10^{-4}
8 days	30	9.3	9.5×10^{-5}
10 days	30	6.5 (approx.)	1.5×10^{-5} (approx.)
Lacquer *A(1)* cold-check cycled:			
13 cycles	30	7.4	8.1×10^{-4}
13 cycles (repeat)	38	8.8	8.2×10^{-4}
Lacquer *A(2)* heated at 60°C for:			
1 hour	25	10 (approx.)	3×10^{-4} (approx.
2 hours	25	16	—
5 hours	25	14	1.1×10^{-3}
30 hours	25	10	9×10^{-4}
3 days	25	18	8×10^{-4}
5 days	25	10	7.4×10^{-4}
15 days	25	20	7×10^{-4}
19 days	25	20	5.3×10^{-4}
21 days	25	20	4.2×10^{-4}
28 days	25	23	4.6×10^{-4}

storage at 65 per cent RH) was found to be too brittle to test satisfactorily, although on immersion in acetone a significant quantity of material remained undissolved, indicating that some crosslinking had already taken place.

A film stored for one month was also brittle and was found to be developing cracks, mainly at the edges. Upon heating the films at 60°C, however, the fracture resistance rose rapidly, and the data are shown in Fig. 5. The value of γ rose until it was similar to that for lacquer *A(1)* at its optimum, but thereafter fell away very much more gradually than had occurred with the aged lacquer. These measurements highlight another area in which the measurement of γ should prove useful, namely the effect of in-can storage on the subsequent mechanical properties of the lacquer.

In terms of the cold-check test, the behaviour at short heating times is of interest. The possibility arises that the first hour of the test (at 60°C) might sufficiently toughen a brittle lacquer through crosslinking to enable it to survive the remainder of the test intact, although this increase in γ on heating did not appear to occur with the nitrocellulose lacquer *C(4)* (see Fig. 4). To investigate the possibility, however, four glass plates were spread with lacquer *A(2)* and stored for seven days. One plate was placed in the cold cabinet at —23°C and examined after one hour. Small cracks were observed near blemishes in the film (dust, fibres, etc), and after replacement in the cold cabinet for a further 30 hours, these were found to have propagated throughout the film. A second plate was heated at 60°C for one hour and placed in the cold cabinet. This was still clear and free from any cracks after 31 hours.

Two plates were placed in the cold cabinet for one hour and then removed. As before, small cracks were visible. One of these plates was then heated for one hour, the other for three hours, and then both were placed in the cold cabinet for 30 hours. Little, if any, crack propagation was found to have occurred after this period. Thus, it can be concluded that the first hour of the cold-check test can have a marked effect on the fracture resistance of some lacquers. The test will give a good correlation with service performance only where the changes in γ which occur during the test reflect the changes which are due to occur in service. After solvent evaporation, the mobility of polymer molecules in the film will be severely restricted, and it is not at all unlikely that in some convertible coatings, a significant proportion of potential crosslinking sites will remain unreacted throughout the life of the film. This proportion will be very much reduced by heating to 60°C and, as a result, the mechanical properties of the lacquer may be rendered atypical compared with those of the same lacquer formulation when used in service.

It is of interest to note that the film which had been subjected to 13 cold-check cycles had a value of γ close to that for films continuously heated for similar periods and rather higher than that for unheated material. Thus, the concept of the cold-check test as an accelerated ageing procedure (that is, of causing an enhanced deterioration in properties) seems rather unsound.

Conclusions

The work described here has been of an exploratory nature, aimed at investigating the usefulness of fracture mechanics to provide an index of brittleness for lacquer films. The provision of such an index can be regarded only as the first step in the search for a suitable accelerated ageing procedure for these materials. It must be emphasised that such measurements provide data only on the state of the material at the time of test and are in no way predictive. Nevertheless, they offer a means whereby various ageing procedures can be evaluated in a quantitative manner. Future work will explore the effect on various test lacquers of such parameters as natural sunlight, xenon arc radiation and heat. The work reported here, however, would indicate that heat alone is unlikely to be a satisfactory means of accelerating the ageing process.

Further work is also planned to investigate the effect of film thickness on propensity to crack, by making measurements of the internal stress in the dried lacquer.

Acknowledgment

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[*Received 13 August 1975*

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Appendix

Ref. 6

The plots of tensile strength against the factor $(ay^2)^{-\frac{1}{2}}$ were found to be substantially non-linear, in contradiction to equation (2). This was found to be the case mainly for the unheated films. The fracture mechanics theory described in the introduction is strictly applicable only to elastic materials (that is, to materials having a linear stress-strain curve up to rupture). As indicated in the introduction, the theory uses a critical strain-energy criterion for fracture. For the elastic case, the strain-energy density W (that is, the area under the stress-strain curve) is given by:

$$W=0.5\,\sigma\,\varepsilon\,=\sigma^2/2E$$

where σ=tensile strength

ε=elongation to break

For materials where the stress-strain curve is not linear, W can be determined from a calibration test on unnotched material and a plot of W against elongation constructed. From measurement of the elongation-to-break for the notched specimens, γ can be obtained from equation (2) when this is recast[6] as :

$$W=\gamma/ay^2$$

This approach has been carried out for representative sets of data and the results are shown in Figs. 6 and 7. For lacquer *B*, which showed the greater linearity, Fig. 6 indicates that either the tensile strength method or the strain-energy density method will give equivalent results. In Fig. 7 an extreme example of the non-linearity

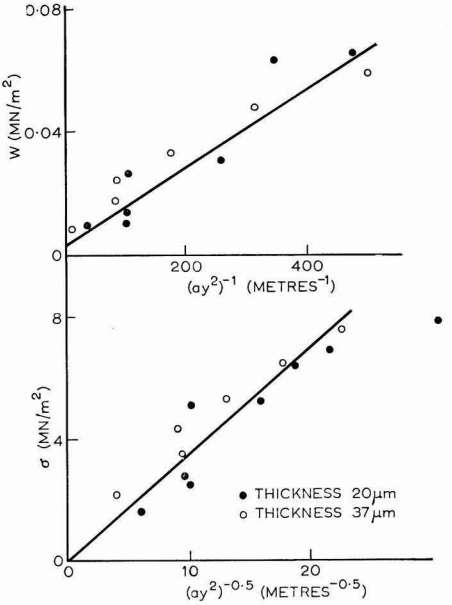

Fig. 6. The tensile strength and strain-energy density methods of obtaining γ (lacquer B, unheated)
($\gamma = 1.3 \times 10^{-4}$ MN/m in both cases)

present in the mechanical response of lacquer *A(1)* is shown. The tensile strengths of the small-crack specimens appear to approach the yield strength of the material, and the two methods of calculation give slightly different results: $\gamma = 8.2 \times 10^{-4}$ MN/m by the tensile strength method and $\gamma = 6.2 \times 10^{-4}$ MN/m by the strain energy density method (the reason for the non-zero intercept is not known). The latter approach is more likely to give the correct value of γ than the former. However, as the difference is not large, the tensile strength method has been employed for experimental convenience.

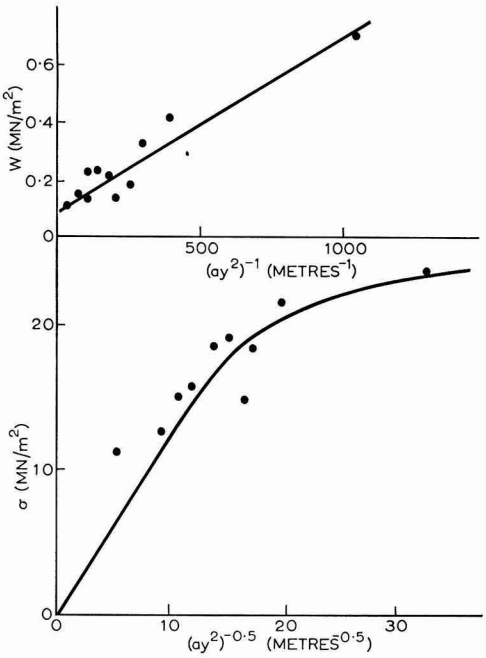

Fig. 7. The tensile strength and strain-energy density methods of obtaining γ

Lacquer *A(1)* after 13 cold-check cycles, 40μm thickness.
$\gamma = 8.2 \times 10^{-4}$ MN/m by tensile strength method; $\gamma = 6.2 \times 10^{-4}$ MN/m by strain-energy density method.

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Analysis of polyamide resins: A co-operative IUPAC study*

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Summary

In continuation of the IUPAC co-operative studies to assist the selection of the best techniques for the analysis of synthetic resins, five polyamide resins have been analysed by four European laboratories using their own techniques. The results show that whilst some information on the composition of the resins can be obtained by direct spectroscopic analysis (IR or NMR), hydrolysis of the resin with mineral acid under pressure to obtain the acid and amine components is necessary for more complete analysis: the monomer/dimer/trimer ratios of the acids may then be obtained chromatographically and the composition of the amines spectroscopically. Poor agreement is obtained if the determination of the amine values of the resins is by titration.

Keywords

Raw materials:

binders (resins, etc.)

polyamide resin

used in manufacture or synthesis of ingredients for coatings

amine
dibasic acid
fatty acid

Processes and methods primarily associated with analysis, measurement or testing

acid number
amine number
elemental analysis
gel permeation chromatography
hydrolysis
infrared spectroscopy
nuclear magnetic resonance spectroscopy

L'analyse des résines polyamides: Une étude coopérative de l'IUPAC.

Résumé

En vue de continuer l'étude coopérative de l'IUPAC destinée à faciliter la seléction des meillures techniques d'analyser les résines synthetiques, cinq résines polyamides ont été analysées, selon leurs propres techniques, par quatre laboratoires en Europe. Le résultats démontrent que bien que l'on puisse obtenir une indication de la composition des résines au moyen de l'analyse spectrographique (à l'I.R. ou R.N.M.) des résines elles-mêmes, l'hydrolyse, sous pression de la résine par un acide minéral, qui donne les constituants acides et amines est nécessaire à l'obtention d'une analyse plus détaillée: les rapports monomère/dimère/trimère des acides peuvent être déterminés chromatographiquement, et la composition de l'amine par spectroscopie. Un mauvais accord est obtenu dans le cas où la détermination de la valeur amine de la résine est effectuée par titrimétrie.

Analyse von Polyamidharzen: Eine Kooperative IUPAC Untersuchung.

Zusammenfassung

Im Laufe weiterer kooperativer IUPAC Untersuchungen, die darauf hinzielen die besten Metboden für die Analyse von Kunstharzen auszusuchen, wurden von vier, ihre eigenen Methoden benutzendeneuropäischen Laboratorien fünf Polyamidharze analysiert. Die Ergebnisse zeigen, dass man zwar durch direkte spektroskopische Analyse (IR oder NMR) manche Information über die Zusammensetzung des Harzes erhalten kann, dass aber für eine vollständigere Analyse Hydrolyse des Harzes mit Mineralsäure unter Druck erforderlich ist, um Säure—und Aminkomponenten zu erhalten: dann können die Monomer-/Dimer-/trimerproportionen der Säuren chromatographisch und die Zusammensetzung der Amine spektroskopisch beistmmit werden. Wenn die Bestimmung der Aminwerte der Harze durch Titrierung vorgenommen wird, ist die Übereinstimmung schlecht.

Introduction

Refs. 1-4

Within the series of co-operative analytical investigations by the former Organic Coatings Section of IUPAC[1-4], two recent papers dealt with the efficiency of modern analytical techniques for the analysis of thermosetting acrylic resins[3] and polyurethane resins[4]. A similar study has now been carried out on polyamide resins.

The same procedure was followed: namely, resins whose compositions were not disclosed until the end of the work, were distributed to the individual laboratories for analysis by techniques chosen at their discretion. The laboratories taking part were:

Sadolin & Holmblad Ltd (Denmark)

Scandinavian Paint & Printing Ink Research Institute (Denmark)

Paint Research Association (Gt. Britain)

Cray Valley Products Ltd (Gt. Britain)

*A report from the Working Party on Supported Polymer Films of the Macromolecular Division of the International Union of Pure and Applied Chemistry.

The compositions of the resins are shown in Table 1.

Table 1
Composition of the polyamides used for the co-operative analysis

Polyamide	Component	Weight per cent
A	Methyl epoxy stearate	16.0
	Tall oil fatty acids	37.3
	Tetraethylene pentamine	46.7
B	Common dimer acid A*	73.8
	Tall oil fatty acid	9.1
	Diethylene triamine	15.1
	p-tert butyl phenol novolak (antioxidant)	2.0
C	Common dimer acid B*	80.0
	Propionic acid	6.0
	Hexamethylene diamine	9.0
	Ethylene diamine	5.0
D	Distilled dimer acid*	63.4
	Azelaic acid	17.3
	Ethylene diamine	6.1
	Piperazine	13.2
E	Common dimer acid A*	63.0
	Tall oil fatty acid	2.6
	Triethylene tetramine	24.0
	Tetraethylene pentamine	10.4

*The common dimer acid A contained (determined by GLC by the supplier) monomeric monocarboxylic acid 11.9%, dimeric monocarboxylic 3.9%, dimeric dicarboxylic 66.2%, trimeric 18.0%. Common dimer acid B gave 7.0, 4.7, 70.7, 17.6 for the same components. For the distilled dimer acid the corresponding figures were 7.1, 0.7, 92.2, 0.0.

The general procedure used by all laboratories was similar: a direct analysis of the resin, followed by hydrolysis and examination of the liberated acids and polyamines.

Techniques used to study the total resin were: elemental analysis, determination of amine, acid and imidazoline values, infrared (IR) and nuclear magnetic resonance (NMR) spectroscopy and gel permeation chromatography (GPC).

By far the most widely used and successful hydrolysis technique was with hydrochloric acid under pressure. This gave the fatty acids, which could be extracted with hexane or ether, and the amine hydrochlorides.

The fatty acids were then examined by IR and NMR spectroscopy, gas liquid chromatography (GLC) and GPC and the amine hydrochlorides by IR and NMR spectroscopy and paper chromatography.

Examination of original polyamides

Refs. 5, 6

Chemical methods

Acid values

These were determined by three laboratories in the conventional way by titration of an ethanol/toluene solution of the polyamide with methanolic potassium hydroxide. Values were in fair agreement and for all resins less than 10.

Amine values

These were determined in all cases by the usual method, which involves titrating solutions of the resin in butanol/toluene with 0.1N aqueous hydrochloric acid, using bromocresol green indicator. Although the individual laboratories could obtain fairly reproducible figures, agreement between the different laboratories for the reactive high amine polyamides was poor, as shown in Table 2.

Table 2
Amine values of polyamides

Laboratory	Value				
Polyamide:	*A*	*B*	*C*	*D*	*E*
I	462	85	1.8	0.4	351
II	382	76.5	1.2	0.3	287
III	504	101	5.8	1.3	389
IV	422	83.8	1.0	0.3	307

Two laboratories (II and IV) also tried titration with perchloric acid under non-aqueous conditions using visual or potentiometric end-points, but results were even less consistent, being for polyamides *A*, *B* and *E*: 311, 65 and 164 in one case, and 588, 92 and 372 in the other.

This position is clearly unsatisfactory and requires further examination. Undoubtedly, with the reactive polyamides there are a variety of basic species and it is uncertain which groups are being titrated by the two different methods. In addition, judgement of the position of the bromocresol green end-point varies between different operators.

Only one laboratory (IV) determined imidazoline values[5, 6] and found 16, 54 and 67 for resins *A*, *B* and *E*, in turn.

Elemental analysis

One laboratory (III) recorded the elemental analysis of the resins, with the results shown in Table 3. Another laboratory (IV) determined only the N contents (results in parentheses).

Table 3
Elemental analysis of polyamides

Component	Percentage				
Polyamide:	*A*	*B*	*C*	*D*	*E*
C	61.79	77.32	77.11	74.61	71.31
H	11.38	11.15	11.12	10.50	11.16
N	16.50 (17.0)	6.60 (6.23)	5.38(4.81)	6.16 (5.31)	12.69 (11.71)

The reactive polyamides A and E are clearly distinguishable by their high N contents

Table 4

Molecular sizes of polyamides by GPC

Polyamide:	*A*		*B*		*C*		*D*		*E*	
Laboratory	An	Aw	An	Aw	An	Aw	An	Aw	An	Aw
II	65	154	73	112	144	387	*	*	50	59
III	27	76	66	144	117	276	203	1051	33	52

*Not determined owing to poor solubility

Chromatographic and spectroscopic methods

Gel permeation chromatography

The gel permeation chromatograms of the resins in tetrahydrofuran solution were obtained by three of the laboratories, two of which calculated number and weight average molecular sizes (A_n and A_w), as shown in Table 4. (The value A, the equivalent angström length, is a measure of the molecular size in dilute solution, and is obtained from the gel permeation chromatograph by reference to a calibration graph.)

These were in fair agreement for three of the resins and discrepancies may have been due to the fact that one laboratory did not include low molecular size components in the calculation.

Infrared spectroscopy

All laboratories examined the IR spectra of the original polyamides, which showed that they were aliphatic polyamides. One laboratory (I) recorded the band intensities, as shown in Table 5. This showed similarities between *A* and *E*, and between *C* and *D*, the presence of imidazoline groups in *B* and *E* and characteristic bands in *D* suggestive of piperazine. Laboratory IV, with access to a much wider range of reference spectra, was able to obtain more information.

Table 5

Infrared spectra of polyamides

Wave number	Assignments	Result*				
(cm^{-1})	Polyamide:	*A*	*B*	*C*	*D*	*E*
3312	NH stretch				m	
3290	NH stretch	s	m	ms		ms
3200 sh		w	w	w	w	w
3070		w		w	w sh	
3050 sh			w			w
3005	CH stretch of —CH=CH—	w	vw		vw	
2912	CH stretch of CH_2 asym.	s	s	s	s	s
2850	CH stretch of CH_2 sym.	s	s	s	s	s
2820 sh		ms				ms
1650-40	Amide I	s	s	s	vs	s
1610-05	C=N stretch of imidazoline		m			s
1550	Amide II	s	s	s	m	s
1460	CH_2 scissor	s	s	ms	s	s
1425	CH_3 asym. deformation				s	
1375-65	CH_3 sym. bending	w	w	w	w	w
1300		ms				w
1281	Amide III				m	
1270-60			mw	w		mw
1240				w	m	
1218-10			w		m	
1180-72			w	w	w	w
1125		ms	w	w	w	m
1016-10		w	w		m	w
985					w	
965		vw	vw	w		w
940-30		w				
915		w				
815		w	vw			w
775		wm				wm
760					w	
722	(CH_2) n rocking	wm	wm	wm	wm	wm
700-695	Amide V			w	w	
590	Amide VI	vw	vw	vw	vw	vw
545					vw	
440		vw		vw	vw	vw

*Key: vw very weak; w weak; wm weak to medium; ms medium to strong; s strong; sh shoulder.

