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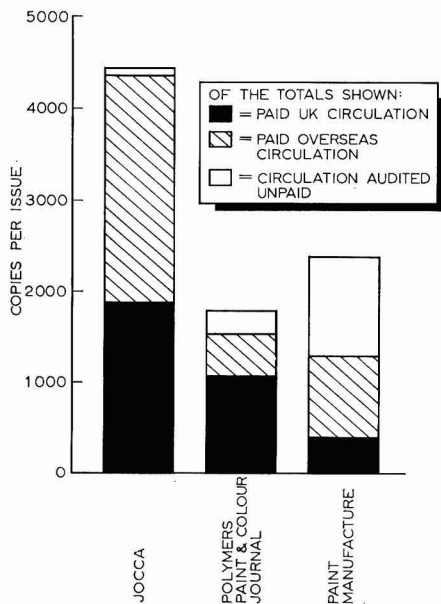
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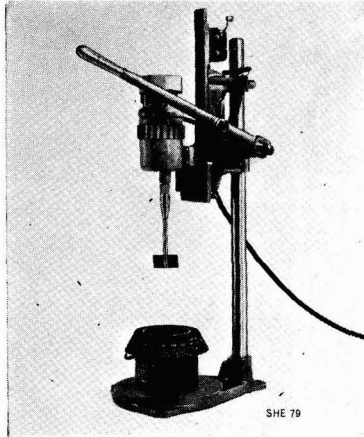


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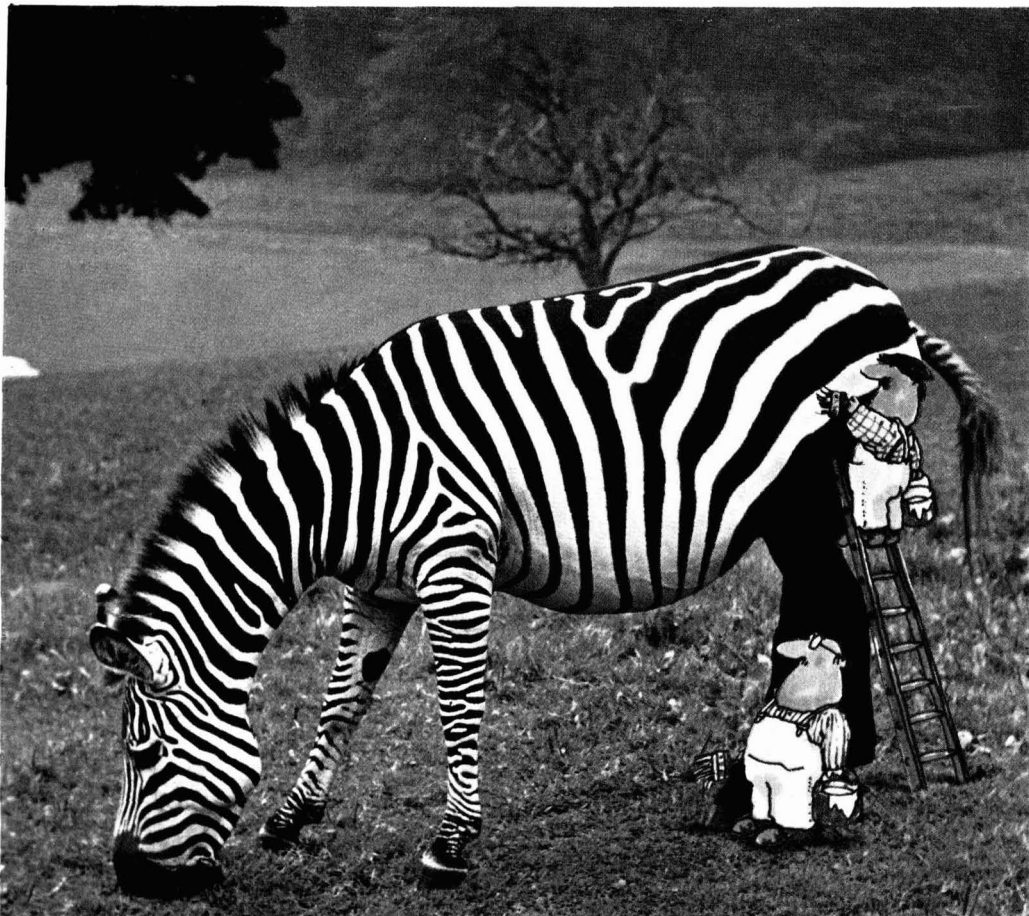
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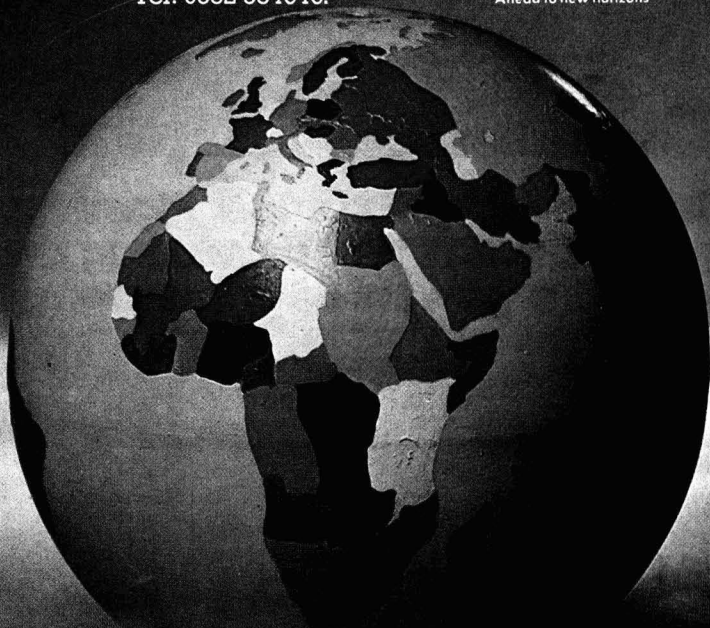
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Vol. 62 No. 3

March 1979

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Annual subscription to non-members:  
£30.00 (\$70), post free by surface mail,  
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Single copies £3.00 (\$7), post free by  
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Published by

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

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# Quantitative estimation of aldehydic acids in lac resin and its fractions

By S. C. Sengupta, S. C. Agarwal and N. Prasad

Indian Lac Research Institute, Division of Chemistry, Namkum, Ranchi 834010, India

## Summary

A quick and convenient method for the estimation of aldehydic acids, both before and after hydrolysis, in lac resins is described. The estimation shows that nearly two-thirds of the aldehydic acids are present in a combined state in lac resin and its fractions (hard and soft resins). The earlier contention that the whole of the

aldehyde function is free in lac resin has been shown to be incorrect. The combined aldehyde group is perhaps present in the form of an acylal linkage, but not as acetal or hemiacetal which are both resistant to alkali.

## Keywords

*Types and classes of coatings and allied products*

shellac

*Supplies and other materials primarily associated with analysis, measurement or testing*

analytical reagent

*Raw materials for coatings binders (resins, etc.)*

natural resin

## Le dosage quantitatif d'acides aldéhydiques en résine de gommelaque et ses fractions

### Résumé

On décrit une méthode rapide et commode pour le dosage d'acides aldéhydiques en résines de gomme-laque, avant et après l'hydrolyse. Le dosage démontre que deux-tiers à peu près d'acides aldéhydiques sont présents en résine de gomme-laque et en ses fractions (résines dures ou tendres) sous forme combinée. On démontre que la conviction antérieure que la totalité de la fonction aldéhydique se

trouve dans un état libre au sein de la résine de gomme-laque est fautive. Le groupement aldéhydique combiné se trouve peut-être sous forme d'une liaison acylale, mais non pas sous forme d'un groupement acétal ou héli-acétal, qui sont tous les deux résistants aux alcalis.

## Quantitative Bestimmung von Aldehydsäuren in Lac-Harz und seinen Fraktionen

### Zusammenfassung

Eine Beschreibung schneller und bequemer Bestimmung der Aldehydsäuren sowohl vor als auch nach Hydrolyse. Die Bestimmung zeigt, dass beinahe zweidrittel der Aldehydsäuren in einem kombinierten Zustand im Lacharz und seinen Fraktionen anwesend sind (bei harten und weichen Harzen). Es wird gezeigt, dass sich

die frühere Behauptung, dass die gesamte Aldehydfraktion in Lacharz frei sei, als inkorrekt erwiesen hat. Die kombinierte Aldehydgruppe könnte vielleicht in Form einer "acylal" Bindung zugegen sein, aber nicht als Azetal oder Hemiazetal, welche beide gegen Alkalien beständig sind.

## Introduction

Refs. 1-11

In an earlier communication<sup>1</sup> the identification of shellac, either as such, or in admixture with other resins, by making use of the presence of aldehydic constituents in shellac has been reported. The quantitative estimation of aldehydic acids in lac resin and its fractions is now reported in order to obtain a more definite picture of the lac molecule as a whole.

Lac resin is not a single chemical entity, but is a solid solution of several components of different molecular complexity derived from hydroxy aliphatic and sesquiterpenic acids. The resin can be broadly separated<sup>2</sup> into ether-insoluble hard resin (70 per cent) and ether-soluble soft resin (30 per cent). Recent investigations<sup>3-7</sup> have shown that the aliphatic and the terpenic acids are present in lac and its fractions almost in the proportion of 50:50. The aldehydic acids (jalaric and laccijalaric) form the major portion (70 per cent)<sup>7</sup> of the terpenic acids.

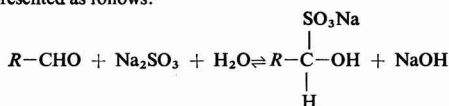
Although several methods<sup>8</sup> (such as oxime formation, bisulfite addition, oxidation of aldehydes only and hydrazone formation) are available for the estimation of aldehyde as well as carbonyl groups, Bhatt *et al.*<sup>9</sup> and Sengupta and Tripathi<sup>10</sup> recommended the sulfite method as the most suitable for the estimation of aldehydic function present in lac. According to these authors, the aldehydic function in shellac is partly combined, since the carbonyl values vary between 15-25 before hydrolysis and 50-60 after hydrolysis. On the other hand, Weiss and Beinfest<sup>11</sup> criticised Sengupta's work and suggested that the lower values might be due to acetal formation during the dissolution of the shellac samples in hot alcohol. Their carbonyl value ranged between 70-90 for various types of shellac, thus indicating a completely free aldehyde function. Later work of Khurana *et al.*<sup>3</sup>, also revealed that the aldehyde function is completely free in lac resin and its fractions (hard and soft resins). By adopting the alkaline silver oxide method they indicated that dewaxed shellac contains nearly 26 per cent of the aldehydic acids. Recently Sengupta<sup>6</sup> estimated aldehydic acids gravimetrically by preparing the 2,4-Dinitrophenyl hydrozine (2,4-DNPH)

derivatives from the mother liquor of hydrolysates of *palas*, *kusmi*, *ber* and *jalar* seedlacs and obtained the values ranging between 23–26 per cent which were in very good agreement with those of Khurana<sup>3</sup>. Sengupta suggested that the aldehyde function is not completely free, but is partly masked. He also pointed out that under the conditions of estimation, i.e. strongly alkaline and acidic conditions adopted by Khurana *et al.*<sup>3</sup>, the resin had undergone hydrolysis setting free the total amount of the aldehyde function.

It is evident from the above that although systematic work on the estimation of aldehydic acids has been attempted, the results are contradictory and the studies have not been carried to their logical conclusion.

Hence, in order to arrive at a correct picture, a method based on less drastic reaction conditions was sought and the modified sulfite method has been studied in detail.

The reaction between an aldehyde and sulfite may be represented as follows:



There is an equilibrium in this reaction and the reverse reaction is quite pronounced. In case of shellac, the alkali liberated may be consumed by the free carboxyl group and so carry the reaction to completion. However, the chances of the hydrolysis of shellac, although very remote, should not be overlooked. In the modified method, the addition of

standard sulfuric acid to a large excess of sodium sulfite solution produces sodium bisulfite *in situ* and so eliminates the chances of the hydrolysis of shellac. The aldehyde group in shellac will react with bisulfite and the excess bisulfite is titrated with standard alkali. The reaction might also be viewed as the aldehyde reacting with sulfite to liberate sodium hydroxide which is being consumed by the acid present, thus forcing the reaction to completion. The large excess of sulfite helps the reaction essentially to reach completion when the unreacted bisulfite is titrated with alkali. Moreover, the modification has the advantage that both the blank and the sample are titrated against the same standard alkali to the same end point which, incidentally, is quite sharp with thymolphthalein.

In order to obtain a correct estimation of aldehydic acids in lac resin and its fractions, before and after hydrolysis, various reaction conditions were tried initially on soft resin. The values obtained under those conditions are shown in Table 1 and the results are expressed both as a percentage and as carbonyl value (mg KOH/g of resin).

It is evident from Table 1 that under the above reaction conditions, except for 1(a) and (b) where a mixture of sulfite-sulfuric acid is used at room temperature, there appears to be a complete liberation of the combined aldehyde function present in the resin. The percentage of total aldehydic acids estimated under various conditions (SI.2–6, see Table 1) are in very good agreement. Based on the above findings and taking the time factor into consideration, the three conditions 1(a), 4 and 6 were chosen as the most suitable for estimation. Under these three conditions the values for various samples

Table 1  
Estimation of aldehydic acids (in terms of jalaric acid)  
in soft resin under various reaction conditions

SI No.	Reaction condition	% of aldehydic acids found	Carbonyl value
1(a)	Sample* and reagent** solution, kept at room temperature for 30 minutes	13.2	25.1
(b)	Sample and reagent solution kept at room temperature for 24 hr	12.6	24.8
2	Sample and reagent solution at water bath temperature for 3 hr	33.8	68.0
3	Sample and alkali (15 ml, 0.1 N) kept at room temperature for 24 hr followed by addition of 15 ml sulfuric acid solution (0.1 N) and reagent solution	36.3	72.7
4	Sample and alkali (15 ml, 0.1 N) refluxed at water bath temperature for 3 hr followed by addition of 15 ml sulfuric acid solution and then reagent solution	36.2	72.5
5	Sample and sulfuric acid solution (5 ml, 0.1 N) kept at room temperature for 24 hr followed by addition of sodium sulfite solution (20 ml)	34.4	68.2
6	Sample and sulfuric acid solution (5 ml, 0.1 N) refluxed at water bath temperature for 3 hr followed by addition of sodium sulfite solution (20 ml)	34.5	68.1
7	Sample and sodium sulfite solution (20 ml), kept at room temperature for 24 hr followed by addition of sulfuric acid solution (5 ml)	34.6	68.6
8	Sample and sodium sulfite solution (20 ml), refluxed at water bath temperature for 3 hr followed by addition of sulfuric acid solution (5 ml)	34.6	68.6

\*Sample solution—0.1–0.2 g soft resin, dissolved in 20 ml alcohol (95%, aldehyde free) and 5 ml of water.

\*\*Reagent solution—20 ml sodium sulfite solution (0.8 N) with 5 ml standard sulfuric acid solution (0.1 N).

were estimated and the procedure standardised which are as follows:

### Reagents

All the reagents should preferably be of extra pure quality.

Aqueous sodium sulfite solution — 0.8 N

Ethyl alcohol — 95 per cent and free from aldehyde, acids and esters

Aqueous sodium hydroxide solution — 0.1 N

Aqueous sulfuric acid solution — 0.1 N

Thymolphthalein indicator — 1 per cent solution in 95 per cent ethyl alcohol.

### Procedure

An accurately weighed sample of resin (1.0–2.0 g), finely powdered in case of seedlac or hard resin, is placed in a 100 ml measuring flask, gradually dissolved in 95 per cent alcohol by agitation and finally the volume is made up to 100 ml.

#### Before hydrolysis

An aliquot (10 ml) of the above resin solution is placed in a 250 ml stoppered Erlenmeyer flask, 10 ml alcohol and 5 ml water are added with agitation and followed by the addition of 20 ml sodium sulfite and 5 ml sulfuric acid solutions. The mixture, after thorough agitation, is allowed to stand in the dark for 30 min. at room temperature. A duplicate with the resin solution, and a blank with all the solvents and reagent solutions, but omitting resin are also run simultaneously. These are then titrated against standard aqueous sodium hydroxide solution using thymolphthalein as internal indicator.

The free acidity in the resin is found by taking 10 ml of the resin solution, 10 ml alcohol, 5 ml of water and titrating against standard alkali using thymolphthalein as internal indicator.

#### After hydrolysis

The resin solution (10 ml) is placed in a 250 ml standard ground neck round-bottomed flask, 10 ml alcohol and 5 ml water added and then either 15 ml of standard sodium hydroxide solution or 5 ml standard sulfuric acid solution is added. The mixture is refluxed at water bath temperature for 3 hours and cooled to room temperature. Standard sulfite

solution (20 ml) is added, but in case of alkaline hydrolysis, 20 ml of standard sulfuric acid is added prior to the addition of 20 ml of standard sulfite solution. Simultaneously a duplicate and a blank are also run. After thorough agitation, they are allowed to stand in the dark for 30 min. and then titrated as before against standard aqueous alkali.

The total acidity in the resin is found by taking 10 ml of the resin solution, 10 ml alcohol and 5 ml water and then hydrolysing with 15 ml of standard alkali at water bath temperature for 3 hours and titrating against standard sulfuric acid using thymolphthalein as internal indicator.

The carbonyl value (in terms of mg KOH/g of resin) and the percentage of aldehydic acids are then calculated from the following formulae:

#### Calculations:

$$\text{Carbonyl value} = \frac{(A + B - C) \times N \times 56.1}{W}$$

where *A* = Millilitres of standard alkali solution needed to neutralise the free acidity before hydrolysis or total acidity after hydrolysis in *W* gm of resin.

*B* = Millilitres of standard alkali solution used to titrate the blank.

*C* = Millilitres of standard alkali solution used to titrate the sample after reaction.

*W* = Weight of sample taken.

*N* = Normality of alkali used.

*EW* = Equivalent weight of the aldehyde present.

Percentage of aldehydic acids =

$$\frac{(A + B - C) \times N \times EW \text{ of jalaric acid}^* \times 100}{W \times 1000}$$

The estimation of aldehyde content before and after hydrolysis in various seedlacs, hard and soft resins, prepared from genuine and fresh sticklac samples have been carried out by the standardised procedures. The average values obtained for them are summarised in Tables 2 and 3. The values reported by Khurana *et al.*<sup>3</sup>, using 2,4-DNPH method are also included in the Table 2 for comparison.

\*Since the percentage of aldehydic acids other than jalaric acid is extremely low in the resin, the latter has been used for the calculation. Equ. Wt. = 280.

Table 2  
Percentage of aldehydic acids in seedlac, hard and soft resins

Source	Before hydrolysis			After hydrolysis			Recorded by Khurana <i>et al</i> (DNPH-method)	
	Seed-lac* (%)	Hard resin (%)	Soft resin (%)	Seed-lac (%)	Hard resin (%)	Soft resin (%)	Hard resin	Soft resin
Palas	10.4	13.7	13.2	27.8	38.6	35.4	31.1	36.1
Kusmi	11.0	14.8	12.9	28.3	37.4	34.1	37.2	34.6
Ber	12.2	13.8	12.0	28.0	37.8	34.9	41.0	36.8
Jalari	12.4	16.6	11.9	28.2	42.5	34.5	37.2	34.1

Table 3  
Carbonyl values of seedlac, hard and soft resins

Source	Before hydrolysis			After hydrolysis		
	Seedlac*	Hard resin	Soft resin	Seedlac	Hard resin	Soft resin
Palas	20.3	27.5	25.1	56.0	77.5	70.4
Kusmi	24.0	29.9	26.0	55.4	75.0	70.2
Ber	24.8	27.8	24.2	56.8	75.8	70.8
Jalari	24.9	33.3	24.8	55.0	85.0	72.2

\*The values obtained on the basis of lac content in seedlac samples.

The results recorded in Table 2 reveal that the percentages of aldehydic acids determined in hydrolysed and intact resin are not identical. The estimated values found before hydrolysis are nearly one-third of that found after hydrolysis, thus clearly indicating that the aldehyde function is masked in seedlac, as well as in hard and soft resins. From the values (Tables 2 and 3), it is quite clear that two-thirds of the aldehyde content is present in the combined form and one-third in free form. It is evident that the values obtained by the present method after hydrolysis are in close agreement with the values reported by Khurana *et al.* by the DNPH method, thereby indicating the correctness of this simple method. These results confirmed the views put forward by Bhatt *et al.*<sup>9</sup>, and Sengupta and Tripathi<sup>10</sup> that aldehyde function is partly masked in lac resin, and contrary to the contention of Khurana *et al.*<sup>3</sup> and Weiss and Beinfest<sup>11</sup> that the aldehyde function is completely free in lac resin. Further, the liberation of total aldehyde function under acidic condition also disproves the explanation of Weiss and Beinfest that the lower carbonyl values, as reported by Sengupta and Tripathi<sup>10</sup>, are due to partial acetal formation when lac dissolves in alcohol in presence of acid.

Since all the aldehydic acids present in lac resin are liberated during alkaline hydrolysis, the study suggests that the combined aldehyde function is most probably present in the form of acylal<sup>12</sup> and not as acetal<sup>4</sup> or hemiacetal linkages which are resistant towards alkali. The opening of the total aldehydic function under acidic condition further indicates that the acylal linkage is labile to acid.

## Acknowledgment

The authors are grateful to Dr T. P. S. Teotia, Director, and Dr B. B. Khanna, Head of the Chemistry Division, for permission to publish this paper.

[Received 27 November 1978]

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# Polarisation resistance—Its meaning when applied to a coated substrate

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## Summary

The use of polarisation resistance as a technique for the assessment of anticorrosive coatings on metals is critically reviewed. A new AC impedance technique for studying coatings on metals

under immersed conditions is described and some preliminary findings with chlorinated rubber on mild steel in sea water are presented.

## Keywords

*Types and classes of coatings and allied products*

anticorrosive coating  
primer

*structures or surfaces being coated*  
corrosion

*Specifications, standards and regulations*  
test method

*Properties, characteristics and conditions primarily associated with materials in general*

electrical resistivity  
polarisation resistance

## La résistance de polarisation—sa signification à l'égard d'une surface revêtue de peinture

### Résumé

On donne une revue critique de l'utilisation de la résistance de polarisation en tant que technique pour apprécier les revêtements anti-corrosions pour métaux. On décrit une nouvelle technique faisant appel à l'impédance au courant alternatif pour étudier le

comportement des revêtements appliqués aux métaux et immergés dans un milieu aqueux. On présente certaines observations préliminaires dans le cas d'un revêtement à base de caoutchouc chloré appliqué à l'acier doux et immergé en eau de mer.

## Polarisierungswiderstand—seine Bedeutung, wenn auf beschichtete Substrate angewandt

### Zusammenfassung

Eine kritische Betrachtung der Nützlichkeit des Polarisierungswiderstands als eine Technik zur Bewertung antikorrosiver Beschichtungen auf Metallen. Es wird eine neue Impedanztechnik zum Studium von Beschichtungen auf Metallen, wenn unter

Wasser, beschrieben; ebenfalls werden einige vorläufige Feststellungen von Befunden mit Chlorkautschuk auf Blech in Seewasser vorgelegt.

## Introduction

Refs. 1-18

A variety of electrochemical techniques has been used to study the anticorrosive properties of coated metal substrates. The more common techniques, namely potential-time measurements and DC resistance have been reviewed<sup>1,2</sup> and the second paper casts some doubt upon electrical techniques for coating evaluation and suggests that such techniques are useful merely to quantify what can be readily observed visually.

