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Measurement of the electrical properties of typical tank coatings:
Some preliminary investigations of the effects of seawater and cargoes
on such properties *W. M. Groenewoud*

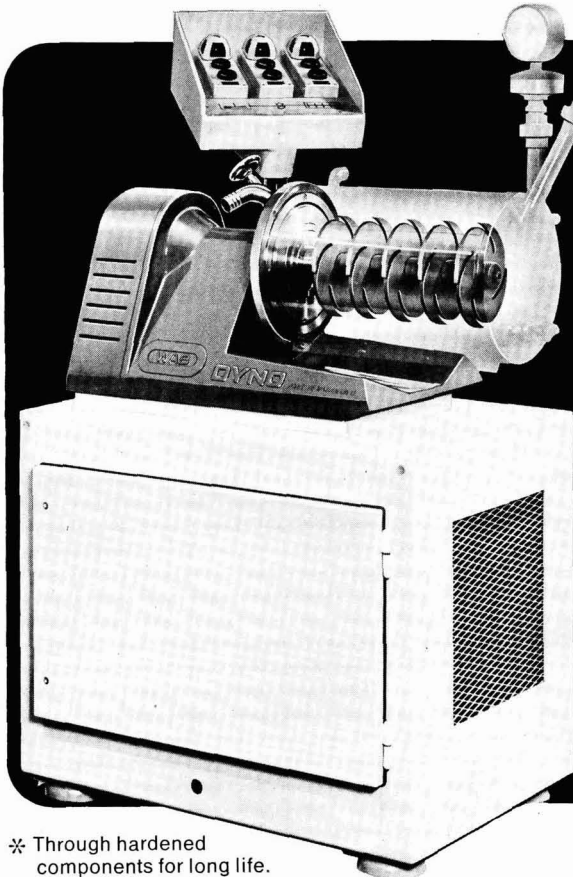
The realistic prediction of primer performance—A case history
J. B. Harrison

Protection by organic coatings
K. S. Rajagopalan, S. Guruviah and D. N. Roy

A method for testing the mould resistance of paint films (*Short
Communication*) *S. Barry, A. F. Bravery and L. J. Coleman*

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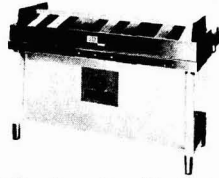
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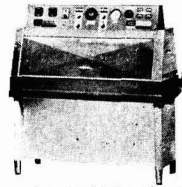
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Transactions and Communications

Measurement of the electrical properties of typical tank coatings: Some preliminary investigations of the effects of seawater and cargoes on such properties*

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Summary

A semi-automatic procedure for measuring the resistivities and dielectric constants of paint films applied to steel substrates is described. Data are presented which illustrate the time and voltage dependence of the charging and discharging currents. It is shown that accurate values of the specific volume resistivity of a film can be obtained long before current equilibrium is established, which can take several hours.

Comparison of the resistivities obtained by direct current measure-

ments with those by alternating current methods shows that the latter methods are unsuitable for characterisation of the sustained transport of electrical charges (such as occurs, for example, in the dissipation of electrostatic charges).

Some examples are given which illustrate how the electrical properties of a number of typical tank coatings are affected by exposure to seawater, kerosine or crude oil

Keywords

Types and classes of coatings and allied products

epoxy coating
coal tar epoxy coating

Types and classes of structures or surfaces to be coated

steel

Properties, characteristics and conditions primarily associated with materials in general

dielectric constant
electrical conductivity
resistivity
capacitance
alternating current
electrical potential

dried or cured films

sea water immersion

La détermination des caractéristiques électriques de peintures-types pour citernes. Quelques études préliminaires à l'égard de l'influence sur telles caractéristiques qu'exercent les eaux marines et les substances transportées dans les citernes

Résumé

On décrit une méthode demi-automatique pour déterminer la résistivité et la constante diélectrique des films de peinture appliqués aux subjectiles en acier. On présente des données qui montrent la dépendance en fonction de temps et de tension des courants de charge et de décharge. On démontre que les valeurs précises de la résistivité spécifique du film peuvent être déterminées bien avant que soit atteint l'équilibre du courant, ce qui ne pourrait arriver qu'après quelques heures.

Une comparaison des résistivités rendues par les mesures effectuées

au courant continu avec celles rendues par les méthodes au courant alternatif démontre que ces dernières méthodes ne sont pas convenables pour caractériser le transport entretenu de charges électriques, (qui se produit, par exemple, au cours de la dissipation des charges électriques).