Nuclear magnetic resonance spectroscopy

Three laboratories examined the NMR spectra of the resins. One laboratory (II) gave a detailed account of the assignments, as shown in Table 6. The polyamides were examined on a 60MHz spectrometer as solutions in chloroform, using TMS as an internal reference. This technique enabled many of the component amines to be identified, including piperazine in polyamide *D*.

Table 6

Nuclear magnetic resonance spectra of polyamides

All 5 polyamides:	
Chemical shift δ	
0.8 –1.15	unsharp triplet from C—CH_3 in fatty acids
1.15–1.6	high peak from "neutral" CH_2 in fatty acids
2.0 –2.4	low hump from CH_2—C(=O)—N and possible CH_2—C=C— and N—C(—N)=CH_2
7.3	Solvent impurity
	Methine protons from branching or cyclisation of fatty acids are buried in the region 1.5–2.4 —CNH—R (C=O) is supposed to signal at δ greater than 6.4. In the spectra, where no signals are seen in this area, the reason is probably that they are too weak to be recorded, or the protons are so "active" that they signal together with free amine and carboxylic acid protons.
Polyamide A	
1.8 –2.0	sharp peak, mainly from free NH and NH_2 but also from COOH
2.5 and 2.8	two sharp peaks from CH_2 adjacent to free amino groups in the two main components of
3.1 –3.6	tetraethylene pentamine low hump from C—N—CH_2 (C=O)
	ring—CH_2 of imidazoline—if any—should also signal about 3.6
5.2 –5.4	unsharp multiplet from CH=CH of fatty acid
Polyamide B	
2.5 –3.0	very low hump from CH_2 next to free amine
3.1 –3.5	—CH_2—N—C(=O)—
3.5 –3.8	small hump from ring—CH_2 of imidazoline?
5.2 –5.4	CH=CH from fatty acids
	In spite of an amine value of about 70 no sharp signal can be seen from free amine protons. The signal is perhaps a low hump overlapped by other signals, but the missing signal in combination with the small absorption at 3.5–3.8 may also be interpreted as an indication of a certain content of imidazoline.
Polyamide C	
1.2	small peak on right side of the big peak cannot be explained
1.2 –1.6	CH_2 from fatty acids and CH_2^3—CH_2^4 from hexamethylene diamine
	Signals from CH_2^2—C^3—C^4—CH_2^5 in hexamethylene diamine are buried somewhere between 1.5 and 2.5
3.1 –3.3	CH_2—N—C(=O)— from hexamethylene diamine
3.3 –3.5	CH_2—N—C(=O)— from ethylene diamine
Polyamide D	
1.7	impurity?
3.3 –3.5	CH_2—N—C(=O)— from ethylene diamine
3.5 –3.8	CH_2—N—C(=O) from piperazine
Polyamide E	
1.55	free NH, NH_2 and COOH. The fact that this signal is at higher field than the corresponding signal in A is in accordance with the lower acid value of E.
2.5 and 2.8	CH_2 adjacent to free amino groups.
3.0 –3.5	CH_2—N—C(=O)—
3.5 3.8	ring CH_2 from imidazoline

Hydrolysis of polyamides

All laboratories obtained satisfactory hydrolysis of the polyamides with hydrochloric acid under pressure, using a small bomb or other pressure vessel. Conditions used were:

Laboratory	Hydrolysis conditions
I	6N HCl *at* 130°C *for* 30 hours
II	5N HCl *at* 120°C *for* 20 hours
III	6N HCl *at* 140°C *for* 17 hours
IV	Conc. HCl *at* 150°C *for* 24 hours

Laboratory III also carried out some hydrolyses with 50 per cent hydrochloric acid or concentrated ethanolic potassium hydroxide under normal reflux conditions, but this gave unsatisfactory quantitative results for the monomeric/dimeric/trimeric acid ratios.

Examination of fatty acids

After hydrolysis of the polyamides, the fatty acids were extracted with hexane or ether. No definite identification of the fatty acids was obtained by any laboratory and no laboratory identified the presence of epoxy stearic acid in polyamide *A*. Difficulty in detecting this acid was not surprising since reaction between the epoxy and primary or secondary amine groups would yield a hydroxy-amino acid, and the epoxy stearic acid would not be recovered after hydrolysis. Two laboratories (I and IV) measured the ratio of monomeric, dimeric and trimeric fatty acids after conversion to methyl esters, the former by GPC in tetrahydrofuran on "Styragel" columns and the latter by GLC on an OV-1 silicone column programmed from 100° to 350°C. The results for resins *B*, *C*, *D* and *E* are shown in Table 7.

Both techniques gave results in reasonable agreement and of the right order, as compared with the calculated figures. The GLC technique was also able to differentiate between monocarboxylic and dicarboxylic dimeric acids.

With regard to other acids present, no laboratory identified the propionic acid in polyamide *C*. Refinement of technique by recovering the water-soluble acids from the aqueous phase after hydrolysis with the aid of an ion-exchange column should help, however, with this problem. Laboratory III isolated a white crystalline hexane insoluble acid from the hydrolysis of products of polyamide *D* and identified it by IR and GLC as azelaic acid. Laboratory IV confirmed the presence of azelaic acid in the ether soluble acids by TLC; in the laboratory's GLC analysis, this was recorded with the monomeric acids.

Examination of amine hydrochlorides

The amine hydrochlorides obtained after acid hydrolysis were examined by all laboratories by IR spectroscopy for comparison with reference spectra as available and, in the case of laboratories II and III, by NMR spectroscopy as well. The identifications are given in Table 8.

Table 7
Polymeric fatty acid composition of polyamides

Polyamide	*B*			*C*			*D*			*E*		
Laboratory	I	IV	Calc.	I	IV	Calc.	I	IV	Calc.	I	IV	Calc.
Monomeric	25	22.1	21.6	6	7.8	7.0	3	17.1*	7.1	10	12.9	15.4
Dimeric	56		(62.4)	70		(75.4)	92	82.2	(92.9)	72		(67.4)
(Monocarboxylic)		4.6	3.5		4.7	4.7			0.7		3.9	3.8
(Dicarboxylic)		57.4	58.9		70.9	70.7			92.2		65.8	63.6
Trimeric	19	15.9	16.0	24	16.6	17.6	5	0	0	18	17.4	17.3

*Also includes the azelaic acid present

Table 8
Identification of amine hydrochlorides

Laboratory	*A*	*B*	*C*	*D*	*E*
I	Tetraethylene pentamine	Diethylene triamine	Ethylene diamine Hexamethylene diamine	Ethylene diamine Piperazine	Triethylene tetramine
II	Tetraethylene pentamine	Diethylene triamine	Ethylene diamine Hexamethylene diamine	Ethylene diamine Piperazine	Triethylene tetramine Tetraethylene pentamine
III	Tetraethylene pentamine	Diethylene triamine	Ethylene diamine Other diamine	Pentamethylene hexamine or mixture	Triethylene tetramine and/or tetraethylene pentamine
IV	Tetraethylene pentamine	Diethylene triamine	Ethylene diamine Other diamine	Ethylene diamine Piperazine	Triethylene tetramine

Table 9

Determination of amine hydrochlorides

Polyamine	Actual composition	Analysed composition
C	36% Ethylene diamine 64% Hexamethylene diamine	43% Ethylene diamine 57% Hexamethylene diamine
D	32% Ethylene diamine 68% Piperazine	30% Ethylene diamine 70% Piperazine

The results show that all four laboratories correctly identified the single amines in polyamides *A* and *B*, two correctly identified both amines in *C* and *E*, and three both amines in *D*. For the mixed amines, IR spectroscopy alone does not always seem sufficiently informative and NMR spectroscopy or chromatographic separations may sometimes be necessary. However, by IR spectroscopy of mixed amine hydrochlorides, results in reasonable agreement with the actual compositions were obtained by one laboratory (I) for polyamides *C* and *D* and these are given in Table 9.

Conclusions

A certain amount of information on the composition of polyamides can be obtained by IR spectroscopy and more by NMR spectroscopy. Reproducibility of values for the amine content by titration with acid was poor between different laboratories.

For detailed analysis, hydrolysis of the polyamide is necessary and this can be effected satisfactorily with strong hydrochloric acid under pressure. This gives the acid components and amine hydrochlorides.

The monomer/dimer/trimer ratio of the acids can be obtained by GPC or GLC. The individual component fatty acids are not readily distinguishable. No satisfactory technique was found for identifying epoxy stearic acid or propionic acid in the polyamides, but azelaic acid could be detected.

Single amine components, and sometimes the composition of mixed amines, could be identified readily by IR spectroscopy. Where insufficient information is given by IR spectroscopy, analysis by NMR spectroscopy or chromatographic separation is necessary.

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In-situ epoxidation of linseed oil in the presence of ion-exchange resins

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Summary

Linseed oil has been epoxidised *in situ* with hydrogen peroxide and acetic acid in the presence of ion-exchange resins (Zeo-Karb 225 and modified Lignosite) as catalysts. Alkali-refined oil was used. The parameters studied were time, temperature, the amount of catalyst, and the hydrogen peroxide and acetic acid concentrations. The maximum oxirane content was 8.8 per cent when Zeo-Karb 225 was used, and 5.6 per cent in case of modified Lignosite.

Keywords

Raw materials: oils
linseed oil

Raw materials: plasticisers
epoxidised oil

L'époxydation in situ de l'huile de lin en présence de résines échangeuses d'ions

Résumé

L'huile de lin a été époxydisée *in situ* avec le peroxyde d'hydrogène et l'acide acétique en présence de certaines résines échangeuses d'ions (Zéo-Karb 225 et Lignosite modifié) en tant que catalysateurs. On a utilisé l'huile de lin raffinée par traitement avec alcali. Les paramètres étudiés furent, la durée et la température de la réaction, la teneur en catalysateur, et les concentrations de peroxyde d'hydrogène et d'acide acétique. En utilisant la Zéo-karb 225 on a obtenu une teneur maximale en oxirane de 8,8% et de 5,6% dans le cas de Lignosite modifiée.

In-situ Epoxidierung von Leinöl in Gegenwart von Jonenaustauschharzen

Zusammenfassung

Leinöl wurde in-situ mit Wasserstoffsuperoxid und Essigsäure in Gegenwart von Jonenaustauschharzen (Zeo-Karb 225 und modifiziertem Lignosite) als Katalysatoren epoxidiert. Es wurde alkali-raffiniertes Leinöl benutzt. Die untersuchten Parameter waren Zeit, Temperatur, Katalysatorenmenge und die Wasserstoffsuperoxid-sowie Essigsäurekonzentration. Wenn Zeo-Karb 225 benutzt wurde, war der Höchstgehalt an Oxiran 8,8% und mit modifiziertem Lignosite 5,6%.

Introduction

Refs. 1-6

The catalysts used in the epoxidation of oils are of two main types: the first includes aqueous catalysts or solids dissolved in the reaction medium (homogeneous phase reaction); the second comprises solid catalysts, usually ion-exchange resins, which do not dissolve in the reaction medium during the course of reaction, so that a two-phase (solid : liquid) reaction takes place. In general, insoluble solid catalysts are more desirable, because they minimise epoxide ring opening[1]; are easy to separate from the reaction medium; and can be regenerated for repeated use. Special resins crosslinked only to a small extent yield mostly by-products, whilst resins with a low metal content give the best results[2].

Epoxidised linseed oil of 9.1 per cent oxirane content has been prepared by Rheineck and Wako[3], by de Clerck's technique[4], using 23 per cent Dowex 50W-X8 as catalyst. Nagiah[5] has prepared epoxidised linseed oil of 8.7 per cent oxirane content in the presence of 15 per cent Amberlite CG-120 as catalyst.

To the best of the authors' knowledge, modified Lignosite (a formaldehyde-treated lignin calcium sulfonate) has not previously been used as an epoxidation catalyst for linseed oil. It was used in their previous work for the epoxidation of dehydrated castor oil[6].

Experimental

Refs. 7-9

Materials used were as follows:

Linseed oil Alkali refined; iodine value (IV) 173.

Hydrogen peroxide Chemically pure. Strength determined precisely by the thiosulfate method[7] and found to be 32 per cent.

Zeo-Karb 225 A crosslinked polystyrene sulfonic acid (product of the Permutit Co.) with a dark yellow colour and rather coarse average particle size: granules passed through a 14 mesh but were retained by a 52 mesh sieve (—14+52). Sulfur content approximately 17 per cent, sulfonyl group content approximately 44 per cent.

Lignosite This is a fine, tan coloured powder, obtained from Georgia-Pacific, Bellingham Division, USA. Total sulfur content approximately 6.6 per cent, sulfonyl-group content approximately 14 per cent.

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Preparation of modified Lignosite

Refs. 8-13

The Lignosite was modified by heating with a mixture of concentrated sulfuric acid and formaldehyde at 140°C for 24 hours[8,9]. The product was a very hard, black, solid resin, which was insoluble in water. This was crushed and sieved to the mesh number (—20+50) and the sieved resin particles were washed with dilute hydrochloric acid until calcium free[10], and then with distilled water to remove the acidity. They were then washed with ethyl alcohol and dried under reduced pressure at 50°C.

Epoxidation

The oil was mixed with the required amount of acetic acid, and the required percentage of catalyst added, together with benzene, which served as the reaction medium. Continual moderate stirring of the mixture during the run is very important. With the reaction mixture at the correct temperature, hydrogen peroxide was added dropwise for a period of two hours*. The reaction was considered to begin when the first drop of hydrogen peroxide was added. At the end of the experiment the mixture was poured on to ice and immediately filtered. The residue was transferred to a separating funnel, the water layer was separated, and the oily layer was washed with warm distilled water until acid free, and then centrifuged and finally dried under vacuum at 40°C.

Oxirane content

The oxirane content was determined volumetrically by titrating the sample dissolved in benzene directly with 0.1 N hydrogen bromide in acetic acid (Durbetaki's reagent) using Crystal Violet as indicator[11,12].

Iodine value

The Woburn[13] method of determining the IV was employed.

Results and discussion

The *in situ* epoxidation of linseed oil was fully investigated using as catalysts: lignosulfonic acid polymer (modified Lignosite); a natural polymer sulfonic acid, and Zeo-Karb 225; a synthetic polymer sulfonic acid. Test runs were carried out to determine the conditions which give the highest oxirane content. The parameters studied were the reaction time and temperature, the amount of catalyst and the concentration of the epoxidation reagents (hydrogen peroxide and acetic acid).

Effect of time

Two series of experiments were performed to find out the effect of time on the process of epoxidation of linseed oil. The first series of reactions was catalysed by modified-Lignosite, the second by Zeo-Karb 225. The reaction conditions were the same in the two series, except that the amount of catalyst was 25 per cent in the first and 15 per cent the second. The temperature was fixed at 50°C, and the molar ratio of oil: acetic acid: hydrogen peroxide was 1:6:6 in all experiments. The results obtained are shown graphically in Fig. 1.

*In the experiments with reaction time of one hour, the hydrogen peroxide was added over a period of half an hour; in those of 1.5 hours reaction time, the hydrogen peroxide was added over a period of one hour.

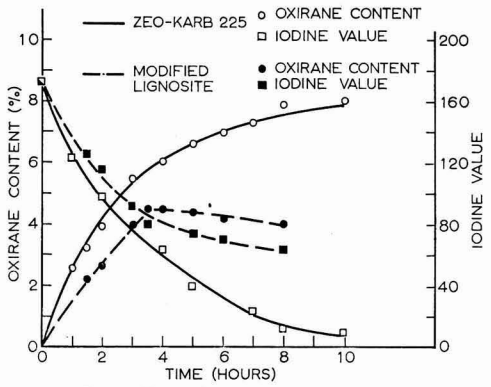

Fig. 1. Effect of time on the epoxidation process

Fig. 1 shows that modified Lignosite produces maximum epoxidation in a reaction time of 3.5 hours, after which the oxirane content decreases. On the other hand, the IV decreases with time, indicating that the double-bonds are opened in spite of the decrease in oxirane content. This means that fission of epoxide rings occurs with time; thus an acetoxy-hydroxy compound is formed as a byproduct.

It is also clear that using Zeo-Karb 225, no depression of oxirane content is evident up to a reaction time of 10 hours.

Effect of temperature

Two other series of experiments were performed to find the effect of temperature on epoxidation. The molar ratio of oil : acetic acid : hydrogen peroxide in all experiments was 1 : 6 : 6. The reaction time was 3.5 hours, and the amount of catalyst was 25 per cent for the modified Lignosite series; for the Zeo-Karb 225 series, the reaction time was four hours and the amount of catalyst was 15 per cent.

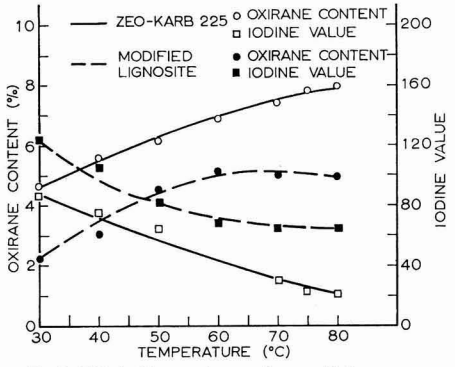

Fig. 2. Effect of temperature on the epoxidation process

Fig. 2 illustrates the effect of reaction temperature on IV and the oxirane content. Whilst modified Lignosite produces maximum oxirane content at 60°C, Zeo-Karb 225 catalyses the epoxidation progressively as the reaction temperature increases. On the other hand, the iodine value decreases gradually in both cases; this means that the small depression

observed in oxirane content at above 60°C with modified Lignosite may be due to fission of the epoxy groups to give saturated products.