Recently, the use of polarisation resistance techniques on coated substrates has become more common and it is the purpose of this paper to review this work and to discuss in greater detail the significance of this term as applied to coating investigations. Finally, some results obtained with a plasticised chlorinated rubber coating using polarisation resistance techniques will be presented and discussed. The original study was carried out by Stern<sup>3,4</sup> who investigated iron in deaerated acid solutions. He found a relationship between the slope of the potential/current curve at the corrosion potential and the corrosion rate. This study was further extended by Stern and Geary<sup>5</sup>, who, in a now classic paper, derived a similar relationship between the corrosion current, the slope of the potential/current curve at or near the corrosion

potential (within  $\pm 10\text{mV}$ ) and the Tafel coefficients of the anodic and cathodic reactions. These authors, however, state that this relationship holds only for a freely corroding specimen in the absence of resistance and concentration polarisation and when under activation control. These final points are frequently disregarded by many workers who attempt to use the Stern-Geary relationship to determine corrosion rates under conditions which are far from those originally suggested. Considerable experimental and theoretical work has been carried out in situations where the original Stern-Geary premises are not satisfied and these have been summarised by Callow *et al*<sup>6</sup>. In particular, they refer to a variety of possible problem areas, many of which are directly applicable to coated metals including low resistances, failure to achieve steady state during polarisation and time-dependent corrosion potentials.

These particular problem areas have not deterred numerous workers from employing polarisation resistance techniques to study paint films. Bureau<sup>7</sup> studied painted metal substrates and attempted to correlate the polarisation resistance with exposure tests. He made no attempt to compensate for the paint resistance and, furthermore, his polarising potential was not  $\pm 10\text{mV}$  but  $\pm 100\text{mV}$ . Kleniewski<sup>8</sup> used polarisation resistance techniques to investigate lacquered tinplate. Polarisation resistance and free film ionic resistance were

compared for a variety of solutions and for two coating thicknesses and a good correlation was obtained. It may have been possible, since this work also appeared to disregard the previously mentioned disclaimers of Stern and Geary, that Kleniewski, instead of measuring a true polarisation resistance, was indeed measuring ionic permeability through the film. Recently, Joly and Laout<sup>9</sup> carried out similar investigations on pure iron coated with acrylic varnishes containing various anticorrosive pigments immersed in a 3 per cent NaCl solution. They also obtained values for polarisation resistance under a variety of conditions, but again a lack of appreciation for the principles of the measurement casts some doubt upon the validity of their results. Dévay<sup>10</sup> *et al.* clearly appreciated the problem of the paint film resistance when employing polarisation resistance techniques, since before carrying out the electrochemical measurement, they removed the paint coating by dissolution. However, the effect of coating removal on the properties of the metal substrate is not known and any relevance of any subsequent measurement to the situation before coating removal is somewhat doubtful.

The meaning of the term polarisation resistance so far has been shown to be related to the response of the corroding electrode during the application of a small potential perturbation. It is worthwhile to consider now the meaning when the coated electrode as an equivalent circuit of combinations of capacitors and resistors is involved. The meaning is most clearly brought out by Mikhailovskii *et al.*<sup>11</sup>. They suggest that although the relationship between ohmic film resistance and film protective quality is sometimes valid, frequently organic coatings are found whose ohmic resistance is low (facile ionic permeability) but which form good anticorrosive coatings. They point out that the anticorrosive properties are related to the retardation of the interfacial electrochemical reactions and this resistance is known as the *Polarisation Resistance*. These workers employed interrupted galvanostat techniques and analysed their data assuming their coating was equivalent to that shown in Fig. 1.

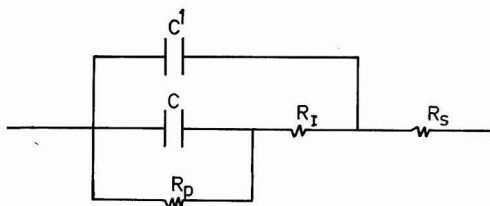


Fig. 1. Equivalent circuit

where  $C^1$  is the capacitance of an intact film  
 $R_l$  is the resistance of a pore penetrating to the metal  
 $C$  is the capacitance at the base of the pore  
 $R_p$  is the polarisation resistance  
 $R_s$  is the electrolyte resistance

Using 10 $\mu$ m thick bitumen films on iron electrodes they were able to distinguish between the ohmic and polarisation resistances. Clearly, their porous model seems quite valid when considering the film thicknesses employed.

Kendig and Leidheiser<sup>12</sup> studied a variety of thin lacquers on steel; coating thicknesses varied between 3.5 $\mu$ m and 29 $\mu$ m. They used Mayne's  $D$  and  $I$  model<sup>13-15</sup> where electrolyte is thought to penetrate into specific areas of low cross-link density, their coating being equivalent to the following circuit (Fig. 2).

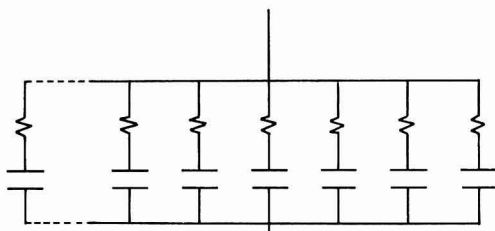


Fig. 2

With this circuit they matched complex permittivity data determined for their steel/lacquer systems and they looked at electrolyte penetration into the porous coating.

Another useful equivalent circuit for a corroding electrode has been suggested by Sluyters<sup>16</sup>. (Fig. 3).

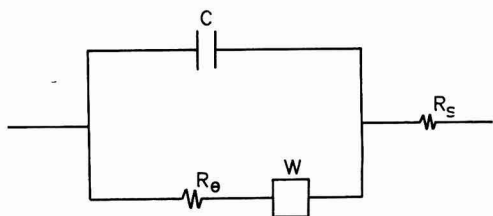


Fig. 3

where  $C$  is the double layer capacity  
 $R_e$  is the charge transfer resistance  
 $R_s$  is the ohmic resistance  
 $W$  is known as the Warburg impedance and represents diffusion controlled reactions

If the  $W$  term is neglected then this circuit can be represented on a complex impedance diagram as a semi-circle with the following features (Fig. 4):

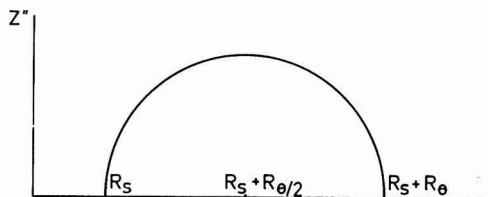


Fig. 4

Using conventional DC techniques, the polarisation resistance measured is the diameter of the semicircle plus  $R_s$ . Clearly this definition is consistent with that proposed by Mikhailovskii where the retardation of the electrochemical reaction at the interface is governed by both the film ohmic resistance and the charge transfer resistance. This graphical method has been further extended by Armstrong<sup>17</sup> and the first application of this graphical method to coated substrates was carried out by Epelboin *et al.*<sup>18</sup>. They investigated, using impedance techniques, thin epoxy coatings on mild steel (thicknesses of coatings 20 $\mu$ m) in  $N.H_2SO_4$ . They used the circuit proposed above by Sluyters and produced graphical impedance data. Considering their coating thicknesses and the aggressive media used, it is hardly surprising that

they explained their data in terms of a porous coating structure.

It has been shown by these workers, however, that the real corrosion rate is not related to the DC polarisation resistance but to  $R_0$ , the charge transfer resistance. Subsequently, in this paper reference will not be made to the term polarisation resistance but to the term charge transfer resistance as an indication of the electrochemical changes taking place at the paint metal interface.

The latter part of this paper describes an investigation using impedance techniques and the graphic interpretation method into a mild steel, chlorinated rubber system immersed in neutral sodium chloride solutions.

## Experimental

### Materials

The coating material was a chlorinated rubber (Alloprene) plasticised with a chlorinated wax (Cereclor 42) in the ratio 70:30 by weight. Both were supplied by ICI Ltd. The solvent employed was toluene. The mild steel, the composition of which is given in Table 1, was a 2mm thick sheet cut into

Table 1  
Mild steel composition

C	Si	Mn	S	P	Fe
0.18	0.02	0.58	0.033	0.012	balance

$2 \times 3$  cm pieces with the edges chamfered to minimise thin regions of coating. A mild steel rod, 2mm diameter, was spot welded to the end of each plate and, after degreasing in acetone, each electrode was pickled in concentrated HCl for 15 minutes, after which time the electrode had a shiny and uniform appearance. The electrodes, after thorough washing in doubly distilled water, were finally rinsed in isopropyl alcohol, dried in a stream of warm air and stored in a desiccator for at least two days before coating.

The immersing solution was 3 per cent NaCl which was aerated for 15 minutes before each test. Aeration was maintained throughout each test. A platinum electrode of  $32\text{cm}^2$  was used as the counter electrode of the two electrode cell, the other electrode being the coated mild steel.

### Preparation

Films were prepared by a withdrawing technique using an accurate constant speed motor and a system of gears and pulleys. The coating apparatus was contained in a vertical chamber through which filtered air was continuously being drawn. Coated specimens were allowed to dry at room temperature in this environment for two days followed by two days in an air-circulated oven at  $50^\circ\text{C}$ . The coating thickness produced by this technique was  $55 \pm 2\mu\text{m}$ . The rear and edges of the specimens were masked in paraffin wax before use, exposing a surface area of  $1.75\text{cm}^2$ .

### Testing method

Ref. 19

A Transfer Function Analyser (TFA) Solartron 1172 together with a data transfer unit also by Solartron were

employed. This equipment acts as a programmable sine wave generator of variable frequency which applies a sinusoidal potential to the electrode system and analyses the response of that system in terms of gain and phase shift.

In view of the fact that a good paint coating would have a high ionic resistance<sup>19</sup> and that the applied potential of the TFA was only 20mV, an adaptor was built for the TFA to amplify the output signal. A standard FET operational amplifier was used (Radio Spares No. 405-456) and the circuit is shown in Fig. 5.

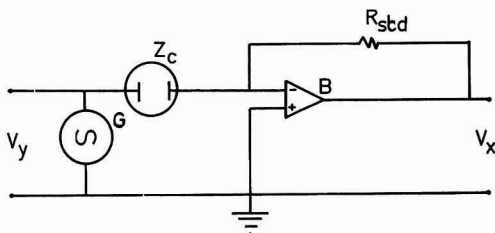


Fig. 5

where  $Z_c$  is the two electrode cell impedance  
 $B$  is the operational amplifier  
 $G$  is the sine wave generator from the TFA  
 $R_{std}$  is a standard resistor  
 $V_y$  is the output from the generator  
 $V_x$  is the response of the system

It can be shown that the cell impedance is:

$$Z = V_y/V_x \times R_{std}$$

The value  $V_y/V_x$ , the phase shift  $\phi$  and the frequency of the sine wave generator  $\omega$  are digitally displayed. Thus the in phase (real) component  $Z'$  and out of phase (imaginary) component  $Z''$  can be computed as:

$$Z' = Z \cos \phi$$

$$Z'' = Z \sin \phi$$

and these values may be plotted as a function of changing frequency  $\omega$ .

## Results and discussion

Figure 6, curve 1 shows the complex impedance plot of the coated mild steel electrode after two days immersion and the behaviour after four days immersion is identical. This curve shows a virtual lack of dependence on  $Z'$  with the curve running parallel to the  $Z''$  axis. This data may be explained by thinking of the coating at this time as a pure capacitor with the polarisation resistance infinitely large. In this model the coated mild steel behaves as a capacitor in series with the ohmic resistance. Analysis of this data gives a film capacitance of between 190 to 200pF. Substitution of the electrode cell for a commercial capacitor of the same value gave identical results. The other curves in Figure 6 show the complex impedance plots at seven, eight, nine and ten days immersion. These plots show an almost perfect semi-circular behaviour which is in sharp contrast to the behaviour after two and four days. Furthermore, the diameter of the semi-circle decreases with time. This behaviour may be explained by referring to the Sluyters equivalent circuit already discussed. The diameter of the circle is  $R_0$ , the charge transfer

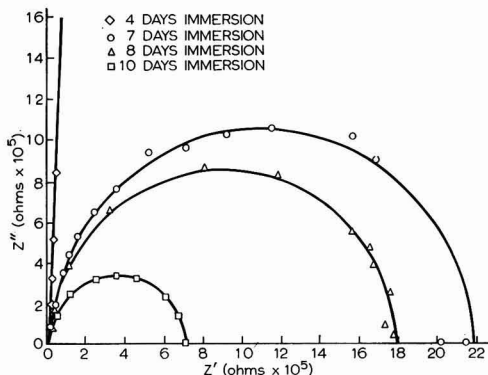


Fig. 6.

resistance. Furthermore, it can be shown that  $C$  may be calculated from the relationship:

$$C = \frac{1}{\omega_{max} R_0}$$

where  $\omega_{max}$  is the frequency at the highest point in the semi-circle. Table 2 shows the values for  $R_s$ ,  $R_0$ , and  $C$  extracted from the figures. Not surprisingly, the values for  $R_s$  remain constant with time, whereas the value of the charge transfer resistance slowly decreased with time. Interestingly, the value for the capacitance changed very little during the time of measurement. It is thought that this lack of change of capacitance may be explained by the fact that the uptake of water, the major factor influencing capacitance, takes place within one day's immersion and thereafter stays constant provided film integrity is maintained.

Table 2

Immersion time (days)	$R_s$ (ohm-cm <sup>2</sup> )	$R_0$ (ohm-cm <sup>2</sup> )	$C$ (pF/cm <sup>2</sup> )
2	14,000	$>10^9$	198
4	14,000	$>10^9$	201
7	14,000	$2.1 \times 10^6$	216
8	14,000	$1.8 \times 10^6$	200
9	14,000	$6.8 \times 10^5$	233
10	14,000	$5.5 \times 10^5$	222

It is worthwhile at this stage to discuss the surface appearance of the coated electrode during the time period of this test. Although the solution was not clouded, and there was no visible breakdown of the coating, at the period of time between four and seven days, a small black spot appeared under the film which slowly grew with time. Moreover, other similar small spots appeared on the specimen surface after seven days.

It is thought that the growth of these spots, the corrosion of the mild steel, and the change in the charge transfer resistance from  $7 \times 10^9$  to  $10^6$  are related phenomena.

## Conclusions

- (1) AC impedance techniques have been applied to a typical coating of a typical thickness in a neutral sodium chloride solution.
- (2) The results obtained are readily understood by using a simple circuit model.
- (3) The meaning of the term *Polarisation Resistance* arises directly from the choice of this model.
- (4) The value of the *Polarisation Resistance* for this coating is seen to decrease with time and this is seen to match the corrosion of the underlying steel.

## Acknowledgments

The authors wish to thank the Procurement Executive, Ministry of Defence, for financial support and encouragement, without which this work could not have been carried out.

[Received 23 November 1978]

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# Electrochemical testing of the protective power of zinc rich paints

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## Summary

A new accelerated test is developed to distinguish between zinc rich paints having different performances. Comparisons are made by

using more traditional tests, and results are given for a few commercial and laboratory made paints.

## Keywords

### *Types and classes of coatings and allied products*

zinc rich coating  
primer  
anticorrosive coating

### *Processes and methods primarily associated with service or utility*

corrosion

### *Properties, characteristics and conditions primarily associated with materials in general*

electrical resistivity

### *Structures or surfaces being coated*

corrosion

### *Specifications, standards and conditions*

test method

## L'appréciation du pouvoir protectrice des peintures riches en poudre de zinc au moyen des essais électrochimiques

### Résumé

On décrit la mise au point d'un nouvel essai accéléré pour faire une distinction entre des peintures riches en poudre de zinc ayant de différents comportements. On fait des comparaisons en utilisant

les essais conventionnels, et on présente des résultats pour quelques peintures et de commerce et préparées aux laboratoire.

## Elektrochemische Prüfung der Schutzwirkung zinkreicher Anstrichfarben

### Zusammenfassung

Ein neuer beschleunigter Test wird vorgeführt, um zwischen Leistungen von sich verschieden verhaltenden, zinkreichen Anstrichfarben Unterschiede machen zu können. Es werden unter Mit-

wendung von üblicheren Prüfmethode Vergleiche gezogen, und Ergebnisse für einige im Handel befindliche und im Laboratorium angefertigte Farben mitgeteilt.

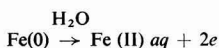
## Introduction

### Refs. 1-3

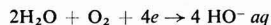
The use of protective coatings to prevent the corrosion of steel structures is the most usual anticorrosive practice. Since the time when synthetic resins of the polyurethane, chlorinated rubber, epoxy types etc., became available, there has been an ever increasing tendency to employ coatings having a long service life (10 to 20 years), in order to protect immersed steel structures which may be subjected to severe conditions and where maintenance operations may be very costly. This is the case with the reinforced tubing, the gates and other components at hydroelectric power stations. The coatings employed to protect these structures consist, in general, of an anticorrosive primer and a highly resistant top coat.

In order that the corrosion of iron in an aerated aqueous environment can occur, water and oxygen must be consumed in the corrosion process, according to the following scheme:

### Anodic process:



### Cathodic process:



Consequently, to inhibit corrosion either the anodic or the cathodic process must be retarded. Water is normally available to the coated corroding steel, because as a rule water permeability through paints is sufficiently high to guarantee that this is not the rate determining step<sup>1</sup>. On the other hand, Funke<sup>2</sup> has recently raised doubts about the values usually accepted<sup>1</sup> for the permeability of oxygen and considers that oxygen transport through the film may be one of the rate determining steps for the corrosion of coated steel.

However, the general practice consists of employing an anticorrosive primer which controls the anodic process in either of two ways:

- Anodic passivation of the steel substrate by employing chromates or various metal oxides in the primers;
- The steel may be cathodically protected by paints rich in a highly active metal dust, such as zinc.

In any case the top coats<sup>3</sup>, apart from giving a high mechanical strength to the paint as a whole, markedly decreases the rate of corrosion of the steel by interposing large electrical resistance between anodic and cathodic areas of the metal (ohmic barrier), and acting as a diffusional barrier for the various aggressive species in the aqueous medium.

In order to select paints for coatings that are required to have a prolonged service life, it is most convenient to have

reliable accelerated tests in order to screen the commercially available products before they are applied, and so that poor quality paints become evident within a few weeks or months of being applied because of coating deterioration. This is especially true when chemical analysis alone is not a sufficient criterion to guarantee the quality of a paint.

Due to the popularity of zinc rich primers and the fact that in many cases difficulty has been experienced in selecting the best paint on the basis of chemical analysis, this important primer has been studied. In this work, an electrochemical accelerated test for zinc rich paints has been developed, which allows its anticorrosive capacity on painted specimens to be tested in a few minutes or, at most, in one hour. The conclusions obtained from this accelerated test compare very well with those obtained with the same paints applied to panels which were exposed to an aggressive medium.

## Zinc rich paints

Ref. 4

### Main characteristics

These paints contain a large proportion of metallic zinc powder which exceeds 85 per cent (w/w)\* in order that the

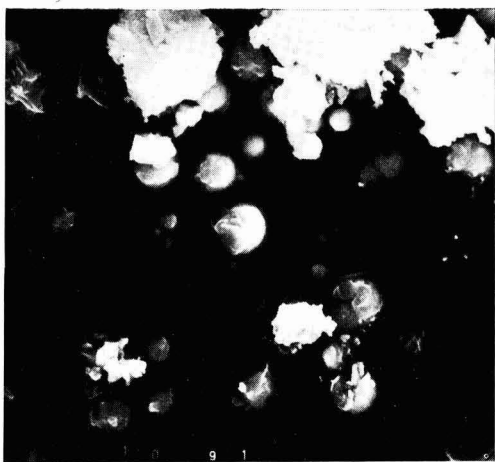


Fig. 1. Scanning electronic microphotograph of a zinc-rich epoxy primer. Magnification  $\times 5000$

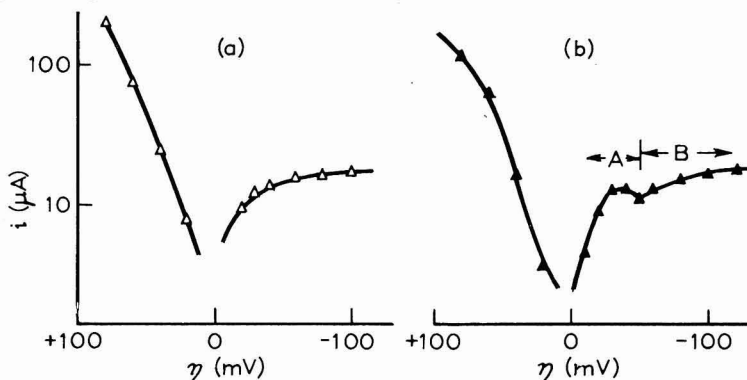


Fig. 2. Potentiodynamic polarisation curves for hot dipped galvanised zinc (a), and zinc-rich epoxy primer (b). Sweeping rate  $10 \text{ mV sec}^{-1}$

metallic particles are all electrically interconnected. Otherwise, the particles are surrounded by the polymeric resin and become electrically insulated from each other due to the high resistance of the polymeric materials used. This is illustrated in the photomicrograph of Figure 1, corresponding to a paint that did not perform satisfactorily and had a rather low zinc content.

A high zinc content alone is not a sufficient guarantee that a given zinc rich paint may work efficiently once it is applied. Two other factors which influence the performance of the paint are (i) a correct particle size distribution of the metallic particles, and (ii) the absence of ZnO on the surface of the particles. If the particle size distribution is not correct the pigment sediments before film formation is completed and even flocculates in some paints. Figure 1 also shows the presence of oxide on some of the metal particles of a poor performance paint.

### Mode of action

In order to devise an accelerated test for zinc rich paints, it is necessary to know, at least schematically, the mechanism of protection of the paint. Figure 2 compares the potentiostatic polarisation curves for galvanised steel (Fig. 2a), and for steel coated with a zinc rich epoxy paint (Fig. 2b). The similarity of the anodic and cathodic branches of the curves for both specimens is apparent. The most important difference between the coatings is that the paint acts as a porous electrode and that in galvanised steel the coating is composed of iron-zinc alloys having a higher iron content in the inner layers of the coating.

In both cases, the anodic curves correspond to the dissolution of zinc metal to give Zn (II) ions, and the curves are of the Tafel type. However, the one corresponding to the zinc-rich paint starts to deviate from the Tafel curve at overpotentials around  $+80 \text{ mV}$ . The cathodic branch corresponds to the reduction of corrosion products (region A) and to the diffusion limited oxygen reduction (region B).

The resistance of the zinc-rich film is an important parameter in establishing its efficiency in the cathodic protection of steel. Once a given area of the metal substrate becomes accidentally exposed (e.g., scratched), corrosion in such areas will be prevented by the preferential dissolution of zinc metal in the neighbouring region. The protective action of zinc particles becomes poorer as the distance between them and the exposed steel increases. This is due to the high electrical



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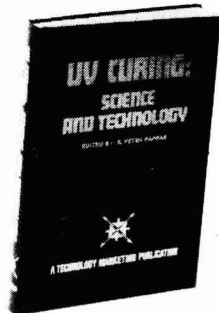
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resistance between these anodic particles and the cathodic steel. Consequently, iron dissolution will compete with the oxidation of zinc in regions separated from the exposed steel. Thus it may be considered here that there is an effective sacrificial area around the damage.

A consequence of this fact is that when zinc-rich primers are top coated with paints having a high electrical resistance, the effective sacrificial area of the coating is quite small, and even small scratches exposing the steel become oxidised after a few hours of exposure to one per cent NaCl solution. However, the advantage of the primer consists in very efficiently healing the damaged area and avoiding its subsequent spread (rust creep).

## Experimental

### Materials

Four commercial epoxy zinc-rich paints have been used. Their characteristics are given in Table 1. The performance of the coatings was established in a series of tests in which painted panels were immersed for long periods (several months) in aqueous solutions.

Table 1  
Characteristics of the commercial zinc rich paints used

Paint	Resin	% Zinc	Performance*
X1	Epoxy-polyamide	90	—
X2	Epoxy-polyamide	90	+
X3	Epoxy-ester	92	++
X4	Epoxy-polyamide	86	—

The top-coat employed was a commercial epoxy coal tar paint cured with epoxy amine adduct.

\*The performance is indicated by a (+) when considered satisfactory and by a (—) when inadequate.

Through the courtesy of Dr R. Haas (Luzol), metal zinc powder of appropriate particle-size and several resins (epoxy-polyamide, epoxy-ester and chlorinated rubber) were obtained. They were used to prepare paints having different zinc contents.

Wherever the effect of top-coating was evaluated, a commercial two-component epoxy/coal tar paint was used. The crosslinking agent was a polyamide.

