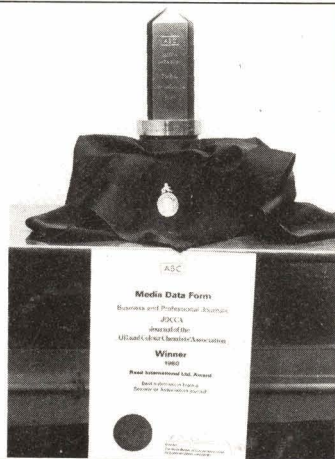


J
O
C
C
A

JOCCA WINS AN **ABC** AWARD

SEE PAGE 503



Nomination forms for 1981 AGM enclosed to members of General Overseas Section.

JOURNAL OF THE IL & OLOUR HEMISTS' SSOCIATION

The value of tributyltinfluoride as a toxicant in antifouling formulations
F. H. de la Court

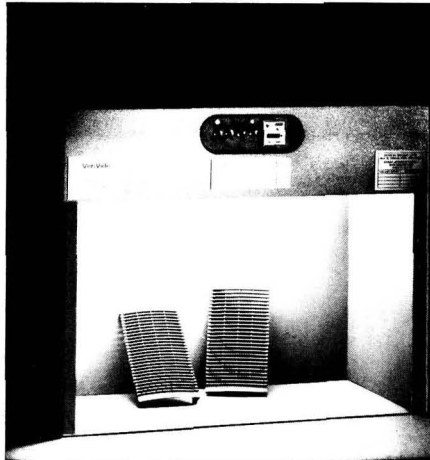
Partial allyl ethers of polyhydric alcohols as intermediates for water soluble vehicles
N. Krishnamurti, M. M. Shirsalkar and M. A. Sivasamban

Electrodeposition: anodic versus cathodic
H. U. Schenck and J. Stoelting

Applied finishes for timber in exterior situations in New Zealand (*Short Communication*)
C. Gooch

INDEXES FOR 1980 VOLUME

Authors	page 513
Keywords	page 514
Subjects	page 517



VeriVide

Dyers' and Colourists' Range
of colour matching cabinets

INDUSTRIAL 1470×610×610mm*
LAB. (shown) 710×410×410mm*
PORTABLE 640×280×280mm*

NOW internationally
standardised

Sophisticated and costly instruments assist colourists to work quickly, but only normal human colour vision can confirm the results, and then only when the illumination and viewing conditions conform to the relevant provisions of B.S.950, C.I.E. and I.S.O. standardisation.

Technical Data & Catalogue from

Jeremy Owen

Leslie Hubble Limited,
Cundy's, Frog Island,
Leicester LE3 5AG, England.
Telephone: (0533) 20228

* Viewing cavity



Pira member

Be wise . . .
standardise

Immediate Delivery of

GRINDING BEADS

of glass and zirconium oxide

We carry large stocks of grinding beads made of **specialy formulated wear resistant lead-free glass**. The beads are carefully selected for surface perfection, being as near as possible to spherical shape to minimise fracture. Equally important they are meticulously double sifted to sizes of close tolerances. The entire range extends from 0.1 mm to 3.0 mm ϕ .

And now, we also stock beads of ZIRCONIUM OXIDE to give you a really startling improvement in the quality of inks and paints. The high density of these beads shortens milling times and they last up to eight times longer than those made of best quality glass. Available at present in sizes 0.5 to 0.8, 0.8 to 1.0 and 1.0 to 1.25 mm ϕ . Larger sizes will be produced later.



Please telephone or write for prices to
Glen Creston Machinery Ltd, 16 Carlisle Road, London NW9 0HL.
Telephone 01 2001666 Telex 925791
Telegrams Glencrest London NW9

Flow Control

BENTONE Gellants give precise control over flow properties.

By modifying rheology they ensure, for a wide range of products and applications, that selected viscosity and levelling targets are met. BENTONE Gellants prevent sagging and settling in solvent or water based coatings, varnishes, printing inks and adhesives.

STEETLEY Minerals Ltd
Carlton Road
Worksop, Notts S81 7QG

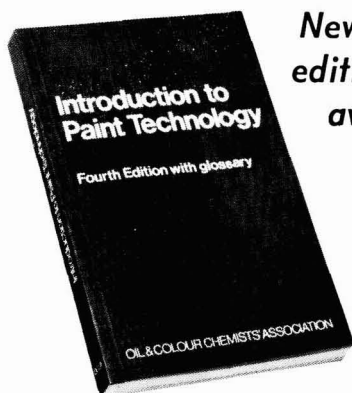
NL Chemicals Europe Inc.
31, rue de l'Hôpital
B-1000 Bruxelles



BENTONE® Gellants

NL Chemicals

OIL & COLOUR CHEMISTS' ASSOCIATION—PUBLICATIONS



**New fourth
edition now
available**

The Introduction to Paint Technology, of which 20,000 copies have already been sold, forms an excellent introduction to the whole field of surface coatings and related technologies. The fourth edition contains the important addition of a glossary of the terms used in the book together with explanations of their derivations. The text has been thoroughly revised and updated to incorporate recent advances in technology of the surface coatings industries.

Price: £5.00 (US \$12.00)

Paint Technology Manuals Works Practice

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

Price: £3.00 (US \$7.00)

Biennial Conference PREPRINTS

The Association organises an international Conference every two years and preprints of the papers are prepared for delegates. A strictly limited number of the following are available to those who wish to have the complete bound sets of papers.

1977 Eastbourne *The conservation of energy, materials and other resources in the surface coatings industries.*

Fourteen papers presented. **Price £5.00 (US \$12.00)**

1975 Scarborough *Performance of surface coatings—does reality match theory?* Seventeen papers presented. **Price: £5.00 (US \$12.00)**

1973 Eastbourne *Towards 2000.* Sixteen papers presented. **Price: £5.00 (US \$12.00)**

UV

Ultraviolet polymerisation and the surface coatings industries

The Association has published two volumes on this subject comprising 23 papers presented at Symposia, forming an authoritative work of reference for this rapidly developing technology.

Special offer: £10.00 (US \$24.00) for both volumes purchased together.

UV2

Monograph No. 1. MARINE FINISHES. Now available **Price £2.00 (US\$5.00)**

ORDER FORM

To: **Oil & Colour Chemists' Association,**
Priory House, 967 Harrow Road,
Wembley, Middlesex HA0 2SF, England.

I enclose remittance of £ (US \$).....to cover the cost.

Name: _____

Please send me copies of the books as listed below:

Address to which books should be sent:

Prices include postage and packing (surface mail).

OIL & COLOUR CHEMISTS'



ASSOCIATION

Marine Finishes

Reprints are now available of the OCCA Monograph number 1 on Marine Finishes by Dr T. A. Banfield from the Association's offices. These bound copies reprinted from the February and March issues of the *Journal* cost £2 including post and packaging.

CHLORINATED POLYPROPYLENE
&
CHLORINATED POLYETHYLENE



It'll help you
in formulating
**High build chlorinated
rubber-type paints** for
Ships, Tanks, Bridges,
and other steel works,
with outstanding
exterior durability,
storage stability and
airless sprayability.

Try Superchlone for
your formulations.

For detailed information, please
contact:



Sanyo-Kokusaku Pulp Co., Ltd.
CHEMICALS SALES DEPT.

1-4-5 Marunouchi, Chiyoda-ku, Tokyo, Japan
Telex: J24279 SKPULP
Cable: SANKOKUPA TOKYO

Index to Brochure

1. **What is SYLOID?**
2. **The Advantages of SYLOID**
3. **The SYLOID Programme**
 - Pore Volume
 - Average Particle Size
 - Surface Treatment
 - Typical Data
4. **Matting with SYLOID**
 - Influence of the Pore Volume and the Average Particle Size on the Matting Efficiency
 - Right SYLOID Grade
5. **Dispersing SYLOID**
 - Dispersing with the Dissolver
 - SYLOID Concentrate and SYLOID Paste
 - Dispersion in Sand or Pearl Mill
 - Dispersion in Ball Mill and Three-Roll Mill
6. **SYLOID in Air-Drying Systems**
 - Guidelines for the Selection of the Right SYLOID Grade
7. **SYLOID in Stoving Systems**
 - Guidelines for the Selection of the Right SYLOID Grade
8. **SYLOID in Thin-Film Applications**
 - Leather Top Coats
 - Lacquers for Film and Sheet
9. **SYLOID in Water-Based Systems**
10. **SYLOID in High-Solids and Radiation Curable Systems**
11. **Other Applications**
 - SYLOID AL-1 and SYLOSIV: Moisture Scavengers for Paints Systems
 - SYLODEX: a Thickening and Thixotroping Agent
12. **SYLOID-Packaging, Storage and Handling**

SYLOID[®]

Matting Agent for Surface Coatings



GRACE

W. R. Grace Limited
 Davison Product Line
 Northdale House
 North Circular Road
 London NW10 7UH
 Tel: (01) 965 0611
 Telex: 25139

Colour makes reading beautiful!

Yes you read it correctly, colour makes reading beautiful. Our new brochure "SYLOID - matting of Paints and Varnishes" will prove it to you.

Tables and graphs are all in colour and this helps you to grasp the context at a quick glance. Interesting illustrations

bring the brochure to life and encourage your eyes to linger.

Information? The index, which is printed here on the top left hand side, gives you an idea what to expect.

The brochure, which makes reading beautiful, will be sent to you, obviously at no cost, just give us your name and address.

JOURNAL of the OIL AND COLOUR CHEMISTS' ASSOCIATION

Hon. Editor: D. S. Newton, AMCT,
CGIA, FICorrT, FTSC

Publications Committee:

J. Ambury
T. A. Banfield, PhD, DIC, ARCS,
FInst.CorrT, FTSC
H. I. Bosman, BComm, FTSC
J. Bourne, FTSC
T. Entwistle, CChem, FRSC, FTSC
A. W. Fell, BSc, AMCT, ATSC
C. N. Finlay, ATSC
S. R. Finn, BSc, CChem, FRSC, FTSC
H. R. Hamburg, PhD, FTSC
T. Harbottle
T. J. S. Henning
A. MacDonald, ATSC
W. MacDonald
D. V. Maltman
P. McCrudden
D. J. Morris
B. E. Myatt
A. J. Newbould, BSc, CChem, MRSC
F. D. Robinson, BSc, ATSC
T. W. Slinn, BSc, FTSC
F. M. Smith, BSc, PhD, CChem, FRSC,
CCol, FSDC, MIOP, FTSC
J. R. Taylor, BSc, CChem, FRSC, FTSC
E. G. Warman, FDISA
F. B. Windsor, ATSC

Editorial correspondence should be
addressed to the Hon. Editor, JOCCA,
Oil and Colour Chemists' Association
at the address below.

General correspondence should be
addressed to:

R. H. Hamblin, MA, FCIS,
Director and Secretary,
Oil and Colour Chemists' Association
at the address below.

Tel: 01-908 1086
Telex 922670 (OCCA G)
Telegrams: OCCA Wembley Telex

Assistant Editor: D. N. Buddles, BSc

Annual subscription to non-members:
£40.00 (\$100), post free by surface mail,
payable in advance.

Single copies £4.00 (\$10), post free by
surface mail, payable in advance.

Contents **Vol. 63 No. 12** **December 1980**

Transactions and Communications

The value of tributyltinfluoride as a toxicant in antifouling formulations	465
<i>F. H. de la Court</i>	
Partial allyl ethers of polyhydric alcohols as intermediates for water soluble vehicles	474
<i>N. Krishnamurti, M. M. Shirsalkar and M. A. Sivasamban</i>	
Electrodeposition: anodic versus cathodic	482
<i>H. U. Schenck and J. Stoelting</i>	
Applied finishes for timber in exterior situations in New Zealand (Short Communication)	492
<i>C. Gooch</i>	
<i>OCCA Meetings</i>	496
<i>News</i>	497
<i>OCCA News</i>	502
<i>Association Notices</i>	505
<i>New members</i>	511
<i>OCCA Diary</i>	511
<i>Indexes - Authors</i>	513
<i>Keywords</i>	514
<i>Subjects</i>	517

© Copyright 1980

ABC

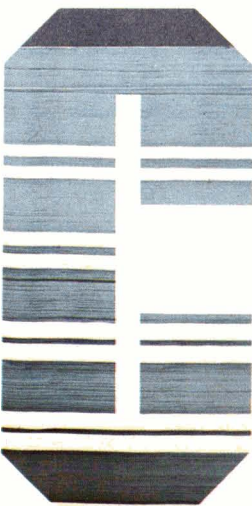
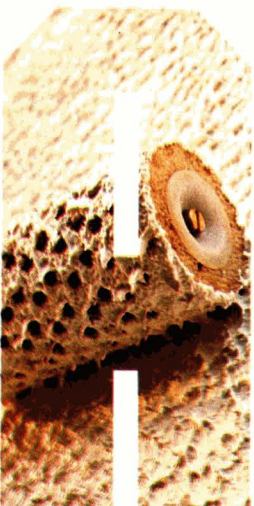
OIL AND COLOUR CHEMISTS' ASSOCIATION
Priory House, 967 Harrow Road, Wembley, Middlesex, HA0 2SF England

The Honorary Editor, the Council and the Oil and Colour Chemists' Association do not accept responsibility for opinions expressed by correspondents or contributors to this Journal. The contents of the Journal are copyright and permission to reproduce Transactions and Communications, in full or in part, must first be obtained from the Honorary Editor

GOOD YEAR
CHEMICALS

PLIOLITE®

**A new line of polymers.
Unique binders for high performance
exterior coatings.**



Write or call:
Mme Manceau
Compagnie Française GOODYEAR
European Chemical Division
Avenue des Tropiques
B.P. 31
91941 Les Ulis Cedex
Tél. (6) 907.72.41
Télex : 692895

Trade-mark
The Goodyear Tire & Rubber Company
Akron (Ohio) USA.

The value of tributyltinfluoride as a toxicant in antifouling formulations

By F. H. de la Court

Paint Research Institute TNO, Delft, Netherlands

Summary

In this paper results are discussed of investigations into the use of tributyltinfluoride (TBTF) as a toxicant in antifouling paints. The results confirm the leaching mechanism proposed in an earlier paper: fast conversion of TBTF into a toxic product followed by diffusion of this product into the seawater which governs the leaching. However, the critical leaching rate necessary to kill algal spores and barnacle larvae appeared to be much higher than originally estimated. These rates, $4 \mu\text{g}/\text{cm}^2/\text{day}$ to kill barnacle larvae and $9 \mu\text{g}/\text{cm}^2/\text{day}$ for algal spores, are a great disadvantage to formulating longlife anti-

fouling paints, e.g. to bridge the period of 2.5 years between the drydocking of a ship. It has been shown in this paper that this cannot be overcome by using thicker coats or by changing the paint formulation, which is in agreement with the diffusion mechanism.

Where, however, such longlife anti-fouling protection is not a prerequisite e.g. in the case of yachts, TBTF is a versatile biocide which can easily be used in combination with other coating materials.

Keywords

Types and classes of coatings and allied products
antifouling coating

Raw materials for coatings
biologically active agents
organo tin

Processes and methods primarily associated with
analysis, measurement or testing
raft test

Properties, characteristics and conditions primarily associated with

materials in general
toxicity

dried or cured films
film thickness
leaching

La valeur de tributylfluoride d'étain en tant qu'agent toxique en peintures "anti-fouling"

Résumé

Dans cet exposé on a discuté les résultats des études sur l'emploi de tributylfluoride d'étain (TBTF) en tant qu'agent toxique en peintures "anti-fouling". Ces résultats confirment le mécanisme d'extraction proposé dans un exposé paru il y a un certain temps: d'abord une conversion rapide du TBTF à un produit toxique, suivie par la diffusion de ce produit dans l'eau de mer, et c'est ce processus qui contrôle l'extraction. Toutefois, la vitesse critique d'extraction qui est nécessaire à tuer les zoospores d'algue et les larves de bernacle paraît beaucoup plus élevée que l'on a prévu au début. Ces vitesses: $4 \text{ g}/\text{cm}^2$ par jour pour tuer les larves et $9 \text{ g}/\text{cm}^2$ par jour pour les zoospores sont un grand inconvénient en mettant au point les peintures "anti-fouling" à

longue durée, par exemple pour couvrir l'intervalle de 2.5 ans entre chaque mise en cale sèche du navire. On démontre dans cet exposé que l'on ne peut pas surmonter cet inconvénient en servant des couches plus épaisses ou en modifiant la composition de la peinture. Cette observation est en accord avec le mécanisme de diffusion.

Cependant, où une telle protection de longue durée n'est pas nécessaire au préalable, par exemple dans le cas des yachts, le TBTF est un biocide polyvalent qui peut être utilisé avec facilité en combinaison avec d'autres constituants de revêtements.

Der Wert von Tributylzinnfluorid als Giftstoff in Rezepturen für Antifoulingfarben

Zusammenfassung

In diesem Vortrag wurden die Resultate von der Untersuchung zu der Benutzung von Tributylzinnfluorid als Giftstoff in Antifoulingfarben diskutiert. Diese Resultate bestätigen den Auslaugmechanismus der in einem vorherigen Vortrag vorgeschlagen wurde: erstens eine schnelle Umwandlung des Tributylzinnfluorid (TBTF) in einen Giftstoff und dann folgt die das Auslaugen beherrschende Diffusion dieses Produktes in Seewasser. Aber die kritische Auslaugeschwindigkeit die nötig ist um die Algenzoosporen und Bernickellarve zu töten, schien viel höher als was zuerst geschätzt wurde. Diese Geschwindigkeiten, $4 \text{ g}/\text{cm}^2$ pro Tage für die Larve und $9 \text{ g}/\text{cm}^2$ pro Tage für die Zoosporen, sind ein wichtiger Nachteil bei der Formulierung

der dauerhaften Antifoulingfarben, die während des Zeitraums von 2.5 Jahren zwischen jeder Schiffrockendocking dauern kann. Man hatte in diesem Vortrag gezeigt dass dieser Nachteil nicht überwunden werden kann indem man entweder dickere Schichte oder andere Rezepturen benutzt. Dies ist in Übereinstimmung mit dem Diffusionsmechanismus.

Wenn, jedoch, solch ein dauerhafter Antifoulingsschutz keine Vorbedingung ist, z.B. im Falle der Yachten, dann ist TBTF eine vielseitige Biocide, die in Zusammensetzung mit anderen Beschichtungsmitteln leicht benutzt werden kann.

Introduction

Refs. 1,2

The leaching mechanism of some organotin-toxicants from antifouling paints has been discussed in an earlier paper¹. It appeared from the results that one of the most promising biocides was tributyltinfluoride (TBTF). Because these were the first results of an extensive research programme, conclusions as to the real value of TBTF as a toxicant were preliminary and needed a more solid base. Therefore investigations were carried out to explore the possibilities to TBTF further.

Quite a number of papers² dealing with the use of TBTF have already been published. However, this study is concerned with the investigation of systematically formulated paints, by using a well controlled rotor-ageing technique combined with fouling tests to determine the resistance against algal and barnacle growth. At the same time, analysis of the residual tin was carried out to determine leaching curves. In most of the other studies this combination of tests was not used.

By using this combination it was hoped to obtain as much useful information as possible with regard to the relationship between formulation, leaching rate and fouling growth, a relationship about which very little is known.

The rotor-ageing technique, fouling tests and the analysis of tin content are described in Appendix 1. to this paper. The investigations were carried out according to the procedures described in this appendix, unless stated otherwise.

The real value of a toxicant in antifouling paints is determined by two factors:

- (i) The potential toxicity or, in other words, the concentration of toxicant in the seawater necessary to kill e.g. algal spores and barnacle larvae.
- (ii) The ability to regulate the leaching rate from the paint film, such that this concentration is maintained as long as possible.

It was concluded in an earlier paper¹ that 1.5 µg Sn/cm²/day of TBTF seemed sufficient to prevent fouling and that leaching can be effectively adjusted by changing the paint composition.

This study looks into both factors thoroughly and the results are discussed in this paper in order to see whether these preliminary conclusions still hold.

Theoretical

Ref. 1

As has been outlined before¹ the leaching of TBTF occurs in two consecutive stages. First a conversion takes place and then toxic degradation products are transported by diffusion according to the equation:

$$\ln V = \ln V_0 - K.t \dots\dots\dots (1)$$

where:

- V = the leaching rate of toxic agent from the paint matrix at time t after the beginning of rotor-ageing
- V₀ = the initial leaching rate
- K = a constant for the film under investigation.

V₀ as well as K are complex functions of the film thickness l and the diffusion coefficient D (Appendix 2.).

Equation 1. appeared to hold well for the six formulations investigated. From the point of view of fouling protection the ideal situation for Equation 1. would be a straight line parallel with the time-axis, because the leaching rate would be constant.

Because V₀ and K are dependent on film thickness l and the diffusion coefficient D, a parallel line might be achieved by changing these two parameters (D may be changed by changing the paint composition).

With regard to this it can be predicted from diffusion theory that:

- V₀ will decrease slowly when l increases and D decreases
- K will decrease proportionally with increasing l.
- With decreasing D, K will decrease slowly.

Many formulations with TBTF were investigated and the leaching could always be described by Equation 1.

As has been outlined in Appendix 1. during rotor-ageing residual amounts of Sn in the paint film were determined and from these a leaching curve was drawn. From this curve V was determined and plotted logarithmically against time. Because different compositions can be compared more easily in this way, only these plots will be used in this paper.

The critical leaching rate of TBTF

Ref. 4

The critical leaching rate of a biocide, defined as the minimum rate necessary to prevent fouling, has to be regarded as insufficient to guarantee the effectiveness of a biocide⁴. This is because in fact, a minimum concentration (C₀) of the biocide in the seawater at the interface with the film surface is the determining factor in preventing fouling. The biocide is removed from this surface however, by diffusion or mass-transfer into the bulk of the seawater. On the other hand it does diffuse from the paint film to the interface at a certain leaching rate. Thus C₀ depends on two processes of which leaching is only one.

C₀ however is not entirely suitable for measuring the potential toxicity of a biocide, this is due largely to the time and expense involved in its determination. Most investigators therefore use the critical leaching rate.

The critical leaching rate for TBTF has been determined from experiments in which paints of different compositions were aged using the rotor technique and subsequently raft tested. During rotor-ageing the leaching of Sn was also determined. From the curves obtained leaching rates were determined for the test-panels exposed on the raft. The fouling growths observed were plotted against the leaching rates in Figure 1. This was done for "algae" (*Enteromorpha*) and "barnacles" (*Balanus balanus*).

Above about 9 µg Sn/cm²/day no algal fouling occurred. For barnacles the limit was about 4 µg/cm²/day. Below these critical rates fouling occurred, however not in every case. This reflects the difficulties as mentioned at the beginning of this chapter. Though the leaching rate is

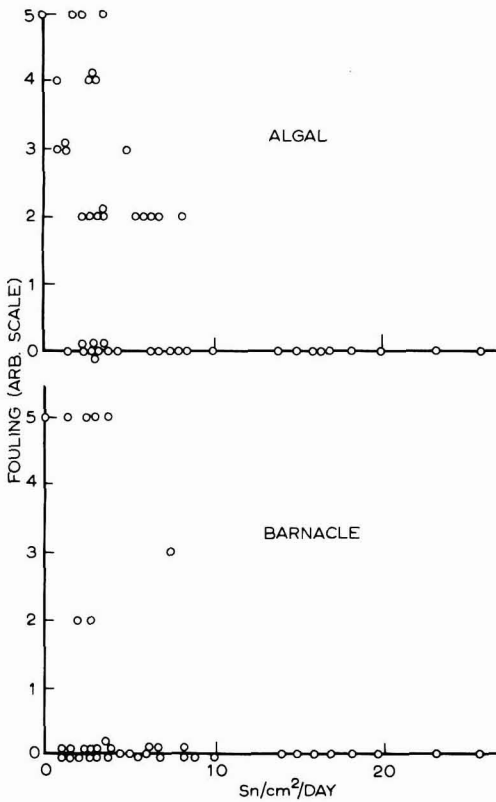


Figure 1. Fouling/leaching rate

below the limits as indicated, it may be high enough to maintain the minimum concentration (C_0) necessary when the transport of biocide from the boundary layer is low enough. Because the water flow along the panels depends on their position on the raft, the tide etc, low flow rates will occur causing lower transport from the interface. On the other hand higher flow rates will also occur, the leaching rate may then not be sufficient to maintain the C_0 .

Above the critical limits, the leaching rate seems high enough to compensate for the different transport rates occurring under the stationary conditions on the raft.

The critical leaching rates of 4 and $9 \mu\text{g Sn/cm}^2/\text{day}$, are the lowest rates determined under dynamic conditions, above which, under stationary conditions, no fouling will occur. This is a very useful practical measure because the uncertain hydrodynamic situation during the fouling test did not increase fouling. Because TBTF contains about 40 per cent Sn, the leaching rates 4 and $9 \mu\text{g Sn/cm}^2/\text{day}$ are equivalent to about 10 and $22 \mu\text{g TBTF/cm}^2/\text{day}$. An antifouling paint with about 25 per cent by weight TBTF contains, in a film-thickness of $100 \mu\text{m}$, about $1450 \mu\text{g TBTF/cm}^2$. Taking into account the leaching rates necessary this means that, assuming a constant leaching rate, such a paint will provide protection against algae for about 70 days and against barnacles for about 150 days.

In the same way it can be estimated that a paint with 33 per cent TBTF gives protection for about 90 and 190 days respectively. Obtaining longer protection by increasing the amount of TBTF in the paint is not an attractive proposition because 33 per cent by weight of TBTF is equivalent to about 40 per cent by volume and higher concentrations would lead to "bad" paint and film properties. Furthermore it would be very costly.

To increase the effective life time therefore, the only approach worth investigating is (ii) namely: improving the leaching rate time curve by changing the film thickness l and the diffusion coefficient D .

Leaching rate and film thickness l

Ref. 4

Three formulations of different compositions (Table 1.) were investigated at various film thicknesses. The leaching rate time curves are shown in figures 2a., 2b. and 2c.

The influence of l can be seen in two of the three cases.

Table 1

Raw materials*	Paint		
	1	2	3
TBTF	30	40	40
Alloprene R20	39		25
Vinylite VYHH		41	
Rosin WW	13		16.5
Diphenylkresylphosphate	8	6	6
Zinc oxide	10	6	11.5
Inert pigments		5.5	
Thickener		1.5	1

* per cent by volume

Another example of the influence of l has been reported in an earlier paper⁴. The effect of l however, is never such that an almost constant leaching rate is obtained, higher than the critical rate necessary and also remaining constant for long periods. Higher film thicknesses than those investigated may lead to the desired result but are rather impractical.

Leaching rate and paint formulation

Refs. 2b, 4

As has already been pointed out, the second proposition for obtaining the required leaching rate time curve, is to change the diffusion coefficient D by changing the formulation.

The binder

To investigate the influence of the binder on leaching, paint number 1. (Table 1.) was formulated with nine different binders. The amount and type of the other raw materials was kept the same.

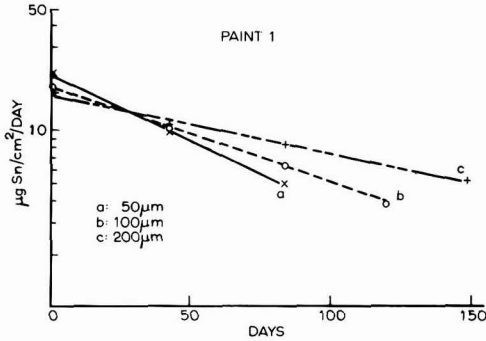


Figure 2a. The leaching rate time relationship for Paint 1 at three film thicknesses

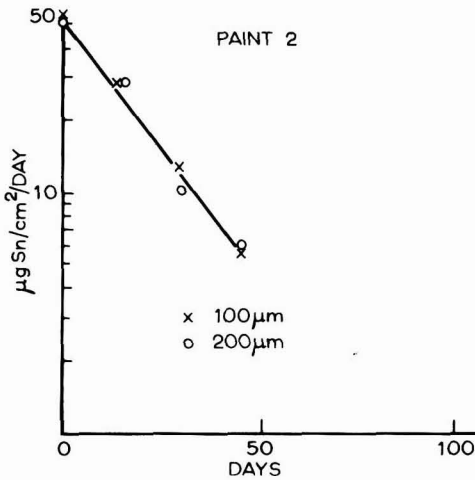


Figure 2b. The leaching rate time relationship for Paint 2 at two film thicknesses

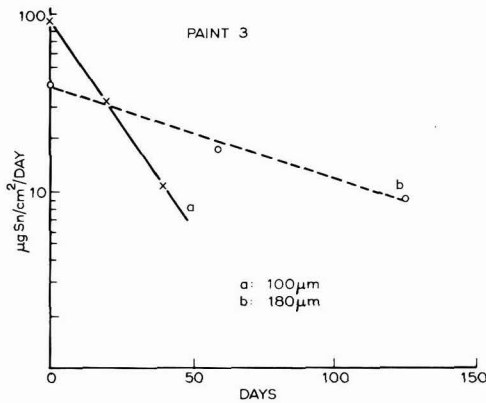


Figure 2c. The leaching rate time relationship for Paint 3 at two film thicknesses

The following binders were used:

vinylchloride-vinylacetate	Vynlite VYHH, VAGH and VYHD (ex Union Carbide); Vinnol H 40/60 (ex Wacker Chemie)
chlorinated rubber	Alloprene R20 (ex ICI)
vinylchloride-vinylisobutylether	Laroflex MP 35 (ex BASF)
acrylics	Paraloid B72 (ex Rohm and Haas) Neocryl B 725 (ex Polyvinyl Chemie)
vinyl toluene-acrylic	Pliolite VTAC (ex Goodyear)

The paints were investigated at thicknesses of about 50 100 and 200 µm.

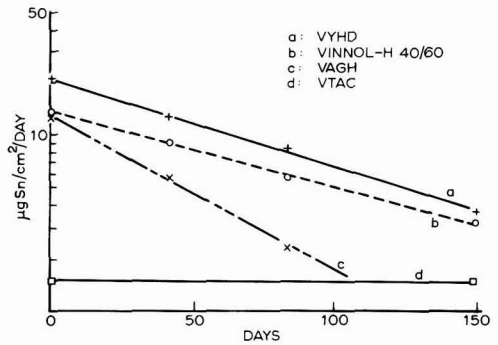


Figure 3. The leaching rate time relationship for Paint 1 with different binders, l = 100µm

In Figure 3, some characteristic examples of the leaching rate time curves obtained are shown. All the other curves were similar. As for coating thickness the same conclusions as above were drawn (under the sub-heading "Leaching rate and film thickness I"). The curves shown in Figure 3, were the most favourable of all coatings at 100 µm.

Four formulations with the binders Laroflex MP35, Paraloid B72, Neocryl B725 and Pliolite VTAC, had very low constant leaching rates (Figure 3.d.).

Obviously these binders decrease K in Equation 1, to a very low value. Unfortunately V_0 also decreases to a very low value (1-2 µg Sn/cm²/day) so that algae and barnacles grew on these formulations within 12 weeks.

The formulation with VYHH also leached at a constant rate, however, this was at a somewhat higher level (about 4 µg Sn/cm²/day). In accordance with the "critical rates" algae grew on this paint within 12 weeks but it remained free from barnacles for at least 36 weeks. For the remaining four binders, Alloprene R20, VAGH, VYHD and Vinnol H40/60, it was apparent that one binder was sometimes more effective than another, however, this made little difference because all leaching rates soon fell below the critical limit for algae and after some time also below that for barnacles. Within 12 weeks therefore all four had lost their algal resistance. Within 24 weeks the formulations

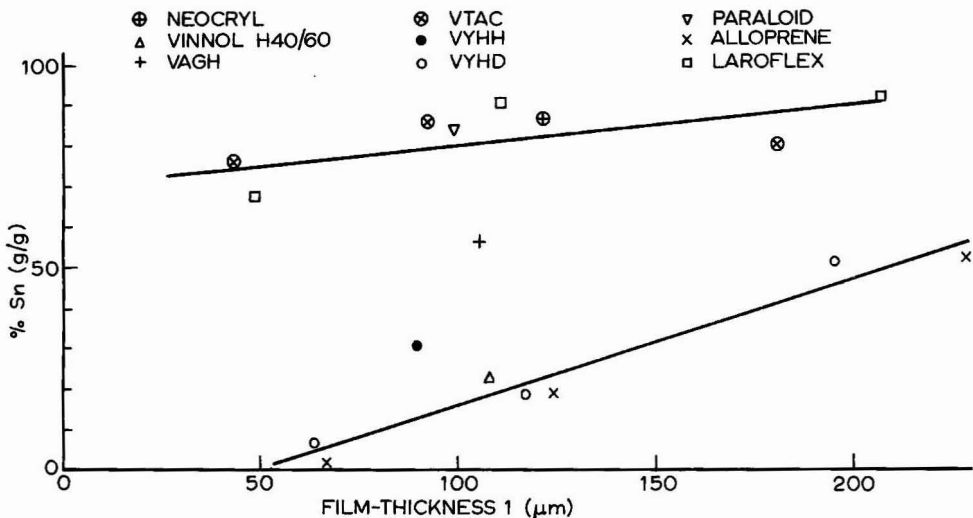


Figure 4. Residual percentage of Sn in paint film after 250 days rotor ageing

with VAGH and VYHD had lost their barnacle resistance, only Alloprene and Vinnol lasted up to about 36 weeks.

The separation of the binders into two groups can be observed in Figure 4. In this figure the residual amounts of Sn in the films after 250 days rotor-ageing were plotted against the original film thicknesses. Obviously the first group of binders causes the diffusion to be very low, giving a very low leaching rate. As a consequence high amounts of TBTF remained in the paint after 250 days.

The second group, consisting of Alloprene R20, VYHD and Vinnol H40/60, lost TBTF from the thin coatings rather easily, but when l was increased considerable amounts of TBTF remained in the paint coatings, unusable because the leaching rate then was too low to protect the surface against fouling. Two binders, VYHH and VAGH, have an intermediate position between the two groups.

The problems of the leaching of TBTF seem not to be restricted to solvent based systems but are the same with water-based formulations. To illustrate this the formulations (paints 4, and 5.) in Table 2, were investigated. Both were water-thinnable emulsions. The epoxy resin and the

amine were not mixed in an equivalent amount in order to enable the tin compound to diffuse from them more easily.

The leaching rate time curves are shown in Figure 5. As can be seen a small change in the epoxy/amine ratio changes the leaching pattern completely. Paint 4, lost all TBTF within 90 days and was not resistant to fouling after this period.

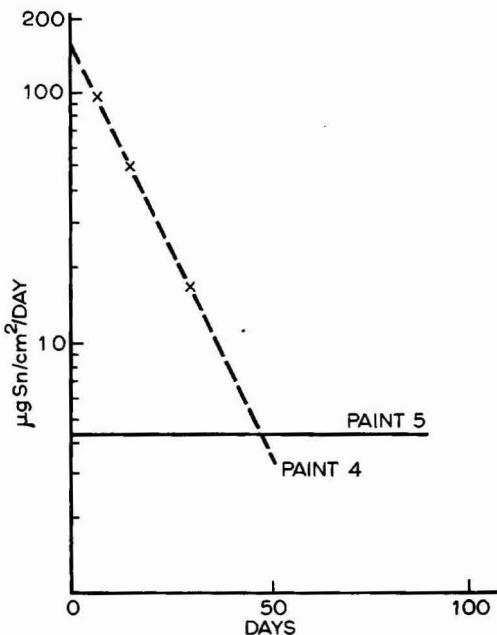


Figure 5. The leaching rate time relationship for two water based epoxy paints, l = 100 µm

Table 2

Raw material*	Paint	
	4	5
TBTF	46	47
Epikote 255†	29	26
Epilink 360 (100% solids)‡	13	15
Zinc oxide	12	12
Emulsifier	0.4	0.4

* per cent by volume † ex Shell ‡ ex AKZO

Paint 5. was still resistant to algae and barnacles after this period, though the constant leaching rate was only $4\text{--}5 \mu\text{g Sn/cm}^2/\text{day}$.

Rosin

In many antifouling formulations rosin is used to improve leaching of the biocide. The role of rosin in paints containing cuprous oxide has been demonstrated in another paper⁴.

