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INDEX FOR 1979 VOLUME

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COLOUR
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Characterisation of the interaction between pigments and binder solution using rheological measurements
A. Saarnak

A study of the effects of increasing crystallinity in polyvinylidene chloride coated polypropylene (Prop C) and cellulose (mxxT/s)
M. W. Leonard

Coatings based on fatty acid modified cellulose phthalate resins
B. P. Singh, S. Chandra and A. K. Vasishtha

Raft trials of anticorrosive paints of high resistance
V. J. D. Rascio, J. J. Caprari, D. del Amo and R. D. Ingeniero

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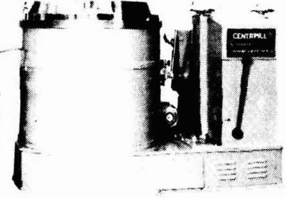

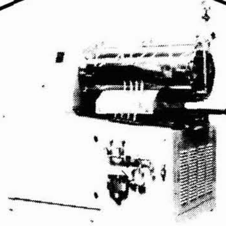

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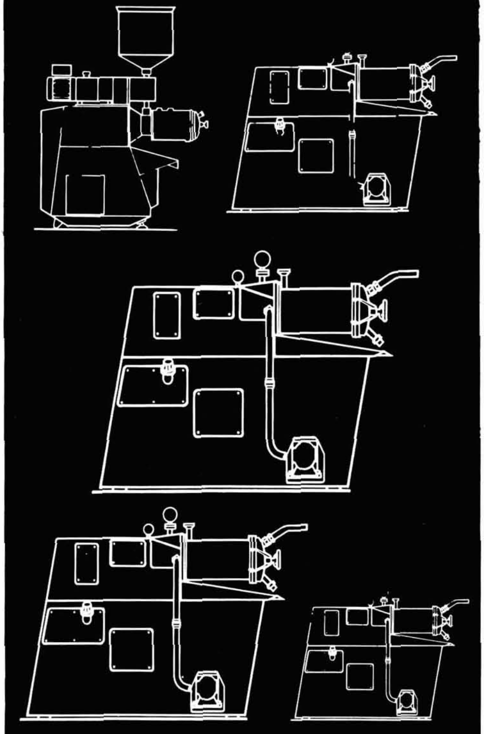

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Dr. Pappas has authored (or co-authored) over 30 journal articles on synthesis, reaction mechanisms, photochemistry, and coatings technology, including a recent review paper on photochemical aspects of ultraviolet curing. His papers on the photochemistry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

ABOUT CO-AUTHORS

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

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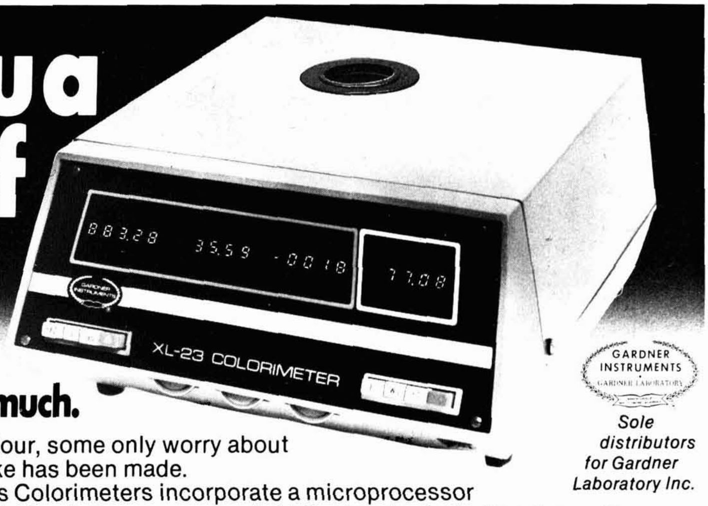

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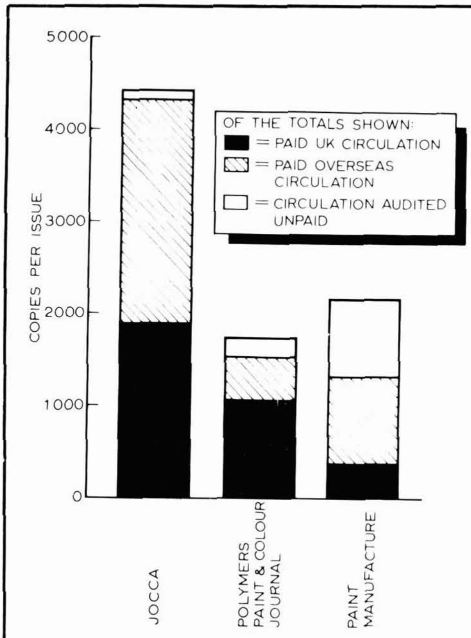

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Contents **Vol. 62 No. 11** **December 1979**

Transactions and Communications

OIL AND COLOUR CHEMISTS' ASSOCIATION
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OIL & COLOUR CHEMISTS' ASSOCIATION

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UV2 UV2

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

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Transactions and Communications

Characterisation of the interaction between pigments and binder solution using rheological measurements*

By A. Saarnak

Scandinavian Paint & Printing Ink Research Institute, Agern Alle 3, DK-2970 Hørsholm, Denmark

Summary

It has been shown that, at high rates of shear, the relative viscosity of suspensions of a rutile titanium dioxide in solutions of epoxy resins can be calculated according to the Brinkman and Mooney equations when the particle volume is adjusted for the volume of the adsorbed layer and the entrapped liquid. The correction factor is a constant for a pigment/binder pair and can be determined from the difference between the measured and the calculated relative viscosities. This is valid for pigment concentrations lower than 20 per cent by volume.

For stable suspensions, the volume correction is approximately equal to the adsorbed layer, i.e. very little solution is entrapped and the adsorbed volume can be estimated.

For unstable, flocculated systems the volume correction needed is considerably greater than the adsorbed layer, indicating stable flow units containing immobilised polymer solution in addition to the adsorption layer. In this case the adsorbed volume cannot be calculated from simple viscosity measurements.

An automated viscometer is a convenient and useful tool for evaluation of the rheology of pigment suspensions.

Keywords

Raw materials for coatings
  binders (resins, etc.)

epoxy resin

prime pigments and dyes

titanium dioxide

Processes and methods primarily associated with
  manufacturing or synthesis

pigment dispersion
flocculation
adsorption

Properties, characteristics and conditions primarily
  associated with

materials in general

viscosity
thixotropy

La caractérisation de l'interaction de pigments et de liants en solution au moyen des mesures rhéologiques

Résumé

A des vitesses de cisaillement élevées, on a démontré que la viscosité relative des suspensions d'un pigment de dioxyde de titane du type rutile en solutions des résines époxydes peut être calculée selon les équations de Brinkman et Mooney, où le volume particulaire est ajusté afin de tenir compte du volume de la couche adsorbée et aussi du liquide occlus. Le facteur de correction est constant pour chaque couple pigment/liant, et peut être déterminé à partir de la différence entre la viscosité relative measurée et la valeur calculée. Cette détermination est valable dans le cas des concentrations pigmentaires inférieures à 20 pour cent par volume.

Dans le cas des suspensions stables, la correction de volume est à peu près égale à la couche adsorbée, c'est-à-dire, très peu de solution est occlus et on peut estimer le volume adsorbé.

Dans le cas des systèmes instables et floconneux, la correction de volume requise est beaucoup plus importante que la couche adsorbée, qui indique la présence des éléments d'écoulement stables et contenant de solution polymère immobilisée ainsi que la couche adsorbée. Dans ce cas on ne peut pas calculer le volume adsorbé à partir des simples mesures de viscosité.

Un viscosimètre automatisé est un outil commode et utile pour évaluer la rhéologie de suspensions pigmentaires.

Charakterisierung mittels rheologischer Messungen der zwischen Pigmenten und Bindemittellösung stattfindenden Reaktion

Zusammenfassung

Es wurde demonstriert, dass die relative Viskosität von Suspensionen eines rutilen Titaniumdioxides in Epoxyharzlösungen bei hohen Schergeschwindigkeiten nach den Brinkman und Mooney Gleichungen berechnet werden kann,

---

*Paper presented on behalf of SLF at the Association's Conference held at Stratford upon Avon from 20-23 June 1979.

wenn das Partikelvolumen dem Volumen der adsorbierten Schicht und der eingefangenen Flüssigkeit angepasst werden kann. Der Korrekturfaktor ist eine Konstante für ein Pigment/Bindemittelpaar und kann aus dem Unterscheid zwischen den gemessenen und berechneten relativen Viskositäten bestimmt werden. Dies gilt für niedrigere Pigmentkonzentrationen als 20 vol.%.

Für stabile Suspensionen ist die Volumenkorrektur annähernd der adsorbierten Schicht entsprechend, d.h. sehr wenig Lösung wird zurückbehalten, und das adsorbierte Volumen kann geschätzt werden.

Für unstabile, flockulierte Systeme ist die erforderliche Volumenkorrektur beträchtlich grösser, als die adsorbierte Schicht, ein Anzeichen für stabile Flusseinheiten, enthaltend immobilisierte Polymerlösung zusätzlich zur Adsorptionsschicht. In diesem Falle kann das adsorbierte Volumen nicht aus einfachen Viskositätsmessungen berechnet werden.

Zur Bestimmung der Rheologie von Pigmentsuspensionen ist ein automatisch arbeitendes Viskometer ein bequemes und nützliches Gerät.

Introduction

Refs. 1–4

The performance of a coating is determined to a considerable extent by the interactions between its constituents. When the coating is applied as a solution or a dispersion, the interactions taking place in the fluid state are of great importance. It is well known that the efficiency of the pigments, e.g. colour strength and hiding power, depends on the state of the dispersion.

The behaviour of pigments has been studied during recent years at the Scandinavian Paint and Printing Ink Research Institute. The conditions necessary for obtaining stable suspensions of pigments in paint media have been especially investigated. It has been shown that the use of the solubility parameter concept[1] can facilitate an understanding of the adsorption phenomena taking place in the fluid paint[2–4].

Stability of pigment suspensions

Refs. 5, 6

A suspension of a pigment in a paint media can usually be described as a colloidal system. There is a general attractive force between the particles, which will always cause an agglomeration if there are no counteracting repulsive forces. These can be of two kinds:

- stability can be achieved by an adsorbed layer on the surface of the pigment particle i.e. steric stabilisation
- stability can be achieved by electric charges (zeta potential) on the surface of the particles creating repulsive forces.

In organic systems with a low dielectric constant, steric stability prevails, especially in concentrated solutions. In water-borne systems both mechanisms are probably active simultaneously[5,6]. Studies of adsorption phenomena are, therefore, of great interest.

Adsorption

Refs. 3, 4, 7–9

When a pigment is dispersed in a polymer solution, some adsorption of parts of the solution always takes place. What is adsorbed, and to what extent, is determined by the competing interactions in the system[3,4].

Rehacek[7] has demonstrated how adsorption can be determined in relatively concentrated solutions, and showed that the true adsorption can be found from a conventional adsorption isotherm (see for example Figure 3). The true amount of polymer adsorbed is given by the intercept with the ordinate, and the concentration of the adsorption layer is found as the intercept with the abscissa. He and others have found adsorption layers up to 15 nm in thickness[7–9].

Such investigations of adsorption behaviour are rather time consuming as experienced by the author. It is, therefore, desirable to find other means of describing adsorption on pigment particles in order to characterise the state of pigment dispersion in paint media. Rheological measurements have been investigated for this purpose.

Rheology of pigment dispersions

Refs. 10–13

The rheology of suspensions of solid particles has attracted many researchers and a multitude of mathematical descriptions of such systems have been presented. Rutgers[10] gives a thorough survey of equations which have been proposed for describing of the relationship between relative viscosity (η_r) of disperse systems and concentration of the dispersed phase. The most simple expression is the well known Einstein formula:

$$\eta_r = 1 + k.c$$

where $k = 2.5$ for rigid uniform spheres, and c is the volume fraction of the dispersed phase. This equation is valid only at very low concentrations ($c < 0.01$).

Other general formulae are principally of two different kinds, power series and logarithmic expressions, or combinations of each. Two much used formulae were chosen for these investigations:

A power series according to Brinkman[11]

$$\eta_r = 1 + 2.5\,c + 4.38\,c^2 + 6.56\,c^3$$

and the Mooney formula[12]

$$\ln \eta_r = \frac{\alpha \cdot c}{1 - s.c}$$

Here α is the intrinsic viscosity. For ideal spherical particles α is identical with 2.5 in the Einstein equation. s is the self-crowding factor which is about 1.4 in the ideal case. The differences are believed to depend on adsorption layers. The Mooney formula can be rewritten in a linear form:

$$\frac{2.5}{\ln\ \eta_r} = \frac{1}{c} - s$$

This means plotting $1/c$ against $2.5/\ln \eta_r$ should give a straight line with slope $+1$ and $-s$ as the intercept with the ordinate. This has been shown to be valid for organic pigments[13].

When making rheological measurements on pigment suspensions, the experimental conditions must be chosen carefully. Ordinary pigment suspensions are often non-newtonian, i.e. they can form structures. Such structures can be the result of particle to particle interactions at high particle concentrations or due to unstable suspensions i.e. flocculation. These effects can be shear dependent and sometimes also time dependent. It is rather difficult to give a quantitative description of time and shear dependent suspensions, because the equilibrium values are difficult to determine. In this work the viscosities discussed occur in true Newtonian systems or are determined at such high rates of shear that all structures are broken down and a Newtonian state has been reached.

Experimental

Refs. 7, 14

Materials

Suspensions of a rutile titanium dioxide (RN 45, Kronos, Norway) having different concentrations (the concentrations are given as volume fraction) in solutions of different commercial epoxy resins, 40 per cent by weight in methyl-ethyl-ketone.

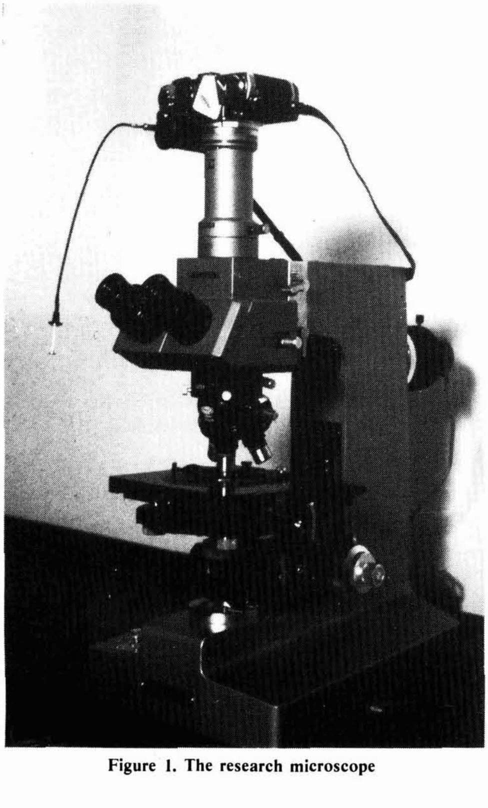

Figure 1. The research microscope

The suspensions were dispersed by shaking in glass jars with 3 mm glass beads on a Red Devil shaker.

Methods

The state of dispersion was determined by subjective evaluation of microphotographs obtained from microscope slides in transmitted light using an Olympus Vanox research microscope (Figure 1), at approx. 500 x magnification.

The viscosity was measured using an automated viscometer consisting of a Contraves Rheomat 30 in line with a Hewlett Packard 9815A via an especially made interface, and with a Hewlett Packard plotter 9862A[14]. The equipment is shown in Figure 2.

Figure 2. The automated viscometer

The measurements were carried out using a standard procedure stored on tape. The results are immediately calculated by the computer, printed out and plotted. Such an automated routine and data processing is exactly reproducible and time saving.

Adsorption. The adsorption isotherms were determined by gravimetric determination of changes in polymer concentration after dispersing the pigment. The results were evaluated according to the method of Rehacek[7].

Results

Adsorption

From the adsorption isotherms, shown in Figure 3, the true amount of adsorbed polymer was determined as the intercept with the ordinate and the concentration of the adsorbed layer as the intercept with the abscissa. The thickness of the adsorbed layer was calculated assuming complete wetting and uniform distribution of the adsorbed layer on the surface of the pigment. The specific area of the pigment was 15 m^2/g. The results are summarised in Table 1.

The state of dispersion

The suspensions in solutions of Epikote 1001 were flocculated. The suspensions using the epoxies with higher molecular weights (1004, 1007 and 1009) were all well dispersed. Photomicrographs of the suspensions in solutions of 1001 and 1004 are shown in Figures 4A and 4B.

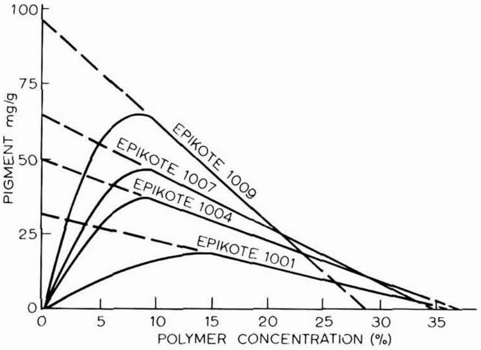

Figure 3. Adsorption isotherms

Figure 4A. A suspension of titanium dioxide in a solution of Epikote 1001. x500

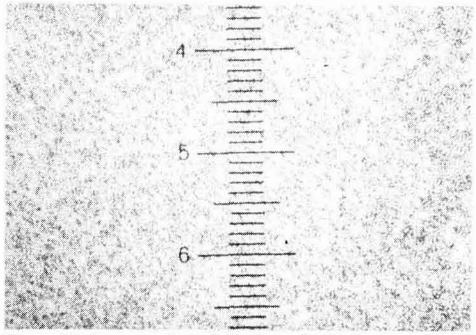

Figure 4B. A suspension of titanium dioxide in a solution of Epikote 1004. x500

Viscosities

The viscosities for all systems were determined when the Newtonian region was reached. This usually happened at shear rates between 500–1000 s^{-1}. The absolute values were taken from the computer print out and the relative viscosities were calculated. These measured values are compared in Table 2 with calculated relative viscosities using the Brinkman formula.

In addition to these series having a variable pigment concentration, viscosities have been measured for $c = 0.1$ in solutions with different concentrations of Epikote 1009. Relative viscosities between 1.9 and 2.1 have been found as compared with the calculated value of 2.00.

Table 1
Adsorption characteristics for solutions of epoxy resins on a rutile titanium dioxide.

Resin	Adsorption		
	mg polymer/ g pigment	the concentration of the layer, %	calculated thickness, nm
Epikote 1001	36.6	36.7	7
Epikote 1004	49.8	37.3	10
Epikote 1007	65.3	34.8	14
Epikote 1009	96.7	28.9	25

Table 2
Comparison between measured and calculated relative viscosities

Pigment concentration		Epikote 1001			Epikote 1004		
Volume fraction	Calc. (1)	Meas.	Calc. (2)	Calc. (3)	Meas.	Calc. (4)	Calc. (5)
0.05	1.14	1.29	1.20	1.30	1.19	1.23	1.20
0.10	1.30	1.59	1.45	1.73	1.43	1.54	1.45
0.15	1.50	2.23	1.78	2.32	1.78	1.95	1.78
0.20	1.73	3.33	2.19	3.12	2.58	2.46	2.19
0.25	2.00	5.98	2.69	4.17	4.00	3.12	2.69

(1) uncorrected for adsorption
(2) corrected with factor 1.4 from adsorption measurements
(3) corrected with factor 2.0, the theoretical fit
(4) corrected with factor 1.6 from adsorption measurements
(5) corrected with factor 1.4, the theoretical fit

The measured relative viscosities are plotted according to Mooney's method in Figures 5 and 6. Two different methods were used to evaluate the concentration of the dispersed phase:

(a) the nominal pigment concentration, and

(b) the volume of the pigment increased by the volume of the adsorbed layer.

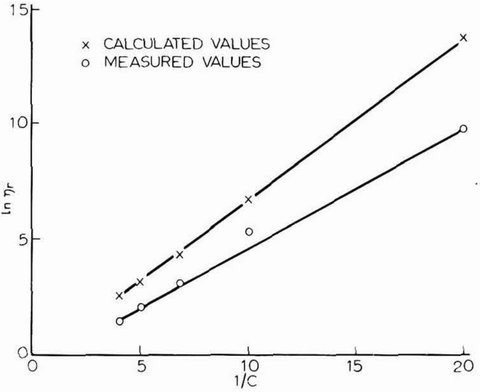

Figure 5. The relative viscosity versus pigment concentration according to Mooney. Solution of Epikote 1001 in MEK

The suspensions in Epikote 1001 solutions were all very shear dependent (shear thinning), whilst the suspensions in solutions of Epikote 1004, 1007 or 1009 were Newtonian or nearly so.

Discussion

When the nominal pigment concentrations are used for calculating the relative viscosities, the values obtained are considerably lower than those measured. The reason probably is that the adsorbed layer increases the volume of the dispersed phase. The thickness of the adsorption layer has been determined according to the method of Rehacek. Using the corrected concentrations, the relative viscosities calculated using the Brinkman formula in well dispersed systems are rather close to the measured ones, at least at lower concentrations. The highest concentration ($c = 0.25$) gives much higher values than calculated, probably due to strong particle-particle interaction.

The measured viscosities for the non-stable suspensions (with 1001) are much higher than the calculated ones, even if the adsorption layer is taken into consideration. It seems that rather stable flocculated flow units may be formed (stable at shear rate 1000 s^{-1}). These flow units contain immobilised polymer solution so that the effective volume of the suspended phase is much higher.

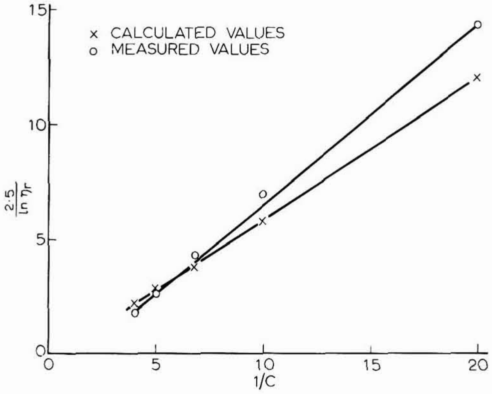

Figure 6. The relative viscosity versus pigment concentration according to Mooney. Solution of Epikote 1004 in MEK

When the data are plotted according to Mooney, straight lines are obtained (Fig. 5), but the slopes differ from +1, the theoretical value. Corrections taking the adsorption layer into consideration also do not give the theoretical slope. See Table 3.

When the volumes of dispersed phases are corrected to obtain a slope of +1, different behaviours are observed.

The flocculated suspensions need a doubling of the volume of the dispersed phase. This implies that the dispersed phase, at high rates of shear, consists of 50 per cent pigment, 20 per cent adsorbed layer and 30 per cent immobilised solution. At lower shear rates, the immobilised volume probably increases still more as larger flocculates are formed and more solution is entrapped.

The well dispersed, stable systems (in solutions of 1004) need a volume correction of only 40 per cent to fit the theory (Fig. 6). That is somewhat less than the adsorption layer found. The well dispersed suspensions in solutions of the higher molecular weight epoxy resin (1009) needed a volume correction of about 150 per cent to fit the Brinkman equation. This is in accordance with the adsorption measurement.

Table 3

Evaluation of the state of dispersion according to the Mooney equation

	Epikote 1001	Epikote 1004
Uncorrected slope	0.4	0.8
Corrected slope (addition of the adsorbed layer)	0.75	1.2
Correction factor from adsorption measurements	1.4	1.6
Correction factor to obtain slope +1	2.0	1.4

When the particle concentrations needed for obtaining theoretical fit in the Mooney formula were used in calculations of η_r according to Brinkman, perfect agreement with the determined values are obtained in most cases (See Table 2). The models used by Brinkman and Mooney are seemingly consistent with each other. This increases the possibility that these models are valid for the suspensions investigated.

The correction factor seems to be approximately constant for a given binder/pigment pair in the concentration ranges studied. This is in accordance with the assumption made by Rehacek that the composition of the adsorption layer is constant and independent of the polymer concentration. This means that the viscosity at high rates of shear can be calculated when the pigment concentration is changed within reasonable limits, up to volume fraction 0.2 which corresponds to a pigment volume concentration of 40 per cent in conventional paint systems.

Flocculated systems and well dispersed systems with thick adsorption layers can give relative viscosities of the same order of magnitude at high rates of shear. Other types of measurement are needed to distinguish between them. The differences can be determined qualitatively by microscopy or by measuring the viscosity as function of the shear rate.