Effect of catalyst

In view of the above results, the reaction time was fixed at 3.5 hours and the temperature at 60°C for the modified Lignosite series, and for Zeo-Karb 225 the corresponding figures were four hours and 75°C. The molar ratio of oil : acetic acid : hydrogen peroxide was 1:6:6 in all experiments.

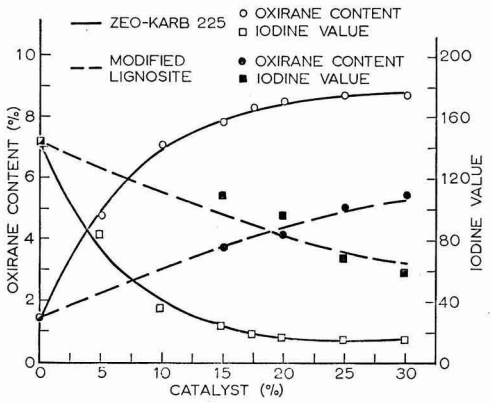

Fig. 3. Effect of choice of catalyst on the epoxidation process

The two oxirane curves in Fig. 3 show that the oxirane content increases with increasing amounts of catalyst. With modified Lignosite, the oxirane content is always lower, and 25 per cent catalyst is needed to produce an oxirane content of 5.10 per cent. With Zeo-Karb 225, 17.5 per cent catalyst is sufficient to produce an oxirane content of 8.30 per cent.

Effect of acetic acid

The effect of acetic acid was studied in two series of experiments to select the most suitable amount of acetic acid, which gives the highest oxirane content using both modified Lignosite and Zeo-Karb 225. The reaction conditions in the first series were reaction time 3.5 hours, reaction temperature 60°C, modified Lignosite catalyst concentration 25 per cent; and in the second series, the reaction time was four hours, reaction temperature 75°C, Zeo-Karb 225 content 17.5 per cent. The concentration of hydrogen peroxide in the two series was fixed at six moles/mole of oil.

The curves showing the influence of acetic acid concentration in the epoxidation reaction are given in Fig. 4.

With modified Lignosite, there is a small increase in oxirane content with an increase in acetic acid content until a value of about 5.10 per cent is reached at six moles of acetic acid per mole of oil. Using Zeo-Karb 225, the oxirane content is always higher; the maximum (8.40 per cent) is reached when between 5.5 and 6.0 moles of acetic acid per mole oil are used.

Effect of hydrogen peroxide

Finally, the effect of hydrogen peroxide concentration was studied in two series. The reaction conditions selected were 3.5 hours reaction time, at 60°C and with 25 per cent modified Lignosite in the first series, and four hours reaction time, 75°C,

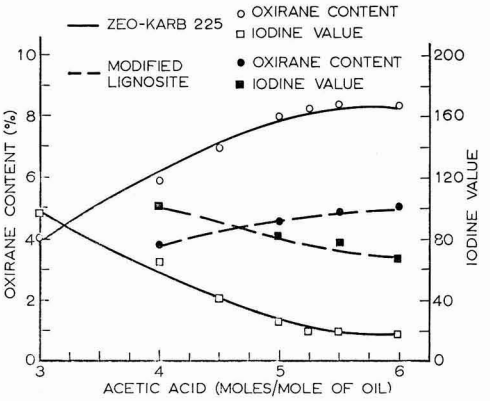

Fig. 4. Effect of acetic acid on the epoxidation process

and 17.5 per cent Zeo-Karb 225 catalyst in the second. The amount of acetic acid in the two series was fixed at 5.5 moles/mole of oil. The changes of oxirane content and IV with hydrogen peroxide content are shown in Fig. 5.

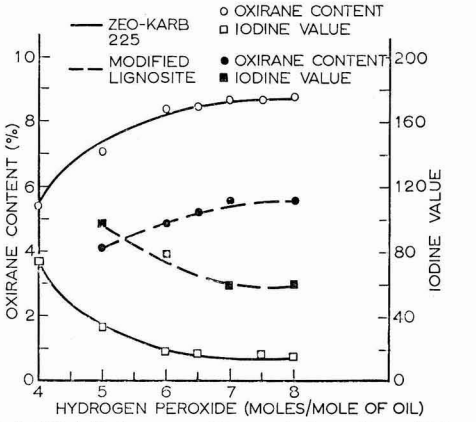

Fig. 5. Effect of hydrogen peroxide concentration on the epoxidation process

The two oxirane curves show that increasing the amount of hydrogen peroxide increases the oxirane content; Zeo-Karb 225 being more efficient than modified Lignosite. With Zeo-Karb 225, the maximum oxirane content of 8.8 per cent was obtained when eight moles of hydrogen peroxide were used per mole of oil, whilst with modified Lignosite, the maximum oxirane content of 5.6 per cent was reached with seven moles of hydrogen peroxide/mole of oil. The IVs decrease with increasing hydrogen peroxide content in both cases.

Conclusions

The optimum conditions for the *in situ* epoxidation of linseed oil, using solid sulfonated synthetic and modified, naturally occurring polymers as catalysts, have been obtained. Zeo-Karb 225 is found to be more efficient than modified Lignosite, which may be attributed to the higher $-SO_3H$ content of the former and its attachment to an aromatic residue.

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Next month's issue

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

Kinetics of film formation of alkyl silicate zinc-rich coatings *by T. Ginsberg*

Paint disfiguration by migration of antioxidant from wall board adhesive *by D. A. St. John and K. R. Markham*

Polyester resins and glass reinforced polyesters (GRPs) with particular emphasis on chemical plant *by J. A. Raymond*

Prospects for surface coating resins in the European market *by Ch. P. Martin*

The Health and Safety Act *by D. M. Wilson* (*Student Review*)

J. Oil Col. Chem. Assoc. 1976, 59, 295-296

Short Communication

Industrial carcinogens*

By D. J. T. Howe

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*Statement prepared by the Paintmakers Association of Great Britain Limited and adopted as its official policy. It is published here for the benefit of Members of OCCA both in the UK and overseas.

It should be noted that references in the paper to "The Association" and to "Member" refer in all cases to the Paintmakers Association and not to the Oil and Colour Chemists' Association.

Agents carcinogènes industriels

Industrielle karzinogene Stoffe

The reports of the discovery of new carcinogens, or of established chemicals being found to possess a carcinogenic potential, are occurring with regular frequency. Amongst those substances which have been suggested as potential carcinogens—and which are used in the paint industry, or occur in paint manufacture or use—are asbestos, talc containing asbestine, *bis*chloromethyl ether, vinyl chloride, nitrosamines, chromates and trichlorethylene. There is the possibility that at any time a material which is basic to the industry may be included with these. This document is intended to introduce an element of perspective and to offer guidance to Members on reaction to the appearance of reports of new carcinogens and to suggest a sequence of actions.

However, it is not intended that it should inhibit any Member from taking the immediate action necessary to fulfil his own obligations under the Health and Safety at Work etc Act, when he believes that the use of a specific chemical substance in a product or process is liable to expose his employees, or those of his customers, to a carcinogenic risk.

Chemical carcinogens

Cancer is probably the most emotive of diseases suffered by man. The belief that it is incurable and causes great pain persists, despite the advances of medical science. By public demand, investigations into the cause, prevention and cure of cancer have increased on a world scale and particularly in the United States.

It has been established for some time that chemical substances can initiate the cell changes which result in some kinds of cancerous growth. Little is known at the moment of the mechanism whereby these changes come about, and therefore it is difficult to forecast the possible carcinogenic properties of any substance. At one time it was thought by some that these properties were confined to certain chemical classes, but recent discoveries have indicated that other classes contain potential carcinogens. At the present time little is understood of the relationship between carcinogenic behaviour and chemical structure. All that is possible is to suggest that certain substances are likely to be carcinogenic and that others will not be, by reference to their structures.

Testing for chemical carcinogens

The above considerations mean that, for the time being, methods for investigating carcinogenic potential are crudely empirical. There are two main methods: epidemiological surveys, and experiments with animals. With established chemicals, both or either are used.

The epidemiological survey is simply the study of the health records of an industry, factory, or process to see whether carcinogenesis of a particular nature occurs more frequently than it does in the public at large, and whether indeed this more frequent occurrence can be associated with the use or manufacture of a particular chemical. The possible carcinogenesis of chromates is likely to be established this way, and indications of animal experiments on vinyl chloride were confirmed in a survey of occurrences in plants which manufacture polyvinyl chloride.

Animal experimentation, as used at present, relies simply upon the examination for cancerous effects on animals which have been exposed either by injection, oral administration, inhalation or skin-painting to the chemical under test. Since cancer is normally a disease of old age, the animals have to be dosed for most of their lifetime. Therefore, the animals used are normally those whose lifespan is short, such as rats and mice. Since all animals, particularly mice, can contract cancer naturally, it is necessary to use sufficient animals in both control and test groups to allow statistically valid comparisons to be made between groups. There is, too, a sex variation to the response to carcinogens, so each sex has to be represented in the groups. Finally, it may be necessary to use more than one dose level and more than one animal species.

From the above, it is clear that animal experimentation for carcinogenesis involves the use of a large number of animals for a long time and is consequently expensive. The costs vary, but are of the order of tens of thousands of pounds per compound and per route of administration, depending upon the method of administration.

Interpretation of results

The results can be clear-cut and positive, but in many cases they are not. On the basis of the tests, expert pathologists have to decide whether there are changes in tissues resulting from the administration of the chemical under test, which are indicative of malignancy. Then an assessment has to be made as to whether the increase of such changes in the test groups in specific organs is sufficiently valid statistically to suggest that the test compound has potential carcinogenic properties. Very often the results merely indicate that a certain chemical is likely to induce cancer in a certain animal species if administered by a certain route. It does not mean that the

substance will be definitely carcinogenic to man by that route, probably still less by another route. Nevertheless, with man's present state of knowledge, the report of carcinogenesis from animal experiments must be taken as a red signal, and, thereafter, the compound in question must be treated as a possible carcinogen in man until such time as expert opinion or definite evidence suggests otherwise.

Reaction to reported carcinogenesis

At one time the mere suggestion that a substance could be a suspect carcinogen was sufficient for some industrialists to ban it from their plant, irrespective of whether the evidence was substantiated or relevant to their industrial situation. With an increasing number of previously "safe" chemicals being declared carcinogens, however, this became impractical. Unilateral action in such circumstances is unwise, and because the announcement of a new carcinogen is unlikely to affect the paint industry alone, the Paintmakers Association would consult the other industries concerned so that all those affected would act in conformity. Again, industry itself could not seek to propose action without consulting the relevant governmental departments. This does not mean that the paint industry would not wish to establish its own position with respect to the possible risks from the use of compounds considered to be carcinogens.

On the receipt of information that an established chemical has been shown to possess carcinogenic potential, the following would be the sequence of action taken by the Association:

1. It would use the expert advice it has available to determine the validity of the conclusion that the said chemical possesses carcinogenic potential.
2. If the findings of the report were confirmed, it would establish whether they had any relevance to the manufacture and use of paints.
3. If they had, then after consultation with other industries affected, a note would be issued warning members of the risk, to enable them to fulfil their obligations both to employees and customers under the Health and Safety at Work etc Act 1974. It would be drafted in terms which would suggest the interim safety measures necessary.
4. If there was a ready alternative to the offending chemical, advice would be given on its replacement.
5. If there was not, then conditions of operation with the chemical would have to be established, whereby there would be minimum risk to those who had to use it. If the carcinogen could be absorbed orally, strict conditions of industrial hygiene would have to prevail; if dermally, then skin and eye protection would be essential. The most common route whereby cancer is produced in industry is by inhalation. Thus, the Health and Safety Executive would almost certainly recommend a concentration of the chemical in the working atmosphere below which it would be safe for men to work without protection (Working Standard).
6. After consultation with industries where similar problems arise from use of the chemical, another note would be issued to Members describing the conditions under which it should be used in paint manufacturing processes. Such information should also be passed at this stage by Members to their customers.
7. Individual Member-companies and their customers should then examine the conditions under which they used the chemical or the products containing it, and in the case of a risk by inhalation, monitor the working atmosphere to check whether it complies with the "Working Standards". An assessment would have to be made, of course, of the increased costs of introducing the necessary precautions, to see whether they would render the product or process no longer viable.
8. If this should be the case, a decision would have to be taken either to make a reappraisal of possible alternative chemicals, even though they might lead to an inferior product, or to abandon the product and process.

The above suggested sequence of actions to be followed when a component is reported as a carcinogen is also relevant, of course, to chemicals with other toxic manifestations. The difference is that their implementation in the case of carcinogens should be more immediate. With an acute toxin, the effects are obvious and immediate. The subjective reactions of those exposed to the hazard can give a crude guide as to the effectiveness of precautionary measures. In addition, some exposure to substances with long-term toxic properties during the time when precautions are being introduced would usually not lead to serious consequences.

With carcinogens this is not the case. Their effects are insidious. Exposure to concentrations well below that which produces subjective reaction may initiate changes, which will become evident only after many years as malignant tumours. Hence precautionary measures should be introduced as soon as the presence of a carcinogen is indicated. It is evident that industry will have to learn to live with carcinogens. It is believed that the paint industry will be able to live with them more safely if the above procedures are adopted.

[*Received 9 June 1976*

Review

Concise etymological dictionary of chemistry

By S. C. Bevan, S. J. Gregg and A. Rosseinsky.

London: Applied Science Publishers 1976.

Pp. ix + 140. Price £7.00

The entries in this etymological dictionary are selective, naturally, but they appear adequate, with the origins of many words familiar to polymer scientists explained—"oligomer", "epoxy", "mercaptan", for example. The notes are informative, so much so that the reader tends to browse around, having found the origin of the word first in question. The subject should be of interest to all who recall Faraday's view that the vocabulary of science has been developed over the centuries "to avoid confusion and circumlocution for the sake of greater precision of expression". Useful appendices give lists of Latin and Greek prefixes and roots. The introduction, describing the technical development of a special vocabulary of science, is particularly interesting.

J. L. PROSSER

Annual Report of the Council for 1975

Adopted at the Fourteenth Annual General Meeting of the Incorporated Association held at the Crown Hotel, Harrogate, at 3.00 p.m. on 25 June 1976.

General

As mentioned in the report of the Council for 1974, the financial position was greatly strengthened in the latter half of that year by earlier Council decisions and the improvement was maintained during 1975. The Council were, however, aware that for three successive years the Association had incurred deficits on its annual income and expenditure account, and it was determined to do everything possible to rectify the position.

The 27th Technical Exhibition took place at the Empire Hall, Olympia, from 22 to 25 April; a report appears later under the heading "Exhibition Committee" and a review appeared in the June issue of the *Journal*.

The Association's Biennial Conference was held at the Grand Hotel, Scarborough, 17 to 21 June, when the Association was pleased to receive the Presidents of the other three societies in the international alliance—Mr J. C. Leslie, President of the Federation of Societies for Coatings Technology, and Mrs Leslie; Mr J. Roire, the President of Federation d'Associations de Techniciens des Industries des Peintures, Vernis, Emaux et Encres d'Imprimerie de l'Europe Continentale; and Mr L. O. Portin, President of Scandinaviska Lackteknikers Forbund, and Mrs Portin.

Seventeen papers were presented in five technical sessions, together with three workshop sessions; the technical sessions were well attended and lively discussions took place after each session. A full report appeared in the August issue of the *Journal*.

The Association was pleased that it was possible to arrange for papers to be presented by the three other members of the international alliance at the Conference, and later in the year the Association was represented at the Los Angeles Convention (29 to 31 October) of the Federation of Societies for Coatings Technology not only by the President, Mr A. T. S. Rudram, but also by the inclusion of a paper on behalf of the Association by Mr J. K. Sinclair entitled "Recent developments in epoxy resin based coatings".

The Thirteenth Annual General Meeting of the Incorporated Association took place at the Grand Hotel, Scarborough, on 20 June, when Mr A. T. S. Rudram was elected President. The following Vice-Presidents were elected:

Mr W. F. McDonnell
Mr A. S. Gay
Mr A. G. Holt
Mr F. D. Robinson
Mr F. D. H. Sharp
Mr L. F. Saunders
Mr J. Beachen

The Honorary Officers were elected as follows:

Honorary Secretary	Mr D. J. Morris
Honorary Treasurer	Mr F. Cooper
Honorary Editor	Mr S. R. Finn
Honorary Research and Development Officer	Mr C. N. Finlay

The report of the Auditors on the scrutiny of the postal votes was received and it was announced that the following members had been elected to the Council for the year 1975-1976:

Mr M. J. Heavers
Mr H. C. Worsdall
Mr C. Butler

Votes of thanks to the retiring President, retiring Council members, the Honorary Officers and the Director & Secretary were carried with acclamation, and a special tribute was paid to the work of the retiring Honorary Research and Development Officer, Mr A. R. H. Tawn, who had previously served as Honorary Editor.

The Jordan Award was presented jointly on this occasion to Mr J. G. Balfour and Dr M. J. Hird for their paper "Flocculation—its measurement and effect on opacity in systems containing titanium dioxide pigments" which had been presented at the Conference.

At the July Council meeting it was agreed to confer a Commendation Award upon Mr T. R. Smith (Honorary Treasurer, West Riding Section since 1965) in recognition of the outstanding part which he had played in the affairs of the Section since its inception in 1952. The Award was presented to Mr Smith at the West Riding Section dinner dance on 28 November.

The Annual General Meeting agreed, without discussion, to increase the membership subscriptions from 1 January 1976 to £12.00 for Ordinary and Associate Members, £3.00 for Registered Students under 21, £6.00 for Registered Students between 21 and 25 years, and the Retired Member's rate remained at £1.50 per annum.

On the evening of 15 October the Council reunion dinner held at the Rugby Club, London, was once again extended to include any members who had previously served on the Council. On this occasion, the guests of the Association were four Past-Presidents and three Past Honorary Officers. The function was a most successful venture, allowing many old friendships to be renewed.