### Specimen preparation

The paints were applied to 1020 steel panels, the area of the coating exposed in the test being restricted by the cell employed (see below). The films of zinc-rich primer had a thickness of  $100 \pm 20 \mu\text{m}$ , whilst the epoxy coal tar top-coat was  $200 \mu\text{m}$  thick.

The films were cut through with a sharp knife in the form of a 2 cm-long cross, exposing the steel substrate.

### Accelerated electrochemical test

This consists essentially of galvanostatically forced metal dissolution. The experimental arrangement is schematically shown in Figure 3. An *Electrargen* constant current power supply (*A*) was used to polarise the specimen (*S*); a Pt wire (*B*) was used as counter-electrode. The electrical potential of the specimen was measured with a *Fluke* digital multimeter using

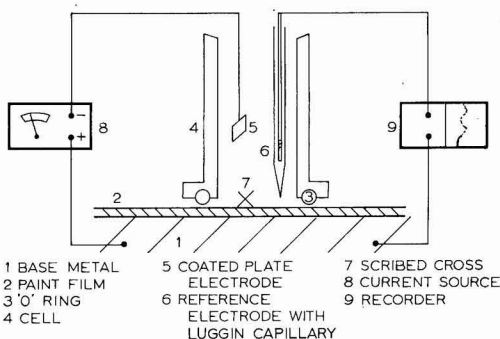


Fig. 3. Cell

a SCE reference electrode (*D*). If desired, the potential could be simultaneously recorded. An acrylic cell (*E*) having an "O" Ring to make a tight seal against the paint surface was used in the tests. The cell was held to the specimen magnetically.

The cell was filled with electrolyte solution to which 50 ppm of *o*-phenantroline was added. The presence of Fe (II) was detected by the appearance of colour due to (*o*-phen)<sub>3</sub> Fe<sup>2+</sup> complex ion. The time at which the colour appeared,  $T_c$ , was used to evaluate the performance of the tested specimen.

## Results

Ref. 5

In principle, the test could be employed either potentiostatically or galvanostatically. Figure 4 shows two representative examples of specimens of paints X1 and X3. It will be observed that potentiostatic dissolution does not allow a ready differentiation of these two paints, which had such a different performance in normal exposure tests (see Table 1).

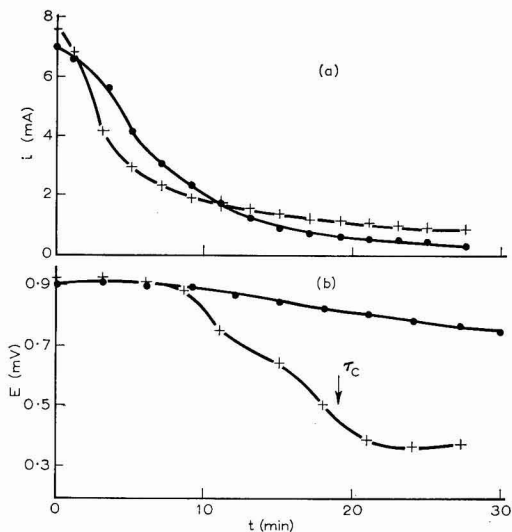


Fig. 4. Potentiostatic (a) and galvanostatic (b) behaviour of primers of known performance: ● good performance; + bad performance

On the other hand, the galvanostatic test proved very effective in distinguishing between both paints.  $T_c$  for X1 was 19 minutes, whilst at the same current density no colour appeared on X3 after 30 minutes of galvanostatic dissolution. Consequently, the galvanostatic method was employed for all other tests.

It may be noted that the colour always appeared when the specimen tested had a potential close to  $-500$  mV (SCE), which was the potential of the bare steel in the medium used. It was observed that immersing an uncoated steel plate in the test solution caused colour to develop almost instantly, even without any applied current.

Table 2 gives the results obtained for the commercial paints. It may be seen that  $T_c$  is much smaller for the paints having a poor performance. It may be added that  $T_c$  decreases with an increase in the current circulating through the paint; this is illustrated in Figure 5. It was found that for currents not less than  $0.3$  mA, the product of  $T_c$  times the current is a constant, whilst for smaller currents, a linear relationship between the factors is observed. That is:

$$T_c \times i = \text{Constant} \quad i \geq 0.3 \text{ mA}$$

$$T_c = a - b.i \quad i < 0.3 \text{ mA} \quad \dots \dots \dots (1)$$

Table 2

Results of the accelerated test for zinc rich paints (Area = 12cm<sup>2</sup>)

Medium and type of coating	Zinc-rich paint	<i>i</i> (mA)	<i>T<sub>c</sub></i> (min)
Zinc-rich primer in 0.1 molar KCl	X1	0.3	20
	X2	0.5	50
	X3	1.0	120
	X4	0.3	26
Zinc-rich primer and epoxy coal tar top coat in 0.1 molar KCl	X1	0.5	10
	X3	0.5	85
	X4	0.5	13
Zinc-rich primer in 10 <sup>-3</sup> molar NaHCO <sub>3</sub>	X1	1.0	7
	X2	3.0	90
	X3	3.0	60
Zinc-rich primer and epoxy coal tar top-coat in 10 <sup>-3</sup> molar NaHCO <sub>3</sub>	X1	0.5	2
	X3	0.5	15

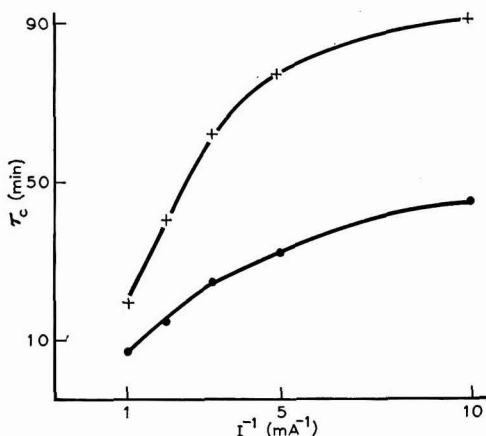


Fig. 5.  $I^{-1}$  vs.  $T_c$  relation for two different qualities of zinc rich epoxy primers: + good performance; ● bad performance

The first expression is related to Faraday's Law for electrochemical dissolution. The fact that this expression is not valid for all the range of currents, is to be attributed to the fact that if zinc dissolution occurs at a moderate rate, the corrosion products of zinc, which are so important in the mechanism of protection with non-accelerated corrosion given by films of this metal<sup>5</sup>, may deposit, thus filling the pores of the paint film and leading to an increase in film resistance.

When tests are carried out at  $0.3$  or  $0.5$  mA ( $12 \text{ cm}^2$  area) then, if it is assumed that zinc metal dissolution is occurring, equation (1) becomes:

$$T_c \times i = 163.3 (A \times e) \quad \dots \dots \dots (2)$$

where  $e$  is the film thickness, and  $A$  is the effective area of sacrifice.

It was found that for a good paint,  $T_c \times i > 1.0$  coulomb, or  $A > 0.6 \text{ cm}^2$ , while for poor performing coatings  $T_c \times i < 0.5$  coulomb or  $A < 0.3 \text{ cm}^2$ .

A number of factors affecting  $T_c$  have been evaluated in this work. Figure 6 illustrates the effect of film thickness ( $e$ ), which was observed to agree fairly well with equation (2).

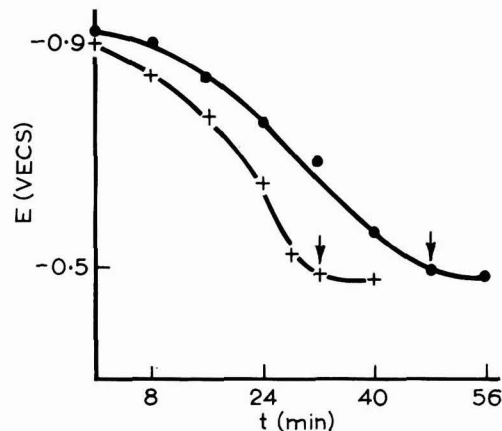


Fig. 6. Influence of paint thickness on coating performance: + 150 μm; ● 200 μm

The zinc content of the paint is a very important factor in determining the quality of the paint as shown in Figure 7. On the other hand, if the painted panels are immersed some hours before being tested,  $T_c$  increases. In the case of epoxy zinc-rich paints, the method employed to cure the paint may be important because it affects the resistance of the paint film. The influence of these factors is illustrated for an epoxy polyamide primer shown in Figure 8.

The effect of top coating the primer is quite clear from the results plotted in Figure 9.

In order to compare the results of the accelerated test with the actual performance of the paints, panels coated with different paints were immersed in  $0.1 \text{ M NaCl}$ , the variations of potential of the panels and the appearance of oxide and/or blisters being recorded. Figures 10 and 11 give some typical results for chlorinated rubber and epoxy ester resins.



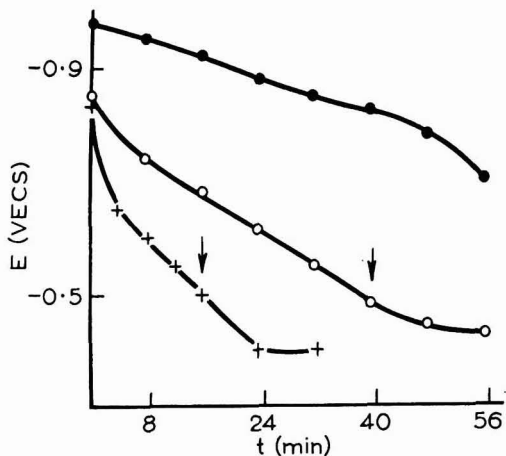


Fig. 7. Effect of metallic zinc content on coating performance: ● 90% w/w; ○ 80% w/w; + 70% w/w

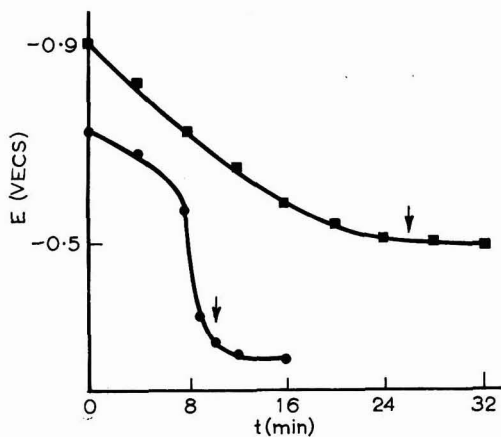


Fig. 9. Effect of top coat on anticorrosive properties of zinc rich primer: ■ no top-coat; ● coal tar epoxy coated

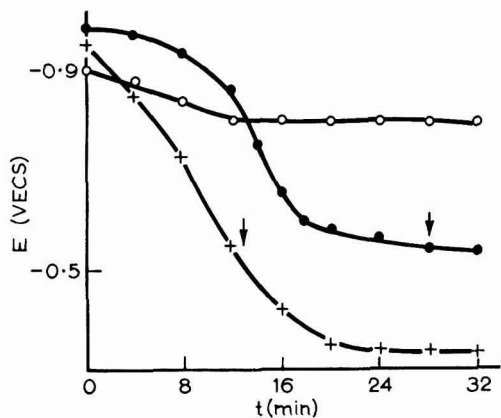


Fig. 8. Effect of treatment on paint performance for zinc-rich epoxy primer: ● 8 days, 20°C; + 6 days 20°C plus 2 days 60°C; ○ 6 days 20°C plus 2 days 60°C, immersed for 18 hours in the test solution before test started

Those coatings giving a good value of  $T_o$  in the accelerated test did not show any oxide formation on the arms of the cross after 15 days of immersion. Coatings with less than 80 per cent zinc did not protect the exposed metal, and oxide appeared very quickly. Blisters appeared most frequently in those paints having 80 per cent zinc metal.

**Conclusions**

The accelerated electrochemical test described provides an easy way of distinguishing between zinc rich paints having different performances. It was possible to detect in a few minutes those paints which failed after a rather long immersion period under unpolarised conditions.

The advantage of the test is, moreover, its simplicity and quickness; it may be easily implemented as an acceptance test, both in laboratory or field conditions, and is applicable to both specimens and steel structures already coated.

The test also provides a quantitative measure of the protection afforded by any given zinc rich paint, as estimated from the effective sacrificial area.

[Received 22 November 1978

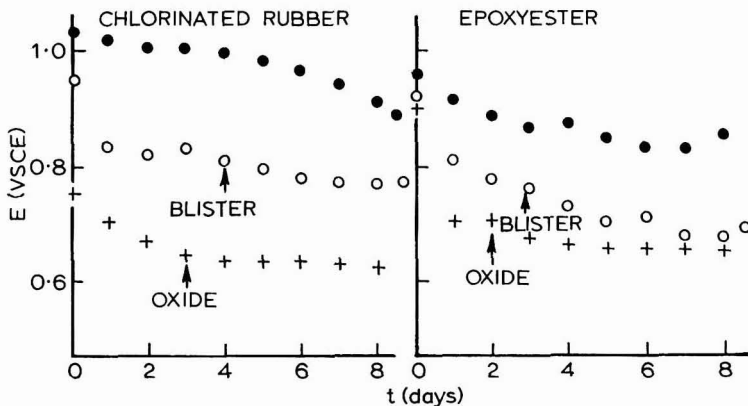


Fig. 10. Potential vs. time relation for zinc rich primers with cross, immersed in 0.1 molar KCl: ● 90% zinc; ○ 80% zinc; + 70% zinc

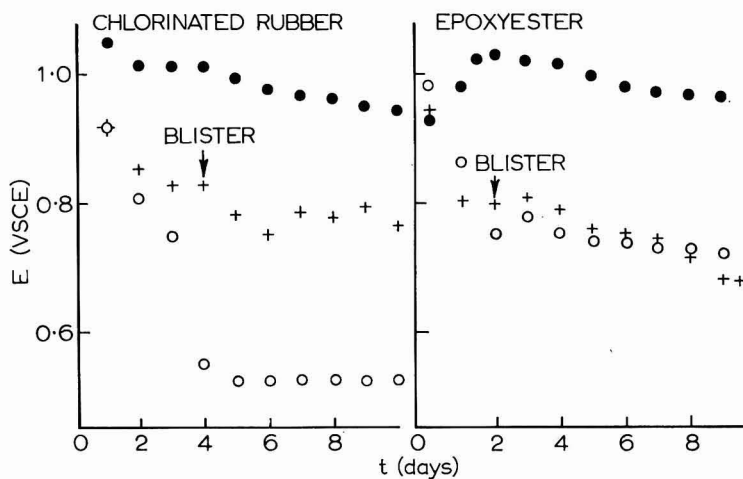


Fig. 11. Potential vs. time relation for zinc rich primers without cross, immersed in 0.1 molar KCl:  
 ● 90% zinc; + 80% zinc; ○ 70% zinc

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# Regulatory legislation—Effect on preservative choice\*

By A. J. Hinton

Imperial Chemical Industries Ltd, Organics Division, PO Box 42, Hexagon House, Blackley, Manchester M9 3DA

## Summary

The human and environmental hazards arising from the use of in-can preservatives in water-based paints and other water borne products are described. The consequent governmental and other restrictions on their use limits the choice of possible preservatives.

The hazards caused by mercurial, phenolic and formaldehyde donating preservatives are described and the criteria for satisfactory materials are considered. 1,2 Benzisothiazolin-3-one is found to be one of the safest and most effective substances.

The high cost of testing materials for possible toxic and undesirable ecological effects makes the development of new preservatives extremely expensive. A better understanding of the relationship between molecular structure and biocidal activity is required to reduce the amount of trial and error testing.

Test methods for the assessment of in-can preservatives for use in emulsion paints are described.

## Keywords

*Types and classes of coatings and allied products*  
emulsion paint  
water base paint

*Raw materials for coatings*  
*biologically active ingredients*  
preservative  
chlorinated phenol  
mercurial fungicide  
microbiological agent  
1,2 Benzisothiazolin-3-one

## La législation régulatrice—son influence sur la sélection de l'agent de préservation

### Résumé

On décrit les risques à l'environnement et aux humains provoqués par l'utilisation des agents de préservation en tant que constituant de peintres à base d'eau et d'autres produits aqueux. La sélection des agents de préservation éventuels est limitée par les règlements gouvernementaux ou d'ailleurs qui en résultent.

On décrit les risques mettent en évidence par les agents de préservation capables de dégager le mercure, le phénol ou l'aldéhyde formique, et l'on considère les critères applicables aux substances convenables. On trouve que 1,2. benzisothiazolin-3-one est une des substances la plus sûre et la plus efficace.

A cause de l'importance du prix entraîné par l'appréciation des substances à l'égard des risques toxiques éventuels et des effets indésirables sur l'écologie, la mise au point de nouveaux agents de préservation est extrêmement coûteuse. On a besoin d'une meilleure compréhension du rapport entre la structure moléculaire et l'activité biocide, afin de réduire le nombre des essais de sondage.

On décrit certaines méthodes pour évaluer les agents de préservation utilisés en tant que constituants des peintures-émulsions.

## Regulierende Gesetzgebung—ihr Einfluss auf die Wahl von Schutzmitteln

### Zusammenfassung

Eine Beschreibung von Risiken, die sich aus der Benutzung von "in der Kanne"-Schutzmitteln für Anstrichfarben auf Wasserbasis und andere wasserhaltige Produkte für Menschen und Umwelt ergeben.

Die daraus resultierenden Regierungs- und anderen Beschränkungen in der Anwendung begrenzen die Auswahl möglicher Schutzmittel.

Es werden die Risiken betrachtet, welche sich bei Verwendung von Quecksilber, Phenol und Formaldehyd abgebende Schutzmitteln ergeben. 1,2 Benzisothiazolin-3-eins wird als eines der

verlässlichsten und wirkungsvollsten Substanzen befunden.

Die hohen Kosten für das Prüfen von Stoffen auf ihre mögliche Giftigkeit und unerwünschte ecologische Auswirkungen macht das Entwickeln neuer Präservierungsmittel ungewöhnlich kostspielig. Um die Zahl der Prüfungen zu reduzieren, ist ein besseres Verständnis der Beziehungen zwischen Molekülstruktur und biozidaler Aktivität erforderlich.

Es werden Prüfmethode für die Bewertung von "in der Kanne"-Schutzmitteln für Dispersionsfarben beschrieben.

## The need for emulsion paint preservatives

Refs. 1-4, 7, 8

The use of industrial biocides serves an essential function in modern society in ensuring not only that domestic and industrial products are technically acceptable for their intended purposes, but also that there is maximum utilisation of expensive raw materials and that the manufacturing processes

operate at optimum efficiency with minimum shut-downs for cleaning.

In emulsion paint manufacture, microbiological contamination from the air, the water supply, the raw materials used and dead-spots in the manufacturing plant, will readily attack the binders, thickeners, surfactants and dispersants and, if not controlled, this will lead to physical phenomena which

\*Paper presented at the South African Division Symposium "Coatings 78" at Cape Town on 2-5 November 1978.

render the paint unusable after an unacceptably short storage period. These observed physical effects are well known to the paint industry, namely viscosity loss, leading to separation into layers and settling out in the paint can, corrosion of the can as the bacteria metabolise to produce acids, gassing as the acids produce hydrogen sulfide (under anaerobic conditions) or carbon dioxide (in the presence of carbonate pigments) and unpleasant odours. These effects are very expensive or impossible to rectify and, therefore, the use of an acceptable "in-can" preservative is a relatively cheap insurance against these problems.

To survive and multiply, micro-organisms require water and nutrient. Therefore, microbial deterioration of solvent-based paints during storage in the can is not a problem. However, aqueous-based paints have always required protection, in common with a host of other aqueous-based products; for example, synthetic polymer emulsions, adhesives, polishes, detergents, metal working fluids and even water itself<sup>1,2</sup>. Traditionally, mercurials and, to a lesser extent, phenolic biocides, have provided adequate protection at reasonable cost and were used extensively until the wider implications of the use of toxic materials were forced on Governments by a series of tragic incidents in Japan, Sweden, Italy and USA<sup>3,4,7,8</sup>.

#### Potential hazard factors

Before discussing the effects of Government actions to control the use of toxic substances, it is worth considering the potential hazard factors when handling such substances in paint manufacture (see Table 1 below), because these are the factors which concern Government bodies.

Table 1

Potential hazard factors in handling the neat biocide and the paint containing the biocide

Human hazards	Environmental hazards
Oral toxicity	Effect on sewage systems
Dermal toxicity	Effect on fishing waters
Inhalation toxicity (i.e. volatile substances)	Long-term accumulation effects

#### Human hazards

The oral toxicity (the amount that has to be consumed in order to kill) is not a problem with most biocides. Mercurials are an exception, since they are highly toxic and are also accumulative poisons, i.e. small sub-lethal doses can accumulate in various organs leading eventually to a toxic effect. Phenolics, particularly chlorinated phenolics, also possess high oral toxicity and rapid toxic effects may occur by adsorption through the skin. On the other hand, most non-metallic synthetic organic biocides possess an acceptable oral toxicity (LD 50's in the range 1-5 g/kg body weight for rats) on the grounds that it would be necessary to ingest relatively large amounts (say, 100-500 ml) to produce lethal effects.

Virtually all industrial preservatives are skin irritants and most are potential skin sensitisers and should be handled using gloves to avoid direct skin contact with the neat biocide.

Many industrial biocides are volatile or possess volatile components and may present a toxic hazard during handling

or during the drying-out of the paint film. Many formaldehyde, tin or phenol-based biocides fall into this category.

#### Environmental hazards

The most effective way to reduce the toxic or pollutional effects of an effluent is to discharge it to a domestic sewage system. The heavy and varied microbial population in the aerobic and anaerobic digestion sewage systems is often capable of degrading quite toxic waste, provided that it is biodegradable and that the toxic level is insufficient to kill the microbial flora. However, certain antimicrobials (e.g. mercurials, phenols) are generally objectionable because they may poison the system and are generally difficult or impossible to biodegrade.

Since most biocides are relatively toxic to fish, any discharges into fishing waters should be diluted by a factor that ensures the toxic level is below that which may kill fish. Controls by local River Board Authorities or Central Government legislation exist in many countries to prevent the discharge of mercury or phenolic-containing wastes to rivers, lakes and estuaries. The main concern here is to avoid potential long-term ecological problems arising from the slow rate of breakdown of some biocides (e.g. phenols), and the actual accumulation in the environment of substances more toxic than the original discharge (e.g. mercurials biodegrade via methylation to even more toxic methyl mercury compounds).

The general properties of the major biocide groups are summarised in Table 2.

#### National regulatory controls

Nearly all the incidents referred to earlier resulted from the effects of the long-term use of well-known chemicals, such as mercurials, cadmiums and detergents, and the subsequent accumulation of toxic residues in the environment. However, the justified emotional outcry prompted Governments to act, initially in the USA during the 1950's, and since then in most major industrial countries. The form this action has taken has not been consistent from country to country, but has varied from enforced Government controls (e.g. in the USA) to merely making Government recommendations for voluntary control. Some Governments have concerned themselves mainly with long-term effects on the environment (e.g. MITI, Japan), others with protecting the industrial worker (e.g. Health & Safety at Work Act, UK), and still others with ensuring that the toxic material is technically effective (e.g. EPA, USA; Fytofarmacie Committee, Holland).

Thus there exists a confusion of national regulations to be complied with and protocols to be satisfied before a particular biocide can be sold in a given market. Apart from attempting to comply with these multiple regulations, the biocide supplier must be able to make technically acceptable recommendations, which also permit a paint maker to export his biocide-containing paint to other countries without infringing those countries' regulations.

It will be many years before national regulations are harmonised internationally, but already certain trends have become obvious and these trends are having a pronounced effect on international biocide usage.