That the presence of rosin is not a prerequisite for the leaching of TBTF confirms the results with paint 2. (Figure 2b.) and with the water thinnable compositions 4. and 5. (Figure 5.). It has been found, however, that when rosin is incorporated leaching can be increased. This is shown in Figure 6. in which, for Paint 3., V_0 and K are plotted as a function of rosin content. As can be seen, at about 10 per cent rosin V_0 as well as K increase sharply. This means that by increasing the rosin content above 10 per cent the initial leaching rate increases, but because K also

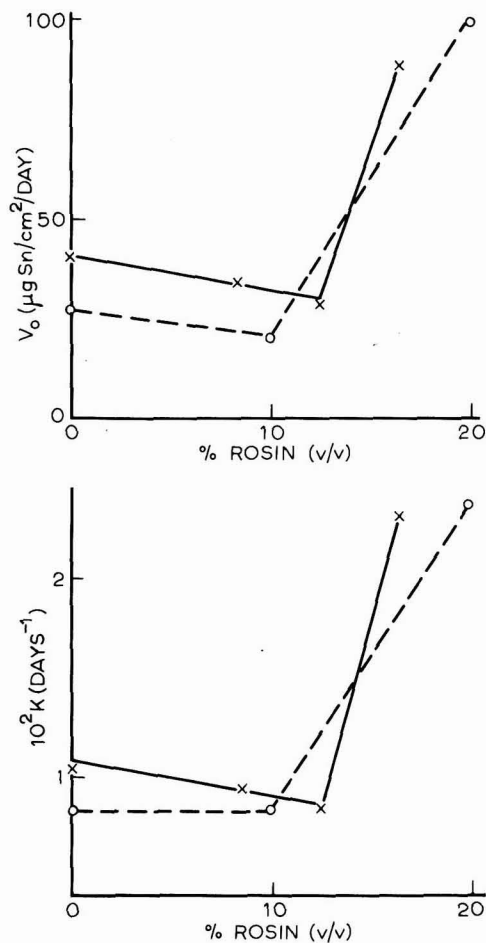


Figure 6. V_0 and K percentage rosin relations for paint 3(x) and a slightly different formulation (o), $l \approx 100 \mu\text{m}$

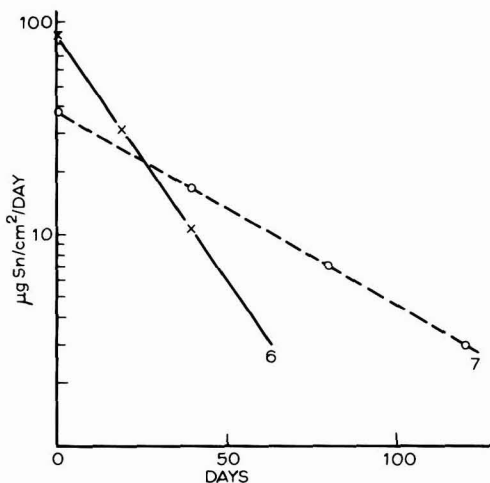


Figure 7. The leaching rate time relationship of one formulation with 11.5% ZnO (6) and 6% ZnO + 5.5% BaSO₄ (7) respectively

increases, this leaching rate will decrease rather fast. The initial advantage of a higher leaching rate is therefore soon lost. The same phenomenon has been observed with other formulations with different amounts of TBTF, different binders etc. Therefore it seemed possible to increase the leaching rate of the binders which retarded leaching so much. Ten per cent rosin was found to be approximately the critical amount.

The increase of V_0 and K must be due to an increased value of the diffusion coefficient D . This probably came about because incorporating rosin into the paint film increased the water content making diffusion easier, though the existence of a "critical amount" is not understood at present.

The pigment

The influence of pigment on leaching has not been examined systematically. From the literature^{2b} it must be concluded that such an influence could be important. One example is given in Figure 7. It shows the change in leaching pattern when zinc oxide is partly replaced by BaSO₄ in a formulation. The exact formations are given in Table 3.

Table 3

Raw material*	Paint	
	6	7
TBTF	40	40
Alloprene R20	25	25
Rosin w.w.	16.5	16.5
Diphenylkresylphosphate	6	6
Zinc oxide	11.5	6
BaSO ₄		5.5
Bentone 34	1	1

* per cent by volume

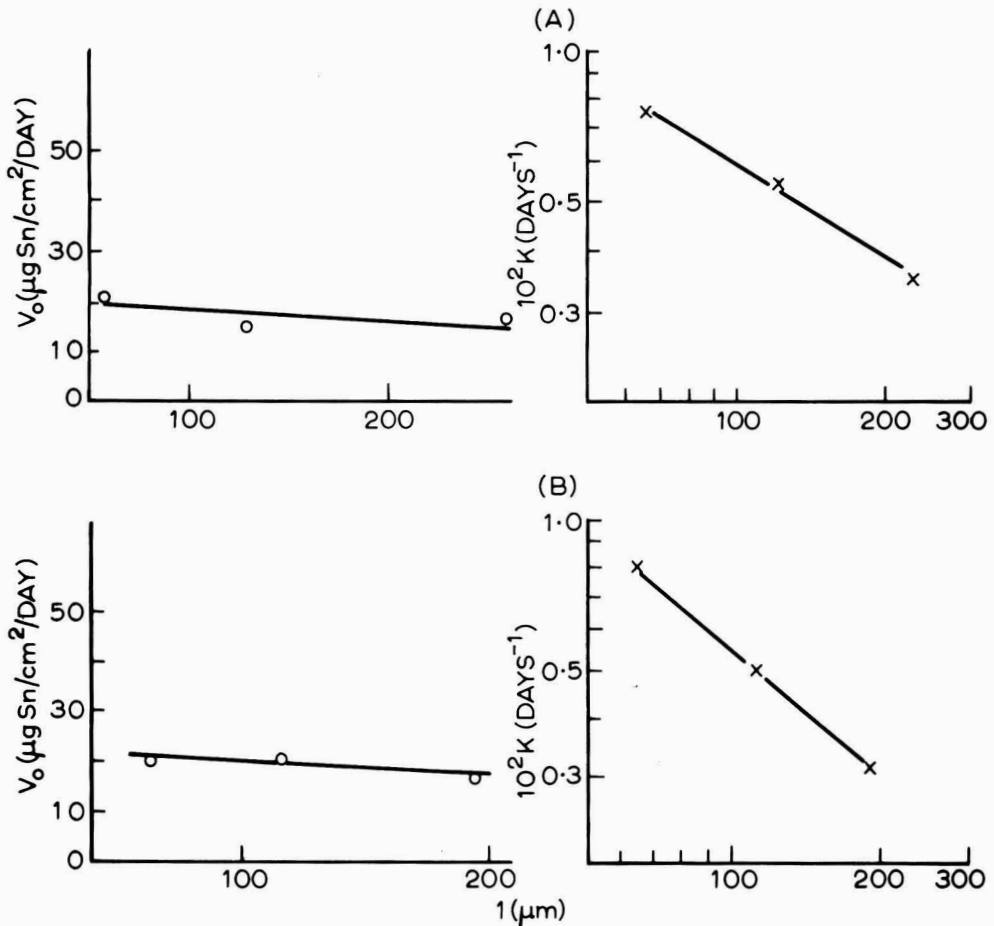


Figure 8. V_0 and K as a function of l for Paint 1 with: (A) alloprene R20 and (B) vinylite VYHD

Discussion

So far it is clear that the rather high critical leaching rate of $4 \mu\text{g Sn/cm}^2/\text{day}$ to prevent barnacle growth and $9 \mu\text{g Sn/cm}^2/\text{day}$ for algae, is a great drawback for TBTF as a biocide. As has been shown, at a constant critical leaching rate the protection time will be relatively short when the paints are applied at the usual thickness of $100 \mu\text{m}$.

The situation is made worse because in most cases the leaching rate is not constant but rapidly decreases below the critical rate. As has been pointed out before, theoretically, the means to overcome these problems are: increasing the film thickness l and adjusting the diffusion coefficient D by changing the formulation.

However, this does not seem to lead to the desired result, though generally speaking the leaching rate time curve could be changed according to the predictions made on the basis of diffusion theory.

This is illustrated by the relationship between l and V_0

and l and K with two different binders for Paint 1 (Figure 8.). It appears from this figure that for both binders V_0 decreases slowly with increasing l as has been predicted. Furthermore, K decreases with increasing l though strictly speaking, not proportionally.

From the figures for B, the time was calculated (at two thickness levels) when the critical leaching rates would run out for algal and barnacle protection. The results are given in Table 4.

Table 4
Number of days after which the critical leaching rate is no longer reached, at two levels of l .
Paint 1. (Figure 8B.)

l (μm)	V_0 ($\mu\text{g Sn/cm}^2/\text{day}$)	$K \cdot 10^2$ (days^{-1})	Days for	
			Algae	Barnacles
100	20	0.55	63	127
340	15	0.2	110	290

As can be seen from Table 4, the performance of the paint film is increased by increasing l to $340\ \mu\text{m}$. However, for ships with an interdock period of 2.5 years, the lifetime of such an antifouling paint is still very short. For ships lying partly stationary the lifetime of the paint may be for example 50 per cent longer, but this is still short with an impractically thick coat of $340\ \mu\text{m}$ as an additional disadvantage.

The influence of D on the leaching pattern cannot be shown from a plot of V_0 and K against D , because the latter is not known. However, while it is true that both increase with D , it may be interesting to plot K against V_0 . This has been done in Figure 9, for many TBTF paints regardless of their formulations and at a film thickness of about $100\ \mu\text{m}$.

As can be observed there is an unambiguous relationship between V_0 and K . K increases with V_0 , which must be expected when K and V_0 change with D as predicted. The scatter around the curve in this figure may be partly due to differences in practical film thickness. Because Figure 9, is based upon so many formulations with two levels of TBTF, many binders etc, it supports the general applicability of the leaching mechanism as has been described.

Obviously V_0 and K are interdependent and Figure 9, shows that at the desired value for V_0 of $10\ \mu\text{g Sn/cm}^2/\text{day}$ K will never be lower than $0.3 \times 10^{-2}\ \text{day}^{-1}$, which means that the leaching rate will be below the critical values after 15 and 130 days respectively.

When a higher initial leaching rate is chosen, K will also be higher and for this reason the time taken to reach the critical rate will not be increased enough to give long life performance, apart from the fact that the films will be exhausted sooner.

It appears therefore, to be impossible to improve the leaching rate time curve by changing D , to the extent that it becomes a straight line parallel to the time axis with the desired leaching rate above the critical value.

Besides the high critical leaching rates necessary, the diffusion mechanism of leaching of the TBTF prevents "long life" antifouling paints from being formulated (as with cuprous oxide paints). To circumvent the difficulties inherent in this mechanism, organo tin polymers may be used. Here the paint film gradually dissolves in sea water so that there is always a new toxic surface exposed to fouling organisms and this, at present, seems to be the only potential solution for considerably increasing the performance of antifouling paints.

Conclusions

TBTF is not a suitable biocide for incorporation into coatings with long lifetimes, e.g. to bridge the 2.5 year period between drydocking, because of the rather high critical leaching rates necessary to prevent fouling. This disadvantage can be overcome partly by changing the formulation or by applying thicker coats. For shorter periods, e.g. on yachts, it is a very suitable toxicant, which can easily be used in combination with all types of coating materials. The diffusion mechanism seems to be a problem common to all antifouling paints. It prevents paints being formulated which resist fouling growth for a long time. The only solution for this problem at present seems to be formulations where the paint matrix becomes water soluble, as is obtained with organo tin polymers.

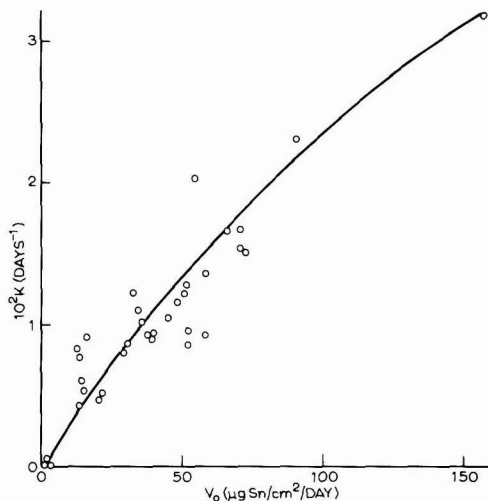


Figure 9. The relationship between V_0 and K at $l = 100\ \mu\text{m}$ for paint films, regardless of their formulation

Acknowledgements

Many of the results discussed in this paper were obtained within the framework of a joint research programme of the Research Organisation of Dutch Manufacturers of Ship Paints, M & T Chemicals B.V. Vlissingen and the Paint Research Institute TNO.

Furthermore results have been used in this paper which have been obtained in research programmes sponsored exclusively by M & T Chemicals B.V. Vlissingen. Thanks are due to these organisations for their permission to publish these results.

Finally thanks are due to F. W. Kielhorn, J. Roelofs and J. Hink of the Den Helder Laboratory, for carrying out so many of the experiments.

[Received 7 August 1980]

References

- de la Court, F. H. and de Vries, H. J., "Proceedings of the Congress on Marine Corrosion and Fouling", *Juan les Pins (France)* 1976, pages 113-118.
- a. Evans, C. J. and Smith, P. J., *JOCCA*, 1975, **58**, 160.
b. Nefgen, B. and Plum, H., "Proceedings Fatiepec congress, 1976", 462-466.
c. Ghanem, N. A., *JOCCA*, 1979, **62**, 142.
- Crank, J., "The Mathematics of diffusion", *Oxford University Press*, 1967, page 56.
- de la Court, F. H., "Third International Conference in organic coatings, science and technology, Athens 1977, Proceedings vol. 1 - Advances in Organic Coatings Science and Technol. Series", *Technomic Publishing Co Inc.*, Westport CT-USA, pages 170-188.
- de la Court, F. H. and de Vries, H. J., *JOCCA*, 1973, **56**, 388.

Appendix 1

Rotor procedure, analysis of total amount of tin and raft test

Rotor procedure

Paints to be investigated were applied by spray gun onto

aluminium test panels (8 × 15 cm), which had previously been coated with an anticorrosive primer.

The test panels were attached to the rotor-apparatus, a cylindrical drum rotating in seawater with a circumferential speed of 10 kn. (A picture of the rotor, which has a diameter of 50 cm, is shown in Reference 5.)

The test panels were rotated in natural seawater that was continuously renewed at a constant rate and at a nearly constant temperature. The seawater was controlled for pH (about 8) and salinity (about 2.8 per cent). After different ageing times, samples were taken for analysis for total tin content and tin distribution by cutting a piece (8 × 1 cm) from a panel especially rotated for analysis purposes. The remainder of the analysis panel was rotated further. Other panels were rotated, to be examined on the raft for antifouling resistance after each "ageing time". There were usually two panels each time.

Analysis of tin content

Of the small piece cut from the test panel, a piece (5 × 1 cm) was brought into the path of a neutron-beam of a nuclear reactor, to activate the tin that was present. The resulting radiation was counted and compared with the radiation of a standard sample with known tin content. From this, the amount of tin left in the aged film was calculated in mg/cm².

Raft test

To investigate the fouling resistance over a period of time, two panels were exposed on a raft in Den Helder harbour. One panel, horizontally, about 10 cm below the surface of the water to test for algae and the other panel, vertically, about 1.5 m below the surface to test for barnacles. In each case a non-toxic panel was also exposed in the same way. When the panels in the latter category were covered with growth, which took about six weeks, an assessment was made of the fouling on the paints being tested, and hence the effectiveness of the paints.

Appendix 2

Ref. 3

Diffusion of an organotin biocide from a paint film on a substrate

According to Crank³ the rate of loss of a diffusing substance from the surface of a plane sheet can be represented by:

$$-D \frac{\delta C}{\delta x} = \alpha (C_o - C_s) \dots \dots \dots (1)$$

where: C_s = the actual concentration just within the sheet
 C_o = the concentration just outside the sheet, required to maintain equilibrium with the surrounding medium
 α = a constant of proportionality

For the sheet 0 < x < l, with the face x = 0 impermeable, the solution of Equation 1. is given by the following expression:

$$\frac{M_t}{M_\infty} = 1 - \sum_{n=1}^{\infty} \frac{L^2 e^{-\beta_n^2 D t / l^2}}{\beta_n^2 (\beta_n^2 + L^2 + L)} \dots \dots \dots (2)$$

where:

M_t = the total amount of diffusing substance entering or leaving the sheet up to time t, depending on whether C_o is greater or less than the concentration in the film.

M_∞ = the corresponding quantity after infinite time
 β_n = positive roots of β tan β = L

$$L = \frac{l \cdot \alpha}{D} \text{ a dimensionless parameter.}$$

It is a reasonable assumption that this theory (for a plane sheet) applies to the leaching of an organo tin biocide from a paint film on a substrate and that this leaching progresses according to Equation 2.

Because β₁ is always much smaller than β₂, β₃ up to β_n, terms with β₂, β₃ up to β_n are always much smaller than the first term with β₁ and as a first approximation, may be neglected. Equation 2. then reduces to:

$$\frac{M_t}{M_\infty} = 1 - \frac{L^2}{\beta_1^2 (\beta_1^2 + L^2 + L)} e^{-\beta_1^2 D t / l^2} \dots \dots \dots (3)$$

By differentiating Equation 3. the diffusion rate is found:

$$\frac{dM_t}{dt} = \frac{M_\infty L^2}{(\beta_1^2 + L^2 + L)} \frac{D}{l^2} e^{-\beta_1^2 D t / l^2} \dots \dots \dots (4)$$

or

$$\ln v = \ln v_o - K t \dots \dots \dots (5)$$

where: v = $\frac{dM_t}{dt}$

$$v_o = \frac{L^2 M_\infty}{(\beta_1^2 + L^2 + L)} \frac{D}{l^2} \dots \dots \dots (6)$$

$$K = \frac{\beta_1^2 D}{l^2} \dots \dots \dots (7)$$

Using the values of β₁ at different levels of L, as given by Crank³ (Table 4.2), predictions can be made with regard to changes in v_o and K due to l and D, as mentioned in the text. With respect to these predictions it has to be borne in mind that β as well as L are both dependent on l and D.

Partial allyl ethers of polyhydric alcohols as intermediates for water soluble vehicles

By N. Krishnamurti, M. M. Shirsalkar and M. A. Sivasamban

Regional Research Laboratory, Hyderabad-500009, India

Summary

High purity partial allyl ethers of trimethylol propane, glycerol and pentaerythritol were prepared. This was done with a view to their potential utility when designing water soluble, air-drying and alkali resistant vehicles suitable for electrodepositable coat-

ings. The products prepared were characterised by chemical and spectroscopic methods such as infrared and proton magnetic resonance spectroscopy.

Keywords

Processes and methods primarily associated with analysis, measurement or testing

spectroscopy
thin layer chromatography

application of coatings and allied products

electrocoating

Raw materials used in manufacture or synthesis of ingredients for coatings

allyl alcohol
epichlorohydrin
ether
glycerol
pentaerythritol

Les éthers partiels d'allyl alcool et des alcools polyhydriques en tant que produit intermédiaire pour des véhicules solubles dans l'eau

Résumé

On a préparé des éthers d'haute pureté d'allyl alcool et de triméthylolpropane, de glycérol et de pentaérythrit, en vue de leur utilité potentielle au cours de la mise au point des véhicules résistants aux alcalis, séchant à l'air, solubles dans l'eau, et qui

sont convenables pour revêtements à être électro-déposés. Les produits préparés de cette façon ont été caractérisés au moyens des méthodes chimiques ou spectroscopiques, telles qu'à l'infrarouge ou résonance magnétique protonique.

Partielle Allyläther von Polyolen als Zwischenprodukte zur wasserlöslichen Bindermitteln

Zusammenfassung

Hochreine partielle Allyläther von Trimethylolpropan, Glycerin und Pentaerythrit wurden hergestellt, weil man an ihre eventuelle Nützlichkeit für die Zusammensetzung der wasserlöslichen, luft-trocknenden, alkalibeständigen und für Elektrottauchlacke

geeigneten Bindermittel denkt. Die hergestellten Produkte wurden durch chemische und spektrometrische Methoden als Infrarot- und magnetische Protonenresonanzspektroskopie charakterisiert.

Introduction

Refs. 1-8

The success of water-thinned emulsion paints which generally give matt finishes has stimulated, in the past few years, a great deal of research into producing water-thinnable air drying coatings that will produce glossy finishes¹. Many attempts have been made to develop air drying water-thinnable glossy paints based on water soluble resins as media. These were prepared by reacting maleic anhydride with vegetable drying oils and converting the products into their water soluble salts². These maleinised oils gave glossy, but unsatisfactory paint films which yellowed on ageing and were sensitive to water. High molecular weight maleinised oils with slightly improved properties have been reported³ and are prepared by esterifying a styrene-allyl alcohol copolymer with drying oil fatty acids and reacting the resulting ester with

maleic anhydride. Later, alkyds with high acid values were developed⁴ which when neutralised with organic bases produced water soluble media. These were used to formulate glossy paints. Several other types of water soluble resin systems were developed based on vinyl modified maleinised oils, maleinised oil esters, adducts of polyol esters, bisphenol-A diglycidyl ethers, phenol novolak and ethylene oxide reaction products for use in formulating air drying and glossy paints. However, none of these resin systems gave acceptable drying and gloss. Moreover, some of these media are reported to exhibit hydrolytic properties and poor storage stability due to the presence of many ester linkages which hydrolyse in aqueous solutions. They also have limitations such as slow drying and poor colour retention.

The polyether-esters, derived from the allyl ether alcohols and dicarboxylic acids, have been reported to give solvent soluble air drying resins^{5,6} with good

resistance to elevated temperatures and discolouration by UV light as well as giving high gloss to the dried coating. The drying potential increases with the percentage of allyl ether groups present in the polymer molecule⁷. The incorporation of allyl ether linkages in the hydrolytically stable water soluble resins to obtain air drying and glossy paint films has been reported in a few patents⁸. However the information available therein is insufficient to help in their preparation or in designing products for a particular use.

In the present work, the preparation of water soluble resins based on partial allyl ethers of polyhydric alcohols has been taken up for study. The syntheses of partial allyl ethers of glycerol, trimethylolpropane and pentaerythritol were carried out and the purity of these compounds checked by thin layer chromatography (TLC). The products were characterised by chemical methods and also spectroscopic methods, namely, proton magnetic resonance spectroscopy (PMR) and infrared spectroscopy (IR). The designing of hydrolytically stable, air drying and glossy water soluble media based on these allyl ethers will be the subject of a subsequent paper.

Preparative methods

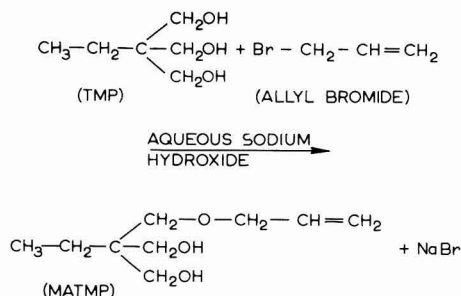
Refs. 9-12

The preparation of partial and complete allyl ethers of carbohydrates and other polyols is reported in the literature^{9,10}. Partial etherification has been carried out by reacting a polyhydric alcohol with allyl bromide in the presence of alkali. In the present work a modified method has been used to obtain better yields.

Monoallyl ether of trimethylol propane (MATMP)

In one set of experiments trimethylol propane (TMP) (135 g, 1.0 mole) was reacted with allyl alcohol (58 g, 1.0 mole) in the presence of sulfuric acid, as catalyst, to get a monoallyl ether of trimethylol propane (MATMP). The degree of conversion was not more than 10 per cent. The use of other catalysts such as hydrochloric acid, *p*-toluene and β -naphthalene sulfonic acids with longer reaction times did not improve the conversion of TMP to its monoallyl ether.

In another set of experiments, a procedure similar to that described by Nichols and Yanovsky⁹ was followed.



TMP (134 g, 1.0 mole) and freshly distilled allyl bromide (121 g, 1.0 mole) were placed in a 3 necked flask fitted with a stirrer, a condenser and a dropping funnel. The contents were heated to 70-75°C on a water bath and to this

60 per cent aqueous sodium hydroxide solution (44 g, 1.1 moles sodium hydroxide dissolved in 30 g water) was added dropwise through the dropping funnel over a period of 3 hours. The reaction was continued for another 2 hours to ensure completion. The sodium bromide which was formed in the reaction was filtered off. The monoallyl ether was extracted with diethyl ether, washed free of alkali, dried over anhydrous sodium sulphate and the ether stripped off. The crude allyl ether was fractionally distilled to obtain a pure product (yield 60 per cent).

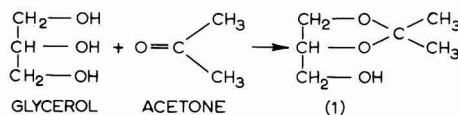
Diallyl ether of Trimethylol propane (DATMP)

This diallyl ether was prepared in the same manner except that for every mole of TMP, 2 moles of allyl bromide and 2.2 moles of sodium hydroxide were used instead. The yield obtained was 75 per cent.

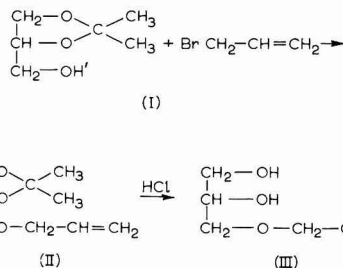
Monoallyl ether of glycerol (MAG)

This partial allyl ether was prepared by two methods. In the first method glycerol was directly reacted with allyl bromide in the presence of aqueous sodium hydroxide (55 per cent) solution. As the monoallyl ether of glycerol was fairly soluble in water, the washings were carried out using cold water (10°C) to prevent loss of product due to washing, and to remove the sodium bromide and alkali. The product was purified by fractional distillation under reduced pressure, to separate the di and triallyl ethers from the monoallyl ethers. The yields obtained by this method were, however, low (30-35 per cent).

In the second method 1, 2-*iso*-propylidene glycerol (1) was prepared first by reacting anhydrous glycerol (92 g, 1.0 mole) with dry acetone (145 g, 2.5 moles) using *p*-toluene sulfonic acid as catalyst, the water produced was removed azeotropically using chloroform¹¹.



The 1, 2-*iso*-propylidene glycerol was then reacted with allyl bromide (121 g, 1.0 mole) as described earlier. The resulting compound 3-allyloxy-1, 2-*iso*-propylidene glycerol (II) was then hydrolysed using cold 10N hydrochloric acid, as recommended by Fischer and co-workers¹².



The product MAG (III) was purified by fractional distillation under reduced pressure. The yields obtained by this process were well over 75 per cent.

Diallyl ether of glycerol (DAG)

This product was prepared by two different routes. In the first method epichlorohydrin (93.0 g, 1.0 mole) was reacted with allyl alcohol (116 g, 2.0 mole) in the presence of 50 per cent aqueous sodium hydroxide (40 g, 1.0 mole plus 40 g water), this was carried out at 100°C for a period of 5 hours. The product was extracted with diethyl ether, washed with water and distilled to obtain diallyl ether of glycerol. The yield obtained was however not very satisfactory (30 per cent).

In the second method, glycerol was reacted directly with allyl bromide in the appropriate mole ratio in the presence of 55 per cent aqueous sodium hydroxide solution as described earlier. Though the yields obtained by this method were 55.0 per cent, the purified product was found to contain a mixture of 1, 3- and 1, 2-diallyl ethers of glycerol in a ratio of 60:40 respectively. This ratio was estimated quantitatively by using the TLC method described later in this communication.

Diallyl ether of pentaerythritol (DAPE)

Two methods were tried in synthesising this partial ether. In the first method pentaerythritol (136 g, 1.0 mole) was mixed with allyl chloride (153 g, 1.0 mole) and refluxed at 50°C. Aqueous sodium hydroxide solution (55 per cent) was then added dropwise and the reaction continued at 50°C for almost 12 hours. However, 10 per cent was the highest conversion rate that could be achieved.

In the second method allyl bromide was used instead of allyl chloride and the temperature of the reaction was held at 80°C. The reaction was completed in five hours and the yield was 60.0 per cent.

Triallyl ether of pentaerythritol (TAPE)

TAPE was prepared by reacting pentaerythritol with allyl bromide by the procedure adopted by Nichols and Yanovsky⁹ as described earlier. The yield obtained was 65 per cent.

Purification and analysis

Refs. 13-15

All the partial allyl ethers, being liquids, were purified by repeated fractional distillation under reduced pressure. The purity of all the products was checked by thin layer chromatography on glass plates coated with silica gel G by the method described by Stahl¹³. For qualitative work, the thickness of the silica gel G used was 250 μm and for preparative work 500 μm . The solvent used was a mixture of *n*-hexane and ethyl ether in ratios of 50:50 and 40:60 respectively. The eluted chromatographic plate was developed in a chamber containing iodine crystals. Figure 1. shows the positions of the six allyl ethers on the TLC plate developed in a solvent system of *n*-hexane: ethyl ether (50:50 v.v.). The compounds from left to right are di and triallyl ethers of pentaerythritol, mono and diallyl ethers of trimethylol propane, and mono and diallyl ethers of glycerol.

The diallyl ether of glycerol gave two spots at retention factor values 72.0 and 66.0 corresponding to 1, 3- and 1, 2- isomers in solvent system *n*-hexane and ethyl ether (30:70 v.v.). The ratio of these two isomers was found to be 60:40 respectively when examined by densitometer.

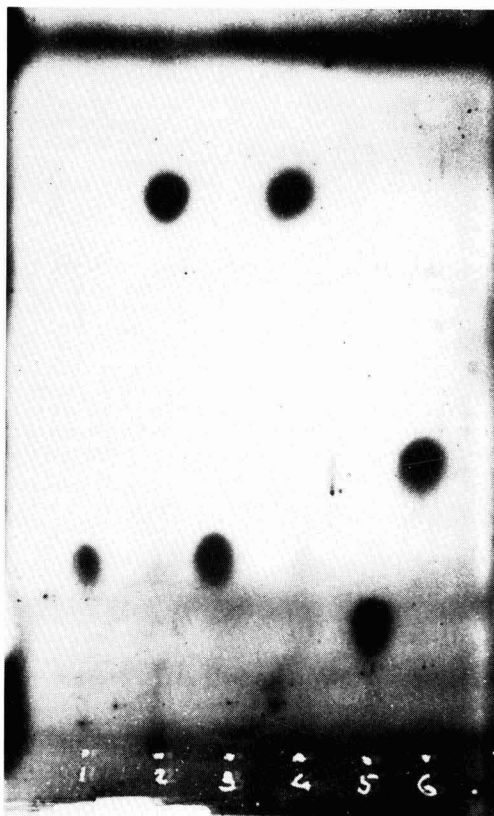


Figure 1. Thin layer chromatogram of partial allyl ethers. 1 = DAPE, 2 = TAPE, 3 = MATMP, 4 = DATMP, 5 = MAG, 6 = DAG

The physico-chemical characteristics such as boiling points³, refractive indices, TLC values ($R_f \times 100$), iodine values, and hydroxyl values are shown in Table 1. Iodine values of these allyl ethers were determined by the procedure described by Stanley¹⁴, in which pyridine sulfate dibromide was used as a halogenating agent. Hydroxyl values were determined using pyridine and acetic anhydride by the method described by Mehlenbacher¹⁵.

Characterisation

The products were characterised by their IR and PMR spectra. The IR spectra were recorded using a Perkin-Elmer (Model 221) spectrophotometer. The PMR spectra were recorded using a "Varian" 60 MC PMR spectrophotometer. All the spectra were recorded with neat liquid samples.

Infrared spectra of partial allyl ethers

The IR absorption spectra of the six partial allyl ethers are shown in figures 2. and 3. The broad peak between 3400-3440 cm^{-1} is due to O-H stretching vibrations in the partial allyl ethers. Similarly the O-H deformation vibrations and C-O stretching vibrations of these compounds are shown at 1340 cm^{-1} and 1020-1130 cm^{-1} respectively.

Table 1
Physico-chemical characteristics of partial allyl ethers

Allyl ether	Yield (%)	TLC values Rf × 100		Boiling point °C (mm Hg)	Refractive index (°C)	Iodine value		Hydroxyl value	
		(a)	(b)			Observed	Theoretical	Observed	Theoretical
MATMP	60	19.2	28.6	170-172 (10)	1.4572 (27.0)	147.0	146.0	643.7	644.8
DATMP	75	55.4	75.0	138-140 (10)	1.4515 (26.5)	239.2	237.4	258.0	262.1
MAG	75	8.5	14.3	150-151 (10)	1.4491 (29.0)	189.9	192.4	831.4	850.0
DAG	55	42.3	60.7	125-126 (10)	1.4444 (27.0)	293.5	295.4	320.0	326.2
DAPE	60	18.5	27.1	215-217 (15)	1.4598 (27.0)	237.0	235.2	505.1	519.4
TAPE	65	53.8	73.5	158-159 (10)	1.4572 (29.0)	295.1	297.7	216.6	219.1

Solvent system: *n*-hexane¹: Ethyl ether (a) 50 : 50 (v.v.) (b) 40 : 60 (v.v.).

The two peaks at frequencies 980 and 910 cm⁻¹ are due to the C-H out of plane deformation vibrations, (-CH=CH₂) of allyl ethers. The C-H in-plane deformation bands (-CH=CH₂) occurred in the region 1220-1260 cm⁻¹ and also at 1400-1420 cm⁻¹ for allyl ethers. The unsaturation due to the presence of allyl groups can be identified by the C-H and C=C stretching vibrations which occurred at bands 3020-3080 cm⁻¹ and 1620-1640 cm⁻¹ respectively.

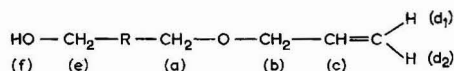
The correlation between the absorption maxima and the nature of the frequencies are shown in Table 2, which can be used to distinguish clearly between each group of monomers.

PMR spectra of partial allyl ethers

PMR spectra of the partial allyl ethers MATMP,

DATMP, MAG, DAG, DAPE and TAPE are shown in figures 4, 5, 6, 7, 8, and 9, respectively. The chemical shift values are reported in δ-values (ppm).

A partial allyl ether has the structural formula:



The protons corresponding to (b), (c), (d₁) and (d₂) of the allyl ether linkage are seen as multiples of an AMX₂ system. The X₂ part is represented by protons (b) and is split into a doublet by the adjacent olefinic protons (c). Each member of this doublet is further split by two olefinic protons (d₁) and (d₂) to give a multiplet in the region 3.8-4.1. The part 'A' is represented by the olefinic proton

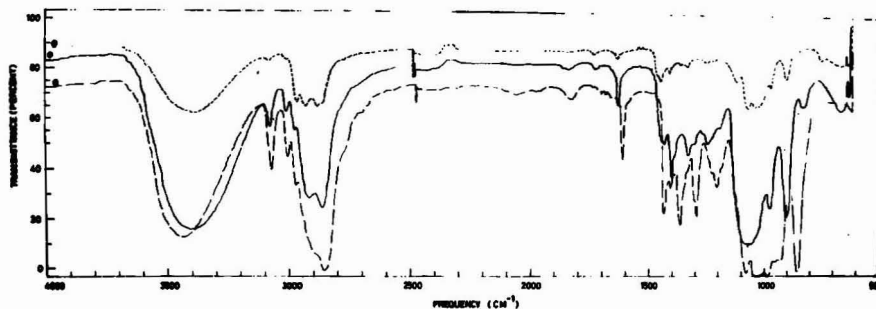


Figure 2. Infrared spectra of partial allyl ethers. From top to bottom MATMP, MAG and DAPE

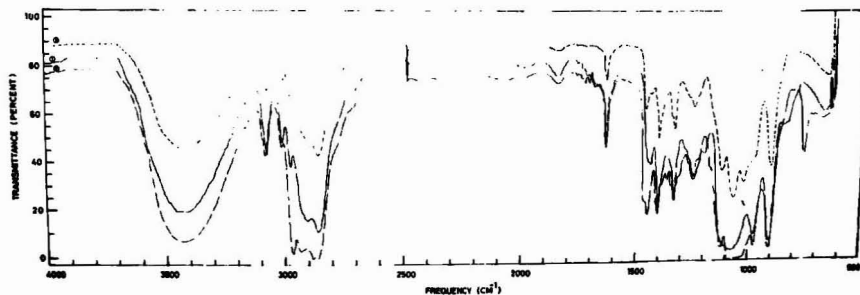


Figure 3. Infrared spectra of partial diallyl ethers. From top to bottom DAG, DATMP and TAPE

Table 2
Absorption frequencies in the infrared spectra of partial allyl ethers

*Nature of the vibration and functional group in brackets	Wavelength position of maxima (cm ⁻¹) for partial allyl ethers					
	1	2	3	4	5	6
O-H str. vb.	3400	3430	3400	3420	3420	3440
C-H str. vb. (-CH=CH ₂)	3080	3080 3020	3080 3020	3080 3010	3080 3020	3080 3010
C-H str. vb. (-CH ₂ -)	2970 2940 2880	2970 2940 2870	2980 2920 2860	2980 2910 2860	2910 2910 2860	2910 2910 2860
C=C str. vb. (Alkenes)	1640	1640	1640	1640	1640	1620
C-H df. vb. (-CH ₂ -)	1450	1450	1440	1440	1470	1440
C-H i.p. df. vb. (-CH=CH ₂)	1420	1410	1400	1400	1410	1370
O-H df. vb. (C-CH ₃)	1370	1370				
O-H df. vb.	1340	1340	1340	1340	1340	1300
C-H i.p. def. vb. (-CH=CH ₂)	1250	1260	1250	1250	1250	1220
C-O str. vb. (ethers)	1130 1080 1020	1120 1070	1080	1080	1130 1080 1030	1080 1030
C-H o.p. df. vb. (-CH=CH ₂)	980	980	980	980	980	980
C-H o.p. df. vb. (-CH=CH ₂)	910	900	910	910	910	910

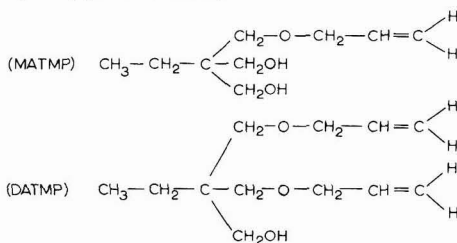
*Abbreviations: str = stretching, o.p. = out of plane, i.p. = in plane, vb. = vibration, df. = deformation. 1 = MATMP; 2 = DATMP; 3 = MAG; 4 = DAG; 5 = DAPE; 6 = TAPE.