On donne certains exemples qui indiquent la manière par laquelle les caractéristiques d'une série de peintures-types pour citernes sont influencées par l'exposition aux eaux marines, au kérosène, et au pétrole brut.

Messung der elektrischen Eigenschaften von typischen Tankanstrichen: Einige vorbereitende Untersuchungen der Einwirkungen von Seewasser und Schiffsladungen auf derartige Eigenschaften

Zusammenfassung

Beschreibung eines halbautomatischen Verfahrens zur Messung der Widerstandskraft und dielektrischen Konstanten von auf Stahlsubstrate aufgetragenen Anstrichfilmen. Daten werden vorgelegt, welche die Abhängigkeit von Zeit und Voltspannung von den Ladungs- und Entladungsströmen beleuchten. Es wird gezeigt, dass genaue Werte für den spezifischen Volumenwiderstand eines Films erhältlich sind lange ehe Stromgleichgewicht hergestellt ist, was mehrere Stunden in Anspruch nehmen könnte.

Vergleiche der spezifischen, durch direkte Strommessungen mit

Wechselstrommessungen erhaltenen Widerstände zeigen, dass die letzteren Methoden für die Charakterisierung des unbehinderten Transportes elektrischer Ladungen (wie sie beispielsweise im Energieverbrauch elektrostatischer Ladungen vorkommen) ungeeignet sind.

Einige Beispiele werden gegeben, welche zeigen, wie die elektrischen Eigenschaften einer Zahl von typischen Tankbeschichtungsmitteln betroffen werden, wenn sie Seewasser, Kerosin oder Rohöl ausgesetzt sind.

*Paper presented at the XIVth FATIPEC Congress in Budapest 1978, and published by kind permission.

Introduction

Refs. 1-5

In recent years there has been a vast increase in the bulk shipment of refined and chemical products. In addition, cargo tanks are increasingly used to store various products instead of reserving separate tanks for each special product. In consequence, there has been an increase in interest in coatings for tanks having an improved resistance to various chemicals. These changes have meant that the electrical properties of tank coating systems have become important, not only in connection with the decay of electrostatic charge and corrosion protection, but also because they provide a sensitive aid for monitoring changes in a coating's performance.

The principal aim of the actions taken with regard to the electrostatic problems has been to promote the safe discharge of such charges during their development. The two factors which determine the ability of electrostatic charges to disappear through a paint layer are its volume resistivity and dielectric constant. The product of these, called the "relaxation time", represents the time taken for the charge to decrease to 1/e th ("e" the base of the natural logarithm) of its original value, and is used as a measure for the coating's charge dissipation ability.

If the resistivity and the dielectric constant of a tank coating are of the same order of magnitude as those electrical properties of the product carried, the relaxation time of the whole system is not increased and this situation is generally accepted to be safe. From an anti-corrosion point of view, however, coatings with a high volume resistivity are favoured. The resulting high resistance of the paint layer can act as a barrier preventing ions reaching the metal surface; this is called resistance inhibition. This factor will result in greater disparity between the electrical properties of the coating and typical cargoes and thus tend to increase the likelihood of electrostatic charge build-up. Apart from this aspect, the volume resistivity may also considerably affect the efficiency of the impressed current cathodic protection systems typically used in tanker situations.

A further complication is that the volume resistivity of coating materials is strongly dependent on their composition and this, in turn, can be greatly affected by contact with different cargoes. Hence, knowledge of this property for present day coating systems, as a function of time and contact with different media, is desirable.

The literature data on paint film resistance values are mainly obtained by alternating current measurements performed at different frequencies (see for example Ref. 1). The rather scarce direct current resistance values reported were all measured at low potentials (less than 1 volt) in connection with the corrosion processes being studied²⁻⁵.

The present paper describes a partly automated system developed for measuring DC volume resistivity of coatings and also presents some initial results. The method described enables the effect of time to be taken into account, as well as the effects of voltage and exposure of the coating to various media of interest. The AC properties of the same coatings have also been measured at about 1000 Hz and the results obtained are discussed in comparison with those obtained using the DC method.