Table 2  
Toxicity and environmental characteristics of major classes of in-can paint preservatives

Class	Toxicology			Environmental	Examples
	Oral (LD50)	Inhalation (TLV)	Dermal		
Mercurials	High (40 mg/kg)	High (0.001 ppm)	Sensitiser	Accumulates as highly-toxic methylmercury in food chains of fish. Fish toxicity 0.01 ppm max. safe upper limit	Phenylmercuric acetate. Phenylmercuric oleate
Formaldehyde and Formaldehyde-donors	Low (1000-5000 mg/kg)	High for HCHO (2 ppm-ceiling)	Sensitiser	Generally well tolerated	Formaldehyde, paraformaldehyde, hexamethylenetetramine. Benzyl formal. Various hexahydro 1,3,5 trisubstituted-s-triazines. Hydroxymethylamine alcohols. Hexaminiun salts. Dimethyltetrahydrothiadiazine thione (DMTT)
Chlorinated phenols	High (100-200 mg/kg) Dioxin impurities (1-5 µg/kg)	High (0.4 ppm)	Irritant Rapid toxic effects by absorption through skin	Very slowly biodegradable. Toxic impurities (dioxins) accumulate in plankton	Pentachlorophenate. Hexachlorophene. Trichloro and tetrachloro phenols
1,2 Benzisothiazolin-3-one (10-33 %)	Low (1000-5000 mg/kg)	Not volatile	Sensitiser	Biodegrades to lower toxicity. Does not accumulate in fish. Can be accepted by sewage systems	Proxel AB Proxel XL2

### Effects of national and local regulatory controls on biocide usage

Refs. 5-13, 17

Although the power behind various national authorities controlling the use and discharge of toxic substances varies tremendously in different countries, the effects have been remarkably similar in all industrial countries. In effect, the accumulated data from industrial usage and exposure is tending to classify the more traditional biocides as unacceptable. The reasons behind this thinking are summarised below:

#### Mercurials

The use of mercurials as preservatives has diminished from its peak in about mid-1950's to its very selective usages today<sup>5</sup>. Although generally very effective as "in-can" preservatives, their excellence tended to be exaggerated when good alternatives were not available; they do tend to discolour in the presence of sulfides and they possess poor heat stability. Their major advantage is their ability to kill enzymes which may cause thinning of paints. However, by reason of their high handling hazards, volatility, fish toxicity, non-biodegradability and accumulation in the environment, their use has diminished dramatically, without any obviously adverse effects on paint quality or manufacturing efficiency.

#### Chlorinated phenolics

This class of biocide has been used for many years, particularly as wood preservatives, and several fatalities have been recorded due to their use. The major cause of toxicity problems arises from the presence of small amounts of highly biologically-active chlorinated dioxins in the technical grade materials<sup>6</sup>. These dioxins are toxic in animal tests at levels of the order of a few micrograms/kg body weight. The recent

Seveso disaster in Italy arose from a dioxin leakage from a chemical plant<sup>7,8</sup>.

This class of biocide is, in general, difficult to biodegrade and there is increasing concern about the long-term ecological effects of chlorinated phenolics and their impurities. For example, their use as preservatives in off-shore oil drilling muds is currently being severely questioned, particularly since it has been shown that dioxins can accumulate in plankton<sup>9</sup>. Sweden has recently banned the use of phenols in wood finishes<sup>10</sup>.

Because they are volatile, chlorinated phenolics tend to possess poor heat stability and, therefore, cannot be added before a heating or drying process which would cause them to volatilise. They are better fungicides than bactericides and, invariably, they can be replaced with advantages in emulsion paints by safer alternative preservatives.

#### Formaldehyde and formaldehyde-donor biocides

Probably the largest number of industrial biocides is to be found in a group which relies on the activity of formaldehyde as an antimicrobial agent. Formaldehyde itself, and the so-called formaldehyde-donor or release biocides, are often very effective "in-can" preservatives when long-term protection is not essential. Since formaldehyde is volatile, the majority of this class of biocides possesses poor heat stability (they decompose at 40-60°C) and many of them react with proteins and become de-activated. They tend to have activity within a limited pH range, some being stable only under alkaline conditions and others stable only under acid conditions.

Their oral toxicity is low and is not normally a cause for concern. However, the inhalation toxicity of formaldehyde has led to a recommendation to reduce the Threshold Limit Value (Ceiling) to 1 ppm<sup>11,17</sup>. This figure may be exceeded by a factor of 30 if a paint containing 1200 ppm formaldehyde

is used to cover the walls and ceiling of a typical room ( $10 \times 10 \times 3 \text{ m}^3$ , assuming a paint coverage of  $16 \text{ m}^2/\text{l}$  and all the HCHO volatilises into the unventilated room). Professor Thiemann of Cologne University considers that levels as low as 0.1 ppm formaldehyde in the ceiling tiles of school-rooms could be detrimental to pupils' health<sup>12</sup>.

Because of occasional hypersensitivity reactions to formaldehyde, which prompted a regulation<sup>13</sup> in Japan to limit the residual formaldehyde in textile materials which may come into contact with skin, the use of formaldehyde-donor preservatives in Japan has greatly diminished.

Provided that adequate precautions are taken to prevent skin contact and inhalation when adding the biocide, there should be no problems in paint manufacture with this class of biocide. However, a possible occupational hazard to professional decorators is the repeated inhalation of volatiles released during the drying of the paint film, and it makes sense to reduce these to a minimum. Mercurial, phenolic and organotin biocides also give toxic vapours.

### Criteria for paint preservatives

*Ref. 14*

It is, therefore, not enough for a paint preservative simply to protect an emulsion paint from microbial attack at reasonable cost and produce no deleterious side-effects on the paint. Ideally they should also satisfy the following criteria:

- The biocide should be environmentally acceptable, i.e. it must show evidence of eventual biodegradation, so that it can be degraded by sewage systems and eventually in the environment, without future dangers by its accumulation.
- The biocide should be non-volatile and heat-stable and, therefore, avoid potential inhalation toxicity problems. The toxic effects from inhalation are generally significantly greater than the effects produced by ingestion of the same amount of the toxic substance. The inhalation toxicity aspects of toxic materials have largely been ignored until recently.
- The biocide should be relatively low in human toxicity effects (LD 50, dermal toxicity, skin effects, etc.).

One of the few biocides of proven cost/effectiveness, which satisfies these criteria, is 1,2 Benzisothiazolin-3-one (1,2 BIT). This unique biocide is one of the few preservatives available which is effective at levels similar to those of mercurials<sup>14</sup>, but can be tolerated by sewage systems, degrades to less toxic substances in the environment and does not appear to accumulate in fish tests (bluegill sunfish). Its heat stability and non-volatility is demonstrated by the fact that it can be added to starch slurries which are then drum-dried at temperatures up to  $150^\circ\text{C}$  without loss of antimicrobial activity. This stability ensures that the paint has a long-term protection, which is not achieved with many other preservatives. Non-volatility is also a safety factor in paint manufacture and eventual application of the paints. 1,2 BIT may cause skin sensitisation in some individuals and, as with other industrial biocides, precautions should be taken to avoid skin contact.

### Development of new biocides

*Ref. 16*

The stringency, complexity and increasing number of national controls on the use of toxic substances is obviously a deterrent to all but the most determined biocide producer. Because of the difficulty in predicting which molecular structures are

likely to be successful antimicrobials, the only approach is to screen very large numbers of novel chemicals; this is very much a needle-in-a-haystack approach and its success rate<sup>16</sup> is probably no more than 1 in 10,000. Hopefully, in the future, more scientific approaches to the biochemistry of antimicrobial activity will lead to more frequent success. However, the cost of development (say, £0.5-£1.0 million)<sup>16</sup> together with the added cost of toxicological and environmental testing (say, an additional £0.25 million to the development cost), makes it virtually impossible for any but the largest companies to participate. Because of this, it is increasingly likely in the future that only the larger biocide suppliers, who have access to in-house toxicity and environmental testing stations, will be able to satisfy the changing needs of the paint customer as well as complying with the national controls.

### Testing "in-can" preservatives for emulsion paints

The method used to evaluate and compare potential "in-can" paint preservatives will differ from one manufacturer to another, but the basic aims are to make the test conditions as close as possible to those obtained in practice, whilst, at the same time, keeping the test simple and as rapid as possible. Essentially the same test procedure is used for evaluating potential preservatives in a variety of substrates, such as aqueous emulsion paints, synthetic co-polymer lattices, adhesives, polishes, oil emulsions, etc. This test procedure is described below.

Representative 100 g samples of the test material are weighed into clean wide-neck screw capped bottles. Various concentrations of biocide are added, sufficient to give the required concentration in each sample. A control sample containing no added preservative should always be included.

To each sample approximately 1 ml of inoculum is added sufficient to give approximately  $100 \times 10^3$  organisms/g of sample. Preferably, the inoculum should consist of material similar to that being tested, which has been degraded by bacteria and contains a high level of viable organisms.

Alternatively, a mixed suspension of typical spoilage organisms may be used.

The inoculum is thoroughly mixed into the samples and 1 ml/g aliquots are taken immediately for counting. The samples are incubated at  $30^\circ\text{C}$  ( $\pm 2^\circ\text{C}$ ) and 1 ml/g aliquots taken at various intervals (normally 1 to 7 days) for determination of the viable organism numbers.

The counting method preferred is a standard dilution technique in which the 1 ml/g aliquot of sample is diluted in 9 ml of 0.9 per cent sodium chloride solution to give a 1:10 dilution. This 1:10 dilution is then diluted further (1 ml of 1:10 dilution plus 9 ml of 0.9 per cent NaCl solution) to give a 1:100 dilution. The procedure is repeated to give a range of dilutions, e.g. 1:10 ( $10^1$ ), 1:100 ( $10^2$ ), 1:1000 ( $10^3$ ), 1:10,000 ( $10^4$ ), 1:100,000 ( $10^5$ ), 1:1,000,000 ( $10^6$ ), etc. It is not normally necessary to prepare dilutions greater than  $10^7$ .

One ml of each dilution is then mixed with approximately 15 ml of a suitable media in a Petri dish. The organisms responsible for degradation in the can do not normally require specialised media and can be grown readily in standard Nutrient Agar media.

The Petri dishes are incubated for 72 hours at  $25^\circ\text{C}$ - $30^\circ\text{C}$ , when, the resultant colonies can be conveniently counted by



the naked eye. Results are expressed as number of colonies counted  $\times$  dilution factor, e.g.  $143 \times 10^4$ ,  $76 \times 10^6$ ,  $14 \times 10^1$ ,  $0 \times 10^1$  ( $<10$ /ml).

Two further inoculations are carried out and for the preservative to be considered effective it should eliminate contamination after at least 48 hours for each inoculation.

The control sample in all tests should indicate either:

- (a) That the control paint actively supports the growth of bacteria. In this case the counts would rise from approximately  $100 \times 10^3$  (original inoculation level to a level where degradation might be expected, e.g.  $>100 \times 10^5$ ) or,
- (b) That the paint supports the survival of bacteria. In this case the counts would remain at approximately the original level of inoculation.

The advantage of this method is that the full bacteriological picture can be obtained, indicating the susceptibility or otherwise of the paint system to microbiological attack and the effectiveness of different preservative conditions.

Typical results obtained from the above type of testing, using the counting method, could be represented as shown in Table 3.

Such results would indicate that:

- (a) The basic paint formulation without any added biocide is vulnerable to degradation by bacteria.

(b) The biocide system in use at 0.1 per cent provides satisfactory preservation, even against repeated gross contamination.

(c) Biocide *A*, initially giving acceptable results at 0.05 per cent, did not give satisfactory preservation after re-inoculation.

(d) Either Biocide *A* is unstable in paint systems, or dosages in excess of 0.05 per cent are required to provide protection against re-contamination.

(e) Biocide *B* provides adequate in-can preservation, even against gross re-contamination at a dosage rate of 0.04 per cent.

Providing that the cost-efficiency relationship in comparison to the biocide currently used is favourable, these results would be an encouraging basis for field trials with Biocide *B*.

The degree of contamination used for these tests is considered high in comparison to that normally encountered during manufacture. However, the ability of a biocide to provide satisfactory protection against this initial contamination and further high levels of re-contamination, is an indication of its activity in the long term against normal contamination.

An alternative method to the counting technique described above is to plate out a small loopful of each sample on to the surface of nutrient media, incubate and examine for bacterial growth. The results are expressed as "growth" or "no-growth",

Table 3

Sample	Organisms/ml or g after incubation at 25°C for				
	0 Hours	24 Hours	72 Hours	7 Days	14 Days
<i>PVA based paint containing:</i>					
0.05% Biocide <i>A</i>	$40 \times 10^4$	$<10$	$<10$	$<10$	$<10$
0.04% Biocide <i>A</i>	$25 \times 10^4$	$46 \times 10^1$	$17 \times 10^1$	$<10$	$<10$
0.03% Biocide <i>A</i>	$30 \times 10^4$	$20 \times 10^4$	$48 \times 10^4$	$110 \times 10^5$	$141 \times 10^5$
0.02% Biocide <i>A</i>	$62 \times 10^4$	$78 \times 10^4$	$135 \times 10^5$	$27 \times 10^6$	$107 \times 10^6$
0.05% Biocide <i>B</i>	$23 \times 10^4$	$<10$	$<10$	$<10$	$<10$
0.04% Biocide <i>B</i>	$82 \times 10^4$	$<10$	$<10$	$<10$	$<10$
0.03% Biocide <i>B</i>	$60 \times 10^4$	$18 \times 10^1$	$<10$	$<10$	$<10$
0.02% Biocide <i>B</i>	$57 \times 10^4$	$27 \times 10^2$	$95 \times 10^3$	$103 \times 10^4$	$40 \times 10^5$
Control— Containing no added biocide	$39 \times 10^4$	$11 \times 10^4$	$78 \times 10^5$	$193 \times 10^5$	$81 \times 10^6$
Control— Containing 0.1% biocide in use	$46 \times 10^4$	$<10$	$<10$	$<10$	$<10$
<i>After 1st Re-Inoculation</i>					
0.05% Biocide <i>A</i>	$83 \times 10^4$	$12 \times 10^1$	$11 \times 10^1$	$<10$	$<10$
0.04% Biocide <i>A</i>	$76 \times 10^4$	$55 \times 10^2$	$37 \times 10^3$	$21 \times 10^3$	$22 \times 10^4$
0.05% Biocide <i>B</i>	$92 \times 10^4$	$<10$	$<10$	$<10$	$<10$
0.04% Biocide <i>B</i>	$64 \times 10^4$	$<10$	$<10$	$<10$	$<10$
0.03% Biocide <i>B</i>	$70 \times 10^4$	$32 \times 10^1$	70	$<10$	$<10$
Control (0.1% biocide in use)	$58 \times 10^4$	$17 \times 10^1$	$<10$	$<10$	$<10$
<i>After 2nd Re-Inoculation</i>					
0.05% Biocide <i>A</i>	$95 \times 10^4$	$16 \times 10^2$	$103 \times 10^1$	20	$<10$
0.04% Biocide <i>A</i>	$127 \times 10^4$	$43 \times 10^4$	$90 \times 10^5$	$151 \times 10^5$	$18 \times 10^6$
0.05% Biocide <i>B</i>	$141 \times 10^4$	$<10$	$<10$	$<10$	$<10$
0.04% Biocide <i>B</i>	$107 \times 10^4$	$<10$	$<10$	$<10$	$<10$
0.03% Biocide <i>B</i>	$63 \times 10^4$	$77 \times 10^1$	$16 \times 10^1$	$<10$	$<10$
Control (0.1% biocide in use)	$88 \times 10^4$	$12 \times 10^1$	$<10$	$<10$	$<10$

or +, ++, +++, etc to indicate the abundance of growth. This method of determining surviving organisms is useful for paint formulations with a low susceptibility for bacterial degradation. It suffers, however, from major disadvantages:

- (i) It is difficult to determine the significant increases or decreases in viable organisms.
- (ii) The "carry over" of biocide in the sample interferes with growth and can lead to erroneous results.

It is not necessary for the biocide to kill all the organisms in any aqueous system within a few minutes to ensure satisfactory preservation over the long term. Provided that the cells are virtually eliminated within 24-72 hours following gross contamination, the biocide should give satisfactory results in practice.

In addition to possessing acceptable environmental and toxicological properties, and to providing protection according to the above test method at the reasonable cost, the selected preservative should also meet the following criteria:

- (1) It should present no corrosion problems in the can.
- (2) It should not discolour either immediately on addition to the paint or during storage in the can or in the dried paint film.
- (3) It should not give off objectionable odours.
- (4) It should be compatible with the paint system and remain stable and active for long periods in the can (e.g. 6-12 months).
- (5) It should be in an acceptable physical form, preferably liquid, to facilitate automatic handling techniques.
- (6) It should not be prone to the development of resistant strains.

## Conclusions

National safety regulations are being strengthened in most countries in order to protect individuals who come into contact with toxic substances and to minimise the long-term risk of the build-up of toxic residuals in the environment. In the short term, these controls will tend to prolong the life of various existing biocides which satisfy the criteria listed earlier.

In the longer term, some international harmonisation of the regulations is desirable if the development of more effective and safer preservatives is not to cease altogether.

[Received 17 November 1978]

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## Next month's issue

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

**Reflection measurements on synthetic silica products** by D. Koth and H. Ferch

**Avoiding paint failures by cohesion** by F. D. Timmins

**Accelerated weathering tests** by M. L. Ellinger

**Preparation and use of antifouling coatings based on tributyltin fluoride** by N. A. Ghanem and M. M. Abd El-Malek

## Correspondence

### BS 950: Part 1. Artificial Daylight for Colour Matching

Sir,

The above British Standard was published in 1967 and is based on extensive measurements of daylight made in Enfield (Middlesex), Rochester (New York) and Ottawa, the colour temperature selected being 6,500K.

Since then, fluorescent tubes conforming to the specification have been marketed under the name "Artificial Daylight" and widely used both for normal illumination and in colour matching cabinets.

The standard is now being revised and the committee responsible (LGL/9) would welcome any comments con-

cerning the suitability of "Artificial Daylight" tubes for illuminating objects of any kind for the purpose of visual colour matching or colour appraisal. Particularly welcome would be instances where the tubes have not proved entirely satisfactory as a substitute for natural daylight.

Observations should be sent to the secretary of the committee: Mr B. V. Stallworthy, British Standards Institution, 2 Park Street, London, W1A 2BS.

Yours faithfully,

K. McLAREN

(Chairman LGL/9 Committee)  
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February 1979

## Section Proceedings

### Hull

#### The safe use of solvents

The second ordinary meeting of the Hull Section was held at the George Hotel, Land of Green Ginger, Hull, on Monday 6 November 1978. Mr G. Hicks of Esso Chemicals Ltd presented his talk to 25 members and guests on "The safe use of solvents and the trend towards the development of low aromatic grades".

He first summarised in detail the regulations relating to hydrocarbon solvents, since the new legislation in this area needed to be clarified, particularly since the concern about air pollution, labelling requirements and toxicity had led to the widescale use of low aromatic solvent grades overseas, principally in the USA, France and Scandinavia.

The major questions raised were, whether the benefits of the low aromatic outweighed the problems and what sort of future there was for hydrocarbon solvents.

The vote of thanks was given by Mr P. Munn.

#### Self-adhesive labels

The third ordinary meeting in December was held at the Royal Station Hotel, Hull, when Mr R. Couch of Harlands of Hull Ltd, gave a talk entitled "The self-adhesive label, its manufacture and application".

Harlands of Hull, Ltd, was established in 1832, and began life printing pawn-tickets. Since then, the company has developed to one of the foremost manufacturers of printed self-adhesive labels and labelling systems in the country. Mr Couch outlined the stages used throughout the process, from the initial multicoating of the backing paper, through the "cutting" of the "coating" to give the label shape required, to the automatic application of the label on one of Harlands' machines.

Mr Couch amply demonstrated each section of his talk with practical examples of labels of different designs, shapes and printing methods. Harlands use letterpress, photogravure and flexographic inks, and are well advanced in UV curing with some IR curing systems being used.

The vote of thanks was given by Mr F. D. Robinson on behalf of the 35 members and guests who were present.

F.D.R.

### London

#### Permeability of paint films to chloride ions

The third evening technical meeting of the 1978/79 session was held at the "Princess Alice", Romford Road, E7 on Thursday 18 January 1979 when Mr A. Roberts, of Scientific Services Department of the CEGB, presented a paper on the "Permeability of paint films to chloride ions". Despite the bad weather and a train strike, 21 members and guests were present at the meeting which was chaired by Mr D. Bayliss.

The presentation was based on part of Mr Roberts' MSc thesis and described a technique for investigating the permeability of paint films to corrosive chloride ions.

Mr Roberts briefly discussed his literature survey into paint film permeability and then went on to describe the experimental procedure used to investigate the permeability of coal tar—epoxy/polyamide cured paints to radioactive chloride ions. The work was carried out on attached, rather than unattached, paint films and brushed, sprayed and doctor blade applied coatings were prepared on steel panels. Various, non-ideal conditions such as pre-aged (artificially) and precontaminated panels or pinholed films were included in the second stage of exposure of these panels to radioactive chloride ions.

The rate of uptake of chloride ions was determined by measurement of the radioactivity of the surface and the permeability measured by abrading the film to specific depths and re-measuring the radioactivity of the film.

Examination of the results indicated that doctor blade applied films exhibited little chloride ion penetration whereas sprayed panels exhibited significant levels of permeability. Brush applied panels were soft and abraded badly with the result that erroneous data was obtained.

The results indicated that penetration of the ions through the fissures and vacuoles in the paint film was the cause of the adverse results experienced with the spray applied panels. Mr Roberts commented that the work carried out only superficially examined the potential of the technique to the investigation of paint film permeability and that much more would need to be done to establish it.

After the discussion period, Mr Bayliss proposed a vote of thanks to the lecturer. It is hoped that an extended version of the lecture will be published in the *Journal*.

A.J.N.

# Manchester

## Titanium dioxide in coloured stoving enamels

Twenty-three members and visitors braved a petrol famine plus Arctic weather to hear Dr R. Schwindt of Kronos Titan GmbH, Leverkusen, W. Germany at the Woodcourt Hotel, Sale, on Monday 8 January 1979 at 6.30 p.m.

Speaking in excellent English, Dr Schwindt stated his lecture was a condensation of a seven-year exposure programme at Leverkusen, weathering and durability being the lecturer's main area of work. The lecture results were based on the use of 19 grades of titanium dioxide, 13 coloured pigments, 4 depth of shade—1/200, 1/25, 1/3, 1/1 and related BASF colour values plus calculated scattering coefficients. The binder used was a special fatty acid/dehydrated castor oil/melamine formaldehyde resin combination which was crosslinked by stoving at 125°C for 30 minutes. More than 1,000 aluminium panels were used, preparation time was 2 years and the exposure results included the following tests measured at 4 monthly intervals:

- (1) Colour—Tri-filter Elrepho Instrument—Zeiss
- (2) Gloss—45° Gloss Meter—Lange
- (3) Discolouration—A.N.S. Formula
- (4) Chalking—Kempf method.

Dr Schwindt used many slides which illustrated both the numerical data obtained and actual colour photographs of exposed panels. His conclusions were many, but included reference to the high chalking rate of quinacridone reds, general instability of red pigments combined with high ratios of titanium dioxide and the general lack of influence of depth of shade values with all the pigments tested.

With reference to the basic question of reaction between coloured pigments and TiO<sub>2</sub>, Dr Schwindt stated that the only pigment to give a positive answer was the violet type.

This 60 minute lecture was extended to 90 minutes with a very lively question time in which Dr Schwindt stated that a typical pigment was phthalocyanine green; the statistics presented by the lecturer were then fully discussed and finally the vote of thanks proposed by F. B. Windsor was warmly received.

Dr Schwindt has since stated that his lecture will be presented at Fatipec in September 1979.

## Prohesion PoP and new environmental tests

This lecture was presented by Frank Timmins, BR retired, at the Manchester Literary and Philosophical Society on Friday 8 December 1978 to 50 members and visitors. Sporting an Alloprene tie and with a return (train) ticket to Derby in his top pocket, Frank proceeded to both educate and entertain for the next 90 minutes in his well-known controversial but serious approach to the lecture topic. He defined "Prohesion" as protection in relation to adhesion and "PoP" as "Prediction of Performance". His 48 years career with BR Surface Coatings Laboratory had obviously influenced his thinking on performance claims made by paint manufacturers and the need to re-examine established testing methods.