(c) and is split by coupling with (d₁) and (d₂) and to the methylene protons (b) to give a symmetric 12 line pattern in the region 5.6–6.2. The MN portion is represented by the geminal protons (d₁) and (d₂). The two protons are coupled with each other, with the methylene protons (b) and with the olefinic protons (c) to give a multiplet in the region 5.0–5.4.

The methylene protons (a) being adjacent to a quarternary carbon atom in the case of MATMP, DATMP, DAPE, and TAPE, forms an A₂ system and thus registers as a singlet in the region 3.3–3.4.

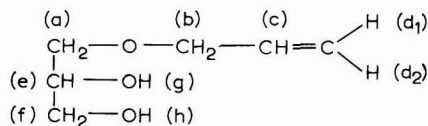
The methylene protons (e) of the primary alcohol present in compounds MATMP, DATMP, DAPE and TAPE are adjacent to a quarternary carbon atom and so appear as a singlet in the region 3.4–3.6. The proton signal corresponding to (f) is merged with that of (e) in the region 3.4–3.6. This assumption is supported by D₂O exchange.

In the case of mono and diallyl ethers of trimethylol propane (figures 4. and 5.)



the ethyl part is represented as an A₂ B₃ system in the PMR spectrum in which the CH₃ (a) and CH₂ (b) protons appear as distorted triplets and quartets at 0.7–1.0 and 1.1–1.5 respectively.

In the case of the monoallyl ether of glycerol (Figure 6.) the methylene protons (a)



being adjacent to the methine protons (e) appear as a doublet in the region 3.3–3.6. The methylene protons (f) which are also adjacent to the methine protons (e) should normally appear as a doublet, but as it merged with protons of (a), it appears as a singlet in the region 3.5–3.6. The carbinol (methine) proton (e) appears as a multiplet at 3.6–3.9 due to its coupling with methine protons (a) and (f). The signals of the protons (g) and (h) were merged together with those of (b) in the region 4.0–4.1; D₂O exchange resulted in the decrease of the proton integration corresponding to 2H.

Comparative characteristic positions of various proton signals in these six partial allyl ether alcohols are shown in Table 3.

The designing of hydrolytically stable, air drying and glossy water soluble media based on the above allyl ethers will be the subject of a subsequent paper.

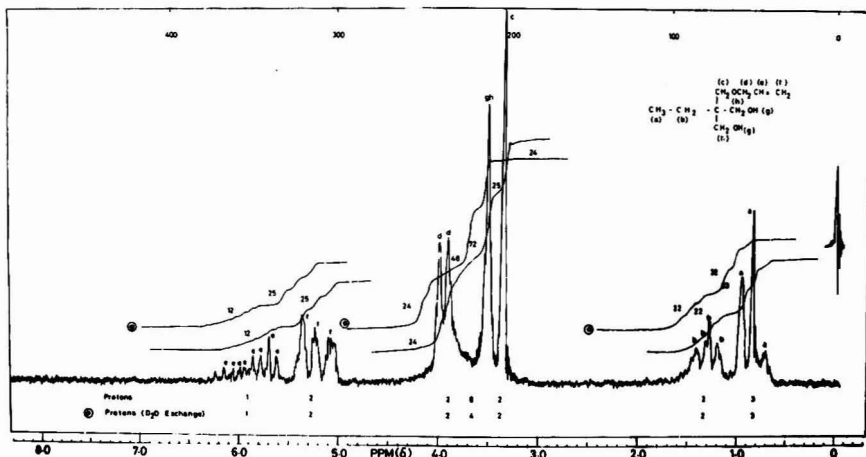


Figure 4. PMR spectrum of monoallyl ether of trimethylol propane

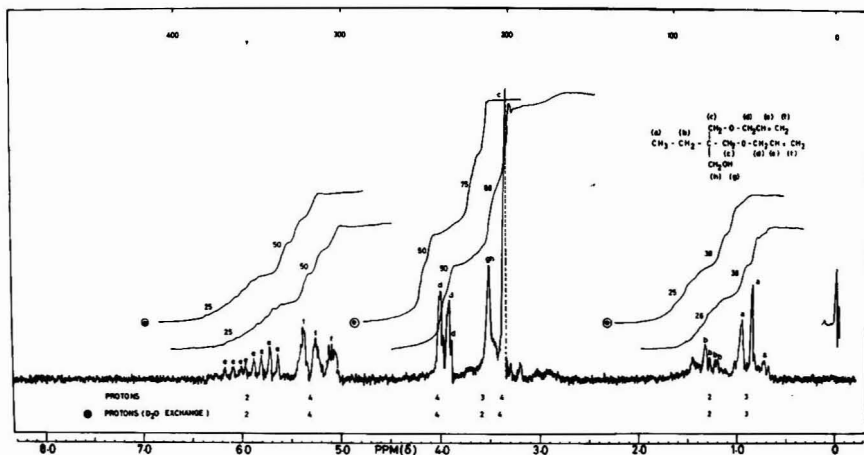


Figure 5. PMR spectrum of diallyl ether of trimethylol propane

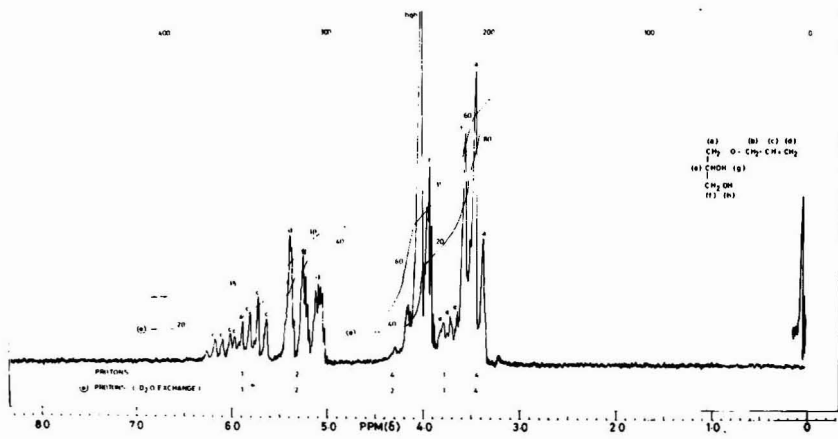


Figure 6. PMR spectrum of monoallyl ether of glycerol

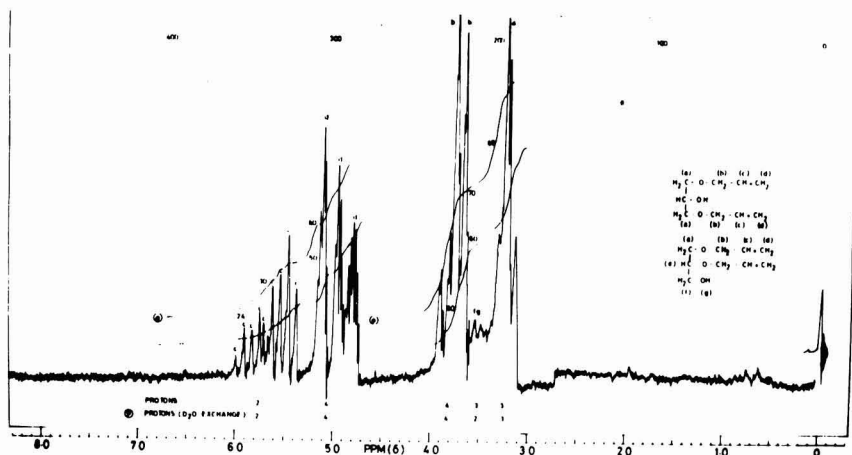


Figure 7. PMR spectrum of diallyl ether of glycerol

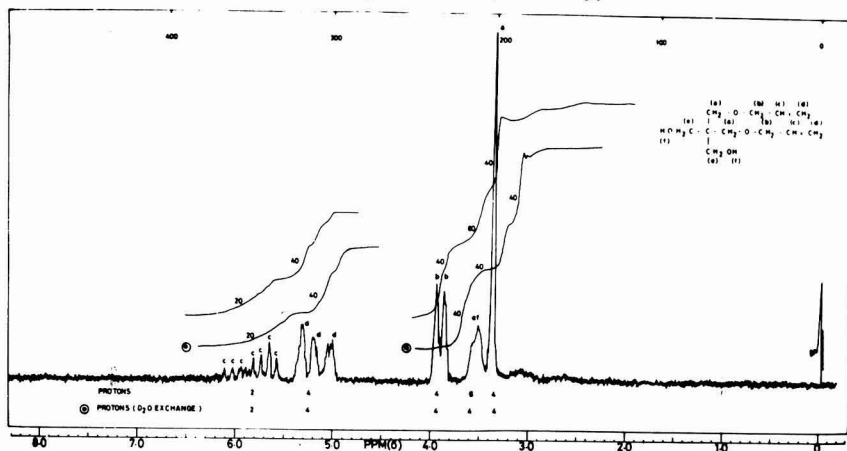


Figure 8. PMR spectrum of diallyl ether of pentaerythritol

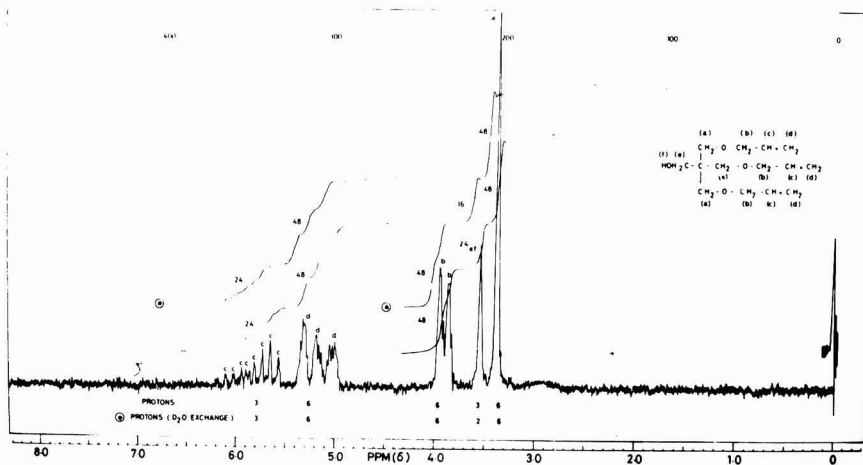


Figure 9. PMR spectrum of triallyl ether of pentaerythritol

Table 3
Characteristic positions of various proton signals, δ -values (ppm) in partial allyl ethers

Group (protons)	Partial allyl ethers (chemical shift values)					
	MAT	DAT	MAG	DAG	DAPE	TAPE
-CH ₃	0.7-1.0 (t)	0.7-1.0 (t)				
-CH ₂ -	1.1-1.5 (q)	1.2-1.5 (q)				
$\begin{array}{c} \\ -\text{C}-\text{CH}_2-\text{O}- \\ \end{array}$	3.3-3.4 (s)	3.3-3.4 (s)	3.3-3.6 (d)	3.2-3.4 (d)	3.3-3.4 (s)	3.3-3.4 (s)
-CH ₂ -OH	3.4-3.6 (s)	3.5-3.6 (s)	3.5-3.6 (m)	3.3-3.6 (m)	3.4-3.6 (s)	3.5-3.6 (s)
-CH ₂ -OH	3.4-3.6 (s)	3.5-3.6 (s)	3.4-3.6 (s)	3.3-3.6 (s)	3.4-3.6 (s)	3.5-3.6 (s)
-O-CH ₂ -CH=	3.8-4.1 (d)	3.8-4.1 (d)	3.9-4.1 (d)	3.6-3.9 (d)	3.8-4.0 (d)	3.8-4.0 (d)
-CH=CH ₂	5.0-5.4 (m)	5.0-5.5 (m)	5.0-5.5 (m)	4.7-5.2 (m)	4.9-5.4 (m)	4.9-5.4 (m)
-CH=CH ₂	5.6-6.2 (o)	5.6-6.2 (o)	5.6-6.2 (o)	5.3-6.0 (o)	5.5-6.2 (o)	5.5-6.1 (o)
$\begin{array}{c} \\ -\text{CH}-\text{OH} \end{array}$			3.6-3.9 (m)			
$\begin{array}{c} \\ -\text{CH}-\text{OH} \end{array}$			4.0-4.1 (s)	4.0-4.1 (s)		

s = singlet, d = doublet, t = triplet, q = quartet, o = octet, m = multiplet.

Acknowledgement

The authors are grateful to Dr D. S. Iyengar for his valuable suggestions in this work.

[Received 18 August 1980

References

- Hunt, T., *JOCCA* 1970, **53**, 380.
- US Pats., 2,188,883; 2,188,885; 2,262,923; 2,285,646.
- Hahn, F. J., Sullivan, M. R. and Steinhauer, S., *Off. Dig.*, 1965, **37**, 1251.
- Berger, Jenson and Nicholson Ltd. Brit. Pat., 1,013,933, (1965).
- Jenkins, V. F., Mutt, A. and Wicker, R. J., *JOCCA*, 1961, **44**, 42.
- Chatfield, H. W., *Paint Technol.*, 1962, **26** (4), 17.
- Miranda, T. J., *Off. Dig.*, 1965, **37**, 62.
- Distillers Company Ltd, Brit. Pats., 1,029,544, (1966); 1,048,060, (1966); 1,042,662, (1966);
- Nichols, P. L. (Jr) and Yanovsky, E., *J.Am.Chem.Soc.*, 1944, **66**, 1625. 1945, **67**, 46.
- Nichols, P. L. (Jr), Wrigley, A. N., and Yanovsky, E., *ibid*, 1946, **68**, 2020.
- "Final technical report of Project No. UR-A7-(40)-3", USDA, Washington DC, page 10.
- Fischer, E., Bergmann, M. and Barwing, E., *Ber.*, 1920, **53**, 1589.
- Stahl, E., "Thin layer chromatography, A Laboratory Hand Book", *Academy Press inc*, New York, 1965.
- Stanley, E. L., "Analytical Chemistry of Polymers part-1, High Polymer series", *Interscience Publishers inc*, New York, 1959, vol. 12, p. 1.
- Mehlenbacher, V. C., "The Analysis of Fats and Oils", *The Garrard Press Publishers*, Champaign, Illinois ed., 1960, p. 490.

Electrodeposition: anodic versus cathodic*

By H. U. Schenck and J. Stoelting

BASF AG, Kunststofflaboratorium, Ludwigshafen, Germany

Summary

Deposition mechanisms, the chemistry of binders and the properties of anodic and cathodic electrodeposition materials are compared. Investigations into the deposition mechanisms using the rotating disc electrode show the similarity of the

anodic and cathodic processes. The basic resin chemistry of the polymers is illustrated. The advantages of cathodic electrodeposition materials over the anodic ones are discussed with respect to properties such as corrosion resistance.

Keywords

Raw materials for coatings

oils

natural oil
synthetic oil

binders (resins, etc)

acrylic resin
epoxy resin
polyurethane
polyester resin

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

electrocoating

service or utility

corrosion

Electrodéposition: la déposition anodique comparée à la déposition cathodique

Résumé

On compare les mécanismes de déposition, la chimie des liants et les propriétés des matériaux obtenus par déposition anodique et cathodique.

Des essais faits avec l'électrode tournante révèlent la similitude des processus de déposition anodique et cathodique.

On discute la chimie des principaux types de liants. On expose les avantages offerts par les matériaux déposés cathodiquement, par exemple en ce qui concerne la protection contre la corrosion.

Elektrotauchlackierung: ein Vergleich anodisch gegen kathodisch

Zusammenfassung

Abscheidungsmechanismen, Bindemitteltypen und Eigenschaften von Lacken für die anodische und die kathodische Elektrotauchlackierung werden vergleichend beschrieben. Durch Versuche mit der rotierenden Scheibenelektrode wird die Ähnlichkeit des anodischen und kathodischen Abscheidvorgangs aufgezeigt.

Die Chemie der wichtigsten Bindemitteltypen wird diskutiert. Die Eigenschaften der kathodisch abscheidbaren Materialien z. B. hinsichtlich Korrosionsschutz werden erläutert.

Introduction

Refs. 1-4

One of the more important types of water soluble industrial coatings is used in electrodeposition. A large proportion of car-body primers are of this type and in addition a lot of smaller automotive parts and household appliances are coated by this process.

In recent years the situation concerning electrodeposition has changed somewhat with the impressive success of new cationic ED materials.

This success is undeniable, although in a review article

on the subject of coatings for "cathodic ED" written in 1974 it was said that "owing to the difficulties mentioned earlier, cathodic deposition and thus cathodic binders will find their outlet only for special purposes"¹.

In the sixties, anionic ED materials dominated the ED market, but by 1965 the first experiments were already being carried out to develop cathodically depositable resins². It was assumed that these products would offer substantial advantages over the anionic ones as shown in Table 1. The first resins described were cationic acrylics.

Cathodic ED first found application in the early seventies, in appliance coating and the smaller end of the automotive parts industry, such as wheels. This took place

*Presented to a meeting of the Manchester Section on 10 March 1980

Table 1

- Electrochemical oxidation of the resin at the substrate (which represents the cathode) is impossible, because there is no oxygen in the nascent state.
- Dissolution of metal ions from the substrate is avoided; therefore neither contamination nor discolouration of the paint film is caused by metal ions.
- Passivating layers on the substrate are not attacked in the alkaline medium surrounding the cathode; therefore better corrosion resistance can be expected.
- Cationic paint films are expected to protect the substrate well against the attack of alkaline agents.

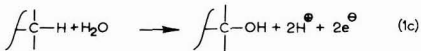
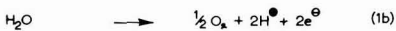


Figure 1. Possible reactions during anodic deposition

in the USA using cationic epoxies with capped isocyanate and hydroxy and/or amino functions for crosslinking³. In Europe the first cationic ED systems used were Mannich-base modified epoxy-phenolic resins⁴ for wheel coatings in Germany in 1975.

The introduction of cathodic ED into its most important area, that of car body primers, began in the USA in 1976 and in Europe in 1978-79. According to a rough estimate, nowadays more than 50 per cent of the automobiles which are coated with ED primers in the USA are coated by the cathodic process. This situation will be reached in Europe as well in a few years.

Comparison of deposition mechanisms

Ref. 5

The fundamental physical aspects of anodic ED and

cathodic ED are very similar and have been described by Beck in several publications⁵.

During anodic deposition several reactions are possible (Figure 1):

- Direct discharge of the carboxylate groups (1a)
- Electrolytic decomposition of water (1b)
- Oxidation of the binder (1c)
- Metal dissolution of the anode (1d)

All these reactions may take place at different rates depending on the process conditions. They take place in a thin diffusion layer next to the anode. Generally, the most important reaction is the decomposition of water (1b). Metal dissolution (1d) may be important with certain metals.

Resins for ED are coagulated from solution or the dispersion (Figure 2), mainly by converting the highly soluble carboxylate groups into the much less hydrophilic carboxylic acid groups (Figure 1.(1e)). The bases which are used for dissolving the binder remain in the electrodeposition bath. A method that is frequently employed to avoid a rise in pH, is the use of compensation material which is neutralised to a low degree only. Therefore the actual degree of neutralisation of the binder in the electrodeposition bath remains constant.

Coagulation of the binders may also be effected by multicharged metal ions. In this case ionic crosslinking occurs (Figure 1. (1f)).

Naturally the formation of metal cations depends strongly on the electrode material. Correspondingly, the extent to which the metal ions cause coagulation of the binder varies considerably. Most of the technically important metals do not contribute much in this respect.

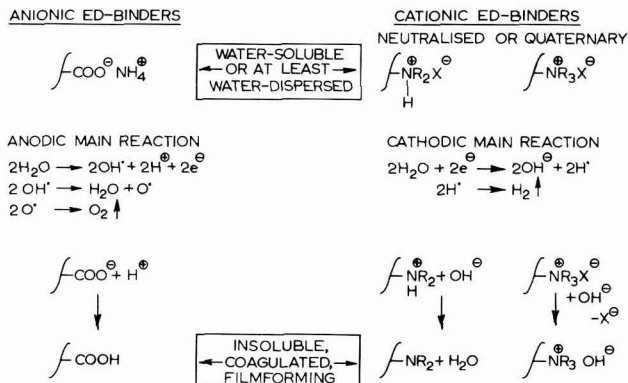


Figure 2. Comparison of deposition mechanisms

Resins for cathodic electrodeposition must be polymers which are soluble or readily dispersible in the acidic or slightly alkaline pH range of the paint bath but which coagulate in the very alkaline diffusion layer at the cathode. Suitable polymers are either polycations or neutral polymers kept in solution by cationic emulsifiers. The main reaction leading to cathodic deposition is the electrochemical decomposition of water, as is the case in anodic deposition.

Amine resins neutralised with acids are discharged by an acid-base reaction and lose their solubility.

Deposition is caused by the reduced solubility of the amine base compared with the amine salt. Whereas in the anodic deposition process dissolution of metal ions and oxidation reactions may contribute to the coagulation, in the cathodic deposition process the above-mentioned formation of OH⁻ ions is the only cause of deposition. Therefore very similar deposits are formed on different metals as found by Beck *et al.*⁵

Polymers dissolved by quaternary ammonium or phosphonium ions seem to be coagulated by the very high concentration of OH⁻ ions in the vicinity of the cathode (concentration coagulation).

By investigations with the rotating disc electrode Beck⁵ showed that for anionic ED resins there is a critical rotation speed n^* which is in agreement with the theory of an acid boundary layer.

With increasing speed of rotation the thickness of the diffusion layer and the concentration of protons at the anode surface decreases. At the critical rotation speed n^* the concentration of protons at the anode drops below the critical concentration which is necessary for resin coagulation and the deposition process fails to occur.

A linear relationship exists between n^* and the square of current density, n^* depends on the acid number of the polymer and the degree of neutralisation.

On the basis of the dependence of n^* on the concentration of free amine at constant current densities it is possible to calculate the pH value at the anode which is necessary for coagulation.

In addition to Beck's experiments, comparative investigations with cationic acrylic resins were made. Cationic resins as model substances were prepared as shown in Table 2.

They were neutralised to various degrees with acetic acid. In addition, quaternised products were prepared on the basis of some of the same resins. To this end the dimethylamino groups were fully quaternised with methyl iodide and the iodide ions exchanged by means of a strong anion exchange resin. The polymeric quaternary ammonium hydroxides were then fully neutralised with acetic acid.

On the basis of the neutralised ammonium group containing resins, 10 per cent aqueous solutions were prepared, if possible, and the deposition behaviour investigated at a platinum rotating disk electrode.

Figure 3. shows the results obtained with a cationic resin which had a 20 per cent content of neutralised dimethylamino ethyl methacrylate. A similar relationship was found for the other cationic resins. In contrast to Beck's results, these experimental points do not exactly fit the straight lines calculated by the least squares method. Nevertheless, the similarity of the results with those of Beck for anodic deposition is convincing. In both cases a linear relationship of n^* versus j^2 was found.

As is the case with anionic acrylics⁵, n^* also drops for cationic resins at constant current density with increasing degrees of neutralisation. This is because of the higher solubility of these resins. To neutralise the larger amounts of acid a higher concentration of hydroxyl ions in the boundary layer at the cathode is necessary. This can only be achieved if the rotation speed of the disk is lowered.

Figure 4. shows that in the case of cationic acrylic resins a similar dependence of n^* on the content of ionic groups in the polymers exists, as is the case with anionic resins.

A steady decrease of n^* with increasing ionic modification can be observed. This is due to the increasing solubility of the resins. Therefore they need an increasing concentration of protons, in the case of anionic resins, and hydroxyl ions, in the case of cationic modification, for coagulation and deposition to take place. It has been estimated that a fully neutralised product with more than about 30-40 per cent dimethylamino ethyl methacrylate, together with the above-mentioned co-monomers, cannot be deposited even if high current densities are used.

On the basis of all these results it can be assumed that the basic reactions which are responsible for anodic and cathodic ED are analogous.

Table 2
Model cationic polymers

Dimethylamino ethyl methacrylate	20	10	7.5	5	2.5
Styrene	40	50	52.5	55	57.5
Ethyl hexyl acrylate	20	20	20	20	20
Hydroxypropyl acrylate	20	20	20	20	20
Molecular weight (Mn)	4,300	3,770	3,520	4,060	≈ 4,000
Degree of neutralisation with acetic acid	60-130	60-130	80-130	130	
Quaternisation	100	100	100	100	100

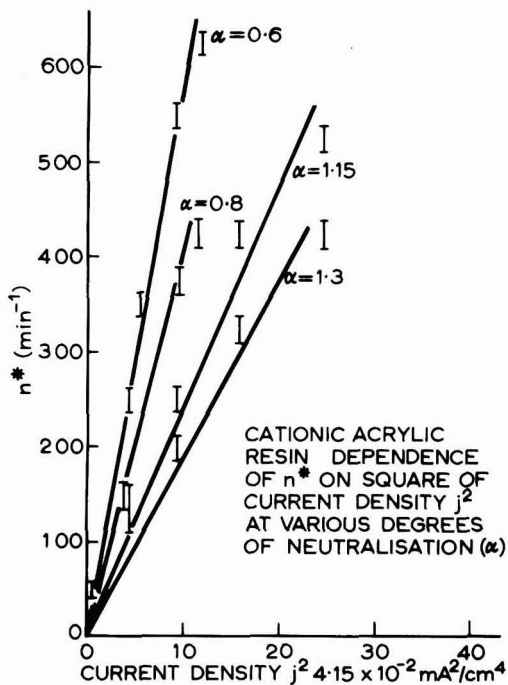
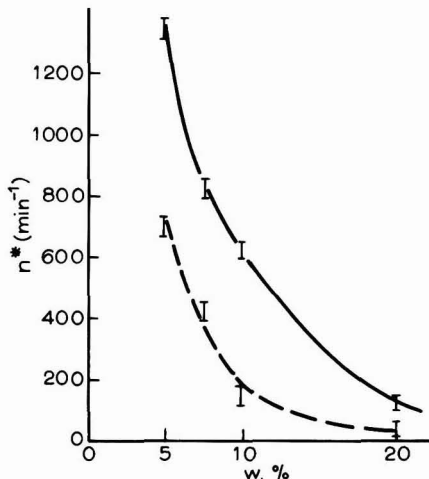


Figure 3.



CONTENT OF DIMETHYL ETHYL AMINO METHACRYLATE IN THE COPOLYMER DEPENDENCE OF n^* ON CONTENT OF DIMETHYL ETHYL AMINO METHACRYLATE IN THE COPOLYMER AT DIFFERENT CURRENT DENSITIES AND DEGREES OF NEUTRALISATION

— $j^2 = 0.166 \text{ mA}^2/\text{cm}^4$, $\alpha = 1.30$
 - - - $j^2 = 0.014 \text{ mA}^2/\text{cm}^4$, $\alpha = 1.30$

Figure 4.

Table 3
 Solubility and deposition behaviour of cationic acrylics

Degree of cationic modification	Neutralised resin			Quaternised resin		
	Solubility	Electro-deposition	Coagulation	Solubility	Electro-deposition	Coagulation
20	clear soln. (100% acid)	0.4mA/cm ² (n*=175)	NH ₃ : + NaOH: + (pH<8.5)	clear soln.		NH ₃ : - NaOH: +
10	slightly turbid soln. (100% acid)	0.125mA/cm ² (n*=125)	NH ₃ : + NaOH: +	clear soln.	≥5.5mA/cm ² (n*=0) ≥13.5mA/cm ² (n*=800)	NH ₃ : - NaOH: + (pH 13-14)
7.5	turbid dispersion (100% acid)	0.125mA/cm ² (n*=275)	NH ₃ : + NaOH: +	slightly turbid soln.	≥5.0mA/cm ² (n*=0) ≥12mA/cm ² (n*=800)	NH ₃ : - NaOH: + (pH 13-14)
5	not dispersible (100% acid)			dispersion	≥4.5mA/cm ² (n*=0) ≥6mA/cm ² (n*=800)	NH ₃ : - NaOH: +
2.5	not dispersible even with >130% acid			dispersion	≥3mA/cm ² (n*=0) ≥4mA/cm ² (n*=800)	NH ₃ : - NaOH: + (pH 12-13)

A further question which arises, with respect to the mechanism of deposition of cationic binders, is whether the deposition behaviour of resins with quaternary ammonium groups is the same as that of binders containing neutralised tertiary amino groups.

This problem was investigated by comparing the behaviour of the above-mentioned copolymers of dimethylamino ethyl methacrylate, which were fully neutralised, with those of the analogous fully quaternised resins as shown in Table 3.

The solubility and the deposition behaviour of these resins was compared at different levels of cationic modification, each based on exactly the same starting material.

It was found that the solubility of the quaternised resins was much better, at the same degree of cationic modification, than that of the neutralised binders. Therefore, a binder with, for example, 5 per cent dimethylamino ethyl methacrylate, is not dispersible in water even if neutralised with 100 per cent acetic acid, whereas the same resin fully quaternised can be readily dispersed in water.

The difference in solubility results in different behaviour with respect to coagulation with bases. Whereas the neutralised resins can be readily coagulated with ammonia from their 10 per cent aqueous solutions, the quaternised resins remain in solution. In this case a very strong base such as NaOH is necessary. A determination of the pH necessary for coagulation for quaternised products shows values between 13 and 14 are necessary.

Nevertheless electrodeposition of quaternised resins is possible if the cationic modification is not too extensive. However in contrast to the neutralised resins, with the same degree of cationic modification, a much higher current density must be used to achieve deposition. As shown in Table 3, a copolymer with 7.5 per cent cationic modification, which is 100 per cent neutralised, can be deposited within a few seconds at a current density of 0.125 mA/cm²; whereas in the case of the quaternised product the current density has to be higher than 5.0 mA/cm² to achieve deposition in less than seven minutes.

In any case, a simple relationship was not found between n^* and j^2 or j for the quaternised resins using the rotating disk electrode method. Surprisingly for these resins, n^* seemed independent of the current densities used. This phenomenon needs to be investigated further.

Chemistry of binders for ED

Refs. 2, 4, 6-18

Several types of binders may be suitable for ED. No one system is better than the others in every respect, but according to the field of application, each of the different binders or combinations of binders have their own merits.

One important difference between anionic and cationic ED materials is the crosslinking mechanisms used. Due to the fact that the usual anodic ED bath has a pH value above seven and that the deposited film is, in contrast, highly acidic, crosslinking reactions which are acid-catalysed can be used without problems.

Therefore all the reactions via methylol or methylol ether groups with acid X-H- functions (OH-, COOH-, NH(O)- groups etc) are in use in crosslinking in anodic ED. The situation is somewhat different with cathodic ED, this will be discussed in detail later.

Binders described in the patent literature and binders that are used in practise have to be distinguished, but it is hard to do this because few chemical details are published with respect to the latter.

The following synopsis does not claim to be complete. This would go far beyond the limits of this paper. A

detailed review of the chemistry of binders for ED was published recently⁹.

Maleinised drying oils or their fatty acids were the starting point for the development of water-soluble paint resins. They were also the basis for the first commercially used ED paints, where they were employed as automotive primers. For this type of resin both anionic modification by maleinisation and cationic modification by reaction of the maleinised product with α -primary- ω -tertiary diamines⁷ are described (Table 4).

With the increasing requirements placed on ED paints, particularly in their main application (automotive primers), the properties of the modified natural oils were no longer satisfactory. Their place was taken mainly by synthetic oils. Especially the polybutadiene oils which were anionically modified. These resins exhibit a good combination of an unsaponifiable backbone and the capability to crosslink via double bonds 1,4-polybutadienes as well as 1,2-polybutadienes are in use. There are several ways to make such resins anionic but the most important one is the reaction with maleic anhydride.

Because of the well-known high quality of anionic polybutadiene ED binders, several companies have done work during recent years on modifying polybutadienes cationically. The theory behind this is to combine the advantages of cathodic ED with the quality of polybutadiene ED materials.

Thus a maleinised polybutadiene can be reacted with an, α -primary- ω -tertiary diamine, such as N, N-dimethyl propylene diamine, to give an amino group substituted imide⁷; or an epoxidised polybutadiene may be reacted with an amine to give amino and hydroxyl substituted resins⁸. Hydroxyl group containing products can be crosslinked not only via their double bonds but also with capped polyisocyanates.

In addition to maleinised natural oils anionic polyesters and alkyds have been used in ED. A few examples of cationic versions of these binder types are also described. Neither the former nor the latter type of binder holds a strong position today. The method of modifying these resins anionically is to co-condense them with a tri-carboxylic acid such as trimellitic acid. One way to modify them cationically is to react carboxyl terminated polyesters with primary aminoalcohols⁹. The resulting polyesters with terminal oxazoline rings can be used as ED materials in combination with aminoplast resins as crosslinkers.

A class of binders of great importance for ED are the epoxies, including epoxy esters, epoxy ethers, epoxy-phenolic resins and other epoxy resin derivatives (Table 5.). Modified epoxy resins have considerable importance as coating binders in conventional coatings technology. They impart to coatings properties such as hardness, flexibility, outstanding adhesion and corrosion resistance. Therefore much work has been done to utilise the properties of this class of resin for ED.

Anionic epoxy ED binders have been in use for a number of years. There are several methods to achieve anionically modified epoxies as shown in Table 5. For instance by esterifying the epoxy groups of an epoxy resin, e.g. of a bisphenol-A-epichlorohydrin type, with unsaturated fatty acids and afterwards maleinising the reaction product. Another way is to copolymerise an

Table 4
Chemistry of electrodeposition binders

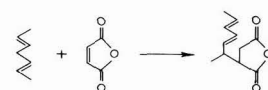
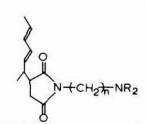
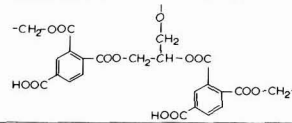
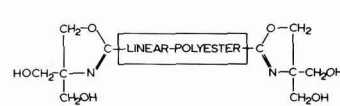
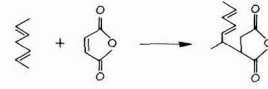
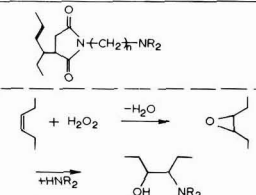
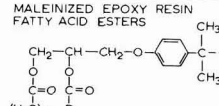
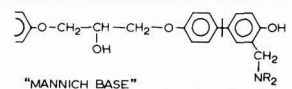
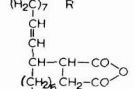
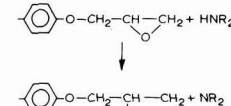
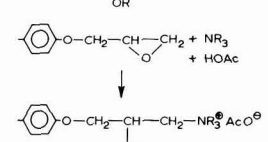
GENERAL TYPE OF BINDER	ANODIC ED		CATHODIC ED	
	ANIONIC MODIFICATION	CROSSLINKING	CATIONIC MODIFICATION	CROSSLINKING
NATURAL OILS	MALEINIZATION  AND HYDROLYSIS	AFTER COMBINATION OR CO-REACTION WITH PHENOL-FORMALDEHYDE RESINS, AMINOPLAST RESINS VIA UNSATURATION		VIA UNSATURATION
POLYESTERS AND ALKYDS	INCORPORATION OF TRIMELLITIC ACID 	WITH PHENOL-FORMALDEHYDE RESINS, AMINOPLAST RESINS		AMINOPLASTS, CAPPED POLYISOCYANATES
SYNTHETIC OILS EG. LOW MOLECULAR WEIGHT POLYBUTADIENES	MALEINIZATION AND HYDROLYSIS 	VIA UNSATURATION COMBINATION WITH PHENOL-FORMALDEHYDERESINS		VIA UNSATURATION, AMINOPLAST RESINS, CAPPED POLYISOCYANATES VIA UNSATURATION, CAPPED POLYISOCYANATES

Table 5
Chemistry of electrodeposition binders

GENERAL TYPE OF BINDER	ANODIC ED		CATHODIC ED	
	ANIONIC MODIFICATION	CROSSLINKING	CATIONIC MODIFICATION	CROSSLINKING
EPOXIES	MALEINIZED EPOXY RESIN FATTY ACID ESTERS 	VIA UNSATURATION, PHENOL-FORMALDEHYDE RESINS, AMINOPLASTS	 "MANNICH BASE"	SELF-CROSSLINKING VIA -CH2OH, -CH2NR2
	EPOXY ESTERS  EPOXY ETHERS	COPOLYMERS: EPOXY RESINS ETHERIFIED WITH UNSATURATED ALCOHOLS + ACRYLIC ACID	 OR 	SELF-CROSSLINKING VIA CAPPED ISOCYANATE GROUPS; ACTIVATED DOUBLE BONDS EXTERNALLY CROSSLINKING VIA FULLY CAPPED POLYISOCYANATES, MF-RESINS, PHENOL-FORMALDEHYDE RESINS

unsaturated epoxy derivative, e.g. an ether of an epoxy resin with an unsaturated alcohol, with an unsaturated acid such as acrylic acid and other monomers. These products can be externally crosslinked with phenoplast or aminoplast resins. With respect to crosslinking most of the epoxy ED binders no longer have free epoxy groups. These groups are used for reactions in binder synthesis and modification. They would lack the necessary stability in an aqueous ED bath.