Acknowledgement

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Discussion at Stratford Conference

DR G. D. PARFITT commented that there were many equations in the literature relating viscosity to concentration, and asked why the Brinkman and Mooney equations had been chosen for this work.

MR SAARNAK agreed that there were a vast number of equations which could have been used for his calculations. The Brinkman and Mooney equations had been chosen because it had been shown previously by other workers that they were particularly useful in this application.

Dr Parfitt referred to the flocculated system used, which appeared to involve the incorporation of large amounts of immobilised solution in the dispersed particles, and exhibited Newtonian behaviour. He asked if this behaviour was normal for such a system.

Mr Saarnak stated that he was not sure whether the behaviour was normal for this type of system. There is always an equilibrium between the inter-particle attractive forces and the shearing stress created in the viscometer. If the attractive forces within an aggregate (flow unit) are large enough, the system can behave in a Newtonian manner. These particular results had not been expected. He pointed out, however, that even in a well dispersed system, the pigment was not present as single particles, but as small aggregates, although these would not contain very much immobilised liquid.

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A study of the effects of increasing crystallinity in polyvinylidene chloride coated polypropylene (Prop C) and cellulose (mxxT/s)*

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Summary

The crystallinity of polyvinylidene chloride (PVdCl) coated films of polypropylene and cellulose increases with time. This development causes changes in the adhesion, surface tension and transmission of water vapour through the films, resulting in failure, after storage, of the films to meet the stringent requirements of some types of packaging.

Keywords

Types and classes of coatings and allied products

ink
varnish

Raw materials for coatings binders (resins, etc.)

polyvinylidene chloride

Properties, characteristics and conditions primarily associated with

materials in general

adhesion
crystallinity
surface tension
vapour transmission

Une étude des effets sur les feuilles de polypropylène (Prop C.) et de cellulose (mxxT/s) provoqués par la croissance du degré de la cristallinité dans les revêtements du chlorure de polyvinylidène

Résumé

Le degré de cristallinité dans les revêtements du chlorure de polyvinylidène appliqués aux feuilles de polypropylène et de cellulose monte à mesure du passage de temps. Cette augmentation entraîne des altérations de l'adhérence, de la tension superficielle et de la transmission de la vapeur d'eau à travers les feuilles et aboutit, après une période de stockage, à l'insuccès des feuilles en répondant aux strictes exigences de certains types de conditionnement.

Eine Untersuchung der Auswirkungen ansteigender Kristallinität in mit Polyvinylidenchlorid beschichtetem Polypropylen (Prop C) und Zellulose (mxxT/s)

Zusammenfassung

Die Kristallinität von mit Polyvinylidenchlorid beschichteten Filmen von Polypropylen und Zellulose wird mit der Länge der Zeit stärker. Diese Entwicklung verursacht Änderungen in Haftung, Oberflächenspannung und Wasserdampftransmission durch die Filme, mit dem Ergebnis von Filmschäden nach Lagerung welche den strengen Anforderungen nicht entsprechen, die an manche Arten von Verpackungen gestellt werden.

Introduction

Refs. 1-3

Flexible packaging is a very recent and modern development, but is one that has shown quite a remarkable growth rate. However, it is only fair to say that the development of surface coatings for flexible packaging has been a direct result of the development of flexible films and the process of printing, laminating and converting these films[1-3].

The plastics packaging industry has grown enormously and the plastics packaging printer may now be required to print upon a host of different plastics, from polyethylene to polypropylene, polyester, PVCl, cellulose acetate etc., which may in turn be barrier coated with, for instance, PVdCl. These printed plastic films may then have to withstand freezing, boiling, irradiating, impact and chemical attack etc. It is easy to understand, therefore, why the printer should take every care to ensure that what he produces will perform satisfactorily in use.

Over the past ten years the move towards PVdCl coated cellulose and plastic films has been considerable. This move started with the acknowledged superiority of mxxT/s type films over the, then standard, MS types. In the UK, next, came the British Cellophane development of mxxT/A, followed by ICI's Propafilm C, and more recently from most cellulose film manufacturers, high barrier mxxT/s films.

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*This paper is based upon a dissertation submitted by its author for a Licentiateship in the Professional Grade of the Association.

It was the development of these materials with their exceptional moisture and gas barrier properties, coupled with the market pressures for more and more convenience foods, that has given rise to the "high specification" sector of the packaging industry.

There are many factors which influence ink formulation and within the limits set by the opposing requirements of these factors it is the aim of the ink manufacturer to formulate a product which fulfils these requirements. Typical parameters would be adhesion, end usage, printability on the type of press concerned, commercial viability and freedom from effect on the substrate's barrier properties.

Background

Refs. 4–6

The two outstanding characteristics of polyvinylidene chloride (PVdCl) polymers are, thermal instability and impermeability. The present commercial success of these materials is due to the fact that the instability problem has been overcome, so that their valuable properties can be exploited. The techniques, i.e. copolymerisation and plasticisation, were developed by Ralph Wiley and co-workers[4] at the Dow Chemical Company during the period of 1932–1939. The commercialisation of these polymers under the trade name, 'Saran' began in 1939.

There is no doubt that PVdCl dispersions possess properties that distinguish them from all other types of polymer dispersion used in industry. The coatings that they yield provide protection against a large number of harmful influences. Their excellent resistance to gas and moisture-vapour transmission (see Table 1), their high resistance to attack by solvents, fats and oils, their high strength and their ability to be heat sealed are just a few advantages they offer.

A primary use of vinylidene chloride polymer lacquers is the coating of films made from regenerated cellulose, polyamides, polyester, polyethylene, polypropylene, polyvinylchloride, and polyethylene-coated board or paper. PVdCl dispersions are predominantly unpigmented in these applications.

The lacquers are applied commercially by roller coating, dip and doctor blade, knife coater and spraying. When drying the coatings by infrared heating or forced air drying, temperatures of 90°–140°C are used. Temperatures in the range of 60°–95°C promote the recrystallisation of the polymer after the solvent has been removed. A large part of the work carried out in this paper arises from the above mentioned fact; namely that temperatures of 60°–95°C promote recrystallisation in the polymer film–a process which occurs more slowly at room temperature, but nevertheless causes problems in the handling of the PVdCl materials as they age (see *Test methods*).

The property that is mainly responsible for the protective action of PVdCl dispersions is a change in morphology[5] that takes place in the coating after it has been applied. During the drying process, the largely amorphous i.e., non-crystalline, polymer particles within the dispersion are firstly converted into a dense, cohesive film. The water in the film acts to some extent as a plasticiser. After it has been removed the film changes into a partially crystalline state at a rate that depends on the temperature and on the type of PVdCl, i.e. the presence of co-monomers added to form the copolymer. Minor co-monomers in these copolymers are generally from the group: vinyl chloride, alkyl acrylates, alkyl methacrylates, acrylonitrile, methacrylonitrile and vinyl acetate[6]. Small concentrations of carboxylic acids, such as acrylic acid, methacrylic acid or itaconic acid are sometimes included to enhance adhesion of the polymer to the substrate. Crystallisation is generally reduced with increasing concentration of the co-monomers. Some copolymers used commercially fail to crystallise at all.

Permeabilities

Ref. 4

The aim of this work, as already stated, was to determine how increasing crystallinity affects the chemical and physical properties of particular relevance to printing of two packaging films (mxxT/s and Propafilm C) both coated with PVdCl, and how the printer and ink technologist might find ways of avoiding any problems that are caused.

The main objective was to assess at which stage in the "life" of the above mentioned films crystallinity causes detrimental effects.

By artifically accelerating the ageing of the film, the crystallinity was increased and the point at which adhesion to the film failed was assessed. Having found a way of plotting this deterioration in printing qualities, other qualities, such as wetting tensions, water vapour transmission, could also be evaluated and the manner in which they interrelated and associated with the age of the film could be determined.

Ultimately, it was hoped to provide a method of assessing how long these films could be stored and what properties, other than printability, were likely to be affected by age. If the film can be printed early in its life, when adhesion to it

Table 1
Comparison of the permeabilities of various polymers to water vapour[4]

	Density, kg.m^{-3}		Permeability*	
Polymer	Amorphous	Crystalline	Amorphous	Crystalline
ethylene	0.85×10^3	1.0×10^3	200 – 220	10 – 40
propylene	0.85×10^3	0.94×10^3	420	
isobutylene	0.915×10^3	0.94×10^3	90	
vinylchloride	1.41×10^3	1.52×10^3	300	90 – 115
vinylidene-chloride	1.77×10^3	1.96×10^3	30	4 – 6

*In g/hour per 2.54 m^2 area at 53 N m^{-2} pressure differential and 39.5°C for a film 25 microns thick will be optimal and it is not used for some time, other properties such as flexibility, water transmission or heat sealability may change, so affecting the barrier properties initially present in the films e.g. crisp packets are heat sealed and must keep out moisture to retain the freshness of the product inside.

Test methods and procedures

Ref. 7

Adhesion

The AIC2 IGT is an electronic printing unit used in paste ink technology for preparing high quality "proof" prints. The author has developed a method during the course of this investigation for using this machine to measure the adhesion of ink to the films.

(i) A printed strip of film (3 x 15 cm) is taken and covered with Scotch tape on the printed face. Scotch tape specified for the adhesion tests (this same roll of tape was used throughout the experimental work to eliminate the risk of different adhesive strengths which might vary from tape to tape).

The printed strip is left with several centimetres of tape unattached at the leading edge of the print.

(ii) The print is attached to the IGT blanket in the usual way and a given impressive force is applied at the "nip" between the disc and blanket. In this way the tape is pressed on to the print at a constant force per unit area.

(iii) The print is now left on the blanket and the loose end of the tape is stuck to the IGT steel disc. When the machine is operated the tape and film are separated at the nip.

(iv) The impression at the nip is adjustable (in Newtons) and the speed at which the separation takes place is also adjustable (m $\sec^{-1}$).

The results are then quoted as the pull-off speed at a given impression required to separate the tape and printed ink from the film. See Figure 1.

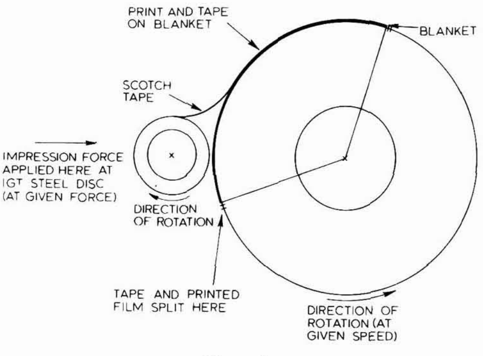

Figure 1

Water vapour transmission

The film under test is stretched over an aluminium Payne cup by means of retaining screws and clamps. Some dehydrated silica gel is placed inside the cup. The cup, film and silica gel are weighed accurately (to 0.1 mg) before being placed in an oven at 50°C and at a fixed relative humidity. At the end of the test period (seven days) the apparatus is reweighed and any increase in weight is attributed to water vapour transmitted through the film under test.

Wetting tensions[7]

(ASTM Standard Method for Test D2578)

In this method, drops of a series of mixtures of formamide and ethyl cellosolve of gradually increasing surface tension are applied to the surface of the film until a mixture is found that just wets the film surface. The wetting tension of the film surface will be approximated by the surface tension of this particular mixture.

When a drop of liquid rests on the surface of a solid, and a gas (atmosphere in this case) is in contact with both, the forces acting at the interfaces must balance. These forces can be represented by interfacial tensions acting in the direction of the surfaces.

It follows that:

$$\gamma_{GL} \cos\theta = \gamma_{GS} - \gamma_{SL}$$

where;

θ = angle of contact of the edge of the drop with the solid surface

γ_{GL} = Surface energy of the gas-liquid interface

γ_{GS} = Surface energy of the gas-solid interface

and

γ_{SL} = Surface energy of the solid-liquid interface

The right hand side of the above equation is defined as the wetting tension of the solid surface. It is not a fundamental property of the surface, but depends on interaction between the solid and a particular environment.

When the gas is air saturated with vapours of the liquid, γ_{GL} will be the surface tension of the liquid. If the angle of contact is 0 degrees the liquid is said just to wet the surface of the solid and in this particular case (since $\cos\theta = 1$) the wetting tension of the solid will be equal to the surface tension of the liquid. i.e., if $\theta = 0°$, $\cos\theta = 1$, then $\gamma_{GL} = \gamma_{GS} - \gamma_{SL}$ and the liquid just wets the solid surface.

Practical method of determining wetting tension of PVdCl coated substrates

All that are required are some cotton tipped cocktail sticks and a set of the solutions described above for measuring wetting tension.

Some care is necessary as a heavy application of wetting solution can often give misleading results. The cotton tipped cocktail stick is dipped in the wetting solution and the

Table 2
Concentrations of ethyl cellosolve–formamide mixtures used in measuring wetting tensions of films[7]

Formamide	Ethyl cellosolve	Wetting tension Nm^{-1}
0	100.0	30
2.5	97.5	31
10.5	89.5	32
19.0	81.0	33
26.5	73.5	34
35.0	65.0	35
42.5	57.5	36
48.5	51.5	37
54.0	46.0	38
59.0	41.0	39
63.5	36.5	40
67.5	32.5	41
71.5	28.5	42
74.7	25.3	43
78.0	22.0	44
80.3	19.7	45
83.0	17.0	46
87.0	13.0	48
90.7	9.3	50
93.7	6.3	52
96.5	3.5	54
99.0	1.0	56

excess allowed to drip off. The saturated cotton tip is then drawn evenly over the surface of a clean sample of the film under test. The test is repeated several times for each solution over different "sections" of the film. When the correct wetting solution has been found the solution will be seen to spread evenly over the surface to which it is applied and then, within two seconds, it must reticulate (become broken into small droplets).

If the solution spreads and does not reticulate a solution of higher wetting tension must be tested. If the solution reticulates immediately, a lower wetting tension solution should be tried.

It might be asked why the wetting solution must reticulate after two seconds, since if the contact angle is zero then no reticulation should occur. Since the test method states that the liquid should only *just* wet the surface of the film, it would be expected that reticulation would occur after a short time.

Assessment of crystallinity by attenuated total reflection–IR spectroscopy

This is a method which allows changes in the crystallinity of coatings to be measured without causing any changes in the system[5]. The method is a special form of infrared spectroscopy referred to as attenuated total reflection (ATR).

The infrared rays do not pass through the specimen, which is placed on both sides of the ATR crystal, but are reflected at the surface of the polymer. The depth of penetration depends on the angle of incidence and is of the order of a few micrometres (10μm max.).

It can be seen from Figure 2 that the ATR method consists of allowing a defined ray of light to be repeatedly reflected between prisms and the coating under investigation. In this case the prism was a mixture of thallium bromide and iodide, but extremely pure silicon or germanium may also be used. The ray of light is reflected about eighty times in the layer before it reaches the analyser.

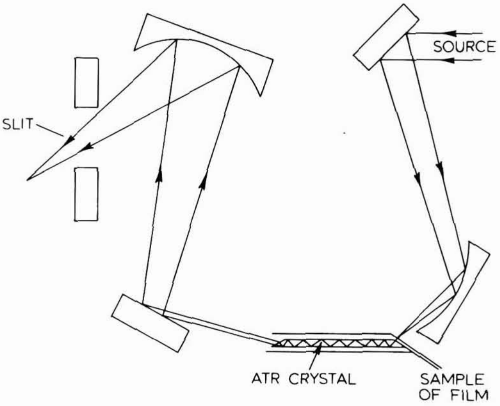

Fig 2. Schematic diagram illustrating ATR spectroscopy

There are several ways in which the spectra obtained may be interpreted:

(i) The extinction of a crystallisation-dependent waveband, usually that at 530 cm^{-1}, is compared with the extinction of a crystallisation-independent waveband for a CH-valency vibration, e.g. 568 cm^{-1}. The quotient of the two extinctions is a useful measure of the crystallinity of a coating[8].

(ii) Another method (used in this work) which shows close agreement with X-ray diffraction photographs and the physical properties of the films, is to measure the absorption at 750 cm^{-1} calculated by the usual baseline technique. The film is then removed from the spectrophotometer and its thickness measured using a micrometer[9].

The crystallinity is then calculated as follows:

$$\textit{Crystallinity Index} = \frac{A750 \times Z}{\text{Film thickness (cms)} \times 10^{-3}}$$

where A750 is the absorption at 750 cm^{-1}, and Z is a scaling factor to bring results within convenient limits (in this case 30).

Artificial ageing

This was carried out using a BS oven kept at a constant temperature of 65°C. The films under test were stored, rolled loosely in Kilner jars[10] and placed on the top shelf of the oven. Keeping the jars sealed helps to maintain constant atmospheric conditions within.

Coating film for print quality checks

For adhesion tests the film was coated using a K coater bar.

The greater the diameter of wire the higher the K bar number and, therefore, a greater film weight is deposited.

Print keying

Once the print has dried it is drawn slowly over a metal cylinder at 80°kC (Figure 3).

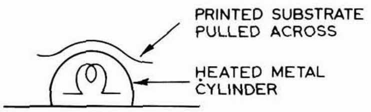

Figure 3

Test procedure

Large samples of mxxT/s and Prop C of known date of manufacture were obtained. Infrared, ATR analysis was used to obtain the initial degree of crystallinity in both films.

The films were then coated using a white gravure ink suitable for these substrates. The printing was carried out using a No. 2 K bar and pad.

When the ink had dried it was "keyed" to the film at 80°C, as would be the case industrially. The print was then cut into three strips 3 cm wide and 15 cm long and the adhesion measured with the IGT AIC2 machine. Small samples of the film were also taken (unprinted) and checked for wetting tension.

The final test at this stage was to check the water vapour transmission rate with the Payne cup.

The films under test were then placed in their Kilner jars and sealed. The jars were placed in the oven for ninety-six hours. After this period the films were removed from the oven and the above tests repeated under the same conditions. The films were then returned to the oven for a further five day period.

The above tests were performed at five day intervals (average) and visual checks were also made on the physical properties of the film, i.e. flexibility and colour.

The tests on crystallinity were duplicated as a test control.

Discussion of results

Significance of graphical results

Table 4 and Figure 4–Crystallinity vs time

(i) Both Propafane "C" and mxxT/s give similar curves. This is probably due to the fact that the polyvinylidene chloride is very similar (i.e. solvent applied) in both cases; only the stock varies.

(ii) Propafane "C", being a later sample, starts at an initially lower crystallinity index.

(iii) Both curves follow a similar pattern:

A sudden rise in the crystallinity index during the first hundred hours of accelerated ageing.

Over the next two hundred hours there follows a period when the rate of crystallisation slows down and rises more steadily.

The last two hundred hours show a marked increase in crystallinity and finally a "tapering off", which could be due to complete or almost complete crystallisation of the PVdCl coating. It should be pointed out that both samples were very brittle and fragile at the end of the ageing checks due to the, already mentioned, high degree of crystallinity. The film could never be used in this condition.

(iv) It also appears from the graph, that overall, the rise in crystallinity in both stocks is almost identical if the 13 units of crystallinity difference at the beginning due to difference in ages are taken into account (Table 3).

Table 3

No. of hours	(total)	mxxT/s	Prop "C"
100	100	30	18
200	300	13	10
275	575	37	64
75	650	4	5
Total		84	97
Subtract initial crystallinity difference		–	13
Δ C.I.		84	84

This shows that the rate at which the crystallinity increased was the same in both samples and that any tests carried out on these samples will show differences due to the nature of the substrate to which the PVdCl was applied as well as the polymer itself.

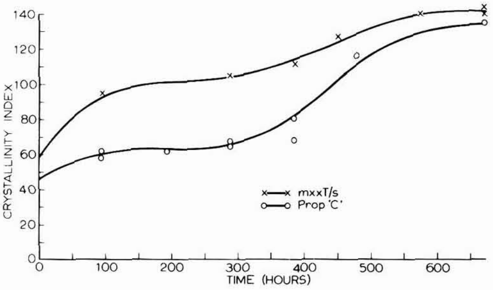

Figure 4. Graph of crystallinity vs time (accelerated ageing tests)

Table 5 and Figure 5–Adhesion vs crystallinity index

(i) It would appear that adhesion to mxxT/s diminishes quickly above a crystallinity index of approximately 90–95.

(ii) Adhesion to Prop "C" diminishes at a more steady rate, but up to a crystallinity index of 105 it shows the worst adhesion throughout.

This is not surprising, as commercially, good adhesion to Prop "C" is always harder to obtain.

(iii) Above a crystallinity index of 105, mxxT/s continues to give rapidly decreasing values for adhesion

Table 4
Crystallinity vs time (see Fig. 4)

Natural age:	mxxT/s	9 months
	Prop C	2 months

Accelerated ageing		Crystallinity indices			
		mxxT/s		Propafilm "C"	
Time (hours)	Date	Pilot	Duplicate	Pilot	Duplicate
0	9.1.78	60	60	37.03	37.03
96	16.1.78	95	91.3	61.1	58.3
192	20.1.78	100	91.2**	62.3	59.1**
288	26.1.78	105.5	105.0	65.0	66.0
384	3.2.78	111.1	112.0	85.0	75.0
480	13.2.78*	124.4	127.7	116.0	115.5
576	20.2.78	140.0	136.0	133.0	133.3
672	26.2.78	144.4	140.7	136.0	134.0

* Overnight ageing prohibited due to fire hazard during firemans strike
** Erroneous figures–double checked

Note: Both sets of results (pilot and duplicate) were not plotted on the graph owing to their close agreement and a small scale on the graph.

and at 115 adhesion is non existent and the ink simply falls off. The film at this stage is also quite brittle.

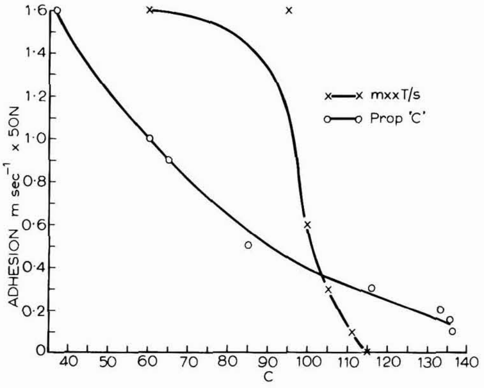

Figure 5. Graph of adhesion vs crystallinity index

(iv) Prop "C", due to the nature of the substrate, maintains better flexibility right to the end; its values for adhesion never disappear completely and a very slight degree of adhesion always remains. However, it should be pointed out that this, "slight degree" of adhesion, is somewhat academic. Far higher levels of adhesion are required in practice.

(v) Whilst it takes 288 hours for critical adhesion failure for Prop "C", it only takes 102.5 hours with mxxT/s. This is due to the fact that a higher level of crystallinity is found in mxxT/s after a shorter period of time.

Table 6 and Figure 6–Surface tension vs adhesion

This graph is closely related to Figure 8.

(i) There is a greater drop in wetting tension in the case of Prop "C" than there is with mxxT/s.

(ii) It can be concluded that over the same change in crystallinity the surface tension of the two samples varies considerably.

Table 5
Adhesion vs crystallinity index (see Fig. 5)

mxxT/s		Prop "C"	
Adhesion (m sec^{-1} x 50N)	Crystallinity	Adhesion (m sec^{-1} x 50N)	Crystallinity
$>$1.6	60	1.6	37.3
1.6	93	1.0	59.8
0.6	100	1.0	60.8
0.3	105	0.9	65.5
0.1	111.5	0.5	80.0
$<$ 0.1	125	0.3	115.5
$<$ 0.1	138	0.2	133.0
$<$ 0.1	142.3	0.15	135.0

Table 6
Surface tension vs crystallinity (see Fig. 6)

mxxT/s		Prop "C"	
Surface tension (dynes cm^{-1})	Crystallinity	Surface tension (dynes cm^{-1})	Crystallinity
34	60	41	37.3
34	93	40	59.8
34	100	39	60.8
33	105	38	68.5
32.5	111.5	37	80.0
32	125	36.5	115.5
31.5	138	36.0	133.0
31	142.3	36.0	135.0

(iii) Thus, the adhesion to mxxT/s varies considerably over a narrow range of surface tensions, whilst Prop "C" shows a wider range of surface tensions to study differing degrees of adhesion.

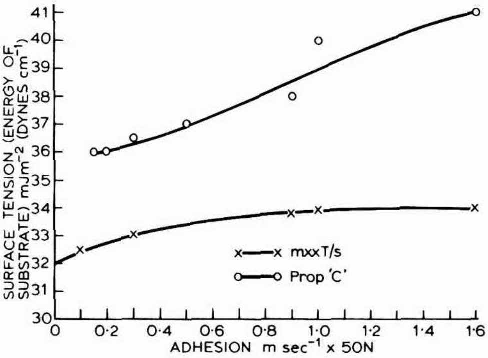

Figure 6. Graph of surface tension vs adhesion

Table 7 and Figure 7–Percentage water vapour transmission vs crystallinity

(i) Both samples show similar curves. Prop "C" begins at a lower crystallinity index for reasons already mentioned.