Reference to the latter was in the form of modifying a weatherometer by removal of the arc lamp and conversion

to a salt spray apparatus using a test solution based on aqueous ammonium sulfate-sodium chloride, cycled testing, etc.

The preferred substrate was blast-cleaned steel; choosing the correct corrosion inhibiting pigment was fully discussed. Mr Timmins is not alone in his claim that zinc phosphate is inactive in preventing corrosion at the substrate, but it has other desirable properties related to shape, particle size and toxicity. Using many coloured slides and actual test panels the lecturer illustrated the efficiency of a zinc chromate/zinc phosphate pigment mixture in primers and demonstrated that corrosion failure of applied protective coatings was basically a function of adhesion failure.

Further subjects discussed were primers for rusty steel, metal sprayed steel, replacement of zinc chromate in relation to toxicity and last, but not least, water borne protection systems.

After a question period Elizabeth Stretton proposed a vote of thanks which was enthusiastically received.

F.B.W./H.P.O.

# Newcastle

## Paint industry profitability

The first meeting of the 1979 session was held at St Mary's College, Durham on 4 January, when members and guests braved the Arctic conditions to hear a paper entitled "Profitability in the paint industry". The speaker was Mr C. C. Day, Accounts and Finance Manager of I.C.I. Paints Division, who had made the long journey north from Oxfordshire in appalling conditions. Using examples from published literature and his own research, the speaker demonstrated the variability in the measuring of profit and discussed the main factors affecting profit as described in company balance sheets. The main factors included economic conditions, company accounting policy, methods of finance and "unusual" items. Various methods of defining profitability and the effects of market share, selling price and raw materials costs were described and discussed by the lecturer. Mr Day concluded that whilst profit appeared to be high at 10 per cent on sales income, the profitability of the paint industry was not high enough.

Following a discussion period and a vote of thanks by the Chairman, Mr F. Hellens, the members partook of the buffet meal and then proceeded homewards in freezing fog.

T.H.

# Midlands

## The protection of structures involved in North Sea oil operations

The Midlands Section Annual Dinner Lecture, a joint meeting of the Midland Section and the Trent Valley Branch, was held at the Birmingham Chamber of Commerce on 19 January when Mr F. Palmer of British Petroleum Limited, in conjunction with Mr J. Bourne of Mebon Ltd, delivered a lecture with the above title.

Mr Palmer outlined the practical problems involved with preparation of the substrates, coating and off-shore maintenance of oil platforms to prevent corrosion. Blast cleaning

to SA3 followed by zinc silicate primer and either vinyl or chlorinated rubber finishing coats are usually employed. In the "splash zone", due to the intensive buffeting by waves, a tougher coating, such as epoxy coal tar, is needed. About 15,000 gallons of paint are used on each platform. Areas which still provide problems are coating hot risers, non-slip deck coatings and painting wet surfaces.

Mr J. Bourne of Mebon Ltd offered the paint manufacturers' viewpoint. The new Muchison platform, 866 feet tall, will cost about £800 million and use £0.5 million of paint. Mr Bourne talked about coatings based on urethane epoxy pitch which will tolerate damp conditions and sub-zero temperatures, high build epoxies with glass flake which at 1000 microns are used in the splash zone, but reiterated the point made by Mr Palmer that zinc based primers and zinc silicates in particular still predominate. Recently urethane/epoxy zinc primers have been investigated.

The duet prompted many questions from members who had braved ice and snow to attend but seemed in no hurry to leave.

A vote of thanks was given by Mr S. Hawley.

R.K.C.

## Ontario

### Drier technology

A meeting at the Ontario Section was held on 15 November 1978 at the Constellation Hotel, Toronto.

The subject was, "A review of current drier technology" given by Mr L. Campey of Nuodex Canada Limited.

The subject of current drier selection techniques was discussed with special emphasis on ways to extend existing cobalt supplies due to current world wide supply difficulties.

Lead free drier systems were also discussed.

After a lively question period the meeting expressed their thanks to Mr Campey in the usual manner.

D.S.W.

## Thames Valley

### Coatings for wood

A one-day meeting was held at the Princes Risborough Laboratory of the Building Research Establishment on 12 October 1978, with "Coatings for wood" as the subject. The meeting was attended by 72 delegates. The Chairman, Mr G. V. G. Hill, welcomed the delegates, particularly those from Germany, Belgium, Eire and Canada and then introduced Dr R. Miller, Head of the Finishes Section of Princes Risborough Laboratory, who pointed out the economic importance of wood. Although wood had many desirable properties, problems were encountered when it was coated due to its porosity, dimensional instability, photodegradability and susceptibility to attack by insects and micro-organisms. Dr Miller then reviewed the subjects to be covered in the lectures to follow against the background of changing requirements and developments in technology.

Mr A. J. Sparkes of the Furniture Industry Research Association presented a paper on the cracking of finishes on

birch plywood materials. He described the effect of various factors such as substrate material, finishing treatment and exposure conditions on the cracking characteristics of birch plywood. Lathe checks were an inherent defect of rotary cut veneers and could lead to surface checking when plywood or blockboards made from large movement timbers, such as birch or beech, were painted and then used in a dry environment. Apart from controlling the moisture content of the plywood at the time of painting, the incidence of cracking could be minimised by the choice of lacquer or by bonding a paper overlay to the plywood prior to painting. The effects of board construction on cracking were also described.

In the discussion following this paper, questions were asked about lacquer penetration and on the effect of lacquering both sides of plywood. An over-riding effect was the original tree diameter. The dangers of getting erroneous results by accelerating the testing of the crack resistance of lacquers were also described.



Dr R. Miller of Princes Risborough Laboratory giving the introductory address at the 'Coatings for wood' one-day meeting

Dr R. J. Tillott of Rentokil Limited gave a paper on flame retardant coatings for timber. Growing losses due to fire were making the use of these coatings increasingly important. The two main types of coating were based either on intumescent materials or on antimony oxide. All flame retardant coatings were tested firstly by the manufacturer during their development and, later, by independent laboratories and authorities before becoming generally acceptable for use. Tests included those normally carried out on conventional paints, such as covering power, washability, pot-life etc, as well as tests for flame retardance. The results of fire tests to BS 746 led to the classification of treated timber as Class 1 or Class 0. Such classifications were necessary for compliance with UK Building Regulations and the Fire Precautions Act, stimulating a demand for successful flame retardant treatments.

A lively discussion followed on the toxicity of such treatments and the variation in test methods for flame retardance between different countries. The generation of smoke was a further hazard, necessitating agreement on a reliable test method. The durability and washability of flame retardant coatings had been improved in recent years, whilst compatibility with other coatings applied under or on top of the flame retardant finishes was generally satisfactory, performance being maintained, except over exceptionally thick layers.

Mr P. Dufour of UCB SA, Belgium, contributed a paper on

UV-cured acrylic coatings for wood. The essential properties of varnishes based on unsaturated acrylics were summarised and their different applications in modern wood finishing were reviewed. A tentative explanation of their present success in France, but not in other European countries, was given. The cost of finishing veneers with varnishes based on unsaturated acrylics was not considered to exceed finishing with unsaturated polyesters dissolved in styrene, because of lower energy requirements and film build considerations. Mr Dufour believed that advantages of higher productivity and low investment with the acrylates would procure a growing share of the market in future. The ensuing discussion showed that UK manufacturers were concerned about skin irritation from certain monomers, in spite of a lack of such incidents in France. There appeared also to be a difference in the minimum finish acceptable in France as compared to the UK. A question on different makes of lamp for curing produced the answer that lamps of the same wattage were equally effective but the design of the reflector could introduce advantages for particular end-uses.

Mr G. Keith of Rohm and Haas (UK) Limited presented a paper on acrylic systems for wood. Water-borne coatings were expected to continue to make inroads into markets once dominated by solvent-borne systems. Projections for the future showed that emulsion paints would continue to grow at the expense of alkyds. One such area where this was already happening was decorative coatings for wood. There was now an established British Standard for water thinned wood primers (BS5082) and Mr Keith covered the development of acrylic polymers for this application with demonstrations of how 100 per cent acrylic wood primers filled this role. Recent developments in acrylic emulsion polymer technology allowed levels of film build, flow and gloss holdout to be obtained that were not previously possible in undercoats. Quick-drying, easy to use water-borne undercoats could now be formulated which offered significant cost savings to trade users of such products. To complete the acrylic coating system for wood, developments in gloss emulsion paints were described, with demonstrations of the current state of progress.

Topics raised during the discussion were the toxicity of some coalescing solvents and the effect of low temperature and high humidity on emulsion systems during application. In reply to another question, Mr Keith stated that significant advances had been made in formulating block-resistant acrylic primers for industrially applied joinery finishes. Recent developments had also helped to bring the film build of acrylic emulsion paints nearer that of alkyds.

The first part of the paper giving a continental viewpoint of wood stains by Dr R. Henkler of Hermann Wiederhold was presented by Mr J. Graystone of ICI owing to the delayed arrival of Dr Henkler's plane. However, the author arrived in time to conclude the presentation and to conduct a lively discussion period.

Dr Henkler said that wood stainers were becoming increasingly important, their function being to protect and emphasise the natural beauty of wood. To fulfil these functions they had to protect against photochemical attack by UV light and to suppress deformation by controlling the water permeability. Three types of stainer were recognised. Firstly, "impregnating", the main function being chemical preservation. Secondly, "thin coating", to achieve a decorative effect at low cost. Thirdly, "thick coating", giving higher UV protection and the controlled release of water vapour. The desired protection must be weighed against the properties of the stainers, for no stainer was ideal. Optimum protection could be achieved only with a stainer combination. For

successful application many factors had to be considered. These included the type of construction and type of wood and the colour of stainer specified. The climatic conditions at the site were important and also the moisture content of the wood when coated. Any wood defects could affect the performance of the coating. So too could unsuitable elements in the construction, such as putties and sealants in window frames. Provision had to be made for protection against fungi in the surface layer of the wood.

During the discussion it emerged that the quality of timber in the UK was worse than in Germany, but restrictions on the use of pentachlorophenol and lindane in Germany led Dr Henkler to suggest that where chemical protection was necessary, it should be specified by the architect and carried out by the manufacturer, using a high pressure process to locate the chemicals in the heart of the wood. In reply to a question on organic UV absorbers in clear coatings for wood, Dr Henkler stated that he did not know of any absorber which was effective in varnishes without producing undesirable colour effects. For wood stains, an interval system of maintenance involving inspection at yearly intervals and repair where necessary was recommended for prolonged protection. Problems that could arise due to incompatibility between stains and water-soluble impregnating materials included colour changes and delayed drying effects, *eg* with pentachlorophenol. Sometimes adhesion problems could occur. There was a balance to be found between the moisture in the wood and the water permeability of the applied material.

The Chairman concluded the meeting by thanking all the lecturers for their contributions and the Princes Risborough Laboratory for the use of their excellent Lecture Theatre and other facilities.

G.V.G.H.

## Transvaal

### Paint industry—Where are we going?

At a meeting of the Transvaal Section held on Thursday 30 November at Prolux Paint Holdings, Alrode, Mr K. Dienst presented a lecture with the above title to 49 Members and guests.

This extremely well formulated talk, was opened with the present day and future research and development requirements and dealt in some detail with future trends. Paint manufacturers were warned of complacency since the future could well bring revolutionary marketing methods such as intermediates being supplied to end users in the building block system. A note of warning was sounded about too heavy reliance on coal and oil as basic raw materials, and it was suggested that the abundant element silicon might hold considerable future potential. Equally, sugar is seen as a source of carbon for organic synthesis.

Mr Dienst ended his talk on an optimistic note stating that whilst at present the South African paint industry serves a mere 8 million, the African sub-continent offers a potential of some 40–50 million people which, once political problems have been ironed out, would offer this industry an enormous expansion possibility.

Lively contributions were made by Mr J. Muller of Watermeyer Legg, Consulting Engineers, Mr G. Bennet, representing the end-users' standpoint, Mr H. Bosman speaking for OCCA and Mr N. Venus of Plascon Evans. Further contributions were made by Mr Pienaar, Mr Loewensohn, and Mr Edwards.

# Information Received

## Enlarged paint plant

Blundell-Permoglaize have announced that over £750,000 is being spent on its Hull decorative paint manufacturing plant. The company is enlarging its site area, increasing the size of its roller manufacturing unit, installing a new resin plant and generally expanding its production and distribution facilities.

## Mobile automatic make-up system

Allied Colloids Ltd has introduced a mobile automatic make-up system for the evaluation of polymers for enhanced solid/liquid separation. This system enables users of flocculant, drainage and retention aids to take full advantage of the polyacrylamide water soluble polymers produced by the company. The mobile system complements the existing preparation equipment and reduces response time for mill trials.

## Microprocessor applications consultancy

Ferranti Computer Systems Ltd has introduced a Microprocessor Applications Consultancy, based on twenty years of wide experience in design, manufacture, installation and commissioning of real time computer based systems, to advise companies on their present systems and future requirements.

## New company formed

Albright & Wilson has formed a new company, Albright & Wilson Intertrade Ltd, in recognition of the importance of its continually growing business with Eastern European socialist countries and to facilitate trade with them.

## UK Agency

F. T. Scientific Instruments Ltd have been appointed as UK distributors for C. Gerhardt of West Germany, one of Europe's leading manufacturers of laboratory equipment, specialising in the field of nitrogen determination, automatic steam distillation apparatus and conventional Kjeldahl systems.

## New products

### New modular spray system

A highly flexible system for the airless spray application of solvent-free coating materials has been developed by Graco. Called the Modular Fixed Ratio Hydra-Cat the new system is air-powered and offers a wide choice of delivery volumes and pressures and a range of fixed mix ratios from 1:1 to 4:1. Typical uses are in the coating of large structures such as ship's hulls, docks, storage tanks, etc.

### New masonry paint colours

Eleven new colours have been included in the revised Micatex Masonry Paint colour range introduced by Blundell-Permoglaize. The new colour range, totalling 24 colours, is the result of a nationwide research study into attitudes to colour.

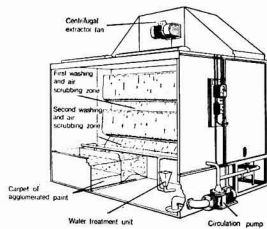
### Automatic solvent cleaner

Newgate Simms Ltd has introduced a new automatic solvent cleaner which has been

designed to reclaim most solvents commonly used in the plastic, paint, printing and plating industries. The Newgate Simms P40 unit operates by evaporating contaminated solvents with a 4.8kW electrical oil heater and then condensing the evaporated solvent in an air cooled condenser. A water cooled condenser is also available where high ambient temperatures prevail.

## New spray booth

Kremlin Spray Painting Equipment Ltd has introduced the Kremlin Washair design booth which incorporates a unique distributed extraction system operating along the face of the booth canopy, which prevents overspray from returning, thus virtually eliminating paint fog.



The Kremlin Washair spray booth

## New conveyor cleaner

Alvax Designs Ltd has introduced a new conveyor cleaner which is claimed to eliminate the problems of container contamination caused by product spillage or dirt build-up on slotband conveyors.

## Powder coatings leveller

A new levelling agent for powder coatings, Borchigol PK 800, is now being marketed in the UK by the Stratton Chemicals division of Chemitrade. PK 800 is a free-flowing, silicone-free, powder, designed to be used in formulations based on epoxy or polyester resins.

## Diaphragm pumps

Charles S. Madan and Company Ltd have increased their range of air powered double differential diaphragm pumps to satisfy increased demands from industry. The pumps are now available in three forms, general duty, manufactured from aluminium, with a nitrile diaphragm and two chemical models which are both fitted with viton diaphragms. The chemical models, available in stainless steel or aluminium, are capable of withstanding many corrosive compounds.

## Laboratory and industrial scales

Industrial Scales (Kent) Ltd has recently introduced the Weightech range of bench mounted platform scales designed for use in laboratories and industrial applications. The balances incorporate a high-precision load cell mounted in a robust cast aluminium cast. The read out is in the form of a digital display.

## High vacuum pump fluid

Ion Tech Lid has announced the introduction of Invoil 30, a doubly distilled hydrocarbon oil containing a strong antioxidant, which can be used in diffusion pumps to give a good high vacuum whilst possessing excellent decomposition resistance at high pressures and elevated operating temperatures. Invoil 30 is compatible with all oil diffusion pumps and possesses low back streaming and creep characteristics.

## New aluminium paste

A new aluminium paste that resists gassing in waterborne coatings is now being produced by Claremont Polychemical Corporation, USA. Excellent self stability has been obtained in a variety of acrylic formulations stored at room and elevated temperatures over extended periods of time. The new product, known as "Claribrite" Aluminium Paste XP-24050, contains 60 per cent aluminium and is easily added to aqueous formulations by simple mixing.

## Increased metering pump range

Extreme corrosion resistance characterises the material combination of borosilicate glass "Duran" and PTFE, which has been used to construct the increased range of metering pumps available from the Schott Group. Fourteen types of metering pumps are now available covering capacities of between 40 and 1900 litres per hour, and have been designed for operating temperatures up to 100°C.

## New centrifugal pumps

Stuart Turner Ltd has introduced a new centrifugal pump which has been developed to operate continuously with no routine maintenance after installation. The new model, the RG50, is designed for a wide range of applications within the industry and is suitable for pumping water, light oils, mild solvents and chemicals and a variety of other liquids on an industrial level.

## Conferences, courses, etc.

### British Standards

The British Standards Institution has available *BS 5598: Part 6: 1979* Methods of sampling and test for halogenated hydrocarbons. Part 6 determination of acidity of fluorochlorinated hydrocarbons, and *BS 662: Part 3: 1979* Carbon disulphide for industrial use. Part 3 Additional methods of test.

### Emulsion polymerisation course

The Department of Chemical Engineering, Lehigh University, USA is organising a one week short course on "Advances in emulsion polymerization and latex technology", to be held from 4-8 June 1979.

### Products leaflet

Albright & Wilson Ltd have published an eight page leaflet itemising their products for industry in the South East Asian markets, listing details of the company's 25 manufacturing facilities and marketing organisations throughout the region.



# OCCA-31 Exhibition

Alexandra Palace, London, 3-6 April 1979

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

## EXHIBITION PREVIEW

The Exhibition Committee is pleased to welcome to the OCCA-31 Exhibition 112 organisations, representing the United Kingdom and fourteen overseas countries:

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

It is particularly pleasing to note the return of many exhibitors from previous years, as well as new exhibitors.

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

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

### Theme of the Exhibition

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

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

### Dates and times

The thirty-first annual Exhibition organised by the Association, OCCA-31, will be held at Alexandra Palace, London on the following dates:

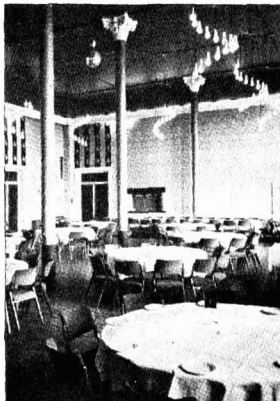
Tuesday 3 April .. 09.30 to 17.30 hrs.  
Wednesday 4 April .. 09.30 to 17.30 hrs.  
Thursday 5 April .. 09.30 to 17.30 hrs.  
Friday 6 April .. 09.30 to 16.00 hrs.

### Visits by principal officers of other societies

The Exhibition Committee has extended an invitation to the principal officers of many technical societies, research associations and government departments, to a private luncheon at Alexandra Palace on the opening day (Tuesday 3 April). The Committee will be conducting the party around the Exhibition and visiting the stands during the afternoon.

### Facilities at Alexandra Palace

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



The Edinburgh Room at Alexandra Palace, which will be open daily for luncheon

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

### Improvements at Alexandra Palace

In July 1978 work was started on a comprehensive refurbishment of the facilities at Alexandra Palace, and much of this has now been completed. The floor of the Great Hall, in which the Exhibition is held, has been resurfaced and the walls and pillars have been redecorated. The West Corridor and the restaurants and bars have also been completely refurbished, and the work to the exterior of the building is scheduled to be completed by the time of the Exhibition.

### Refreshments on stands

Exhibitors were allowed for the first time in 1977 to serve alcoholic refreshments on their stands and this innovation will be continued at OCCA-31. Many exhibitors expressed their appreciation of this as it allowed their personnel to remain on the stands with visitors for the whole period of the Exhibition.

### Information in foreign languages

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

### Official Guide

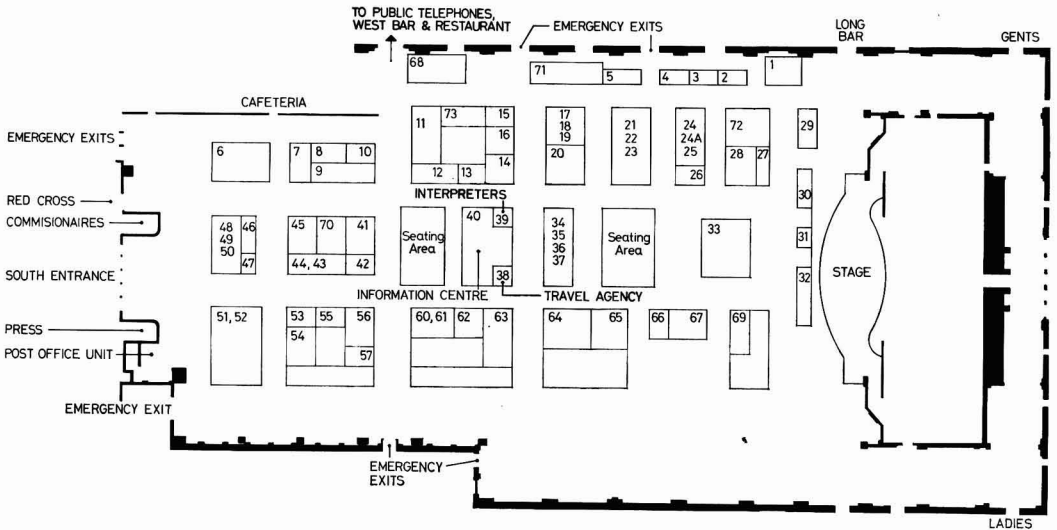
The Official Guide to the Exhibition has now been published and dispatched to all members of the Association and those requesting copies as a result of the Association's widespread publicity.

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

Copies of the Official Guide (including season admission ticket) are available at £2.00 (prepayment only) from the Association's offices and they will also be available for purchase at the entrance to the Exhibition Hall.



# Plan of the Exhibition Hall at Alexandra Palace



Diagrammatical representation only 16.2.79. Any later allocations to be shown in leaflets available at the Exhibition Hall.