Beginning in the late sixties great efforts were made to develop cationically modified epoxies. There exists a huge number of patents in this field and the most important cathodically depositable ED resins are of this type. The first cathodically depositable resins used in Europe were

epoxy-phenolic resins which were cationically modified by mannich-base groups⁴. The cationic modification is introduced by reacting a resin, with terminal phenolic groups, with formaldehyde and a secondary amine. This resin type exhibits self-crosslinking properties due to methylol and the mannich-base groups which can be considered as aza-analogous methylol groups. During curing a crosslinking mechanism similar to that of phenol-formaldehyde resins takes place. These resins thus lose their hydrophilicity. With these products pH values of above seven in the ED bath can be achieved. The resins can be dispersed in water even without full neutralisation.

Another important way of modifying epoxy resins cationically is the reaction of the free epoxy groups in

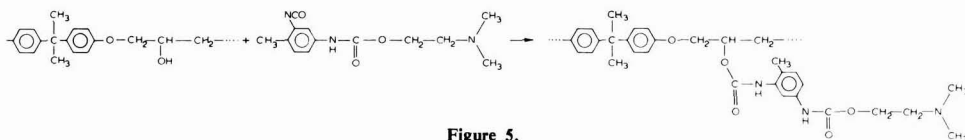


Figure 5.

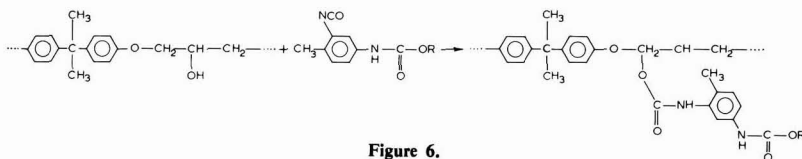


Figure 6.

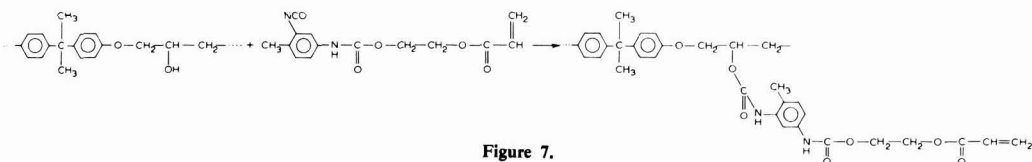


Figure 7.

resins of the bisphenol-A-epichlorohydrin type, with amines^{4,10}. This may be done with primary monoamines, secondary monoamines or polyamines, such as di, tri or tetramines, e.g. triethylene tetramine. The reaction with a combination of several amines is also described. Products with terminal amino groups and/or amino groups which are incorporated in the polymer chain may result. When using polyamines the primary amino groups may be capped by the formation of ketimines during synthesis of the resin.

By reaction of the epoxy resins with a tertiary amine and an acid such as acetic acid quaternary ammonium group containing resins result¹¹.

Another method of modifying epoxy resins cationically is the reaction of the hydroxyl groups in the resins with amino group bearing isocyanates, e.g. with a reaction product of one mole toluylene diisocyanate with a dialkyl alkanolamine¹² (Figure 5).

The crosslinking of these cationic epoxy resin derivatives can be either internal or external as is the case with all ED resins. External crosslinking with e.g. phenol-formaldehyde or aminoplast resins is mentioned in the patent literature¹³ but difficulties may exist because of the strongly alkaline nature of the deposited film.

To overcome this, the addition of capped strong acids such as tricresyl phosphate is described¹⁴.

However, important crosslinking mechanisms for this type of cationic resin are those via capped isocyanate groups^{10,11} with hydroxyl and/or amino groups, or via the reaction of activated double bonds¹².

The capped isocyanate groups may be incorporated into the resin to give self-crosslinking systems^{10,11}, or fully blocked polyisocyanates can be mixed with the cationic epoxy resins^{10,11}.

A typical method of building up self-crosslinking systems is to combine a reaction product of one mole of toluylene diisocyanate with one mole of a capping agent, e.g. 2-ethylhexanol, which gives a semi-blocked diisocyanate, with an epoxy resin¹⁰ containing a hydroxyl group as shown in figure 6.

On curing, the blocking agent is released and the free isocyanate groups can react with the hydroxyl and/or amino functions of the epoxy resin derivative.

The introduction of crosslinkable double bonds can be achieved as shown in Figure 7.

The reaction product of one mole of a hydroxyalkyl acrylate such as 2-hydroxyethyl acrylate with one mole toluylene diisocyanate is combined with a hydroxyl group containing epoxy resin¹².

A further important class of ED binders consists of addition polymers. For instance, there is widespread use of anionic ED polyacrylics as binders in one coat white ED systems. The anionic modification is introduced, e.g. by copolymerisation with acrylic or methacrylic acid (Table 6.).

There are self-crosslinking resins in use which contain e.g. N-methylol ethers of acrylamide or methacrylamide and externally crosslinked systems which are cured, e.g. by melamine formaldehyde resins.

The first patents describing cationically depositable polyacrylics were published in the mid-sixties².

Amino groups can be introduced into acrylic and vinyl copolymers by free-radical copolymerisation with monomers containing such groups. Examples are copolymers of acrylic esters and other co-monomers with monomers containing tertiary amino groups such as dimethylaminoethyl methacrylate, vinylimidazole or aminoalkylamides of (meth)acrylic acid². In general these

Table 6
Chemistry of electrodeposition binders

GENERAL TYPE OF BINDER	ANODIC ED		CATHODIC ED	
	ANIONIC MODIFICATION	CROSSLINKING	CATIONIC MODIFICATION	CROSSLINKING
ADDITION POLYMERS EG, POLY(METH) ACRYLICS	COPOLYMERISATION WITH UNSATURATED ACIDS $\left[\text{CH}_2 - \underset{\text{X}}{\text{CH}} \right]_n \left[\text{CH}_2 - \underset{\text{COO}^\ominus \text{R}}{\text{CH}} \right]_m$	SELF-CROSSLINKING: -OH + N-METHYLOLETERS EXTERNAL: -OH AND/OR -COOH GROUPS	COPOLYMERISATION WITH AMINO GROUP CONTAINING MONOMERS OR REACTION OF EPOXY-GROUP CONTAINING POLYMERS, EG COPOLYMERS OF GLYCIDYL METHACRYLATE WITH AMINES $\left[\text{CH}_2 - \underset{\text{X}}{\text{CH}} \right]_n \left[\text{CH}_2 - \underset{\text{C}=\text{O}}{\text{CH}} \right]_m$ $\begin{array}{c} \text{O} \\ \\ \text{O} \\ \\ \text{CH}_2 \\ \\ \text{CH}_2 \\ \\ \text{NR}_2 \end{array}$	SELF-CROSSLINKING VIA -OH AND CAPPED ISOCYANATE GROUPS, ACTIVATED DOUBLE BONDS EXTERNAL VIA -OH AND FULLY CAPPED POLYISOCYANATES, AMINOPLAST-RESINS, PHENOL FORMALDEHYDE RESINS
COPOLYMERS OF VINYL-ESTER				
STYRENE COPOLYMERS		+ AMINOPLAST PHENOPLAST RESINS		

Table 7
Chemistry of electrodeposition binders

GENERAL TYPE OF BINDER	ANODIC ED		CATHODIC ED	
	ANIONIC MODIFICATION	CROSSLINKING	CATIONIC MODIFICATION	CROSSLINKING
POLYURETHANES	REACTION OF OH-GROUPS CONTAINING PRODUCTS WITH A POLYCARBOXYLIC ANHYDRIDE, EG, TRIMELLITIC ANHYDRIDE		REACTION OF NCO-GROUPS CONTAINING PRODUCTS WITH A NN-DIALKYLALKANOLAMINE	SELF-CROSSLINKING VIA CAPPED ISOCYANATE GROUPS
POLYAMIDES	POLYAMIC ACIDS, EG, BASED ON TRIMELLITIC ANHYDRIDE AND AROMATIC DIAMINES $\text{---NH---C} \begin{array}{c} \text{O} \\ // \\ \text{C}_6\text{H}_2 \\ // \\ \text{C} \end{array} \begin{array}{c} \text{COO}^\ominus \text{Na}^\oplus \\ \\ \text{O} \end{array} \text{---NH---R---}$		CONDENSATION PRODUCT OF DIMERIZED LINOLIC ACID WITH DIETHYLENE TRIAMINE	IN COMBINATION WITH AMINO-SUBSTITUTED EPOXY RESINS CROSSLINKING VIA CAPPED ISOCYANATE GROUPS

copolymers are soluble in water as acetates at a pH of between 3.5 and 6. Similar copolymers can be synthesised by the reaction of epoxy group containing polymers (such as copolymers of glycidyl methacrylate) with secondary amines¹⁵.

By the use of additional monomers containing hydroxy groups and capped isocyanate groups, self-crosslinking copolymers may be prepared.

Self-crosslinking polymers with primary amino groups can be prepared by the reaction of polymers containing carboxyl and methylol amide ether groups with alkylene imines¹⁶.

The cationic acrylic resins have not yet gained any great practical importance.

Anionically as well as cationically modified polyurethanes are described in the patent literature as ED binders (Table 7.).

A cationically depositable polyurethane system, as claimed in the patent literature, consists for instance of a reaction product of an isocyanate terminated polyurethane based on toluylene diisocyanate, and polypropylene glycol with triethanolamine. By modification of the resulting hydroxyl group containing polyurethane with semi-blocked toluylene diisocyanate, a self-crosslinking system is obtained¹⁷.

Only a few details are published concerning the synthesis of anodically depositable polyamides, but there exists a cathodically depositable ED system of practical importance which includes a cationic polyamide.

Thus a combination of a condensation product of dimerised linolic acid with diethylenetriamine (versamide-type), with an amino substituted epoxy resin and a semi-capped polyisocyanate, results in a self-crosslinking cationic ED binder¹⁸.

Comparison of properties: cathodic versus anodic ED

Refs. 19, 20

Over the past few years several papers¹⁹ have been published which deal with this subject. They all state that cathodically depositable ED coatings are, on the whole, better than anodically depositable materials. They are said to have "a better corrosion resistance".

These statements refer almost exclusively to a binder system based on a reaction product of a bisphenol-A-epichlorohydrin resin with an amine which bears capped isocyanate functions as cross-linkable sites. But in most cases the exact chemical structures of the systems compared are not described in these publications.

To investigate the statement above and whether cationic ED products are better than the anionic ones, the types of binders or coating systems that are compared and the type of application they are used for must be examined. In addition, to compare different coating systems an estimate has to be made of the whole range of properties. It is no use comparing e.g. only the corrosion resistance on bare steel. All properties have to fit the requirements of a particular case. It may be that the main advantages of different ED materials lie in different properties. It depends on the particular field of application and the pre-

Table 8
Differences in application of anodic and cathodic ED

Anodic	Cathodic
• No basic difference with respect to rationalisation of the process and environmental advantages	
• Metal dissolution at the anode	• No metal dissolution at the cathode (?)
• Possible attack on passivating phosphate layer	• No attack on passivating layer
• Steel counter electrode can be used	• Counter electrode can be oxidised. Must be inert – graphite, stainless steel
• Less gas (O ₂) evolution	• Twice as much evolution of gas (H ₂) by volume with the same electrochemical equivalent
	• Corrosion of equipment with low bath pH values. No general problem for all cathodic ED materials
• Usual film thickness $\geq 25\mu\text{m}$	• Usual film thickness 15 – 20 μm

ferences of the customer as to what combination of properties seems best.

Optimised anodically depositable ED systems of very high quality exist, while on the other hand cathodically depositable ED materials which totally fail can be prepared.

In addition a decision has to be made as to what is to be compared: the binders or optimised coating formulations. The binder of course, does not tell the whole story. The properties depend on the total formulation, e.g. pigments, fillers, use of corrosion protective agents etc. Therefore one of the main properties of a car body primer, that is its corrosion protection, may be influenced strongly by anti-corrosive pigments such as strontium or zinc chromate.

First of all, what are the differences between cationic and anionic ED materials with respect to application mode? They result from the basic differences in deposition mechanisms (Table 8).

The modification of equipment required when changing from anodic to cathodic ED is slight. The main difference results from the fact that the counter electrode has to be inert in the case of cathodic ED and that the walls of the ED bath have to be insulated and cannot be used as a counter electrode.

Another important factor concerns the bath pH. In the case of anodic ED material, no corrosion problems, with regard to the equipment, exist for bath pH values above seven. In the case of cathodic ED this problem depends on the particular pH value of the bath. There are cationic ED materials on the market which allow bath pH values above seven.

For a comparison of anodic and cathodic systems those properties are chosen which are of most importance for the main application of ED, that is of car body priming.

In Table 9, two anionic ED systems, an acrylic and a maleinised polybutadiene one, and two cationic ED systems, an epoxy-amine derivative with capped isocyanate crosslinking sites and a mannich-base system, are compared.

These products are all in practical use. The comparison

does not refer to the binders but to the coating formulations.

Overall the results indicate that the best cathodically depositable ED systems available on the market have better corrosion resistance, especially on bare steel, than the best available anodic ED systems if compared at the same film thickness. For high anti-corrosion quality performance, the best anodically depositable materials need a film thickness which is up to 50 per cent greater than the best cationic materials.

This property together with good throwing power, offer particular benefits in coating box sections, especially in Europe where the car body pretreatment is by spray-phosphating, which leaves the car body interiors partially uncoated.

With respect to throwing power, it has to be taken into consideration that this property is not only influenced by the type of binder used but also by the whole coating formulation.

The solids content of the ED bath in particular has a favourable influence on the throw: the higher the solids content the better the throw; but due to higher losses at the rinsing stage, the loss of coating material may also increase with increasing solids. In addition several methods are used to determine the throw and therefore an exact comparison of results from these different tests is difficult to produce.

Thus the throw of the two cationic materials, as shown in Table 9., cannot be compared exactly. However, both cationic materials fit the specifications of automobile producers for use in car body primer ED tanks.

In the literature several attempts to interpret, in chemical terms, the advantages of cathodic ED in corrosion resistance have been described. One is based on the fact that there is no dissolution of the metal or the phosphate layer in the case of pretreatment at the cathode, in contrast to the situation at the anode.

This point has to be investigated further. Anderson *et al.*²⁰ for instance, found a metal ion content even in cathodically deposited films.

Table 9
Comparison: anodic versus cathodic ED

	Anodic		Cathodic	
	Acrylic copolymer plus phenolic resin	Maleinised polybutadiene	Epoxy-phenolic resin mannich-base	Epoxy-amine resin capped isocyanate
pH value (bath)	7.5-8.0	7.0-7.5	7.5-8.2	6.0-6.5
Solids content (bath%)	12-14	12-14	12-15	18-20
Deposition voltage (V)	230-300	180-230	100-350	250-350
Curing temperature (°C)	170	170	180	180
Film thickness (µm)	22-26	22-26	15-20	15-20
Use of corrosion protective pigments	chromates	chromates	optional	chromates plus water-soluble lead salts
Loss of solids at curing (%)	≈5	<5	≈11	≈13-16
Throwing power	+	++	++/+++	+++
Corrosion resistance (salt spray test, DIN 50 021) ¹ :				
Untreated degreased steel	0	0	+	+
Zinc phosphated steel with water-rinse	0	+	0	-
Zinc phosphated steel with chromic acid rinse	+	+	+	+

¹Corrosion resistance (mm from the scribe after 240 hours salt spray)

Untreated steel

Zinc phosphated steel (H₂O-rinse)

Zinc phosphated steel (chromic acid rinse)

0: 4-7 mm /+; 1.5-3 mm

0: 1-3 mm /+; 0-1 mm /-; 5 mm

+; 0.5-1 mm

In conclusion, it has to be stated that much more basic work has to be done in the future to understand the advantages of cathodic ED. For example, the properties of the binder (molecular weight, chemical nature, type and order of cationic modification, crosslinking mechanism, etc.) and their effects on ED.

In this way further improvements in cathodic ED, e.g. lower curing temperatures, better chip resistance, even better corrosion resistance and white single coat finishes should be achievable.

[Received 11 July 1980]

References

- Verdino, H., *JOCCA*, 1976, **59**, 91.
- BASF, Ger. Pat. Appl's., 1 546 840 (1965); 1 276 260 (1965); 1 546 854 (1965); 1 546 848 (1965).
- Schuchert, G., *Industrial Finishing*, 1973 August, 18. PPG, Ger. Pat. Appl., 2 252 536 (1971).
- Kempter, F. E., Gulbins, E. and Caesar, F., "Proc. XIV Fatipee Congr.", Budapest. BASF, Ger. Pat. Appl's., 2 320 301 (1973); 2 320 536 (1973); 2 357 075 (1973).
- Beck, F., *Chemie-Ing.-Tech.*, 1968, **40**, 575. Beck, F., *Prog. Org. Coat.*, 1976, **4**, 1. Beck, F., Pohlemann, H. and Spoor, H., *Farbe und Lack*, 1967, **73**, 298. Beck, F., *Farbe und Lack*, 1966, **72**, 218.
- Schenck, H. U., Spoor, H. and Marx, M., *Prog. Org. Coat.*, 1979, **7**, 1.
- Nippon Oil Co. Ltd, Ger. Pat. Appl., 2 616 591 (1975).
- Akzo, Ger. Pat. Appl., 2 833 786 (1977). Chemische Werke Hüls, Ger. Pat. Appl., 2 732 736 (1977). Polymer Investment, Ger. Pat. Appl., 2 828 014 (1977). Nippon Oil Co. Ltd, Ger. Pat. Appl., 2 734 413 (1976).
- Vianova, Austrian Pat., 314 695 (1972).
- PPG, Ger. Pat. Appl's., 2 033 770 (1969); 2 003 123 (1970); 2 065 775 (1970); 2 265 195 (1971). Kansai Paint Ltd, Ger. Pat. Appl., 2 541 234 (1974). PPG, Ger. Pat. Appl., 2 603 666 (1975). PPG, US Pat., 3 975 250 (1975). Dulux Australia Ltd, Ger. Pat. Appl., 2 426 996 (1973). BASF AG, Ger. Pat. Appl., 1 930 949 (1969).
- PPG, Ger. Pat. Appl's., 2 163 143 (1970); 2 363 074 (1972).
- Vianova, Ger. Pat. Appl's., 2 755 538 (1976); 2 836 830 (1977).
- American Cyanamid Co., Ger. Pat. Appl., 1 669 593 (1966).
- BASF AG, Belgian Pat., 862 193 (1976).
- Shinto Paint, Ger. Pat. Appl's., 2 325 177 (1972); 2 324 019 (1972).
- PPG, US Pat's., 3 679 564 (1970); 3 953 391 (1972).
- Mitsubishi Chem. Ind. Ltd, Ger. Pat. Appl., 2 165 361 (1970).
- Kansai Paint, Ger. Pat. Appl., 2 733 188 (1977).
- Saatweber, D., *Metalloberfläche*, 1977, **31**, 455. Anon, *Oberfläche/JOT*, 1978, 204. Vollmar, J. P., *Surfaces*, 1977, **113**, 33. Salmen, K., *Metalloberfläche*, 1978, **32**, 254. Van Westrenen, W. J., *JOCCA*, 1979, **62**, 246.
- Anderson, D. G., Murphy, E. J. and Tucci, J., *Journ. Coat. Technol.*, 1978, **50**, 38.

Short Communication

Applied finishes for timber in exterior situations in New Zealand

By C. Gooch

PO Box 36 006, Lower Hutt, New Zealand

Before developing the main theme of this paper, it will be advantageous to consider the timber surface which is to be coated.

Most timber is made up of cellulose fibres arranged in long, slender, hollow tubes or cells. The cellulose fibres are bound together with lignins, hemicellulose, and a wide variety of compounds lumped together under the term "extractives". The thickness of the cell walls and the ratio of cellulose to lignins varies with seasonal growth so that the surface of any piece of timber is, by nature, a non-uniform substrate.

Timber is in general a very stable material retaining its mechanical and chemical properties over long periods of time. It will however, undergo cyclical changes of expansion and contraction with heat and cold; and swelling and shrinking with the ingress and egress of moisture. This dimensional instability with moisture varies from species to species and has been correlated with the "paintability" of individual species.

The chemical stability of the timber surface is poor under the influence of UV light. Under such circumstances wood loses methoxy groups and lignin, with a corresponding increase in acidity and the evolution of formaldehyde and methanol. Loss of these elements creates voids in the timber which results in enlargement of the cell orifices and cracking of the cell walls. Areas of high lignin content are more prone to UV damage than areas of low lignin content. These chemical changes are accompanied by a colour change towards grey and the exposure of loosely bound cellulose fibres on the surface of the timber.

The prime considerations for a coating for timber, therefore, must be:

- (a) moisture impermeability
- (b) ability to resist UV degradation of itself and to screen the timber from UV
- (c) flexibility
- (d) heat reflection

It is assumed that the timber requiring coating is in ideal condition, i.e. it has had the correct pretreatment commensurate with the projected exposure conditions; it has been dried to the correct moisture content; it has been carefully stored and is free from surface checking; and has been correctly detailed to avoid sharp arrisses and allow free drainage of water. The next all-important step is in the choice of a primer.

The principal requirement of a primer is that it adheres tenaciously to the substrate both initially and long term (ideally the life of the structure). Other properties which are desirable in a wood primer are:

1. Long term flexibility. This function is more easily

achieved with saturated high polymers (such as acrylics) than unsaturated vegetable oils and alkyds. Within the oil-based varieties, oils with the least degree of unsaturation (whilst still allowing air-drying), have the potential for longer term flexibility than the more unsaturated oils such as linseed.

2. The ability to make uniform the porosity of a non-uniform substrate. It is accepted that the porosity of timber surface varies widely on the same piece of timber, and the need for the primer to cope with this can lead to some archaic concepts. The phrase "oil-based paints feed the timber surface" has for many years "coloured" the thinking of the primer function. Though penetration into timber pores can occur, it takes place in a selective manner; usually the solvent first followed by low molecular weight vehicle fractions and so on as viscosity increases and drying speed permits. This then can also lead to lack of uniformity in the primer surface. It is the Author's belief that penetration should be reduced to a minimum by formulation and uniformity of surface, achieved by a tightly adhering primer film on top of the timber surface.

3. Water Resistance. Accepting that water is one of the most severe degrading influences on timber it is obvious that the ability of the primer (and the rest of the system) to keep the timber dry is beneficial. However totally waterproof coatings are rarely a practical proposition and it must be accepted, even in a well coated system, that the moisture content of the timber will vary with subsequent swelling and shrinking. There is a case for inducing into primers a degree of hydroplasticity such that it can move sympathetically with the timber.

4. Stain Resistance. Timbers, according to species, contain extractives which can migrate through paint films causing objectionable staining on the surface. It is yet another function of the primer to prevent or reduce this phenomenon. Since the majority of the extractives are water soluble, the problems are most noticeable (but not wholly confined to) water-based primers. Reactive pigments and ion-exchange type resins are useful in reducing these problems, as is the careful screening of the water-phase components of the primer. In the Author's experience there will always be one bit of timber that will beat the system!

5. Fungal Resistance. The timber surface is often a happy hunting ground for moulds and fungi. Hoffman has shown that increased fungal resistance occurs when fungicides are incorporated throughout the paint system rather than concentrated in the top coat. A good timber primer should show fungicidal properties.

6. Corrosion Resistance. Whilst it may seem strange discussing corrosion resistance in relation to wood primers, it is a fact that the appearance of many otherwise

satisfactory paint jobs can be marred by the presence of rust stains derived from nail head corrosion. Wood primers should assume the job of combatting this.

7. Toxicity. The law in New Zealand states that paints containing more than 0.5 per cent by weight (dry film) of lead must not be used on surfaces which children can chew. This is a fact of life which must be accepted. It is the responsibility of paint manufacturers to ensure that suitable products are available to specifiers and painters.

8. Recoatability. The primer must present a surface suitable for recoating.

Wood primers in New Zealand are traditionally a shade of pink (even though the base paint may be white) notwithstanding considerable pressure from the painting trade to have them white. The painters reasons are obvious – the manufacturers not so. The primers are shaded pink so that they do not contribute to the hiding of the system. A contribution to the hiding implies a contribution to the absorption and reflection of light including the damaging UV component. In the interests of maximum durability of the primer, this is not desirable. As listed above, the primer has sufficient functions to perform as it is.

Primer types

1. Red and/or white lead in oil – historical interest only.
2. General purpose Oil/Alkyd, lead-free – this is the largest category of wood primers used. They are easy to apply, level well, adhere well and have reasonable stain resistance. Due to the absence in New Zealand of any confining specifications, the formulating latitude is very wide. Problems can arise in the area of joinery shop primers where the speed of drying may be put ahead of, and to the detriment of, the performance parameters outlined above.
3. Aluminium pigmented oil/alkyd primers. This class of wood primer is very effective in utilising the barrier properties of the lamella aluminium pigment. Prior to finger-jointing they were particularly effective for painting over knotty pine where resin bleed was a problem. They have excellent stain resistance and are generally used when all else fails. They have never achieved commercial popularity in New Zealand.
4. Water based acrylic primers. This class of material has been slow to gain acceptance because of the problems of poor stain resistance and an inclination to grain-raising. Otherwise, on well prepared timber these materials can perform excellently, long term flexibility, durability, and mould resistance being strong points. Improvements in stain resistance have been detailed above, but grain-raising remains a problem. Grain-raising is attributed to the swelling by water of partially attached splinters of wood occurring during the preparation of the timber, i.e. planing, routing or sanding. Although grain-raising is not acceptable aesthetically, there is evidence of it being technically preferable for improved long term durability. It is felt that grain-raising relieves stresses in the timber surface which unrelieved, will contribute to the breakdown of the coating system.

Prior to this discussion on primers, four factors which were assumed to be perfect before painting were mentioned. It may be opportune to discuss the consequences if these factors are less than perfect.

1. Pretreatment. The two major pretreatments used in New Zealand are boron and tanalith, used to greater and lesser degrees. It is important to realise that the tanalith treatment is a fixed salt and the boron a soluble salt. Boron treatment should only be used in dry areas, unless protected by a substantial, durable paint system. Highly permeable systems or systems prone to checking can allow the soluble salts to be leached from the timber, thus increasing the risk of the timber rotting.

2. Moisture content. The moisture content of timber at the time of painting should ideally be as close to the moisture content expected in service. Too high a moisture content can lead to blistering and flaking problems; too low a level can lead to cracking following the swelling of the timber when it comes up to it's equilibrium level. Moisture problems occur less frequently with water-based paints than with other systems.

3. Storage. Incorrect storage can result in the contamination of the timber with a variety of contaminants which can affect paint performance, i.e. mould, soil, fuel oils, cement dust etc. Individual discussion of these points is not necessary as the problems are self-evident. A less easily distinguished problem is the effect of weathering which can leave a loose mat of cellulose fibres on the surface or lead to checking of the timber surface. Unless weathered timber is sanded back to a sound surface, premature failure of the paint, usually by flaking, is certain.

4. Detail and Design. It is a phenomenon of all liquids that, due to surface tension effects, they will pull away from sharp edges resulting in a decrease in thickness at those edges. In paint systems this can result in sharp edges being only half as thick as the rest of the paint system. As sharp edges also tend to become drip points for water, they can easily be identified as weak spots in the system. Practice bears this out as failure of paint on exterior woodwork invariably starts as cracking then curl-back from a sharp edge. The radiusing of sharp edges even by as little as a 5 mm radius, can increase paint durability by a more significant amount than any of the formulating principles known to the industry at present.

With regard to finishing systems for exterior timber, there are two main classes, alkyds and acrylics, each of which have their sworn and loyal devotees.

Alkyds as a class have had a long and useful history. Apart from a shaky beginning when the use of zinc oxide contributed to "tissue paper" peeling problems, they have been relatively trouble-free. Systems have invariably been glossy and the bulk of the comments will be confined to this area.

Gloss alkyds, because of their excellent flow properties will tend to flow away from any high points on the surface and leave areas of low film build and hiding. This is one of the major reasons why undercoats are traditionally used. The function of the undercoat is to adhere to the primer and fill minor imperfections; it should have good hiding properties and provide a surface (either with or without sanding) such that the topcoat will adhere well without sinkage, and so provide maximum gloss and durability. The balance between the flexibility required in any exterior wood finish and the ability to be sanded in a reasonable time is a delicate one to achieve but is essential in a good undercoat.

The requirements of the topcoat are that it be easily

applied, have sufficient flow to level brush marks but not so much that it will sag. It must dry in a reasonable time to minimise disfigurement with airborne dust and protect and beautify for as long as possible. Film build and flexibility are of great importance and must not be sacrificed for speed of drying.

There are modifications of alkyd resins (mainly urethane, epoxy esters, and silicon alkyds) which whilst having some specialist uses, are of minor importance commercially.

Although only two coats of finishing paints have been discussed, this is due to commercial practise rather than technical preferment. Increased film thickness will increase overall durability and better cost/performance comes from a second coat of undercoat.

Alkyd resins are by nature glossy and generally require large levels of fillers to reduce the gloss – this in turn reduces the level of binder present. The consequence of this is that very little binder erosion need occur before the onset of chalking. The films still remain protective but paints that chalk early are not acceptable in the New Zealand market.

The parallel does not exist with water-based acrylics as they have less inherent gloss and require only small filler additions to produce low gloss products.

The water-based acrylics (and formerly PVA copolymers) make up the other large group used for the exterior painting of timber. Early products of this type suffered from poor flow, early wet-adhesion problems, and excess thermoplasticity which led to severe dirt retention problems.

The thermoplasticity of modern water-based coatings has been reduced by the use of harder polymers and more importantly higher molecular weights. Their dirt retention now compares with alkyds but they are still not suitable for use on joinery working surfaces.

The early wet adhesion problems have now been totally overcome by the use of adhesion promoting monomers in the base resins. These monomers, are, in general, only compatible with acrylics and hence the demise of PVA's in the timber painting and repainting area. This is not to say that all acrylics have this adhesion but the better ones do.

The problem of flow is still present and will probably remain so whilst we live in a "water-based environment". The film forming mechanism of these paints is a fusion or coalescence of particulate spheres of the polymer after the evaporation of water. If the conditions are warm, windy, and of a low humidity, the rate of evaporation of water will be very fast allowing little time for flow to take place. There are flow agents and humectants which can give adequate flow under these conditions, but are likely to give sagging, extended drying, and even coalescing problems when used under cool, humid conditions. There is at present a new class of thickener/flow agent available which is showing a lot of promise in this area.

The acrylics as a class have very high durability and long-term flexibility which makes them useful for timber coatings. They are non-yellowing and colour fast. Their chemical inertness makes them suitable for use with dark colours which would normally lead to premature embrittlement of an alkyd. Acrylics have virtually no

ability to penetrate loose, cracked, or chalky surfaces and demand good surface preparation on repainting.

Clear varnishes for exterior coatings

The term varnish usually refers to homogeneous mixtures (either chemical or physical) of oils and resins. The film deposited (usually from a solvent) will dry at ambient temperature to give a solid, usually gloss but ranging to flat, clear finish. The materials used to produce these varnishes include linseed oil (raw and processed); tung oil/phenolic resin blends (spar varnish); alkyd resins straight and modified with acrylic, silicone, urethane; urethane oil; two-pack urethanes and various other filmogens.

The clear coating does not easily match the requirements of a coating for timber as mentioned above. It cannot reflect heat, as any heat reflecting pigment will reduce or eliminate the clarity of the coating. The path through the film for moisture is very short and unimpeded, due to the absence of pigments.

A clear coating designed to allow the unrestricted passage of visible light cannot stop the passage of closely related UV light.

Clear films however, can be designed to have excellent resistance to UV light themselves and this, in general, has been the tack that manufacturers have taken.

The results have been disappointing to date. Failure of UV resistant clear films generally follow a classic pattern.

1. Cracks developing in the coating/timber system due to attack from UV light and moisture penetrating the coating.
2. Rapid attack by UV and moisture at the site of the crack.
3. Colonisation by mould at the timber interface and subsequent attack.
4. Failure of the timber/coating interface resulting in discolouration of the timber and "peel-back" of the coating.

That the problem is intimately tied to the substrate can be demonstrated by the fact that masonry surfaces have been protected by clear coatings for up to 15 years.

Organic UV absorbers have been put forward as an answer to the problem and although these can extend the useful life of the system to a degree, their long-term efficiency appears suspect. It is not expected that one application of sun tan oil at the beginning of summer will last all season! Yet this is what is expected of the UV absorbers for coatings. Recent work would indicate that inorganic UV absorbers offer longer service life than their organic counterparts.

Another avenue of development lies in the stabilisation of the timber surface itself, chromic acid and zinc/ammonium complex treatments have recently been reported.

The major hope for producing a satisfactory clear finish for timber lies with acrylic varnishes and considerable work is being done in this area.

Exterior pigmented stains

Small levels of opaque pigments in a film-former can have a degree of transparency. This feature is used to advantage

in exterior stains. The basic technology is to introduce sufficient pigment (usually iron oxides) to protect the timber from UV light but not sufficient to completely obliterate the grain.

These products do not in fact fit the definition of a stain as they rely on forming a film on the surface of the timber. They are in reality, half-way between paints and stains and if sufficient coats are applied complete obliteration will be achieved. As they are semi-transparent a relatively high level of UV light will strike the timber.

The most popular class of these stains is the well-known "Madison" type. It is based on processed linseed oil with auxiliary waterproofing agents. Durability of these types depends heavily on the exposure conditions and anything from two to six years has been reported. The stain itself breaks down relatively quickly with UV light and the type of failure leads to fairly easy preparation for recoating as long as bare timber has not been exposed to the atmosphere for long periods.

The second class of these stains available, utilises water based acrylic binders. These binders are more resistant to UV degradation than the oils of the "Madison" formula. It will be interesting to examine the balance of UV resistance of binder/UV screening timber and find out whether eventual failure is powdering or peeling.

Flat acrylic finishes

The last coating in this paper is in fact a true paint but it is convenient to consider it here.

This is the water-based pigmented acrylic for direct application onto timber. These low sheen paints will dry at slightly different rates over spring and summer wood. This affects the final gloss of the film and grain becomes apparent due to these slight gloss differences in adjacent bands. These paints screen the timber from UV and they are highly resistant to UV themselves. Eventual failure is by slow erosion of the film.

As has been described earlier, weathering of timber leads to the formation of loosely bound cellulose fibres on the surface. This is a poor surface to coat and will lead to premature failure of the coating. It has been shown that exposure of timber for as little as one week has a definite deleterious effect on the long-term performance of a subsequently applied coating. Remedial action is to sand back the exposed timber to a sound surface and this is vital if

the full service potential of these exterior coatings is to be realised.

In conclusion, some general comments on coatings as they affect performance:

1. Film Thickness. The amount of coating applied to a surface is proportional to the protection it can give. In purchasing paint, "volume solids" is one of the most important criteria. Even the best of paints however, can be adulterated by a heavy hand with either turps or water. Only on-site supervision can rectify this problem.