During the year, the Council took note of the desire of the Sections overseas to have an organisation which would reflect their status within their own countries, and the suggestion was put to the Sections in South Africa and New Zealand that Divisions should be formed in those countries, composed of Sections. In New Zealand two Sections were already in existence at Auckland and Wellington and it was further agreed that the three Branches of the existing South African Section would, in 1976, become three separate Sections of a South African Division. For many years Council has appointed a Vice-President from New Zealand and South Africa, and it was further agreed that these Vice-Presidents would act as the Chairmen of the Divisions, by presiding at Conferences if the Section so wished.

It was reported in the Annual Report for 1974 that the London Section had taken the first steps towards the establishment of a Branch in Ontario, and this was successfully accomplished on 26 May, when both the Chairman of the Section, Mr J. Tooke-Kirby, and the Honorary Secretary, Mr H. C. Worsdall, visited Toronto for the inauguration of the Branch. The Association was also represented at the same time at the Canadian Institute of Chemistry's Convention by Dr W. Carr, who presented a paper on behalf of the Association.

By the end of the year, the new Ontario Branch had attracted a considerable number of new Members and Council confidently expects the Branch to achieve Section status shortly.

The twelfth New Zealand Convention was held at the Wairakei Hotel from 1 to 3 August.

Symposia were arranged by Sections in the United Kingdom: on 25 March the Thames Valley Section held its first symposium at Brunel College, Uxbridge, under the title "Gloss and its assessment" and in April the Newcastle Section ran a symposium at Durham University under the heading "Ultraviolet polymerisation and the coatings industry" which attracted a large number of non-Members from both the United Kingdom and overseas.

The most significant anniversary to be celebrated by a Section of the Association fell to the Manchester Section, which celebrated the fiftieth anniversary of its foundation by a full programme during the latter part of the year. A special commemorative booklet was prepared under the management of Mr G. W. Hurst, a member of the Committee, and was sent to Members of the United Kingdom, Irish and General Overseas Sections with the October issue of the *Journal*. At the Council reunion dinner, the President presented a commemorative scroll to the Chairman of the Manchester Section, Mr Guy Clayton, whose father had been the first Honorary Secretary of the Section. In return, Mr Clayton presented the President with an Address on behalf of the Section at a special commemorative dinner held on 6 November. The Section's annual dinner dance on 24 October also formed part of the anniversary celebrations, which included the innovation of a ladies' lecture and supper evening in November and will conclude with a symposium on "Films—formation and behaviour" to be held in April 1976.

The London Section held a one-day symposium on "Aqueous coatings" at the Polytechnic of the South Bank on 21 January, and a one-day symposium on 19 November jointly with the Kent Sub-Section of the Plastics and Rubber Institute at the Thames Polytechnic, Woolwich, on "Decoration of plastics". On successive days in October—16 and 17—the London and Midlands Sections had the privilege of a lecture by Dr H. Witcoff, professor of chemistry at the University of Minnesota, and special adviser to General Mills Chemical Inc., USA, on "The coatings industry in a changing world".

Council was saddened to learn of the death of two Honorary Members of the Association—Mr G. N. Hill at the end of March and Mr L. O. Kekwick at the beginning of April. Mr Hill was also an Honorary Member of the Federation of Societies for Coatings Technology and had been Honorary Editor of the Association's Journal from 1937-1947, the longest time this post had been held by one person. Mr L. O. Kekwick was a former Chairman of the London Section and President of the Association from 1951-53. In memory of Mr Kekwick, the London Section Committee has decided to present annually prizes to be known as the "Leslie Kekwick Prizes", to the best students in paint technology at the East Ham Technical College, London College of Printing and the Polytechnic of the South Bank. An obituary notice on Mr Hill appeared in the May issue of the *Journal* and another on Mr Kekwick in the June issue. Another Member of the Association, Mr J. S. Jordan of the Hull Section, died on the 11 February. Council was also saddened to learn of the death of two former Chairmen of the Scottish Section during the year—Mr E. A. Bullions died in March and an obituary notice appeared in the August issue of the *Journal* and Mr J. Miller died in September, an obituary notice appearing in the December issue of the *Journal*.

In its report for 1974 Council drew attention to the very great amount of work which had been undertaken by the Director & Secretary and his staff, and it feels sure that Members will once again appreciate that the high standard of the work of the Association could only have been maintained by the continued sacrifice of leisure time by the Director & Secretary and the Assistant Editor, Mr C. A. Tayler. On behalf of the Members, the Council records its thanks to the Director & Secretary, Mr R. H. Hamblin, and his staff for their continued efforts on behalf of the Association throughout the past year.

Membership of the Association

Council is pleased to report that the total membership of the Association has been maintained during this critical year and the figures given below at 31 December 1975 relate only to those Members whose 1975 subscriptions have been received; the names of those in arrears with subscriptions have been removed.

Section	*Ordinary*	*Associate*	*Honorary*	*Student*	*Tota*
Bristol	62	12	—	1	75
Hull	65	6	—	2	73
Irish	43	12	—	—	55
London	576	62	3	9	650
Manchester	351	38	2	7	398
Midlands (including Trent Valley Branch)	181	21	—	2	204
Newcastle	117	8	—	9	134
Scottish (including Eastern Branch)	103	19	—	12	134
Thames Valley	101	14	—	6	121
West Riding	63	13	—	2	78
Auckland	93	44	—	2	139
Wellington	53	29	—	3	85
South African	213	49	1	3	266
General Overseas	358	23	2	—	383
Ontario Branch of London Section	50	4	—	—	54
Total 1975	2429	354	8	58	2849
Total 1974	2414	351	10	72	2847
Net increase/decrease during 1975	+15	+ 3	— 2	—14	+ 2

The Council

During the calendar year the Council has met five times, the average attendance being 26. All meetings were held in London.

Committees of the Council

The Committees of Council met as set forth below:

Exhibition Committee	1
Finance Committee	2
Liaison Committee	1
President's Advisory Committee ..	4
Professional Grade Committee ..	2
Publications Committee	1
Technical Committee	1
Jordan Award Committee	1

Exhibition Committee

Chairman: The Honorary Treasurer, Mr F. Cooper

The Twenty-Seventh Technical Exhibition was held at the Empire Hall, Olympia, London, from 22 to 25 April 1975 and the situation was completely different from that against which the 26th Technical Exhibition had been arranged. The exhibitors were drawn from 16 countries and there were visitors from the UK and nearly 50 overseas countries. A full review of the exhibition, including a review of the stands, appeared in the June issue of the *Journal* and the Exhibition Committee recorded its thanks to Mr S. R. Finn, the Honorary Editor, who prepared the review.

The opening of the exhibition had to be delayed for three hours on this occasion, since industrial action had prevented the removal of the exhibition which had occupied the Empire Hall prior to the Association's tenancy, but the Committee recorded its gratitude to exhibitors for their forbearance and co-operation in these most difficult circumstances. The exhibition was remarkably successful and many exhibitors commented on the high level of technical personnel who attended this important annual function.

For the first time a small charge was made for season admission tickets and copies of the "Official Guide". This in no way deterred serious visitors, but had the advantage of precluding casual visitors who had often taken away quantities of expensive technical literature from the stands.

The theme of the Technical Education Stand was "Radiation curing" and the Committee was again indebted to the London Technical Colleges and the Paintmakers' Association, who provided staff for the stand, to Mr S. R. Finn who wrote the leaflet, and to Mr G. H. Hutchinson who conducted the school parties.

Finance Committee

Chairman: The Honorary Treasurer, Mr F. Cooper

In the Annual Report for 1974 it was stated that the steps taken by the Committee and adopted by the Council during that year were having a beneficial effect, but the Association had incurred deficits for three successive years. It was hoped to restore the financial position in 1975 and to lay a basis for future development; Members will see that the surplus achieved in 1975 did offset these deficits.

The Committee was conscious that the Sections had played their part in helping to restore this position. They were particularly pleased to receive the donation of £3,000 from the surplus arising from the Newcastle Section Symposium and an appropriation of this amount had been made to start a premises fund, since it had long been the wish of the Committee that the Association should acquire its own headquarters building. It was hoped that further surpluses derived from Section Symposia might be transferred to this fund during 1976 and subsequent years.

Although the financial position for 1975 was a satisfactory one, it could already be seen that a surplus of the same size could not be expected in 1976, since this depended very much upon the receipts from the Exhibition. However, it was hoped that new publications and new editions of previous publications would be available in 1976 and that these would make a valuable financial contribution. The attention of Members was drawn to the market value of investments in the Annual Report for 1974, as the equities then stood at £10,121 below their purchase price, but it will be seen from the balance sheet that the equities, including the rights issues taken up during the year, stood at £13,452 above their purchase price. The increase in British Government securities arose from the redemption of stock upon reaching maturity and its reinvestment. The stock stood at £2,121 below their purchase price, compared with £3,049 at the end of 1974.

Jordan Award Committee

Chairman: The Honorary Research and Development Officer (Mr A. R. H. Tawn until June, Mr C. N. Finlay since June)

The Committee, having studied the applications received, agreed to make the award jointly on this occasion to Mr J. G. Balfour and Dr M. J. Hird for their paper "Flocculation—its measurement and effect on opacity in systems containing titanium dioxide pigments", which had been presented to the Scarborough Conference in June. The Award was presented in the form of a scroll and a cheque for £50 each to Mr Balfour and Dr Hird at the Annual General Meeting held on 20 June 1975 at the Grand Hotel, Scarborough.

Liaison Committee

Chairman: The President

On the occasion of the Scarborough Conference, a meeting of the Liaison Committee was held, which was attended by Mr J. Roire, President of Fédération d'Associations de Techniciens des Industries des Peintures, Vernis, Emaux et Encres d'Imprimerie de l'Europe Continentale, Mr L. O. Portin of Scandinaviska Lackteknikers Förbund, and Mr S. L. Davidson a Past President of the Federation of Societies for Coatings Technology, representing Mr J. C. Leslie, the President of the Federation, who had had to return to the United States for his daughter's wedding. Also present was the Chairman of the Midlands Section, Mr D. E. Hopper.

Various aspects for closer co-operation between the members of the international alliance were discussed, and it was noted with pleasure that the Association had been able to present a paper at the Conferences held by the three other members of the alliance, and had also welcomed papers from the other three member Societies at the Scarborough Conference. The Association agreed to send copies of the joint Section Programme to the other member Societies as soon as this became available so that their members would be aware of the meetings which take place during visits which might be made by their members.

During the year the President visited the Federation's Convention at Los Angeles (29 to 31 October) and conveyed the good wishes of the Association to the Federation.

President's Advisory Committee

Chairman: The President

For the 1975-1976 session, Mr A. T. S. Rudram invited the Chairmen of the Hull Section, Mr E. Armstrong; the Irish Section, Mr D. Power; and the Manchester Section, Mr G. Clayton; all of whom were in their second year of office, to serve on the Committee together with the Honorary Officers of the Association.

Professional Grade Committee

Chairman: The President

During the year the total number of those admitted to the Professional Grade for the first time exceeded 400 and the Committee were particularly pleased with two developments on which they reported to Council—first, the increasing interest of Members overseas in the Professional Grade, where the Committee has been able to advise and help applicants for admission. Applications have been received not only from areas where there are Sections or Branches of the Association, but also from countries where there are at present few Members. The Committee particularly wishes to encourage the growth of the Professional Grade overseas as it is felt that this constitutes a very worthwhile activity of the Association. The second feature on which the Committee has commented this year has been the increasing co-operation of the technical colleges in preparing suitable students for the Licentiate grade, and several colleges have now satisfied the Committee that the diplomas and courses organised by them can be accepted as qualifications which satisfy the regulation A.3(f).

The regulations have been reprinted in the *Journal* from time to time and are also available from the Association's offices.

A full list of Members admitted to the various grades appeared in the December 1975 issue of the *Journal* and the Table below shows the position in the various categories of the Professional Grade at the end of the year. The Committee particularly draws attention to the transfers between grades as some Members have moved from Licentiateship to Associateship or Associateship to Fellowship, and it naturally wishes to encourage Members who are so qualified to do so.

During the year *viva-voce* examinations have been held not only in London but in places outside London in the United Kingdom and in the Sections overseas, and arrangements have been made for the holding of these examinations in East Africa. There is also a possibility that in 1976 they will also be held in Canada in conjunction with the newly-formed Ontario Branch of the London Section.

Technical Committee

Chairman: The Honorary Research and Development Officer, Mr C. N. Finlay (since June 1975)

The Technical Committee met in November in order to prepare the format for the 1977 Biennial Conference and to consider the holding of symposia during 1976-1977. Details of the subject for the Technical Sessions for the 1977 Conference will be published in the January 1976 issue of the *Journal*.

Technical Education Committee

Chairman: The President

As stated in the report of the Professional Grade Committee, liaison has been maintained with various technical colleges and the Committee is maintaining its interest in the work of the new Technician Education Council. Representation has been made to the Technician Education Council for the Association to nominate members for service on relevant Committees of this Council.

Publications Committee

Chairman: The Honorary Editor, Mr S. R. Finn

During 1974 it was decided to send technical papers to the printer three months in advance of the date of publication. There were several reasons for this action. Firstly, during the "three-day working week" it helped the printer to complete the *Journal* by the intended publication date; secondly, there was concern about the lateness of its appearance in many months and thirdly, a number of Errata notes became necessary due, mainly, to overseas authors failing to return the corrected galley proofs by the required date. The policy has been continued in 1975 and it is hoped that readers will have noticed the improvement in the time of arrival of the *Journal* in most months during the year. The *Journal of the Oil and Colour Chemists' Association* has occasionally been late, but these delays have been caused by the difficulties in obtaining information for essential notices and to a lesser extent by the slowness of the distributors and postal delivery.

This policy does mean that there are 50 per cent more papers in the "pipeline" than previously and hence it becomes necessary to have, at least, 5-6 months supply of papers on hand at any given time. At the beginning of 1975 it seemed doubtful whether the number of papers on hand would be sufficient to last until the start of the publication of the papers from the Scarborough Conference in September. In the event there was a large influx of papers during the first half of the year, so that at present an adequate number of papers are in hand. It seems likely that it will be necessary to be more selective in the choice of papers for publication and that it may not, in the near future, be possible to publish all the papers given at symposia held by the Sections.

The number of pages in volume 58 (1975) was 474 compared with 432 in the previous year. The number of pages occupied by Transactions and Communications was 319, which is 67 per cent of the total and about the same as in most recent years. Thirteen Book Reviews were published, there were no Student Reviews and the Correspondence with the Honorary Editor amounted to only five letters.

The Honorary Editor wishes to thank the Honorary Publications Secretaries for their accounts of Section

	Applications received	*Applications transferred between grades*	*Successful*	*Awaiting fulfilment of regulations*	*Not accepted*	*Resignations and deaths*	*Upgradings*	*As shown in December 1975 Journal**
Fellowship	199	*Less* 43 *Add* 4	153	4	3	6	—	147
Associateship	256	*Less* 15 *Add* 44	250	17	18	4	2	244
Licentiateship	34	*Add* 11 *Less* 1	13	23	8	—	1	12
	489	—	416	44	29	10	3	403

*As well as United Kingdom and Ireland, 30 countries are represented in the list of successful candidates published in the December 1975 issue of the *Journal*.

Proceedings and all those who have contributed to Book Reviews.

The Publications Committee met on one occasion during the year.

As well as considering the papers which were available for publication, the Committee also completed arrangements for the revision of The Introduction to Paint Technology, the stocks of which were exhausted, and for the revision of Part IV of the Paint Technology Manuals. The Committee decided that revision was necessary before The Introduction to Paint Technology could be reprinted, and it was decided to bring out a third edition in 1976. It was hoped that the revision of Part IV of the Manuals would also be completed by the end of the year, and an announcement regarding its availability would be published in the *Journal*. The only copies of the Manuals which were available at the end of the year were a few copies of the second edition of Part III—"Convertible Coatings", and Part VII—"Works Practice", which had originally appeared as Student Reviews in the *Journal*.

It was also decided at the meeting to continue the procedure used for the writing of the Exhibition Report in 1976 as on the previous three occasions, since experience has shown this to be the most convenient way of ensuring that the Review appeared as quickly as possible after the event.

Survey of published papers. Forty-three technical papers were published, the same number as in the previous year. Eight papers were submitted directly by authors in the U.K., fourteen arose from Section meetings and symposia and twelve from the Scarborough Conference. Nine papers were submitted directly by overseas authors but if the Conference and symposia are included a total of nineteen papers originated from overseas sources. The Newcastle Section's symposium on UV curing was held during the year but, owing to the Conference, it was not possible to publish the papers in this year's volume.

Papers originating from Section symposia and lectures	1973	1974	1975
Bristol	—	—	—
Hull	1	—	—
Irish	—	1	—
London	4	1	4
Manchester	13	4	—
Midlands	—	6	—
Newcastle	—	1	—
New Zealand	—	1	—
Scottish	—	—	—
South African	—	—	5
Thames Valley	—	—	—
West Riding	—	1	2
	18	15	11
Papers submitted directly			
United Kingdom	12	2	8
Overseas	10	26	9
Conference	16	—	12
Association Symposium	—	—	3
	38	28	32
Total	56	43	43

Representation on other organisations

The Association was represented on other organisations as follows:

Technical Training Board for the Printing Ink and Roller Making Industry: Mr H. C. Worsdall and Mr A. R. H. Tawn (until October). Mr N. Locke has served with Mr Worsdall since October.

Paint Apprenticeship Council: Dr H. W. Keenan.

The Parliamentary and Scientific Committee: The President and Director & Secretary.

The British National Committee for Chemistry: Mr A. R. H. Tawn until December, Dr R. C. Denney since December.

City and Guilds Advisory Committee for the Chemical Technicians Certificate: Dr J. G. Gillan.

East Ham Technical College Consultative Committee for the Science Department: Mr R. M. W. W. Wilson.

Association of Exhibition Organisers: The Director & Secretary.

Programme Liaison Committee: The Honorary Programmes Officer of the London Section and the Director & Secretary.

The Paintmakers' Association Training and Technical Education Committee: The Honorary Secretary and the Director & Secretary.