Electrical properties of paint coatings

Volume resistivity

Ref. 6

Several standard methods exist for the measurement of the specific volume resistivity, e.g. ASTM (D257), BS (202A), DIN (53596/51953) and ISO (93). In these methods an electric field from a stable DC voltage is applied across the sample contained between two electrodes. The current through the sample is subsequently measured and the specific volume resistivity is calculated according to Ohms law:

$$\rho = \frac{U \cdot A}{I \cdot d} \dots\dots\dots(1)$$

where ρ : specific volume resistivity, conventionally expressed in ohm.cm

- A*: area of the electrode, (cm²)
- d*: distance between the electrodes, (cm)
- U*: voltage applied, (Volts)
- I*: current measured, (Ampères)

At a constant temperature, the time during which the voltage is applied (the electrification time) and the magnitude of the voltage, may strongly influence the results obtained. Conventionally, the electrification time is one minute and the voltage is either 100 or 500 V (the thickness of the sample is not specified). However, particularly if the materials under investigation have a pronounced time dependency (which may in any case be different for each material), comparisons based on the one minute measurements may be misleading. Means of offsetting or counteracting this time-dependency would thus be of considerable interest.

The time dependency of the currents measured is due to the fact that the paint film not only represents a pure ohmic resistance, but also has a certain capacitance. Moreover, extra capacitances may be formed by interfacial polarisation and certain electrode effects⁶. These capacitances give rise to an extra time-dependent contribution to the measured current. The time-dependent part of the charging current is reversed if the sample cell is discharged by short-circuiting after charging for some time. Consequently, the stationary DC current, I_s , can be found from the known values of the charging current, I_c , and the discharge current, I_d , by taking the values of I_c and I_d at equal times after the start of charging and discharging, respectively, according to:

$$I_s = I_c + I_d \text{ (} I_d \text{ has a negative sign)} \dots\dots\dots(2)$$

Before inserting I_s in eq. 1, it may be necessary to take into account the contribution due to electrochemical and/or contact potential differences. If the current I_0 associated with these is the same for the charging and discharging steps, the current required for eq. 1 can be obtained from:

$$I = I_c + I_d - 2I_0 \dots\dots\dots(3)$$

Current I_0 can be found by measuring the equilibrium current during short-circuiting of the system before charging. At sufficiently high voltages the I_0 correction can presumably be neglected and the I_s value can then be used in equation 1.

Figure 1 shows schematically the procedure for measuring current I according to equation 3. Formerly, such a procedure

was very time-consuming but nowadays, however, application of sophisticated measuring and calculation equipment makes these measurements possible using relatively little manpower.

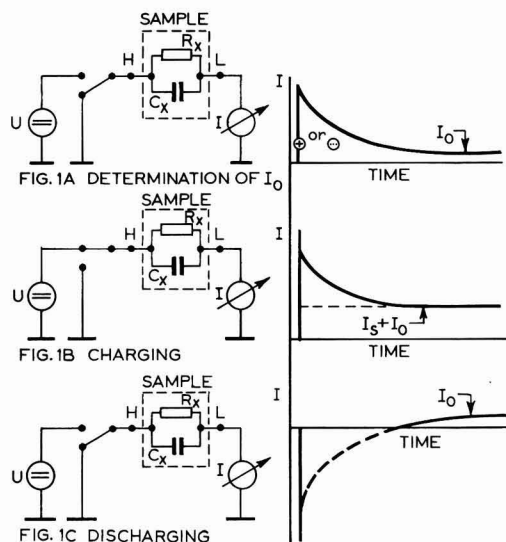


Fig. 1. Current flows during volume resistivity measurements

Dielectric constant and loss factor

The AC properties of a tank coating system can be measured with a suitable measuring bridge using the same sample and electrode configuration as in the determination of the volume resistivity. Such a bridge measures the equivalent parallel capacitance (C_x) and conductance (G_x) of the sample at a chosen frequency. These values are used to calculate the relative dielectric constant (ϵ_r') and the relative dielectric loss factor (ϵ_r'') according to:

$$\epsilon_r' = \frac{C_x}{C_0} \dots\dots\dots(4)$$

$$\epsilon_r'' = \frac{G_x}{\omega C_0} \dots\dots\dots(5)$$

where $\omega = 2\pi f$, f the frequency in Hz.