2. Colour. The majority of paints produced for timber are colour fast although fading can still be expected in some pinks and light yellows. The most important aspect of colour is the depth of it. Dark colours not only absorb light but also heat – and in large quantities. It is not unusual on a summers day when a white painted surface is at, for example 20°C, for a dark coloured surface to be at 70-75°C. This imposes considerable stress on the timber and also any old paintwork which may be under the new dark colour. Houses painted with light coloured paints for 30-40 years and in a perfectly stable condition, have been stripped back to bare timber after the application of a dark coloured paint.

3. Repainting. It is clearly established that old alkyds in sound condition can be successfully recoated with adhesion promoted acrylics. Failures can occur over unsound alkyd surfaces but there exists the high probability that the failure would also occur had it been overcoated with alkyd. There is insufficient evidence to be certain about the ability of acrylics to be overcoated with alkyds. Some failures have occurred (due to splitting of the alkyd) but these have been associated with the older PVA/acrylic copolymers. In the Author's opinion, the present acrylics will provide sound substrates for alkyds, but instances of reverting to alkyds will become less frequent with the better performance of the present acrylics.

The successful coating of timber starts with the forester with his silvicultural methods. It continues at the timber mill with the method of cutting the logs. The timber treater plays his part as does the designer of the timber profiles. The care of the timber then passes into the hands of the builder, the carpenter, and finally the painter. All must play their parts conscientiously if the best is to be made of this beautiful natural product.

[Received 17 October 1980]

Next month's issue

The Honorary Editor has accepted the following papers for publication. They are expected to appear in the January issue of the *Journal*:

Determination of metallic copper, cuprous oxide and cupric oxide during the manufacture and storage of antifouling paint by C. A. Giudice, B. del Amo and J. C. Benitez

Spectrophotometric studies on shellac. The relation between optical density and colour index by D. N. Goswami, N. Prasad and R. N. Das

The influence of thixotropic agent concentration on the rheological properties of protective coatings based on oxidised bitumen by A. Papo and F. Sturzi

The influence of pressure on blister growth by L. A. van der Meer-Lerk and P. M. Heertjes

occa meetings

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

Midlands

Litho Plates – Future Developments

The first meeting of the 1980/81 session was held at the County Cricket Ground, Edgbaston, Birmingham on 25 September 1980. Members of the Institute of Printing were invited to join the section members for this meeting. Members and guests heard Mr J. Ling of Coates Bros. (Litho Plates) Ltd give a talk entitled "Litho Plates – Future Developments".

Mr Ling opened his talk by explaining to those present not familiar with printing terms what was meant by lithography. The lithographic plates can be constructed from various metals such as zinc, aluminium, chromium plated brass, steel and stainless steel. Also, they can be made from such non-metallic materials as polyester. The life of the plate and the number of copies it will produce very much depends on the material used for its construction. Zinc plates can be anodised for extra strength. Aluminium plates tend to be very brittle and are used only once for short runs. Chromium plated brass, called bi-metal plates, are very malleable and can be re-used giving the plate a long life. Steel plated with copper and chromium, called tri-metal plates, are used for very long runs.

The plates have to be coated with light sensitive materials. Conventionally these are such compounds as dichromate in combination with gum arabic or polyvinyl alcohol, or diazo compounds with polyvinyl alcohol or synthetic resin. More recent non-conventional coatings have been made from silver halide based materials and an electrostatic process has been developed. All the foregoing coatings, with the exception of the electrostatic process, have to be exposed to light shining through a negative of the print and then pass through a developing process.

Mr Ling concluded his talk by describing a laser system which can print directly onto the lithographic plate thus avoiding the use of negatives and the developing process. A lively question time followed and the meeting closed with a vote of thanks proposed by Mr D. Kimber.

The Midland Section would like to express their thanks to Coates Bros. (Litho Plates) Ltd for providing the buffet.

B. E. MYATT

London

Building Research Establishment

On 8 July 1980 a party of 20 London Section members and guests visited the Princes Risborough Laboratories of the Building Research Establishment.

The tour was organised by Dr R. Miller, Department Head, Protection Section and with his colleagues Messrs. J. Boxall, G. Smith and T. Dearling guided the party around the BRE.

The equipment available for simulating the weathering of timber and investigating the causes of failure was shown and discussed. As an example of timber failure, the effect of UV radiation on the strength of timber was being determined by monitoring the change in tensile strength during exposure to such radiation.

The work being carried out into the most suitable way of preparing a weathered surface for repainting was discussed. Photography was used to monitor the performance of timber pretreated with hand or mechanical sanding, burning off or wet scouring. The latter technique was producing the best results to date.

Suitable systems for, and the failure of, plywoods were being investigated; plywoods, covered kraft, overlaid plywood, hardboard, chipboard and waferboard.

The different approaches to timber preservation and the choice of primer were described. Both aqueous and solvent borne primers were being examined.

An excellent display of the variety of fungal, mould and insect attack on timber made an interesting focal point for the description of the biodegradation of timber; most of the mould problems commonly associated with paint were in fact generally due to construction problems such as condensation traps or the use of permeable timber.

The visit was concluded with a tour of the field test facilities. The majority of the exposures were to 45° south and the test panels included lacquers under evaluation as well as sealants, putties and mastic window seatings.

Electronic monitoring of the weathering conditions was used to accurately record the exposure cycle.

Vehicle refinishing

The first technical session of the 1980-81 session was held at "The Princess Alice", Romford Road, E7 on Thursday 25 September 1980. Mr E. W. Fennell, Berger Paints, presented a lecture on "Vehicle Refinishing" to an audience of 35 members and guests.

In the first part of his presentation, Mr Fennell reviewed the past and future market trends in refinishing in the UK and Europe. Refinishing included not just car crash repair paints (40 per cent of the total usage) but also warranty repairs to damaged original finishes (40 per cent) and cosmetic repainting on secondhand cars (20 per cent). The use of refinishes also covered commercial vehicles. The use of refinish paints in this area was split as follows:

Livery	71 per cent
Accident Repairs	27 per cent
Statutory (e.g. internal coatings on food vehicles)	2 per cent

Synthetic alkyds were predominantly used on commercial vehicles. The paint types used in car finishes were

most varied and different types were used in different countries, for instance:

UK	Nitrocellulose
Europe	Two pack acrylic, alkyd
USA	Thermoplastic acrylic, nitrocellulose.

The choice of particular resin types in each country was dependent on historical factors, such as restrictions on the availability of nitrocellulose in Germany following the war; the tendency of European refinishing to be concentrated at large refinishers with low baking ovens; good marketing of certain products in the USA.

Comparison of the application, drying and film properties of the various systems demonstrated that two pack acrylic coatings offered the most advantages. However, the health and safety aspects associated with the use and handling of isocyanate products and the general reluctance to change from proven and established systems meant that it would be some years before they enjoyed a significant market share. This would be accelerated by the development of non-isocyanate containing two pack systems which provided all the benefits of the present acrylic-isocyanate products.

Following the showing of a Berger training film, which demonstrated some of the differences between the back street cowboy and the properly equipped refinishing shop; Mr Fennell described the mixing scheme technique for



matching individual colours. It simply consisted of a limited range of finished colours from which the thousands of individual car colours could be mixed. Either volume or weight mixing could be used. The success of the system depended on up-to-date mixings and good colour accuracy of the formulations being available as well as the scheme being easy to use. The choice of individual pigments was extremely important to ensure that only a minimum range of basic colours need be held and that pigment mixtures did not exhibit defects such as flocculation, flooding etc. which would make the scheme unworkable.

After an interesting question time, a vote of thanks was proposed by Mr F. D. H. Sharp to which the audience responded warmly. As was the custom at the "Princess Alice" a free buffet was provided for members and guests.

A. C. SAXBY/A. J. NEWBOULD

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

Tor Coatings expands again

Tor Coatings Limited the Tyne and Wear based specialist coatings manufacturer have just completed a further building extension to their freehold factory which increases its size from 10,500 sq ft to 23,000 sq ft.

Tor Coatings Limited has shown dramatic growth since its formation in 1976 and is expecting a turnover of £1,500,000 in its current year against £1,000,000 in its last financial year.

Reader Enquiry Service No. 31

Perkin-Elmer Model F11 trade-in

Perkin-Elmer have introduced a trade-in programme to enable users of the Model F11 Gas Chromatograph to obtain a new chromatograph at substantial discount. As manufacture of the F11 ceased six years ago the availability of parts for maintenance and service is becoming increasingly difficult to ensure.

Reader Enquiry Service No. 32

Powder coatings growth

Usage of thermosetting powder coatings in EEC countries is expected to grow at an average annual rate of 11-12 per cent over the next decade, propelling volume from 27,900 tons in 1979 to 93,800 tons by 1990, according to a new study by Frost & Sullivan, Inc.

Reader Enquiry Service No. 33

New powder paints company

Unilever is launching a new company in Britain to market and ultimately manufacture powder paints which can be sprayed electrostatically on to a wide range of industrial products without the use of solvents. With powder paints no primer is necessary and surface preparation is reduced to a minimum.

The new company, Unipaint Limited, will be based initially in Surrey, and will operate as a sister company to Societe Industrielle de Voisins in France, and Vereinigte Pulverlack in Germany, who together form the largest powder coating manufacturing group in Europe.

Reader Enquiry Service No. 34

Berger bring "liquid powders" to the UK

The Berger Group is to develop and manufacture a new "Liquid Powder" or "slurry" paint. This follows the signing of a licensing and co-operation agreement between the Hoechst paint group (of which Berger is a member) and the Grow Group Inc, one of America's leading chemical companies, who originated the new technology.

Berger believe that the "liquid powders" will have considerable impact on metal finishing, especially in the automotive, cycle, domestic appliance and furniture industries.

Reader Enquiry Service No. 35



Small-batch paints unit

On 2 October 1980 in Stratford East London, Berger Industrial Coatings opened what is claimed to be the most cost-effective and environmentally-safe facility for producing small batches of industrial paints.

The £0.5 million addition to Berger Industrial Division's 10-million-litres-a-year Carpenters Road facility will meet an increasing requirement amongst stock-conscious automotive, construction, chemical plant and other industrial paint users for 200-900 litres quantities.

Reader Enquiry Service No. 36

BOCM Silcock win oil order from China

BOCM Silcock's Seed, Oil and Cake Division has won its first export order from China for 75 tonnes of linseed oil for the manufacture of paint.

It is hoped by the company that this order worth £37,000 is the forerunner of future business with China.

Reader Enquiry Service No. 37

news

Ellis & Everard (Exports) Ltd

UK chemical distributors Ellis & Everard have formed a new company, Ellis & Everard (Exports) Ltd, to meet growing overseas demand for industrial chemicals in composite and individual consignments.

Reader Enquiry Service No. 38

Overseas expansion by ECC

English China Clays, who claim to be the world's largest supplier of pigments to the paper industry, is now nearing completion of a new calcium carbonate and china clay processing and distribution centre at Lixhe, near Liege, in Belgium. ECC has invested £4.5 million in this development which will produce the Carbital range of top quality calcium carbonates for use as a coating pigment by the paper industry.

In Sweden, ECC has formed a new company with Cementa AB. ECC will have a 75 per cent holding in this company. Cementa AB, which is a subsidiary of Industri AB Euroc, is Sweden's major producer of cement. The Carbital range will also be produced there from a plant being built at Cementa's works at Köping on Lake Malaren.

Reader Enquiry Service No. 39

Ciba-Geigy Pigments to streamline operations

The continuing decline in the profitability of organic pigments has caused the Pigments Division of Ciba-Geigy in the United Kingdom to review the structure of its operations.

The Division, which is part of the Ciba-Geigy Plastics and Additives Company, has announced proposals to consolidate operations at its manufacturing plant in Paisley.

Reader Enquiry Service No. 40

new products

New Ciba-Geigy pigment

Ciba-Geigy's Pigments Division has recently launched a new pigment, Irgalite Blue BCNF. It is a flocculation resistant, alpha phthalocyanine blue pigment with, it is claimed, excellent colour strength and a bright, attractive red hue. It disperses readily in a comprehensive range of



Three new double cone blenders from Winkworth

decorative and industrial paint vehicles to give flocculation resistant finishes with very good colouristic properties.

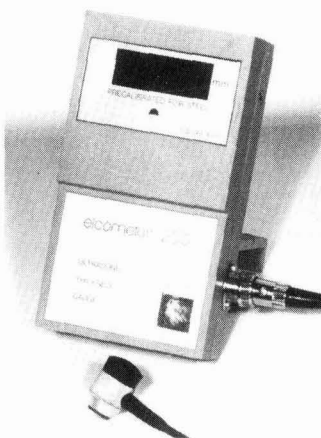
Reader Enquiry Service No. 41

Ultrasonic thickness gauge

The Elcometer 200 has been designed to measure the thickness of steel and in particular to check for corrosion with application in such areas as: the oil industry, chemical industry, and steel industry.

The instrument is so designed that there are no operator controls and it is precalibrated for steel. It is possible to measure other materials by applying a simple conversion formula. Housed in a case 241 x 159 x 67 mm, the display is LED and is easily read.

Reader Enquiry Service No. 42



The elcometer thickness gauge

Double cone blenders

Three new models have just been added to the range of double cone blenders manufactured by Winkworth Machinery. The capacities of the three are 12, 40 and 85 litres and their introduction extends the Winkworth range from 12 to 1400 litres. Marketed specifically for those applications where small batches of chemicals, granules or powders need to be blended prior to analysis, the blenders are particularly simple to use, clean and maintain.

Reader Enquiry Service No. 43

Gradient oven

The Paint Research Institute in Amsterdam, the TNO, has produced a laboratory gradient oven for the drying, stoving, baking etc, of enamels, plastisols, organosols powder coatings and so on. All these functions can be carried out over a continuous range of temperatures in a single operation. Thus only one test panel is needed to determine a range of properties as a function of stoving temperature.

Reader Enquiry Service No. 44

Colour comparison cabinet

Erichsen have introduced their new Erichsen Duolux Colour Comparison Cabinet Model 425.

It is intended to consistently re-create conditions under which colour can be assessed or compared. This is done with the aid of fluorescent tubes which simulate daylight and typical artificial light.

Reader Enquiry Service No. 45

New defoamer

Byk-Mallinckrodt have developed a new defoamer for water-dilutable paint systems.

Byk Defoamer VP 020 becomes oriented along the liquid-gas interface. It penetrates the coat where it causes stresses through its differential spreading power which therefore produces a defoaming action.

Byk Defoamer VP 020 is used in aqueous primers, fillers and one-coat finishing paints. The problems which arise during dipping, flow-coating and spraying in particular can be counteracted with this defoamer. One crucial advantage of the Byk defoamer is its wide range of activity. It can be dependably used in amine-neutralised, air drying and stoving alkyd resins, oil-free polyesters and epoxy esters.

Reader Enquiry Service No. 46

Diaphragm pumps

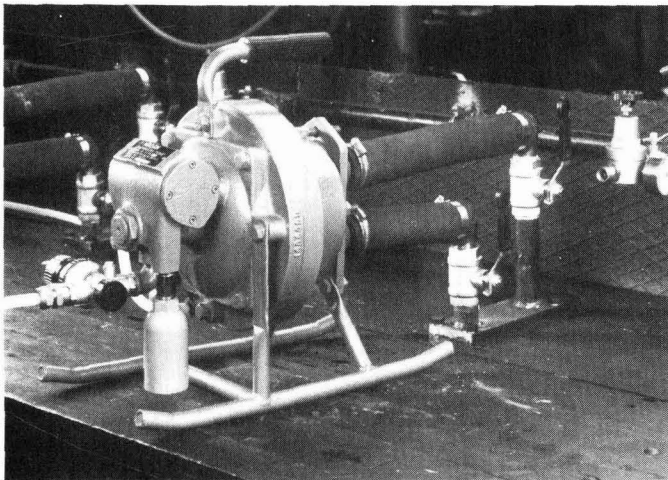
Charles S. Madan & Company Ltd have announced their new MK II range of air powered diaphragm pumps.

According to the company, low cost and greatly enhanced service life are the main features of the new series of pumps which will deliver up to 23 gallons per minute (105 l/min) against delivery heads of up to 200 feet (61 m).

The pumps operate from a compressed air supply of between 10-100 psi (0.7-6.8 bar) and are completely portable. Being air powered, they can be used freely in fire hazardous areas and will run dry without damage.

Madan diaphragm pumps are self-priming with suction lifts of up to 10 feet (3 m) and will handle liquids with solids in suspension.

Reader Enquiry Service No. 47



The Madan air powered diaphragm pump

BP Chemicals

BP Chemicals has just launched Bisomer HEMA, a versatile intermediate of particular use in the preparation of high quality acrylic paints for the automotive industry.

Bisomer HEMA (2-hydroxyethyl methacrylate), it is claimed, provides better protection against scratching, especially for vehicle underbodies, and gives a better shine in metallic paints. It can also be used in primers for rust prevention on steel.

It can be copolymerised with many other vinyl monomers and finds uses in a number of industries. The printing industry uses photo-sensitive resin compositions derived from Bisomer HEMA for relief printing plates, lithograph plates and photoresists. It can also be used with other monomers in adhesives for metals, wood, glass and plastics.

BP Chemicals is now marketing its wide range of polyalkylene and polyethylene glycols under a new trade name, Breox. The product nomenclature system has also been changed to bring it in line with commonly accepted European practice.

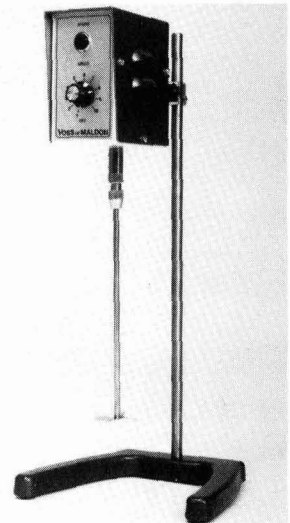
Reader Enquiry Service No. 48

Quick-dissolve label material

Fasson UK Ltd has produced, from a new self-adhesive material called FasSolve, labels which stick to jars or containers yet disappear when immersed in water.

FasSolve is a 120 microns uncoated matt-white "paper-type" face material, coated with a permanent grade water-soluble adhesive. In dry conditions it adheres well to most substrates - glass, plastics, stainless steel and aluminium - and is sufficiently flexible for application to curved surfaces.

Reader Enquiry Service No. 49



The S20 stirrer

Stirrer

Voss Instruments are introducing a new mechanical stirrer to complement the existing range of fractional horse power conventional paddle stirrers. The new stirrer has a rated power of 1/20th horse power and so has been designated the S20.

Speed range is from near zero to 3000 rpm, with stepless variable speed through an energy saving solid state voltage regulator.

Reader Enquiry Service No. 50

New fume cupboard grille

A new high level hinged top grille, recently introduced by A. R. Hoare & Co. Ltd, will be especially useful in the elimination of access problems for maintenance engineers and laboratory staff associated with fume cupboards and extract systems.

The new grille, designed for standard fitting to the latest range of Hoare's fume cupboards, is a significant development in that it provides easy access to the upper areas of the fume cupboard, usually difficult to reach with safety, for regular cleaning and maintenance and for reaching extra tall equipment used within the cupboard.

Reader Enquiry Service No. 51

Bagging free flowing materials

Polythene self-seal gusseted "valve" sacks designed for fast clean bagging of granular and free flowing materials, particularly those which produce dust or chemical fume hazards, are now available from Palagan & Co.

As filling progresses through a feed neck, the accumulating contents serve to force shut an integral throat seal incorporated within each sack. This overcomes the need for time consuming stitching or sealing operations and as the bags are gusseted, box ends are formed to promote better stacking for storage and transit. Also, being polythene the bags are suitable for outside storage applications.

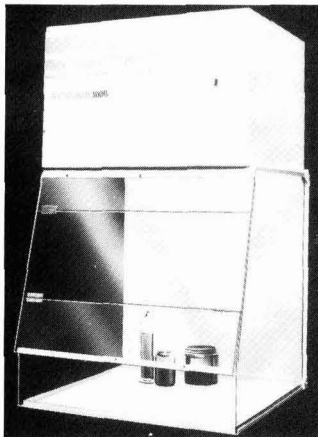
Reader Enquiry Service No. 52

A portable fume cupboard

Although fume cupboards are generally thought of as large immobile structures in the corner of a laboratory, the Astecair 3000 can be thought of as a standard piece of bench equipment. Because no special fittings or ducting are required, it can be carried to any position within the laboratory.

The Astecair 3000 is also adaptable in format. It is formed from the hood, containing the filters and electrical components, and the cabinet base. More than one base can be fitted to each hood, so the only restrictions on the possible number of combinations is the size of the laboratory.

Reader Enquiry Service No. 53



Portable fume cupboard

New high shear mixers

A new range of high shear fluid mixing machines, the UNL Rotoshear range, has been developed for low abrasive mixes. The range features a flow control device which may be used to achieve single or two-stage mixing processes.

The models incorporate two stators, a low pre-dispersion stator and a fine mesh upper stator for final mixing. By placing the flow control in its lowest position, the flow of materials to the upper stator is closed off, thus forcing the materials to pass only through the lower stator. Liquids, solid agglomerates, fibrous materials, emulsions, dispersions, gums, etc. are pre-sheared to a fine even consistency without any possibility of holes in the upper stator becoming blocked. Then, by raising the flow control, material is allowed to flow through the fine mesh of the upper stator for intensive secondary shear action and final dispersion. There is thus no need to change stators during the mixing process, reducing mixing time by between 25 and 50 per cent in many instances and greatly increasing productivity of the plant.

Reader Enquiry Service No. 54

New conductive coating for plastics

New from the Bee Chemical Company is R-65, a one-package, high performance conductive coating for all types of plastics. Supplied as a lacquer type coating, R-65 is reducible with standard thinners.

Spray applied under agitation, R-65 will form a thin protective coating and be effective over a wide attenuation or frequency range. It will cover approximately 300 square feet per gallon. Air dried or force dried, this coating, it is claimed, offers excellent film properties, adhesion, and mar resistance.

Reader Enquiry No. 55

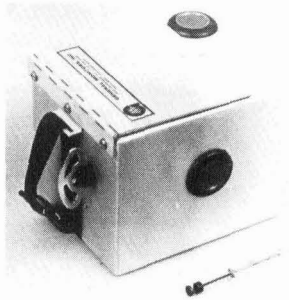
New IR and UV/VIS spectrophotometers

Perkin-Elmer have introduced a new range of low-cost Infrared Spectrophotometers, the Model 1300 Series.

The basic Model 1310 covers the range 4000 cm^{-1} to 600 cm^{-1} . Models 1320 and 1330 scan from 4000 cm^{-1} to 600 cm^{-1} and 200 cm^{-1} respectively and offer a choice of two slit programs as well as manually selectable fixed slits. For ease of operation the controls are colour coded and the slit width and scan times are integrated together in optimised combinations.

Also from Perkin-Elmer is the Lambda 3, a new low-cost UV/visible double-beam spectrophotometer, with microcomputer control, offering many advanced design features.

Reader Enquiry Service No. 56



Portable calibration chamber

Calibration device for combustible vapours

A portable purge calibration chamber hitherto available only with the General Monitors range of gas monitoring instruments, is now available as an independent unit from Allison Engineering Ltd, agents for General Monitors UK Ltd.

The device is designed to provide a known vapour concentration thus allowing for easy calibration of detection equipment in the field. Use is made of a sample of any liquid, typically a solvent from which a combustible vapour is likely to be generated within a factory, process plant or other location. An appropriate amount of solvent is injected into the calibration chamber by means of a calibrated syringe supplied as part of the kit. This solvent is then vapourised by a clockwork fan, providing a predetermined percentage of LEL concentration within the enclosed volume. This is applied to the sensor to allow quick, simple and accurate calibration.

The device is ideally suited to field calibrating in hazardous areas as there are no electrical components.

Reader Enquiry Service No. 57

New cyanoacrylate adhesive

Industrial Science Ltd has launched a new grade of cyanoacrylate adhesive. Called Cyanolit 811 its unique feature is that it is the first non-pungent, non-odour cyanoacrylate. It is anticipated that many companies that have previously rejected the use of cyanoacrylate adhesives due to odour and associated problems will find 811 a suitable material.

Reader Enquiry Service No. 58

PRI's gold medal award

Professor Sir Geoffrey Allen, Chairman of the Science Research Council since 1977, has been awarded the Swinburne Gold Medal of the Plastics and Rubber Institute for his significant personal contributions "to the advancement and diffusion of the science and technology of polymers and of polymer engineering".

Reader Enquiry Service No. 59

Polyurethane transfer-coated fabrics

A major development in polyurethane transfer coating technology has enabled Stahl Chemicals (GB) Limited, to announce a successful one coat system for coating a wide range of fabrics. As a result, Stahl is now able to offer several products under its "Permethane" brand name which overcome the usual problem associated with transferring very thin coatings, in the 20 to 30 g/cm² range, onto light-weight fabrics. The technique is believed to open up new prospects for producing weatherproof textiles for the garment manufacturing industry which are both dry cleanable and heat resistant for ironing.

Conventional transfer coating systems require a skin coat to be coated onto release paper and dried before a wet adhesive is used to laminate the skin coat to the fabric. Inevitably there is gross penetration by the adhesive into the fabric which results in a finished product with poor drape and "feel".

Stahl's one coat system overcomes these problems through a new approach to the lamination process. The special polyurethane which comprises the one coat system is first applied as a conventional skin coat onto release paper and dried. This same skin coat is then hot-laminated at about 120°C to the fabric before curing at 150°C in the second oven. This approach means that there is very little penetration into the fabric and therefore the "feel" and drape of the cloth remain virtually unchanged.

Since no solvents are used, coatings can be applied to fabrics sensitive to solvents. It is also possible to apply coating weights of only 20 g/m² by this process.

Reader Enquiry Service No. 60

Intermediate bulk container

A new rotationally moulded intermediate bulk container, specially designed with a low centre of gravity for exceptional safety and stability, is announced by Van Leer (UK) Limited.

This new generation of polyethylene IBC's (250 gal/1150 litre capacity) is particularly suited to the handling and storage of chemicals, adhesives, paints, printing inks and allied products. The container material complies with the US Food and Drug Administration regulations, and is recommended for carrying wine and liquid foodstuffs. The container is an addition to the existing Van Leer ranges of IBC.

The low centre of gravity has been achieved by removal of the sump to enable the bottle to sit from nine to twelve inches closer to the base of the stillage. To replace the function of the sump, Van Leer has developed a new internal channelling feature for the base and valve outlet so that total gravity evacuation is

possible. However, this is the first plastic IBC which can also, if the contents require it, be decanted under pressure. It has been designed to withstand an internal pressure of three psi.

Reader Enquiry Service No. 61

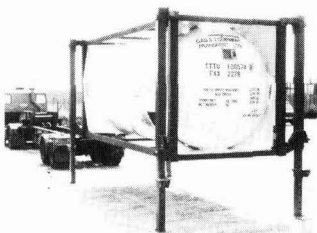
Manual handling

A safe, simple, manually-operated means of transferring laden or empty IMCO Types 1-5 tank containers to and from vehicle decks opens the way to greatly improved utilisation of containers and transit vehicles alike.

This new development is of interest to those handling anything from water to the most hazardous liquids, also liquid gases and powders in bulk.

Compact, robust and easily operated by semi-skilled personnel, the MDS. 88/HH Transfer-System consists of four guided and stabilised, telescopic lift posts which are positioned with the aid of a standard pedestrian or rider-controlled forklift truck, lightweight lorry-mounted crane, or using a tripod and chain. Lifting or lowering is by means of specially designed, manually operated jacking mechanisms used in conjunction with saddle brackets which fit around and are locked into the lift posts at the required height.

Reader Enquiry Service No. 62



Tank transfer system

Hyper-dispersants for ink manufacture

A new range of products which are claimed to increase productivity and formulating flexibility in the manufacture of printing inks is at an advanced stage of market development by ICI Organics Division. The products are being introduced to ink-makers, initially in Europe, under the "Solsperser" trademark. They interact with pigment surfaces but differ from conventional surfactants in that they are designed for use

news

in the non-aqueous solvents of printing inks, are exceptionally effective and do not degrade lithographic behaviour.

Reader Enquiry Service No. 63

literature

Polymer selection guide

Du Pont has published its Polymer Selection Guide. It is made up of comparative listings intended to help designers and users of rubber products to make preliminary choices of material.

Reader Enquiry Service No. 64

New books

The Royal Society of Chemistry has announced the publication of three new books "The Industrial Use of Thermochemical Data", "Properties and Applications of Zeolites" and "Analysis of Airborne Pollutants in Working Atmospheres: The Welding and Surface Coatings Industry".

Reader Enquiry Service No. 65

Buyers guide

Captan Associates Inc., has announced a new, updated, and expanded 1981 second edition of "Reactive Cure Systems: UV-IR-EB Buyers Guide" for technologists covering radiation curing for coatings, inks, and adhesives. This buyers' guide is a third larger than its predecessor, is projected to contain over 250 pages and cover 700 supplier companies worldwide.

Reader Enquiry Service No. 67

Bioscan bulletin

Bioscan has made available two technical bulletins entitled "New GC column packing for detection of contaminants in food and chemicals" and "Column Selection for gas and light hydrocarbon analysis".

Reader Enquiry Service No. 68

Chromatography newsletter

The latest issue in the continuing series of Chromatography Newsletters is now available from Perkin-Elmer Limited. These regular publications feature articles on advanced technology applications in both liquid and gas chromatography.

Reader Enquiry Service No. 69

news

meetings, etc.

Carbocations

The International Symposium on the Chemistry of Carbocations is to be held at University College of North Wales, Bangor on 7-11 September 1981. For further information contact Dr J. F. Gibson, The Royal Society of Chemistry, Burlington House, London W1V 0BN, England.

OCCA news

Manchester Section

The paper by J. Valpola entitled "Titanium dioxide for decorative emulsion paints" that appeared in the September 1980 issue of the *Journal* was based on a paper presented at a Manchester Section seminar on 15 September 1978

1980 Golf Tournament

A record total of 61 members and guests competed for the Manchester Section Jubilee Trophy (Members only) and many additional prizes on Wednesday 10 September 1980 at Stockport Golf Club, Cheshire.

Variable weather conditions were encountered, initial light drizzle being replaced by occasional showers and high winds obviously influenced the scoring which was based on the single Stableford system.

This year John Everett failed to complete his hat-trick and the Manchester Jubilee Trophy was won by Walter Ollett of Crown Paints with a total of 32 points. Walter also received a replica tankard and first choice of the prizes, specifically a Golf Trolley donated by BTP Ltd. The

Colour symposium

A symposium on instrumentation for measuring colour and appearance will be held on 24-26 March 1981 at the Executive West, Louisville, Ky. For further information contact T. A. Kocis, c/o Federation of Societies for Coatings Technology, 1315 Walnut St., Suite 832, Philadelphia, Pa. 19107, USA.

appointments

Joe Kane has been appointed Managing Director of Swale Chemicals Ltd, the Croydon based subsidiary of Brent Chemicals International specialising in coatings and inks for the packaging industry.

Mr Ernest Lauchenauer has been appointed chief engineer of the Pigments Division of Ciba-Geigy Plastics and Additives Company. He succeeds Mr Roger S. Mortimer who has become chief engineer designate of Ciba-Geigy Pharmaceuticals Division.

For information on membership of OCCA, enquiries should be sent to the Association's offices, see front cover for address

winning guest with the highest score was John Stewart of Process Inks who attained a commendable 35 points.

Specialist prizes were awarded to Paul Turner of Kronos for driving his tee shot nearest the 11th hole, and John Roberts of BOC for scoring a nett two. Tradition was continued enabling all entrants to participate in prize giving albeit in a diminishing system, the booby prize winner actually received two prizes!

Tony Jolly, Section Chairman presented the prizes which followed an excellent four-course dinner. It should be noted that the 1981 event, to be held on 9 September 1981, will include the OCCA National Golf Trophy due to the excellent effort of Jim Jackson, BASF, at Harlow this year. Also the Northern Section Golf Tournament will be held at Pannal on 25 June 1981. Finally the sections gratitude is extended to the many individuals and companies who donated prizes necessary to conclude an excellent Golf Tournament.

F.B.W.

Midland Section

Ladies' Night

On Friday 26 September 1980 the Annual Ladies' Night of the Midland Section was held in the Westbourne Suite of the Botanical Gardens, Edgbaston, Birmingham.

Among the top table guests welcomed by the Chairman, Mr R. L. Devenish were the President, Dr F. M. Smith and

David Clegg has joined Baird & Tatlock to head the newly formed General Laboratory Products Division as Marketing Manager based at Chadwell Heath.

Mr John Youngman has been appointed Group Managing Director of Coates Brothers & Company Limited, the parent company of the Coates Group, with effect from 1 October.

John Green, who in December retires after two years as Chairman of the British Resins Manufacturers' Association, took on a new responsibility from 2 October 1980 when he became President-elect of the Birmingham Paint, Varnish and Lacquer Club.

As Marketing Manager for coating resins with BIP Chemicals Division, John looks upon this new appointment with particular pleasure. Raw materials suppliers form only a very small proportion of the club's membership and only under a new ruling have they become eligible for election to the position of President, John being the first.

Mrs Smith, the immediate Past-President of the Birmingham Paint, Varnish and Lacquer Club, Mr D. M. Heath and Mrs Heath and the Director and Secretary of the Association, Mr R. H. Hamblin.

After dinner the Chairman proposed the loyal toast and then welcomed the Section's guests and their ladies. In his response on behalf of the guests the President spoke of the many functions he had attended in many parts of the world on behalf of the Association. Afterwards the members and guests adjourned to the ballroom where dancing to the Phil Phillips Band continued until 1.00 a.m.

B.E.M.



Shown at the Midlands Section Ladies' Night, left to right, Mrs Devenish, Mr R. Devenish (Chairman Midlands Section), Mrs Smith and Dr F. M. Smith (President of OCCA)

OCCA news

Dr Wernick's 50 years at the IMF

A Commemorative Dinner was held at the Bakers' Hall on 31 October 1980 to commemorate the 50 years service to the Institute of Metal Finishing of their Secretary General, Dr Simon Wernick, OBE.

The Director & Secretary (Mr R. H. Hamblin) was amongst the speakers who paid tribute to the work of Dr Wernick and presented him with a wall plaque bearing a replica of this Association's insignia in recognition of the high regard in which Dr Wernick is held by members of this Association

Ontario Section

The following meetings have been arranged for 1981 by the Ontario Section:

Wednesday 18 February, 1981
 Wednesday 18 March, 1981
 Wednesday 22 April, 1981 – AGM
 Wednesday 20 May, 1981

Programme details will be sent to all section members in advance of each event. All meetings will be held at 6.00 p.m. in the York Suite of the Cambridge Motor Hotel, 600 Dixon Road, Rexdale (Toronto), Ontario. Dinner tickets are Cdn \$15.00 per person. Overseas members and friends will be welcome.

Report of the Council Meeting

A meeting of Council took place at 2.00 p.m. on Wednesday 22 October 1980 at the Great Northern Hotel, King's Cross, London, N1 9AN with the President (Dr F. M. Smith) in the Chair. There were 26 members present.

The Council noted with regret the death of an Honorary Member, Mr A. R. Penfold, the founder Chairman of the original Australian Section of the Association, which took place on 16 June, within six weeks of his ninetieth birthday.

The President extended a welcome to Mr P. Birrell (the first Chairman of the



The Director & Secretary (right) receiving the Reed International Trophy from the Chairman of the ABC, Mr Colin Bell, at the Hyde Park Hotel on 12 November

The Journal wins a prestigious award

The Audit Bureau of Circulations annually makes Awards to publications who are adjudged to have completed the best Media Data Forms and readers of this *Journal* will be pleased to learn that *JOCCA* was declared the 1980 winner of the Reed International Award for the best submission from a society or association journal.

The Director & Secretary (Mr R. H. Hamblin) received the Award at the Luncheon following the Annual General Meeting of the Audit Bureau of Circulations at the Hyde Park Hotel on 12 November.

Copies of the Media Data Form which shows, amongst other information, that the estimated average readership of the *Journal* is 22,408, are obtainable from the Association's offices on request.



The Director & Secretary with the ABC's Reed International Award, the Certificate and the Media Data Form (left) copies of which can be obtained from the Association's offices



Ontario Section and currently serving on Council as a Vice President).

Reports were received on various changes to the BSI Committee structure and the appointment of Association nominees to these Committees.