(ii) As the crystallinity increases the water vapour transmission rate also initially increases. However, the water vapour transmission rate then decreases quite considerably, probably due to the material becoming almost totally impervious to water as its crystallinity increases.

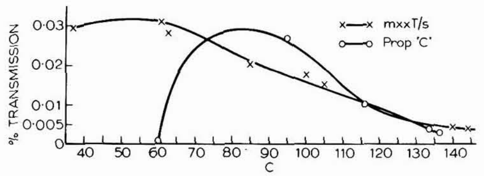

Figure 7. Graph of percentage water vapour transmission vs crystallinity

Table 8 and Figure 8–Surface tension vs crystallinity

(i) Adhesion fails as surface tension falls. The surface tension of the ink remains constant (before printing), but if the surface of the substrate has a low surface tension, the ink when applied, shows slight reticulation which leads to poor adhesion.

(ii) Prop "C" again shows a more steady decline. It can be seen that the critical surface tension of Prop "C", where adhesion to it becomes unacceptable, is much higher than the critical surface tension of mxxT/s (38 for Prop "C" as compared with 33.5 for mxxT/s). In general, a wetting tension of 35 or above is regarded as a "safe" value. This may explain why good adhesion to Prop "C" is generally

Table 7
Percentage water vapour transmission vs crystallinity (see Fig. 7)

mxxT/s		Prop "C"	
% H_2O Vapour Transmission	Crystallinity	% H_2O Vapour Transmission	Crystallinity
0	60	0.027	37.3
0.027	93	0.031	59.8
0.018	100	0.025	60.8
0.015	105	0.02	65.5
0.005	111.5	0.01	80.0
0.01	125	0.004	115.5
0.004	138	0.003	133.0
0.004	142.3	0.003	135.0

Table 8
Surface tension vs adhesion (see Fig. 8)

mxxT/s		Prop "C"	
Surface tension (dynes cm^{-1})	Adhesion (m sec^{-1} x 50N)	Surface tension (dynes cm^{-1})	Adhesion (m sec^{-1} x 50N)
34	> 1.6	41	1.6
34	1.6	40	1.0
34	0.6	39	1.0
33	0.3	38	0.9
32.5	0.1	37	0.5
32	< 0.1	36.5	0.3
31.5	< 0.1	36.0	0.2
31.0	< 0.1	36.0	0.15

harder to obtain. Perhaps if printers were aware that a higher wetting tension is required for Prop "C", adhesion failure could be minimised.

(iii) Therefore, crystallinity affects surface tension which in turn affects adhesion.

(iv) A further point of interest is the graph of $\frac{d\gamma}{dC}$ vs C (see Table 9 and Figure 9) where $\frac{d\gamma}{dC}$ = the rate of change in surface tension with crystallinity index.

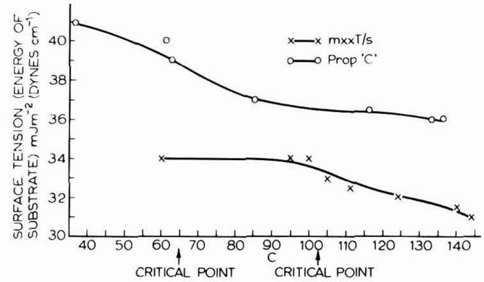

Figure 8. Graph of surface tension vs crystallinity

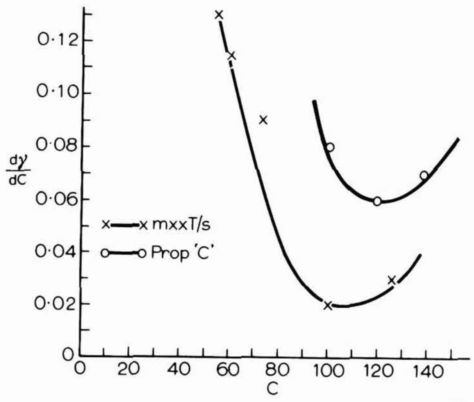

Figure 9. Graph of rate of change of surface tension ($\frac{d\gamma}{dC}$) vs crystallinity

Table 9
Rate of change of surface tension ($\frac{d\gamma}{dC}$) with crystallinity (see Fig. 9)

mxxT/s		Prop "C"	
$\frac{d\gamma}{dC}$	C	$\frac{d\gamma}{dC}$	C
0.13	55	0.08	100
0.09	75	0.06	120
0.02	100	0.07	137.5
0.03	126.5		
0.04	40		

Conclusions

The aim of this work was to study the effects of increasing crystallinity in PVdCl coated polypropylene and cellulose. These effects have been studied, artificially accelerated, and the following conclusions may be made.

1. A study of the increase in crystallinity shows that:
    - (i) mxxT/s shows severe deterioration in adhesion results early in its life since crystallinity increases more quickly initially in this film.
    - (ii) Prop "C" shows deterioration after a longer period of time, but a lower crystallinity index.
2. Water vapour transmission, adhesion, surface tension and the physical properties of the films are all affected by increasing crystallinity.
3. It should be noted that Prop "C" fails "adequate adhesion" tests at high surface tensions and, therefore, the usual criterion of 35 dynes/cm. should be increased in this case to 38 dynes/cm. (mJm^{-2}).
4. Although, generally, the water vapour transmission rate decreases as crystallinity increases, the flexibility of the films deteriorates and cracking or splitting and especially heat-sealing failure becomes more likely to occur.
5. It should be noted that the crystallinity has been accelerated in all of these tests and that at room temperature this dangerous increase would take several years to occur. It might be asked why, if this time is required at room temperature, these failures ever occur

when printers work on such a fast "work and turn" basis?

The answer to this question is not easily found. Perhaps a better dating system should be used and all batches of material clearly labelled and used within the time limits.

6. If printers are made more aware of the need to use up old stock for obvious reasons, perhaps problems could be minimised.

Suggestions for further development

1. The increase in crystallinity alters the surface tension; further work could be carried out to determine why and how this process can be slowed down to a rate that is acceptable.
2. Inks could be so formulated that they would adhere to surfaces of even lower surface tensions.
3. Cold storage might be the answer to slowing down the rate of crystallisation.
4. Printers could be shown how to carry out their own tests on the films before use so that they could save a lot of time, money and effort.

Formulation of inks to adhere to low energy substrates is not beyond the realms of possibility. When an ink does reticulate, the tiny droplets formed sometimes do adhere to the substrate. It might be found that low surface energy only causes reticulation and if that were the case, the question of what causes the poor adhesion that accompanies it might be investigated. It might be interesting to note that the transition from a surface comprised of $-CH_3$ groups to one of $-CH_2$ groups results in an increase in surface tension of some 10 dynes/cm. (mJm^{-2}).

Literature survey

Refs. 2, 8

Substantially no work has been published on this subject, however certain conclusions have been reached concerning crystallinity adhesion and surface tension.

B. Lindberg[8] found that: "It was difficult to find any positive relationship between the surface tensions of the two adherents (film and ink) and the adhesion between them. The use of the concept "wetting tension" was found to give some information about the possibility of painting (and printing) plastic substrates."

At the International Seminar 1977 on PVdCl, H. P. Jones and J. S. Marsh[2] when talking about "Adhesion to PVdCl coatings" stated that "most liquid inks will wet out PVdCl coatings because their surface energy is greater than the critical surface tension of the coating". If this were the case adhesion would improve with increasing crystallinity since the surface tension of the coating falls with age. In actual fact adhesion deteriorates due to the fact that the surface tension of the ink is so high in comparison with the aged and consequently low surface energy film that it causes it to reticulate and results in poor adhesion. An analogy would be water (high surface tension) on a glass plate (low surface energy), where water reticulates and forms small "blobs".

Other references given do not give conclusive evidence relevant to this project. Instead they quote chemical and physical properties of the different types of PVdCl coated stocks available. Information as to the chemical constituents of these coatings found in the literature has been recorded in the introduction.

It is, however, a well known fact that rising crystallinity is a cause of adhesion failure and that crystallinity increases with ageing. Unpublished work by several companies involved with these coatings has been carried out, but this information is not available.

[Received 22 June 1979

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J. Oil Col. Chem. Assoc. 1979, **62**, 470-474

Coatings based on fatty acid modified cellulose phthalate resins

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Summary

Cellulose mixed esters of phthalic acid and long chain fatty acids were prepared and their film properties were studied and compared with those of corresponding alkyds. The fatty acid modified cellulose phthalate coatings exhibited excellent physical, chemical and mechanical properties and were found to be superior to the corresponding alkyds.

Keywords

Raw materials for coatings
binders (resins, etc.)

cellulose ester
cellulosic resin
polyester resin
alkyd resin

Raw materials used in manufacture or synthesis of ingredients for coatings

dibasic acid
fatty acid

Processes and methods primarily associated with analysis, measurement or testing

mandrel test

Properties, characteristics and conditions primarily associated with coatings during application

drying time

dried or cured films

scratch resistance
water resistance
solvent resistance
chemical resistance

Revêtements basés sur les résines de cellulose phtalate modifiées par des acides gras

Résumé

On a préparé des esters cellulosiques mixtes de l'acide phtalique et des acides gras de chaîne longue, on a étudié les caractéristiques de leurs films et l'on les a comparées à celles des résines alkydes correspondantes. Les revêtements á base du cellulose phtalate modifié par l'acide gras ont rendu d'excéllentes propriétés, physiques, chimiques et mécaniques et l'on les a trouvés supérieurs à ceux des alkydes correspondantes.

Beschichtungen auf Basis von mit Fettsäure modifizierten Zellulose-Phthalatharzen

Zusammenfassung

Es wurden Mischester von Phthalsäure und langkettigen Fettsäuren hergestellt, und deren Filmeigenschaften geprüft und mit denen entsprechender Alkyde verglichen. Die fettsäremodifizierten Zellulose-Phthalatlacke besassen ausgezeichnete physikalische, chemische und mechanische Eigenschaften und wurden als den entsprechenden Alkyden überlegen befunden.

Introduction

Refs. 1–4

The usefulness of cellulose depends not only on the excellent physical properties possessed by the cellulose itself, but also on its ability to be transformed into a variety of derivatives[1]. Cellulose, as a polyhydroxy alcohol, offers the possibility of branching and crosslinking by formation of ester and ether linkages. Amongst these, the products formed through ester linkages have shown the greater promise[2]. The complexity of the cellulose molecule, however, makes it difficult to obtain a high degree of esterification with many acids and also limits the variety of reaction methods which can be applied successfully for this purpose. Cellulose esters, in general, are prepared by reaction with acids, anhydrides and acid chlorides[3].

Esterification of cellulose with organic dibasic acids, such as, phthalic, maleic and adipic acids, and film properties of the resulting polyester resins have already been reported in an earlier communication[4]. Cellulose phthalate half-esters treated with glycerol and glycol and modified with rosin and ester gum have also been reported as useful film formers. The main short-comings of the above cellulose derivatives were their lack of flexibility and solubility in aliphatic hydrocarbon solvents.

Therefore, in the present work, attempts have been made to overcome these short-comings by incorporating long chain fatty acids in the cellulose phthalate half-esters. Cellulose was first partially esterified with phthalic anhydride, followed by further esterification with fatty acids in various proportions depending upon the oil length desired. Two types of fatty acids, namely, linseed fatty acids having an air drying property and the castor fatty acids having non-drying property were used. These mixed ester products closely resembled conventional alkyd resins based on glycerine, phthalic anhydride and fatty acids. Therefore, the properties of cellulose mixed phthalate fatty acid esters have been compared with such alkyds in order to examine their relative commercial usefulness.

Experimental

Ref. 4

Materials used

The raw materials used in the preparation of cellulose derivatives and alkyds were as follows:

Cellulose: Waste cotton lints of short fibre length were collected from a local cotton processing industry and used as the base material after its treatment.
Sulfuric acid: Sulfuric acid of L.R. grade was used as catalyst in the degradation of cellulose.
Hydrochloric acid: Hydrochloric acid of L.R. grade was used for the removal of pyridine from the cellulose derivatives as pyridine salt.
Sodium hydroxide: Sodium hydroxide of L.R. grade was used for the purification of raw cotton.
Phthalic anhydride: Phthalic anhydride of L.R. grade was used for the preparation of cellulose phthalate mixed esters and of conventional alkyds.
Glycerol: Glycerol of L.R. grade was used for the preparation of cellulose mixed esters and alkyds.
Pyridine: Pyridine of commercial grade, redistilled at 115-116°C, was used in the preparation of cellulose esters.
Magnesium perchlorate: Magnesium perchlorate was used as catalyst in the preparation of cellulose esters.
Linseed fatty acids: Linseed fatty acids were obtained from raw linseed oil by first saponifying the oil and then decomposing the soap with sulfuric acid.
Castor fatty acids: Castor fatty acids were also obtained from raw castor oil in the manner described above.
Driers: Cobalt naphthenate and lead naphthenate were used as driers for fatty acid modified cellulose phthalate and for the alkyd films.
Solvents: All solvents used were of L.R. grade for dissolving and thinning the cellulose derivatives and alkyds.

Preparation of cellulose esters

Cellulose was first degraded and purified by the procedure reported in the earlier work[4] and the processed cellulose was then used for the preparation of mixed cellulose esters with phthalic anhydride and fatty acids. These esters were prepared in the following manner:

Cellulose mixed phthalate linseed fatty acid esters: Two samples of cellulose mixed phthalate linseed fatty acid esters were prepared; one containing 60 per cent cellulose fatty esters and 40 per cent cellulose phthalate and the other containing 45 per cent cellulose fatty esters and 55 per cent cellulose phthalate. The first sample was considered as a long linseed fatty cellulose mixed phthalate ester and the second sample as a medium linseed fatty cellulose mixed phthalate ester. The quantities of ingredients were calculated on the basis of the formation of partial cellulose phthalate esters and cellulose fatty esters depending upon the desired oil length. The formulation of the two samples prepared is as follows:

Ingredient	Long linseed fatty cellulose mixed phthalate ester	Medium linseed fatty cellulose mixed phthalate ester
Cellulose	20 g	23 g
Phthalic anhydride	30 g	40 g
Linseed fatty acids	55 g	40 g
Glycerol	10 g	12 g
Magnesium perchlorate	3 g	3 g
Pyridine	100 ml	100 ml
Hydrochloride acid	85 ml	85 ml

The cotton linters (degraded and purified), phthalic anhydride and fatty acids were placed in a three-necked flask. Pyridine and magnesium perchlorate catalyst were added and the whole mass was heated to 150°C for 12 hours with continuous stirring. During this time the material formed a clear viscous solution which was poured into a large volume of water containing hydrochloric acid for precipitation. The product was then washed with hot distilled water until free from any traces of acid and finally dried at 60°C for 2 hours. The acid value of the product was determined and the calculated quantities of glycerol were reacted with the free acidity at a temperature of 150°C for 3 hours which gave a clear viscous mass. This was then dissolved in mineral turpentine to give a solution containing 50 per cent solids.

Cellulose mixed phthalate castor fatty acid esters: Two samples of cellulose mixed phthalate castor fatty acid esters were prepared; one containing 45 per cent cellulose fatty ester and 55 per cent cellulose phthalate and the other containing 30 per cent cellulose fatty ester and 70 per cent cellulose phthalate. The first sample was considered as a medium castor fatty cellulose mixed phthalate ester and the second sample as a short castor fatty cellulose mixed phthalate ester. The quantities of ingredients were calculated on the basis of the formation of cellulose phthalate half esters and cellulose fatty acid esters. The formulation of the two samples prepared is given below:

Ingredient	Medium castor fatty cellulose mixed phthalate ester	Short castor fatty cellulose mixed phthalate ester
Cellulose	23 g	25 g
Phthalic anhydride	40 g	51 g
Castor fatty acid	40 g	27 g
Glycerol	12 g	15 g
Magnesium perchlorate	3 g	3 g
Pyridine	100 ml	120 ml
Hydrochloric acid	85 ml	100 ml

These samples were prepared according to the method adopted for the preparation of cellulose mixed phthalate linseed fatty acid esters as described above and the products were dissolved in the mixture of xylene and mineral turpentine (1:1) to 50 per cent solids.

Preparation of alkyd resins

Two samples of each of linseed and castor oil alkyds, having oil lengths equivalent to those of cellulose phthalate fatty acid esters, described above, were prepared using the appropriate amounts of glycerol, fatty acids and phthalic anhydride. Linseed oil alkyds were dissolved in mineral turpentine and castor oil alkyds were dissolved in the mixture of xylene and mineral turpentine (1:1), all to 50 per cent solids.

Results and discussion

All samples prepared as above were studied for acid value, colour, viscosity, drying characteristics and film properties. The results showing acid value, colour and viscosity of 50 per cent solutions are given in Table 1. Drying time of air drying samples, flexibility and scratch hardness are given in Table 2. Water and alkali resistance of all the cellulose derivatives are given in Table 3. Resistances to sulfuric, hydrochloric and nitric acids are given in Table 4.

Drying characteristics

About 0.5 per cent lead and 0.05 per cent cobalt as metal in the form of naphthenate driers were added to all samples and films were applied by brush on 6 x 2 inch glass and tin panels. Linseed fatty cellulose phthalate ester samples and linseed alkyds were air dried. No significant differences in the drying time of cellulose based resins and alkyd resins were observed. Castor fatty cellulose phthalate ester samples and castor alkyds were baked at 140°C for 40 minutes.

Flexibility

Flexibility of the dried film was tested on tin panels with 1/4 inch mandrel. All the samples passed this test, as there was no detachment of the film or visible damage in any of the samples.

Scratch hardness

Scratch hardness of the dried film was tested on tin panels with an automatic 'Sheen' scratch hardness tester by placing increasing loads over a hardened needle. Scratch hardness (grams) of cellulose phthalate fatty acid esters and

Table 1
Physical properties of cellulose derivatives and alkyds

Sample Code	Description	Acid value	Colour of 50 per cent solution by, Lovibond tintometer with 1/4 inch cell Y + R	Viscosity of 50 per cent solution by Ford cup No. 4 at 30°C, Sec.
A	Long linseed fatty cellulose phthalate ester.	9.0	6.5 + 14.3	100
B	Medium linseed fatty cellulose phthalate ester.	8.7	8.4 + 11.8	105
C	Medium castor fatty cellulose phthalate ester.	8.0	3.2 + 11.7	111
D	Short castor fatty cellulose phthalate ester.	7.5	5.2 + 8.9	115
E	Long linseed oil alkyd.	12.5	3.1 + 5.4	95
F	Medium linseed oil alkyd.	11.0	5.1 + 2.6	102
G	Medium castor oil alkyd.	10.5	7.5 + 4.2	110
H	Short castor oil alkyd.	9.0	7.1 + 2.1	120

Table 2
Drying time of air drying samples and mechanical properties of cellulose derivatives and alkyds

Sample Code	Drying time in hours			Flexibility by 1/4 inch mandrel	Maximum scratch hardness (Load in g)
	Surface dry	Hard dry	Tack free		
A	4	10	22	Passed	3400
B	3	9	20	Passed	3600
C		Baked		Passed	4000
D		Baked		Passed	4100
E	4	10	24	Passed	1500
F	4	10	22	Passed	2400
G		Baked		Passed	3500
H		Baked		Passed	3700

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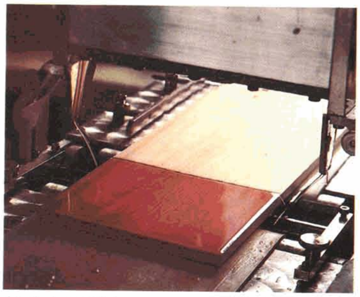
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15 pbw.	Di-butyl phthalate
15 pbw.	EDENOL® BS 20 N
185 pbw.	Toluene
120 pbw.	Isopropanol
110 pbw.	Spirit 110/140
100 pbw.	Butyl acetate
40 pbw.	Silicone Oil A, 1% in toluene (Bayer, Germany)
1000 pbw.	

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alkyds is shown in Table 2. Cellulose phthalate fatty acid esters had better scratch hardness than those of the corresponding alkyds, possibly because of the ring structure of the cellulose molecule. Films of castor fatty cellulose phthalate esters showed better scratch hardness than those of linseed fatty cellulose phthalate esters, because the former were stoved finishes and contained lower amounts of fatty acids.

Water resistance

The water resistance of cellulose phthalate fatty acid esters and alkyds is given in Table 3. Almost all samples had good water resistance. However, films of cellulose phthalate fatty acid esters showed better water resistance than those of alkyds. There was no effect of water on the former, even after 8 days of immersion, whilst the alkyd samples lost some gloss.

Alkali resistance

Glass panels of all samples were dipped in 20 per cent sodium hydroxide solution at 30 °C and the condition of the films was noted at regular 4 hour intervals. The effects are shown in Table 3. Films of cellulose phthalate fatty acid esters had better alkali resistance than those of the corresponding alkyds. The films of all the alkyd samples were completely removed within 14 hours of immersion in alkali solution, whereas those of cellulose phthalate fatty acid esters were only partially removed.

Acid resistance

Table 4 shows the results of acid resistance. The samples were tested in three acids, namely, hydrochloric, sulfuric and nitric acids. Films were examined at a regular interval of two days. After 8 days immersion in the acid solutions, it was observed that the films of cellulose phthalate fatty acid esters showed loss in gloss, whereas the films of the alkyds were either partially cracked or partially removed. The effect of acids on linseed oil alkyds was more pronounced than on castor oil alkyds. The above observations establish that the cellulose phthalate fatty acid ester possessed better acid resistance than the corresponding alkyds.

Conclusion

From the results obtained, it can be concluded that cellulose mixed phthalate fatty acid esters showed excellent physical and chemical properties, such as, flexibility, scratch hardness, and resistance to alkali and acids. Cellulose mixed phthalate castor fatty acid esters showed better properties than those of cellulose phthalate linseed fatty acid esters. Results of cellulose derivatives were compared

Table 3
Water and alkali resistance of cellulose derivatives and alkyds at 30° C

Sample Code	Condition of the film after 8 days of immersion in water	Condition of the film immersed in 20 per cent sodium hydroxide solution		
		After 6 hrs	After 10 hrs	After 14 hrs
A	5	3	2	1
B	5	3	2	1
C	5	3	2	1
D	5	3	2	1
E	4	2	1	0
F	4	2	1	0
G	4	2	1	0
H	4	2	1	0

5 = Unaffected
4 = Slight loss in gloss
3 = Loss in gloss
2 = Loss in gloss and film partially cracked
1 = Film cracked and partially removed
0 = Film completely removed

Table 4
Acid resistance of cellulose derivatives and alkyds at 30° C

Sample Code	20 per cent H_2SO_4		20 per cent HCl		20 per cent HNO_3	
	After 6 days	After 8 days	After 6 days	After 8 days	After 6 days	After 8 days
A	4	3	4	3	4	3
B	4	4	4	3	4	3
C	4	3	4	4	4	4
D	4	3	4	3	4	4
E	3	2	3	2	3	1
F	4	2	3	1	3	2
G	3	2	4	2	3	2
H	3	2	3	2	3	2

5 = Unaffected
4 = Slight loss in gloss
3 = Loss in gloss
2 = Loss in gloss and film partially cracked
1 = Film cracked and partially removed
0 = Film completely removed

with those of corresponding alkyds. Almost all the cellulose derivatives prepared, possessed better physical and chemical properties than the corresponding alkyds.

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Raft trials of anticorrosive paints of high resistance

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Summary

Optimisation has been carried out on a series of anticorrosive paints for the protection of ship's bottoms, following tests on experimental rafts. This is a new approach to the subject, prior to their application on the hulls of ships in service.

Five anticorrosive pigments (red lead, basic lead silico-chromate, a mixture of basic lead sulfate and non-leafing aluminium and two basic zinc chromates of different solubilities) were used in the formulations. The pigments and extenders were dispersed in a binder based on a phenolic varnish, with which various quantities of chlorinated rubber (20 cP) were incorporated.

"High build" chlorinated rubber paints, plasticised with chlorinated paraffin or chlorinated biphenyl and vinyl paints, were also tested.

The paint systems were applied to plates subjected to different surface treatments and of different thickness and then tested on an experimental raft at Puerto Belgrano, Argentina.