C_0 : capacitance of the electrode assembly without a sample, Farad

C_x : capacitance of the electrode assembly with the sample, Farad

G_x : conductance, ohm⁻¹

If the dielectric (AC) type of measurement is used for the determination of the volume resistivity, the latter is calculated by

$$\rho = \frac{A}{G_x \cdot d} \dots\dots\dots(6)$$

The values obtained from equations 1, 4, 5 and 6 may not be specific values in the strict sense, i.e. independent of layer thickness. It is believed, however, that for practical purposes they are suitable for comparing the results obtained with different samples and under different circumstances.

Experimental

The coatings used in this investigation were deposited on both sides of grit-blasted steel panels, 10 × 15cm. The different coatings applied and the immersion media used are described in Tables 1 and 2. The coated panels were left to age at room temperature for about two months.

Table 1
Description of samples

Sample code	Sample type	Film thickness, μm	Number of coats	PVC*
A	Epoxy coal-tar system, cured with amine adduct	250	2	16
B	Epoxy system cured with isocyanate	275	3	40
C	Epoxy powder coating	305	1	16
D	Cold-applied solvent-free epoxy system	340	1	19

*PVC: pigment volume concentration.

Sample cells (Figure 2) were then constructed upon the coated panels by glueing the ground end of glass tubes (about 50mm internal diameter) on to the coated surface with epoxy cement. Before placing the tube, its inner diameter was measured accurately and the thickness of the coatings was determined at five arbitrary locations on the cell bottom using a Fisher ESO-8 permascop. The sample cells were stored at 22±2°C and a relative humidity of 55±5 per cent. The steel panel served as high potential electrode (H), and a mercury electrode, connected by a platinum wire, as low

Table 2
Description of the immersion liquids

Immersion liquid	Specific volume resistivity, ohm. cm 23°C, 10 volt	Dielectric constant 23°C, 1000Hz	Immersion experiments with the samples:
1. Synthetic seawater composition according to DEF 1053, method 29	35	—	A, B, C, D
2. Middle East (Kuwait) crude oil	2.1×10^9	2.47	A
3. Kerosine hydrotreated kerosine from an Iranian Light crude, final boiling point 290°C	6.5×10^{13}	2.10	B, C, D

potential electrode (*L*). Guarding was achieved by using a brass bell-shaped cover which also supports the connector of the low potential electrode.

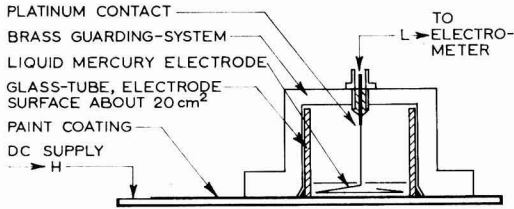


Fig. 2. Construction of the sample cell

In the immersion experiments the sample cells were filled to a depth of 2.5cm with the appropriate liquid. Before each measurement the liquid was decanted and the surface to be measured was wiped dry with a soft tissue. The mercury electrode was then introduced. After the measurement the mercury was removed and fresh immersion liquid was reintroduced if exposure for an additional period of time was required. The immersion liquids were renewed at least every 14 days.

Figure 3 shows schematically the electrical measuring system. The current flowing in the circuit was measured using a Keithley 616 auto-ranging digital electrometer. Used in its fast mode (a feed-back configuration), its input resistance was less than 10^7 ohm, or less than 0.002 per cent of the resistance value being measured. The analogue output of this meter was recorded using a two-pen XT recorder, or stored on magnetic tape by a data-logger system. The digitised data from the recorder or the data-logger output were processed with the aid of a Hewlett Packard 9830-A calculator and the results of the measurement of charge and discharge current versus time were calculated according to equations 1 and 3 and listed. With the aid of an HP 9862-A plotter the currents measured were subsequently plotted as a function of time on a logarithmic scale. This plot and listing allow the results to be displayed rapidly and easily.

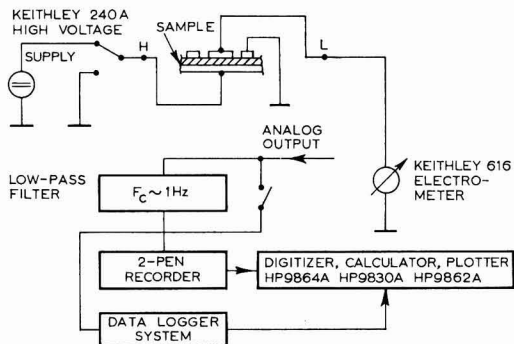


Fig. 3. Block diagram of the measuring circuit

The AC properties were obtained from the capacitance and conductance of the sample cells as measured by a General Radio 1680-A automatic capacitance bridge assembly, modified to make measurements at 400, 1000 and 2500Hz.