As Dr G. D. Parfitt who had been the Association's representative on the British National Committee for Chemistry was now at the Carnegie Mellon University, Pittsburgh, it was agreed that Dr F. M. Smith should represent the Association on this Committee. Mr J. R. Bourne was appointed to the Technical Committee to replace Dr Parfitt.

Information on the arrangements for the technical sessions and the social programme for the Bath Conference (17-20 June 1981) was given to Council and it was reported that the Presidents of FSCT, SLF and FATIPEC would be the Association's guests at the Conference.

The registration fees for members, non-members and daily registrations for the Conference were agreed and, provided that all information was available, it was hoped to issue the brochure with the January issue of the *Journal*.

The half-year accounts and estimates were presented and adopted.

A report was submitted on the number of names of members removed from the

Register and it was hoped that the addition of new elections by the end of the year would maintain the total number of members.

Council discussed and approved arrangements for the 1981 subscriptions for members attached to Sections in New Zealand and South Africa.

A report was received on the response to the 1981 Exhibition which had attracted some applications from organisations which had not shown for some years.

Discussion on topics for further monographs took place.

Council was reminded that nominations for the Jordan Award were to be submitted by 31 December 1980.

The newly appointed Technical Education Officer, Mr A. T. S. Rudram, reported on the discussions which he had had during the summer recess with representatives from technical colleges and other organisations.

It was agreed that, provided suitable arrangements could be made, the venue for the 1983 Conference would be York (with either Chester or Harrogate as alternatives) and in 1985 the venue would be in Scotland where provisional dates had been reserved at Aviemore.

It was reported that at the meeting of the Professional Grade Committee held earlier in the day, authority had been given for the admission of 4 Fellows and 8 Associates and the transfer of 1 Associate to Fellowship. The Professional Grade Committee had been considering amendments to the present regulations and hoped to be in a position to present these to the meeting of the Council scheduled to take place in February 1981.

Section Chairmen and Representatives

reported on Section activities and Council was particularly interested to hear from Mr P. Birrell of the progress in the course being organised by the Ontario Section which was now in its third year; it was expected that the first students to complete the course would receive diplomas in 1981.

Suggestions on economies in the number of circulars dispatched to Sections were discussed and the Finance Committee was asked to review all possible ways in which savings could be effected.

Since the Society of Dyers and Colourists would in a few years time be celebrating their centenary, it was agreed to confer Honorary Membership of this Association on the President of the Society at that time and to announce the Association's intention at this stage.

The President reported on his visit to the New Zealand Division's Convention and the Convention held by the Oil and Colour Chemists' Association Australia and expanded on his suggestions for the formation of an OCCA International. It was agreed that a group of Past Presidents (Mr A. T. S. Rudram, Mr L. H. Silver and Mr A. McLean with the President in the Chair) with advice from the Director & Secretary should explore this concept and report back to Council.

Since the President and Mrs Smith would shortly be leaving for a visit to the South African Division's Symposium, where the President would present the Keynote Address, Council took the opportunity of recording their best wishes for a successful visit and asked the President to convey their greetings to the South African Division.

There being no other business, the President thanked members for their attendance and declared the meeting closed at 4.10 p.m.



Planning for the 1981 Spring Sales Campaign!



The OCCA-33 Exhibition (28-30 April at the Cunard International Hotel, London) offers companies a splendid opportunity to show their existing range of products and to show what developments in materials and equipment will be available in a period when customers will be looking eagerly both for cost-saving equipment and cost-effective ways of using raw materials.

This is the established annual forum for the surface coatings industries, which

brings together representatives from a high level of the industries (32 per cent of registration cards completed at OCCA-32 in May 1980 were by directors/owners/managers) and visitors have come from between forty to fifty overseas countries in recent years.

Enquiries for visits by overseas parties from Continental Europe, Korea and Japan have been received; some arrangements for receptions for overseas visitors have already been agreed and it is hoped to extend this facility to other parties.

The Exhibition Committee has made it possible for exhibitors to participate in a wide variety of ways - those who wish to show machinery on stands with platforms may do so in the New Hall *where this year a licensed refreshment bar will be available*; others wishing to use rooms which have carpets, lights and telephones already installed - and thus reduce the cost of participating - can apply for these facilities on either the Mezzanine or third floors (on both of which there are rooms of varying sizes and charges) and others still may apply for stands in the Queen

Mary Suite, where no platforms are provided since the floor is carpeted as an integral part of the hotel decoration. Some organisations have already booked both stand space and rooms for more private interviewing and hospitality, and the hotel will also arrange for alcoholic and other refreshments to be served on any of the stands in both the New Hall and the Queen Mary Suite.

In order to encourage exhibitors with stands in the halls wishing to have separate private rooms for interviews and hospitality, the Committee has decided to make substantial reductions of 25 per cent and 10 per cent on the charges for the third floor rooms in these cases. Full details can be obtained from the Association's offices.

Not only is London a nerve centre of the air travel networks, but it offers unrivalled entertainment facilities for after-exhibition hours. Arrangements have been made with various hotel groups (for example Grand Metropolitan Hotels and British Rail Hotels) for special reduced accommodation rates for the period of the Exhibition and leaflets will be available from the Association's office.

The Cunard International Hotel is

situated in Hammersmith, West London and is within easy walking distance from Hammersmith Station, which has a direct link by Piccadilly Underground Line to Heathrow Central Station at Heathrow Airport. Those arriving at Gatwick Airport should proceed, via Victoria Station, on the District Underground Line to Hammersmith Station. Hammersmith Station is also served by the Metropolitan Line. The Hotel is adjacent to the Hammersmith Flyover on the M4 Motorway and there is a large car park in King's Mall off nearby King Street.

The Association each year produces an information leaflet in six languages (English, French, German, Italian, Russian and Spanish) and these are widely distributed both to visitors at previous exhibitions and through overseas and United Kingdom journals. The Exhibition is also widely advertised in journals within the surface coatings industries.

Admission to the Exhibition will, once again, be FREE but visitors will be asked to sign registration cards and these can be obtained in advance of the Exhibition by exhibitors wishing to send them to their customers, or by individuals applying to the Association for copies of the "Official

Guide" (£1.50 each - 12 copies free to exhibitors). The "Official Guide" (in which each exhibitor has a free editorial entry) will as usual be available several weeks prior to the Exhibition and further publicity about the stands, exhibits and other arrangements will appear in the Exhibition Preview issue of *JOCCA*; a full report will appear in the Review issue.

Full details of the facilities available are given in the Invitation to Exhibit and copies of this leaflet, together with application forms and leaflets describing advertising in both the "Official Guide" to the Exhibition and the Association's Journal *JOCCA* can be obtained from the Association's offices at the address of which is shown on the contents page.

Association Notices

Binding of Journal

Members will be pleased to know that J. S. Wilson & Son, 14a Union Road, Cambridge CB2 1HE, will undertake the binding of back volumes of the Association's *Journal* sent in by individual Members. Quotations will be given on request.

Members wishing to avail themselves of this facility should send the parts, securely wrapped, direct to J. S. Wilson & Son, enclosing the remittance for each volume, and ensuring that notes bearing names and addresses are enclosed with the parcels. It is particularly important that packets are sufficiently wrapped to negate the possibility of damage in the post.

1981 Members subscriptions

Members are reminded that the 1981 Membership subscriptions to the Association are payable on 1 January 1981. Forms were despatched to Members in October or November, depending upon address.

The Commissioners of Inland Revenue have approved of the Association for the purpose of the 1970 Income and Corporation Taxes Act Section 192, so that a Member subject to United Kingdom income tax is entitled to a deduction from the amount of his emoluments assessable to income tax under Schedule E for the whole of the annual subscription to the Association, provided that the subscription is defrayed out of

the emoluments of his office or employment and that the interests covered by the objects of the Association are relevant to such office or employment.

Members resident in the United Kingdom are reminded that if there is any change in the standard rate of Value Added Tax announced before they send in their 1981 subscription, the VAT payable on membership subscriptions is the amount which applies on the date of payment.

1981 Library subscriptions

The *Journal* subscription rate to non-members, including libraries, for 1981 will be £40.00 (\$100) post free by surface mail, home and abroad. Individual copies can be purchased for £4.00. Remittances should be sent with an order to the Association's offices.

Retired Members

Council also wishes it to be known widely that in 1962 it introduced a reduced Membership subscription rate for Members who have retired from Business. This applies to a Member who has completed 20 years as an Ordinary or Associate Member and has retired from business and normally has reached the age of 60; he may apply for his name to be retained on the Register of Members at an annual subscription rate of £1.50 and he will retain the same rights of Membership as the class of Membership to which he was attached upon retirement.

Members wishing to avail themselves of this concession should write, in confidence, to the Director & Secretary at the address on the Contents page, giving the relevant information under the four headings: (a) name, address and Section, (b) date of election, (c) date of retirement, (d) age.

Situations wanted

Any Member who wishes to place a small advertisement (with Box Number) in the Situations **WANTED** section of *JOCCA* can do so *without charge* by sending details to the Director & Secretary, marking the envelope "**CONFIDENTIAL**".

Monographs and Student Reviews

Council wishes to publish in the *Journal* occasional monographs or Student Review type articles for the benefit of younger technologists to act as introductions to some specialised fields in the industry. It is intended that such articles would then be reprinted as separate booklets. Council wishes to invite suggestions from Members of suitable topics for such a series of articles, *together with the names of persons who would be willing to write the articles*.

Any Members who would be willing to write such a monograph, or who can suggest another person who might be willing to do so, should write to the Director & Secretary at the address on the Contents page giving full details.

Anyone who has allowed his membership of the Association to lapse and now desires to rejoin the Association is reminded that previous service as an Ordinary member (or Registered Student) can be counted towards the qualifying period of membership set out in the regulations.

The attention of senior members of the Association is particularly drawn to the Licentiate Grade and they are asked to encourage younger technical personnel to take advantage of this important Association activity. Several Colleges are now willing to help suitable candidates with the preparation of dissertations and a list of Colleges was given in the August 1980 issue of the *Journal* (p 361).

Reprints of the regulations covering the Professional Grade are obtainable from the Association's offices, together with application forms.

List of successful candidates

As laid down in the report of the Working Party on Education, Training and Qualifications which was adopted in the institution of the Professional Grade, a list of those Members in the Grade is published in the December issue of the *Journal* each year. The ninth such list appears below and includes the names of members resident in 33 countries.

The Section to which the Member is attached is given in italics.

The certification fees at present are: Fellows £10.00 + VAT, Associates £6.00 + VAT, and Licentiates £3.00 + VAT. The regulations for admission to each grade appear on page 509 of this issue of the *Journal*.

Fellows

Addenbrooke, Brian John (*Midlands*)
Aitken-Smith, Frank Joseph (*Auckland*)
Anderson, George (*Scottish*)
Anneveldt, Jan Johan Willem (*South Africa*)
Apperley, Thomas William James (*West Riding*)
Archer, Harold (*Manchester*)
Arnold, Michael Henry Miller (*London*)
Ashworth, Norman (*Manchester*)
Astfalk, Anthony Noel (*Transvaal*)
Atherton, Donald (*Scottish*)
Austin, Denis Leonard (*Bristol*)
Bailey, John Noel (*Newcastle*)
Banfield, Thomas Arthur (*London*)
Bayliss, Derek Arthur (*London*)

Optional Professional Grade for Ordinary Members

Beachen, John Frederick (*Auckland*)
Beere, Andre Jaimie (*Thames Valley*)
Bell, Richard Thomas (*Auckland*)
Bell, Sydney Hector (*London*)
Bennett, Norman Arthur (*General Overseas-Malta*)
Bester, Lawrence Percy (*Transvaal*)
Bhumkar, Chidanand Jayram (*General Overseas-India*)
Birrell, Peter (*Ontario*)
Bishop, Eric Harold Abbott (*West Riding*)
Bohringer, Eberhard (*London*)
Boroky, Joseph Stephen (*General Overseas-Australia*)
Bosman, Herman Izak (*Transvaal*)
Bourne, John Robert (*Midlands-Trent Valley Branch*)
Brooks, Leo James (*London*)
Brown, Arthur Ernest Girdlestone (*London*)
Butcher, George Alfred (*Midlands*)
Butcher, Kenneth William George (*Manchester*)
Butler, Cecil (*West Riding*)
Caldwell, David George (*Wellington*)
Campbell, George Alexander (*Manchester*)
Carr, William (*Manchester*)
Carter, Eric Victor (*Midlands*)
Chatfield, Herbert Walter (*London*)
Chessman, Clifford Reginald (*Transvaal*)
Clarke, Harry James (*Midlands*)
Colborn, Douglas Charles (*Thames Valley*)
Cole, Derek (*General Overseas-Australia*)
Cole, Reginald Joseph (*London*)
Collier, Claude William (*Midlands-Trent Valley Branch*)
Collings, Arthur Geoffrey (*London*)
Cook, Harold Gilbert (*London*)
Coupe, Raymond Richard (*London*)
Coverdale, Peter Frederick Muir (*Midlands*)
Cutter, John Outram (*London*)
Davidson, John Dixon Wilson (*Scottish*)
Davidson, Sigismund Leonard (*General Overseas-USA*)
de Jong, Jan Lauwrens (*Transvaal*)
Dowsing, George Frederick (*London*)
Duckworth, Samuel (*Manchester*)
Duligal, Eric Arthur (*Transvaal*)
Dunkley, Frederick George (*Midlands-Trent Valley Branch*)
Durrant, George Geoffrey (*Hull*)
Easton, James Douglas (*Ontario*)
Eglington, Roland Alexander (*Natal*)
Ellinger, Marianne Livia (*London*)
Entwistle, Thurston (*Newcastle*)
Ernst, Joel (*London*)
Faulkner, Raymond Noel (*Manchester*)
Finn, Stanley Russell (*London*)
Froggatt, Joshua John (*London*)
Fullard, John Edward (*Transvaal*)
Gate, Peter Atholl Jackson (*Transvaal*)
Gay, Philip James (*Hull*)
Geddes, Kenneth Raymond (*Manchester*)
Gellay, Victor Peter (*London*)
Gelman, Alexander (*London*)
Ghosh, Sunil Kumar (*General Overseas-India*)
Giesen, Mathias Franz (*General Overseas-Germany*)
Gillan, James Graham (*Manchester*)
Gollop, Percy Lionel (*London*)
Gooch, Colin (*Wellington*)
Gosling, Harry (*Manchester*)
Graham, Thomas (*Manchester*)
Grainger, William Alan (*Irish*)
Gray, Denis Roy (*West Riding*)
Grover, Donald Henry (*London*)
Haken, John Kingsford (*General Overseas-Australia*)
Hamburg, Herman Rudolf (*London*)
Hanson, Robert Philip (*Newcastle*)
Hawkey, John Albert Lawrence (*London*)
Hill, Gilbert Victor Geoffrey (*Thames Valley*)
Hill, Lawrence Albert (*General Overseas-Australia*)
Hipwood, Hubert Allan (*London*)
Hodgson, Kenneth Vickerson (*Newcastle*)
Holbrow, Gordon Leonard (*London*)
House, Dudley James (*Natal*)
Hutchinson, Geoffrey, Herbert (*Scottish-Eastern Branch*)
Inshaw, John Leslie (*Thames Valley*)
Iyengar, Doreswamy Raghavachar (*General Overseas-USA*)
Jacob, Basil (*Thames Valley*)
Johannsen, Ralf Peter (*Cape*)
Johnson, Roland Emanuel George (*General Overseas-Zimbabwe Branch*)
Jolly, Anthony Charles (*Manchester*)
Kalewicz, Zdzislaw (*General Overseas-France*)
Kane, Joseph Richard (*London*)
Keenan, Henry Wilfred (*London*)
Kotwal, Hoshidar Peshotan (*General Overseas-Pakistan*)
Kut, Sigmund (*London*)
Landmann, Axel Wolfgang (*London*)
Lasser, Howard Gilbert (*General Overseas-USA*)
Lewin, John Buckingham Grey (*London*)
Lewis, Fred (*Manchester*)
Ley, John Barry (*Ontario*)
Lomas, Harold (*Ontario*)
Lunt, Walter Richard (*West Riding*)
McKelvie, Archibald Neil (*London*)
McLean, Angus (*Scottish*)
McQuirk, Peter John (*London*)
Mitchell, John Edmund (*Manchester*)
Mitchell, Seward John (*Midlands*)
Moll, Ivor Stuart d'Anvers (*Manchester*)
Monk, Cyril James Henry (*Bristol*)
Moon, William Robert (*Manchester*)
Morgans, Wilfred Morley (*London*)
Morris, David (*London*)
Munn, Raymond Henry Edward (*London*)
Newnham, Herbert Alan (*London*)
Newton, Dennis Sydney (*London*)
Newton, Donald Stringer (*Bristol*)
Nutt, William Owen (*London*)
Oostens, Emile Elie Eugene (*General Overseas-Belgium*)

OCCA news

Parfitt, Geoffrey Derek (*Newcastle*)
 Pienaar, Dirk Jacobus (*Transvaal*)
 Piggott, Kenneth Elliot (*Natal*)
 Poborca, Stefan (*Midlands*)
 Polaine, Sidney Alan (*London*)
 Raaschou Nielsen, Hans Kristian
 (*General Overseas-Denmark*)
 Ray, Stanley Arthur (*Midlands*)
 Rechmann, Heinz
 (*General Overseas-Germany*)
 Reid, John Rodney Stanford
 (*Natal*)
 Rileigh, Albert Kenneth
 (*General Overseas-Australia*)
 Roe, David Edwin (*London*)
 Rose, Charles (*Manchester*)
 Rouse, Robert Earnshaw (*Transvaal*)
 Rubin, Wallace (*London*)
 Rudram, Arthur Thomas Stephen
 (*London*)
 Saunders, Laurence Frederick (*Natal*)
 Seymour, Norman Henry (*Manchester*)
 Shepherd, Joseph (*Newcastle*)
 Silsby, Denys John (*Midlands*)
 Sim, Richard Alastair
 (*General Overseas-Australia*)
 Simon, Raymond (*Irish*)
 Slade, Harold Aitken (*Midlands*)
 Slinn, Thomas Walter (*Wellington*)
 Smethurst, Jack (*Manchester*)
 Smith, Francis Mark (*Manchester*)
 Smith, Harry (*Manchester*)
 Smith, John George Nixon (*Newcastle*)
 Sowerbutts, Frank (*London*)
 Sreeves, John Ernest (*Midlands*)
 Stoodley, Keith Herbert (*London*)
 Stoyle, Francis Wilbert (*Irish*)
 Talbot, Ernest Alexander
 (*Thames Valley*)
 Tatton, William Henry (*Thames Valley*)
 Tawn, Alec Richard Hornsey (*London*)
 Taylor, John Roberts (*Bristol*)
 Thukral, Prem Sager (*London*)
 Tickle, Trevor Cyril Kenneth
 (*Manchester*)
 Tooke-Kirby, John Theodore
 (*London*)
 Tooth, John Henry Collins (*London*)
 Touchin, Herbert Roy (*Manchester*)
 Turner, John Harry Wallace
 (*Manchester*)
 Valentine, Leslie (*London*)
 Walker, Alan Gordon (*Newcastle*)
 Wall, Dennis Charles (*Manchester*)
 Warner, Eric Albert Andrew
 (*Wellington*)
 Watkinson, Leonard James
 (*West Riding*)
 Westwood, George Ernest (*London*)
 White, Robert Arthur (*Auckland*)
 Whiteley, Peter (*London*)
 Whitfield, Thomas (*Auckland*)
 Wilkinson, Thomas William (*Hull*)
 Willis, Gervase Hewitson (*Manchester*)
 Wood, George (*London*)
 Woodbridge, Richard John (*Bristol*)
 Worsdall, Herbert Charles (*London*)
 Yorath, Robert Stanley (*Wellington*)

Associates

Abel, Adrian George (*Manchester*)
 Acey, John Arthur (*London*)
 Adams, John Charles (*Midlands*)
 Adams, Terry Ernest (*London*)
 Anthony, Alan Sydney (*London*)

Armstrong, Edward (*Hull*)
 Armstrong, Herbert Walter Maynard
 (*London*)
 Arnold, Frank (*Manchester*)
 Assink, Jo (*Auckland*)
 Asubonteng, Samuel Kofi
 (*General Overseas-Ghana*)
 Awan, Mumraiz Khan
 (*General Overseas-Kuwait*)
 Bains, Ranjit Singh (*London*)
 Baldwin, George William (*Manchester*)
 Bannington, Donald Bertram (*London*)
 Bargrove, Kenneth Laurence (*London*)
 Barnes, Peter James (*London*)
 Barton, James Francis (*London*)
 Batch, Alan James Edward (*London*)
 Bax, John Charles
 (*General Overseas-USA*)
 Beckley, Albert Henry (*London*)
 Bell, Brian Robert (*Midlands*)
 Belsham, Barry Michael
 (*General Overseas-Cyprus*)
 Bentley, Major Gordon (*West Riding*)
 Bird, George Donald Chaplyn
 (*Midlands*)
 Bloomfield, Kenneth Vincent (*London*)
 Bluck, Ross Steele (*Wellington*)
 Bolam, Ion Barrow (*Newcastle*)
 Bose, Sunil Kumar (*London*)
 Bowler, Kenneth Ernest (*Midlands*)
 Boxall, John (*Thames Valley*)
 Braund, Valerie Mavis (*Bristol*)
 Brooke, Leslie John (*Bristol*)
 Brown, Peter Thomas (*London*)
 Byrns, Arthur Robin (*Cape*)
 Caffery, George Francis (*London*)
 Calder, Robert Malcolm (*Auckland*)
 Campbell, Douglas Shaw (*Transvaal*)
 Campey, Leslie John Randall
 (*Ontario*)
 Canterford, Barry Albert (*London*)
 Cartwright, Jeffrey (*London*)
 Catchpole, David Thomas (*Scottish*)
 Catherall, Kenneth David (*Midlands*)
 Chambers, Anthony (*London*)
 Chebsey, Maurice (*Manchester*)
 Chellingsworth, Horace Thomas
 (*Midlands*)
 Chippington, Kenneth Alan (*Bristol*)
 Churchman, Anthony Edward
 (*London*)
 Clark, Laurence Norman (*London*)
 Clark, Michael Denis Thomas
 (*Wellington*)
 Clarke, Raymond John (*London*)
 Clayton, David Walter Norbury
 (*Manchester*)
 Clausen, Hans Christian (*Natal*)
 Clement, Donovan Harry (*Midlands*)
 Coates, John Allen (*Manchester*)
 Cole, Francis William (*Midlands*)
 Constantinides, Erricos (*London*)
 Cordwell, Terrence Allan
 (*Midlands-Trent Valley Branch*)
 Cowie, Edward Bruce
 (*General Overseas-Kenya*)
 Cox, Garth Anthony (*West Riding*)
 Craske, Anthony John
 (*General Overseas-Indonesia*)
 Cunnington, Robin Roy Carol
 (*London*)
 Daggett, Wilfred Francis (*London*)
 Dalton, Frank
 (*General Overseas-Denmark*)
 Davies, Frank Watkin (*Manchester*)
 Davis, Reginald Albert (*Bristol*)
 de Waal, Tielmann Johannes
 (*Cape*)
 Dennis, Reginald Herbert (*London*)
 Devine, James (*Transvaal*)
 Donkersley, Brian (*London*)
 Downham, Stephen Airey
 (*Manchester*)
 Drew, Harold Henry Lennox
 (*Midlands*)
 Dunn, Paul Alan (*London*)
 Durant, Leslie Arthur William
 (*London*)
 Durdy, Alan James (*Newcastle*)
 Dury, Ian Clifford James
 (*Thames Valley*)
 Eaton, Michael George
 (*Thames Valley*)
 Ebdon, James William
 (*General Overseas-Zimbabwe Branch*)
 Ekeh, Godwin Chukoemeka
 (*General Overseas-Nigerian Branch*)
 Elliott, Peter (*London*)
 Eltringham, James Norman (*Auckland*)
 Fairless, Joseph (*London*)
 Fell, Alan William (*Thames Valley*)
 Fernandes, Larry Raphael Francis Joseph
 (*London*)
 Field, Lawrence Edward (*Natal*)
 Finlay, Cecil Newton (*Newcastle*)
 Fisher, Leslie Alexander
 (*General Overseas-Malaysia*)
 Flood, Geoffrey Terence (*Manchester*)
 Ford, Keith Sydney (*Manchester*)
 Formanek, Leopold
 (*General Overseas-Czechoslovakia*)
 Frazee, Jerry Daniel
 (*General Overseas-USA*)
 Fry, Jack Ian (*Wellington*)
 Garratt, Peter Garth
 (*General Overseas-Austria*)
 Gascoyne, John (*Auckland*)
 Gay, Alan Stanley (*Midlands*)
 Gibson, Frank (*Manchester*)
 Gibson, John Carrington (*Hull*)
 Gilliam, Brian Frederick (*London*)
 Goodman, Robert John
 (*General Overseas-Spain*)
 Green, Basil Ray
 (*General Overseas-Trinidad*)
 Green, Brian James (*London*)
 Greenall, Brian John (*Wellington*)
 Greenfield, Eric (*Midlands*)
 Griffiths, Henry James (*Midlands*)
 Grime, David (*London*)
 Gunn, David John (*Midlands*)
 Gunn, Reginald (*Thames Valley*)
 Hackney, Thomas (*Auckland*)
 Hamilton, Alexander (*Scottish*)
 Hardie, Ian William (*London*)
 Harrison, Cyril Geoffrey (*Hull*)
 Harty, David Basil
 (*General Overseas-Australia*)
 Hasnip, John Anthony (*Hull*)
 Heald, Desmond (*Manchester*)
 Heffer, Victor George (*Manchester*)
 Herriott, Charles Edward (*London*)
 Hickman, Edwin Peter (*Midlands*)
 Hill, Raymond Forsyth (*Scottish*)
 Hitchough, Rex Henry (*London*)
 Hodge, Robert Alexander Paul
 (*Auckland*)

OCCA news

Holden, William Desmond
(*Manchester*)
Holt, Clifford (*West Riding*)
Homden, Kenneth James Arthur
(*London*)
Honiball, Alan Edward (*Manchester*)
Hopper, Derek Edgar (*Midlands*)
Hossack, James (*Scottish*)
Howard, Eric (*Manchester*)
Howells, Barry John (*Hull*)
Howes, Edward John (*London*)
Hughes, Anthony Harold (*Manchester*)
Humphrey, Thomas Lawson Myles
(*Scottish*)
James, Tudor Herbert (*Irish*)
Jangbahadur, Shyam Sharan
(*General Overseas-India*)
Jenkins, Brian Gordon Allan
(*Auckland*)
Johnsen, Svend
(*General Overseas-Denmark*)
Johnstone, James William
(*Manchester*)
Jones, Derek Frederick Arthur
(*Thames Valley*)
Jones, Geoffrey Peter (*Wellington*)
Kaye, Dennis David (*London*)
Kenna, Frank William (*Manchester*)
Kerr, Michael Anthony (*Manchester*)
Khan, John Mohammed (*Manchester*)
King, Charles William Henry
(*Midlands*)
King, Raymond John (*Midlands*)
Kirkwood, Thomas (*Scottish*)
Kirlew, Charles Wesley
(*General Overseas-USA*)
Kitchen, John Robert
(*Midlands-Trent Valley Branch*)
Knight, Richard Charles (*London*)
Laker, Bernard George (*London*)
Lakshmanan, P. R.
(*General Overseas-USA*)
Lander, Wilfred Terence (*London*)
Lang, Robert (*Scottish*)
Langford, Henry (*London*)
Langley, Robert (*Scottish*)
Lau, Ang Kong
(*General Overseas-Singapore*)
Lawton, Cyril Victor (*Midlands*)
Leathley, George Derek (*Auckland*)
Le Maistre, Paul Francis (*Midlands*)
Lever, Colin (*Manchester*)
Lewis, Geoffrey John (*Midlands*)
Lewis, John David (*Thames Valley*)
Low, Charles
(*General Overseas-Australia*)
Macdonald, Alan (*Auckland*)
Malik, Javed Haider
(*General Overseas-Pakistan*)
Mandagi, Willy
(*General Overseas-Indonesia*)
Mandelson, Jack (*Scottish*)
Maple, Donald Peter (*London*)
Marsden, Chris Eyre (*Manchester*)
Martin, Christian Pierre
(*General Overseas-France*)

Maynard, Albert William David
(*Overseas*)
McCallum, Ian Robert (*Scottish*)
McCapra, Ronald (*Auckland*)
McDonald, Kenneth Roy (*Natal*)
McDonnell, Christopher Robin Stack
(*West Riding*)
McFetridge, John Henry (*Wellington*)
McKay, Alan Gordon (*London*)
McKean, James Newlands (*Auckland*)
McMillan, James (*Manchester*)
Mephram, Brian Edwin (*London*)
Mikucki, Wiktor (*London*)
Mills, Thomas Nelson (*Transvaal*)
Moore, Frank Roden (*West Riding*)
Moore, James (*Thames Valley*)
Moore, Ronald Henry (*West Riding*)
Moore, William Alexander (*Auckland*)
Morpeth, Frederick Johnson
(*Manchester*)
Moss, Noel Sydeny (*London*)
Mun-Gavin, Patrick William James
(*Natal*)
Munro, Hugh Anderson (*Scottish*)
Murray, David John (*Manchester*)
Murray, Robert Frederick (*London*)
Myers, Gordon (*Transvaal*)
Mynett, Raymond John (*Midlands*)
Naess, Erik
(*General Overseas-Norway*)
Ness, Robert Alexander (*Auckland*)
Newman, Derek George (*Transvaal*)
Nolan, Michael Melvyn (*Irish*)
Norton, Douglas Kent (*Midlands*)
Oakley, Ernest (*Newcastle*)
O'Connor, Eugene Daniel
(*Manchester*)
Ohene-Kwadade, Kofi
(*General Overseas-Ghana*)
Orpwood, John Leonard (*London*)
Oswitch, Stanley (*Ontario*)
Pace, Graham (*Thames Valley*)
Parry, Martin Gerald (*London*)
Patel, Shrish Manibhai (*Ontario*)
Patrick, Alan Clive (*Irish*)
Payne, Edward James (*Manchester*)
Payne, Kenneth (*Bristol*)
Pemberton, Joseph James (*London*)
Peng, William Yeo Kok
(*General Overseas-Singapore*)
Perry, Leonard C. (*Bristol*)
Pessall, Robert George (*Midlands*)
Piper, Norman William (*Manchester*)
Porteous, Barrie Milroy (*Ontario*)
Proudley, Philip Miles (*West Riding*)
Provan, Andrew Wilson (*Wellington*)
Quorn, Peter James (*Cape*)
Rackham, John Michael (*Newcastle*)
Rampley, Dennis Neil (*London*)
Redman, Frank Benson (*Manchester*)
Reeve, Frank Nicholson (*Transvaal*)
Roberts, Peter David Mynwy
(*London*)
Robinson, Arthur Graham
(*Manchester*)
Robinson, Francis Derrick (*Hull*)
Rothwell, Gerald William (*London*)
Rout, Peter George (*West Riding*)
Routley, Alan Francis (*London*)
Russell, Frederick Charles (*London*)
Rycroft, Christopher Peter (*London*)
Scheinost, Bernd (*Natal*)
Semple, James William (*London*)
Sharp, Peter Frank (*Auckland*)
Sharpe, David (*London*)
Sheikh, Saed
(*General Overseas-Pakistan*)
Silverwood, David (*Manchester*)
Smith, Brian James (*London*)
Smith, David Dorman (*Scottish*)
Smith, Harry Bertram (*London*)
Soman, Chettiparambil
(*General Overseas-Spain*)
Sowerby, Alan Hope (*Auckland*)
Spaargaren, Albert Arend (*Natal*)
Spargo, Robert (*Auckland*)
Speding, George (*London*)
Springett, Robert Arthur Edward
(*London*)
Staples, Peter Graham (*London*)
Stephenson, Robert Perry (*Auckland*)
Stone, James Bryan (*London*)
Stott, Raymond (*Manchester*)
Stretton, Elizabeth (*Manchester*)
Surinphong, Julian Suriya
(*General Overseas-Thailand*)
Sutton, Peter Michael (*London*)
Talwalkar, Vinayak Sakharam
(*London*)
Tape, Brian William Charles
(*General Overseas-USA*)
Taylor, Richard Anthony John
(*London*)
Taylor, Terence (*Manchester*)
Thomas, Anthony
(*General Overseas-Brazil*)
Thornton, Philip Joseph Martin
(*Irish*)
Tillyer, Richard Brian (*London*)
Topping, George David (*London*)
Toovey, John (*Scottish*)
Trevitt, Edwin William (*London*)
Triggs, Francis Cyril (*London*)
Troparevsky, Alejandro
(*General Overseas-Argentina*)
Tye, Terence Thomas (*Midlands*)
Van der Merwe, Hendrik Albertus
Johannes (*Natal*)
Van Londen, Anton Matthijs
(*General Overseas-Holland*)
Venus, Norman (*Transvaal*)
Walker, Peter (*Thames Valley*)
Webb, Laurence (*Manchester*)
Weineck, Terrence Graham (*Natal*)
Whalley, James (*Nigeria*)
Whalting, Allan (*Manchester*)
Wheatley, Kenneth Valentine (*Irish*)
Whetstone, Peter John (*London*)
Whiteside, Alexander Edward
(*General Overseas-USA*)
Williams, Adrian Arthur Owen
(*London*)
Williams, Cyril (*Manchester*)
Windsor, Frederick Barry
(*Manchester*)
Woolf, John Clifford (*Bristol*)
Woolf, Frederick James (*London*)
Wu, Andrew Chi Kit
(*General Overseas-Hong Kong*)
Young, Hugh (*West Riding*)
Zissel, Martin John (*London*)

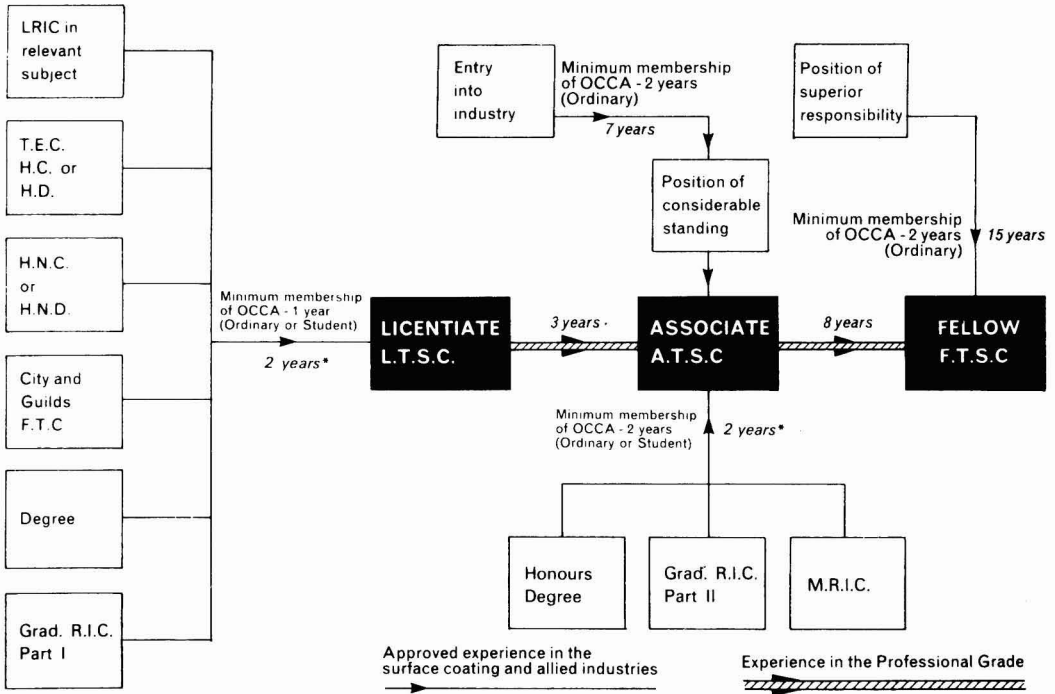
Licentiates

Asiedu-Dompreeh, Johnathan (*London*)
Hemmens, Anthony John (*Bristol*)
Leonard, Michael William (*London*)
Lodge, David William (*London*)
Richardson, Robert Keith (*London*)
Rogers, Michael Ambrose
(*General Overseas-Trinidad*)
Rowntree, Randal Peter (*Manchester*)
Saggarr, Anoop Kumar
(*General Overseas-Kenya*)
Sawyer, Olatunji Pekun
(*General Overseas-Nigeria*)
Schiebaum, James Helmut (*London*)

Optional Professional Grade for Ordinary Members

The innovation of the Professional Grade has proved to be most successful, as evidenced by the impressive list of names in the December issue of the *Journal*. For the convenience of potential applicants, a chart indicating different routes to the various grades is shown below.