Keywords

Types and classes of coatings and allied products

ship bottom paint
anticorrosive coating

Types and classes of structures or surfaces to be coated

steel

Processes and methods primarily associated with drying or curing of coatings

sea water immersion test

Raw materials for coatings
binders (resins, etc.)

phenolic resin
chlorinated rubber
vinyl copolymer resin

prime pigments and dyes

red lead
lead silico chromate
aluminium pigment

chemically active pigments

zinc chromate

Les essais sur radeau des peintures anticorrosives à haute résistance

Résumé

En conséquence des essais effectués sur des radeaux expérimentaux, il est possible de déterminer le rendement optimal d'une série de peintures anticorrosives pour la protection des fonds de navires, avant leur application aux coques des navires en service. C'est un nouvel abord à ce sujet.

Dans la composition des peintures on a utilisé cinq pigments anticorrosifs (minium, silico-chromate basique de plomb, un mélange de sulfate basique de plomb avec du poudre d'aluminium non pelliculant, et deux chromates basiques de zinc ayant différentes solubilities aqueuses). On a dispersé les pigments et les matières de charge dans un vernis phénolique auquel on a ajouté différentes quantités de caoutchouc chloré (20cP).

On a essayé d'ailleurs des peintures vinyliques et des peintures "high build" à base de caoutchouc chloré plastifié avec la paraffine chlorée ou le diphényle chloré.

Les peintures ont été appliquées à des plaques de diverses épaisseurs et qui ont subies différents traitements superficiels, et ensuite ces peintures ont été essayées sur un radeau expérimental à Puerto Belgrano, en Argentine.

Raftversuche mit Rostschutzfarben hoher Widerstandsfähigkeit

Zusammenfassung

Optimalversuche wurden an einer Reihe von Rostschutzfarben zum Schutze von Schiffsböden nach vorausgegangenen Raftversuchen ausgeführt. Dies ist eine neuartige Methode des Vorversuchs, ehe Anstriche an der Hülle fahrender Schiffe vorgenommen werden.

Fünf Rostschutzpigmente (Mennige, basisches Bleisilicochromat, eine Mischung von basischem Bleisulfat und nicht-blättchenbildendem Aluminium, sowie zwei basische Zinkchromate verschiedener Löslichkeit) weuden in den Rezepturen benutzt. Die Pigmente und Extender werden in einem Phenolharzlack dispergiert, welcher verschiedene Mengen von Chlorkautschuk (20 cP) enthielt.

Ebenfalls geprüft wurden Chlorkautschukfarben mit hohem Festgehalt, weichgemacht mit chloriniertem Paraffin oder chloriniertem Bisphenol und Vinyllacken.

Die Anstrichsysteme wurden auf verschieden vorbehandelte Taflen und in verschiedenen Dicken aufgetragen und dann auf einem Versuchraft in Puerto Belgrano, Argentinien geprüft.

Introduction

Refs. 1, 2

In previous stages of this series of research projects on the properties of anticorrosive paints for the protection of ship hulls, various formulations have been studied[1,2].

Simultaneously, the question of the protective properties of the anticorrosive paints was studied in relation to the characteristics of the metallic substrate, to the influence of the surface cleaning and preparation and to the passivity obtained by the use of a vinyl wash-primer as a pretreatment.

The influence of sand blasting and grit blasting has been demonstrated by the authors and by other investigators, as well as demonstrating the fact that the protective film formed as a result of the chemical reaction of the metal-primers or metal conditioners with steel, which forms a thin film and is highly adhesive, causes the formation of complex phosphates and chromates with iron, which are effective, because of their passivating properties, on the behaviour of the protective schemes.

With regard to anticorrosive paints applied to ship hulls, it has been proved that an adequate selection of the components, principally of pigments and binders, results in products highly resistant to electrolytes such as sea water, which are slightly alkaline. The films so obtained have, furthermore, good anticorrosive properties and an adequate hardness, the latter being very necessary in hull coatings which must have a reasonable mechanical resistance in order to reduce deterioration caused by impact, scraping or fouling settlement.

All the above must be applied to the adequate selection of the painting schemes which must have a minimum thickness in order to ensure the "barrier effect" and must include, if possible, intermediate coats formulated with inert pigments.

The fundamental purpose of this research is to adjust all the compositions successfully tested to date, before the start of experiments on ship hulls which are planned in accordance with the objectives of an agreement signed with the Naval Research and Development Service (SENID) of Argentina.

It is well known that differences arise between the results obtained in a static test (as the experimental raft) using panels prepared in ideal conditions and always applied by expert operators, and those achieved with the same paints on the hull of a ship.

A shipowner tends to select paints that have the best properties and which ensure protection for a longer period of time, but such paints are not always applied to adequately prepared surfaces or under the temperature and humidity conditions recommended by the manufacturers. From this point of view, some paints are more sensitive than others and, therefore, formulations with very varied binders have been included in this work. Vinyl paints are the most demanding with regard to surface preparation and application. Paints with oleoresinous binders, either modified or not with chlorinated rubber, and paints based solely on chlorinated rubber have no such requirements, although it is advisable to take minimum precautions if good durability is desired.

It should not be necessary to establish that anticorrosive paints should be complemented by the use of effective antifouling products which maintain the surface of the hull free from fouling for periods of not less than 18–24 months, according to the operational conditions of the various ships.

Finally, another aspect taken into account is that related to the thickness of the painted system, which should not be less than 250 microns in the case of ship hulls.

Variables studied

Refs. 3–6

The variables considered have been established by taking into account results obtained previously on the experimental rafts at Mar del Plata and Puerto Belgrano[3–5].

(a) *Anticorrosive pigments.* Five pigments were used. Three of them (red lead, basic lead silico-chromate and a mixture of basic lead sulfate with non-leafing aluminium) were of the *basic type*. The other two are of the *soluble type* (zinc tetroxychromate and zinc yellow). Both types act as corrosion inhibitors, although by different mechanisms[6].

(b) *Binders.* Formulations having different resistances to sea water were used. One of the series was prepared with a phenolic resin-wood oil varnish, and in order to increase the water resistance, mixtures of this varnish with chlorinated rubber, 20 cP, were obtained (3/1, 2/1 and 1/1 ratios, w/w). Two other series were prepared with a chlorinated rubber thixotropic binder, using Cereclor 42 per cent (chlorinated paraffin) and Clofen (chlorinated biphenyl) as plasticisers. Finally, a last series was prepared with a vinyl resin (VAGH, polyvinyl chloride-polyvinyl acetate copolymer), plasticised with tricresyl-phosphate.

It is very important to note the toxicity of the chlorinated biphenyl. This plasticiser was incorporated in the work purely from the scientific point of view, but it is necessary to stress that the authors do not advise its use.

(c) *Extenders, additives and solvents.* As extender pigments, red iron oxide and barytes were used. Aluminium stearate was included as flatting agent and some humidifiers and stabilisers were also employed during the manufacture of the samples. Aliphatic hydrocarbons, aromatics and ketones were used as solvents in the various cases and each solvent mixture was selected in accordance with the nature of the resins employed.

Preparation of the samples

Porcelain laboratory ball mills were used for the preparation of paints of normal viscosity, and a high speed sand mill was used for the thixotropic series, which have a high viscosity.

In all, *seven series of anticorrosive paints* were prepared, with the following binders:

Series 1: Pure phenolic resin-wood oil varnish (see Table 1).

Series 2: Phenolic varnish-chlorinated rubber (20 cP) (weight ratio 3/1) (Table 1).

Series 3: Phenolic varnish-chlorinated rubber (20 cP) (weight ratio 2/1) (Table 1).

Series 4: Phenolic varnish-chlorinated rubber (20 cP) (weight ratio 1/1) (Table 1).

Series 5: Chlorinated rubber (Alloprene 20 cP) with an organic gellant (modified castor oil), plasticised with chlorinated paraffin 42 per cent (Table 2).

Series 6: Chlorinated rubber (Alloprene 20 cP) with the same gellant as used for series 5, but plasticised with chlorinated biphenyl (Table 2).

Series 7: Vinyl resin (VAGH) plasticised with tricresylphosphate (Table 3).

The thixotropic paints of series 5 and 6 were formulated for brush application.

Each series includes five paints. The series were identified by the numbers 1 to 7 mentioned above. The five pigments correspond, 1 to red lead, 2 to the lead basic silicochromate, 3 to the mixture of basic lead sulfate/non leafing

Table 1
Paint series 1 to 4 (Compositions in weight, g/100 g)

	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5
Red lead	27.0	–	–	–	–	24.7	–	–	–	–
Basic lead silico-chromate	–	18.0	–	–	–	–	18.0	–	–	–
Basic lead sulfate	–	–	15.0	–	–	–	–	14.6	–	–
Aluminium, non-leafing	–	–	5.0	–	–	–	–	4.9	–	–
Zinc tetroxychromate	–	–	–	8.0	–	–	–	–	8.6	–
Zinc yellow	–	–	–	–	10.0	–	–	–	–	10.5
Barytes	10.0	10.0	10.0	10.0	10.0	9.2	10.0	9.8	10.7	10.5
Red iron oxide	10.0	10.0	10.0	10.0	10.0	9.2	10.0	9.8	10.7	10.5
Aluminium stearate	2.0	2.0	2.0	2.0	2.0	1.8	2.0	1.9	2.1	2.1
Phenolic varnish (solids)	27.5	27.5	27.5	27.5	27.5	18.9	20.6	20.2	22.1	21.6
Chlorinated rubber (20 cP)	–	–	–	–	–	6.3	6.9	6.7	7.4	7.3
Additives	0.7	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.7
Solvents	22.8	31.8	29.8	41.8	39.8	29.3	31.8	31.4	37.7	36.8
PVC	50	52	51	52	52	50	52	51	52	49

	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.4	4.5
Red lead	24.7	–	–	–	–	24.7	–	–	–	–
Basic lead silico-chromate	–	18.0	–	–	–	–	18.0	–	–	–
Basic lead sulfate	–	–	14.6	–	–	–	–	14.6	–	–
Aluminium, non-leafing	–	–	4.9	–	–	–	–	4.9	–	–
Zinc tetroxychromate	–	–	–	8.6	–	–	–	–	8.6	–
Zinc yellow	–	–	–	–	10.5	–	–	–	–	10.5
Barytes	9.2	10.0	9.8	10.7	10.5	9.2	10.0	9.8	10.7	10.5
Red iron oxide	9.2	10.0	9.8	10.7	10.5	9.2	10.0	9.8	10.7	10.5
Aluminium stearate	1.8	2.0	1.9	2.1	2.1	1.8	2.0	1.9	2.1	2.1
Phenolic varnish (solids)	14.8	16.0	16.0	17.2	17.0	10.3	11.5	11.2	12.2	12.0
Chlorinated rubber (20 cP)	7.4	8.0	8.0	8.6	8.5	10.3	11.5	11.2	12.2	12.0
Additives	3.8	4.2	4.0	4.3	4.2	5.0	5.4	5.4	5.8	5.8
Solvents	29.1	31.8	31.0	37.8	36.7	29.5	31.5	31.2	37.7	36.8
PVC	50	52	51	52	49	50	52	51	52	49

Table 2
Paint series 5 and 6 (Composition in weight, g/100 g)

	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5
Red lead	23.4	–	–	–	–	23.4	–	–	–	–
Basic lead silico-chromate	–	18.1	–	–	–	–	18.1	–	–	–
Basic lead sulfate	–	–	14.8	–	–	–	–	14.8	–	–
Aluminium, non-leafing	–	–	4.9	–	–	–	–	4.9	–	–
Zinc tetroxychromate	–	–	–	12.0	–	–	–	–	12.0	–
Zinc yellow	–	–	–	–	17.0	–	–	–	–	17.0
Barytes	8.4	9.1	8.9	6.0	5.7	8.4	9.1	8.9	6.0	5.7
Red iron oxide	8.4	9.1	8.9	6.0	5.7	8.4	9.1	8.9	6.0	5.7
Aluminium stearate	1.9	2.0	2.0	2.4	2.3	1.9	2.0	2.0	2.4	2.3
Chlorinated rubber (20 cP)	14.6	15.6	15.2	18.7	17.7	14.6	15.6	15.2	18.7	17.7
Plasticisers	6.2	6.4	6.2	7.5	7.1	6.2	6.4	6.2	7.5	7.1
Additives	1.7	1.7	1.8	2.0	1.9	1.7	1.7	1.8	2.0	1.9
PVC	57	61	68	58	59	57	61	68	58	59

aluminium, 4 to the zinc tetroxychromate and 5 to the zinc yellow. The pigment identification is given as the second digit. Thus, a paint identified 5.2 is pigmented with basic lead silico-chromate dispersed in a chlorinated rubber (20 cP) binder; this is one of the "high build" series.

When a laboratory ball mill was used, the milling time for each batch was fixed at 24 hours (Series 1, 2, 3, 4 and 7). For the thixotropic paints (series 5 and 6) prepared in the sand mill, pigments were dispersed for 15 minutes. After that the rotor was replaced by the dispersing plates and steel balls were added; 20 minutes milling was necessary to reach the fineness values required.

In order to obtain comparative results, all the anticorrosive paints were prepared at the same pigment volume concentration (PVC). This means that the formulations have different pigment/binder ratios by weight, as the result of using pigments with very different densities.

Two *intermediate paints*, intended to increase thickness and the "barrier effect" in some of the paint systems, were prepared. One of these paints was pigmented with red iron oxide and the other with high-leafing aluminium. Since the binder of the paints must be compatible with those of the anticorrosive formulations, a vehicle prepared with a phenolic varnish-chlorinated rubber (20 cP 1/1) was employed in the case of the intermediate paints to be applied over the anticorrosion samples of series 1 to 4; chlorinated rubber plasticised with chlorinated paraffin was used as binder for the intermediate paints in the case of series 5 and 6 and a vinyl binder was employed in the case of series 7. These formulations are shown in Table 4.

The behaviour of paint systems prepared with and without intermediate coats was compared in raft trials.

On the *water line panels*, three boot-topping paints, pigmented with lampblack (Table 4) were used. The same criteria mentioned above were applied to the selection of binders for these paints.

Antifouling paints of soluble matrix type were prepared and employed as finishing coat on the completely immersed plates of levels 2, 3 and 4 (Fig. 1).

Experimental and discussion

Refs. 7–9

Raft trials

The experimental raft anchored at Puerto Belgrano was used for these trials. Considering the space limitations of the

Table 3
Paint series 7 (Composition in weight, g/100 g)

	7.1	7.2	7.3	7.4	7.5
Red lead	22.1	–	–	–	–
Basic lead silico-chromate	–	15.9	–	–	–
Lead basic sulfate	–	–	15.1	–	–
Aluminium, non-leafing	–	–	5.1	–	–
Zinc tetroxychromate	–	–	–	8.1	–
Zinc yellow	–	–	–	–	10.2
Red iron oxide	4.9	5.3	5.0	5.8	5.7
Micronised talc	2.5	2.6	2.5	2.9	2.8
Vinyl resin (VAGH)	15.8	17.0	16.1	18.6	18.1
Plasticiser	1.6	1.7	1.6	1.9	1.8
Solvents	53.1	57.5	54.6	66.4	61.4
PVC	56	58	56	59	56

Table 4
Intermediate and boot topping paints (Compositions in weight, g/100 g)

	4.6	4.7	4.8	5.6	5.7	5.8	7.6	7.7	7.8
Red iron oxide	25.0	–	–	20.0	–	–	12.0	–	–
Titanium dioxide	–	–	5.0	–	–	5.0	–	–	–
Aluminium, high-leafing	–	17.0	–	–	17.2	–	–	8.0	–
Zinc oxide	–	–	–	–	–	5.0	–	–	–
Black pigment	–	–	5.0	–	–	5.0	–	–	5.0
Baryte	8.2	–	25.0	12.0	–	20.0	–	–	10.0
Aluminium stearate	1.8	–	–	2.0	–	–	2.0	2.0	–
Phenolic varnish (solids)	12.5	20.0	12.5	–	–	–	–	–	–
Chlorinated rubber (20 cP)	12.5	20.0	12.5	20.0	28.6	20.0	–	–	–
Vinyl resin (VYHH)	–	–	–	–	–	–	16.0	16.0	16.0
Plasticisers	5.3	8.5	5.3	8.5	12.5	8.5	1.6	1.6	1.6
Additives	–	–	–	1.6	1.9	1.5	–	–	–
Solvents	34.7	34.5	34.7	35.9	40.1	35.0	68.4	72.4	67.4

4.6 and 4.7 are intermediate paints for series 1, 2, 3 and 4; 4.8 is the corresponding boot topping paint (Table 1).
5.6 and 5.7 are intermediate paints for series 5 and 6; 5.8 is the corresponding boot topping paint (Table 2).
7.6 and 7.7 are intermediate paints for series 7; 7.8 is the corresponding boot topping paint (Table 3).

raft (36 places for water-line panels and 108 places for completely immersed panels), the following procedure was used:

(a) The boot-topping systems were tested using sand blasted plates, pretreated with a vinyl wash-primer, front and back. Two coats of the anticorrosive paints and one coat of the finishing paint were brushed, with 24 hours of drying between each application. The maximum thickness was obtained for series 5 and 6 (thixotropic paints) and the minimum correspond to the vinyl formulations. In the case of series 1 to 4, intermediate values of thickness were obtained (Fig. 1).

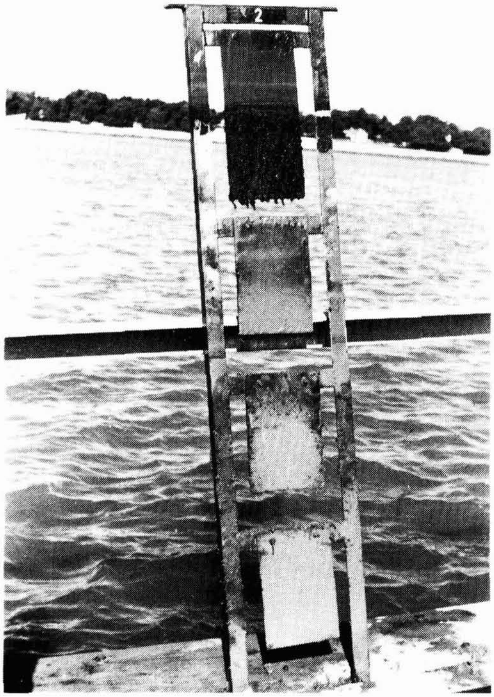

Figure 1. View of frame of the raft at Puerto Belgrano with four plates: one for the water line level and three for complete immersion tests

(b) In the immersed plates corresponding to the first level, the sandblasted surfaces were pretreated with vinyl wash-primer only at the front and edges, the back remained without this additional protection. On these plates four coats were applied, two corresponding to the anticorrosive formulations and two to the antifouling paints.

(c) The same procedure was followed to determine the influence of the pretreatment in the cases of the second and third immersed levels; in both cases the system applied was of five coats (two of anticorrosive paint, one of intermediate and two of antifouling). On the second level the intermediate paint pigmented with high leafing aluminium was used and on the third the paint pigmented with red iron oxide.

The painting of the samples was done with a brush, with 24 hours drying time allowed between each coat. In all the cases, the plates were placed in the raft 48 hours after the application of the last coat. Checks were carried out 6, 12, 18 and 22 months after immersion; the experiment was started in September, 1974 and completed in June, 1976.

In the Puerto Belgrano area, which has a temperate climate, the greatest fouling on the inert plates simultaneously exposed on the experimental raft, was observed between December, 1974 and April, 1975, and between December, 1975 and April, 1976. The fouling settlement in the area was studied previously by Bastida *et al*[7–9] (Fig. 2).

Figure 2. View of one of the inert plates with the fouling collected after 10 months immersion at Puerto Belgrano

The final results of this experiment are shown in Tables 5 and 6. It is important to observe that the antifouling paints (100–150 microns thickness) remained free of fouling during the 22 months of immersion.

In the case of the *water line panels* it is necessary to note that at Puerto Belgrano the immersed parts of these plates were always completely colonised by various species of *Balanus*. These organisms may degrade the paint film and if the coat is soft, they can penetrate the coat and get into contact with the metallic substrate. This causes a discontinuity of the film, giving access to the electrolyte. The attack of the metal is facilitated by the phenomena of differential aeration which takes place at this level where the panels are partially immersed.

At the end of the test the paint film was removed with solvents and the plates observed to determine the degree of

Table 5
Results of raft trials, 22 months' immersion period, Puerto Belgrano, Argentina.
Anticorrosive paints formulated with phenolic varnish and phenolic varnish-chlorinated rubber binders

Panel and level	Defects observed	Paints																			
		1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.4	4.5
Boot-topping (*F*)**	Rusting...	3	3	3	3	3	2	3	3	1	3	2	3	3	2	2	1	2	0	0	0
Boot-topping (*B*)**	Rusting...	3	3	3	3	3	3	3	3	2	3	2	3	3	2	2	1	3	0	0	0
Bottom 1st. (*F*)**	Blistering	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	2	2*
	Scaling...	3	3	3	3	3	3	3	1	1	1	3	3	3	3	3	3	3	3	3	0
	Rusting...	3	3	3	3	3	3	3	1	2	0	3	3	2	3	2	2	3	2	2	0
Bottom 1st. (*B*)**	Blistering	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3*	3	3
	Scaling...	3	3	3	3	3	3	1	2	1	2	3	3	0	3	3	0	2	0	3	0
	Rusting...	3	3	3	3	3	3	1	0	3	1	3	3	0	3	3	0	3	0	3	0
Bottom 2nd. (*F*)**	Blistering	3	3	3	3	3	3	3	2	2	2	3	2	3	2	3	3	3	2*	0	0
	Scaling...	3	3	3	3	3	2	3	0	0	0	3	0	0	0	0	2	3	0	3*	0
	Rusting...	3	3	2	3	3	3	3	0	0	0	3	2	0	1	0	2	3	0	0	0
Bottom 2nd. (*B*)**	Blistering	3	2	3	3	3	3	3	2	2	2	2	3	1	2	3	1	2	1*	1	2
	Scaling...	3	3	3	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rusting...	3	3	2	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bottom 3rd (*F*)**	Blistering	2	3	3	2	3	0	0	2*	0	2	1	3	3	2	2	2	1	0	0	0
	Scaling...	2	3	2	3	3	0	2	0	0	0	0	3	0	0	0	2	0	0	0	0
	Rusting...	2	3	2	3	3	0	2	0	0	0	2	3	2	0	0	2	0	0	0	0
Bottom 3rd. (*B*)**	Blistering	3	2	3	3	3	2	3	3*	2	2	2	3	2*	2*	3	1*	2	1*	2*	0
	Scaling...	3	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rusting...	2	2	1	3	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0

Table 6
Results of raft trials, 22 months' immersion period, Puerto Belgrano, Argentina.
Anticorrosive paints formulated with cholorinated rubber (thixotropic) and with vinyl binders

Panel and level	Defects observed	Paints														
		5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	7.1	7.2	7.3	7.4	7.5
Boot-topping (*F*)**	Rusting...	2	1*	1	1	1	1	1	1	1	1	1*	1*	1*	1*	1*
Boot-topping (*B*)**	Rusting...	2	1*	1	1	1	1	1	1	1	1	1*	1*	1*	1*	1*
Bottom 1st. (*F*)**	Blistering	0	2	0	1	1	1	3	0	1*	0	0	0	2*	0	0
	Scaling...	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0
	Rusting...	0	0	0	0	0	1*	3	0	1*	3	0	0	0	0	0
Bottom 1st. (*B*)**	Blistering	3	3	0	3	2*	3	3	0	2	1	0	0	2*	0	0
	Scaling...	1	1	0	2	0	2	0	0	0	0	0	0	0	0	0
	Rusting...	1*	1	0	0	0	2	1*	0	0	0	0	0	0	0	0
Bottom 2nd. (*F*)**	Blistering	2*	1*	0	2	1	0	1*	0	1*	1	0	0	3*	1*	2*
	Scaling...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rusting...	1*	0	0	0	0	0	1*	0	0	0	0	0	0	0	0
Bottom 2nd. (*B*)**	Blistering	3	3	0	2	3	3	3	0	2	3	0	0	3*	2*	0
	Scaling...	3	2	0	0	0	1	0	0	0	0	0	0	0	0	0
	Rusting...	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Bottom 3rd (*F*)**	Blistering	0	0	0	0	1	0	2*	0	2*	2	0	0	2	0*	2*
	Scaling...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rusting...	1	0	0	0	0	2	0	0	0	0	0	0	2*	0	0
Bottom 3rd. (*B*)**	Blistering	3	2	0	1	1	3	2	0	1*	1	0	0	2*	0	0
	Scaling...	2	1	0	0	0	2	1	2	0	0	0	0	0	0	0
	Rusting...	2	0	0	0	0	1	2	2	0	0	0	0	2*	0	0

References: * edges of the plates; 0 (without deterioration); 1 (little); 2 (moderate); 3 (abundant).
** *F*, front of the panels; *B*, back of the panels.

corrosion. The rusting of the plates and the order of merit of the paints from the view point of the anticorrosive action of the pigments employed was established using a scale where 0 corresponds to the plates without deterioration, 1 to a slight attack, 2 to moderate rusting and 3 to abundant corrosion.