In connection with the expected behaviour discussed above, the following measuring sequence was adapted:

- measurement of I_0 until an equilibrium value was reached;
- 40 minutes charge at 1 volt potential followed by 40 minutes discharge: the currents flowing being monitored continuously;
- the same charge and discharge procedure was followed applying 10 volt and 100 volt potentials respectively;
- measurement of the dielectric properties.

The time needed for such a measuring sequence was about five hours.

Results and discussion

Refs. 7-9

Figure 4 shows an example of a print-out and Figures 5 and 6 are typical examples of the plots obtained. The pronounced time dependency of the currents measured for sample B before immersion is clearly shown in Figure 5. This behaviour was hardly altered by immersion in kerosine, but the time dependency of the charging current clearly decreased during seawater immersion, Figure 6.

Charge/discharge currents

Date: 12/10/76
 Time: 11.00 UUR
 Temperature: 23.0°C
 Sample Number: 2C
 Sample Name: Sample B
 Electr. Surface: 19.861 cm²
 Thickness: 0.0253 cm
 Meas. Voltage: 100.0 Volts
 Capacity, Co: 69.47 pF
 Scale Factor:
 Charge Curr.: 2.00E-09 A
 Discharge Curr.: 2.00E-09 A
 Rest Curr., I_0 : 1.00E-13 A
 Remarks: None
 Remarks: None

Time Sec.	Charge current A	Discharge current A	Direct current A	Specific resistance ohm. cm
30	5.00E-10	-4.09E-10	9.13E-11	8.60E+14
60	2.92E-10	-2.57E-10	3.54E-11	2.22E+15
90	2.21E-10	-1.85E-10	3.52E-11	2.23E+15
120	1.84E-10	-1.44E-10	3.97E-11	1.98E+15
180	1.41E-10	-1.02E-10	3.92E-11	2.00E+15
300	1.04E-10	-6.52E-11	3.83E-11	2.05E+15
600	7.34E-11	-3.45E-11	3.89E-11	2.02E+15
900	6.07E-11	-2.33E-11	3.75E-11	2.09E+15
1200	5.42E-11	-1.75E-11	3.66E-11	2.14E+15
1800	4.70E-11	-1.14E-11	3.57E-11	2.20E+15
2400	4.31E-11	-8.28E-12	3.48E-11	2.25E+15

Time sec.	Freq. HZ	Loss Factor AC+DC	Factor AC
30	3.33E-03	3.4	2.8
60	1.67E-03	4.0	3.5
90	1.11E-03	4.6	3.8
120	8.33E-04	5.0	4.0
180	5.56E-04	5.8	4.2
300	3.33E-04	7.1	4.5
600	1.67E-04	10.1	4.7
900	1.11E-04	12.5	4.8
1200	8.33E-05	14.9	4.8
1800	5.56E-05	19.4	4.7
2400	4.17E-05	23.7	4.6

Spec. res. after 60 sec. (charge current), ASTM D 257-IEC 93 = 2.69E+14

Fig. 4. Print-out of the results of one measurement

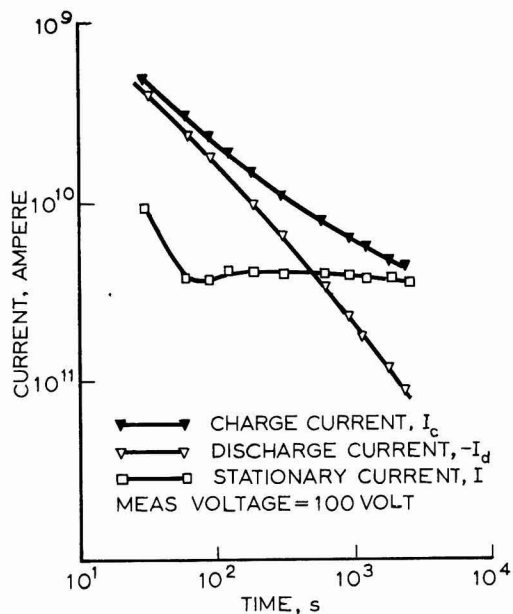


Fig. 5. Plot of the measured and calculated currents for sample *B* before start of immersion experiments