Routes to the Professional Grades



*Not necessarily after qualification - see regulations.

Note: At present there is no restriction on Students up to 21; between 21 and 25 a certificate from the employer or college confirming the course being taken is required.

Regulations for admission to the Professional Grade - Amended December 1979

Note: For the sake of simplicity, reference is made only to UK examinations etc., but equivalent qualifications overseas will naturally be accepted.

A. Licentiate

1. Shall be an Ordinary Member of the Association and have been an Ordinary Member or Student of the Association for not less than one year.
2. Shall have attained the age of 22.
3. (a) Shall be a Licentiate of the Royal Institute of Chemistry in Coatings Technology or another relevant subject, such as advanced analytical chemistry, colour chemistry or polymer science.
- OR (b) Shall have passed the Higher Certificate or Higher Diploma of the Technician Education Council in coatings technology or other relevant subjects.

- OR (c) Shall have passed Higher National Certificate or Higher National Diploma in a relevant subject.
- OR (d) Shall hold the Full Technological Certificate of the City and Guilds of London Institute in a relevant subject.
- OR (e) Shall be a graduate in a relevant subject.
- OR (f) Shall have passed Part I of the examination for the Graduateship of the Royal Institute of Chemistry or Council of Physics.
- OR (g) Shall have passed such other qualifications as approved by the professional Grade Committee from time to time.

4. Shall have attained approved experience in the science or technology of coatings. It is not expected that sufficient experience would be gained in a period of less than two years in the industry. Approved experience may be gained before, during or after the qualifications in paragraph (3) above have been attained.
5. Shall be required to satisfy the Professional Grade Committee, or some other body approved by the Professional Grade Committee in a *viva voce* examination and submit a dissertation on a topic previously approved by the Professional Grade Committee.
6. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either

Associate or Fellow) at least one of whom must be a Fellow.

7. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

B. Associate, being already a Licentiate

1. Shall, since his election to the Licentiatehip, have practised the science or technology of coatings for not less than three years.
2. Shall provide evidence acceptable to the Professional Grade Committee of his superior professional skill and maturity.
3. Shall have published work which, in the opinion of the professional Grade Committee, is of a sufficiently high standard OR may be required to submit a thesis or dissertation on a topic previously approved by the professional Grade Committee OR shall hold the City & Guilds of London Institute Insignia Award.
4. MAY be required to satisfy the Professional Grade Committee or some other body as approved by the Professional Grade Committee in a *viva voce* examination.
5. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.
6. Shall have paid the fee stipulated by Council and have paid the current subscription payable by an Ordinary Member.

C. Associate, not already a Licentiate

EITHER

1. Shall be not less than 24 years of age.
2. Shall be an Ordinary Member of the Association and have been an Ordinary member or Student of the Association for not less than two years.
3. Shall hold the Graduateship of the Royal Institute of Chemistry or Council of Physics or a University or Council of National Academic Awards degree recognised by the Royal Institute of Chemistry or Institute of Physics as giving full exemption from the Graduateship examination.
4. Shall have attained approved experience in the science or technology of coatings. It is not expected that sufficient experience

would be gained in a period of less than two years in the industry. Approved experience may be gained before, during or after the qualifications in paragraph (3) above have been attained.

5. Shall normally be required to satisfy the Professional Grade Committee or some other body approved by the professional Grade Committee in a *viva voce* examination.
 6. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.
 7. Shall have paid the fee stipulated by Council and have paid the current subscription payable by an Ordinary Member.
- OR
8. Shall be not less than 30 years of age.
 9. Shall be an Ordinary Member of the Association and have been an Ordinary Member of the Association for not less than two years.
 10. Shall have been engaged in practising the science or technology of coatings for not less than seven years and shall have attained a position of considerable standing in the industry.

11. Shall normally be required to satisfy the Professional Grade Committee in *viva voce* examination of his professional competence.
12. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.
13. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

D. Fellow

Note: This is the senior award of the professional grade and signifies that the holder has made outstanding contributions to the science or technology of coatings or has reached a position of eminence in the industry through the practice thereof. The Professional Grade Committee will require substantial evidence of professional maturity in the science or technology of coatings although commercial experience will be taken into account in assessing the merits of candidates.

1. Shall be not less than 33 years of age.
2. Shall have been an Ordinary member of the Association for not less than two years.

3. Shall be engaged in a position of superior responsibility in the coatings industry.

4. EITHER (a) shall have been an Associate of the professional grade for at least eight years;

OR (b) shall have not less than fifteen years' experience of the science or technology of coatings in a position of superior responsibility.

5. Shall submit, with his application, an account of his experience, with due reference to scientific and technological interests, achievements and publications.
6. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade, all of whom must be Fellows.
7. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

The fees payable with applications are as follows:

Fellow—£10.00	Associate—£6.00
Licentiate—£3.00	
(Plus VAT at standard rate)	

Application

Completed application forms should be returned, together with the appropriate remittance, to the Director & Secretary at the Association's offices (except in the case of those Members attached to the Cape, Natal, Transvaal, Wellington, Auckland and Ontario Sections, who should address their forms to their Section Hon. Secretaries).

The Committee wishes it to be known that members rejoining the Association after a period in other industries may include length of service as an Ordinary Member before their resignation as part of the qualifying periods for entry into the Grade.

Students wishing to apply for entry into the Professional Grade must first make application in writing for upgrading to Ordinary Membership, giving the reasons for their eligibility for such regrading. Applications, together with the appropriate remittance, should be addressed as for application for admission to the Professional Grade.

Potential applicants are recommended to give the fullest possible details of their appointments, including the number and type of staff under their control, and indicating to whom the applicant is responsible, as this aids the committee considerably in its deliberations.

Professional Grade



At the meeting of the Professional Grade Committee held on 22 October 1980 the Committee authorised the following admissions to the Professional Grade Register. The section or branch to which each successful candidate is attached is shown in brackets.

Admitted as Fellows

Bell, Richard Thomas (*Auckland*)
de Jong, Jan Lauwrens (*Transvall*)
House, Dudley (*Natal*)
Sim, Richard Alastair (*General Overseas – Australia*)

Transfer from Associate to Fellow

Addenbrooke, Brian John (*Midlands*)

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

HENDERSON, ELIZABETH JANE, Inmont Ltd., James House, Roockery Street, Wednesfield, Wolverhampton (*Midlands*)

PORTER, FRANK CECIL, 7 Parke Road, Barnes, London SW13 9NF (*London*)

MACALLISTER, NEIL GORDON, 32 Tulloch Road, Springhill, Shotts ML7 5LD (*Scottish*)

HOLT, KENNETH ANTHONY, BSc, MSc, 36 Burnell Court, Manchester Road, Heywood, Lancs. OL10 2NW (*London*)

THOMSEN, GERT KOBURG, MSc, Furesokrogen 6, DK-2830, Virum/Denmark (*General Overseas*)

CRAWFORTH, CHARLES GEOFFREY, BSc, DPhil, 8 Ashgate Road, Willerby, Hull (*Hull*)

LUCY, CARYS GLENYS GRACE, BSc, Chinghall Ltd, Ward Road, Bond Avenue, Bletchley, Milton Keynes (*London*)

BALL, DONALD, C&G Croda Paints Ltd, 40 Jane Street, Leith, Edinburgh (*Scottish-Eastern*)

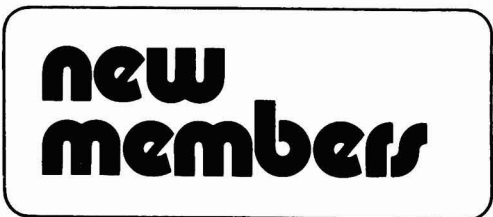
KEMMIS, LEONARD GEORGE, Walpamur Co. Ireland Ltd, 9 Cardiff Lane, Dublin 2 (*Irish*)

CHUA, AH GUAN, Block 9, 38A Holland Avenue, Singapore 1027 (*General Overseas*)

HOLT, MARTIN JOHN, BSc, 48C Grove Avenue, Yeovil, Somerset BA20 2BE (*Bristol*)

Admitted as Associates

Asubonteng, Samuel Kofi (*General Overseas – Ghana*)
Bains, Ranjit Singh (*London*)
Clausen, Hans Christian (*Natal*)
Ekeh, Godwin Chukoemeka (*Nigerian Branch*)
Gunn, David John (*Midlands*)
Mandagi, Willy (*General Overseas – Indonesia*)
Mun-Gavin, Patrick William James (*Natal*)
Porteous, Barrie Milroy (*Ontario*)
Van der Merwe, Hendrik Albertus Johannes (*Natal*)



HOWSE, IAN STUART, BSc, PO Box 494, Johannesburg 2000, South Africa (*Transvaal*)

CLOWES, MICHAEL IAN, 72 Robin Hey, Moss Side, Leyland, Preston, Lancs. (*Manchester*)

Registered Student

CARLISLE, JOHN ANDREW, 338 Leeds Road, Wakefield, West Yorks WF1 2JA (*West Riding*)

RAMSEY, KEITH LIONEL, 1 White Oak Gardens, Swanley, Kent BR8 7BA (*London*)

O'FLYNN, PAUL ANTHONY, 33 Hector Street, Plumstead, London SE18 1QT (*London*)

LE-MOIGNAN, ANTHONY, 58 Dunvegan, Vigo, Chester-le-Street, Co. Durham (*Newcastle*)

Associate Members

PALMER, BRIAN JOHN, 25 Glenlea Close, Stanningley LS28 6QH (*West Riding*)

HERCOCK, DEREK, 6 Rotherham Road, Dinnington, Sheffield S31 7RG (*West Riding*)

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

December

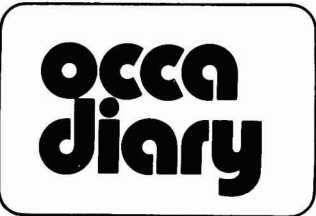
Monday 1 December

Hull Section: "Appreciation and Application of Microprocessors" by H. Dempsey, Senior Lecturer, Hull

College, at the Queens Hotel, George Street, Hull, commencing at 6.45 p.m.

Tuesday 2 December

West Riding Section: "Colour Measurement and Surface Coatings"



occa diary

by Dr D. A. Plant, at the Mansion Hotel, Roundhay Park, Leeds 8, commencing at 7.30 p.m.

Thursday 4 December

Newcastle Section: "The Impact of Recent Legislation on Health and Safety Aspects of Paint Products and Processes" by D. Howe, Toxicological Advisor, Paintmakers Association of Great Britain, at the Students Common Room, St. Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m.

Thames Valley Section: "Marketing practice at home and abroad" by R. L. T. Bickers, visiting tutor - International Market Staff College, Henley, at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing at 6.30 p.m. for 7.00 p.m.

Friday 5 December

Irish Section: "Pigmentation of White Printing Inks" by T. Entwistle of BTP Tioxide Ltd, at the Clarence Hotel, Dublin, commencing at 8.00 p.m.

Thursday 11 December

Scottish Section: "The Use of Liquid Colourants and Additives" by J. Hastings-Lang, Croda Chemicals Ltd, at the Albany Hotel, Glasgow, commencing at 6.00 p.m.

Friday 12 December

Manchester Section: Lecture "Solvent Based Masonry Paints" by Goodyear Ltd, at the Manchester Polytechnic, New Administration Building, All Saints, commencing at 6.30 p.m.

January 1981

Manchester Section: January, Joint Lecture with the Institute of Printing. *Details to be announced.*

Monday 5 January

Hull Section: "The Paint Tin" by J. B. Welbury and Mr Holmes of Metal Box Ltd, at the Queens Hotel, George Street, Hull, commencing at 6.45 p.m.

Thursday 8 January

Newcastle Section: "Stability of

Pigment Dispersions" by Dr M. Jaycock, Loughborough University, at the Students Common Room, St Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m.

Thursday 15 January

"Advances in Development of Water-Borne Printing Inks for the Major Printing Processes" by Dr C. Armstrong of Coates Bros Ltd. This meeting will be held in the Royal Scot Hotel, Edinburgh and is a joint *Scottish Section/Eastern Branch Meeting.*

London Section: "Hydrocarbon Solvents" by A. M. Cumbers of Carless Solvents Ltd, at the "Princess Alice", Romford Road, Forest Gate, E7, commencing at 6.15 p.m. To be followed by a buffet supper.

Friday 16 January

"Automotive Paints - Views of a user and a manufacturer" by M. Kelly of BL Ltd and R. Tennant of Carrs Paints. This will be held at the Chamber of Commerce and Industry, Birmingham and is a joint *Midlands Section/Trent Valley Branch Dinner Lecture.*

Wednesday 21 January

Manchester Section: Student Lecture "Pigments for Printing Inks" by Dr J. D. Sanders of Ciba-Geigy Plastics & Additives Co., at the Manchester Polytechnic, New Administration Building, All Saints, commencing at 4.30 p.m.

Thursday 22 January

Thames Valley Section: Works Visit. *Details to be announced.*

Friday 23 January

Irish Section: Open Forum - Panel from Paint/Printing Ink Industries and IIRS, at the Clariféic Höfel, Dublin, commencing at 8.00 p.m.

Friday 30 January

Bristol Section: "Paint Specifications - Acceptance procedures as they affect the Paint Industry" by R. L. J. Morris, QAD Woolwich, at the Royal Hotel, Bristol, commencing at 7.15 p.m.

February

Monday 2 February

Hull Section: "The Maintenance and protection of North Sea Structures" by F. M. Small of Berger (UK) Ltd, at the Queens Hotel, George Street, Hull, commencing at 6.45 p.m.

Tuesday 3 February

West Riding Section: Lecture on

"Some Aspects of Micro Processors". *Details to be announced.*

Thursday 12 February

Midland Section - Trent Valley Branch: "Dispersants-Theory and Practice" by Dr R. D. Harding of Bevaloid Ltd, at the Derby Crest Motel, Pasture Hill, Littleover, Derby, commencing at 7.15 p.m.

Scottish Section: "Water-Borne Systems" (a) Industrial Finishes by Tioxide International, (b) Wood Finishes by Hill Son & Wallace, at the Albany Hotel, Glasgow, commencing at 6.00 p.m.

Friday 13 February

Manchester Section: Lecture "Computer Match Prediction" by Dr I. Bridgman of Ciba-Geigy Ltd, at the Manchester Polytechnic, New Administration Building, All Saints, commencing at 6.30 p.m.

Scottish Section - Eastern Branch: Annual "Burns Supper" at the Commodore Hotel, Marine Drive, Edinburgh. *Details to be announced.*

Tuesday 17 February

London Section: "Surface Character & Performance of Organic Pigments" by Dr R. R. Mather of Ciba-Geigy Pigments & Additives Co. Joint meeting with the Society of Chemical Industry at the S.C.I. 14 Belgrave Square, London SW1 commencing at 6.00 p.m.

Midlands Section: "Pretreatment for Paint" by M. Danks of W. Cannings Materials Ltd, at the Calthorpe Suite, County Cricket Ground, Edgbaston, Birmingham, commencing at 6.30 p.m.

Thames Valley Section: "Truflex coatings for tennis court surfacing" by B. R. Wynne of R. J. Hamer & Sons Ltd, at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing at 6.30 p.m. for 7.00 p.m.

Wednesday 18 February

Manchester Section: Student Lecture "Woodpriming Paints" by Messrs F. Redman and W. Phillips of Crown Paints Ltd, at the Manchester Polytechnic, New Administration Building, All Saints, commencing at 4.30 p.m.

Ontario Section: Meeting at the York Suite of the Cambridge Motor Hotel, Ontario, commencing at 6.00 p.m.

Friday 20 February

Irish Section: Ladies' Evening. *Details to be announced.*

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

Index to Volume 63 – 1980

Page

Key:

- (E)—Editorial and Comment
- (L)—Letters
- (OM)—OCCA Meetings
- (ON)—OCCA News
- (R)—Reviews
- (SC)—Short Communications
- (T)—Transactions and Communications

Authors

- | | | |
|----------|--|-----|
| | Cross, J. A., Sampuran-Singh and Abu Bakar Ahmed. Deposition efficiency of powders in the electrostatic powder coating process (T) | 326 |
| D | | |
| | D'Alkaine, C. V., Garcia, C., Corti, H. and Gomez, D., Epoxy-chromate coatings: Electric and membrane results (T) | 23 |
| | Das, R. K., <i>see</i> Sengupta, S. C. (T) | 15 |
| | de la Court, F. H. The value of tributyltinfluoride as a toxicant in anti-fouling formulations (T) | 465 |
| | Dombey, S. and Stangroom, B. A., A comparative investigation of stains for wood (T) | 276 |
| E | | |
| | El-Anwar, I. M., <i>see</i> Badran, B. M. (T) | 399 |
| | — <i>see</i> Badran, B. M. (T) | 427 |
| F | | |
| | Falla, N. A. R., Solving air pollution problems in the manufacture and use of surface coatings (T) | 330 |
| | Firmin, R., <i>see</i> Verschupe, R. (T) | 287 |
| | Fowles-Smith, J. E., The corrosion consultant at large (T) | 404 |
| | Froggatt, J. J., Preservation, priming, putty and paints (T) | 237 |
| G | | |
| | Garcia, C., <i>see</i> D'Alkaine, C. V. (T) | 23 |
| | Ghanem, N. A., <i>see</i> Badran, B. M. (T) | 399 |
| | Ghosh, D., <i>see</i> Sengupta, S. C. (T) | 15 |
| | Gomez, D., <i>see</i> D'Alkaine, C. V. (T) | 23 |
| | Gooch, C. Applied finishes for timber in exterior situations in New Zealand (SC) | 492 |
| | Goswami, D. N., The relationship between glass transition and melting temperatures of natural resins (T) | 101 |
| | Guidice, C. A., Benitez, J. C., Rascio, V. J. D. and Presta, M. A., Study of variables which affect dispersion of antifouling paints in ball mills (T) | 153 |
| | Gunn, D. J., The coating of external plywood cladding panels (T) | 28 |
| | Guruviah, S., <i>see</i> Rajagopalan, K. S. (T) | 144 |
| H | | |
| | Haken, J. K. and Obita, J. A., The chromatographic analysis of fatty polyamide resins after alkali fusion (T) | 194 |
| | Heertjes, P. M., <i>see</i> Smits, C. I. (T) | 210 |
| | Hendifar, A. R., and Tirgan, M. R., A gas chromatography study of grape dipping oil (T) | 34 |
| | —A gas chromatography technique for the analysis of solvent mixtures based on hydrocarbons, esters, ethers etc, used in paints and lacquers (T) | 77 |
| | Hingorani, B. H., Uddin, A., Panda, H., and Rakshinda Epoxy esters of rosin (T) | 407 |
| I | | |
| | Ibrahim, M. S., <i>see</i> Badran, B. M. (T) | 399 |
| | — <i>see</i> Badran, B. M. (T) | 427 |
| J | | |
| | Jayasri, A. and Yascen, M., Solubility parameter values suggested using the reported and calculated values for organic compounds (T) | 61 |
| A | | |
| | Abd El-Ghafa, M.A., <i>see</i> Naser, A. M. (T) | 337 |
| | Abd-Ellah, I. M., <i>see</i> Naser, A. M. (T) | 337 |
| | Adefarati, F. B., Paints and painting problems in the tropics (T) | 367 |
| | Ahmad, H., Solubility parameter values of hydroxy polymers through its components and chemical group contribution technique (T) | 263 |
| | Ahmed, A. B., <i>see</i> Cross, J. A. (T) | 326 |
| B | | |
| | Badran, B. M., El-Anwar, I. M., Ibrahim, M. S. and Ghanem, N. A., A surface coating based on dehydrated castor oil. Part I: Physical and mechanical properties (T) | 399 |
| | Badran, B. M., El-Anwar, I. M. and Ibrahim, M. S., A surface coating based on dehydrated castor oil. Part 2: Dielectric properties (T) | 427 |
| | Banfield, T. A., OCCA Monograph Number 1 – Marine finishes. Part I (T) | 53 |
| | Banfield, T. A., OCCA Monograph Number 1 – Marine finishes. Part II (T) | 93 |
| | Bela Rani, Km., <i>see</i> Kapse, G. W., (T) | 70 |
| | Benitez, J. C., <i>see</i> Guidice, C. A. (T) | 153 |
| | Bishop, R. R. and Winnet, M. A., The evaluation of protective coatings on rusty steel with the use of electrical resistance probes as substrates (T) | 433 |
| C | | |
| | Carr, W., Patterson, D. and Tonge, M., Effect of pigmentation level on the efficiency of triple roll milling (T) | 438 |
| | C.E.P.E., American study on mortality rates in the coatings industry, preliminary details published (SC) .. | 340 |
| | Chandra, S. and Pasari, S., Esters of polystyrene glycol and rosin in surface coatings (T) | 225 |
| | Chandra, S. and Pasari, S., Copolymers of polystyrene glycol and glycerol phthalate resins in surface coatings (T) | 321 |
| | Colclough, M. L., Smith, N. D. P. and Wright, T. A., A low shear viscometer: An instrument for measuring flow and sag resistance in coatings (T) | 183 |
| | Cornish, F., <i>see</i> Walker, P. (T) | 243 |
| | Corti, H., <i>see</i> D'Alkaine, C. V. (T) | 23 |
| | Counsell, P. J. C., <i>see</i> Welch, M. J. (T) | 137 |
| | Croll, S. G., Correlation of the adhesion of a polystyrene lacquer to inorganic substrates and their wetting characteristics (T) | 200 |
| | —Effect of solvents on residual strain in clear epoxy coatings (T) | 230 |
| | —An overhanging beam method for measuring internal stress in coatings (T) | 271 |

K	<i>Page</i>	K	<i>Page</i>
Kapse, G. W. and Bela Rani, Km., Zinc-rich paints (T)	70	alkyd based TiO ₂ paints (T)	373
Khanna, B. N. <i>see</i> Tripathi, S. K. M. (T)	149	Schenck, H. U. and Stoelting, J., Electrodeposition: anodic versus cathodic (T)	482
Khouzondar, A. N., <i>see</i> Naser, A. M. (T)	337	Sengupta, S. C., Ghosh, D., Das, R. K. and Sinha, A. R., Modification of shellac. Part I: Using ethylene glycol and dicarboxylic acids (T)	15
Kolar, Z., <i>see</i> Smits, C. I. (T)	210	Shirsalkar, M. M., <i>see</i> Krishnamurti, N. (T)	474
Kornum, L. O., Evaporation and water-dilutable coatings (T)	103	Shukla, I. C., <i>see</i> Prakash, R. (SC)	370
Krishnamurti, N., Shirsalkar, M. M. and Sivasamban, M. A., Partial allyl ethers of polyhydric alcohols as intermediates for water soluble vehicles (T)	474	Sinha, A. R., <i>see</i> Sengupta, S. C. (T)	15
		Sivasamban, M. A., <i>see</i> Sathyanarayana, M. N. (T)	373
		— <i>see</i> Krishnamurti, N. (T)	474
		Smith, N. D. P., <i>see</i> Colclough, M. L. (T)	183
		Smits, C. I., Heertjes, P. M. and Kolar, Z., A radio tracer study of the competitive adsorption on titanium dioxide of stearic acid paired with linoleic acid and palmitic acid (T)	210
		Stoelting, J., <i>see</i> Schenck, H. U. (T)	482
		Strivens, T. A. and Rawlings, R. D., The application of acoustic emission to the study of paint failure (T)	412
		Staddon, A. W. E., Industrial nitrocellulose (T)	446
		Stangroom, B., <i>see</i> Dombey, S. (T)	276
		L	
Lawton, C. V., <i>see</i> Welch, M. J. (T)	137		
		N	
		Naser, A. M., Salman, A. A., Abd-Ellah, I. M., Abd El-Ghafa, M. A. and Khouzondar, A. N., New metal complex pigments (T)	337
		O	
Obita, J. A., <i>see</i> Haken, J. K. (T)	194		
		P	
Panda, H., <i>see</i> Hingorani, B. H. (T)	407	Panda, H., <i>see</i> Hingorani, B. H. (T)	407
Papo, A., and Torriano, G., Rheological properties of high-build paints containing castor oil derivatives (T)	10	Papo, A., and Torriano, G., Rheological properties of high-build paints containing castor oil derivatives (T)	10
Pasari, S., <i>see</i> Chandra, S. (T)	225	Pasari, S., <i>see</i> Chandra, S. (T)	225
— <i>see</i> Chandra, S. (T)	321	— <i>see</i> Chandra, S. (T)	321
Patterson, D., <i>see</i> Carr, W. (T)	438	Patterson, D., <i>see</i> Carr, W. (T)	438
Prakash, R. and Shukla, I. C., Direct volumetric determination of n-butanol in nitrocellulose thinner (SC)	370	Prakash, R. and Shukla, I. C., Direct volumetric determination of n-butanol in nitrocellulose thinner (SC)	370
Presta, M. A., <i>see</i> Giudice, C. A. (T)	153	Presta, M. A., <i>see</i> Giudice, C. A. (T)	153
		R	
Rajagopalan, C. S., <i>see</i> Rajagopalan, K. S. (T)	144	Rajagopalan, C. S., <i>see</i> Rajagopalan, K. S. (T)	144
Rajagopalan, K. S., Guruviah, S. and Rajagopalan, C. S.,	407	Rajagopalan, K. S., Guruviah, S. and Rajagopalan, C. S.,	407
Rakshinda, <i>see</i> Hingorani, B. H. (T)	153	Rakshinda, <i>see</i> Hingorani, B. H. (T)	153
Rascio, V. J. D., <i>see</i> Giudice, C. A. (T)	412	Rascio, V. J. D., <i>see</i> Giudice, C. A. (T)	412
Rawlings, R. D., <i>see</i> Strivens, T. A. (T)	412	Rawlings, R. D., <i>see</i> Strivens, T. A. (T)	412
		S	
Salman, A. A., <i>see</i> Naser, A. M. (T)	337	Salman, A. A., <i>see</i> Naser, A. M. (T)	337
Sampathkumaran, P. S., <i>see</i> Sathyanarayana, M. N. (T)	373	Sampathkumaran, P. S., <i>see</i> Sathyanarayana, M. N. (T)	373
Sampuran-Singh, <i>see</i> Cross, J. A. (T)	326	Sampuran-Singh, <i>see</i> Cross, J. A. (T)	326
Sathyanarayana, M. N., Sampathkumaran, P. S. and Sivasamban, M. A., Studies on adhesion: Effect of part replacement of TiO ₂ by ZnO or extenders in		Sathyanarayana, M. N., Sampathkumaran, P. S. and Sivasamban, M. A., Studies on adhesion: Effect of part replacement of TiO ₂ by ZnO or extenders in	

Keywords

Reference list of papers

<i>Key</i>	<i>Title</i>	<i>Page</i>	<i>Key</i>	<i>Title</i>	<i>Page</i>
1	Rheological properties of high-build paints containing castor oil derivatives	10	3	Epoxy-chromate coatings: Electric and membrane results	23
2	Modification of shellac. Part I: Using ethylene glycol and dicarboxylic acids	15	4	The coating of external plywood cladding panels	28
			5	A gas chromatography study of grape dipping oil	34

Key	Title	Page	Key	Title	Page
6	OCCA Monograph Number 1 – Marine finishes. Part I	53	26	An overhanging beam method for measuring internal stress in coatings	271
7	Solubility parameter values suggested using the reported and calculated values for organic compounds	61	27	A comparative investigation of stains for wood	276
8	Zinc-rich paints	70	28	Hazards of static electricity in workclothing	287
9	A gas chromatography technique for the analysis of solvent mixtures based on hydrocarbons, esters, ethers etc., used in paints and lacquers	77	29	Copolymers of polystyrene glycol and glycerol phthalate resins in surface coatings	321
10	OCCA Monograph Number 1 – Marine finishes. Part II	93	30	Deposition efficiency of powders in the electrostatic powder coating process	326
11	The relationship between glass transition and melting temperatures of natural resins	101	31	Solving air pollution problems in the manufacture and use of surface coatings	330
12	Evaporation and water-dilutable coatings	103	32	New metal complex pigments	337
13	A study of the natural weathering of sealants	137	33	American study on mortality rates in the coatings industry, preliminary details published	340
14	Evaluation of varnishes by capacitance and resistance measurements	144	34	Paints and painting problems in the tropics	367
15	Modification of hydrolysed lac with epichlorohydrin and epoxy resin	149	35	Direct volumetric determination of n-butanol in nitrocellulose thinner	370
16	Study of variables which affect dispersion of anti-fouling paints in ball mills	153	36	Studies on adhesion: Effect of part replacement of TiO ₂ by ZnO or extenders in alkyd based TiO ₂ paints	373
17	A low shear viscometer: An instrument for measuring flow and sag resistance in coatings	183	37	Titanium dioxide in decorative emulsion paints	379
18	The chromatographic analysis of fatty polyamide resins after alkali fusion	194	38	A surface coating based on dehydrated castor oil. Part 1: Physical and mechanical properties	399
19	Correlation of the adhesion of a polystyrene lacquer to inorganic substrates and their wetting characteristics	200	39	The corrosion consultant at large	404
20	A radio tracer study of the competitive adsorption on titanium dioxide of stearic acid paired with linoleic acid and palmitic acid	210	40	Epoxy esters of rosin	407
21	Esters of polystyrene glycol and rosin in surface coatings	225	41	The application of acoustic emission to the study of paint failure	412
22	Effect of solvents on residual strain in clear epoxy coatings	230	42	A surface coating based on dehydrated castor oil. Part 2: Dielectric properties	427
23	Preservation, priming, putty and paints	237	43	The evaluation of protective coatings on rusty steel with the use of electrical resistance probes as substrates	433
24	The effect of ageing on the ease of decontamination of some paint systems	243	44	Effect of pigmentation level on the efficiency of triple roll milling	438
25	Solubility parameter values of hydroxy polymers through its components and chemical group contribution technique	263	45	Industrial nitrocellulose	446
			46	The value of tributyltinfluoride as a toxicant in anti-fouling formulations	465
			47	Partial allyl ethers of polyhydric alcohols as intermediates for water soluble vehicles	474
			48	Electrodeposition: anodic versus cathodic	482
			49	Applied finishes for timber in exterior situations in New Zealand	492

The number given opposite each keyword in the index below is the key number allocated to the paper to which the keyword refers as shown in the reference list above. It is not a page number; this can be obtained from the reference list.

Index

Keyword	Key No.	Keyword	Key No.
Types and classes of coatings and allied products		Types and classes of structures or surfaces to be coated	
alkyd coating	17, 34	aluminium	13
anticorrosive coating	3, 8	concrete	13, 34
antifouling coating	16, 46	furniture	27
catalysed coating	22	masonry	34
clear coating	14, 19, 21, 22, 26, 29	plywood	4
electrical insulating coating	38, 42	steel	3, 8, 14, 36, 43
emulsion paint	12, 17, 37	veneer	27
gloss finish	24, 37	wood	13, 23, 27, 34
high build coating	1		
house paint	23	Raw materials—Binders (oils)	
lacquer	26	dehydrated castor oil	38, 42
latex coating	34	epoxidised oil	38, 42
lithographic ink	44	natural oil	48
powder coating	30	styrenated oil	38, 42
primer	8, 23	synthetic oil	48
sealant	13, 23		
solution coating	22	—Binders (resins etc.)	
top coat	24	acrylate resin	24
varnish	14	acrylic resin	48
water based paint	4, 12, 34	alkyd resin	24, 36
wood finish	23	bitumen	13
wood preservative	23	chlorinated rubber	1, 8, 14, 24
wood stain	23, 27		
zinc rich coating	8		

<i>Keyword</i>	<i>Key No.</i>
epoxy resin	3, 14, 15, 22, 24, 30, 38, 40, 42, 48
lac resin	15
melamine resin	38
methacrylate resin	26
natural resin	11
phenolic resin	24
phenolic varnish	14
polyamide resin	14, 18
polyester resin	48
polystyrene resin	19, 21, 26, 29
polysulphide	13
polyurethane	24, 48
rosin	21, 29
rosin adduct	21, 29
shellac	2, 15
silicone resin	13
sodium silicate	8
vegetable oil	13

–Prime pigments and dyes

anatase titanium dioxide	36, 37
green pigment	32
organic pigment	32
purple pigment	32
rutile titanium dioxide	37
titanium dioxide	20, 37
zinc oxide	36

–Chemically active pigments

zinc chromate	3
zinc dust	8

–Extender pigments

barytes	36
clay	36
talc	36

–Solvents

alcohol	12
butanol	35
ester	12
ether	12
solvent	7, 9, 12, 35
thinner	35
toluene	26
water	12

–Catalysts, accelerators, inhibitors

amine hardener	22
----------------	----

–Biologically active agents

organotin	46
-----------	----

–Surface active and rheological agents

rheological agent	1
flow control agent	1

Raw materials used in manufacture or synthesis of ingredients for coatings

allyl alcohol	47
amine	18
dibasic acid	18, 32
dicarboxylic acid	32
drying oil fatty acid	40
epichlorohydrin	47
ether	47
fatty acid	40
glycerol	47
linoleic acid	20
pentaerythritol	47

<i>Keyword</i>	<i>Key No.</i>
metal complexing compounds	32
palmitic acid	20
rosin	40
stearic acid	20
tall oil fatty acid	18
urea	32

Supplies and other materials primarily associated with:

–Analysis, measurement or testing

analytical reagent	35
--------------------	----

–Surface preparation before coating

putty	23
-------	----

Equipment primarily associated with:

–Analysis, measurement or testing

electrical resistance probe	43
overhanging beam balance	26
viscometer	17

–Manufacturing or synthesis

ball mill	16
roller mill	44

Processes and methods primarily associated with:

–Analysis, measurement or testing

absorption	3
accelerated weathering	13, 24
acoustic emission	41
adsorption	20
air pollution control	31
corrosion testing	43
gas chromatography	9, 18
gel permeation chromatography	18
hydrolysis	18
pollution control	31
radio chemical method	20
raft test	46
spectroscopy	47
thin layer chromatography	47

–Manufacturing or synthesis

adsorption	20
catalysed conversion	15
dispersion	16, 37
esterification	2, 40
hydrolysis	15
milling	16
pigment dispersion	44

–Application of coatings and allied products

brush coating	17
deposition	30
electrocoating	47, 48
electrostatic coating	30
flow control	17
sagging	1, 17

–Drying or curing of coatings

air pollution control	31
pollution control	31

–Service or utility

corrosion	48
-----------	----

weathering 24

Properties, characteristics and conditions primarily associated with:

—Materials in general

absorption 36
 adhesion 19, 21, 29
 capacitance 14
 contact angle 19
 dielectric constant 42
 dispersibility 37, 44
 electrical resistivity 3, 14
 evaporation rate 12, 22
 flexibility 21, 29
 glass transition point 11
 immersion resistance 14
 internal cohesive energy 7
 melting point 11
 opacity 37
 particle size 16
 rheological property 1
 sandwich pull-off technique 36
 softening point 11
 solubility parameter 7, 25
 surface tension 19
 thixotropy 1, 17
 toxicity 46
 viscosity 1, 44

—Bulk coatings and allied products

pigment content 44
 pot stability 37

—Coatings during application

application characteristics 37
 crazing 37
 drying rate 21, 29
 flow 17
 sagging 17

—Dried or cured films

acid resistance 21, 29, 38
 adhesion 38
 alkali resistance 21, 29, 38
 checking 4

durability 13, 37
 elasticity 38
 elasticity resistance 29
 failure 41
 film thickness 46
 flexibility 2
 humidity resistance 8, 41
 impact resistance 2, 38
 leaching 46
 peeling 19
 scratch resistance 21, 29
 shrinkage 22, 26
 solvent resistance 2, 21, 29
 solvent retention 22
 ultraviolet resistance 27
 water resistance 2, 4, 21, 23, 29, 38
 water vapour permeability 4
 weather resistance 8, 13

—Structures or surfaces being coated

corrosion 43
 edge grain 27
 heartwood 27
 porosity 27
 roughness 27
 sap wood 27
 wood grain 27

—The environment

ambient temperature 34
 humidity 34
 relative humidity 34
 tropical environment 34

Specifications, standards and regulations

pollution control regulations 31

Miscellaneous terms

biodegradation 34
 decontamination 24
 internal cohesive energy 25
 pollution 31, 34
 power factor 42
 strain 22
 stress 26