The Society of Dyers and Colourists Terms and Definitions Committee: Dr J. Toole and Mr J. T. Hurst.

The Society of Dyers and Colourists "Review of Coloration Progress" Committee: Mr H. D. Brearley.

The Colour Group (Great Britain): Mr I. Ford.

Institution of Corrosion Technology Education Committee: Dr J. B. Harrison and Mr D. S. Newton.

Institute of Metal Finishing Technical Education Committee: Mr A. R. H. Tawn.

Scottish Technician Education Council Sub Committee: Mr R. F. Hill.

British Standards Institution:

PVC Pigments, Paints and Varnishes Industry Committee: *Dr J. B. Harrison*
PVC/1 Pigments: *Mr H. G. Cook*
PVC/1/9 Carbon Black: *Mr V. G. Heffer*
PVC/1/11 Extenders: *Mr S. A. Ray*
PVC/1/18 Zinc Dust Pigments: *Mr D. S. Newton*
PVC/3 Oils, Varnishes, Putty, etc. *Mr G. Hutchinson*
PVC/3/5 Test Methods for Paint Media: *Dr L. A. O'Neill*
PVC/4 and PVC/4/1 Lac: *Dr B. S. Gidvani*
PVC/6 Cement Paints: *Mr W. O. Nutt*
PVC/8 Plastic Wood: *Mr V. P. Gellay*
PVC/10 Test Methods for Paints: *Mr A. N. McKelvie*
PVC/11 Revision of the Glossary of Paint Terms: *Mr S. A. Ray*
PVC/14 Colours for Paints: *Mr A. B. Lock*
PVC/15 Water Paints and Distempers: *Mr T. W. Wilkinson*
PVC/16 Ready Mixed Paints: *Mr A. T. S. Rudram*
PVC/19 Bituminous Paints: *Mr J. Rogers*
PVC/20 Calcium Plumbate Priming Paints: *Mr A. G. Walker* until October, *Mr M. Pettit* since October
PVC/23 Zinc Rich Paints: *Dr D. Atherton*
PVC/24 Water Thinned Priming Paints: *Mr J. H. Sparrow*
PVC/25 Organic Finishes for Aluminium Windows: *Dr J. B. Ley* until October, *Mr D. E. Hopper* since October
LGE/9 Artificial Daylight for Colour Matching: *Mr I. Ford*
C/17 Viscosity: *Mr A. N. McKelvie*
C/17/2 Revision of BS188 (Drafting): *Mr A. N. McKelvie*
CHE/43 Test Sieves: *Mr M. J. F. Meason*
CHE/50 Test Methods for Powder Properties: *Mr D. S. Newton*
CIC/4 Solvents and Allied Products: *Mr A. R. H. Tawn*
CIC/6 Glycerol: *Mr W. A. Ledger*
OFFA/7 Sampling Oilseeds, Oils and Fats: *Mr N. F. Lythgoe*
OFFA/24 Analysis of Oilseeds, Oils and Fats: *Mr N. F. Lythgoe*
ELE/16/53/6 Varnishes: *Mr N. H. Seymour*
ACE/44 Aircraft Finishes: *Mr J. B. G. Lewin*

BLCP/18 Code of Practice—Painting: *Mr J. E. Mitchell*
M/26 Artists' Materials: *Mr J. A. L. Hawkey*
RDE/25 Road Marking Compounds: *Mr T. R. Bullett*
OC/20/4/12 Chemistry and Chemical Technology: *Mr J. Orpwood*

Reports submitted by representatives may be seen by members at the Association's offices.

The Association was also represented on overseas organisations as follows:

South Africa

SABS Specifications—Two-pack Chemical Resisting Finishes . . . Mr H. I. Bosman
Watersrand College for Advanced Technical Education, Advisory Committee on Paint Science . . . Mr P. A. J. Gate
Natal College for Advanced Technical Education, Science and Education Advisory Committee . . . Mr K. R. McDonald and Mr K. M. Engelbert.
Council of the National Association of Scientific and Technical Societies . . . Mr L. F. Saunders.
SABS Specification—Non-toxic Coatings . . . Mr I. Lancaster.
SAPMA Technical Education Committee . . . Mr P. A. J. Gate, Mr Dudley House (Adviser for Natal Region) and Mr Johannsen (Adviser for Cape Region).

Appendix

Report of the Council in accordance with the Companies Act 1967

1. The Council presents herewith the audited accounts of the Association for the year ended 31 December 1975.

2. *Results*

The results for the year and the appropriation thereof are set out in the Income and Expenditure Account on page 9.

3. *Principal activities of the Association*

The Association has continued in its work of furthering the development of the science and technology of the oil and colour industries.

4. *Changes in fixed assets*

The movement in fixed assets during the year is set out in the Table on page 10.

5. *The Council*

The following were members of Council at 31 December 1975:

A. T. S. Rudram, FTSC
L. H. Silver
D. J. Morris
F. Cooper, BSc
S. R. Finn, BSc, FRIC, FTSC
A. G. Holt, FTSC
W. F. McDonnell, FRIC, AMBIM
L. F. Saunders, FTSC
L. J. Brooke, ATSC
H. G. Clayton
F. D. Robinson, BSc, ATSC
P. McCrudden *elected 16 April 1975*
W. J. Nunn (co-opted as President of the Oil & Colour Chemists' Association Australia, July 1975)
R. F. Meek *elected April 1975*
O. W. Brett, BSc *elected April 1975*
H. A. Hipwood, FTSC *elected April 1975*
H. C. Worsdall, FTSC *elected 20 June 1975*
M. J. Heavers *elected 20 June 1975*
C. Butler, FTSC *elected 20 June 1975*
J. F. Beachen, MSc, ATSC *elected April 1975*
R. J. King, BSc, AWP, ATSC *elected 18 April 1975*
T. Entwistle *elected September 1975*
M. H. Prigmore *elected 12 April 1975*
M. J. Cochrane *elected 8 April 1975*
E. Armstrong, AMBIM, ATSC
J. R. Taylor, BSc, FRIC, FTSC
N. H. Seymour, FTSC
A. A. Duell, MRIC, FTSC
G. R. Duckett
T. W. Wilkinson, AMCT, FTSC
D. P. Power
F. D. H. Sharp
D. J. Pienaar, MSc
J. T. Tooke-Kirby
J. E. Mitchell, BSc, FRIC, FTSC
A. S. Gay, ATSC
D. E. Hopper, ACT (Birm), ATSC
C. N. Finlay, ATSC
K. V. Hodgson, FTSC
A. McLean, BSc, ARCST, FRIC, FTSC
J. L. Inshaw, MRIC, ACTC, FTSC
J. D. W. Davidson, FIPE, FIWM
R. P. Bartrum
F. Sowerbutts, BSc (Tech), FTSC
G. Willison, FRIC

In addition, the following were members of Council at 1 January 1975 and served during the year; the date shown after each name denotes when during 1975 service on Council terminated:

A. R. H. Tawn, FRIC, FInstPet, FTSC (*June 1975*)
T. W. Slinn, BSc, FTSC (*April 1975*)
D. E. Eddowes, BSc (*June 1975*)
N. Cochrane (*June 1975*)
H. R. Hamburg, PhD (*June 1975*)
F. E. Ruddick (*April 1975*)
R. McD. Barrett, BSc, MSc(Tech), AIWM (*April 1975*)
Miss P. Magee (*A6ril 1975*)
R. H. E. Munn, LRIC, FTSC (*April 1975*)
W. H. Tatton, MRIC, FIMF, FTSC (*April 1975*)
D. Morris, ATSC (*April 1975*)
P. F. Sharp, BSc, ATSC (*April 1975*)
F. Schollick, BSc, FRIC (*September 1975*)
M. D. Taylor, FTSC (*April 1975*)
M. J. Leahy (*July 1975*)
L. Valentine, BSc, PhD (representing the Oil & Colour Chemists' Association Australia) (*28th October 1975*)

6. *Auditors*

The auditors, Coopers & Lybrand, will continue in office in accordance with Section 159(2) of the Companies Act 1948.

By Order of the Council

ROBERT HAMBLIN
Director & Secretary

1 January 1976

OIL AND COLOUR CHEMISTS' ASSOCIATION

BALANCE SHEET as at 31 December 1975

1974 £	£		1975 £	£	1974 £	£		1975 £	£
		ACCUMULATED FUND—					FIXED ASSETS—		
20,805		Balance at 31 December 1975		61,642			Furniture, Fittings, Office Machines and Motor Car		
		PREMISES FUND—				10,408	at cost	10,912	
—		Surplus from Newcastle Section Symposium ..		3,000		6,072	*Less* Accumulated Depreciation	7,278	
				64,642	4,336	8,128			3,634
		CURRENT LIABILITIES—					Leasehold Property at cost ..	8,128	
		Provision for Paint Technology Manuals	398			904	*Less* Accumulated Amortisation	1,356	
398					7,224				6,772
100,924		Receipts in advance ..	52,198						
14,238		Creditors & accrued liabilities	12,649		11,560				10,406
115,560				65,245					
							QUOTED INVESTMENTS—		
						11,708	British Government Securities at cost .. .. (Market Value £9,989) *Market Value 1974 £8,659*	12,110	
						26,896	Other Investments at cost .. (Market Value £41,262) *Market Value 1974 £16,775*	27,810	
		A. T. S. RUDRAM *President*			38,604				39,920
		F. COOPER *Hon. Treasurer*					CURRENT ASSETS—		
						468	Stock of unsold publications at cost	309	
		R. H. HAMBLIN *Director & Secretary*				3,894	Paper stock in hand at cost ..	3,576	
						17,347	Debtors & Payments in Advance	10,771	
						64,426	Balance at Bankers & Cash in hand in United Kingdom & Overseas Sections ..	64,905	
						66	Stock of ties	—	
					86,201				79,561
£136,365				£129,887	£136,365				£129,887

REPORT OF THE AUDITORS TO THE MEMBERS

1. We report on the accounts set out on pages 8 to 10.
2. The accounts include figures taken from the unaudited accounts of the United Kingdom and overseas Sections with net assets at 31 December 1975 of £8946 and at 31 December 1974 of £6257. The only figures of significance included in arriving at these net assets were cash of £10,268 and creditors of £2207 at 31 December 1975 and cash of £6286 at 31 December 1974. We have not verified the net assets of these Sections at 31 December 1975 and 31 December 1974, nor have we verified the change in net assets of these Sections between these two dates.
3. With this reservation, in our opinion, the accounts give a true and fair view of the Association's affairs at 31 December 1975 and of its results for the year ended on that date and comply with the Companies Acts 1948 and 1967.

COOPERS & LYBRAND

London, 17 March 1976

Chartered Accountants

Note: The page references given in the paragraph above are equivalent to pages 303 to 305 in this *Journal.*

OIL AND COLOUR CHEMISTS' ASSOCIATION

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1975

1974 £	1974 £	1974 £		1975 £	1975 £	1975 £
			INCOME			
			MEMBERSHIP AND GENERAL INCOME—			
		21,057	Subscriptions	20,538		
		190	Professional Grade Certification fees	165		
		254	Entrance fees	689		
		1,041	Sundry publications	824		
		1,205	Sundry Income	735		
		760	Profit on sale of equipment	—		
		—	Section Surplus (Note 5)	2,521		
		—	Conference	865		
		3,864	Investment Income	7,451		
	28,371				33,788	
			JOURNAL RECEIPTS—			
		15,139	Advertising	17,492		
		16,796	Sales	19,457		
		2,601	Capitation fees (OCCA Australia)	3,460		
		2,001	Reprints	863		
	36,537				41,272	
	38,011		EXHIBITION RECEIPTS		109,026	
102,919						184,086
			EXPENDITURE			
			MEMBERSHIP AND GENERAL EXPENSES—			
		9,621	Administration expenses (Note 4)	12,750		
		11,869	Journal	15,077		
		5,997	Postage, printing and stationery	7,203		
		694	Publications	526		
		1,350	Section expenditure	—		
		71	Council Reunion Dinner	74		
		2,677	General expenses, inc. accountancy	2,888		
	32,279				38,518	
			JOURNAL EXPENSES—			
		9,621	Administration expenses (Note 4)	12,750		
		14,507	Printing and Publication	18,433		
		1,285	Reprints	586		
		2,416	Postage and Stationery	5,306		
		980	General Expenses	1,095		
	28,809				38,17(	
			EXHIBITION EXPENSES—			
		42,907	Direct expenses	49,981		
		9,622	Administration Expenses (Note 4)	12,751		
		980	General Expenses	1,093		
	53,509				63,825	
114,597						140,513
(11,678)						43,573
45			Profit on Exchange			264
£(11,633)			Surplus/(Deficit) for the Year			£43,837
			APPROPRIATION			
—			Surplus on Newcastle Symposium transferred to Premises Fund (Note 6)			£3,000
£(11,633)			Surplus/(Deficit) for the year carried forward			£40,837

STATEMENT OF RETAINED RESERVES

1974 £		1975 £
(11,633)	Surplus/(Deficit) for the year	40,837
32,438	Balance at 1 January	20,805
£20,805	Balance at 31 December	£61,642

NOTES ON THE ACCOUNTS

1. *Fixed Assets*

	Furniture, Fittings, Office Machines and Motor Car		*Leasehold Property*	
Cost	£	£	£	£
At 1 January 1975	10,408		8,128	
Additions	504		—	
Disposals	—		—	
		10,912		8,128
Depreciation				
At 1 January 1975	6,072		904	
Disposals	—		—	
Charged to Income and Expenditure Account	1,206		452	
		7,278		1,356
Net book value at 31 December 1975		£3,634		£6,772

Depreciation and amortisation of fixed assets is calculated so as to write off the assets over their expected useful lives.

2. *Foreign Currencies*

Overseas Section income, expenditure, assets and liabilities have been converted to Sterling at the rates ruling at 31 December 1975:

New Zealand	$1.94
South Africa	R1.7587
Canada	$2.0557

3. *The Ethel Behrens Fund and the Jordan Award Fund*

The Ethel Behrens Fund and the Jordan Award Fund have not been incorporated in the Association Income and Expenditure Account and Balance Sheet but have been shown as separate accounts.

4. *Administration Expenses*

Administration expenses have been equally apportioned between the three main headings of expenditure in the Income and Expenditure Account. The apportionment has been calculated on the basis of the estimated staff time involved. These expenses are:

1974 £		1975 £
16,673	Salaries	20,987
4,420	Temporary Staff	7,396
346	Welfare	366
6,050	Rent, rates, lighting & telephone	6,646
510	Audit fee, etc.	600
—	Provision for dilapidations	250
865	Depreciation and Amortisation of fixed assets	1,658
—	Bad Debts	258
—	Legal Charges	90
£28,864		£38,251
	The charge to each heading is therefore:	
9,621	Membership	12,750
9,621	Journal	12,750
9,622	Exhibition	12,751
£28,864		£38,251

5. *Section Surplus*

The Section surplus is as follows:

1974 £		1975 £
(150)	Bristol	19
(51)	Hull	(27)
(113)	Irish	(144)
(250)	London	(172)
(770)	Manchester	(2,025)
(12)	*Midlands	(196)
(61)	(Trent Valley Branch)	(14)
(159)	†Newcastle	3,550
399	Scottish	538
(50)	†(Eastern Branch)	(83)
(195)	Thames Valley	60
32	West Riding	157
(239)	Auckland	(235)
(66)	*Wellington	91
425	*South Africa	1,004
—	*Ontario	(2)
£(1,350)		£2,521

NOTES:

(1) *unaudited returns incorporated into the accounts 2.3.76

(2) †estimated returns incorporated into the accounts 2.3.76

(3) Net surpluses are shown without brackets
Net deficits are shown inside brackets

6. *Premises Fund*

This distributable reserve has been set aside by a decision of the Council to provide a fund for a future building programme.

7. *Limited by Guarantee*

The liability of the members of the company is limited by guarantee.

ETHEL BEHRENS FUND

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1975

1974	Expenditure	1975	*1974*	Income	1975
£		£	£		£
52	Income Tax on Investment	100	*134*	Interest on Investment (Gross)	239
—	Dr W. Carr (travelling to Canada)	110			
82	Surplus	29			
£134		£239	£134		£239

BALANCE SHEET as at 31 December 1975

1974	Fund	1975	*1974*	Assets	1975
£		£	£		£
2524	Accumulated Fund	2606	*2442*	British Government securities at cost (Market value £2380)	2446
82	Add surplus	29	*164*	Balance at bank	189
£2606		£2635	*£2606*		£2635

JORDAN AWARD FUND

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1975

1974	Expenditure	1975	*1974*	Income	1975
£		£	£		£
—	Awards	100	*65*	Interest on Investment (Gross)	65
65	Surplus	—	—	Deficit	35
£65		£100	*£65*		£100

BALANCE SHEET as at 31 December 1975

1974	Fund	1975	*1974*	Assets	1975
£		£	£		£
1122	Accummulated Fund	1187	*1000*	British Government securities at cost (Market value £981)	1000
—	Less deficit	35			
65	Add surplus	—	*187*	Balance at Bank	152
£1187		£1152	*£1187*		£1152

Proceedings of the Annual General Meeting

The Fourteenth Annual General Meeting of the Incorporated Association was held on 25 June 1976 at 3.00 p.m. at the Crown Hotel, Harrogate, Yorkshire, with the President (Mr A. T. S. Rudram) in the Chair. There were 19 Members present.

Apologies

Apologies for absence were received from Dr H. R. Hamburg, Mr F. Cooper, Mr D. E. Hopper, Mr D. J. Silsby, Mr L. J. Brooke, Mr J. T. Tooke-Kirby, Dr K. M. Oesterle, Dr G. Gabriel, Mr F. Sowerbutts, Mr H. C. Worsdall, Mr A. McLean, Mr J. E. Mitchell, Mr T. W. Wilkinson, Mr N. H. Seymour and Mr A. R. Hickson.

Minutes

The President asked the Meeting to take as read the Minutes of the Thirteenth Annual General Meeting held on 20 June 1975, as printed and circulated in the *Journal* (*JOCCA*, 1975, **58,** 313-315 inclusive). It was pointed out that on page 315 the proposer of the vote of thanks to the Honorary Officers of the Association was Mr S. Duckworth and not Mr D. E. Hopper as shown. Subject to this amendment, the adoption of the Minutes was put to the meeting and carried unanimously. The President then signed the Minutes.