## Exhibitors at OCCA-31

For position of Stand, see plan of Exhibition Hall above

For alphabetical list of Exhibitors, see Analysis of Exhibits table on pages 113, 114 and 115

**Stand**

- 1 Macbeth Color & Photometry of Kollmorgen (UK) Ltd
- 2 A. Strazdins Pty. Ltd
- 3 Joyce-Loebl Ltd
- 4 Polymers Paint & Colour Journal
- 5 Technology Marketing Corporation
- 6 Synres International NV
- 7 Roban Engineering Ltd
- 8 Wheatland Journals Ltd
- 9 Contraves Industrial Products Ltd
- 10 Libra Chemicals Ltd
- 11 OBS Machines Ltd
- 12 Elcometer Instruments Ltd
- 13 Sub-Tropical Testing Service Inc.
- 14 R. K. Print-Coat Instruments Ltd
- 15 Silberline Ltd
- 16 Society of Dyers & Colourists
- 17 G. J. Erlich Ltd
- 18 Molteni (UK) Ltd
- 19 Alfred Karcher GmbH & Co.
- 20 IBM United Kingdom Ltd
- 21 Cornelius Chemical Co
- 22 Kemira Oy
- 23 Industrial Colours Ltd
- 24 KWR Chemicals Ltd
- 24A Ludwig Schwerdtel GmbH
- 25 Draiswerke GmbH

**Stand**

- 26 Microscal Ltd
- 27 Italtinto Industria Vernici srl
- 28 Industrial Dispersions Ltd
- 29 Diano Corporation
- 30 Baird & Tatlock (London) Ltd
- 31 Allunga Exposure Laboratory
- 32 John Godrich
- 33 Montedison Group
- 34 K & K Greeff Industrial Chemicals Ltd
- 35 Glychem International Ltd
- 36 Dow Chemical Co
- 37 Kirklees Chemicals Ltd
- 38 Mark Allen Travel Agency
- 39 Interpreters
- 40 OCCA Information Centre
- 41 Health & Safety Executive
- 42 Millroom Accessories & Chemicals Ltd
- 43 Samuel Banner & Co Ltd
- 44 IMC Chemie GmbH
- 45 MSE Scientific Instruments
- 46 Ferranti Instrumentation Ltd
- 47 Pye Unicam Ltd
- 48 Marchant Brothers Ltd
- 49 Veb Kombinat Nagema
- 50 Netzsch Feinmahltechnik GmbH
- 51 Cox's Machinery Ltd
- 52 T.K. Vibropower Ltd

**Stand**

53	Paintmakers Association of Great Britain Ltd
54	Instrumental Colour Systems Ltd
55	FECO
56	Ciech—Import & Export of Chemicals Ltd
57	Q-Panel Co
60	Diap A/S
61	Herbert Smith & Co Grinding Ltd
62	Paint Research Association
63	Glen Creston Machinery Ltd
64	Chemolimpex

**Stand**

65	Tiszamenti Vegyimuvek
66	Eiger Engineering Ltd
67	Porter Chadburn (Plastics) Ltd
68	Westlairs Ltd
69	Winter Oy
70	Werner & Pfleiderer (UK) Ltd
71	Mastermix Engineering Co Ltd
72	Torrance & Sons Ltd
73	R. Jackson Wardle

In addition to the Exhibitors listed above, reference is also made in the Official Guide to the following companies whose products are also on show:

**Stand**

33	ACNA
68	Atlas Electric Devices Co
43	BASF
63	Willy A. Bachofen
30	Colora
9	Contraves AG
56	Daltrade Ltd
21	Daniel
21	Dapro
30	Dow Corning
12	Ericksen GmbH
10	Filter Specialists Inc.
23	Flare
12, 68	Gardner
17	Ge-Halin
45	Haake
43	Haltermann
21	Hilton-Davis
33	Hispania ACNA
30	Hopkin & Williams Ltd
65	ICI Ltd

**Stand**

44	International Minerals & Chemicals Corp.
68	H.G. Koehler KG
49	Maschinenfabrik Heidenau
21	Mearl
33	Wm., J. MacNab & Sales Ltd
11	Oliver & Batlle
32	Original Hanau Quartzlampen GmbH
21	Oulu
43	PPG Industries Inc.
4	Portcullis Press
67	Porter Lancaster Ltd
33	ROL
68	Research Inc.
21	Rhoem GmbH
61	Rio Beer
33	SCM Schelde Chemische Maatschappij
11	Ateliers Sussmeyer
61	Sweco
12	Teledyne Taber
11	J. De Vree

**Banking Services**

There will be no mobile Bank unit at Alexandra Palace this year but there are several Bank branches within easy walking distance of the Exhibition and these are as follows:

Midland Bank, 171 Priory Road, London, N.8

National Westminster Bank, 348 Muswell Hill Broadway, London, N.10

National Westminster Bank, 190 Muswell Hill Broadway, London, N.10

Reference should be made to the map, which shows the locality.

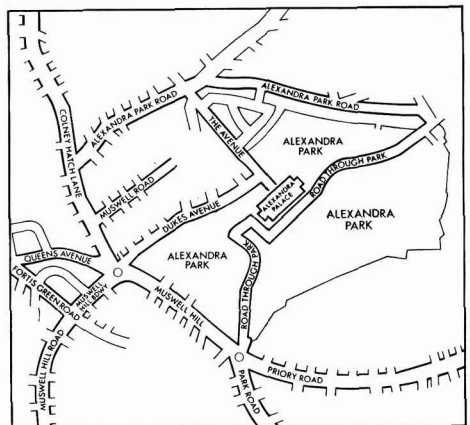
**Alexandra Park and locality**

There are adequate car parking facilities available at Alexandra Palace. Visitors travelling by road may consult the simplified diagram on page 123 showing the approach roads from central London and the Motorways, and the enlargement, right, of the area around Alexandra Park. The entrance through Dukes Avenue is for *pedestrians only*.

Visitors are reminded that the extension of the Piccadilly Underground line to the Heathrow Central Terminal at the airport has now been opened, so that those arriving at the airport can now board an Underground train within the

passenger complex. Trains will be running at approximately four minute intervals during peak hours, and there is increased room in the compartments for travellers with luggage.

Those travelling to the Exhibition by the Underground system should leave the Piccadilly Line at Wood Green station, from which point the Association will again be running a free bus shuttle service to and from the Exhibition.



### Stand telephone numbers

Many Exhibitors have applied to the Post Office for telephones to be connected to their Stand for use during the period of the Exhibition. A complete list (including late allocations made after the "Official Guide" went to press) is given below, but it is emphasised that these numbers are for use during the opening hours of the Exhibition only.

Stand	Exhibitor	Stand telephone number
64	Chemolimpex	01-883 2699
56	Ciech—Import & Export of Chemicals Ltd	01-883 2545
36	Dow Chemical Co.	01-883 1999
25	Draiswerke GmbH	01-883 2399
17	Erich, G. J., Ltd	01-883 2548
46	Ferranti Ltd	01-883 0745
63	Glen Creston Machines Ltd	01-883 0087
35	Glychem International Ltd	01-883 1999
41	Health & Safety Executive	01-883 0240
20	IBM (U.K.) Ltd	01-883 2136
44	IMC Chemie GmbH	01-883 0932
28	Industrial Dispersions Ltd	01-883 0120
54	Instrumental Colour Systems Ltd	01-883 0815
34	K & K Greeff Industrial Chemicals Ltd	01-883 1999
24	K.W.R. Chemicals Ltd	01-883 2399
19	Karcher, Alfred, GmbH & Co.	01-883 2548
37	Kirklees Chemicals Ltd	01-883 1999
1	Macbeth Division Kollmorgen (UK) Ltd	01-883 0458

Stand	Exhibitor	Stand telephone number
48	Marchant Bros. Ltd	01-883 2110
38	Mark Allen Travel Agency	01-883 1730
42	Millroom Accessories & Chemicals Ltd	01-883 0680
18	Molteni (UK) Ltd	01-883 2548
33	Montedison Group	01-883 2899
49	Nagama, Veb Kombinat	01-883 2110
50	Netzsch Feinmahltechnik GmbH	01-883 2110
40	OCCA Information Centre	01-883 1531
4	Polymers Paint & Colour Journal	01-883 2005
67	Porter Chadburn (Plastics) Ltd	01-883 1059
14	R.K. Print-Coat Instruments Ltd	01-883 1161
7	Roban Engineering Ltd	01-883 1363
24A	Schwerdtel GmbH	01-883 2399
15	Silberline Ltd	01-883 2240
65	Tiszamenti Vegyimuvek	01-883 2699
72	Torrance & Sons Ltd	01-883 2788

### Analysis of Exhibits

Stand	Exhibitor	Resins	Extenders, fillers, matting agents	Pigments	Additives, driers, surfactants etc.	Chemical intermediates	Manufacturing equipment, drums etc.	Laboratory apparatus and testing equipment	Miscellaneous
31	Allunga Exposure Laboratory .. ..								Exposure services
30	Baird & Tatlock (London) Ltd. .. ..							•	Silicones
43	Banner, Samuel, & Co. Ltd. .. ..				•	•			Solvents
64	Chemolimpex .. .. .	•				•			
56	Ciech—Import & Export of Chemicals Ltd.			•		•			
9	Contraves Industrial Products Ltd. ..							•	
21	Cornelius Chemical Co. .. .. .	•	•	•	•				Solvents
51	Cox's Machinery Ltd. .. .. .						•		
60	Diaf A/S .. .. .						•	•	
29	Diano Corporation .. .. .							•	
36	Dow Chemical Co. .. .. .	•	•	•	•				
25	Draiswerke GmbH .. .. .						•		
12	Elcometer Instruments Ltd. .. .. .							•	
66	Eiger Engineering Ltd. .. .. .						•	•	
17	Erich, G. J., Ltd .. .. .						•	•	
55	FECO .. .. .						•		Handling systems
46	Ferranti Instrumentation Ltd .. .. .							•	
63	Glen Creston Machinery Ltd .. .. .						•	•	
35	Glychem International Ltd .. .. .					•			
32	Godrich, John .. .. .						•	•	
41	Health & Safety Executive .. .. .								Technical services

## Analysis of Exhibits—continued

Stand	Exhibitor	Resins	Extenders, fillers, matting agents	Pigments	Additives, driers, surfactants etc.	Chemical intermediates	Manufacturing equipment, drums etc.	Laboratory apparatus and testing equipment	Miscellaneous
20	IBM United Kingdom Ltd .. ..							•	
44	IMC Chemie GmbH .. ..				•				
23	Industrial Colours Ltd. .. ..			•					
28	Industrial Dispersions Ltd .. ..			•					
54	Instrumental Colour Systems Ltd. ..							•	
27	Italtinto Industria Vernici srl .. ..								Colour dispensers
3	Joyce-Loebl Ltd .. ..							•	
34	K & K Greeff Industrial Chemicals Ltd ..	•		•	•				
24	KWR Chemicals Ltd .. ..						•		
19	Karcher, Alfred, GmbH & Co. .. ..						•		
22	Kemira Oy .. ..			•					
37	Kirklees Chemicals Ltd .. ..	•	•	•	•				
10	Libra Chemicals Ltd .. ..						•		
45	MSE Scientific Instruments .. ..							•	
1	Macbeth Color & Photometry Division of Kollmorgen (U.K.) Ltd .. ..							•	Standards
48	Marchant Brothers Ltd. .. ..						•		
71	Mastermix Engineering Co. Ltd. .. ..						•		
26	Microscal Ltd .. ..							•	
42	Millroom Accessories & Chemicals Ltd ..						•	•	
18	Molteni (U.K.) Ltd .. ..						•	•	
33	Montedison Group .. ..	•		•		•			
49	Nagama, Veb Kombinat .. ..						•		
50	Netzsch Feinmahltechnik GmbH .. ..						•		
11	OBS Machines Ltd. .. ..						•	•	
62	Paint Research Association .. ..								Services
53	Paintmakers Association of Great Britain Ltd .. ..								TEC, services
4	Polymers Paint & Colour Journal ..								Technical journal, services
67	Porter Chadburn (Plastics) Ltd .. ..						•		Lining bags
47	Pye Unicam Ltd .. ..							•	
57	Q-Panel Co. .. ..							•	
14	R.K. Print-Coat Instruments Ltd .. ..							•	
7	Roban Engineering Ltd .. ..						•		
24A	Schwerdtel, Ludwig, GmbH .. ..						•		
15	Silberline Ltd .. ..			•					
61	Smith, Herbert, & Co. Grinding Ltd ..						•	•	

# Viscosity in 1ml samples



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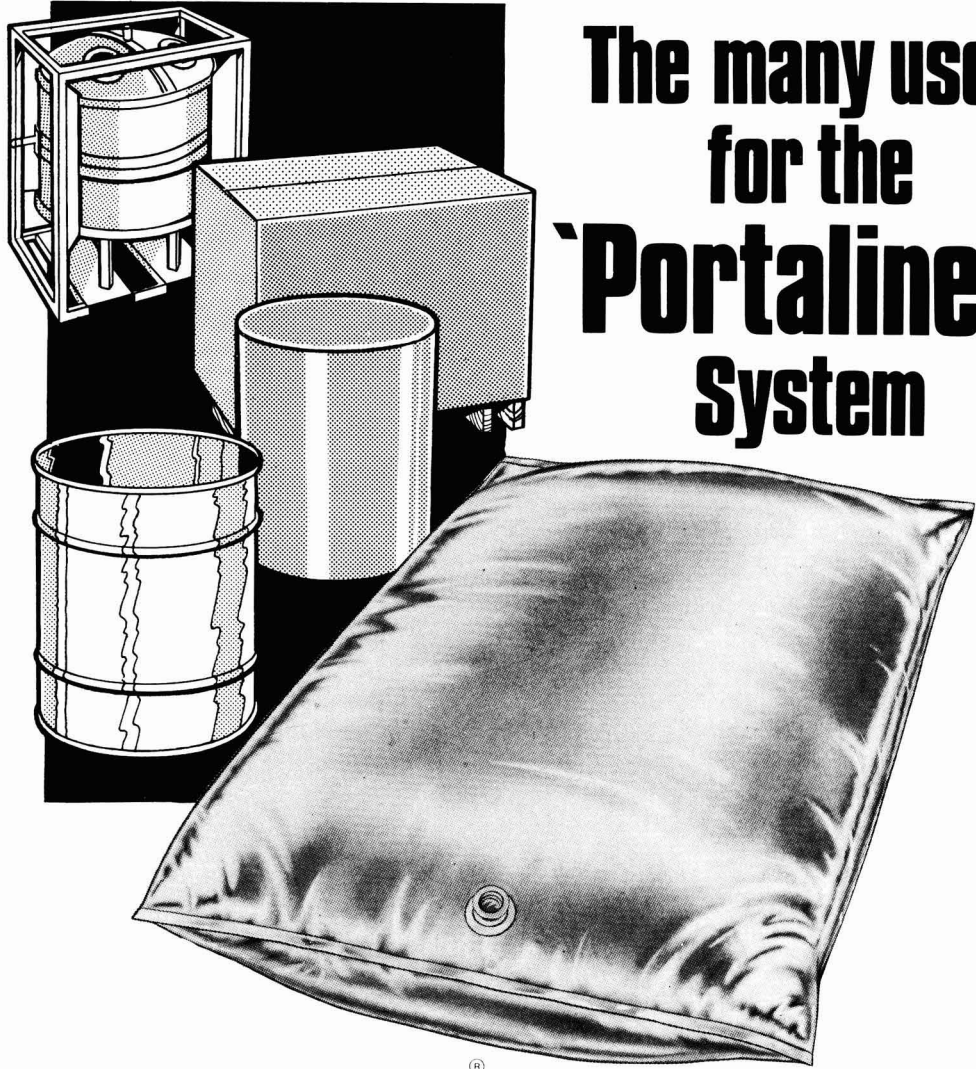
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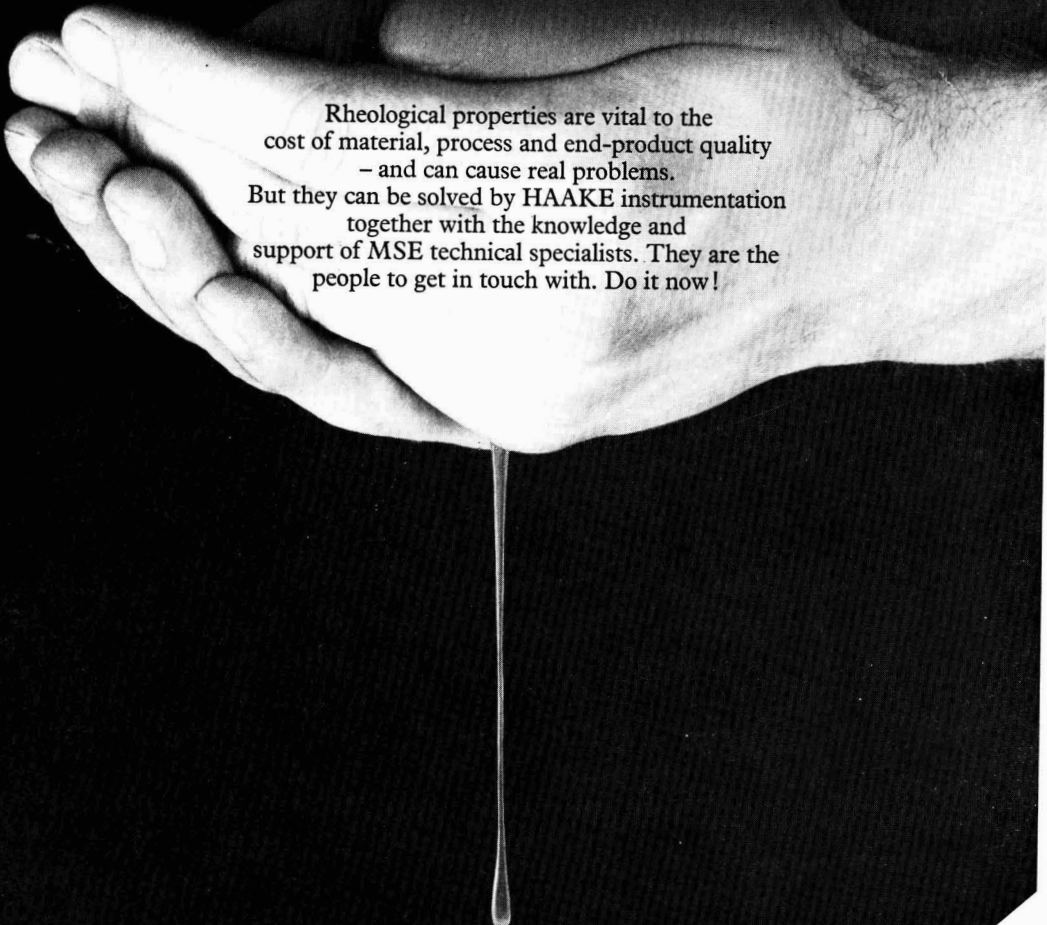
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Exhibition  
STAND  
45**



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## Analysis of Exhibits—continued

Stand	Exhibitor	Resins	Extenders, fillers, matting agents	Pigments	Additives, driers, surfactants etc.	Chemical intermediates	Manufacturing equipment, drums etc.	Laboratory apparatus and testing equipment	Miscellaneous
16	Society of Dyers & Colourists .. ..								Services, colour index
2	Strazdins, A., Pty. Ltd .. ..								Colour dispensers
13	Sub-Tropical Testing Service Inc. .. ..							•	Exposure services
6	Synres International NV .. ..	•			•				
5	Technology Marketing Corporation .. ..								Technical journal, services
65	Tiszamenti Vegyimuvek .. ..			•					
72	Torrance & Sons Ltd .. ..						•		
52	Vibropower, T.K., Ltd .. ..						•		
73	Wardle, Jackson R. .. ..						•		
70	Werner & Pfeiderer (U.K.) Ltd .. ..						•		
68	Westlairs Ltd .. ..							•	
8	Wheatland Journals Ltd .. ..								Technical journal, services
69	Winter Oy .. ..							•	Colouring system
38	Mark Allen Travel Agency .. ..								Services
39	Interpreters .. ..								Services
40	OCCA Information Centre .. ..								Services

## News of Exhibitors at OCCA-31

The OCCA Exhibition "Official Guide" is published many weeks before the dates of the Exhibition, so that visitors can obtain copies in advance and plan their itineraries. The "Official Guide" contains full descriptions of Exhibitors' Stands and much other useful information; copies of the "Official Guide" and season admission tickets may be purchased (at £2.00 each) either in advance from the Association's offices or at the entrance to the Exhibition, and additional copies of the "Official Guide" will be on sale at the Information Centre (Stand 40).

### Stand 46

#### Ferranti Ltd

##### Ferranti Viscosity Measurement Systems

Ferranti viscosity measurement systems include the portable viscometer and a cone and plate rotational viscometer for laboratory use.

##### Ferranti Portable Viscometer

This is a coaxial cylinder viscometer which consists of a pair of cylinders, one located co-axially within the other. The outer cylinder is rotationally driven by a small motor and the inner cylinder is free to rotate against a calibrated scale and has a pointer to register the amount of deflection.

To measure the viscosity of a liquid, the cylinders are immersed in it, the motors are

switched on and the viscosity is indicated on a calibrated dial. Changes in viscosity due to thixotropy or temperature variation can be continuously observed and shear rate can be varied by altering the speed through a three or five speed gearbox.

Each model is supplied with one set of cylinders and additional cylinders are available to extend the operating range. The basic ranges are:

VL 0-0.168/0-3.2 poise in 15 ranges and can be extended by additional cylinders up to 97 poise.

VM 0-0.9/0-40 poise in 9 ranges and from 0-0.33/0-1460 poise with additional cylinders.

CH 0-297/0-19,684 poise in 9 ranges and from 0-4.10/0-19,684 with additional cylinders.

The scale is calibrated from 0-100 and by

the use of constants, results may be directly obtained in centipoise.

##### Ferranti-Shirley Viscometer

The Ferranti-Shirley Viscometer system uses a cone and plate technique to enable the flow behaviour of many types of simple or complex fluids to be examined. Dynamic flow characteristics are automatically plotted as a graph and accurate repeatability of test results are assured. Flow behaviour data may be graphically plotted to give a choice of presentation including shear rate vs. shear stress and time vs. shear stress.

Using the Ferranti-Shirley system, the factors affecting the viscosity of a fluid or plastic formulation are automatically and precisely isolated and quantified. Temperature, cycle time and shear rates, from 1.8 to 18,000 reciprocal seconds, are monitored under strict control. Cleaning down between experiments is minimal, the cone and plate needing only to be wiped over.

Operation is by spreading a small sample on the viscometer plate which is then accurately raised to the cone by a capstan arrangement. The cone, which is motor driven through a compliant spring, rotates to the maximum operating speed and then returns to zero. The drag on the cone is measured and graphically translated as shear stress measured in dynes/cm<sup>2</sup>.

### Stand 9

## Contraves Industrial Products Ltd

A complete range of rotational viscometers and rheometers for the measurement of the viscosity characteristics and flow behaviour of fluids and visco-elastic substances will be shown by *Contraves*, the UK sales and service subsidiary of *Contraves AG*, Zurich, Switzerland.

On display will be multi-speed laboratory rheometers for product development and research, single-speed instruments for batch quality control, and industrial viscometers for in-line process control and coating applications.

*Rheomat 30*—A wide range of interchangeable measuring systems is available for this 30-speed instrument and for all other *Contraves* multi-speed laboratory rheometers, including cone and plate, cylindrical, very high shear rate, high temperature and high pressure types. The *Rheomat 30* may be used with the *Rheoscan 20* or *Rheoscan 30* programmers and an X-Y recorder for automatic plotting of rheograms.

*Rheomat 15T*—A 15-speed instrument eminently suited for wide range general purpose and development work in the laboratory. A semi-automated version is available with chart recorder for automatic plotting of simple rheograms or viscosity vs. time.

*TV* and *STV*—Single and 3-speed instruments for relative and absolute viscosity measurements, especially for quality control of raw materials and final products.

*HV6*—A high pressure capillary viscometer for predicting flow behaviour of non-Newtonian substances at very high shear rates.

*Covistat*—A rugged industrial viscosity regulator for control in open-tank and coating applications. Measuring head may be completely submerged. Available with remote readout and control unit.

*DC Series*—Single or multi-speed process control viscometers for continuous in-line viscosity measurement with temperature compensation. Fitted with stainless steel measuring chambers, these instruments are suitable for high temperature and high pressure applications.

### Stand 49

## Veb Kombinat Nagema

The trade organisation *Veb Kombinat Nagema* will exhibit machinery manufactured by *Maschinenfabrik Heidenau* which include Triple Roll Mills in the following types and roll sizes:

Horizontal type: *3KF1/600* (280 × 540mm)

Inclined type: *813/1* (320 × 800mm)

Inclined type: *913/1* (400 × 1000mm)

Four point hydraulic roll pressure is now available on the above mills. These machines, with their compact quality design, two speed drive and highly competitive price, afford an effective and comparable productive unit for printing inks, paints, pastes and other products.

Information on these mills and on other *Heidenau* products will be available on the stand.

### Stand 61

## Herbert Smith & Co (Grinding) Ltd

Information will be available on a wide range of machinery for use in the paint, ink and chemical industries, including milling, mixing, dispersing, filling, lidding, cleaning and sieving equipment, variously manufactured by the company's overseas principals: *Diaf A/S*, Copenhagen; *Rio Beer*, Switzerland; and *Sweco (Europe) SA*, Belgium.

A recent addition to the *Rio Beer* range of industrial washing equipment is a machine capable of cleaning square and round mobile pans in the same chamber, without changing brushes. This machine is too large to exhibit, but on display will be one of the smaller container washing machines.