It can be observed that in order to achieve better protection and durability the nature of the binder plays an important role. The higher values of rusting correspond to the series 1 (wood oil-phenolic varnish binder), with a general corrosion degree of 3 (Table 5). In series 2 and 3 (with the same binder but reinforced with chlorinated rubber) the amount of rusting determined in the final laboratory examination varies between 1 and 3.

In series 4, on the other hand, where the phenolic varnish-chlorinated rubber relation is 1/1 by weight, the results obtained are closely related to the pigments employed. The panels corresponding to anticorrosive paints prepared with basic lead sulfate/non-leafing aluminium, zinc tetroxychromate and zinc yellow (4.3, 4.4 and 4.5) do not show any rusting. The panel of the paint pigmented with red lead (4.1) has little rust, and rust varies from little to abundant in the case of the paint prepared with basic lead silico-chromate (4.2).

In the two series having thixotropic characteristics (series 5 and 6) little rust is observed on practically all the plates. In one of the samples (paint 5.2) rust is restricted to the edges of the plates (Figs. 3 and 4).

The vinyl series is, undoubtedly, the one that has shown the best results: rusting appears only on the edges, while the centre is completely clean and free from attack. These results agree with those obtained previously by the authors in other raft experiments. The hardness which characterises the film of vinyl paints, together with its low permeability and high chemical resistance to the action of electrolytes of the sea water type are factors that contribute to a good anticorrosive protection (Fig. 5).

Apparently, the type of pigment has no influence on the results, as for the water line panels the "barrier effect" predominates.

In the *completely immersed plates* which were tested in three levels at different depths, fouling is not a variable that has to be borne in mind, as the use of good quality antifouling paints allowed the panels to remain free of fouling during the 22 months of the experiment. In these conditions it is possible to make a very good comparison of the relative merits of the anticorrosive paints tested (Fig. 3, 4, 5).

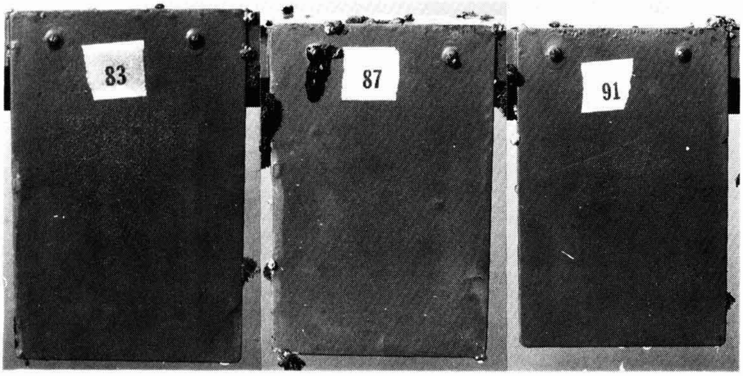

Figure 3. Panels corresponding to anticorrosive paints 5.1, 5.2 and 5.3, based on a chlorinated rubber binder (aluminium intermediate paint), after 22 months immersion

Figure 4. Panels corresponding to the anticorrosive paint 5.4, pigmented with zinc tetroxychromate and chlorinated rubber binder (94, without intermediate paint; 95, with high-leafing aluminium intermediate paint; 96, with red iron oxide intermediate paint), 22 months immersion

According to the results given in Tables 5 and 6, which indicate the amount of rusting established in the final laboratory observation, the degree of attack of the plates decreases from series 1 to 7. Differences can also be established by the use of intermediate paints.

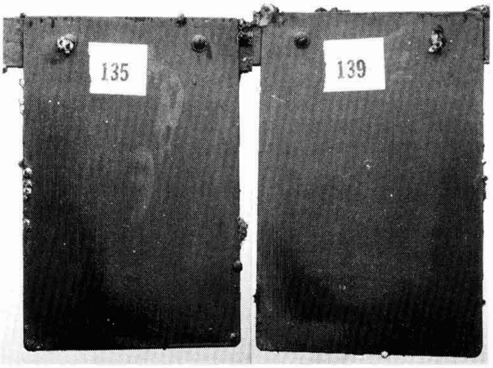

Figure 5. Vinyl paints 7.4 and 7.5, pigmented with zinc chromates and tested with an intermediate coat (high-leafing aluminium), after 22 months immersion; the plates are completely free from fouling

The failure of the paint film is complete with the paints corresponding to series 1, regardless of the pigment type, the method of preparation of the metallic surface and the paint system employed (with and without intermediate coats). For series 2, 3 and 4, reinforcing the binder with increasing quantities of chlorinated rubber (20 cP), the anticorrosive properties of the paints are also increased. Although the results are somewhat erratic, it is evident that the variable having greatest influence is the painting scheme or system selected. The anticorrosive protection is increased in the second and in the third level of immersed plates, where intermediate paints based on red iron oxide (inert pigment) or high leafing aluminium (flake pigment) have been used. Blistering has been observed on many of the panels, but this defect is more evident at the first level, without intermediate paint.

These panels without intermediate paints, where the scheme also has a smaller total thickness, are the most rusted, to such an extent that the influence of the use of vinyl wash-primer as pretreatment cannot be noticed.

Neither in the case of these paints has any significant influence been detected regarding the type of pigment, although it was observed that the zinc chromates and the mixture of non-leafing aluminium/basic lead sulfate behave satisfactorily in almost all the cases, whilst the highest proportion of failures is found in paints pigmented with red lead and basic lead silico-chromate.

The vinyl formulations of series 7, as in the case of water line panels, show the greatest anticorrosive protection obtained. In this case all the panels were pretreated with wash-primer and only scarce blistering and rusting appears in some cases at the edges of the plates (Fig. 5).

Considering all the results presented above, the influence of the pigment is secondary to the use of a binder of high resistance to sea water, particularly in long term tests like the one under consideration.

The incorporation of chlorinated rubber with the phenolic varnishes greatly increases the resistance of the oleoresinous binder. The binders prepared solely with chlorinated rubber (thixotropic paints) because of their great chemical inertness, show a better behaviour in sea water tests, particularly when chlorinated paraffin is used as plasticiser (resin/plasticiser ratio 2/1 in weight).

Finally, the vinyl formulations provide the greatest electrochemical resistance and protection against corrosion.

Regarding pigments, the most important problems occurred with paints based on red lead and basic lead silico-chromate. In these tests they show a clearly inferior inhibitive power to those of the other pigments tested.

The use of intermediate paints, employed with the aim of increasing the thickness of the paint system, contributes to give a better protection to the metallic plates submerged in sea water.

The use of vinyl wash-primer as pretreatment is important in some cases, but in a 22 months test, as presented in this paper, does not improve the anticorrosion protection if the paint film fails. The differences between the results obtained in panels with and without pretreatment do not demonstrate the great significance noted in previous raft and outdoor exposure experiments made by the authors.

Corrosion and accelerated weathering tests

These tests were performed with the aim of establishing the performance of the different paint systems under some particular experimental conditions and they are used to obtain complementary information about the properties of the pigments and the binders used for the anticorrosive formulations.

The *salt fog test* was used to determine the anticorrosion resistance of paint systems under severe laboratory conditions, which according to various authors are similar to those existing in coastal zones.

The method IRAM 121 (similar to ASTM) was used, and the painted panels were exposed for 20 days to a sodium chloride solution (3 per cent), sprayed for 6 hours each day at a temperature of 35°C. The test panels remained in the saturated atmosphere at a temperature of 18–20°C for 18 hours each day. In consequence, it is a discontinuous exposure test.

On the basis of previous experience, these experimental conditions are more severe than those obtained with a continuous spraying.

Plates with and without scratch lines in the paint film were employed for the evaluation of the anticorrosive properties of the paints.

From the results obtained, the salt fog method is not adequate to evaluate the anticorrosive properties of complete systems including finishing boot-topping paints, since the greater part of the plates remain free from rusting (86 per cent of the samples tested without wash-primer and 97 per cent of the panels with wash-primer).

When the plates were painted with the anticorrosive paints only, the attack and rusting of the metallic surface were greater. Under these conditions only 17 per cent of the panels tested without wash-primer do not show rusting; when the pretreatment was used 60 per cent of the plates exposed completed the test without rusting. In all cases the final observation was made in the laboratory after complete removal of the paint film.

Clear differences were not established in the anticorrosive properties of the different compositions tested.

Panels corresponding to complete systems (anticorrosive paint and boot topping paint) were also exposed in a Weather-Ometer Sunshine equipment (Model XW), in an *accelerated weathering test*, for periods of 350 and 700 hours, which correspond in the outdoor exposure to 12 and 24 months, respectively. The final rusting of the plates is shown in Table 7.

It was established that in all cases rusting is not observed at the front of the exposed plates. The rusting at the back of the panels varies widely between 0 and 3 of the scale, because in this case the painted surfaces remain humid for long periods.

From the anticorrosive point of view, the results obtained in this test are not in agreement with those obtained in the raft trials at Puerto Belgrano, but it is important to note that the experimental conditions were not the same.

Finally, the outdoor exposure tests were performed with complete systems including the boot-topping paints, for 2 years, in a maritime coastal zone. The plates were placed 20 metres from the sea. In these aggressive conditions it is possible to obtain complete information about the anticorrosive properties of the paints under test.

The results of this test are shown in Table 8. It was possible to establish that only anticorrosive formulations 1.1, 2.1, 4.1, 4.2 and 4.4 give complete protection to the

Table 7
Results of the accelerated weathering test
(Weather-Ometer Sunshine Arc XW)

Paints	700 hours (equivalent to 2 years of outdoor exposure)			350 hours (equivalent to 1 year of outdoor exposure)		
	Checking	Rusting (front)	Rusting (back)	Checking	Rusting (front)	Rusting (back)
1.1	2	0	0	2	0	0
1.2	1	0	1	1	0	1
1.3	0	0	0	0	0	0
1.4	2	0	0	2	0	0
1.5	2	0	1	1	0	1
2.1	1	0	0	1	0	0
2.2	1	0	0	1	0	0
2.3	0	0	0	0	0	0
2.4	2	0	0	1	0	0
2.5	1	0	0	1	0	0
3.1	0	0	0	0	0	0
3.2	1	0	0	0	0	0
3.3	0	0	0	0	0	0
3.4	1	0	0	0	0	0
3.5	1	0	1	0	0	0
4.1	0	0	0	0	0	0
4.2	0	0	0	0	0	0
4.3	0	0	0	0	0	0
4.4	0	0	2	0	0	1
4.5	0	0	0	0	0	0
5.1	1	0	0	0	0	0
5.2	0	0	2	0	0	2
5.3	0	0	1	0	0	0
5.4	0	0	2	0	0	2
5.5	0	0	2	0	0	0
6.1	0	0	0	0	0	0
6.2	0	0	2	0	0	0
6.3	0	0	0	0	0	0
6.4	0	0	2	0	0	0
6.5	0	0	2	0	0	2
7.1	0	0	1	0	0	1
7.2	0	0	1	0	0	0
7.3	0	0	0	0	0	0
7.4	0	0	0	0	0	0
7.5	0	0	2	0	0	2

Key of the table: 0 Without deterioration
1 Little attack
2 Moderate rusting
3 Abundant corrosion

metallic substrate after 2 years, using pretreated sand blasted plates, and when the finishing coat is excluded. Three of these paints are pigmented with red lead, one with basic lead silico-chromate and the last with zinc tetroxychromate.

In the case of complete systems including the boot-topping paint the greatest protection was found in the panels with wash-primer and it is noted that the four oleoresinous binders (series 1 to 4) provide the paints with greater protective power than those prepared with chlorinated rubber and vinyl resin, i.e. a completely opposite result to that obtained on the experimental raft. With these oleoresinous paints, inclusion of increasing amounts of chlorinated rubber always improves the resistance and the anticorrosive properties.

According to these results, it is possible to conclude that the accelerated corrosion and weathering tests do not reproduce the conditions observed on the raft and they cannot be used for the evaluation of the protective properties of marine systems, due to the different experimental conditions that are present in the tests.

Conclusions

(1) Vinyl resins provide the paints with greater resistance and good anticorrosive properties, measured by raft trials performed over a long period of immersion (22 months).

(2) Chlorinated rubber added to oleoresinous varnishes (phenolic) improved the resistance of the paint film to sea water. The binders prepared with chlorinated rubber and a plasticiser ("high-build" type) showed a better behaviour than the oleoresinous ones because of their chemical resistance.

(3) The use of paint systems including intermediate paints formulated with inert pigments (red iron oxide) or flaking pigments (high-leafing aluminium) increases the anticorrosive protection of metallic surfaces immersed in sea water.

Table 8
Results of the outdoor exposure tests
(Mar del Plata, maritime zone, 2 years)

	Rusting in sand blasted plates		Rusting in sand blasted and pretreated plates	
	With $AC + BT$	With AC only	With $AC + BT$	With AC only
1.1	2	3	0	0
1.2	1	3	1	1
1.3	1	3	1	3
1.4	1	3	1	2
1.5	2	3	1	3
2.1	3	3	0	0
2.2	1	1	1	1
2.3	1	2	1	2
2.4	1	1	1	2
2.5	1	3	1	2
3.1	2	3	0	1
3.2	1	2	0	1
3.3	2	3	1	2
3.4	1	1	0	1
3.5	2	3	0	1
4.1	1	3	0	0
4.2	1	2	0	0
4.3	2	3	0	1
4.4	1	3	0	0
4.5	1	2	1	2
5.1	2	3	2	3
5.2	3	3	2	3
5.3	3	3	2	3
5.4	3	3	2	3
5.5	3	3	2	3
6.1	3	3	1	3
6.2	3	3	1	3
6.3	3	3	1	3
6.4	2	3	1	3
6.5	3	3	3	3
7.1			2	3
7.2			2	3
7.3			1	2
7.4			1	3
7.5			2	3

Key of the table: AC Anticorrosion paint.
BT Boot-topping paint.

(4) The use of a pretreatment of vinyl wash primer increases the anticorrosive properties of the paint systems under test.

(5) Of the different pigments used in this research, the mixture of basic lead sulfate/non-leafing aluminium and the zinc chromates showed the greatest inhibitive properties; greater than red lead or basic lead silico-chromate.

(6) The use of paint systems of greater thickness (300 microns or more) improves the anticorrosive protection. This is a more important variable that the type of pigment used.

(7) The results of accelerated corrosion and weathering tests do not correlate with those obtained in the experimental raft.

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Reviews

The technology of powder coatings

S. T. Harris
Portcullis Press Ltd
Pp 304 Price £20.00

"The technology of powder coatings" is unique in that it treats in one volume all the processes involved in the application of dry powder coatings by electrostatic methods. Presentation of the subject is clear, concise, and arranged in a most logical manner. This makes it most valuable to a newcomer to the subject, who on reading the text from beginning to end will immediately appreciate the subtleties, advantages and problems associated with powder coating techniques.

Three chapters deal with the fundamental chemistry of powder coating resins, and again, although the subject is covered most comprehensively, the author has successfully presented this difficult area in a manner which can be understood by readers with only a very basic understanding of chemistry. Compounding, granulation and fine grinding appear next in the sequence of presentation and these are followed by a chapter on "The powder particle". The remainder of the text, which accounts for about 50 per cent of the volume, concentrates on the application of powder coatings, safety procedures and test procedures. The final three chapters deal with design of complete powder manufacturing plant, design of complete coating plant and future developments; in that order.

In addition to being immensely useful to the newcomer to the subject, the presentation is such that it can equally be used most effectively as a reference book to the more experienced reader. The author has achieved this unique balance in his method of presentation, and throughout the book extensive use is made of diagrams and photographs.

"The technology of powder coatings" is undoubtedly an important contribution to the appreciation of and further understanding of powder manufacturing and powder application.

Reader Enquiry Service No. 21 J. F. HUGHES

The chemical formulary Vol. XXI

H. Bennett (Editor)
George Godwin Ltd, London. 1979
Pp 349 Price: £13.00

There is a long list of contributors to this volume, which may explain why the coverage is somewhat uneven. A general disadvantage of many of the formulations is that they require several materials specified only by proprietary names. There is no indication of the nature of the material or of possible substitutes, but, at least the supplier is named.

The section on coatings is not likely to be of great interest to anyone in the UK paint industry. A formulation for an air-drying lacquer requiring 11 trade name materials, the main one of which is stated to be supplied by Rohm & Haas, Germany, is not very helpful. However, some of the other sections which include adhesives, cosmetics, detergents and polishes specify components in more general terms. Anyone having a sudden requirement to knock up a batch of roofing compound, eye shadow, washing-up liquid or chrome polish may find this book useful.

Reader Enquiry Service No. 22 L. A. O'NEILL

Section Proceedings

London

Painting ship's bottoms

The first technical meeting of the 1979/80 session took place at the Princess Alice, Forest Gate on Thursday 27 September 1979 at 6.30 p.m. The subject of the first meeting of the new Chairman's two year term of office is traditionally the choice of the newly-elected Chairman, and Dr Tom Banfield gave a lecture on "Painting ship's bottoms".

The lecture was concerned with the supertanker class of ships, weighing some 250 000 tonnes, costing about £30 million to build, and having some £40 000 per day running costs.

The electrochemical reactions taking place in the formation of rust were explained, corrosion occurring, for example, at breaks in the millscale. Methods of preventing corrosion could also be electrochemical – the most common method being cathodic protection where the steel hull is made the cathode, with either a sacrificial anode, such as zinc (which preferentially corrodes) or an impressed direct current which uses an inert anode such as titanium. However, by themselves, both methods are expensive and in practice coats of paint are applied, with an impressed direct current used for any film defects. This helps to prevent costly prolonged dry-docking.

The three main types of protective paints were then outlined as anodic, cathodic or resistance inhibition paints. Resistance inhibition is the most common, where a film of high electrical resistance prevents the passage of ions between cathode and anode.

Before any application of paint, the steel has to be prepared by removal of millscale (an oxide formed on the steel during hot-rolling in manufacture). Millscale is removed by blast cleaning, and to prevent flash rusting, a blast primer is applied immediately. This is frequently a polyvinyl butyral/phenolic primer.

When the sections are assembled, a high performance paint is applied at a thickness of about 200 microns. This may be a 2-pack epoxy polyamide, a vinyl or a chlorinated rubber based paint; the latter being the most common. These coatings are applied by airless spraying, with one gun being able to cover some 150–400 m^2 per hour.

Dr Banfield suggested that the time between expensive dry-dockings could be increased by applying a much higher film thickness of paint, perhaps at thicknesses up to 500–600 microns. This could possibly last the lifetime of a ship, which currently is about 15 years.

Following an extensive and interesting question time, Mr D. Bayliss called for a vote of thanks, and the 39 members and guests warmly responded. The meeting was concluded by a buffet supper.

Reader Enquiry Service No. 23 I.W.H.

West Riding

Use of extender slurries in emulsion paints

The first meeting of the West Riding Section for the 1979/80 session was held on Tuesday 4 September at the Mansion Hotel, Leeds.

A talk on the above topic was presented by Mr R. McGuffog of the English China Clay Co Ltd. After a showing of ECC's new publicity film, Mr McGuffog introduced his talk on extender slurries by listing the advantages of such products.

Advantages of extender slurries

1) Handling: (a) Direct road tanker to customer's storage tank discharge.
  (b) Easy automatic metering.
  (c) Automated paint manufacture.
  (d) No dust problems.

2) Requires no dispersion: (a) Simple mixing equipment.
  (b) Possible energy and cost savings.
  (c) Improved paint properties.

On comparing slurry and powder china clays in a typical vinyl silk paint formulation, it has been confirmed that less mixing energy was required to make the paint based on slurry extenders. In addition, improved opacity and gloss were achieved with shorter mixing times.

In order to give the other side of the argument, Mr McGuffog outlined possible disadvantages of slurry extenders.

Possible disadvantages of slurries.

1) Higher transportation costs; it was suggested, however, for the Leeds area, that very little difference in powder and slurry prices existed.

2) Installation of holding tanks and ancilliary equipment: for holding 60 tonnes of slurry, it would cost approximately £17 500.

3) Stability of slurry: it was agreed that the product would be susceptible to settling, bacterial attack and freezing. However, Mr McGuffog suggested that these problems could be overcome by continual stirring, preservation with a biocide "Proxcel GXL", and insulating the holding tank.

4) Non-availability of titanium dioxide and other ingredients in slurry form.

Mr McGuffog went on to to give suggestions on formulations, based on china clay slurries, for silk and matt emulsion paints. It was suggested that the paint formulator should modify his thinking when using slurries.

An example of this was in the order of addition of ingredients. It was thought that the best procedure would be to add the slurry first, then to dilute with water whilst stirring, followed by the addition of the other raw materials.

After a lively question period a vote of thanks was given by Mr G. Law.

Reader Enquiry Service No. 24

The use of titanium dioxide in air drying paints

A meeting of the West Riding Section was held on Tuesday 2 October at the Mansion Hotel, Leeds. The lecture, enjoyed by 28 members and guests, was given by Mr J. Clark of BTP Tioxide Ltd.

Mr Clark's talk was based essentially on his company's experience of dispersing TiO_2 under high speed- and sand-milling conditions.

Mr Clark outlined the factors which optimised dispersion in high speed milling as follows: blade height, speed of impellor, depth of mill base.

He then discussed mill base selection. The first step was the determination of pigment resin demand using a flow point method. Several grade of TiO_2 were tested in a Cowles Dissolver using a system based on a good dispersing resin and the pigment volume concentration (PVC) against flow point curves were produced. These suggested that to have good dispersing properties, a pigment should have a flow point at above 40 per cent PVC.

The effect on dispersion of varying the PVC's of the mill base at different resin concentrations was examined. It was shown that as the concentration of the resin solution increased, so less pigment could be added due to an increase in viscosity. For a Cowles Dissolver, a 20 per cent solution seemed to give the best dispersing conditions. However, a more concentrated resin solution, approximately 45 per cent, was shown to produce a final paint having a higher contrast ratio. It was thought that this was due to improved resistance to pigment flocculation.

Mr Clark then discussed pigment flocculation. Flocculation was illustrated by passing a beam of light from a tungsten source through a thin film of white pigmented paint. It was shown that when dilute resin solutions are used for the mill base, or if the let down resin solution was too weak, then flocculation occurred.

The use of additives to improve dispersion and settling was thought to be unnecessary with a grade of TiO_2 having good dispersion properties.

The second part of Mr Clark's lecture concerned sand mills.

Once again flow point curves were used to determine the optimum PVC and resin solution concentration. It was shown for sand mills, that it was necessary to use more dilute resin solutions for the mill base than with high speed mixers.

In concluding his talk, Mr Clark suggested that the practice of replacing TiO_2 with cheaper extenders may, in certain circumstances, be a false economy because some paint properties, such as gloss and durability, may be impaired.

The vote of thanks was proposed by Mr E. Bishop and afterwards the audience enjoyed the hospitality provided by BTP Tioxide Ltd.

Reader Enquiry Service No. 25 D.V.M.

Scottish

Co-operative Research Project

A joint meeting of the BSI Committee on Wood Primers and the Scottish Section Co-operative Research Project on Wood Primers took place at the Research Laboratories of Ciba-Geigy Plastics & Additives Company, Paisley, on 12 June 1979.

The purpose of the meeting was to present the Project team's work to the BSI Committee, as they are considering the possbility of rationalising the exposure methods in BS.5082 and BS.5358

Reader Enquiry Service No. 26

The joint meeting of the Scottish Section Co-operative Research Project and the BSI Committee of Wood Primers. From left to right: Mr J. D. W. Davidson (Immediate Past Chairman, Scottish Section), Mr P. Whitely (BSI Committee member), Mr E. Oakley (Carlton Weathering Station, BTP Tioxide Ltd), Mr M. Pettit (BSI Committee member), Mr T. L. M. Humphrey (Project Chairman and Scottish Section Vice-Chairman), Mr J. Toovey (Project Secretary and Hon Research Liaison Officer, Scottish Section), Mr W. Phillips (BSI Committee member – OCCA Representative), Mr J. Bowden (Project team member), Mr P. P. Hacket (BSI Committee member) and Mr A. McLean (President OCCA and team member).

Midlands

OCCA – Where do we go from here?

The first ordinary meeting of the 1979/80 session was held at the County Cricket Ground, Edgbaston on Thursday 27 September 1979. This was a joint meeting with the Trent Valley Branch. Members and guests heard Mr R. H. Hamblin, the Director and Secretary of the Association, deliver a talk entitled "OCCA – Where do we go from here?".