Report of the Auditors to the Members

The Report of the Auditors to the Members was read, it being pointed out than on page 9 under the item *Statement of Retained Reserves*, the comparative total for 1974 should have been printed as £20,805.

Annual Report of the Council for 1975

Mr D. J. Morris (Honorary Secretary) moved the adoption of the Annual Report of the Council and the Statement of Accounts for 1975. In the absence of Mr F. Cooper (Honorary Treasurer), this was seconded by Mr S. R. Finn (Honorary Editor). There being no comments, the adoption of the Annual Report of the Council and Statement of Accounts for 1975 was put to the meeting and carried unanimously.

Appointment of President Designate 1976/77

The President stated that, as Members would be aware, Arthur Duell had died suddenly on holiday in Malta the previous weekend. The condolences of the Council had been sent to Mrs. Duell and the family. Arthur Duell had been a long-serving member of the Association and had taken part actively at Section level and on Council; he would be greatly missed by his many friends in the Association. The Annual General Meeting stood in silence in tribute to the memory of Arthur Duell. The Director & Secretary then explained that Article 65(A) stated that the appointment of a

President Designate by the Council was to be made at the next Annual General Meeting following the election of a President. The method to be followed in these circumstances would be to take all other competent business at the Annual General Meeting and then to adjourn the Meeting until 4.00 p.m. on 13 October 1976 at the Great Northern Hotel, London N1 9AN when the sole business to be transacted would be to receive notification of the Council's appointment of a member as President Designate. This was agreed by the Meeting.

Election of Vice-Presidents of the Association

The President read the nominations of the Council and asked the meeting to accept them *en bloc*. This was agreed and the following were then elected as Vice-Presidents:

(*i*) Mr J. Beachen
(*ii*) Mr D. E. Hopper
(*iii*) Mr A. McLean
(*iv*) Mr D. Pienaar
(*v*) Dr H. Rechmann
(*vi*) Dr F. M. Smith
(*vii*) Mr A. R. H. Tawn

Election of Honorary Officers of the Association

It was unanimously agreed to elect the Honorary Officers as follows:

Honorary Secretary	Mr D. J. Morris
Honorary Treasurer	Dr H. R. Hamburg
Honorary Editor	Mr. S. R. Finn
Honorary Research & Development Officer	Mr C. N. Finlay

Honorary Membership

The President stated that it gave him the utmost pleasure to be able to announce to the Annual General Meeting that Honorary Membership had been conferred by the Council upon Dr S. H. Bell, OBE (President 1965-67) in recognition of his outstanding work. Dr Bell was unable to be present at the Annual General Meeting and the President had promised him that he would take the Scroll for safe-keeping until the Council's Reunion Dinner in the Autumn, when he would make the formal presentation of the Scroll to Dr Bell. The wording on the Scroll read as follows:

OIL & COLOUR CHEMISTS' ASSOCIATION

HONORARY MEMBERSHIP

was this day conferred upon

SIDNEY HECTOR BELL, O.B.E.

Doctor of Philosophy, Fellow of the Association in the Technology of Surface Coatings, in recognition of his distinguished services to the Association as an Elective Council Member 1952-1954, 1956-1958 and 1961-1963, Vice-President 1959-1961, 1963-1965 and 1972-1974; President-Designate 1964-1965, President 1965-1967, Chairman Lightfastness Committee 1967-1971, Chairman Working Party on Education, Training and Qualifications, 1968-1970, and to express the admiration of the Members for the way in which he has constantly promoted the interests of the Association throughout his Membership.

A. T. S. Rudram
President

D. J. Morris
Honorary Secretary

R. H. Hamblin
Director & Secretary

25 June 1976

Announcement of election of three Elective Members to Council 1976-78

The President read the following report which had been received from the Auditors:

We have scrutinised the voting papers for the three elected members of the Council received from the Members in the United Kingdom and General Overseas Sections, and certify that the votes cast, including those notified by telex from the Ontario and South African Sections, show that the following obtained the largest number of votes:

J. Smethurst J. R. Bourne F. B. Redman

Three voting papers were rejected as being not in order.

London,
15 June 1976

COOPERS & LYBRAND
Chartered Accountants

The President then declared the three Members listed elected to Council.

Chairmen of Sections for the coming session

The names of the Section Chairmen for the coming year were given as follows:

Auckland	Mr R. F. Meek
Bristol	Mr L. J. Brooke
Cape	Mr E. G. Warman
Hull	Mr T. W. Wilkinson
Irish	Miss P. Magee
London	Mr J. T. Tooke-Kirby
Manchester	Mr J. E. Mitchell
Midlands	Mr R. J. King
Natal	Mr D. J. House
Newcastle	Mr K. Hodgson
Ontario	Mr P. Birrell
Scottish	Mr J. D. W. Davidson
Thames Valley	Mr M. H. Prigmore
Transvaal	Mr E. P. Wright
Wellington	Mr O. W. Brett
West Riding	Mr P. Bartrum

Reappointment of Auditors and fixing the remuneration thereof

It was proposed by Mr T. R. Smith that Coopers and Lybrand (Chartered Accountants) be reappointed Auditors of the Association and that their fee for 1976 be £500. This was seconded by Mr D. W. Komrower and carried unanimously.

Vote of Thanks to retiring Council Members

The President called upon Mr J. Smethurst to propose a vote of thanks to those Members retiring from Council and not serving in another capacity in the forthcoming session. On behalf of the Members, Mr Smethurst proposed a vote of thanks to all those Members, both at home and overseas, who had given so willingly of their service. At the same time he felt that the Association should not forget the support which it had received from the industries it served. The vote of thanks was then carried with acclamation.

Vote of Thanks to Honorary Officers of the Association

Mr M. J. Cochrane moved a vote of thanks to the Honorary Officers of the Association and, in particular, wished to

mention the work of Mr F. Cooper, who had retired after six years' service as Honorary Treasurer, and Mr L. H. Silver, who now retired from Council after completing his year of service as Immediate Past-President. The vote of thanks was then carried with acclamation.

Vote of Thanks to the Chairman of the Meeting

Mr P. Bartrum proposed a vote of thanks to the Chairman of the meeting, and at the same time thanked him for his support at the Symposium earlier in the day, when he had taken the chair for the morning session. On behalf of the Members he wished him well for his second year of office; the vote of thanks was carried with acclamation.

There being no other competent business the President declared the meeting adjourned at 3.22 p.m. and stated that it would be reconvened at 4.00 p.m. on Wednesday 13 October 1976 at the Great Northern Hotel, London N1 9AN, when the sole business to be transacted would be to receive notification of Council's appointment of a Member as President designate.

Presentation to the Director & Secretary

The President stated that Members would be aware that the Director & Secretary had completed 25 years' service as chief executive officer on 1 April 1976 and Council felt that the Members would wish a presentation to be made to him following the Annual General Meeting to mark the occasion. Mr Hamblin had chosen a print with a West Country theme by John Piper and the President then made the presentation to Mr Hamblin, who thanked the President, Members of Council, Section and Branch Committees, and all Members for their help and support throughout the last 25 years.

OIL & COLOUR CHEMISTS' ASSOCIATION

A company limited by guarantee. Registered in England No. 745691.
Value Added Tax Registration Certificate No. 226 9789 13.

Annual General Meeting 1976

Notice to Members

Adjournment of Annual General Meeting

Owing to the sudden death of Mr A. A. Duell on 20 June 1976 it was not possible for Council to appoint a Member as President Designate at the Annual General Meeting on 25 June 1976. Accordingly, in fulfilment of the provisions of Article 65(A), it has been agreed to adjourn the Annual General Meeting at the conclusion of the remainder of the business on the agenda until 4.00 p.m. on Wednesday 13 October 1976 at the Great Northern Hotel, London N1 9AN, when the sole business to be transacted will be to receive notification of the Council's appointment of a Member as President Designate.

Priory House,
967 Harrow Road,
Wembley, Middlesex,
HA0 2SF

Robert Hamblin
Director & Secretary
25 June 1976

Information Received

A view of the main entrance to the present site of the Clayton Aniline Co. Ltd, which celebrates its centenary this year

Clayton Aniline centenary

The Clayton Aniline Co. Ltd, one of the leading UK manufacturers of dyestuffs, this year celebrates its centenary. The company was founded on 29 May 1876 in Clayton, Manchester, on a one-acre site which over the years has been extended to more than 57 acres.

Founded as a private company by Dr C. Dreyfus, it was acquired by CIBA in 1911, and in 1919 Geigy and Sandoz became minority shareholders. Following the merger between CIBA and Geigy in 1970, Clayton Aniline remains a separate corporate company owned by CIBA-GEIGY (UK) Ltd (majority interest) and Sandoz Ltd.

New speciality isocyanates plant

The Baxenden Chemical Co. Ltd has announced the completion of a new plant to produce approximately 2000 tonnes per annum of speciality isocyantes for use in adhesives, elastomers and surface coatings. The process, which is continuous, has been developed by Baxenden and the plant built by Capper Neill of Baxenden's own design.

The products to be manufactured are trifunctional isocyanates for use as cross-linkers in paints and adhesives, including a non-yellowing type, and long chain di-isocyanates for use in elastomers and coatings. The plant has been designed to produce these isocyanate products with a very low volatile isocyanate content in order to reduce the hazards from inhalation of isocyanate vapours.

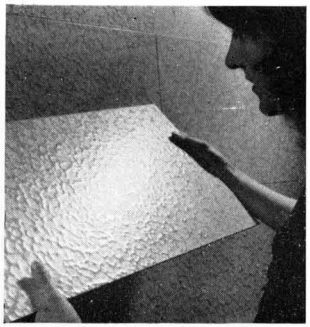
Alfa Chemicals—change of address

Alfa Chemicals Ltd is now operating from 9A High Street, Staines, Middlesex TW18 4QY (tel: Staines 57212/3). The company will be pleased to receive enquiries relating to the products of its principals as follows:

Air Products & Chemicals Inc.,
Polymers Division
G.E. Silicones
Thibaut & Walker Co. Inc.
PVO Inc.
Gattefosse

Distributor for ICI's ethanolamines

ICI Petrochemicals Division has appointed the Cargo Fleet Chemical Company Ltd (CFC) of Eaglescliffe, Cleveland, as official United Kingdom distributor for mono, di and triethanolamines. CFC is also the distributor for ICI's "Synperonic" range of ethoxylates (detergent raw materials) and



A decorative surface finish can be obtained by special techniques, such as scattering granular material on to the surface or spotting it with pigment solutions: because the viscosity of the resin layer increases uniformly during the course of polymerisation, the depth of penetration of the decorative substance as a function of time is easily controlled. Messrs Dibson of Ober-Ramstadt, Germany have utilised this property to develop a continuous coating process for applying multicoloured glaze and ceramic-like coatings with a low relief structure to asbestos cement, wood, chipboard and metal. The photograph shows a decorative panel produced in this way using a pre-accelerated, low viscosity methacrylate resin ("Degalan S 4247" from Degussa), for which the cure time is less than 10 minutes

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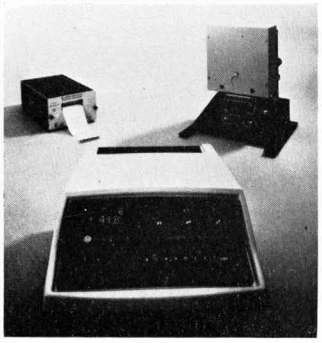
the "Ethoxol" and "Diethoxol" ranges of glycol ether and glycol ether acetates.

BOC automation/Hunterlab marketing agreement

BOC Automation, Daventry, Northants, part of BOC Ltd, has recently concluded an agreement with Hunter Associates Laboratory Inc. of Fairfax, Virginia, USA, to market in the UK and Ireland Hunterlab's range of instruments for appearance measurement. This includes a family of colour measuring instruments, a family of instruments which measure geometric intensity and several on-line continuous monitors.



One of the Hunterlab D25 range of photoelectric tristimulus colourimeters for measuring the colour of a wide variety of objects and materials (see BOC agreement above)

Laporte: new venture in Brazil

Laporte Industries (Holdings) Ltd has acquired, for approximately £1.5 million, a 40 per cent participation in the Bentonit Uniao Group, the principal manufacturer of bentonite in Brazil. Laporte, one of the leading producers in the world of bentonites and similar clays, has long experience of these products and their applications. The B.U.N. Group has manufacturing facilities for bentonite, barytes and other minerals in the states of Paraiba and Habia in the north-east of Brazil.

Nicklin awarded major commission

R.J.P. Nicklin & Co. Ltd, the Sheffield-based corrosion engineering consultancy, has been commissioned to provide an inspection service for all protective coatings applied to steel gates on the Thames Barrier Project, one of the United Kingdom's largest current civil engineering and steelwork projects.

Packaging technology sponsorship

The Paper and Paper Products Industry Training Board is to provide sponsorship for up to eight students on the BSc Packaging Technology course at Watford College of Technology.

The sponsorships will be of £2500 per annum for each student for the duration of the course and will pay for wages during training, accommodation and travel. A scholarship award will also be made during college periods and the Board will help to organise industrial training.

Pattern Recognition Association

The British Pattern Recognition Association has recently been formed to promote the knowledge and application of pattern recognition. The Association, which already has 80 members, is expected to become the British branch of a proposed international association.

Further information can be obtained from the Secretary, Dr M. J. B. Duff, Department of Physics and Astronomy, University College, London WC1E 6BT.

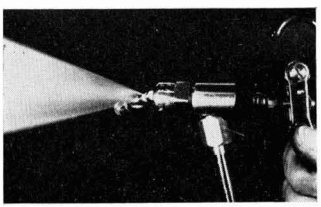
UK inspection engineers expand American operations

BIE AntiCorrosion Ltd of King's Langley, Hertfordshire, a firm of consultants and inspecting engineers specialising in corrosion prevention work, have announced the expansion of their activities in the USA. The company, a member of the British Inspecting Engineers Group, supervises and inspects the preparation and application of surface coatings and insulation materials on industrial installations, particularly in the petrochemical industry.

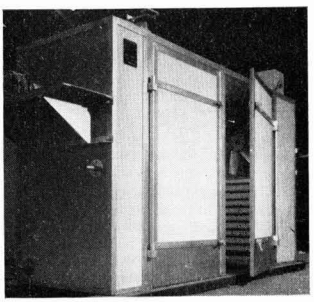
From June 1976, these services will be available in the USA through BIE Marvin Johnson Inc. of Houston, Texas—a subsidiary formed last year by British Inspecting Engineers Ltd. The UK company's clients include a number of American oil companies currently working on North Sea related projects.

New pigment

BASF has introduced a new red pigment, "Lithol Scarlet 3702 K", for colouring rigid and plasticised PVCl for the production of polyethylene-based pigment dispersions. It has a yellowish-red, brilliant shade and is easily dispersible in PVCl and polyethylene.



The Titan "Variotip" airless spray tip with adjustable nozzle opening, from Prodef Engineers Ltd, Birmingham. The spray pattern and output of the nozzle can be varied in seconds and since there are no packing or "O" rings the equipment is practically maintenance free. The Variotip also serves as a tip cleaner and is claimed to be more reliable than conventional rotating cleaners because blockages are easily cleared by increasing the diameter of the orifice



One of a wide range of new drying cabinets specifically designed for use in the dyestuffs, food processing, colour and chemical industries and now available from I & P Chemical Engineers Ltd, Stoke-on-Trent

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Courses, symposia etc.

Small particles

The Particle Size Analysis Group and the Faraday Division Industrial Sub-Committee of the Chemical Society will hold a joint meeting on "Characterisation of very small particles" on Thursday, 23 September 1976, at Loughborough University. The registration fee, to include morning coffee, lunch and afternoon tea, will be £4.00.

Literature

British Standards

The following two British Standards are now available from the British Standards Institution, 101 Pentonville Road, London:

BS 1795:1976 "Extenders for paints"

BS 5358:1976 "Low-lead solvent-thinned paint for woodwork"

Colour research and application

"Color research and application" is the title of a new quarterly journal which is

replacing the journal of the Colour Group of Great Britain. The publication is endorsed by the Colour Group, the Inter-Society Color Council in the USA and the Canadian Society for Colour, and its editor-in-chief is Prof. F. W. Billmeyer, Jnr., of Rensselaer Polytechnic Institute, Troy, New York.

Epoxy-modified resin

Scott Bader Co. Ltd has issued a data sheet describing its new chemically-resistant, epoxy modified polyester resin "Crystic 600", which has been specially developed for the manufacture of chemical plant in glass reinforced polyester (GRP). For contact moulding applications, it is supplied preaccelerated as "Crystic 600 PA."

Fully cured mouldings made from Crystic 600 and 600 PA may be expected to show outstanding resistance to many aggressive alkaline and oxidising chemical environments and to hot aqueous solutions. Further information can be obtained from Scott Bader Co. Ltd, Wollaston, Wellingborough, Northants.

A paper in the September issue will describe polyester resins and GRP with particular emphasis on chemical plant.

Financial results of UK chemical companies

The Chemicals Economic Development Committee has recently published the first edition of "Financial results of UK chemical companies". The financial results of 230 chemical companies employing 150 or more people are given for the years 1971/2 to 1974/5. Copies are available at £3.87 (including postage) from Neddy Books, NEDO, Millbank Tower, London SW1P 4QX.

Paints for steel in acid conditions

The protection of steel against corrosion in a wide variety of acid environments is the subject of a new 20-page booklet published by the Mond Division of ICI. The new booklet is freely available on request from ICI Mond Division, Dept P, PO Box 13, The Heath, Runcorn, Cheshire WA7 4QF.

Surfactants

Tergo-Data, Darlington, County Durham, a newly-established consultancy in the field of detergents, has announced that it will soon be publishing a new reference book, "Surfactants UK", giving details of surface active agents at present available in the United Kingdom. It is intended that the catalogue will be revised and reprinted annually.

Resins in the construction industry

A new 32-page brochure describing the many uses of resins in civil engineering and building construction applications is available from Synthetic Resins Ltd, Speke, Liverpool.