Subjects

A	Page	A	Page
A comparative investigation of stains for wood (T)	276	some paint systems (T)	243
Acoustic emission. The application of, to the study of paint failure (T)	412	Air pollution problems. Solving, in the manufacture and use of surface coatings (T)	330
Adhesion. Correlation of the, of a polystyrene lacquer to inorganic substrates and their wetting characteristics (T)	200	Alcohols, polyhydric, Partial allyl ethers of, as intermediates for water soluble vehicles	474
Adhesion. Studies on: Effect of part replacement of TiO ₂ by ZnO or extenders in alkyd based TiO ₂ paints (T)	373	Alkali fusion. The chromatographic analysis of fatty polyamide resins after (T)	194
Adsorption, competitive. A radio tracer study of the, on titanium dioxide of stearic acid paired with linoleic acid and palmitic acid (T)	210	Alkyd based TiO ₂ paints. Studies on adhesion: Effect of part replacement of TiO ₂ by ZnO or extenders in (T)	373
A gas chromatography study of grape dipping oil (T)	34	Allyl ethers, Partial, of polyhydric alcohols as intermediates for water soluble vehicles (T)	474
A gas chromatography technique for the analysis of solvent mixtures based on hydrocarbons, esters, ethers etc., used in paints and lacquers (T)	77	A low shear viscometer: An instrument for measuring flow and sag resistance in coatings (T)	183
Ageing. The effect of, on the ease of decontamination of		American study on mortality rates in the coatings industry, preliminary details published (SC)	340
		An Infrared Spectroscopy Atlas for the Coatings Industry (R)	386

	Page		Page
Annual Report of the Council for 1979 (E)	341	Coatings, surface, Esters of polystyrene glycol and rosin in (T)	225
Anodic versus cathodic, Electrodeposition: (T)	482	Coatings, surface, Solving air pollution problems in the manufacture and use of (T)	330
An overhanging beam method for measuring internal stress in coatings (T)	271	Coatings, water-dilutable, Evaporation and (T)	103
Antifouling formulations, The value of tributyltinfluoride as a toxicant in (T)	465	Colour: Its measurement, computation and application (R)	453
Antifouling paints in ball mills, Study of variables which affect dispersion of (T)	153	Committees of Council 1979-80 (E)	2
Applied finishes for timber in exterior situations in New Zealand (SC)	492	Committees of Council 1980-81 (E)	313
A radio tracer study of the competitive adsorption on titanium dioxide of stearic acid paired with linoleic acid and palmitic acid (T)	210	Comparative investigation, A, of stains for wood (T)	276
Association Annual General Meeting Luncheon and Lecture (ON)	354	Competitive adsorption, A radio tracer study of the, on titanium dioxide of stearic acid paired with linoleic acid and palmitic acid (T)	210
Association Dinner and Dance 1980 (ON)	260	Complex pigments, New metal (T)	337
A study of the natural weathering of sealants (T)	137	Consultant, The corrosion, at large (T)	404
A surface coating based on dehydrated castor oil. Part 1: Physical and mechanical properties (T)	399	Copolymers of polystyrene glycol and glycerol phthalate resins in surface coatings (T)	321
A surface coating based on dehydrated castor oil. Part 2: Dielectric properties (T)	427	Correlation of the adhesion of a polystyrene lacquer to inorganic substrates and their wetting characteristics (T)	200
Auckland Section—Annual General Meeting (ON)	295	Corrosion, The, consultant at large (T)	404
— — — — —Aqueous pigment dispersions (OM)	163	Council 1979-80 (E)	2
— — — — —Marine anticorrosive systems (OM)	80	Council 1980-81 (E)	312
— — — — —The effective use of solvents (OM)	124	Courses for Licentiatehip (ON)	361

B

Ball mills, Study of variables which affect dispersion of antifouling paints in (T)	153
Bristol Section—Annual Skittles Match (ON)	359
— — — — —Ladies' Night (ON)	295
— — — — —Presentation to Mrs E. N. Harper (ON)	360
n-butanol in nitrocellulose thinner, Direct volumetric determination of (SC)	370

C

Capacitance and resistance measurements, Evaluation of varnishes by (T)	144
Castor oil, dehydrated, A surface coating based on, Part 1: Physical and mechanical properties (T)	399
Castor oil, dehydrated, A surface coating based on, Part 2: Dielectric properties (T)	427
Castor oil derivatives, Rheological properties of high-build paints containing (T)	10
Cathodic, Electrodeposition: anodic versus (T)	482
Chemical group contribution technique, Solubility parameter values of hydroxy polymers through its (T)	263
Chromate-Epoxy coatings: Electric and membrane results (T)	23
Chromatographic, The, analysis of fatty polyamide resins after alkali fusion (T)	194
Chromatography gas, A, technique for the analysis of solvent mixtures based on hydrocarbons, esters, ethers etc., used in paints and lacquers (T)	77
Chromatography study, A gas, of grape dipping oil (T)	34
Cladding panels, The coating of external plywood (T)	28
Clothing, work, Hazards of static electricity in (T)	287
Coating, A surface, based on dehydrated castor oil. Part 1: Physical and mechanical properties (T)	399
Coating, A surface, based on dehydrated castor oil. Part 2: Dielectric properties (T)	427
Coating process, Deposition efficiency of powders in the electrostatic powder (T)	326
Coating, The, of external plywood cladding panels (T)	28
Coatings, clear epoxy, Effect of solvents on residual strain in (T)	230
Coatings, flow and sag resistance in, A low shear viscometer: An instrument for measuring (T)	183
Coatings, industry, American study on mortality rates in the, preliminary details published (SC)	340
Coatings, protective, The evaluation of, on rusty steel with the use of electrical resistance probes as substrates (T)	433
Coatings, surface, Copolymers of polystyrene glycol and glycerol phthalate resins in (T)	321

D

Decontamination, The effect of ageing on the ease of, of some paint systems (T)	243
Decorative, emulsion paints, Titanium dioxide in (T)	379
Dehydrated, castor oil, A surface coating based on, Part 1: Physical and mechanical properties (T)	399
Dehydrated, castor oil, A surface coating based on, Part 2: Dielectric properties (T)	427
Deposition efficiency of powders in the electrostatic powder coatings process (T)	326
Determination, Direct volumetric, of n-butanol in nitrocellulose thinner (SC)	370
Dicarboxylic acids, Modification of shellac. Part 1: Using ethylene glycol and (T)	15
Dielectric, properties, A surface coating based on dehydrated castor oil. Part 2: (T)	427
Dipping oil, grape, A Gas chromatography study of (T)	34
Direct volumetric determination of n-butanol in nitrocellulose thinner (SC)	370
Dispersion of antifouling paints in ball mills, Study of variables which affect (T)	153

E

Effect of pigmentation level on the efficiency of triple roll milling (T)	438
Effect of solvents on residual strain in clear epoxy coatings (T)	230
Efficiency, Deposition, of powders in the electrostatic powder coating process (T)	326
Efficiency, of triple roll milling, Effect of pigmentation level on the (T)	438
Electric and membrane results, Epoxy-chromate coatings: (T)	23
Electrical resistance probes as substrates, The evaluation of protective coatings on rusty steel with the use of (T)	433
Electricity, static, Hazards of, in workclothing (T)	287
Electrodeposition: anodic versus cathodic (T)	482
Electrostatic powder coatings process, Deposition efficiency of powders in the (T)	326
Emulsion paints, Titanium dioxide in decorative (T)	379
Epichlorohydrin and epoxy resin, Modification of hydrolysed lac with (T)	149
Epoxy-chromate coatings: Electric and membrane results (T)	23
Epoxy coatings, clear, Effect of solvents on residual strain in (T)	230
Epoxy esters of rosin (T)	407
Epoxy resin and epichlorohydrin, Modification of hydrolysed lac with (T)	149

	<i>Page</i>		<i>Page</i>
Esters, Epoxy, of rosin (T)	407	Hydrolysed lac, Modification of, with epichlorohydrin and epoxy resin (T)	149
Esters, ethers etc., A gas chromatography technique for the analysis of solvent mixtures based on hydrocarbons, used in paints and lacquers (T)	77	Hydroxy polymers, Solubility parameter values of, through its components and chemical group contribution technique (T)	263
Esters of polystyrene glycol and rosin in surface coatings (T)	225		
Ethers, etc., used in paints and lacquers, A gas chromatography technique for the analysis of solvent mixtures based on hydrocarbons, esters (T)	77	I	
Ethers, Partial allyl, of polyhydric alcohols as intermediates for water soluble vehicles (T)	474	ICCATCI Meeting (ON)	45
Ethylene glycol and dicarboxylic acids, using, Modification of shellac. Part 1: (T)	15	Industrial New Product Development (R)	386
Evaluation of varnishes by capacitance and resistance measurements (T)	144	Industrial nitrocellulose (T)	446
Evaluation, The, of protective coatings on rusty steel with the use of electrical resistance probes as substrates (T)	433	Industry, coatings, American study on mortality rates in the, preliminary details published (SC)	340
Evaporation and water-dilutable coatings (T)	103	Inorganic substrates, Correlation of the adhesion of a polystyrene lacquer to, and their wetting characteristics (T)	200
Exterior, situations in New Zealand, Applied finishes for timber in (SC)	492	Internal stress in coatings, An overhanging beam method for measuring (T)	271
External plywood cladding panels, The coating of (T)	28	Irish Section—Industrial training (OM)	40
		J	
F		Jordan Award (ON)	45, 309, 396, 425
Failure, paint, The application of acoustic emission to the study of (T)	412		
Fatty Acids Manufacture – Recent Advances (R)	452	L	
Fatty polyamide resins, the chromatographic analysis of, after alkali fusion (T)	194	Lac hydrolysed, Modification of, with epichlorohydrin and epoxy resin (T)	149
Finishes, Applied, for timber in exterior situations in New Zealand (SC)	492	Lacquers, A gas chromatography technique for the analysis of solvent mixtures based on hydrocarbons, esters, ethers etc., used in paints and (T)	77
Flow and sag resistance in coatings, A low shear viscometer: An instrument for measuring, (T)	183	Linoleic acid and palmitic acid, A radio tracer study of the competitive adsorption on titanium dioxide of stearic acid paired with (T)	210
F. W. Clark Memorial Prize (ON)	458	London Section—Annual General Meeting (ON)	296
Fusion, alkali, The chromatographic analysis of fatty polyamide resins after (T)	194	— — — — — Drinking and driving (ON)	296
		— — — — — Building Research Establishment (OM)	496
G		— — — — — 1980 Golf Tournament (ON)	391
Gas chromatography A, technique for the analysis of solvent mixtures based on hydrocarbons, esters, ethers etc., used in paints and lacquers (T)	77	— — — — — International standard methods of test for paints (OM)	165
Gas chromatography, study of grape dipping oil, A (T)	34	— — — — — Ladies' Night (ON)	49
General Overseas Section—Insignias of Office (ON)	391	— — — — — Maintenance and protection of North Sea Structures (OM)	387
Glass transition, The relationship between, and melting temperatures of natural resins (T)	101	— — — — — Pigments Symposium (OM)	164
Glycerol phthalate resins in surface coatings, Copolymers of polystyrene glycol and (T)	321	— — — — — Pollution analysis (OM)	254
Glycol, Esters of polystyrene, and rosin in surface coatings (T)	225	— — — — — Preservation, priming, putty and paint (OM)	38
Glycol, polystyrene, Copolymers of, and glycerol phthalate resins in surface coatings (T)	321	Low shear viscometer, A: An instrument for measuring flow and sag resistance in coatings (T)	183
Grape dipping oil, A gas chromatography study of (T)	34		
H		M	
Handbook of US colorants for foods, drugs and cosmetics (R)	37	Manchester Section—Annual Dinner Dance 1979 (ON)	180
Hazards of static electricity in workclothing (T)	287	— — — — — Annual General Meeting (ON)	360
High-build paints, Rheological properties of, containing castor oil derivatives (T)	10	— — — — — Electrodeposition: Anodic versus cathodic (OM)	215
Honorary Membership—S. R. Finn (ON)	48	— — — — — European test methods for emulsion paints (OM)	39
Hull Section—Adhesion – Facts and fiction (OM)	163	— — — — — Golf tournament 1980 (ON)	502
— — — — — China clays as opacifying extenders (OM)	214	— — — — — High-solid coatings by Luke Kwakman (OM)	254
— — — — — Dinner Dance (ON)	48	— — — — — Informal Buffet Dance (ON)	221
— — — — — Instrumental control in the paint industry (OM)	80	— — — — — Matting silicas in UV cured systems (OM)	125
— — — — — Ladies' Evening (ON)	259	— — — — — Northern Sections proceedings (ON)	395
— — — — — Plant and machinery for processing oil seed (OM)	37	— — — — — Powder coatings by Ad Van Der Werff (OM)	254
— — — — — Synthetic clays – their properties and uses (OM)	214	— — — — — Transportation and Labelling of Hazardous Materials Parts 1 and 2 (OM)	290
Hydrocarbons, esters, ethers etc., used in paints and lacquers, A gas chromatography technique for the analysis of solvent mixtures based on (T)	77	— — — — — Water thinned coatings by Martin Bus (OM)	254
		— — — — — Weatherability of surface coatings (OM)	81
		— — — — — Winter Committee meeting (ON)	295

	Page		Page
Manufacture, Solving air pollution problems in the, and use of surface coatings (T)	330	OCCA Biennial Conference 1981—Call for Papers (ON)	85, 222
Marine finishes, Part I, OCCA Monograph Number 1 (T)	53	OCCA-32 Exhibition Preview (ON)	170
Marine finishes, Part II, OCCA Monograph Number 1 (T)	93	OCCA-32 Exhibition (ON)	46, 86, 131
Mechanical, properties, A surface coating based on dehydrated castor oil. Part 1: Physical and (T)	399	OCCA-32 Exhibition Review (ON)	298
Melting temperatures, The relationship between glass transition and, of natural resins (T)	101	OCCA-33 Exhibition — Preliminary Announcement (ON)	310
Membrane results, electric and, Epoxy-chromate coatings: (T)	23	OCCA-33 Exhibition (ON)	362, 392, 424, 459, 460, 462, 504
Metal, complex pigments, New (T)	337	OCCA Monograph Number 1 — Marine finishes. Part I (T)	53
Midlands Section—AGM Report (ON)	296	OCCA Monograph Number 1 — Marine finishes. Part II (T)	93
— — — — —In-line coatings (OM)	38	Oil, dehydrated castor, A surface coating based on, Part 1: Physical and mechanical properties (T)	399
— — — — —Greetings — millions of them (OM)	254	Oil, dehydrated castor, A surface coating based on, Part 2: Dielectric properties (T)	427
— — — — —Ladies night (ON)	502	Ontario Section—Annual Dinner Dance (ON)	221
— — — — —Litho plates — future (ON)	450	— — — — —Particle size reduction (OM)	39
— — — — —The Paint Research Association and the surface coating industry (OM)	163	Optional Professional Grade see Professional Grade	
— — — — —Solvent system design (OM)	39	Organic compounds, Solubility parameter values suggested using the reported and calculated values for, (T)	61
— — — — —The role of the technologist in marketing (OM)	125	Overhanging beam, An, method for measuring internal stress in coatings (T)	271
Trent Valley Branch—Buffet Dance (ON)	50		
— — — — —Nottingham Evening Post visit (ON)	50	P	
Milling, triple roll, Effect of pigmentation level on the efficiency of (T)	438	Paint, failure, The application of acoustic emission to the study of (T)	412
Mills, ball, Study of variables which affect dispersion of antifouling paints in (T)	153	Paint Formulation: Principles and Practice (R)	386
Modification of hydrolysed lac with epichlorohydrin and epoxy resin (T)	149	Paint systems, The effect of ageing on the ease of decontamination of some (T)	243
Modification of shellac. Part I: Using ethylene glycol and dicarboxylic acids (T)	15	Painting, problems, Paints and, in the tropics (T)	367
Mortality rates in the coatings industry, American study on, preliminary details published (SC)	340	Paints, alkyd based TiO ₂ , Studies on adhesion: Effect of part replacement of TiO ₂ by ZnO or extenders in (T)	373
Most Secret War (L)	124	Paints and lacquers, A gas chromatography technique for the analysis of solvent mixtures based on hydrocarbons, esters, ethers etc., used in (T)	77
N		Paints and painting problems in the tropics (T)	367
Natal Section—New concepts in thixotropy (OM)	215	Paints, decorative emulsion, Titanium dioxide in (T)	379
— — — — —The uses of methylcellulose in surface coating formulations (OM)	82	Paints, high-build, Rheological properties of, containing castor oil derivatives (T)	10
— — — — —Water reducible industrial coatings (OM)	82	Paints, in ball mills, Study of variables which affect dispersion of antifouling (T)	153
Natural resins, The relationship between glass transition and melting temperatures of (T)	101	Paints, Preservation, priming, putty and (T)	237
Natural weathering of sealants, A study of (T)	137	Paints, Zinc-rich (T)	70
Newcastle Section—Annual Ladies' Night (ON)	221	Palmitic acid, A radio tracer study of the competitive adsorption on titanium dioxide of stearic acid paired with linoleic acid and (T)	210
— — — — —Pigment chips (OM)	215	Partial allyl ethers of polyhydric alcohols as intermediates for water soluble vehicles (T)	474
— — — — —The British Titan Cup (ON)	360	Phthalate, resins, Copolymers of polystyrene glycol and, in surface coatings (T)	321
News of members (ON)		Physical, and mechanical properties, A surface coating based on dehydrated castor oil. Part 1: (T)	399
John Green	458	Physical Testing of Paints and Coatings (OM)	291
New metal complex pigments (T)	337	Pigment & Füllstoff Tabellen (2nd Edition) (R)	452
New Zealand, Applied finishes for timber in exterior situations in (SC)	492	Pigmentation level, Effect of, on the efficiency of triple roll milling (T)	438
Nitrocellulose, Industrial (T)	446	Pigments, New metal complex (T)	337
Nitrocellulose thinner, Direct volumetric determination of n-butanol in (SC)	370	Plywood, external, The coating of, cladding panels (T)	28
Northern Section Golf Tournament — Tony McWilliam Memorial Trophy (ON)	169	Pollution, Solving air, problems in the manufacture and use of surface coatings (T)	330
O		Polyamide resins, fatty, The chromatographic analysis of, after alkali fusion (T)	194
Obituary (ON)		Polyhydric alcohols, as intermediates for water soluble vehicles, Partial allyl ethers of (T)	474
Sidney Clifford	359	Polymers, hydroxy, Solubility parameter values of, through its components and chemical group contribution technique (T)	263
G. O. H. J. Delorette	222	Polystyrene glycol and glycerol phthalate resins in surface coatings, Copolymers of (T)	321
Manfred Hess	259	Polystyrene glycol and rosin, Esters of, in surface coatings (T)	225
R. F. G. Holness	294	Polystyrene lacquer, Correlation of the adhesion of, a, to inorganic substrates and their wetting characteristics (T)	200
J. G. Leadbetter	359		
A. H. McEwan	359		
Seymour Lloyd (Slim) Mole	463		
Arthur de R. Penfold	421		
Maurice Tapin	422		
Dorothy Lilian Tilleard	258		
George Wiseman	169		

	<i>Page</i>
Powder coatings process, Deposition efficiency of powders in the electrostatic (T)	326
Preservation, priming, putty and paints (T)	237
President's Page (ON)	49, 422
Priming, Preservation, putty and paints (T)	237
Probes, electrical resistance, as substrates, The evaluation of protective coatings on rusty steel with the use of (T)	433
Proceedings of Annual General Meeting (E)	352
Professional Grade—Admissions (ON)	361
— Committee meeting (ON)	181
— List of successful candidates (ON)	506
Proposed Nigerian Branch (ON)	90
Protective coatings, The evaluation of, on rusty steel with the use of electrical resistance probes as substrates (T)	433
Putty, Preservation, priming and paints (T)	237

R

Radio tracer, A, Study of the competitive adsorption on titanium dioxide of stearic acid paired with linoleic acid and palmitic acid (T)	210
Relationship, The, between glass transition and melting temperatures of natural resins (T)	101
Replacement, of TiO ₂ , Studies on adhesion: Effect of part, by ZnO or extenders in alkyd based TiO ₂ paints (T)	373
Report of Council Meeting (ON)	181, 259, 354, 503
Residual strain in clear epoxy coatings, Effect of solvents on (T)	230
Resin, epoxy, Modification of hydrolysed lac with epichlorohydrin and (T)	149
Resins, fatty polyamide, The chromatographic analysis of, after alkali fusion (T)	194
Resins, natural, The relationship between glass transition and melting temperatures of (T)	101
Resins, phthalate, Copolymers of polystyrene glycol and, in surface coatings (T)	321
Resistance, electrical probes as substrates, The evaluation of protective coatings on rusty steel with the use of (T)	433
Resistance measurements, Evaluation of varnishes by capacitance and (T)	144
Rheological properties of high-build paints containing castor oil derivatives (T)	10
Rosin, Epoxy esters of (T)	407
Rosin, Esters of polystyrene glycol and, in surface coatings (T)	225
Rusty, steel, The evaluation of protective coatings on, with the use of electrical resistance probes as substrates (T)	433

S

Sag resistance in coatings, A low shear viscometer: An instrument for measuring flow and (T)	183
Scottish Section—Annual Dinner Dance (ON)	221
— Annual General Meeting/Ladies' evening (ON)	295
— Forensic science (ON)	180
— Golf tournament (ON)	296
— Morris Ashby Golf Trophy (ON)	130
Sealants, A study of the natural weathering of (T)	137
Section Officers and Committees 1979-80 (E)	4
— 1980-81 (E)	314
Section programmes for 1980-81 session (ON)	363
Shellac, Modification of, Part I: using ethylene glycol and dicarboxylic acids (T)	15
South African Division—Symposium Call for Papers (ON)	50
Solubility parameter values of hydroxy polymers through its components and chemical group contribution technique (T)	263

Solubility parameter values suggested using the reported and calculated values for organic compounds (T)	61
Solvents, Effect of, on residual strain in clear epoxy coatings (T)	230
Solvent mixtures based on hydrocarbons, esters, ethers etc., used in paints and lacquers, A gas chromatography technique for the analysis of (T)	77
Solving air pollution problems in the manufacture and use of surface coatings (T)	330
Spontaneous combustion of paint waste from spray booths (L)	124
Stains for wood, A comparative investigation of (T)	276
Static electricity in workclothing, Hazards of (T)	287
Stearic acid, A radio tracer study of the competitive adsorption on titanium dioxide of, paired with linoleic acid and palmitic acid (T)	210
Steel, rusty, The evaluation of protective coatings on, with the use of electrical resistance probes as substrates (T)	433
Strain, residual, Effect of solvents on, in clear epoxy coatings (T)	230
Stress, internal in coatings, An overhanging beam method for measuring (T)	271
Studies on adhesion: Effect of part replacement of TiO ₂ by ZnO or extenders in alkyd based TiO ₂ paints (T)	373
Study, A, of the natural weathering of sealants (T)	137
Study of variables which affect dispersions of anti-fouling paints in ball mills (T)	153
Surface coating, A, based on dehydrated castor oil. Part 1: Physical and mechanical properties (T)	399
Surface coating, A, based on dehydrated castor oil. Part 2: Dielectric properties (T)	427
Surface coatings, Copolymers of polystyrene glycol and glycerol phthalate resins in (T)	321
Surface coatings, Esters of polystyrene glycol and rosin in (T)	225
Surface coatings, Solving air pollution problems in the manufacture and use of (T)	330

T

Thames Valley Section—Visit to Brent Chemical Co. — (Pyrene) (OM)	80
— Works visit to Rondec (OM)	126
The application of acoustic emission to the study of paint failure (T)	412
The chromatographic analysis of fatty polyamide resins after alkali fusion (T)	194
The coating of external plywood cladding panels (T)	28
The corrosion consultant at large (T)	404
The effect of ageing on the ease of decontamination of some paint systems (T)	243
The evaluation of protective coatings on rusty steel with the use of electrical resistance probes as substrates (T)	433
The Printing Ink Manual (R)	290
The relationship between glass transition and melting temperatures of natural resins (T)	101
The value of tributyltinfluoride as a toxicant in anti-fouling formulations (T)	465
Thinner, nitrocellulose, Direct volumetric determination of n-butanol in (SC)	370
Timber, in exterior situations in New Zealand, Applied finishes for (SC)	492
TiO ₂ , Studies on adhesion: Effect of part replacement of, by ZnO or extenders in alkyd based TiO ₂ paints (T)	373
Titanium dioxide, A radio tracer study of the competitive adsorption on, of stearic acid paired with linoleic acid and palmitic acid (T)	210
Titanium dioxide in decorative emulsion paints (T)	379
Toxicant in anti-fouling formulations, The value of tributyltinfluoride as a (T)	465
Tracer, A radio, study of the competitive adsorption on titanium dioxide of stearic acid paired with linoleic acid and palmitic acid (T)	210
Tributyltinfluoride as a toxicant in anti-fouling formulations, The value of (T)	465
Triple roll milling, Effect of pigmentation level on the	

	<i>Page</i>
efficiency of (T)	438
Tropics, Paints and painting problems in the (T)	367

V

Varnishes, Evaluation of, by capacitance and resistance measurements (T)	144
Viscometer, a low shear, An instrument for measuring flow and sag resistance in coatings (T)	183
Volumetric, determination, Direct, of n-butanol in nitrocellulose thinner (SC)	370

W

Water-dilutable coatings, Evaporation and (T)	103
---	-----

Page

Water soluble vehicles, Partial allyl ethers of polyhydric alcohols as intermediates for (T)	474
Weathering of sealants, A study of the natural (T)	137
West Riding Section—An integrated approach to dispersion applications (OM)	164
— Ladies' Evening (ON)	135
— Quality assurance of batch liquid products (OM)	81
Wetting characteristics, Correlation of the adhesion of a polystyrene lacquer to inorganic substrates and their (T)	200
Wood, A comparative investigation of stains for (T)	276
Workclothing, Hazards of static electricity in (T)	287

Z

Zinc-rich paints (T)	70
ZnO, Studies on adhesion: Effect of part replacement of TiO ₂ by, or extenders in alkyd based TiO ₂ paints (T)	373

OCCA CONFERENCE 1981



ALTERNATIVE TECHNOLOGIES IN COATINGS

Closing date for Registrations, 1 April 1981

NON-MEMBERS WISHING TO RECEIVE COPIES OF THE CONFERENCE BROCHURE IN JANUARY SHOULD COMPLETE AND RETURN THE FORM BELOW (or send REQUEST by TELEX 922670 OCCA G)

To: The Director & Secretary, Oil & Colour Chemists' Association,
Priority House, 967 Harrow Road, Wembley, Middlesex, England, HAO 2SF

Please send a copy of the 1981 Conference Brochure to the following address:

Name
(Block letters please)

Address
(Block letters please)

.....

CLASSIFIED ADVERTISEMENTS

Classified Advertisements are charged at the rate of £5.00 per single column cm. Advertisements for Appointments Wanted are charged at £1.50 per line. A box number is charged at £1.00. They should be sent to D. N. Buddles, 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, D. N. Buddles at the address given above (telephone 01-908 1086, telex 922670 OCCA G).

APPOINTMENTS



COATINGS PROFESSIONALS

GROUP LEADERS

CHEMIST — METAL FINISHES SECTION
CHEMIST — TRADE SALES DIVISION

SICO Inc., a rapidly expanding, major Canadian industrial coatings supplier requires the services of highly motivated professionals for its laboratories located in Montreal, Quebec and Toronto.

Ideal candidates will be self-motivated, goal-oriented individuals with a minimum of five years experience. Candidates will have excellent organizational skills and proven leadership ability.

In addition to an opportunity for personal growth, the Company offers a competitive salary and a wide range of fringe benefits including a profit-sharing plan. Located in an area with many lakes and mountains, ideal for skiing, fishing and family outings.

Please send résumé to:

Paint Research Association
Waldegrave Road, Teddington, Middlesex TW118LD
Attention: Mr. D. Dasgupta

MISCELLANEOUS

WANTED by a foreign company

a chemist to advise on the manufacture of high quality chrome — yellows and synthetic iron oxide pigments. *Please write in confidence to: Box 487*

MATERIALS FOR SALE

AGENT WANTED

For a paint driers and additives company. Competitive prices, worldwide exports

Please write to:

Shen Enterprise Corporation
P.O. Box 777, Taipei,
Taiwan, Republic of China
Telex 21564 SLLE

APPOINTMENTS WANTED

Anti-Fouling/Corrosion PAINT CHEMIST

based overseas offers expert advice, ideas, project design etc on all aspects of long life, friction reducing, antifouling (toxic and non-toxic) and anti-corrosive paint systems for ships' bottoms.

Also **Spanish/English, English/Spanish** translation service.

Please reply in strictest confidence to Box No. 490

POSITION REQUIRED

30 years experience in: laboratory — technical sales — technical service — management. Protective coatings — industrial finishes — marine — decorative — contracting. Based West Yorkshire or overseas.

Please write in confidence to Box Number 493

JOCCA*

The largest circulation of UK publications to the surface coatings industries — sent each month to over 80 countries with an estimated average readership of over 22,000 (ABC/MDF form available on request).

*Winners of ABC 1980 Reed International Award.

APPEALS



**This year, put
heart research
on your Christmas list.**

All profits made from sales of our Christmas cards and gifts will go to help in the fight against heart disease. A free colour catalogue is available from

British Heart Foundation
57 Gloucester Place, London W1H 4DH.

OCCA-33



**OVERSEAS
MARKETS ARE
NEARER THAN
YOU THINK!!!**

See page 504 for details
or phone 01-908 1086

CLASSIFIED ADVERTISEMENT

ARMOURCOTE SURFACE TREATMENTS LIMITED

Technical Manager

(Surface Coatings)

The Company

Armourcote Surface Treatments, a wholly owned subsidiary of Fothergill and Harvey Ltd, specialise in the application of high technology surface coatings to a wide range of engineering components. To maintain a positive programme of expansion for the 80s, we wish to strengthen our Technical team by recruiting a self-motivated Technical Manager.

The Job

Using our existing technology as a base, the Technical Manager will be required to develop new and improved coating systems as well as continuing to provide a high quality technical service to both the Sales and Production departments.

Personal Requirements**Preferred age:** 30-38.**Minimum Qualifications:** HNC in Chemistry or Metallurgy.

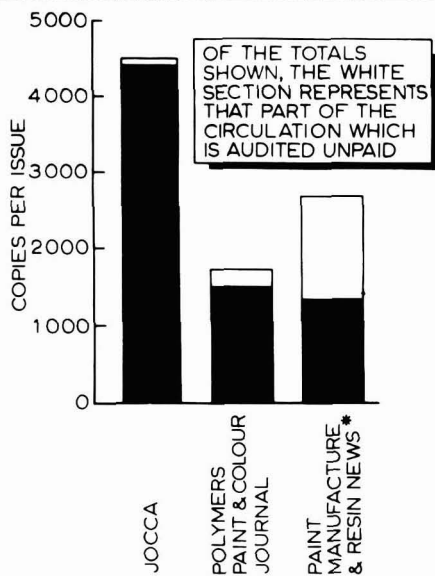
Background Experience: Experience is preferred in the Surface Coatings Industry ideally associated with the close tolerance coating of precision engineered components. Must be able to communicate articulately at all levels.

Rewards

Salary: Negotiable plus a profit related bonus scheme. Other fringe benefits include a Group Share participation scheme plus a Pension and Assurance Scheme. Assistance with relocation where necessary.

Applications in writing – giving personal and career details to:

Mr. J. A. Smith, Personnel Manager
Armourcote Surface Treatments Limited
Long Causeway, Leeds LS9 0NY



(Reference Audit Bureau of Circulations Reviews.
Jan-Dec 1979; *July-Dec 1979)

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

For full details of advertising in this, and other Association publications, contact D. N. Buddles, 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: 922870 (OCCA G)

Classified continued overleaf

CLASSIFIED ADVERTISEMENTS

APPOINTMENTS

SENIOR POSITION
PAINT CHEMIST/TECHNOLOGIST -
COIL COATINGS
NEW ZEALAND

A public New Zealand owned group of companies specialising in marine, consumer and industrial paints, electroplating chemicals, abrasives and bicycle manufacture, has a vacancy for a top flight paint technologist with direct experience of coil coating paints.

Location -
Avondale, Auckland. Only five miles from beautifully wooded residential areas.

Duties -
To assume technical responsibility for formulation, modification, quality control and technical servicing of a specialised range of coil coatings.

Qualifications -
A university degree or equivalent.

Experience -
At least five years relevant experience, together with the ability to solve problems on coil coating lines. A practical person with an outgoing personality would be most suitable. The ability to work in the laboratory and deal with customers at all levels is essential.

Benefits -
An attractive salary will be negotiated and will not be a limitation for the right applicant. A company car will be provided with substantial fringe benefits and assistance with relocation.

Apply in writing to:

**The Group Technical Manager,
Healing Industries Limited,
Private Bag, Rosebank, Auckland, New Zealand.**

INDEX
TO
ADVERTISERS

G	
Glen Creston Machinery Ltd	Cover
Goodyear	vi
W. R. Grace Ltd	iv

H	
Henkel KGaA	Insert
Hubble, Leslie, Ltd	Cover

K	
Kronos Titan GmbH	i

O	
OCCA Conference	vii

S	
Sanyo-Kokusaku Pulp Co. Ltd	iii
Sub-Tropical Testing Service Inc	Cover

JOCCA

READER ENQUIRY SERVICE - DECEMBER 1980

For further information please circle no more than three items:

- 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
- 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
- 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
- 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
- 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
- 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120
- 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140
- 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160
- 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180
- 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200

Name

Job Title

Company

Address

Country Telephone

Please also send information on the following items relating to the above:

Send enquiries to:

Journal of the Oil and Colour Chemists' Association

Priory House, 967 Harrow Road, Wembley, Middx., HA0 2SF, England

Telephone: 01-908 1086 Telex: 922670 (OCCA G)

AT YOUR SERVICE to develop finer, more durable products

The fast, economical weather tests of

SUB-TROPICAL TESTING SERVICE, INC

established 1929

Sub-Tropical Testing Service is known and utilised world wide

Our 52nd Year



Send for free
Sub-Tropical colour
brochure

**Sub-Tropical Testing gives fastest Natural Weather tests available for * paints
* chemical coatings * plastics * textiles * fabrics * related products ***

Wir waren die ersten, welche einen Prüfdienst dieser Art für Lacke, Kunststoffe, chemische Beschichtungen, Stoffe und Gewebe aller Art, Farbstoffe und verwandte Erzeugnisse in den U.S. möglich machten.

Mr. C. Hubbard Davis, Founder, Sub-Tropical Testing Service, Inc. (1904-1977)
P.O. Box 560876, 8290 S.W. 120th Street, Miami, Florida, U.S.A. 33156

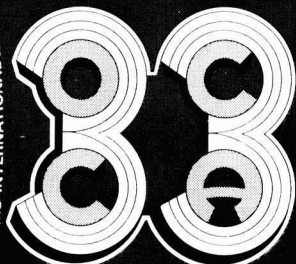
Phones: (305) 233-5341
Cable: SUBTROPIC, Miami



• THE INTERNATIONAL FORUM FOR

• THE SURFACE COATINGS INDUSTRIES

CUNARD INTERNATIONAL HOTEL



• LONDON 28-30 APRIL 1981

Motif designed by Robert Hamblin.

33RD ANNUAL EXHIBITION
OF THE
OIL & COLOUR CHEMISTS' ASSOCIATION
CUNARD INTERNATIONAL HOTEL
LONDON · 28-30 APRIL 1981

The world's most important international exhibition of raw materials, plant and equipment used in the Paint, Printing Ink, Polymer, Colour, Adhesives and Allied Industries.

TUESDAY	28 APRIL	09.30 - 17.30
WEDNESDAY	29 APRIL	09.30 - 17.30
THURSDAY	30 APRIL	09.30 - 17.30

ADMISSION FREE

Copies of the Invitation to Exhibit and application forms obtainable from the Director & Secretary (Mr R. H. Hamblin) at the following address:

Oil & Colour Chemists' Association,
Priory House, 967 Harrow Road, Wembley, Middlesex,
England, HA0 2SF
Telephone: (01) 908 1086 Telex: 922670 (OCCA Wembley)

OIL & COLOUR



CHEMISTS

ASSOCIATION

THE INTERNATIONAL FORUM FOR

CUNARD INTERNATIONAL HOTEL



THE SURFACE COATINGS INDUSTRIES

LONDON 28-30 APRIL 1981

ANNUAL EXHIBITION

28-30 APRIL 1981

INVITATION TO EXHIBIT

Motif designed by Robert Hamblin.

COMPLETE AND RETURN THIS COUPON FOR A COPY OF THE INVITATION TO EXHIBIT

To: Director & Secretary, Oil & Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF ENGLAND
Telephone 01-908 1086 Telex 922670 (OCCA G)

We are interested in exhibiting at OCCA-33 (28-30 April, 1981, Cunard International Hotel, London). Please send us a copy of the Invitation to Exhibit.

BLOCK LETTERS PLEASE

9.1072.2524