Mr Hamblin said that he had seen many changes take place during the almost thirty years he had been the Chief Executive Officer of the Association. In recent years the Association had expanded with new Sections and Branches in Canada and South Africa. The Optional Professional Grade had been instituted and the *Journal* was now distributed in over 80 countries and had sales of more than 1200 copies to non-member subscribers. The exhibition was changing to a new style and venue for 1980. Mr Hamblin went on to say that the exhibition and sales of the *Journal* were important sources of revenue to the Association.

Mr Hamblin's talk was followed by an Open Forum, the panel being: Dr F. M. Smith (President), Mr J. A. Burns (Chairman, Midlands Section), Mr J. R. Tomlinson (Chairman, Trent Valley Branch), Mr D. E. Hopper (Former Chairman, Midlands Section), Mr J. R. Bourne (Former Chairman, Trent Valley Branch) and Mr R. H. Hamblin (Director & Secretary).

A very lively discussion took place with many questions and proposals being put from the floor, most of which were answered or commented on by the panel.

The meeting was brought to a close with a vote of thanks, proposed by Mr D. Kimber.

Reader Enquiry Service No. 27 B.E.M.

Ontario

Perceptions of colour

The Ontario Section held its first technical meeting of the 1979/80 session on Wednesay 12 September at the Skyline Hotel, Toronto.

The subject was "Perceptions of colour" presented by Mr W. Hand of Kodak Canada Ltd.

The illustrated talk given by Mr Hand was a light-hearted look at the significant commercial implications of relative colour differences in the evaluation of print quality in the graphic arts industry.

The meeting was well attended reflecting, as usual, the wide ranging interest of the Section.

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

Reader Enquiry Service No. 28 D.S.W.

Information Received

Further information on any of the 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.

Camrex continue expansion

As part of their expansion programme both at home and overseas, Camrex have commissioned new factories in Brazil, Holland, Kuwait and more recently doubled the size of their Factory 4 in Sunderland by adding a 20 000 ft^2 extension at a cost of some £300 000. Altogether, the total expansion programme for new factories during 1979 has been an investment of £1 million and has given the Camrex group a further capability of 8 million litres.

The new extension to Factory 4 in Sunderland, which was opened by the Rt. Hon. F. T. Willey MP during September, has been specially designed for "low flash conditions" necessary for the manufacture of high technology marine coatings.
Reader Enquiry Service No. 31

The 20 000 square feet extension to the Camrex Factory 4 which is part of a £1 million 1979 expansion scheme.

IMC agency

Techmation Ltd have been appointed sole distributors for the British Isles for the complete range of advanced digital instrumentation designed and manufactured by International Microtronics Corporation.

A complete line of digital panel meters, process indicators/controllers, counters, timers, comparators and thermal numeric printers is available, and many have a wide choice of options to meet almost all mounting and system interfacing requirements.

Techmation have also recently published a comprehensive forty-eight page catalogue which describes applications of the ranges and gives specifications.
Reader Enquiry Service No. 32

Chromatography applications facility expansion

Perkin-Elmer Ltd has recently announced a major expansion of its chromatography applications facilities at Beaconsfield to improve the quality of back-up and after-sales service for customers. The laboratory, which is staffed by specialists in gas chromatography, liquid chromatography and data handling, is capable of providing technical advice, and also has facilities for customer training.
Reader Enquiry Service No. 33

Berger expansion

Berger, Jenson and Nicholson Ltd has bought 30 per cent of the equity of National Lead Company (Philippines) Inc., the second largest Philippines paint company, from NL Industries, USA.

Following this acquisition, the company's name is being changed to Dutch Boy Philippines Inc, to capitalise on National Lead's Dutch Boy brand name, which is well known in the Philippines for both trade and retail decorative paints.

Berger, Jenson and Nicholson have also recently taken over the management of Oxford SA Tintas and Vernizes, a leading Brazilian paint company which, known as Oxford Paints, is already a subsidiary of Hoechst AG, the parent company of the Berger group.

It is envisaged that, following a period of consolidation and development at Oxford Paints, the Berger Group will eventually take a controlling financial interest in the company.
Reader Enquiry Service No. 34

Matting agents for radiation cured systems

The Applied Silicas Division of Joseph Crosfield & Sons Ltd has carried out an extensive evaluation of Crosfield silicas as matting agents for radiation cured systems. Two methods of curing 100 per cent solid or solvent free systems are ultraviolet light and electron beam radiation. As the principles of the two systems are the same, and formulations contain similar basic ingredients, Crosfield has regarded both processes as equivalent for its evaluations.

Unlike solvent based lacquers, UV cured systems do not shrink and are, therefore, more difficult to matt. The criteria considered in matting these systems were matting efficiency, viscosity, film thickness, film smoothness and clarity.

A series of graphs are available summarising the performance of the various Crosfield silicas in each of these area.
Reader Enquiry Service No. 35

Distributor for Imprez 100

ICI Petrochemicals Division has appointed Cole Chemicals Ltd as its UK distributor for small lots of Imprez 100. The new arrangement applies to deliveries of 10 tonnes and less.

Imprez 100 is a petroleum resin which is used as a tackifier for rubber and hot melt and pressure sensitive adhesives, and in thermoplastic road marking compounds, timber treatment, concrete curing, paints and printing inks.
Reader Enquiry Service No. 36

Change of name

Bush Beach & Segner Bayley Ltd, who were taken over by Degussa two years ago, have announced that their name is to be changed to Bush Beach Ltd.
Reader Enquiry Service No. 37

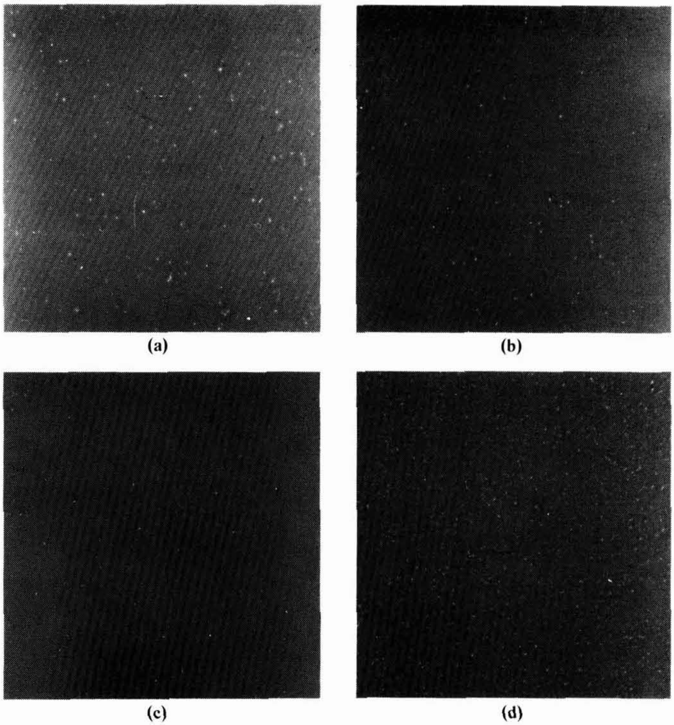
New products

New Blanc Fixe grade from Sachtleben

Sachtleben Chemie GmbH has recently introduced a new extender named Blanc Fixe "Micro", which has been developed to meet the exacting demands of the paint industry.

Advantages claimed for the new extender are low sieve residue, low binder demand, low water soluble matter and high gloss, which are especially important for automotive surfacers. The low binder demand results in a dense packing of the barium sulfate particles, and therefore, an excellent enamel holdout.

Industrial coatings using the Blanc Fixe "Micro" as an extender can be produced in a dissolver without additional milling. This procedure brings considerable energy and time saving during dispersion and filtration. Gloss is not reduced, even at high concentrations, and the same advantages are valid in high gloss emulsion paints.
Reader Enquiry Service No. 38


(a) (b) (c) (d)

The photographs show the dispersion performance of Blanc Fixe "Micro", from (a) to (d), after 1, 5 and 10 minutes in a Cowles Dissolver, compared to Blanc Fixe Grade "F" after 10 minutes. Peripheral speed of Cowles Dissolver – 12 metres per second. Mill base: castor oil alkyd 43.3 per cent by weight (60 per cent solids); melamine resin 10.6 per cent by weight (55 per cent solids); Blanc Fixe 47.1 per cent by weight.

Sub-micron filter elements

Sub-micron, sintered 316 stainless steel filter elements are now available from Techmation Ltd. The elements are designed by Nupro for use with in-line and tee-type filters for the protection of delicate system components.

The sub-micron elements are a nominal 0.5 microns and can handle differential pressures to 1000 psi and temperatures to 900°F.
Reader Enquiry Service No. 39

Workwear "static" problem solved

A new anti-static fabric which could solve many of the problems of workwear experienced in the laboratories of the petrochemical, computers and electronics industries, has been announced by Nicholson's (Overalls) Ltd.

Three companies in the fibre, textile and garment manufacturing fields have pooled their resources to produce the workwear range, and according to their findings, it should no longer be a problem to supply standard garments with a low flashpoint, so essential when working with volatile of highly sensitive materials.

Test results have been conclusive in pointing to the safety of the new garments. These relate to static charges in clothing made from various fabrics, and comparative charts showing surface and transversal resistivity. The tests have also measured the voltage of body emmision necessary for the ignition of seven widely used industrial gases and liquids.

Nicholson's (Overalls) Ltd have available a leaflet illustrating the new anti-static range and containing the test data.
Reader Enquiry Service No. 40

Light source

Starna Ltd has available the Philips GraphicA 47 Colour Matching 55 fluorescent light source, which has been developed specifically to comply with the visible spectrum requirements of BS.950 Part 2.

The lamp is primarily used for viewing booths and transparency boxes and is recommended for general lighting purposes in the same room to preserve chromatic adaptation.
Reader Enquiry Service No. 41

New safety bottles

Hopkin & Williams has introduced the new "Safe-Break" safety bottle. The glass bottles are coated with an adherent plastic coating which will withstand sulfuric, fuming nitric, hydrochloric and perchloric acids. Drop tests with the Safe-Break bottle have shown that the plastic coating effectively contains both shattered glass and liquid. The coating is highly tear resistant, so in the unlikely event of it splitting at the point of impact, spillage is minimal.

The highly resistant nature of the coating ensures that even if a shattered bottle is not discovered for some time, such as overnight, the coating remains unaffected and hence minimises damage to floor and fittings and also any fire hazard.
Reader Enquiry Service No. 42

Lepton Jet Black

BASF Lepton Jet Black is a casein-free, very finely divided dispersion of an organic black pigment which is now available in paste form. The pigment has good covering power, excellent light fastness and gives a deep, brilliant shade of black.

In contrast to a pigment preparation on carbon black, Lepton Black shows only low light absorption and high light reflection in the infrared range.
Reader Enquiry Service No. 43

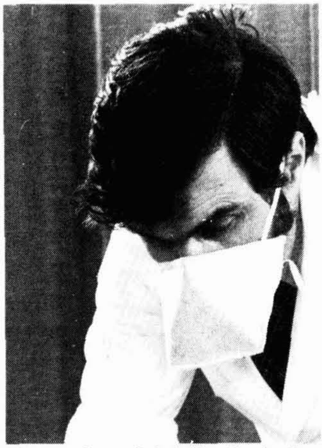
Long path gas absorption cells

Newman-Howells Associates Ltd have announced the introduction of a product programme of long path gas absorption cells (LPGAC), complete with built-in transfer optics based on the design of J. U. White. They are highly efficient cells designed to expand the gas measurement capabilities of spectrophotometers and to provide for other gas analyses and physical and chemical studies.

The cells may be operated with ultraviolet, visible or infrared radiation, and because the cell walls are made of pyrex, photochemical studies may be effected by irradiation of the cell contents.
Reader Enquiry Service No. 44

Bandor masks

Bandor face masks, containing 100 per cent activated charcoal cloth fabric, are now available from Astec Environmental Systems Ltd for use in industry. The vast majority of chemical odours are dealt with effortlessly and the masks are also suitable for use with the atomised liquids and solvents used in paint-spraying operations and the ozone and fumes from welding. The charcoal cloth fibre absorbs up to 20 times as much as granulated charcoal used in conventional face masks.
Reader Enquiry Service No. 45



The new charcoal cloth fibre Bandor face mask

Automatic density determination

A new automatic helium pycnometer, requiring no operator attention after sample loading, is now available from Micromeritics Instrument Corporation, through their UK distributor, Coulter Electonics Ltd.

The Auto Pycnometer provides completely automated density determinations in less than 20 minutes, with an accuracy of up to ± 0.002 cm^3. Using microprocessor technology, sample mass in grams is entered directly into the instrument memory, the dry sample is loaded, and at the end of the run, sample density is displayed on a digital readout.
Reader Enquiry Service No. 46

New hot melt adhesive guns

Two new hot melt adhesive dispensing guns for a wide variety of carton sealing and other packaging applications within the paint industry have been announced by Power Adhesives Ltd. The new guns are the Maximatic, a lightweight design developed for easy handling, and the SST TE, an all electric model. Both guns can be used to bond all substrates including metals, wood, plastics, paper and card.

The SST TE (left) and the Maximatic hot melt adhesive guns from Power Adhesives Ltd.

A major feature is the incorporation of a solid state temperature control which can be adjusted between 300 and 475°F and maintains the temperature of the adhesive cartridge to within 5°F of the required setting.
Reader Enquiry Service No. 47

Safety system for hazardous environments

A unique safety Interlock System for use in hazardous environments has been announced by Unimax Switch Ltd. By use of an air switch arrangement, no electricity is present in the interlock area, thus ensuring that there is no explosion risk from the interlock system regardless of any form of failure.

The heart of the system is an air tube which is monitored for both pressure and air flow. This double monitoring is fail safe, since obstructions to the tube or air leakages are both detected.
Reader Enquiry Service No. 48

Disposable respirator

Face masks, used in conjunction with air extraction systems, provide adequate protection against most health hazards presented by the release of airborne particles, but often regulations regarding their usage are ignored as masks may be a source of discomfort or irritation to the wearer.

R. J. Stokes & Co. Ltd, the Sheffield based paint manufacturer, have overcome this problem with the adoption of a new lightweight, disposable respirator, the 8800 from 3M United Kingdom Ltd.

A bend-to-fit nosepiece which bridges the nose section of the mask makes the respirator adjustable for individual comfort, and the lightweight material from which it is constructed does not irritate the skin, even in hot, humid factory conditions. The 8800 respirator is approved by the Health & Safety Executive for use in a wide range of industries and meets the performance requirements of BS.2091 Type B.
Reader Enquiry Service No. 49

The 3M 8800 disposable respirator

Conferences, courses etc.

UK resins report

"Depth study of the use of resins in the UK adhesives, sealants, printing inks and paints industries" is the title of a new multi-client study which has just been completed by Industrial Aids Ltd. Estimates are made of the tonnage of the major resin types used in these industries.

As well as giving predictions of the likely growth of the market, the report also lists major suppliers of the various resin types.

Reader Enquiry Service No. 50

Preservative leaflet

A new four page leaflet has been published by Sterling Industrial on its range of Parmetol preservatives, which have been formulated to control microbial degradation in many types of aqueous based products.

Reader Enquiry Service No. 51

Radiation curing conference

The Association for Finishing Processes of the Society of Manufacturing Engineers has announced a graphic arts radiation workshop to be held in Chicago, USA, from 15–17 March 1980.

Reader Enquiry Service No. 52

Japanese translations

Mitaka Translation has just formed a specialised unit to provide translations of highly specialised and technical material into Japanese, to deal exclusively with the chemical industry.

Reader Enquiry Service No. 53

Adhesives report

ICC Business Ratios Ltd has recently published a new report which examines the fortunes of sixty of the leading companies in the adhesives industry.

Reader Enquiry Service No. 54

Statistical sources

The Paint Research Association has available a new survey entitled "Statistical sources for the paint industry", which is an inventory of relevant sources of information on the industry.

The Association has also recently published two further reports, an "Analysis of gaseous products evolved in the stoving of industrial paints", sponsored jointly by the Department of Industry together with members of the Paintmakers Association and the Paint RA, and "Abatement of stoving effluent from industrial paints".

Reader Enquiry Service No. 55

Organic coatings technology

"Advances in organic coatings science and technology" is a new series of books which is being published by Technomic Publishing Co., USA, to present important technical studies on various aspects of coatings technology from around the world.

Volumes 1 and 2, which are now available, contain papers presented at the Third and Fourth International Conference in Organic Coatings Science and Technology, both held in Athens.

Reader Enquiry Service No. 56

Adhesives Directory

The 1979 edition of the Adhesives Directory has been published by A. S. O'Connor & Co. Ltd, which classifies over 50 different adhesives by basic type, together with nearly 200 end uses and over 1000 trade names. Other sections include plant and equipment, raw materials and "Who's Who in Adhesives".

Reader Enquiry Service No. 57

Zirconium chemicals

Magnesium Elektron Ltd has available a number of leaflets giving details of the varied uses of zirconium compounds in industry, their range of zirconium chemicals and an article on the industrial importance of their aqueous chemistry.

Reader Enquiry Service No. 58

Resin index

Synthetic Resins Ltd has announced the availability of the SRL surface coatings resin products index for 1980. The guide covers all SRL resin types for the paint, varnish and associated industries, and is published in a new tabulated index to aid speedy selection.

Reader Enquiry Service No. 59

Painting steelwork

"Preparation and painting of structural steelwork" is the title of a two-day symposium being organised by the Paint Research Association, to be held from 9–10 January 1980 at UMIST, Manchester.

Reader Enquiry Service No. 60

British Standards

The following publications are now available from the British Standards Institute:

BS.1000 (667): 1979. Universal Decimal Classification 667 Colour industries (dyes, inks, paints etc.).

BS.1000 (665): 1979. Universal Decimal Classification 665 Oils, Fats, Waxes, Adhesives, Gums, Resins.

Reader Enquiry Service No. 61

Appointments

Mr L. M. Liebster has been appointed a director of Burrell & Co. Ltd. Mr Liebster joined Burrell Colours Ltd as chief accountant in June 1977 and was appointed financial director in January 1978.

Reader Enquiry Service No. 62

David Lawlor has recently joined Grilon (UK) Ltd as a sales representative for Grilonit epoxy resins, curing agents and reactive diluents in the Southern area.

Reader Enquiry Service No. 63

David Lawlor

Vinyl Products Ltd has announced the appointment of Dr John Byrne as works director with responsibility for the company's emulsion polymerisation plants at Carshalton and Warrington.

Reader Enquiry Service No. 64

Dr John Byrne

OCCA-32 Exhibition

13-15 May 1980 Cunard International Hotel
Hammersmith, London W6

Many applications received from UK and overseas in enthusiastic response to new arrangements

The international focal point

Closing date

The closing date for applications to participate at the 1980 OCCA-32 Exhibition was given as 30 November 1979 in the Invitation to Exhibit. Within one week of the Invitation being despatched, all of the rooms in the Armada Suite on the Mezzanine Floor of the Cunard International Hotel were allocated, and a steady stream of applications for space in New Exhibition Floor, the Queen Mary Suite and the hospitality suites on the third floor has been received since that time.

A list of some of the early applicants was published in the October issue of the *Journal*, and this list contained the names of some large multi-national companies returning to the Exhibition after an absence of several years, as well as more regular exhibitors. In addition to these organisations, many others have indicated their intention to apply for space by the closing date. It is hoped that a full list of organisations which had registered by the closing date and which have been allocated space in the the first allocation will be published in the January issue of the *Journal*.

Late applications

Shortly after the closing date for applications, the Exhibition Committee will be meeting to allocate space in the New Exhibition Hall and Queen Mary Suite to those companies whose applications have been registered. As mentioned earlier, all the rooms on the Mezzanine floor have already been allocated, and those suites on the third floor are being allocated upon application on a first come, first served basis. Any company wishing to apply for one of these remaining suites is urged to apply as soon as possible, as the number available is limited.

Any applications for space in the New Exhibition Hall or Queen Mary Suite received after the initial allocation of space has been made will be considered by the Committee and may be allocated any space remaining. However, intending participants are reminded that these applications will have to be sited around those already allocated in the first allocation, and that preferences for positioning and shape will be given to early applicants. **Organisations may telex their requirements (922670 OCCA G)** for the attention of the Director & Secretary to ensure speedy registration.

Theme for the Exhibition

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

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

The Exhibition Committee will be particularly pleased to welcome exhibits relating to the new energy efficient, low polluting technologies, including powder coatings, high solids coatings, radiation curing, water-based coatings and other developments.

Dates and times

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

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

The Cunard International Hotel

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

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

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

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

Invitations to Exhibit

Invitations to Exhibit, giving details of the various types of exhibition facilities available at OCCA-32 have been despatched, together with application forms, to those companies who have exhibited at previous OCCA Exhibitions, or have requested information for the first time for OCCA-32. Any organisation which has not yet received a copy of the Invitation to Exhibit and wishes to do so, should write to the Director & Secretary at the address on the Contents page.

The Annual Exhibition

The OCCA Exhibition is recognised as the world's most important international exhibition for the surface coatings and related industries, and annually provides companies with the opportunity to display their products and services and discuss them with visitors from many parts of the world.

"... the accomplishments of the first day alone were enough to justify our participation in the Exhibit, and I should also point out that the subsequent days were even better..."

In recent years, the Exhibition has regularly attracted visitors from over 50 countries, with a remarkably high proportion of top personnel from both the UK and overseas attending. The value of exhibiting need hardly be stressed when it is considered that it is possible, at this one annual event, to contact and maintain contacts with companies involved in the surface coatings industries from all over the world.

Travel arrangements

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

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

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

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

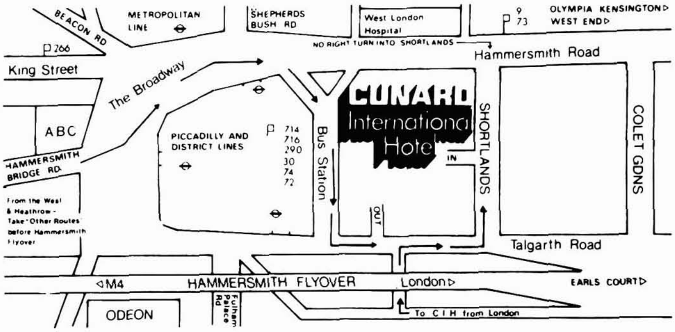
Official Guide

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

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

"Anyone visiting this exhibition *(OCCA-31)* could not have failed to be impressed by the spacious and comfortable layout and the ease with which one could identify individual stands. For those whose range of interests includes all of the varied displays, to be able to see at a glance individual stands and the personnel available for discussion and yet at the same time, while promenading, enjoy the many re-unions is recognised as another of the unique characteristics of this annual event. The atmosphere in this exhibition has never been bettered..."