Notes and News

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 fourth 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 1976 and it is hoped to present the award at the 1977 Association Conference.

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 & Secretary at the Association's offices.

Professional grade admissions

At a meeting of the Professional Grade Committee held on 8 July 1976 the following Ordinary Members were admitted to the categories shown below. The Section to which each Member is attached is given in italics.

Fellow

JOSEPH RICHARD KANE (*London*)

Associates

PETER KENNETH THOMAS OLDRING (*London*)
WILFRED TERENCE LANDER (*West Riding*)
JOHN CLIFFORD WOOF (*London*)
BARRY MICHAEL BELSHAM (*General Overseas–Cyprus*)
CHRISTOPHER ROBIN STACK MCDONNELL (*West Riding*)
FRANK GIBSON (*Manchester*)

Licentiate

DAVID WILLIAM LODGE (*London*)

For his Licentiateship, Mr. Lodge submitted a dissertation on "Coatings for rusty steel". Full details of the regulations covering the Professional Grade and application forms can be obtained from the Director and Secretary of the Association.

World-famous carpet gardens at Eastbourne: this picturesque English seaside town will be the venue for the Association's next biennial Conference to be held in June 1977—for further details see page 312 (Photograph by courtesy of Eastbourne Publicity Dept.)

OCCA-29 Exhibition

22-25 March 1977 at Alexandra Palace, London

Many enquiries received from home and overseas

Closing date for applications for stand space: 1 OCTOBER 1976

Applications for stand space now being taken

The twenty-ninth annual exhibition of raw materials, plant and equipment for the paint, printing ink, colour and allied industries organised by the Association will take place at Alexandra Palace, London N22 from 22 to 25 March 1977. Alexandra Palace was the venue for the exhibition held in March 1976 and for the series of exhibitions from 1965 to 1969.

The Exhibition Committee emphasises on this occasion the quality of the OCCA exhibitions in providing every year a focus for all those connected (either as suppliers of raw materials and equipment, or as buyers or in some other capacity) with the many and varied surface coatings markets throughout the world. The exhibition has long been known as the annual international forum for display and discussion in the surface coatings industries, and the motif for 1977 draws attention to the concept of the annual "focal point" for the industries.

Motif of the Exhibition

The motif, designed by Robert Hamblin, uses red arrows to symbolise how exhibitors and visitors are drawn from all points of the compass to the exhibition. The heads of the red arrows form white arrows in the opposite direction showing the subsequent spreading of knowledge of technical advancements from this unique annual focal point for the surface coatings industries.

Invitation to Exhibit

Copies of the Invitation to Exhibit have been despatched to companies and organisations in the United Kingdom and overseas which have shown at previous OCCA exhibitions or have requested information for the first time for the 1977 exhibition. Completed application forms for stand space must be returned to the Director & Secretary of the Association not later than **Friday 1 October 1976.**

The Exhibition Committee was particularly pleased to see the number of overseas companies showing at OCCA-28, either directly or through their British associates, as this emphasises the international character of the function.

Any organisation which has not previously exhibited and wishes to obtain an Invitation to Exhibit should contact the Association's offices immediately.

Facilities at Alexandra Palace

Visitors to OCCA-28 this year were impressed by the facilities available, which include two restaurants, two bars, a cafetaria and an exhibitors' bar. Other facilities include ample free car parking space, which is of considerable benefit especially to those using the M1 motorway, which links with the North Circular Road.

The Association will once again organise a free bus shuttle service to and from Turnpike Lane Station on the London Underground (Piccadilly Line). The journey from central London on the Piccadilly Line takes approximately 18 minutes and connections to the Piccadilly Line can be made easily from all mainline stations. It is hoped that the new electrification of British Rail services will be completed by March 1977 so that some visitors may find it easier to travel by train from King's Cross to Wood Green Station, from which station the London Transport W3 bus travels to Alexandra Palace. A further link which will be of benefit for those travelling by air will be the extension of the Piccadilly Line to Heathrow Airport, which is scheduled for completion in 1977. This will give a direct link with Turnpike Lane Station and in the meantime a bus service operates from Heathrow Airport to Hounslow West Station. Visitors who prefer to travel from Heathrow Airport to the West London Air Terminal in order to leave their luggage at hotels, can board the Piccadilly Line trains at Gloucester Road Station.

The Association has arranged for the exhibition to be held on its own at Alexandra Palace, which means that the facilities are exclusively available for exhibitors and visitors to this important international meeting place. The Exhibition Committee, therefore, draws particular attention to this aspect of this annual exhibition in providing an annual international focal point for the surface coatings industries, where the display and discussion of technical developments and knowledge can take place in an informal atmosphere.

In pursuance of this idea, the Committee has decided to amend the regulation which has previously precluded exhibitors from offering alcoholic refreshments to visitors on their stands. The Committee feels certain that the relaxation of this rule will be welcomed by exhibitors and visitors alike.

"Official Guide"

This unique publication will contain descriptions of all exhibits and advertising space is available both to exhibitors and those organisations not able to show at the 1977 Exhibition. The "Official Guide" will be published **at the end of January 1977,** so that intending visitors can obtain copies and plan their itineraries.

Each Member of the Association, at home and abroad, will be sent a copy of the "Official Guide" and free season admission ticket.

As for the 1976 exhibition, copies of the "Official Guide" and season admission tickets will be available several weeks in advance of the exhibition (prepayment only) from the Association's office and they will also be available for purchase at the entrance to the Exhibition Hall.

For the last two exhibitions, it was decided that a small charge should be made both for the "Official Guide" and for season admission tickets to the exhibition. This policy undoubtedly deterred casual visitors who might otherwise be attracted to exhibitions for which no admission charge was made and who gathered quantities of technical literature from the stands. The innovation was welcomed by many exhibitors and in no way acted as a deterrent to visitors to this exhibition. A similar charge will be made for the "Official Guide" to OCCA-29.

Information in foreign languages

As in previous years, the Association will be circulating information leaflets in six languages, which will contain application forms for those wishing to purchase copies of the "Official Guide" and season admission tickets before the exhibition.

Arrangements for overseas Members visiting the Exhibition

Members attached to the six Sections overseas and those in the General Overseas Section resident outside the continent of Europe, who are planning to visit the Exhibition, are reminded that upon application to the Director & Secretary, the "Official Guide" and admission ticket will be sent to await their arrival at their temporary United Kingdom address.

OCCA Biennial Conference 1977

The next biennial Conference of the Association will be held at the Grand Hotel, Eastbourne, from Thursday 16 to Sunday 19 June 1977 and the theme for the Conference will be:

The conservation of energy, materials and other resources in the surface coatings industry

It is intended that as on previous occasions, full preprints will be published for despatch to delegates in advance of the Conference. It is important, therefore, that any person, whether or not a Member of the Association, who feels that a report of his work could form the basis of a suitable paper should contact immediately the Honorary Research and Development Officer by writing in the first instance to the Director & Secretary of the Association at the address on the Contents page of this issue.

It will be recalled that it is the custom at the Association's Conferences for the authors merely to outline their papers, highlighting points of interest, and for a general discussion of the paper to follow. The author will not be expected to deliver the paper *in toto* since the object of sending out the preprints in advance is that delegates may read these thoroughly before the Conference.

Eastbourne was the venue for the Association's Conference held in 1953, 1969 and 1973, and has always proved a most popular centre for delegates. Forms for registration will be despatched to all Members of the Association attached to the Sections in the United Kingdom, Ireland and the General Overseas Section early in 1977 and any non-member wishing to receive the registration form should write to the Director & Secretary at the Association's offices before the end of this year.

News of Members

Mr A. Sansum, an Ordinary Member attached to the London Section, will shortly be joining the British Inspecting Engineers Group's American company, BIE Marvin Johnson Inc., based in Houston, Texas.

Mr A. Sansum

Mr Sansum is a specialist in corrosion prevention work in the petroleum industry and is at present a director of BIE Anti-corrosion Ltd, a member company of the British Inspecting Engineers Group.

Section Programmes for the 1976-77 session

Main Association Events

1976

Wednesday 13 October Reunion Dinner for past and present members of Council, to be held at the Piccadilly Hotel, London W1 at 6.30 for 7.00 p.m. Informal dress. See page 314.

1977

Tuesday 22 to Friday 25 March OCCA-29 Technical Exhibition, Alexandra Palace, London N22. See page 311.

Thursday 16 to Sunday 19 June Biennial Conference, at the Grand Hotel, Eastbourne. See above.

Saturday 18 June Annual General Meeting. Grand Hotel, Eastbourne.

Bristol

Unless otherwise stated, all meetings will be held at the Royal Hotel, Bristol at 7.15 p.m.

1976

Friday 24 September Ladies' Evening. *Details to be announced.*

Friday 29 October "North Sea oil and gas—their effect on industry" by Mr J. Tooke-Kirby, FTSC, Chairman London Section. Joint meeting with the Birmingham Paint, Varnish and Lacquer Club.

Friday 26 November "Waste disposal in the surface coatings industries" by Mr H. G. Pullen, Redland Purle Ltd.

1977

Friday 28 January "Smoke emission from polymer and paint films" by Mr K. A. Safe of Vinyl Products Ltd.

Friday 25 February "Paper in relation to printing processes" by Mr A. T. Franklin, Reed Paper and Board (UK) Ltd.

Friday 25 March "Lead chromes, their present uses and future trends, with particular emphasis on recent regulations" by Mr R. M. W.W. Wilson, SCC Colours Ltd.

Friday 1 April Annual Dinner Dance at the Mayfair Suite, New Bristol Centre.

Friday 29 April Annual General Meeting. *Time and venue to be announced.*

Hull

Unless otherwise stated, the meetings will be held at the George Hotel, Land of Green Ginger, Hull, commencing at 6.30 p.m.

1976

Friday 1 October Annual Dinner Dance to be held at the Willerby Manor Hotel, Willerby, Hull.

Monday 4 October "Safety, and pollution effluent disposal" by Mr J. Alexander, P.D.Pollution Control Ltd. Joint meeting with the Institution of Chemical Engineers at the Haven Inn, Barrow Haven, Lincs.

Monday 1 November "The fundamentals of UV curing" by Mr R. G. Smith, A. Holden & Co. Ltd.

Friday 12 November Disco-Dance, to be held at the Cricket Club, Anlaby Road, Hull.

Monday 15 November "Synthetic clays—their properties and uses" by Mr B. J. R. Mayes, Laporte Industries Ltd. *Student lecture.*

Monday 6 December "High solid coating systems" by Dr D. Faulkner, Rohm & Haas (UK) Ltd.

1977

Monday 3 January "The optimum use of organic pigments" by Mr D. M. Varley of CIBA-Geigy (UK) Ltd.

Monday 7 February "The alternative technologies for industrial finishes" by Mr J. Rackham, BTP Tioxide Ltd.

Monday 7 March "Antiques" by Mr G. Baitson, of the Edwardian Auction Galleries. *Ladies' Evening.*

Monday 2 May "Pottery—colour and decoration" by Mr A. Simkin, Blythe Colours Ltd, to be held at the Haven Inn, Barrow Haven, Lincs. *Ladies' Evening.*

Irish

Unless otherwise stated all meetings will be held at the Clarence Hotel, Dublin at 8.00 p.m.

1976

Friday 17 September "Polymer emulsions and their effects on paint properties" by Mr K. R. Geddes, Crown Decorative Products Ltd.

Friday 15 October "Implementation of EEC directives on the packaging in paint, printing ink and adhesive industries" by Mr F. Shaughnessy, Industrial Inspector, Department of Labour.

Friday 19 November Annual Dinner Dance, commencing at 8.30 p.m.

Friday 10 December "UV curing—principles and practice" by Dr B. E. Hulme, BTP Tioxide Ltd.

1977

Friday 21 January Ladies' Evening with a lecture on antiques by Mrs A. Dalton, RDipl, AIDP, of Andrian Interiors.

Friday 18 February *Details to be announced.*

Friday 25 March "Solvents and safety" by Mr C. W. Andrews, BP Chemicals Ltd.

Friday 29 April Annual General Meeting.

June Golf outing—*details to be announced.*

London

1976

Monday 20 to Wednesday 22 September Joint Conference with the Institute of Metal Finishing at Warwick University, entitled "Current trends in industrial finishing".

Thursday 7 October "Water repellent preservative stains" by a speaker from the British Wood Preserving Association. Evening meeting at the Royal Society of Tropical Medicine & Hygiene, 26 Portland Place, London W1 commencing at 7.00 p.m.

Friday 29 October Dinner Dance.

Tuesday 16 November "New approaches to the development of specific properties in paint films" by Prof H. P. Schreiber, Department of Chemical Engineering, Ecole Polytechnique, University of Montreal. To be held in the Colnbrook Room, Sheraton-Heathrow Hotel, Colnbrook Bypass, London Airport, West Drayton, commencing at 11.00 a.m. and to include luncheon.

Wednesday 17 November "Water thinned anti-corrosive coatings". Joint day meeting with the Institution of Corrosion Science & Technology and in association with Thames Polytechnic, commencing at 10.00 a.m.

1977

Thursday 13 January "Micro-emulsions" by Mr K. H. Falklin, Perstorp AB, Sweden. Evening meeting at the Princess Alice, Romford Rd, London E7, commencing at 7.00 p.m.

Wednesday 9 February "Printing on textiles". Joint day meeting with the Society of Dyers and Colourists and in association with Thames Polytechnic, commencing at 10.00 a.m.

Thursday 3 March "Flammability testing and its relevance to flame retardant paints" by Mr A. G. Walker, Associated Lead Manufacturers Ltd. Evening meeting at the Royal Society of Tropical Medicine & Hygiene, 26 Portland Place, London W1, commencing at 7.00 p.m.

Thursday 21 April Annual General Meeting. *Time and venue to be announced.*

Manchester

Unless otherwise stated, all meetings will be held at the Woodcourt Hotel, Sale, Cheshire, commencing at 6.30 p.m.

1976

Wednesday 8 September Golf Tournament to be held at Stockport Golf Club.

Friday 17 September Student Symposium: "The theory and practice of dispersion".

Friday 8 October "Films from particles" by Mr M. J. Waghorn, ICI Paints Division, to be held at the Manchester Literary & Philosophical Society, George Street, Manchester, commencing at 6.30 p.m.

Friday 22 October Annual Dinner Dance to be held at Peacock Suite, Hotel Piccadilly, Manchester.

Friday 12 November "Possibilities and prospects for metal coatings with polyurethanes" by Dr Sonntag, Bayer AG.

Monday 6 December "Decoration of ceramics" by Mr K. Hopkins, Ben Capper Ltd.

1977

Wednesday 12 January "Micro-emulsions" by Mr G. H. Falklin of Perstorp AB, to be held at the Manchester Literary and Philosophical Society, George Street, Manchester, commencing at 4.30 p.m.

Friday 14 January "The use of microvoids as pigments" by Mr J. Clark, BTP Tioxide Ltd, to be held at the Manchester Literary & Philosophical Society, George Street, Manchester, commencing at 6.30 p.m.

Friday 11 February "Organic versus inorganic coatings" by Mr J. R. Lyon, Goodlass Wall and Co. Ltd.

Monday 7 March "High solids water reducible aminoplast crosslinkers for modern coatings" by Dr M. Donnez, Monsanto Europe SA.

Wednesday 16 March Student works visit in the afternoon to ICI Ltd, Organics Division, A.R.T.S. Block.

Midlands

The venues not stated below will be announced in future issues of the *Journal* under "Forthcoming Events".

1976

Friday 17 September Ladies' Night at the Botanical Gardens, Edgbaston B15 at 7.00 for 7.30 p.m.

Thursday 23 September "Litho and letterpress inks: present & future" by Mr F. Whitfield, Mander Kidd Ltd.

Thursday 21 October "The use of aromatic acids in modern coatings technology" by a speaker from Amoco Chemicals UK Ltd.

Thursday 18 November Student lecture: "Paint manufacture" by Mr B. Lucas, Joseph Mason Paints Ltd.

1977

Friday 21 January Dinner lecture: "High solids systems" by Dr Uerdingen, Bayer AG, Germany, to be held at Birmingham Chamber of Commerce and Industry, Harborne Road, Edgbaston B16 at 6.30 for 7.00 p.m.

Thursday 17 February "The Health & Safety at Work Act" by Mr M. Kelly of the University of Aston in Birmingham. Joint meeting with Trent Valley Branch.

Friday 18 March "Newton Friend" Lecture—Ladies Invitation. "A Victorian magic lantern entertainment" by Mr M. J. Simpkins. To be held at Birmingham Chamber of Commerce & Industry at 7.30 p.m.

Thursday 21 April Annual General Meeting.

Trent Valley Branch

Unless otherwise stated, all meetings will be held at 7.00 pm at the Crest Hotel, Pastures Hill, Littleover, Derby.

1976

Thursday 7 October "North Sea oil—inspection" by Mr J. D. Griffiths, R.J.P. Nicklin & Co.

Friday 29 October Social Buffet and Dance at the Cross Keys Inn, Turnditch, commencing at 7.30 p.m.

Thursday 11 November "Inflation accounting" by Mr S. Turner, Mebon Ltd.

1977

Thursday 13 January "Bulk handling of powders and pigments" by Dr N. Harnby of the University of Bradford.

Thursday 17 February "Health and safety at work". Joint meeting with Midlands Section (Birmingham venue).

Thursday 10 March An informal discussion on paint exporting, with Mr L. H. Silver, SPL Group.

Friday 1 April Annual General Meeting followed by Buffet Dance at Cross Keys Inn, Turnditch at 7.30 p.m.

Newcastle

Unless otherwise stated, all meetings will be held at the Royal Turks Head Hotel, Grey Street, Newcastle upon Tyne, commencing 6.30 p.m.

1976

Thursday 7 October Joint Meeting with the Institution of Corrosion Science and Technology. Two papers will be presented: "The integration of the protection function when building a ship", by Mr J. P. Jemitus, Cammell Laird Shipbuilders Ltd, and Mr A. N. McKelvie, Paint Research Association, and "Steel cleaning standards—a case for their reappraisal" by Mr McKelvie. To be held at Newcastle Polytechnic.