From the range of equipment from *Herbert Smith*, two of the smaller mixers will be shown which have recently been redesigned to meet special requirements, including a 2 h.p. mixer with infinitely variable speed between 550 rpm and 2500 rpm controlled manually. The stainless steel shaft carrying a sawtooth impeller is fitted with a quick release chuck and the complete mixer can be mounted on a fixed pillar or hydraulic lift. Safety limit switches are fitted as appropriate to conform with safety and health regulations.

### Stand 15

## Silberline Ltd

Once again *Silberline Ltd* will be showing an extended range of *Sparkle Silver* non-leaving aluminium pigments available from UK production.

The exhibit will feature the use of acid resistant quality pigments in automotive finishes, but also demonstrate applications of non-AR qualities in other industrial finishes, notably vinyl paper coatings, PVC decorative leathercloth, hammer finishes and gold effect non-leaving inks.

In each case particular properties of the *Sparkle Silver* paste can be used giving effects unobtainable with the usual materials.

### Stand 66

## Eiger Engineering Ltd

The company will exhibit several machines from their proven range of direct drive agitated bead/sand mills. This is named the *Motormill* and is used for the production of the finest dispersions of paints, pigment concentrates and printing inks.

Since OCCA-30 the existing range of sizes has been enlarged from 1, 10 and 40 litres to include a 20 litre model and the completely new 0.1 litre laboratory mill.

In designing the *Motormill* it was foreseen that substantial cost reductions would be achieved by eliminating bulky frameworks, adjustable vee belt drives, secondary milling shafts, etc, from conventional bead mills. This has been achieved by directly coupling the milling chamber to a flanged electric motor having a long shaft extension into which the impeller agitators are mounted. The mills, which operate equally well in the vertical or horizontal positions, can use all types of grinding media down to 0.8 mm, which are retained in the mill by a stainless steel slit mesh sieve set into the chamber end plate.

Particular attention has been paid to obtaining the highest dispersing efficiency and to reducing the wear rates of the agitators and chamber walls. This is accomplished by fitting easily replaceable anti-swirl and anti-by-pass baffles which ensure optimum efficiency at lower agitator rotation speeds thus eliminating bead shatter and generally reducing internal wear.

### Stand 48

## Marchant Brothers Ltd

*Marchant Brothers Ltd* design, manufacture and supply machinery and entire plants for the printing ink, paint, plastic, ceramic, cosmetic, confectionery, paper and chemical industries.

The new company supplies Triple Roll Mills both for the production of the usual type of printing ink and also for the newer specialised ink industries, and with the expansion taking place in the field of materials for electronics, the company provides mills of composite design in the smaller range of machines to meet the increasing demand.

The *Marchant* range of Triple Roll Mills includes the following roll sizes: 3" × 6" (77 × 150mm), 6" × 12" (150 × 305mm), 6" × 16" (150 × 406mm), 11" × 23½" (280 × 600mm), 12½" × 31½" (320 × 800mm) and 16" × 40" (400 × 1000mm).

The *Marchant* service includes, spares, maintenance, reconditioning and overhaul, removal and installation of machinery together with the associated electrical, plumbing and structural systems.

### Stand 37

## Kirklees Chemicals Ltd

*Kirklees Chemicals Ltd* will exhibit their range of emulsion resins, primarily for paints and will be pleased to discuss with visitors their own emulsion requirements in any industry.

Although not exhibiting new products, several development areas which should be of great interest both in the UK and overseas, in the next twelve months will be discussed.

The production facilities in Yorkshire are being further expanded during 1979 to enable these products to be produced efficiently, whilst at the same time allowing for continued growth in V.A. copolymers.

## Stand 7

### Roban Engineering Ltd

*Roban Engineering Ltd* will be exhibiting for their third year at OCCA and confidently expect to exceed the previous years record successes at this event.

New for 1979 will be the 'Tokheim' range of positive displacement flowmeters now distributed by *Roban* and available in the size range 1" to 6" and four basic materials of construction including stainless steel.

A feature of the *Tokheim* range is the wide range of accessories available with the basic three piston, or rotary vane, flowmeter such as air separators-strainers, local and remote flowrate indication, remote electronic batch control, magnetic drive, temperature compensators and ticket printers.

The *Tokheim* range gives *Roban* the capability to offer one range of flowmeters to cover the majority of applications in the surface coatings industry.

The famous *Roban R300* and *R400* series of pumpsets will again be on show with particular emphasis on the handling of solvents, and also further examples of the *Yamada* range of air operated double diaphragm pumpsets.

*Roban's* Engineers will be on the Stand to discuss the 'Roban Turnkey' project service for the complete design and erection of liquid bulk storage and distribution facilities.

*Roban's* special expertise is in the ability to work with the raw material supplier and Health and Safety Executive to achieve high levels of performance and safety, at lowest cost to the ultimate user.

## Stand 60

### Diaf A/S

For more than 60 years, *Diaf A/S* have specialised in the manufacture of machinery for the production of paints and printing inks. *Diaf* has been operating on the international market supplying know-how, complete plants or process lines for paint, varnish and printing ink industries since the firm was founded in 1912.

The programme comprises dissolvers and mixers for stationary and portable containers with motor sizes 0.25 h.p. to 275 h.p., complete automatic filling lines, vibration sieves, etc.

In 1979, the following examples of the production of *Diaf* will be displayed at the Exhibition:

*Maxfill* weight filling machine with filling range from 2.5 kilos up to 50 kilos approved in UK according to Weights and Measures Act 1963. In order to meet special conditions and duties pumps, filters, valves, roller conveyors and labelling installations are available. A matching lid closing device will also be on display.

*Laray 2" Filter Battery* for printing ink, constructed for pipe shaped filter cartridges. The filter is designed for 3 independent cartridges each equipped with 1" WRG inlet and outlet ball valve. The filter car-

tridges can easily be replaced by means of a bayonet closing device at the end of each filter unit.

New construction of *Laray Tackmeter, Type 76B*, provided with digital read off and distance thermometer. Allows tack measurements under well controlled test conditions. Infinitely variable splitting speed with robust construction, modern design and with easily exchangeable rollers. Also suitable for the control and measuring of the flying tendency of printing ink.

## Stand 22

### Kemira Oy

UK Distributors:

#### Cornelius Chemical Co. Ltd

Two new titanium dioxide pigment grades, *Finntitan RR2S* and *Finntitan RDDX* will be presented at the Company's stand.

*Finntitan RR2S* is a special weather-resistant, rutile grade intended for use in coil coatings, automotive and industrial finishes and in speciality paints in combination with recently developed resin systems. Its dispersibility, optical properties, particularly gloss and non-chalking properties, are specially developed for the highest performance in the suggested application areas.

*Finntitan RDDX* is a unique development in its class, a voluminous titanium dioxide pigment for high dry opacity, favourable rheology, for a single coat emulsion paint.

*Kemira's* technical experts will be available for discussion about these new products and latest development in the application of existing well established *Finntitan* grades.

## Stand 12

### Elcometer Instruments Ltd

In association with:

#### Erichsen GmbH

*Elcometer Instruments* will be displaying their world renowned range of coating thickness measuring instruments, and will feature the new *Model 150 Mintector*, which is a truly portable instrument with digital display, specially designed for measuring non-conductive coatings on aluminium, brass or other non-ferrous bases. Also on show will be the new *Model 205 High Voltage DC Pinhole Detector* which incorporates those special features which make it internationally acceptable with an exceptional standard of reliability.

Also exhibited will be a selection of the fine instruments chosen by *Elcometer* for excellence in testing coatings and materials.

The *Taber Abrader* needs no introduction since it is the recognised instrument for testing wear and abrasion on most materials.

*Erichsen GmbH* are famous for their coating test instruments which provide tests to international standards of almost every physical parameter affecting coatings and their application. *Gardner Laboratory* colour

and appearance measuring instruments are found wherever precision and repeatability is important. The new *XL200* system incorporates many radically new features and the new *Glossgard* employs the latest techniques to provide a fully portable instrument.



A built-in micro computer coupled to Gardner's new optical system

*Leneta* Hiding Power charts. A wide selection of these excellent charts will be on display including several which are new to the United Kingdom.

## Stand 28

### Industrial Dispersions Ltd

*Industrial Dispersions Ltd* is a company which specialises in powder/liquid technology and offers a complete dispersion service covering industries such as paint, ink, fabric coatings, plastics, rubber, shoe manufacture, floorings, oil industry and cosmetics.

The company will be continuing with the 'modern approach' to dispersion theme which was so successful at last year's exhibition and promoting its predispersed pigment pastes as the economically viable alternative to expensive dispersion equipment and costly skilled labour.

The product range has now been extended to include a universal system which is methacrylate based and is designed for use in all common non-aqueous finishing systems. A long oil soya alkyl system has been introduced which has high pigment loadings and can be let down for direct manufacture of decorative paints as well as being used for tinting purposes.

These two systems, together with the glycol based range for aqueous use and the epoxy, polyester, plasticiser and oil dispersions designed for specific applications, give complete coverage of most surface coating fields.

In addition, the company tailor-makes to meet the more exacting requirements of specific industries and offers a colour matching service and technical advice on any specialised mixing and milling problems.

## Stand 50

### Netzsch-Feinmahltechnik GmbH

The *Netzsch Bead Mills*, incorporating their special designs of grinding techniques, embodied in a comprehensive range of vertical and horizontal machines, cater for

those multifarious products and outputs encountered in the printing ink, paint, plastic and chemical industries.

The combination of the turbulent, centrifugal and gravitational forces generated within the mills together with the effective cooling systems, the grinding media and size, offers high efficient output.

*Netzsch Mills* are available in both vertical and horizontal configurations and generally the former are designed to cater for high viscosity products whilst the latter would cater for low viscosity products.

The choice of the mill rotor is dictated by the type of product and the finish that is required and the selection of the size and type of mill can be readily established through the *Netzsch Service* of sample product testing at the works.

*Netzsch Molinex Mills* use the *Molinex* type of rotor which carries a system of eccentric rings which affords maximum grinding surface contact. The rotor is housed within a watercooled chamber. These mills are available in the vertical or the horizontal configurations.

*Netzsch John Mills*, a further development in bead milling machinery design, incorporate a concentration area which creates a zone of intense and high grinding activity in conjunction with a grinding peg system. The provision of large water cooled surfaces of the rotor and of the chamber ensures the control and the removal of the high temperatures engendered.

## Stand 23

### Industrial Colours Ltd

Since the last time *Industrial Colours Ltd* exhibited at OCCA, a number of new products have been introduced and improvements have been made to existing ranges. Details of these new pigments will be available on the stand and include:

The new *Flare 710 Series*—A fairly new range of high strength thermoplastic pigments giving technical and commercial advantages, which are ideally suitable for low film weight paper coatings and screen inks.

The *Flare 820 Series*—A new range of high strength thermosetting pigments with excellent lightfastness, intended primarily for use in formulations containing polar solvents. Also suitable for plastics and textile inks.

The *Flare 910 Series*—Have been developed as high strength formaldehyde-free polyamide pigments and are ideal for high temperature injection moulding.

## Stand 11

### OBS Machines Ltd

This company, as the sole and exclusive UK and Eire direct Sales/Service operation for all *Ateliers Sussmeyer sprl* and *Oliver & Batlle SA* products, will exhibit details and plant for their extensive range of equipment designed specifically for the paint, ink and allied chemical industries:

#### *Oliver & Batlle SA*

The proven and well established *Super-*

*mill* horizontal beadmill with its unique method of product separation cooling and washing systems will be exhibited in the very popular 15 litre version. All the following sizes are now in production: 1.5 – 5 – 30 – 45 – 60 – 90 – 120, together with the popular 200 litre version used for processing pigment, dyestuff and pesticide dispersions.

The *Viscomill* horizontal beadmill is specially designed for high viscosity paste dispersions and again has unique product separation, cooling and washing systems. This unit is available in 15, 30 and 45 litre versions.

*Dispermix* cavitation mixer/dissolver ranges, incorporating both electro-mechanical and completely hydraulic variable speed systems.

Unique *Dual/Dissolver* incorporating both high speed and low speed elements for processing paste dispersions, if necessary, under vacuum conditions.

The universally acclaimed *Centrimill* batch beadmill with centrifugal discharge system. Available in 50 – 100 – 250 litres working capacities.

#### *Ateliers Sussmeyer sprl*

Vertical sand and micro element mills of the well proven conventional open and fully sealed style having grinding shell capacities from 1 litre up to and including 120 litres capacity.

Resin plants designed for oil, gas or electric induction heating.

Electrically operated vibrating filtration screens.

Hydraulic press for extraction/filling out of heavy pastes, mastics, sealants, etc.

Automated *Can Clean* installation for mobile vessels of up to and including 1800mm diameter x 1500mm high.

#### *J. De Vree*

Weight and volumetrically operated semi-automatic and fully automated filling machines for both liquid and paste products, featuring labour saving devices such as automatic can/lid feeding, leaking can detection, automatic adhesive tab labelling batch code number, etc. Attachments also available for automatic feeding of recently introduced tapered containers.

## Stand 70

### Werner & Pfleiderer (UK) Ltd

The theme of *Werner & Pfleiderer's* display is the manufacture of powder coatings for application by electrostatic spraying without solvents. These are made from a mixture of polyester, acrylic, epoxy etc., resins, fillers and additives. The *W & P* machine converts the dry premix into a hot viscous extruded strip which can then be cooled, crushed and ground into fine powder.

The range of twin-screw intermeshing co-rotating compounding extruders is represented on *W & P's* stand by a motorised model, which clearly shows the principle of operation; the two closely intermeshing screws wipe each other along the entire

length and, therefore, ensure that no powder builds up on them. The screws are made up of separate easily interchangeable components which can be arranged in any desired sequence to achieve just the right melting, homogenising, mixing and dispersing effect without risk of degrading the resin or premature curing. In this way, the machine can run for many hours or days without the need to stop. The barrel is electrically heated and water-cooled and the two screws can also be cooled. The molten mix is discharged, without pressure, straight downwards onto a cooling unit.

When colours or formulation changes need to be made, all that is normally required is for the machine to be emptied and a small quantity of purging material passed through it. The machine need not be opened or dismantled.

*Werner & Pfleiderer* make a wide range of sizes, from the laboratory/small scale production machine type *ZSK 30* (5–50 kg/h) to the *ZDS-K 83* (800 kg/h) or even *ZDS-K 120* (1500 kg/h). More than 50 such machines have been sold world-wide for production of powder coatings.

## Stand 27

### Italtinto Industria Vernici srl

The *Tintopaint* system is a colour system which includes an electronic dispensing machine, a manual dispensing machine, small and big shakers, universal colourant pastes and base paints which are all produced by *Italtinto Industria Vernici srl*.

The *Italtinto* system is one of the most interesting colouring systems because of its ability to accurately repeat a colour formulation (from amongst 3,000 possible shades) even after a long delay.

The electronic dispensing machine is the simplest and most efficient unit on the market; it is provided with 1,800 memory bands which allow the insertion of up to 8,000 different colour shades. By selecting the code number corresponding to the colour shade required, the machine automatically dispenses the colourant or colourants. The shakers are also interesting developments, the small one with a capacity of up to one gallon and the large one (2 speeds) with a capacity from one litre to four gallons.

## Stand 63

### Glen Creston Machinery Ltd

The 1979 OCCA Technical Exhibition presents this Company with the opportunity of displaying, once again, the superb quality of the world-renowned *Dyno Mills*.

The pioneering efforts of all concerned in the *Dyno Mill* project have been rewarded by the successful introduction of this range of mills into 48 countries. Being the first horizontal bead mill and already having more than 12 years of continuous operation throughout industry has firmly established the *Dyno Mill* as the product leader.

Examples of these machines will be on display at Stand 63 at Alexandra Palace;

the mills will include the *KD15* machine and pilot/development machines. Visitors will be able to see for themselves the simplicity of line and attention to detail that is the hallmark of a masterly design concept. It is worthy of note that even the earliest machines, produced in 1967, can be converted to the most up-to-date version, taking advantage of all the recent design improvements.

Experts from Messrs. *Glen Creston* and *W. A. Bachofen* will be available to discuss any potential applications.

Also shown on the stand will be samples of the huge stock of lead free glass and zirconium oxide grinding media held in the UK by *Glen Creston*. Made to the highest standards, both types of media are extremely wear resistant.

## Stand 21

### Cornelius Group

Exhibiting jointly with *Kemira Oy*, *Vuorikemia Division* and *Industrial Colours Ltd*, the *Cornelius Group* will feature the following from their extensive product range:

#### The Mearl Corporation

A new range of *Mearlin* titanium dioxide coated mica pearl pigments, suitable for exterior application in surface coatings and plastics media. Tests have shown that these new exterior pigments are capable of replacing not only conventional pearlescent pigments, but many types of metallic flake pigments as well.

#### Hilton Davis Sup-R-Cryl

A new range of pigment flushings in an acrylic resin solution recommended for use in a wide variety of solvent based coatings.

#### The Rheoem range of surface coating resins and monomers

Emphasising particularly the value of *Plexigum P675*, a pure polymethacrylate resin for exterior solvent based masonry paints, monomers for PVC plastisols, UV curing coating systems and civil engineering applications.

#### The Dapro Disperse-Ayd Range

To the already well established *Disperse-Ayd No. 1* is added *Disperse-Ayd No. 8*, the specific dispersing agent for black pigment. When used as the sole grinding medium, it is possible to produce stable, high concentrated dispersions exhibiting a wide range of compatibilities.

#### Oulu Dipentene 405

Produced in *Oulu's* new turpentine distillation plant in Northern Finland, the new production technology enables *Dipentene* to be offered which will meet the most exacting specification.

## Stand 51

### Cox's Machinery Ltd

Two new machines being shown will extend the well tried and proven range of *Cox Triple Roll Mills* and *Change Can Mixers*.

The first is a small batch scale triple roll mill with rolls 150mm diameter and 400mm working length and made of the bi-metal

spun cast construction. This mill is available in two forms, one for small production use with a delivery roll speed of 300 rpm, and the other for colour matching and small batch use with a delivery roll speed of 200 rpm. The slower speed mode machine has adjustable side hopper cheeks.

The second is a high speed disperser of 15 h.p. capacity with hydraulic lift and variable speed impeller. The machine is designed as a low cost versatile mixer able to handle a wide range of mixing needs. The model on show has a speed range of 600 rpm to 350 rpm together with a number of different mixing impellers.

## Stand 64

### Chemolimpex

#### Export offer:

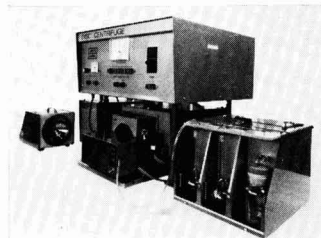
Alkyd resins (more than 30 types); Amine resins; Colophony-based resins—rosin esters, and colophony-modified phenolics with special grades for the printing ink industry; Maleic resins; Epoxy resins; Hydroxyl function synthetic resins for polyurethane coatings; Driers, single and mixed metal versates and octoates; Organic peroxides—acetil, acetone, peroxide, methyl-ethylketone peroxide, cyclohexanone peroxide, benzoyl peroxide, mixed catalysts, nitrocellulose (alcoholic damped or plasticised) and Intermediates.

## Stand 3

### Joyce-Loebl

#### Joyce-Loebl Disc Centrifuge 3, Particle Size Analyser

The *Joyce-Loebl Disc Centrifuge 3* is an instrument used to produce absolute particle size against weight distribution curves in the range 0.01 micron to 30 microns, by separating the sample at pre-selected sizes and quantitatively analysing the collected fractions. The *Photosedimentometer* attachment offers the facility to produce rapid comparative size distribution curves, by continuously monitoring progress of particles past a beam of light.



The Disc Centrifuge from Joyce-Loebl

## Stand 14

### RK Print-Coat Instruments Ltd

*RK Print-Coat Instruments Ltd* is exhibiting a *Bench Mounted Rotary Coater* to which various coating and printing heads may be fitted enabling technologists to carry out a

wide range of research, development and quality control work.

This versatile unit features a variable speed drive, adjustable web tension and a tubular framework that allows variation of web run, unwind and rewind positions; heating and drying equipment may also be added.

The heads available at the moment are for metering bar coating, Anilox roller coating, gravure printing, flexo printing, hot melt application and laminating.

#### Printing Proofers

Motorised or manually operated laboratory proofers for the testing of gravure, flexo and gravure offset inks and substrates. Interchangeable printing heads make this a very versatile instrument.

#### K Control Coaters

Produce complete repeatability of coatings for the evaluation of samples on most substrates. Very simple to use. Models are available to coat areas from 10" x 6" up to 40" x 30".

#### K Lox Roller

The roller coater with a difference. Ideal for applying products in thin films, particularly on absorbent substrates, i.e. flexographic inks. Easy to use and even easier to clean.

## Stand 52

### TK Vibropower Ltd

A range of *TK Vibropower* pneumatically operated variable vibrators will be shown together with a range of equipment. These will be linear and bowl feeders, compacting tables and sieves and a complete weighting system, all utilising the steplessly variable amplitude and frequency characteristics of the vibrators. The low noise level and inherently moisture, dust and flameproof characteristics of the *TK Vibrators* can be seen and any individual requirements can be discussed at the stand.

## Stand 24

### KWR Chemicals Ltd

*KWR Chemicals* are jointly represented with *Draiswiese GmbH* and are showing the *Drais STS* triple cooled mill, the *Drais direct feed Perl* mill system and the *Drais Star Head Disperser*.

*KWR* have also achieved a considerable success with the *Ludwig Schwerdtel* filling machines for viscous products. *Schwerdtel* are now the market leaders in this field with a comprehensive programme which is unrivalled.

## Stand 35

### Glychem International Ltd

*Glychem International Ltd* is a joint company established by *Glychem Singapore Private Ltd* and *K & K Greeff Chemical Group Ltd* for the worldwide marketing of stearic acid from the new plant recently constructed in Singapore.

The *Glychem* Singapore plant, which was designed, constructed and commissioned by Lurgi Apparate Technik GmbH, is amongst the most sophisticated and modern in the world and is capable of producing continuously high quality reliable stearic acid. The plant was sited in Singapore in close proximity to the world's main sources of palm oil and with easy access to the world shipping routes.

The stearic acids offered are the first stage in the long term development of a full range of fatty acids, fatty acid esters and glycerines, which will become available over the coming months.

## Stand 54 Instrumental Colour Systems Ltd

*Instrumental Colour Systems* are Europe's leading suppliers of colour formulation and control systems.

On display will be their latest system for colour formulation in the paint, plastic and printing ink industries. The ability to match non-metamerically any shade in the most cost effective manner leads to extremely rapid colour matching and savings in pigmentation costs of a minimum of 10 per cent.

The ability to control contrast ratio or hiding power and ensure that only the minimum amount of pigment is used in a paint or plastic leads to further large savings.

In addition to initial formulations, another area where investment in instrumentation can yield considerable benefits is ensuring colour consistency from batch to batch. Numerical tolerance values calculated by a colour difference meter allow production staff to ensure shade continuity whilst at the same time increasing productivity.

## Stand 55 FECO & Co

*FECO* are well known in Europe as suppliers of complete integrated handling systems for the paint, ink, pigment and adhesive industry. Their expertise in materials handling has enabled them to erect complete paint plants at very reasonable costs.

The *FECO* programme also includes filling machines, automatic self cleaning filters, automatic feed pumps, bag slitting machines, etc.

*FECO* sets out to offer a unique complete service to the industry in total materials handling.

## Stand 32 John Godrich

*John Godrich* will be showing for the first time the *Xenotest 250 Light Fastness and Weathering Machine*. Designed on the same principles as the *Xenotest 1200* and *Suntest* machines, it has an ozone free xenon lamp, with two intensities, three

different filter systems, five different rain cycles and controlled humidity. A compact unit giving good correlation with natural sunlight and weathering. Also on show again will be the *Suntest Light Fastness Tester*, which is being increasingly used by the motor industry.

The successful '*Credit*' Humidity Cabinet can also be seen with its new accessory to carry out tests to ASTM D 2247 or ISO/DIS 6270. This component will fit existing cabinets already supplied with minimum amount of adjustment.