The British Ink Maker, May 1979



Optional Professional Grade for Ordinary Members

Routes to the three Grades

Anyone who had 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 1979 issue of the *Journal.*

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 all those Members who have entered the Grade will be published in the December issue of the *Journal* each year. The eighth such list appears below and includes the names of members resident in 35 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 amended regulations for admission to every grade appear on page 502 of this issue of the *Journal.*

Fellows

Anderson, George (*Scottish*)
Apperley, Thomas William James (*West Riding*)
Archer, Harold (*Manchester*)
Arnold, Michael Henry Miller (*London*)
Ashworth, Norman (*Manchester*)
Astfalck, Anthony Noel (*Transvaal*)
Atherton, Donald (*Scottish*)
Austin, Denis Leonard (*Bristol*)
Bailey, John Noel (*Newcastle*)
Banfield, Thomas Arthur (*London*)
Bayliss, Derek Arthur (*London*)
Beachen, John Frederick (*Auckland*)
Beere, Andre Jaimie (*Thames Valley*)
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*)
Duckworth, Samuel (*Manchester*)
Duligal, Eric Arthur (*Transvaal*)
Dunkley, Frederick George (*Midlands–Trent Valley Branch*)
Durrant, George Goeffrey (*Hull*)
Easton, James Douglas (*Ontario*)
Ellinger, Marianne Livia (*London*)
Entwistle, Thurston (*Newcastle*)
Ernst, Joel (*London*)
Faulkner, Raymond Noel (*Manchester*)
Finn, Stanley Russell (*Hull*)
Fullard, John Edward (*Transvaal*)
Gate, Peter Atholl Jackson (*Transvaal*)
Gay, Philip James (*Hull*)
Gellay, Victor Peter (*London*)
Gellman, 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*)
Hess, Manfred (*London*)
Hill, Lawrence Albert (*General Overseas–Australia*)
Hipwood, Hubert Allan (*London*)
Hodgson, Kenneth Vickerson (*Newcastle*)
Holbrow, Gordon Leonard (*London*)
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*)
Jolly, Anthony Charles (*Manchester*)
Kalewicz, Zdzislaw (*General Overseas–France*)
Kane, Joseph Richard (*London*)
Keenan, Henry Wilfred (*London*)
Kotwal, Hoshidar Peshotan (*General Overseas–Pakistan*)
Kut, Siegmund (*London*)
Landmann, Axel Wolfgang (*London*)
Lasser, Howard Gilbert (*General Overseas–USA*)
Lewin, John Buckingham Grey (*London*)
Lewis, Fred (*Manchester*)
Ley, John Barry (*London*)
Lomas, Harold (*Ontario*)
Lunt, Walter Richard (*West Riding*)
McKelvie, Archibald Neil (*London*)
McLean, Angus (*Scottish*)
McQuirk, Peter John (*London*)
Mell, Cedric Charles (*Hull*)
Mitchell, John Edmund (*Manchester*)
Mole, Seymour Lloyd (*Ontario*)
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*)
Parfitt, Geoffrey Derek (*Newcastle*)
Penfold, Arthur de Ramon (*General Overseas–Australia*)
Pienaar, Dirk Jacobus (*Transvaal*)
Piggott, Kenneth Elliot (*Natal*)
Polaine, Sidney Alan (*London*)
Raaschou Nielsen, Hans Kristian (*General Overseas–Denmark*)
Ray, Stanley Arthur (*Midlands*)
Rechmann, Heinz (*General Overseas–Germany*)
Rileigh, Albert Kenneth (*General Overseas–Australia*)
Roe, David Edwin (*London*)
Rose, Charles (*Manchester*)
Rouse, Robert Earnshaw (*Transvaal*)

Reader Enquiry Service No. 72

Rubin, Wallace (*London*)
Rudram, Arthur Thomas Stephen (*London*)
Saunders, Laurence Frederick (*Natal*)
Seymour, Norma Henry (*Manchester*)
Shepherd, Joseph (*Newcastle*)
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*)
Thorpe, William Frederick Albert (*Midlands*)
Tickle, Trevor Cyril Kenneth (*Manchester*)
Tooke-Kirby, John Theodore (*London*)
Tooth, John Henry Collins (*London*)
Touchin, Herbert Roy (*Manchester*)
Turner, John Harry Wallice (*Manchester*)
Unsworth, Alfred Kenneth (*London*)
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*)
Addenbrooke, Brian John (*Midlands*)
Aitken-Smith, Frank Joseph (*Auckland*)
Anthony, Alan Sydney (*London*)
Armstrong, Edward (*Hull*)
Armstrong, Herbert Walter Maynard (*London*)
Arnold, Frank (*Manchester*)
Assink, Jo (*Auckland*)
Awan, Mumraiz Khan (*General Overseas–Kuwait*)
Baker, John (*General Overseas–USA*)
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*)
Brockman, Andrew Leonard Sloane (*General Overseas–Australia*)
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*)
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*)
Delorette, Gustav Otto Hans Jurgen (*Transvaal*)
Dennis, Reginald Herbert (*London*)
Devine, James (*Transvaal*)
Donkersley, Brian (*London*)
Downham, Stephen Airey (*Manchester*)
Dowsing, George Frederick (*London*)
Drew, Harold Henry Lennox (*Midlands*)
Dunn, Paul Alan (*London*)
Durant, Leslie Arthur William (*London*)
Durdey, Alan James (*Newcastle*)
Dury, Ian Clifford James (*Thames Valley*)
Eaton, Michael George (*Thames Valley*)
Ebdon, James William (*General Overseas–Zimbabwe-Rhodesia*)
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*)
Geddes, Kenneth Raymond (*Manchester*)
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, 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, Gilbert Victor Geoffrey (*Thames Valley*)
Hill, Raymond Forsyth (*Scottish*)
Hitchmough, Rex Henry (*London*)
Hodge, Robert Alexander Paul (*Auckland*)
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*)
Hughes, Gilbert William (*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*)
Kenna, Frank William (*Manchester*)

Kerr, Michael Anthony (*Manchester*)
Khan, John Mohammed (*London*)
Khidher, Abdul Monim (*General Overseas–Iraq*)
King, Charles William Henry (*Midlands*)
King, Raymond John (*Midlands*)
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*)
Lawton, Cyril Victor (*Midlands*)
Leathley, George Derek (*Auckland*)
Le Maistre, Paul Francis (*Midlands*)
Lewis, Geoffrey John (*Midlands*)
Lewis, John David (*Thames Valley*)
Low, Charles (*General Overseas–Australia*)
Macdonald, Alan (*Auckland*)
Macdonald, Arthur Gillings (*Newcastle*)
Malik, Javed Haider (*General Overseas–Pakistan*)
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*)
Mepham, Brian Edwin (*London*)
Mikucki, Wiktor (*London*)
Mills, Thomas Nelson (*Transvaal*)
Mitchell, Seward John (*Midlands*)
Moore, Frank Roden (*West Riding*)
Moore, James (*Thames Valley*)
Moore, Ronald Henry (*West Riding*)
Moore, William Alexander (*Auckland*)
Moreham, Frank Joseph (*Newcastle*)
Morpeth, Frederick Johnson (*Manchester*)
Moss, Noel Sydney (*London*)
Munro, Hugh Anderson (*Scottish*)
Murray, David John (*Manchester*)
Murray, Robert Frederick (*London*)
Myers, Gordon (*Transvaal*)
Mynett, Raymond John (*Midlands*)
Nelson, John George (*Auckland*)
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 (*Midlands*)
Pace, Graham (*Thames Valley*)
Parry, Martin Gerald (*London*)
Patrick, Alan Clive (*Irish*)
Pemberton, Joseph James (*London*)
Peng, William Yeo Kok (*General Overseas–Singapore*)
Perry, Leonard C. (*Bristol*)
Pessall, Robert George (*Midlands*)
Piper, Norman William (*Manchester*)
Pobjoy, Reginald Claude (*Cape*)
Poborca, Stefan (*Midlands*)
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 Derrik (*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, Saeed (*General Overseas–Pakistan*)
Shoham, Joseph (*General Overseas–Israel*)
Silsby, Denys John (*Midlands*)
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*)
Stubbings, Alec Walter George (*London*)
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*)
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 Londen, Anton Matthijs (*General Overseas–Holland*)
Venus, Norman (*Transvaal*)
Walker, Peter (*Thames Valley*)
Webb, Laurence (*Manchester*)
Weineck, Terrence Graham (*Natal*)
Westbrook, Ernest Louis Edward (*London*)
Whalley, James (*Irish*)
Whatling, 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*)
Woof, John Clifford (*Bristol*)
Wooll, Frederick James (*London*)
Wu, Andrew Chi Kit (*General Overseas–Hong Kong*)
Young, Hugh (*West Riding*)
Zissell, Martin John (*London*)

Licentiates

Asiedu-Dompreh, Johnathan (*London*)
Hemmens, Anthony John (*Bristol*)
Leonard, Michael William (*London*)
Lodge, David William (*London*)
Rogers, Michael Ambrose (*General Overseas–Trinidad*)
Rowntree, Randal Peter (*Manchester*)
Saggar, Anoop Kumar (*General Overseas–Kenya*)
Sawyerr, Olatunji Pekun (*General Overseas–Nigeria*)
Schierbaum, James Helmut (*London*)

Report of 1979 Council Reunion Dinner

A Reunion Dinner for past and present members of Council was held on Wednesday 24 October at the Great Northern Hotel, London N1. There were 38 members present, including seven Past Presidents and three Past Honorary Officers. The Dinner followed a Council meeting held earlier in the afternoon.

After the loyal toast, the President, Dr F. M. Smith, gave the address of welcome stating that he was particularly pleased to be able to welcome the seven Past Presidents to the function, the three Past Honorary Officers and also Mr T. W. Slinn, a former Vice-President of the Association and a recipient of the Commendation Award, who was visiting the UK from New Zealand.

Dr Smith drew the attention of those present to the notes which had been provided, outlining the major events which had taken place since the 60th Anniversary Celebrations in May 1978.

He reviewed some aspects of the Association's progress during recent years. He reported that the membership of the Association was stable, and even increasing slightly, despite reductions in the industry due to mergers etc. The activities of the Sections were thriving in many parts of the world.

Dr Smith then reviewed the finances of the Association. He pointed out that the income was derived from three main sources: the *Journal*, the Membership and the annual Exhibition. The monthly *Journal* had achieved remarkable success, having a very high reputation within the industry. He reported that over 1200 copies of the *Journal* were being sold to non-member subscribers, a figure which on its own compared favourably with other publications in the field.

The annual Exhibition had originally been an innovation of the London Section to help in the education of students. Over the years the emphasis had changed and it was now a commerical opportunity for companies. In recent years, the size of the Exhibition, and consequently the size of its financial contribution to the running of the Association, had fluctuated from year to year, and Dr Smith suggested that one reason for this was that in general, profit margins had been reduced since the oil crisis of 1974. He was pleased to report, however, that the 1980 OCCA-32 Exhibition had been moved to the new venue at the Cunard International Hotel, Hammersmith, and that support for the event to date had been very encouraging.

One of the results of the fluctuating size of the Exhibition was to affect the finances of the Association. The level of the Membership subscription was such that revenue from this source did not cover expenditure on members, and the Association relied on surpluses from the *Journal* and the Exhibition to cover costs. Dr Smith reported that the Immediate Past President, Mr A. McLean, had set up a Forward Thinking group, comprising four members, which was examining this situation. The group would welcome any suggestions from those present or from the Sections of the Association.

The Association had held its Biennial Conference during June at the Hilton Hotel, Stratford-upon-Avon, and Dr Smith reported that it had been an extremely successful event, which compared favourably with other conferences he had attended. He suggested that the OCCA Conference had achieved a balance, particularly with the discussions following the papers which were of great value, and which were missing from other conferences.

Looking to the future, Dr Smith reported that in June he had attended in Paris the inaugural meeting of an international alliance of surface coatings associations, which was to be known as ICCATCI. The other members of the alliance were the Japanese JSCM, the European FATIPEC and SLF, the American FSCT and OCCA Australia. The purpose of the alliance was to coordinate the activities of the various member bodies.

Dr Smith reported on his recent visits to the American Paint Show, and the 25th anniversary celebrations of the SLF at which he had represented OCCA. He had been proud upon these occasions to represent the Association, and reported on the high regard in which OCCA was held.

In concluding his address, Dr Smith reported that it was intended that the next Reunion Dinner would be replaced by a lunch prior to the Annual General Meeting. The reason for this would be to hold a meeting of Past Presidents before luncheon, at which the experience of these members could be drawn upon by those currently serving in office. Dr Smith stated that he thought greater involvement from those who had served the Association in the past would be of benefit to the Association.

Following the President's speech, Dr H. W. Keenan, the senior Past President present, replied on behalf of the guests. He thanked the Association warmly for its hospitality and expressed his personal pleasure in being able to attend and see many old friends.

Mr H. Gosling confirmed that it was with great pleasure that the Past Presidents and Past Honorary Officers of the Association accepted the invitations to be present at the Reunion Dinner. He thanked the Director & Secretary for his continued service to the Association over a period of nearly thirty years, recalling that he had been one of those who had originally selected Mr Hamblin for the position.

After the Dinner, the assembled company retired to a separate room to meet new and old friends.

D.M.S.

Report of Council Meeting

A Meeting of Council took place at 2 pm on 24 October at the Great Northern Hotel, King's Cross, London, N1 with the President (Dr F. M. Smith) in the Chair. In addition to the 25 members present, Mr T. W. Slinn (a former Vice-President resident in New Zealand and a recipient of the Commendation Award) was present by invitation.

The President opened the meeting by extending a welcome to Mr Slinn.

It was reported that, since the last Council Meeting, Mr I Feder (newly elected as Chairman of Auckland Section) had been transferred by his company to Wellington and had resigned as Chairman of that Section, being replaced by Mr W. G. Paul. Dr R. C. Denney had requested that Council should find a replacement as the Association's representative on the British National Committee for Chemistry and Dr G. D. Parfitt was nominated to serve in his place. Similarly, Mr W. R. Moon wished to relinquish representation of the Association on the Technical Training Board for the Printing Ink Industry and Mr G. A. Tabbernor was nominated as replacement.

It was noted that Mr R. Handley had replaced Mr R. Faulkner as the London Section's Honorary Programmes Officer and would accordingly serve on the Programme Liaison Committee.

Reports were received on the final arrangements for the Council Reunion Dinner to be held later in the day (and reported elsewhere in this issue) and on the preliminary arrangements for the Association's Dinner Dance which will take place on 11 April 1980 at the Savoy Hotel, London, WC2. (Brief details appear elsewhere in this issue and forms of application will be sent to members in the New Year).

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 noted that the total membership at the end of the year was expected to show a slight increase.

Council was extremely pleased to learn that the new venue and format for the next Annual Exhibition (OCCA-32, 13-15 May 1980) had met with an encouraging response and that – as well as regular supporters – many new exhibitors and others who had not shown for some years had applied for space.

Council was saddened by the news that the Honorary Editor of the Association (Mr S. R. Finn) had been unwell in recent months and would not be able to continue in office after the 1980 Annual General Meeting. To express their gratitude to Mr Finn for his outstanding service as Honorary Editor since 1969, Council agreed unanimously to confer Honorary Membership upon him.

It was reported that Mr D. S. Newton (a former Honorary Editor) had agreed to assume the responsibilities of Honorary Editor again at the 1980 Annual General Meeting.

On the publication side, Council was interested to learn that the first monograph scheduled to appear in the *Journal* (and subsequent reprinting as a separate publication) had now been completed by Dr T. A. Banfield (Chairman of the London Section) on "Marine Finishes".

The subject, format and venue of the 1981 Conference were discussed.

It was reported that the Professional Grade Committee had met earlier in the day to consider two recommendations from the Technical Education Committee which were then presented to Council for approval. The recommendations related to the point of entry to the Professional Grade of holders of the new Technician Education Council's Higher Certificate or Diploma and it was agreed that this should be at the same point as at present shown for holders of HNC or HND and further, that the qualifying period of technical experience could be obtained at any time (before, during or after a course) with the proviso that this would normally be of not less than two years' duration. Council approved these recommendations and the amended chart and regulations appear elsewhere in this issue.

It was further reported that the Professional Grade Committee had given authority for the admission of 1 Fellow and 4 Associates, together with the transfer of 1 Licentiate to Associateship.

Details were given of the preliminary arrangement for the Association's 1980 Annual General Meeting in London, provisionally fixed for 26 June which would be in the form of a Luncheon followed by a Lecture and the Annual General Meeting. It was intended to combine the Council Reunion with the Luncheon and to invite Past Presidents to an informal meeting before the Luncheon. Full details will be announced in the *Journal* in due course and application forms sent to members.

The Council received details of Section activities and agreed, as requested by the Transvaal Section, that the Rhodesian Branch should be attached henceforth to the General Overseas Section, which it was felt might set a pattern for other possible branches which might be founded in other parts of the world. Mr Slinn gave Council a detailed exposition of the present position of Association activities in New Zealand and this was felt to be of great interest and value to Council in settling outstanding items submitted by the New Zealand Division.

At the conclusion of the Meeting, Mr Slinn, on behalf of the New Zealand Division, presented the Director & Secretary with a cuff link box of New Zealand Paua Shell for his continuous assistance to the two Sections and the Division in New Zealand. Mr Hamblin expressed his gratitude to the New Zealand Division for this charming gift.

There being no other business the President thanked Members for their attendance and declared the meeting closed at 4.55 pm.

Association Dinner Dance 1980

Early in the New Year members attached to the United Kingdom, Irish and General Overseas Sections will be sent an application form for the Association's biennial Dinner Dance to be held at the Savoy Hotel, London WC2R 0EU on Friday 11 April 1980.

The reception will take place at 7.00 p.m. for Dinner at 7.30 p.m. Following the Dinner and speeches, dancing to Ted Hetherington and his Modern Orchestra will continue until 1.00 am and there will be a cabaret act during the intervals.

The price of single tickets is £20.00 plus £3.00 VAT each and applications should be made by members as soon as possible after receipt of the form. Tables will be arranged to accommodate 12 or 10 persons each, although it may be possible to arrange a few tables for eight persons.

Non-members wishing to receive application forms should contact the Director & Secretary of the Association at the address on the Contents page.

Reader Enquiry Service No. 73

News of Members

Honorary Membership conferred upon Stanley Russell Finn

At the meeting of the Council of the Association held on 24 October, it was unanimously agreed to confer Honorary Membership upon Stanley Russell Finn (Honorary Editor since 1969 and currently a Vice-President) to express the admiration of the Members for the way in which he has at all times discharged his duties and raised the prestige of the Association's publications, particularly the *Journal*, to its eminent position in the surface coatings industries. As well as service as Honorary Editor and Chairman of the Publications Committee, Stanley Finn has served on many Committees of Council, including the Professional Grade, Technical, Finance, Technical Education, Jordan Award, Exhibition, and the President's Advisory Committees.

Mr S. R. Finn

Mr A. R. Van Spall, who has been the Hon. Social Secretary of the Hull Section for seven years, has recently moved to Croda Inks Ltd, Edinburgh. Mr Van Spall will be transferring to the Eastern Branch of the Scottish Section.

Manchester Section

Section Golf Tournament 1979

Overcast skies but no Manchester rain over Stockport Golf Club on Wednesday 12 September enabled 54 members and their guests to enjoy their golf on this picturesque course. The excellent turn out, one less than last year's National event, was matched by some high scoring based on the Stableford system.

The prizes were presented by the Section Chairman, Mr Tony Jolly, and commenced with the Manchester Section Jubilee Trophy and tankard, won for the second consecutive year by Mr John Everett with a total of 33 points. The highest score was by Mr Jack Lawton, a guest who obtained an excellent 38 points total. Prizes for "nett two's" were won by Mr John Sinclair, Mr Derek Taylor, Mr Peter Hall and Mr John Roberts. In keeping with tradition, all players received a prize; the Booby Prize winner (not the writer) received two! An excellent meal followed, and the sincere gratitude of the Section is offered to the many companies and individuals who donated prizes.

F.B.W.

Midlands Section

Ladies' Night

On Friday 28 September 1979, the Westbourne Suite of the Botanical Gardens, Edgbaston, Birmingham was once again the venue for the Annual Ladies' Night of the Midlands Section, with a record attendance of 225 members and guests.

The guests welcomed by the Section included the President, Dr F. M. Smith and Mrs Smith, the President-elect of the Birmingham Paint, Varnish and Lacquer Club, Mr J. Hitchin and Mrs Hitchin, Mr D. Penrice, Chairman of the Midlands Section of the Paintmakers Association, and Mrs Penrice, Mr G. Hill, Chairman of the Thames Valley Section and Mrs Hill, and Mr R. H. Hamblin, Director & Secretary.

In his speech proposing the toast to the Ladies and Guests, the Chairman thanked the firms for their support, and also the Social Secretary, Mr D. Kimber, for his efforts in making this such a successful occasion. In response, the President gave an entertaining speech, so continuing the friendly atmosphere of the evening.

After dinner the members and guests adjourned to the ballroom where dancing to the Phil Phillips Band continued until 1 a.m. A photograph of the occasion was included on page 453 of the November issue of the *Journal.*

B.E.M.

London Section

Kekwick Prize

Before the first technical lecture of the 1979/80 technical session, held on Thursday 27 September, Dr Tom Banfield, the Section Chairman, presented the 1979 Kekwick Prize, valued at £25 to Mr D. Taylor of East Ham Technical College. Mr Taylor was judged to be the most promising student studying a surface coatings course at London Colleges during 1979.

A.J.N.

Obituary

T. Long, MSc, PhD, FICI, FRIC

Dr Terence Long, an Ordinary Member of the Association, died in Cork on 22 July, at the age of 58 years.

Terry, as he was known amongst his large number of friends and acquaintances in Ireland, enjoyed a long and distinguished career, and was certainly one of the most respected figures in the Irish Paint Industry.

He joined Harringtons & Goodlass Wall Ltd of Cork in 1946, after qualifying at University College Cork, and at the time of his death he was Technical Manager of the Company and a Director of Harrington's Paints Limited.

He was deeply involved with finishes for the Irish car assemblers and refinishers, together with the wide range of products which his Company manufactures. In 1970 the Minister for Industry & Commerce presented to Terry on his Company's behalf a Scientific & Technological Innovation Award.

He was first President and founder member of the Cork Scientific Council in 1960, whose interests and functions he assiduously promoted for nearly 20 years.

He was a former member of the Board and Chairman of the Institute for Industrial Research & Standards.

He was former President of the Institute of Chemistry of Ireland, the Cork branch of the Institute of Science & Technology, St. Fachtna's Past Pupil's Union, Kinsale Golf Club, and was a member of the Royal Cork Yacht Club.

Terry will be sadly missed by all who knew him, and in particular by his associates in Harringtons.

Sincere sympathy is extended to his widow, Chris.

R.C.S.

F. S. Wilson

It is with regret that the death of Mr F. S. Wilson, an Ordinary Member attached to the Hull Section, is recorded. He was a Committee Member of the Hull Section from 1943-45, a Vice-Chairman from 1946-48 and was the Section Hon. Auditor from 1965.

Water Information sheet

The National Economic Development Office has recently published an information sheet on water. The leaflet is number 2 in a series to be published, and describes how industry uses water, the problems of effluents and pollution control.

Proposals being made by the Sector Working Party are outlined, including those covering recycling of water, flexible controls in pollution legislation, and the likely timescales for the implementation of pollution control legislation.

Reader Enquiry Service No. 74

Mini Motormill success

Since its introduction in 1979 and showing at the OCCA-31 Exhibition, the Mini Motormill from Eiger Engineering Ltd has proved itself in all areas where the finest wet dispersions are required. Eiger Engineering Ltd will be exhibiting at the OCCA-32 Exhibition (13–15 May 1980).

This small horizontal laboratory bead mill functions by way of a self-contained pump, pre-mixer and a bead chamber having an approximate volume of 50 ml. The materials to be dispersed can be either recirculated through the system or passed directly through the mill at a controlled flow rate until the required fineness is obtained.

The mill is completely flameproof as it is driven by an 0.4 hp air motor which operates satisfactorily on air pressures as low as 40 lb/in^2. An alternative slower speed and higher torque motor is now available to widen the mill scope to ensure heavy and viscous pastes can be readily handled.

A hand-held rev-counter has also been introduced to enable comparative tests to be carried out at known rotor speeds. An increased surface cooling jacket which can be either air cooled or water cooled is now fitted as standard.

Reader Enquiry Service No. 75

Nuclear decontamination materials

Imperial Professional Coatings of Louisiana, USA, are supplying a new strippable decontamination coating named "Decon 1146" which is being used to decontaminate the auxiliary building of the stricken Three Mile Island, Unit 2, nuclear plant in America.

The key objective in the decontamination programme was to reduce the exposure of personnel to radiation. Decon 1146 is being spray applied to contaminated surfaces to trap chemically radioactive particles to the floor or walls, thereby reducing airborne radiation levels. The chemistry of Decon 1146 is such that it has an affinity for radioactive particles. When stripped from the surfaces, the radioactive particles are captured by the coating, consequently cleaning the surface. The material is also claimed to be effective in controlling "cross-contamination" from areas yet to be cleaned.

Once stripped, the coating is easy to compact and handle as a "low specific activity" waste.

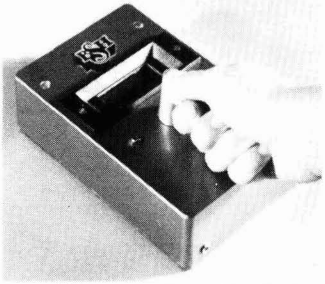
Reader Enquiry Service No. 76

Decon being removed from concrete

Harrison Colourimeters

Mr W. Harrison of Preston was a very well known and respected man in the manufacture of reflectometers/ colourimeters both in the UK and overseas, and he had manufacturing agreements with ICI, Unilever and the Shirley Institute.

On his death in 1977, his business was purchased by BSH Electronics Ltd, who now manufacture and support the full range of Harrison Colourimeters and Reflectometers. Two of the original Harrison instruments are still manufactured, the Harrison 70 Colourimeter and the Harrison Whiteness Meter. In addition, a new range of reflectometers which span the instrument range from portable, hand-held units to bench units with integral micro-computers for secondary calculations, has been developed.