Thursday 4 November "The use of microvoids as pigments" by Mr J. Clark, Tioxide International.

Thursday 2 December "Ion beam etching for the study of paint film structure" by Mr J. L. Prosser, Paint Research Association.

1977

Thursday 6 January "New coatings based on aromatic acids" by a speaker from Amoco Chemicals.

Thursday 3 February "Some techniques in the management of research" by Mr F. Westwick, Department of Management Studies, Sunderland Polytechnic.

Friday 18 February Ladies' Night, at the Five Bridges Hotel, Gateshead.

Thursday 3 March "The value of mechanical tests in assessing paint performance, and their relevance to specifications" by Mr C. E. Hoey, Ministry of Defence.

Thursday 7 April Annual General Meeting, Lambton Worm, Birtley.

Scottish

All meetings will take place at the Beacon's Hotel, 7 Park Terrace, Glasgow G3, at 6.00 p.m., unless otherwise indicated.

1976

Thursday 14 October "Recent developments in polyurethanes" by Mr R. M. Entwhistle, Bayer (UK) Ltd.

Thursday 11 November "Car finishing" by a speaker from ICI Ltd Paints Division. Joint meeting with the Society of Dyers and Colourists.

Thursday 9 December. *Lecture to be arranged.*

1977

uary Annual Dinner Dance at the Albany Hotel, Glasgow.

Thursday 20 January "Pigments dispersions" by Mr R. S. Monk, Kenroy Dispersions Ltd.

Wednesday 9 February "Aspects of packaging" by Mr A. D. Lotte, Metal Box Co. Ltd. Joint meeting with the Eastern Branch at the Carlton Hotel, Edinburgh, commencing at 7.30 p.m.

Thursday 10 March "Primers for wood finishes". Progress report on Scottish Section research project.

Thursday 14 April AGM followed by a Ladies' Evening.

Student Group

Lectures to be arranged. Announcements will be made in future issues of the *Journal.*

Eastern Branch

All meetings will be held at 7.30 p.m. in the Carlton Hotel, North Bridge, Edinburgh unless otherwise stated.

1976

October Annual skittles match vs Student Group. *Date and venue to be arranged.*

Wednesday 10 November "Industrial solvents" by Mr C. Smith of Carless Solvents Ltd.

Wednesday 1 December "Put a sparkle into your industrial finishes" by Dr D. R. King, Silberline Ltd.

1977

Wednesday 9 February "An aspect of packaging" by Mr A. D. Lott, Metal Box Ltd.

Wednesday 16 March AGM followed by a film show.

Thames Valley

Unless otherwise stated, all meetings will be held at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks at 6.30 for 7.00 p.m.

1976

Thursday 7 October "Health and Safety at Work Act". A panel meeting and discussion with speakers from Government and industry.

Thursday 11 November "Zinc coatings" by Mr F. C. Porter, Zinc Development Association.

Thursday 2 December "Colour and gold decoration on pottery and glass" by Mr O. N. Collier, Johnson Matthey. (Ladies invited.)

1977

Thursday 27 January "Pigments for the printing industry" by Mr A. J. Green, Horace Cory & Co. Ltd.

Friday 4 February Buffet Dance at the Great Fosters Hotel, Egham.

Thursday 24 February "Masonry paints" by Mr P. Whiteley, Building Research Establishment.

Thursday 24 March "Return of the vulture" by Dr M. Clarke of City of London Polytechnic. A talk on corrosion.

Thursday 21 April Annual General Meeting and talk on "Furniture" by Mr L. E. D. Baskerville of Parker Knoll Ltd. (Ladies invited.)

West Riding

Unless otherwise stated, all meetings will be held at the Griffin Hotel, Bear Lane, Leeds, commencing at 7.30 p.m.

1976

Tuesday 14 September "The Health and Safety Act" by Mr P. F. Neal, H.M. Factory Inspectorate.

Tuesday 12 October "Water-based stoving finishes" by Dr K. Sellars, Harlow Chemical Co. Ltd.

Tuesday 9 November Lecture by a speaker from SCC Colours Ltd.

Tuesday 14 December Chairman's lecture: "Homemade wines, and the effect of alcohol on the body system". This will be a Ladies' Evening and will be held at the Mansion House Hotel, Roundhay Park, Leeds, commencing at 7.30 p.m.

1977

Tuesday 11 January "Extenders in emulsion paints" by Mr D. J. Huxtable, English Clays, Lovering Pochin & Co. Ltd.

Tuesday 8 February "Silicone resins in the surface coatings industry" by a speaker from Dow Corning Ltd.

Tuesday 8 March "Titanium dioxide pigment selection for water based glosses" by Mr J. Clark, BTP Tioxide Ltd.

Tuesday 12 April Annual General Meeting.

Ontario

The following meetings have been arranged up to the end of October 1976. Details of all other meetings for the coming session will be published nearer to the time in the "Forthcoming Events" Section of the *Journal.*

Wednesday 15 September 1976 Plant tour of Reed Wallcoverings.

Wednesday 20 October 1976 "Fluorescent pigments". A lecture by Mr H. Lavell. *Venue to be announced.*

Register of Members

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

Ordinary Members

CHIN, RAYMOND YOONG FOO, BSc, MSc, 45 Pukatea Street, Eastbourne, Wellington, New Zealand. (*Wellington*)

FOWLER, BRIAN ALISTER, Grilon & Plastic Machinery Ltd, 117-120 Snargate Street, Dover, Kent. (*London*)

HUTCHINSON, MARTIN ALFRED, BSc, High Farm Cottage, Aldburgh, Masham, Ripon, North Yorkshire HG4 4DL. (*West Riding*)

LINTON, JOHN, 115 Tirohanga Road, Melling, Lower Hutt, New Zealand. (*Wellington*)

MAITRA, ACHINTYA KUMAR, BSc, 17 Heston House, 30 Wellesley Road, London W4 4BN. (*London*)

MCDOWELL, WILLIAM, BSc, PhD, 16 Pine Grove, Woburn Sands, MK17 8PX. (*London*)

NORTON, TERENCE ALLAN, BTech, Donald MacPherson Ltd, Bury, Lancs. (*Manchester*)

PATEL, MAGANLAL, BSc, 10 Thornham Crescent, Greenfield Estate, Kirby-in-Ashfield, Notts. (*Midlands*)

SMITH, CHRISTOPER JOHN, BA, Shell Chemicals (Ireland) Ltd, 68-72 Lower Mount Street, Dublin 2. (*Irish*)

ZAND, ALIREZA, Cover Lux Co. Ltd, Shah Reza Ave. 77, Tehran, Iran. (*General Overseas*)

Associate Member

WILLIAMSON, COLIN JOHN, 94 Belvidere Road, Walsall, Staffs. (*Midlands*)

Council Reunion Dinner

A reunion dinner for all past and present members of Council will be held again this year, and on this occasion the venue will be the Piccadilly Hotel, Piccadilly, London W1A 2AU. The dinner will take place on Wednesday 13 October 1976 at 6.30 pm for 7.00 pm, and informal dress will be worn.

The past Presidents, past Honorary Officers, Honorary Members and Founder Member will once again be invited as guests of the Association. All other past and present members of Council should send the necessary remittance with their completed application form. Any member with service on Council who has not received an application form and wishes to do so should write to the Director & Secretary at the Association's offices.

South African Division

Non-conventional coatings

The Sixth National Symposium of the South African Sections, sponsored and arranged by OCCA in collaboration with the South African Council for Scientific and Industrial Research (CSIR), will be held at the Holiday Inn, Summerstrand, Port Elizabeth on Friday and Saturday, 8/9 October 1976.

The theme of the symposium will be "Non-conventional coatings" and the papers to be presented will cover a wide range of topics, concentrating on the more sophisticated aspects of surface coatings technology.

Sixteen papers will be presented and a programme of social functions has been arranged. Further information may be obtained from the Symposium Secretariat, S125, CSIR, PO Box 395, Pretoria 0001.

CLASSIFIED ADVERTISEMENTS

Classified Advertisements are charged at the rate of £3.00 per cm. Advertisements for Situations Wanted are charged at 75p per line. A box number is charged at 50p. They should be sent to C. A. Tayler, BSc, Assistant Editor, Oil & Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF. JOCCA is published EVERY month and Classified Advertisements can be accepted up to at least the 12th, and in exceptional circumstances the 20th of the month preceding publication. Advertisers who wish to arrange for an extension of the copy deadline should contact the Assistant Editor, Mr C. A. Tayler, at the address given above (telephone 01-908 1086, telex 922670 OCCA Wembley).

Send your Classified Advertisement for JOCCA by telex 922670 (OCCA Wembley)

SITUATIONS WANTED

Creative Chemist

S. American, 20 years experience in polymers (alkyd, acrylic, urethane, etc.) and coatings (air and oven dried, solvent and water-based), adhesives and inks, wants to apply his abilities in Europe. Write for details to Dr. H. Rodriguez, 13 rue Gandon, Paris 13e, France.

Qualified Paint Chemist with experience in formulation, production and raw material buying seeks change from present position. Willing to work abroad where English, Spanish or Portuguese spoken. Please reply to Box No. 425 before 31 October.

SITUATIONS VACANT

CHEMISTS
Wood finishes

We seek applications from chemists who can demonstrate a proven record in modern wood finishing developments and who seek a challenging, demanding and thoroughly satisfying outlet for their talents.

We are a leading company well established in this specialist field, located in East London. We are prepared to negotiate realistic and highly competitive salaries, together with an attractive benefit package.

Please apply in confidence to:

Mrs L. Cumper,
L. G. Wilkinson Ltd,
Jenkins Lane,
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Telephone 01-594 5500.

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Liquid Ink Technologist

A well-established Company with an expanding Liquid Ink Division seeks an **INK TECHNOLOGIST** capable of assuming a responsible position in the Laboratory. The successful candidate will probably have had recent Liquid Ink experience, but consideration would also be given to Paste Ink and Paint Chemists. Flair, and the ability to work without direct supervision are essential for this Post, and will be rewarded with a competitive salary and attractive fringe benefits.

For further information about this opportunity to work for a progressive Company in pleasant, rural surroundings Contact:

Mr. P. Fallon,
Technical Manager,
JOHNSON & BLOY LIMITED,
57 Gatwick Road,
Crawley, Sussex.
Telephone:
CRAWLEY (0293) 23152

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Work on your own initiative

. . . with a leading manufacturer who believes that your experience should earn you a high degree of independence in formulation. Valentine Varnish & Lacquer is part of a major international group, which ranks amongst Europe's largest paint and coatings industries. It offers men and women with top experience (qualifications alone are no substitute) excellent opportunities in the development field.

Vehicle Finishes

This is our major product line, providing a complete finishing service to the car industry. We're looking for someone with wide experience of formulating vehicle paint finishes, particularly thermosetting enamels, to automotive industry specifications. He or she will also develop refinishing materials, and a background in nitrocellulose lacquers, synthetic enamel-type finishes or acrylic-based refinishing materials would be a very definite advantage.

General Industrial Finishes

We manufacture a wide range of coatings for industrial use, including polyester lacquers for furniture, electrical goods and similar products. Again we need someone who is a genuine professional in the field, capable of producing formulas and physical samples under his or her own steam and with the minimum of supervision.

Colour Formulation

Our colour laboratory provides a development service across our entire range of products, for our own use and for customers. This position therefore gives an experienced colour chemist the opportunity to work on a considerable variety of different quality materials.

Please write in the first instance, stating length and type of experience, qualifications and current salary to: The Technical Manager, The Valentine Varnish & Lacquer Co. Ltd., Colham Mill Road, West Drayton, Middlesex, UB7 7AS.

Opportunities Abroad

for two Chief Chemists

The International Paint Company is the world's most extensive paint organisation with 35 factories in 25 countries. IPC is the world's major marine paint manufacturer, is Britain's biggest industrial paint producer and holds a commanding position in Europe through the operation of several associated companies.

As a result of continued development we are currently looking for two highly experienced Chemists for the following openings within our International structure.

BRAZIL

Tintas International S.A. a member of the Group based in Rio de Janeiro, require a Chief Chemist for industrial finishes. As the Company is currently entering the industrial field there is considerable scope attached to the position and the right person will have the opportunity to make a material contribution.

To fulfill the requirements you should have at least 5 years relevant experience including time spent in a trouble-shooting capacity.

This can be either a secondment for an initial period of 3 years or, alternatively, could be a permanent appointment. Both salary and conditions offered will be very attractive.

BAGHDAD

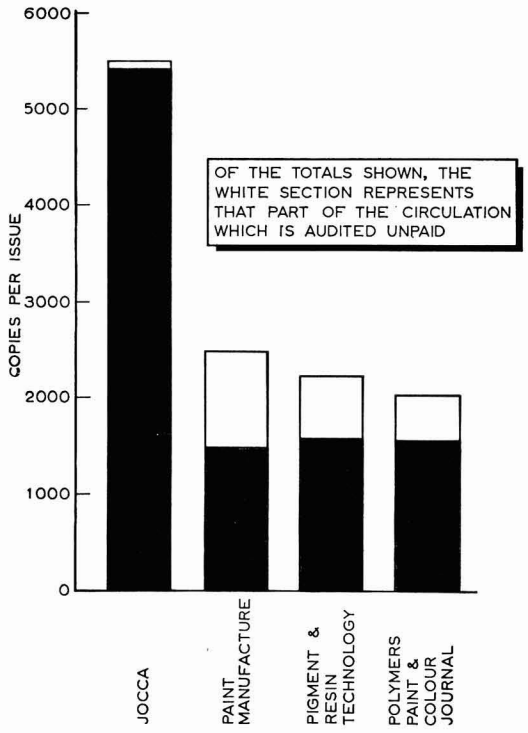
Universal Paint is one of the biggest paint companies in Baghdad and has a turnover around £1m. Working closely with IPC they currently need a Chief Chemist to be responsible for paint formulations, development, quality control and protective coatings.

You will be a member of IPC staff and seconded to Baghdad for an initial period of two years. The salary, which will be very attractive, will be in accordance with qualifications and will be coupled with first-class company benefits.

Both these positions provide valuable platforms for career development as success in these posts will open up opportunities for further progression within the Group.

Please write giving full details to:
D. C. Powell, Group Personnel Manager,
THE INTERNATIONAL PAINT COMPANY
Henrietta House, 9 Henrietta Place,
London W1A 1AD.

Comparison of circulations of U.K. publications to the paint, printing ink and allied industries



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For full details of advertising in this, and other Association publications, contact C. A. Tayler, Assistant Editor

Journal of the Oil and Colour Chemists' Association (JOCCA)

Priory House, 967 Harrow Road, Wembley, Middx. HA0 2SF, England
Telephone: 01-908 1086
Telex: 922670 (OCCA Wembley)

INDEX TO ADVERTISERS

Printed in England by Metchim & Son Ltd., 8 Storey's Gate, Westminster, London SW1P 3AT.

UV polymerisation

The twelve papers in this volume were originally published in the *Journal* earlier in 1976. They are based on lectures given at a Symposium of the Newcastle Section of the Association, held at Durham University on 10 and 11 April 1975. Titles and authors are listed below:

Photochemical excitation and its consequences—a review *by R. B. Cundall*

The application of UV-curing materials and technology to packaging *by A. D. Lott.*

Photoinitiation by aromatic carbonyl compounds *by A. Ledwith.*

The technological literature relating to polymerisation photoinitiators *by A. Pryce.*

Photopolymerisation: the kinetics of a-type photopolymerisation *by F. C. de Schryver and N. Boens.*

The use of polyfunctional monomers in UV curing *by J. R. Younger.*

Sensitisation and stabilisation in monomer/polymer systems *by D. Phillips.*

Photodegradation of polymers *by I. C. McNeill.*

UV-drying equipment, design and installation *by R. E. Knight.*

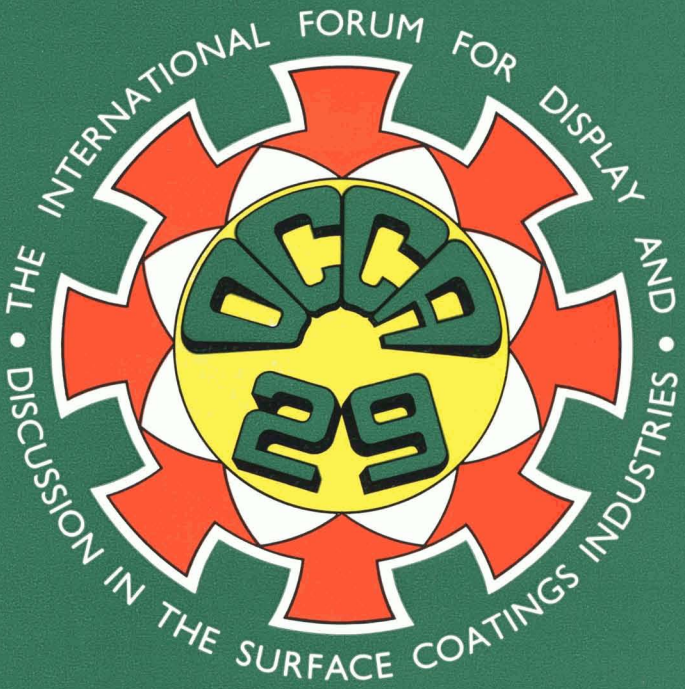
Ultraviolet curing inks *by A. A. Gamble.*

Some aspects of the pigmentation of UV-curable systems *by B. E. Hulme.*

Some aspects of the formulation of UV-curable polyester based systems *by A. Laws, S. Lynn and R. Hall.*

To obtain this book, complete the blue order form facing the back inside cover of this issue and send with the necessary remittance to the Association's offices.

OIL & COLOUR CHEMISTS' ASSOCIATION



TECHNICAL EXHIBITION

22-25 MARCH 1977

The motif, designed by Robert Hamblin, uses red arrows to symbolise how exhibitors and visitors are drawn from all points of the compass to the Exhibition. The heads of the red arrows form white arrows in the opposite direction showing the subsequent spreading of knowledge of technical advancements from this unique annual focal point for the surface coatings industries.

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We are interested in exhibiting at OCCA-29 22-25 March 1977, Alexandra Palace, London). Please send us a copy of the Invitation to Exhibit.

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