The Credit Humidity cabinet

The *Liebisch KS-300 Sulphur Dioxide Cabinet* conforming to the Kesternich test and BS 3900 F8 will be available complete with automatic ventilating device. Descriptive literature and experts will be available to discuss the *Liebisch S-1000 Salt Spray Cabinet*, which conforms to ASTM, BS, DIN, CASS and other Standards.

There will also be on show, *Chemcol Mixers* for laboratory and production with a number of models working. The absence of any bearings in the submerged portion of these machines still continues to be their greatest asset, together with their processing efficiency, because pure mixing is possible with a full flow through the mixing head, which enables the most excellent dispersions, emulsions and general mixes to be achieved with a great saving in time, labour and of course, costs.

Numerous additional components are available for application to these machines to give a wide variety of processing systems i.e. to eliminate air, to create a vortex and allow the fitting of dissolver discs and paddle wheels, etc.

Several designs of stator will allow increased dispersion effects or additional agitation in accordance with the type of fluid being processed.

These features combined with the variety of speeds, gives a very considerable range of mixing capabilities.

The much applauded *Chemcol/Mirap* range of machines will again be on show—the very welcome feature of a mobile mixing machine has created great interest and the hydraulic/manual support systems ensure considerable universal capability.

The *Rotostat Type 'X'* range will also be

on show and working, together with the new *Type 'T'* units which are designed to process high viscosity fluids and have the great advantage of no suspended basket assembly. This allows much better processing characteristics and much easier cleaning. Interchangeable inserts for the mixing head, give an even wider range of mixing capabilities.

Several other items of laboratory equipment marketed in the British Isles by the *John Godrich Organisation* will also be on show.

## Stand 24A Ludwig Schwerdtel GmbH

A major development affecting the entire industry will be announced during the OCCA Exhibition.

## Stand 72 Torrance & Sons Ltd

Following the successful introduction of the *Rotomill*, OCCA 31 presents the opportunity to exhibit both the 25 and 60 litre mills. These fully developed horizontal bead mills are jacketed for maximum cooling or heating. Emphasis in design has been placed on ease of access to the chamber and on the use of special wear resistant alloy steels for the manufacture of the agitator discs and the renewable chamber liner, resulting in longer operational life and less maintenance 'down time'. Another feature incorporated is the cooled balanced mechanical seal which can be used with any compatible solvent and pressurised under an inert gas or compressed air.

These machines have been designed for the continuous production of a wide range of materials with excellent results when processing paint, liquid inks, dyestuffs and pigment dispersions and have the ability to maximise pigment colour developments.

Careful consideration has been given to protecting all *Torrance Rotomills* and complete 'fail safe' operation together with fully automated systems can be discussed with our technical representatives. Literature and technical information will be available on the extensive range of dispersers, batch HSF bead mills and attritors including schemes that can be designed to suit clients' requirements.

## Stand 2 A. Strazdins Pty. Ltd

*A. Strazdins Pty. Ltd* will show their latest range of *Blendorama Colourant Dispensers* on Stand 2.

Innovative design has produced two popular extensions to existing models.

*Model 21PA* with memory and magnifying glass

A modified version of the *21P Model* (50 ml - 2 oz capacity pump) dispenser is now available. The *21PA Model* dispenser has the same features as the *53P* and *200P Models* in that it has a 'memory'—the gauge retains the formula until cancelled by the operator. The gauge setting is separate

from the pump action and is held at the required setting by a locking washer located in the cylinder cap.

The presetting of the gauge enables the operator to check the formula setting at any stage during the dispensing operation. For batch tinting, the presetting feature eliminates errors in individual mixes of paint.

A disadvantage of the present *21P Model* is that by being a 50 ml pump of similar stroke to other makers' 25 ml - 1 oz pumps, the gauge scale had to necessarily be of smaller print. The magnifying lens overcomes this disadvantage and the *21PA* gauge is considered more easily read than the scales on 25 ml pumps.

The *21PA* pump assembly can be exchanged with the existing *21P* pump assembly.

#### *Double Volume Canister for 53P (5 oz pump) Models*

A 5 litre canister for most often used colourants has been developed. It is interchangeable with standard 2.5 litre canisters, having the same height and frontal appearance but extended at the rear. It maintains complete colourant agitation with two synchronised stirrers.

#### *Bulk Dispensing Unit - Model 200P*

The *200P Model* dispenser (600 ml - 20 oz capacity pump) will also be shown. This unit is designed for fitting to 20 litre pails and has won particular favour in larger in-plant tinting concerns.

All *Strazdins* machines use stainless steel cylinders and "Teflon" slirpings in the pumps. In this way *Strazdins* can offer trouble free, versatile machines with the

durability to be expected from high quality precision equipment.

### Stand 73

## R. Jackson Wardle

The following items will be exhibited:

A rebuilt humidity cabinet designed to operate to BS 3900 F2, which can be supplied with or without line recorder. New cabinets with the same control module are also available. Details of the range of laboratory salt spray cabinets will be available on the stand.

The *Werner Mathis DWE* printing device and the *LPE* laboratory paste evacuator will also be displayed and literature on the complete *Mathis* range will be available.

### Stand 45

## MSE Scientific Instruments

The complete range of *Haake Rotational Viscometers* will be available for demonstration by technical specialists.

The *Rotovisco* systems are the highest quality rotational viscometers for maximum accuracy and reliable measurements covering extreme ranges of viscosity, shear stress and shear rate. A system may be designed on a building block principle to suit particular requirements by selection of sensor system: fixed, variable or programmable speed ranges; torque measuring head and data output.

The new *Rotovisco model RV100* base

unit, which combines programmable speed control and built-in recorder, will be the key exhibit. It may be used with the new *CV100* low shear sensor system, which allows low shear measurements to be made at high sensitivity without specialised operating knowledge. Standard small angle deflection torque measuring heads from *Haake* (as used on the *Rotovisco RV11* and *12*) may also be used with the *RV100* basic control unit.

A combination of the *Rotovisco model RV12* including digital torque indication and the model *PG142* programmer offers an extremely versatile system for the automatic plotting of rheograms. The *PG142* programmer can be used with all *Haake Rotovisco* systems so that multiple linear speed programmes and flow curves may be selected. Pause times may be programmed for tests requiring pre-warming or a regeneration period to examine structure recovery of thixotropic samples.

The *Haake PK100* cone and plate sensor system is another new product which is being shown at an exhibition for the first time in the UK. The system incorporates contact indication and digital display of temperature. Cones of up to 50mm in diameter enable shear stability tests on low to medium viscous substances to be carried out and yield point measurements on highly viscous substances to be examined.

The *Haake VT181/24* range of Viscometers are portable rotational viscometers for the measurement of viscosity under defined shear rate conditions (absolute sensor systems and temperature control) or rapid routine tests (suspension sensors). Each unit has two basic fixed speeds with an option to convert to six and with optional recorder output.

## OCCA Biennial Conference 1979

*Stratford-upon-Avon*

20-23 JUNE 1979

### The challenge to coatings in a changing world

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

A list of the papers to be presented together with their summaries and biographies of the lecturers was published in the December 1978 issue of the *Journal* and copies of the Conference brochure and registration form were enclosed in all copies

of the *Journal* sent to Members attached to the General Overseas Section and non-member subscribers to the *Journal*.

The brochures are being sent to all Members attached to the UK and Irish Sections with Section circulars. Any non-

member who has not yet received a copy of the brochure and wishes to register for this important Conference should apply for the necessary form to the Association's offices. Non-members wishing to avail themselves of the preferential Conference fee for Members may do so by sending in a mem-



A view of Anne Hathaway's Cottage, situated close to Stratford-upon-Avon, which contains a museum of Shakespearian articles

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

Preprints of the papers are now being prepared and it is expected that these, together with details of accommodation, badges, programmes etc. will be sent to those who have registered in May 1979. It is a feature of the Association's Conferences that preprints are sent well in advance of the function in order to enable delegates to read them before the Conference, at which the lecturers illustrate their topics but do not read their papers in their entirety. This allows for a much longer discussion period than at many other conferences and has proved of immense value to those attending previous Association Conferences.

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

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



Top Table guests at the Scottish Section Dinner Dance on 12 January (from back, l-r): Mr M. J. Cochrane, Mr T. L. M. Humphrey, Mr M. Nixon, Mr F. Hellens, Mr E. Harper, Mr D. A. Bayliss, Mr I. R. McCallum, Mr A. McLean, Mrs Bayliss, Mrs Humphrey, Mrs Nixon, Mrs McLean, Mrs Cochrane, Mrs E. N. Harper, Mrs Hellens and Mrs McCallum



Shown at the recent London Section Ladies' Night are Mr D. Bayliss and Mrs Bayliss with the principal guest, Miss S. Gaetsky

## News of Members

Mr L. Pyett, an Ordinary Member attached to the Manchester Section, has been appointed Sales Manager of Allied Colloids for the North West area.

Mr D. S. Newton, an Ordinary Member and a Fellow in the Professional Grade attached to the Bristol Section, has retired from ISC Alloys Limited after 25 years service in various capacities, finally as a technical consultant.

Mr Newton is currently a Vice-President of the Association, having previously been Hon. Editor and Hon. Secretary; he was also Chairman of the Bristol Section.

He will continue to act as a consultant to ISC Alloys Limited and intends to act as an independent consultant to the surface coatings industry, with particular interests in corrosion and protection problems.

## 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

- AITKEN, MALCOLM, LRIC, 14 Kingwood Avenue, Bolton BL1 5JA. (*Manchester*)
- ASHER, JOHN, BSc, 11 Merlin Road, Blackburn, Lancs BB2 7BA. (*Manchester*)
- BARNSTORF, PAUL THOMAS, BSc, Lawter Chemicals (Canada) Ltd., 29 Iron Street, Rexdale, Ontario M9W 5E3, Canada. (*Ontario*)
- BARRETT, WILLIAM, BSc, 1B Selekoh Tunku, Kenny Hill, Kuala Lumpur, Malaysia. (*General Overseas*)
- HAKEN, JOHN KINGSFORD, PhD, MSc, Dept. of Polymer Science, University of NSW, PO Box 1, Kensington, NSW 2033, Australia. (*General Overseas*)
- HARRINGTON, PETER TERENCE, 24 Haslam Street, Bury BL9 6EQ. (*Manchester*)
- HOSSAIN, MOZAHAR, MSc, Jenson & Nicholson (Bangladesh) Ltd., PO Box 353, 43/3 Chatterswari Road, Chittagong, Bangladesh. (*General Overseas*)
- INGLIS, DAVID, 60 Jarvie Crescent, Kilsyth G65 0LN. (*Scottish*)
- LOYD, DAVID CHARLES, BSc, 6 Lygrave, Longmeadow, Stevenage, Herts SG2 8JZ. (*London*)
- MILNER, BARRY ROBERT, LRIC, 44 Briergate, Haxby, York. (*West Riding*)

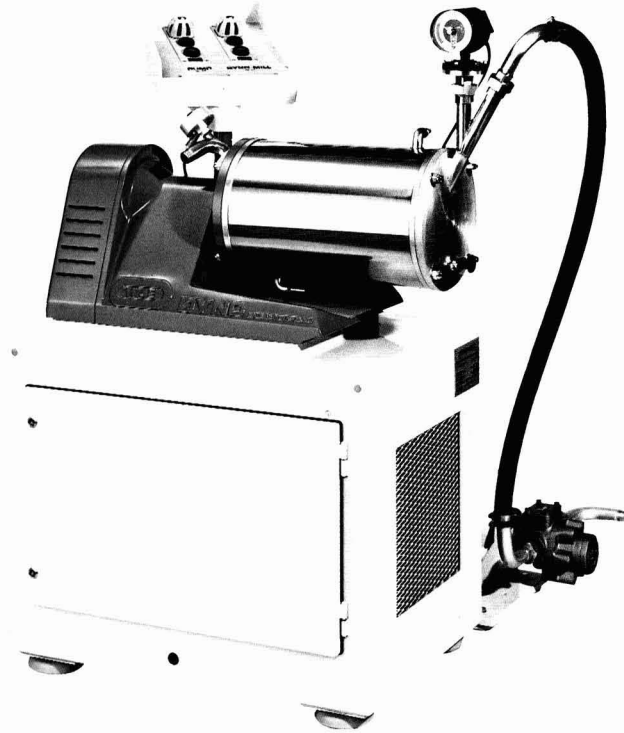
- NASER, ABDEL-RAHMAN, BSc, MSc, PhD, PO Box 1841, Medina Munawara, Saudi Arabia. (*General Overseas*)
- TIMMINS, ERIC, 6 Church Walk, Stow Longa, Huntingdon, Cambs, PE18 0TW. (*Thames Valley*)
- TURNER, JAMES, 4 Swann Grove, Cheadle Hulme, Cheshire SK8 7HW. (*Manchester*)
- URS, BHASKAR, BSc, Rusco/Perma Coating Inc, 1600 N De Prizio Drive, Melrose Park, Ill 60160, USA. (*General Overseas*)
- WALLINGTON, RAYMOND HENRY, BSc, MICorT, 79 Yester Road, Chislehurst, Kent. (*London*)
- WHITE, STANLEY, 5 Alandale Close, Worden Park, Leyland, Preston PR5 2DX. (*Manchester*)

### Registered Students

- CARMICHAEL, IAN, 33 Douglas Drive, Garrowhill, Glasgow G69 6NJ. (*Scottish*)
- MATANLE, EVELYN, 176 Hurstwood Avenue, Erith, Kent DA8 3QA. (*London*)
- MONK, JULIAN KINGSLEY, 42 Park Avenue, Failsworth, Manchester M35 0DY. (*Manchester*)
- MYCOCK, IAN JOSEPH, Manchem Ltd, Ashton New Road, Clayton, Manchester M11 4AT. (*Manchester*)
- SMITH, JOSEPH, 5 Affric Avenue, Plains, Airdrie. (*Scottish*)



# The mill that revolutionised paint technology..



## DYNO<sup>®</sup>-MILL



Willy A. Bachofen AG Maschinenfabrik

CH-4005 Basel/Schweiz, Utengasse 15/17, Telefon 061-335555, Telex 62564 wab



# ...is now firmly established in hundreds of factories throughout the world.

The legendary DYNO-MILL® is a superb product of Swiss engineering. It is the mill you can depend on to produce paints and inks with total reliability, from 2 to 2000 litres/hour, in small batches or in continuous production.

Features include colour change within 20 minutes; self-cleaning dynamic separator; simplicity of design for ease of service.

There are also fully automated models to work without supervision.

For full information on the Dyno-Mill, a demonstration or advice please contact:-

 **Glen Creston  
Machinery Limited**

16 Carlisle Road, London NW9 0HL, England.  
Telephone 01-200 1666 Telex 925791  
Telegrams Glencrest London NW9.

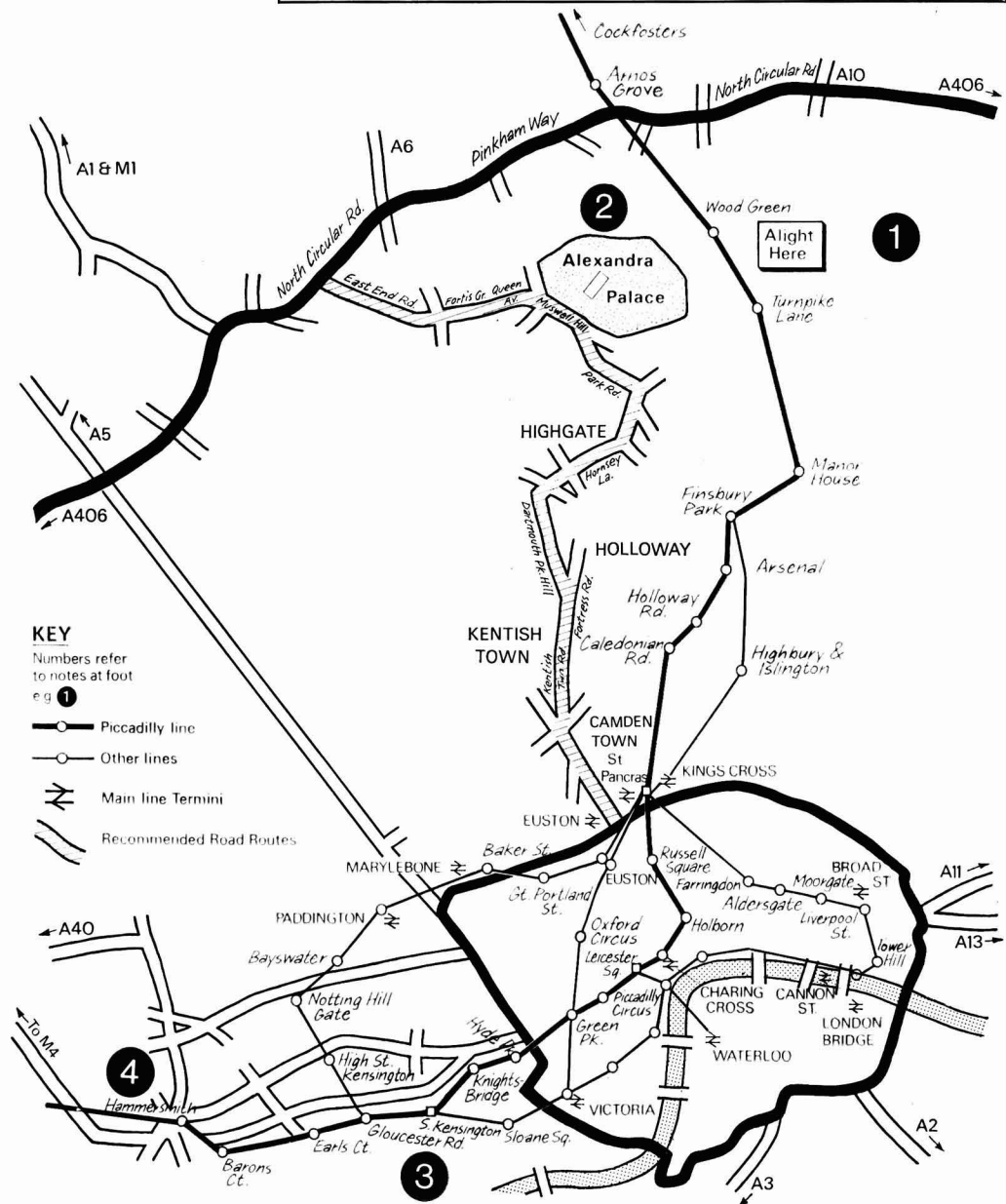
Enquiries outside the UK and Eire please address  
direct to the Manufacturers.

 **WILLY A. BACHOFEN**

Mfg. Engineers, Dept. of Application Technology, CH 4000  
Basle 5 Switzerland. Telephone 061-33 55 55 Telex 62564

# OCCA-31

For the benefit of intending visitors to the Exhibition, a map is reproduced below of the area around Alexandra Palace showing the mainline stations in central London, the Piccadilly, Circle and Victoria Lines of the underground system and also the road links with the North Circular Road and motorways. See also the enlarged map of Alexandra Palace, reproduced on page 112.



1. A free bus shuttle service will operate between Alexandra Palace and Wood Green station on the Piccadilly Line (Underground), which is denoted by the thick coloured line. Destinations of trains may be marked as "Cockfosters" or "Arnos Grove" or "Wood Green".
2. Those travelling by road will find free car parking facilities at Alexandra Palace.
3. Visitors arriving at West London Air Terminal may board the Piccadilly Line trains at Gloucester Road station.
4. The Piccadilly Line has now been extended to the Heathrow Central Terminal at the airport, and visitors can now board a train at the airport which will take them directly to Wood Green station, or to hotels in central London at which they are staying.
5. The map also shows the position of the mainline stations in relation to the Piccadilly Line.

# Forthcoming Events

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

## March

### March

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

### Monday 5 March

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

### Tuesday 6 March

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

### Thursday 8 March

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

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

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

### Friday 9 March

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

### Wednesday 14 March

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

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

### Thursday 15 March

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

### Friday 16 March

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

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

## Wednesday 21 March

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

## Friday 23 March

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

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

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

## Friday 30 March

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

## April

### Monday 2 April

*Hull Section:* Annual General Meeting at the George Hotel, Land of Green Ginger, Hull, commencing at 6.30 p.m.

### Tuesday 3 April

*West Riding Section:* Annual General Meeting at the Mansion Hotel, Roundhay Park, Leeds 8, commencing at 7.30 p.m.

### Thursday 5 April

*Newcastle Section:* Annual General Meeting at St. Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m.

### Friday 6 April

*Midlands Section—Trent Valley Branch:* Annual General Meeting followed by a Buffet Dance at the Cross Keys Inn, Turnditch, at 7.30 p.m. for 8.00 p.m.

### Thursday 12 April

*Scottish Section:* Annual General Meeting followed by Ladies' Evening. Evening of light music, venue to be announced.

### Sunday 15 April

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

### Thursday 19 April

*London Section:* Annual General Meeting at Rubens Hotel, Buckingham Palace

Road, London, S.W.1, at 6.30 p.m.

*Thames Valley Section:* Annual General Meeting followed by a talk on "Local history" by G. Berry at Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing at 6.30 p.m. for 7 p.m.

## Friday 20 April

*Irish Section:* Annual General Meeting at the Clarence Hotel, Dublin, commencing at 9.00 p.m.

*Manchester Section:* Annual General Meeting at the Pavilion Room, Old Trafford, details to be announced.

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

## Friday 27 April

*Bristol Section:* Annual General Meeting at the Royal Hotel, College Green, Bristol, commencing at 7.15 p.m.

## Forthcoming Symposium

### The role of protective coatings

2-3 July, 1979

### South African Division

The South African Division is organising a winter school in conjunction with the South African Chemical Institute and the South African Corrosion Institute to be held in the Dorothy Susskind Auditorium, University of Witwatersrand, from 2-3 July, 1979.

The school is aimed at disseminating up to date practical information on the protection of structures and plant by means of organic and inorganic coatings. Not only will the properties, advantages and disadvantages of various protective systems be discussed in detail, but considerable attention will be devoted to preparing the surface prior to coating, methods of applying coatings, the selection and specifying of coatings for specific environments, methods of coating inspection and the assessment of coating failures.

The winter school is expected to be of particular interest to those who are responsible for specifying coatings for new projects or maintenance coatings in existing operations.

Full details and application forms may be obtained from:

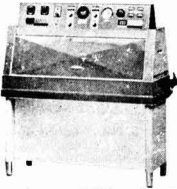
The Secretary  
Corrosion School 1979  
P.O. Box 737  
Edenvale  
1610  
South Africa

## CONDENSATION TESTER



The QCT Condensation Tester tests finishes for resistance to moisture in the form of rain and dew. The QCT's unique condensation system gives faster, more realistic tests than conventional humidity, while maintaining foolproof control of water purity, oxygen saturation, and test temperature. Initial cost is quite low, and maintenance is almost nil. Ordinary tap water may be used, because the QCT distills the water in the process of transporting it to the test surface. Test severity can be varied widely by regulating the temperature.

## ACCELERATED WEATHERING TESTER



The QUV Accelerated Weathering Tester has replaced conventional methods of durability testing in hundreds of labs throughout the world. The QUV simulates rain and dew by the same mechanism as our QCT Condensation Tester. The effects of sunlight are simulated by an array of 8 special fluorescent lamps. Light emission is concentrated in the critical UV wavelengths, providing closer control and faster testing. Users report excellent correlation with outdoors.

Initial cost and operating costs are suprisingly low compared to carbon arc or xenon arc machines. Electrical consumption is just 700 watts. Operation is completely automatic, with a wide variety of temperatures and cycles easily programmed. Scheduled maintenance is just 15 minutes once a month.

## TEST PANELS

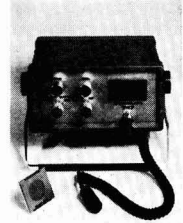
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A member of the Association, attached to the Auckland Section, will be visiting the U.K. from 29 May to 3 August 1979 and wishes to take the opportunity to visit raw material suppliers who would be willing to show him their production facilities and perhaps give him the opportunity of working for a short while in a branch of the British surface coatings industry. Also of interest would be any manufacturers interested in having a New Zealand based agent manufacturing their products under licence. Replies to **Box 469**.

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