One of the range of portable Harrison instruments

The basic instrument is a simple, portable hand-held reflectometer that displays the percentage reflectance of the sample on which it is placed. There is a mains or battery version of the direct reading colourimeter that displays the tristimulus X, Y and Z values. However, the main instrument is a bench standing colourimeter which displays the X, Y and Z values of the sample simultaneously. The unit is offered with a built-in micro computer, which can convert the X, Y, Z values to L a b or other colour space readings and many other functions the user may require.

Reader Enquiry Service No. 77

New approach to blending

Based on driverless trucks known as Robotrailers, a new approach to producing blends of different materials has been developed by Digitron Ltd of Switzerland. The first application of the system in the UK is a plant for blending lubricating oils, but this computer-controlled method is applicable to powders and granules as well as liquids.

A small computer controls the plant, which functions automatically. Each blend is produced in a mobile vessel. Robotrailers transport this vessel between the processing stations for loading mixing, heating and decanting. Whilst there may be a fleet of these driverless vehicles, each is controlled independently to give the plant its operational flexibility.

The control unit of the Robotrailer embodies a microprocessor, which is under the command of the central computer. This hierarchical system ensures that the activities of the truck are integrated into the functioning of the whole plant. In particular, the new technique is capable of achieving high throughput, even when producing an extremely large number of blends of differing composition and in varying amounts.

Reader Enquiry Service No. 78

ICI Paints Division Open Days

On 8 and 15 September, the ICI Paints Division at Slough opened its gates to the public and nearly 3000 people accepted the invitation to see how "Dulux" is made.

On the second of the days, Denys Henderson, Chairman of Paints Division, opened a new boiler plant. In replacing the existing boiler, the plant has been designed to improve efficiency, cut energy costs and reduce atmospheric pollution. The new boiler is part of £6 million of new plant and equipment which has been introduced in the last five years.

The Dulux dog and publicity girl, Christianna Halstead

The tour included a visit to the laboratories and a display of the many hundreds of raw materials used. Computer colour matching equipment and high speed filling lines were also demonstrated.

ICI has been making paint at Slough for over 50 years and has one of the most modern plants in the world, employing two thousand people in the factory and offices.

Reader Enquiry Service No. 79

Laboratory animals – Scientists answer back

The Research Defence Society has recently published a small pamphlet entitled "Regrettably science still needs animals", which highlights the dilemma facing society in general, and MPs in particular, over the use of laboratory animals in medical research and product safety testing.

The pamphlet explains that in the past there has been a paucity of properly documented and interpreted information on animal experiments, which has allowed specualtion and grossly inaccurate claims to be made. Coupled with public campaigns by many anti-vivisection societies, this has resulted in the fact that British Members of Parliament receive more mail on this subject than on any other.

The pamphlet provides some statistical information on the use of animals which has recently been published by the Home Secretary, highlighting such facts as the reduction since 1970 of more than eight million animal experiments as a result of the introduction of alternative non-animal techniques. It is also pointed out that these techniques have been developed by the research scientists who use animals in biological research, in attempts to reduce the number of animals used.

However, the point is stressed that it is not possible to replace all animal experiments with such techniques, as they do have serious shortcomings – for example, tissue cultures would fail to show up strychnine, curare and many other substances as dangerous poisons. In the majority of tests it is necessary to obtain information on how the whole body reacts to a substance.

With 80 per cent of all animal experiments being performed for medical, dental or veterinary advancement, and the remainder being for the protection of consumers or workers in industry, the conflicting pressures affecting the number of experiments performed are outlined. From the point of view of industry, a full battery of tests on a single substance can cost £¼ million, whilst recent Acts, such as the Medicines Act, the Health & Safety at Work Act and new Consumer Protection and Strict Liability legislation have meant that more and more substances need to be tested using animals.

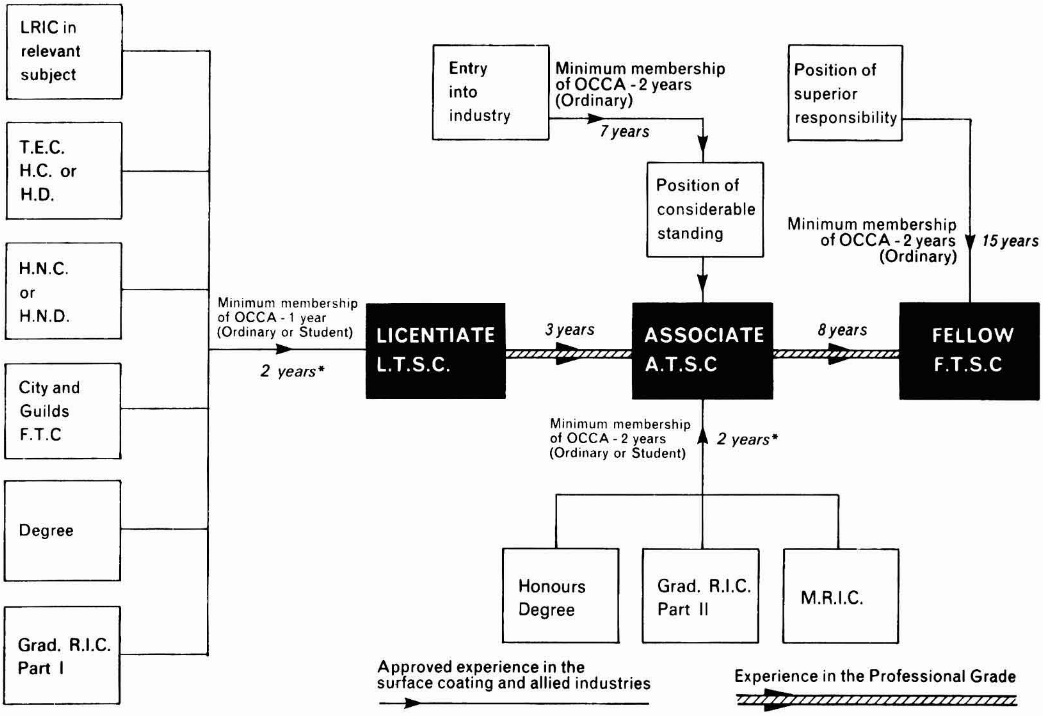
The leaflet concludes with illustrations of some of the double standards which are often applied to this subject, and suggests that it must be ensured that those animals that have to be used are properly safeguarded. It is suggested that the new Laboratory Animals Protection Bill would achieve a solution to this dilemma, but unfortunately no details of the Bill are disclosed in the pamphlet.

Reader Enquiry Service No. 80

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 Licentiateship, 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.

It is felt that applicants for admission to the Licentiate grade might wish to have further information on the pattern which it is suggested should be followed for dissertations, the subjects of which have first to be approved by the Professional Grade Committee.

The dissertation should be preceded by a short summary and commence with a brief introduction and some account of the current state of knowledge. Where practicable it should follow the general format of a paper in *JOCCA*.

The dissertation may be a review of a subject, a theoretical treatment, descriptive of practical work or a combination of these. It must indicate that the candidate has a reasonably wide and up-to-date knowledge of his chosen subject and understands the basic scientific principles underlying it, and that he is able to think critically and constructively.

Length: Text should be approximately 5 000 words.

Applicants should refer to the paper by Moss which appeared in the January 1973 issue or the paper by Leonard which appeared in the December 1979 issue of the *Journal*; the Professional Grade Committee feels that candidates for the Licentiate grade could with advantage use these papers as models for their dissertations.

Professional Grade

At a meeting of the Professional Grade Committee held on 24 October 1979, the following Ordinary Members of the Association were admitted to the categories shown. The Section to which each member is attached is shown in brackets.

Fellow

Gooch, Colin *(Wellington)*

Associates

Devine, James *(Transvaal)*
Gascoyne, John *(Auckland)*
Roberts, Peter David Mynwy *(London)*
Webb, Laurence *(Manchester)*

Transfer from Licentiate to Associate

Ohene-Kwadade, Kofi *(General Overseas – Ghana)*

Amended Regulations

The Professional Grade Committee also recommended to Council that the new Technician Education Council (TEC) qualifications be incorporated into the recommended routes to the Professional Grade, and suggested amendments to the regulations concerning the approved experience in the industry required for admittance. These proposals were accepted by the Council. A new chart showing the routes to the Professional Grade and the amended regulations appear on page 502 of this issue of the *Journal*.

Reader Enquiry Service No. 72

Register of Members

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

Ordinary members

CRAIGHEAD, PATRICK WYLIE, MSc, PO Box 17-201, Auckland, New Zealand. *(Auckland)*

CURRIER, GRAHAM DAVID, 15 Lower Hall Road, Lascelles Hall, Kirkheaton, Huddersfield. *(West Riding)*

ECKFORD, MICHAEL JOHN, BSc, MAE Manufacturing Co. Ltd, 245 (Rear) Acton Lane, London NW10 7NR. *(London)*

GINNS, HARRY GRAHAM LEE, 5 Smit Close, Valance-Dene, PO Mabelreign, Salisbury, Zimbabwe-Rhodesia. *(Zimbabwe-Rhodesia Branch)*

HAIR, NEVILLE ERNEST, Valmore Paints (1973) Pvt. Ltd, Box 3293, Salisbury, Zimbabwe-Rhodesia. *(Zimbabwe-Rhodesia Branch)*

HARDOF, AMOS, Tambour-Askar Paints Ltd, PO Box 238, Akko, Israel. *(General Overseas)*

HYDE, NICHOLAS ROBERT ANTHONY, Chatterton, 129 New Road, Booker, High Wycombe, Bucks. *(Thames Valley)*

LONGWORTH, JOHN STOBART, PO Box ST 364, Southerton, Salisbury, Zimbabwe-Rhodesia. *(Zimbabwe-Rhodesia Branch)*

MACKENZIE, MALCOLM JOHN, BSc, 7 Chaldon Way, Coulsdon, Surrey. *(London)*

MARTIN, JOHN FRANCIS, BSc, 471 Richardson Road, Mt Roskill, Auckland, New Zealand. *(Auckland)*

PECHEY, DAVID THOMAS, PhD, BSc, 32 Braehead Road, Hardgate, Clydebank, Dunbartonshire G81 6PH. *(Scottish)*

PHILLIPS, MICHAEL OWEN, 10 Millside, Culvers Avenue, Carshalton, Surrey. *(London)*

TURNER, ALICIA (MRS), LRIC, 10 Oak Bank, New Mills, Stockport, Cheshire SK12 3LB. *(Manchester)*

WALKER, WILLIAM, LRIC, 30 Leven Road, Troon, Strathclyde. *(Scottish)*

WILLIAMS, IVOR ANDRE, PO Box 2312, Salisbury, Zimbabwe-Rhodesia. *(Zimbabwe-Rhodesia Branch)*

WUSTROW, HORST DIETER, PO Box 50407, Randburg 2125, South Africa. *(Transvaal)*

Associate Members

ARMSTRONG, RONALD, 27 Hindhead Avenue, Chisipite, Salisbury, Zimbabwe-Rhodesia. *(Zimbabwe-Rhodesia Branch)*

AUSTIN, STEPHEN, Revertex Industries, Industry Road, Penrose, New Zealand. *(Auckland)*

WERNIG, HERBERT PETER, PO Box 781174, 2146 Sandton City, South Africa. *(Transvaal)*

WILLIAMS, WARREN FREDERICK, PO Box 23-219, Papatoetoe, Auckland, New Zealand. *(Auckland)*

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.

1980 Members subscriptions

Members are reminded that the 1980 Membership subscriptions to the Association are payable on 1 January 1980. 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 1980 subscription, the VAT payable on membership subscriptions is the amount which applies on the date of payment.

1980 library subscriptions

The *Journal* subscription rate to non-members, including libraries, for 1980 will be £35.00 ($80) post free by surface mail, home and abroad. Individual copies can be purchased for £3.50. Remittance should be sent with 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.

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.

Forthcoming Events

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

Monday 3 December

Hull Section: "Adhesion of surface coatings: Fact and fiction" by M. Wilkinson of Blundell-Permoglaze, Decorative Division, at the George Hotel, Land of Green Ginger, Hull, commencing at 6.30 p.m.

Tuesday 4 December

West Riding Section: "Quality assurance in process industries, with special reference to paint" by D. J. Murray, at the Mansion Hotel, Roundhay Park, Leeds 8, commencing at 7.30 p.m.

Wednesday 5 December

Scottish Section–Eastern Branch: "Fire and hygiene hazards associated with the surface coatings industry" by W. W. Ashcroft-Hutton and R. U. Khan of the Health & Safety Executive, Edinburgh, at the Murrayfield Hotel, 18 Corstorphine Road, Edinburgh, commencing at 7.30 p.m.

Thursday 6 December

Newcastle Section: "Setting up a paint company" by J. R. Bourne of Mebon Ltd, at the Students Common Room, St. Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m.

Thames Valley Section: "Dispersants for emulsion paints" and a film on dispersants by A. S. Doyle of IMC Chemie GmbH, at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks., commencing at 6.30 p.m. for 7.00 p.m.

Friday 7 December

Irish Section: "Progress in printing inks" by G. H. Hutchinson, Technical Director, Croda Inks, at the Clarence Hotel, Dublin, commencing at 8.00 p.m.

Thursday 13 December

Scottish Section: "100 years of colour chemistry" by I. D. Ratee, School of Colour Chemistry, University of Leeds, at the Albany Hotel, Glasgow, commencing at 6.15 p.m.

Friday 14 December

Manchester Section: "Matting silicas and their use in UV cured systems" by R. C. Chapman of Joseph Crosfield & Sons Ltd, at the Manchester Polytechnic, New Administration Building, All Saints, commencing at 6.30 p.m.

January 1980

Thursday 3 January

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

Monday 7 January

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

Thursday 10 January

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

Friday 11 January

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

Monday 14 January

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

Thursday 17 January

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

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

Friday 18 January

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

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

Wednesday 23 January

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

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

Thursday 24 January

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

Friday 25 January

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

February

Monday 4 February

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

Tuesday 5 February

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

Thursday 7 February

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

Friday 8 February

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

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

Thursday 14 February

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

Friday 15 February

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

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

Saturday/Sunday 16/17 February

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

Wednesday 20 February

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

Thursday 21 February

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

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

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

Friday 22 February

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

Wednesday 27 February

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

Friday 29 February

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

Index to Volume 62–1979

Key:
(C)–Correspondence
(D)–Discussion
(E)–Editorial and Comment
(N)–News
(R)–Reviews
(S)–Section Proceedings
(SC)–Short Communications
(SR)–Student Review
(T)–Transactions and Communications

Authors

Keywords

Reference list of papers

Key	*Title*	*Page*
1	Measurement of the electrical properties of typical tank coatings: Some preliminary investigations of the effects of seawater and cargoes on such properties	10
2	The realistic prediction of primer performance	18
3	Protection by organic coatings	23
4	A method for testing the mould resistance of paint films	34
5	Retention properties of a phenoxy resin in the region of glass transition and softening temperatures	51
6	The cracking of finishes on birch plywood materials	55
7	UV cured acrylic coatings for wood	59
8	Corrosion tests for organic coatings–A review of their usefulness and limitations	63
9	Resource problems in the downstream chemical industry	68
10	Quantitative estimation of aldehydic acids in lac resin and its fractions	85
11	Polarisation resistance–its meaning when applied to a coated substrate	89
12	Electrochemical testing of the protective power of zinc rich paints	93
13	Regulatory legislation–effect on preservative choice	99
14	Reflection measurements on synthetic silica products	125
15	Avoiding paint failures by prohesion	131
16	Accelerated weathering tests	136
17	Preparation and use of antifouling coatings based on tributyltin fluoride	142
18	The reaction of epoxy side groups in polymers and amines–influence of solvent and additives	153
19	Lung cancer mortality of workers in chromate pigment manufacture: An epidemiological survey	157
20	The automatic cleaning of tanks, tankers and plant by high pressure spray	164
21	Film characteristics of polyepoxide resins based on novolac resins	168
22	The efflorescence resistance of certain emulsion coatings	173
23	Factors which affect the efficiency of sand grinding	183
24	Insulating surface coatings based on castor oil	199
25	Some effects of interrupted autoxidation	207
26	Paint extenders based upon naturally occurring aluminium silicates (china clays)	233
27	Electron beam curing of coatings	239
28	Modern developments in aqueous industrial coatings	246
29	Mathematical model of growth of blisters in varnish films on different substrates	256
30	Ship's trials of oleoresinous antifouling paints. Part II: Formulations with medium and low toxicant contents	282
31	Epoxy/polyester powder coatings–Economic and technical considerations in their usage	293
32	Emulsion paints in building	299
33	Consultation before painting avoids litigation after	303
34	The challenge to coatings in a changing world: Predestination or prophesy?	331
35	Surface coatings for the nuclear industry	337
36	Original and maintenance painting systems for North Sea oil and gas platforms	351
37	Solvent loss from paint films	359
38	Water-borne industrial thermosetting systems: Physical chemical behaviour of their components and aspects of application technology	375
39	The influence of light intensity on photoactivity in TiO_2 pigmented systems	386
40	Aqueous coil coatings	392
41	Dispersion of pigments: What is the ultimate?	401
42	Aluminium compounds as major components of surface coatings	419
43	"Dry-on-wet"–A new concept in low pollution coatings utilising cellulose acetate butyrate	426
44	The changing role of polymer chemistry in organic coatings technology	432
45	Scanning electron microscope study of a coating component deposited from solution into wood	441
46	Characterisation of the interaction between pigments and binder solution using rheological measurements	455
47	A study of the effects of increasing crystallinity in polyvinylidene chloride coated polypropylene (Prop C) and cellulose (mxxT/s)	461
48	Coatings based on fatty acid modified cellulose phthalate resins	470
49	Raft trials of anticorrosive paints of high resistance	475

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

Subjects

SERVO

SER-AD FA 601

Wetting and dispersing agent for organic solvent systems.

Chemische Fabriek SERVO B.V.
P.O. Box 1, 7490 AA Delden, Netherlands
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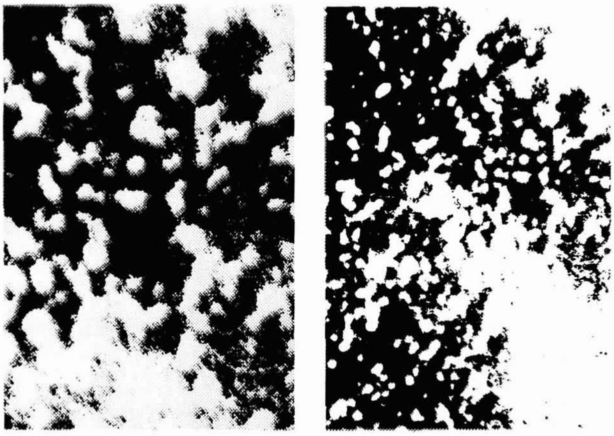

Representative:

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National Trading Estate
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Hazel Grove-STOCKPORT
U.K.
Phone: 061 456 5350.

Applications:

SER-AD FA 601 is used as a wetting and dispersing agent for organic and inorganic pigments in, for instance, alkyd resin systems. The product has no adverse influence on the properties of the ready made paint. SER-AD FA 601 can also be used in high solid systems.

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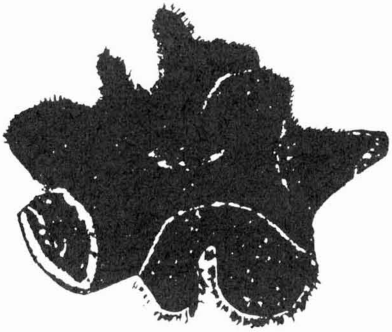

CLASSIFIED ADVERTISEMENTS

Classified Advertisements are charged at the rate of £4.00 per cm. Advertisements for Situations Wanted are charged at £1.00 per line. A box number is charged at 50p. They should be sent to D. M. Sanders, 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. M. Sanders, at the address given above (telephone 01-908 1086, telex 922670 OCCA G).

SITUATIONS VACANT

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We are the UK Subsidiary of Emser Werke AG, a major Swiss chemical manufacturing company.

A vacancy has arisen in the GRILONIT epoxy resin department for a technical representative to take responsibility for our sales interests in the Northern area of the country.

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This position offers an excellent salary, pension scheme, free life insurance and company car. Relocation expenses will be paid where appropriate.

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The Industrial Division of Crown Paints is seeking an enthusiastic, professional salesperson, male or female, to join an established and successful sales team whose prime objectives are to extend business at existing accounts and to generate and develop new business for its range of industrial surface coatings, many of which are market leaders within the field of building, packaging and metal finishes.

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Please write with concise details of career and salary to date to: **Graham Foulkes, Personnel & Training Manager, Crown Paints, at the address below.**

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JOCCA

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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
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Further information on any of the products advertised in this *Journal* may be obtained by circling the appropriate number on the *Reader Enquiry Service (RES)* form above. The *RES* numbers are given in brackets below. Enquiries will be forwarded to the organisation concerned.

Printed by Campbell Graphics Ltd., Newcastle upon Tyne NE6 1AS and 142 Strand, London WC2. Tel 01-836 0471.

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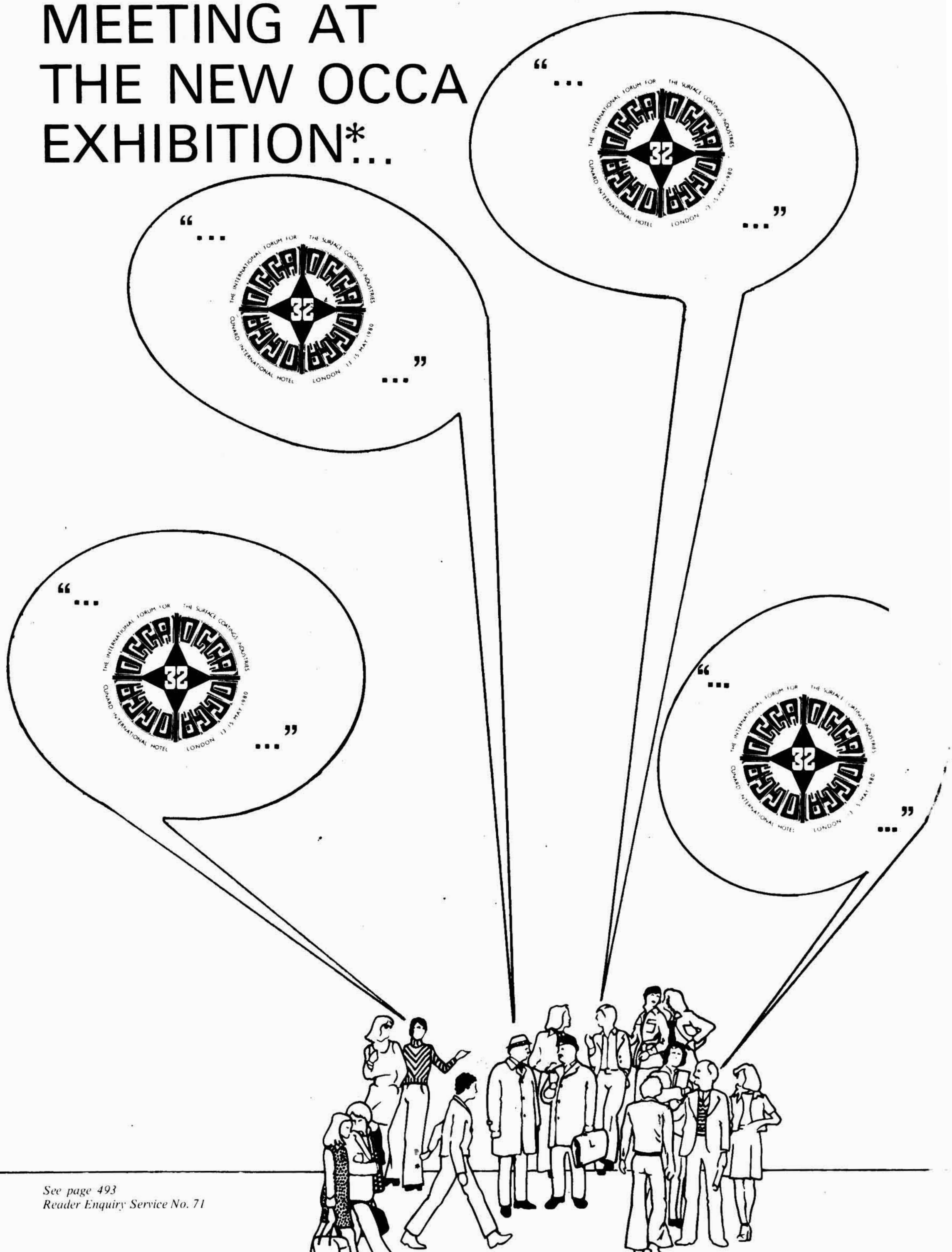

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