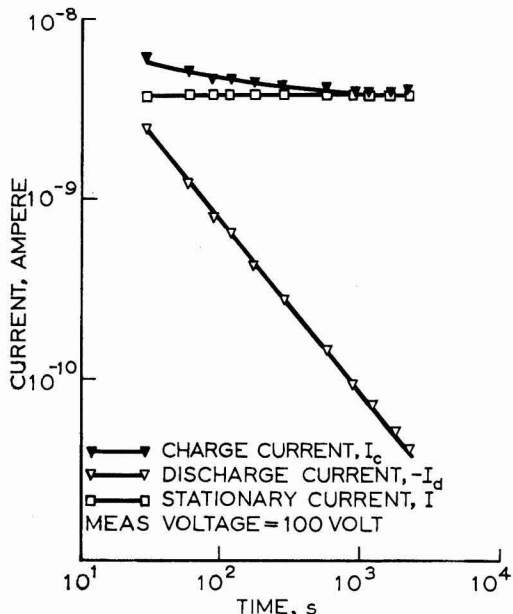


Fig. 6. Plot of the measured and calculated currents for sample *B* after 35 hours immersion in seawater

The results of the application of equations 1 to 3 show that, apart from scatter at the short measuring times (caused by the inevitable inaccuracy resulting from subtraction of two large and rapidly decreasing values), the calculated stationary current is indeed constant. In practice this means that the

resistivity can be derived long before the overall current has become constant.

This procedure may be particularly critical at low measuring voltages and with samples where electrochemical currents may arise. Figure 7 shows the currents I_0 measured as shown in Figure 1A. No attempt will be made to draw conclusions from the magnitude of these currents in the absence of precise knowledge of the composition and oxygen content of the electrolytes in contact with the metal surfaces. However, as Table 3 shows, consistent values of I_0 are obtained for positive and negative voltages applied, in spite of the sometimes large contribution of I_0 . With some samples, or at higher voltages, the contribution of I_0 will be less significant. In a measurement at 10 volts, for instance, I_0 only represents about five per cent of the current measured. Consequently the specific volume resistivity can be confidently derived from measurements made by the above procedure.

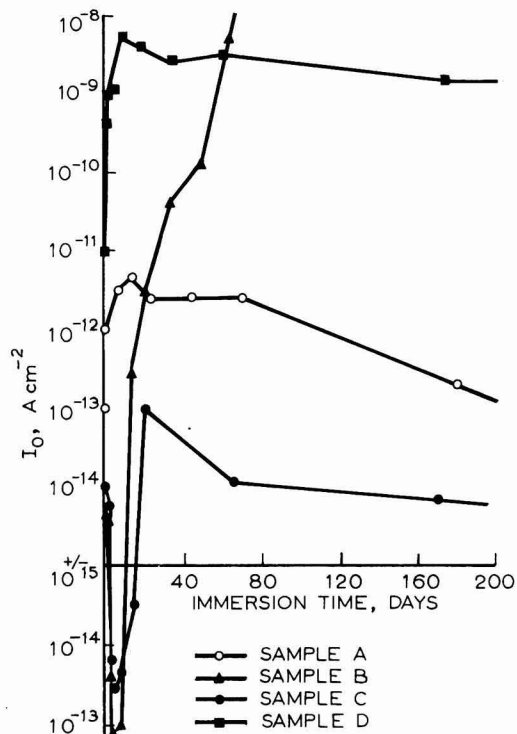


Fig. 7. Equilibrium (I_0) currents as a function of the immersion time of the samples in synthetic seawater

The measurement voltage was found to influence the value of the resistivity for samples *A* and *B*. Table 4 illustrates the effect of measurement voltage on the resistivity values for the dry samples, as well as for samples immersed for about 160 hours in synthetic seawater. It is clear that this voltage dependency is different for both samples and that it significantly increased upon immersion in seawater.

The dramatic changes in the electrical properties after seawater immersion are evident from Figure 8. These results are paralleled by those from the dielectric constant measurements shown in Figure 9. Sample *B*, which showed a con-

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Table 3
Check for consistency of I_0 current correction

Measured currents, Amperes	Sample			
	A	B	C	D
I_0 equilibrium value	0.51×10^{-10}	1.37×10^{-6}	0.50×10^{-15}	3.88×10^{-8}
I_0 , after correction for I_0 , at +1 volt	1.06×10^{-9}	2.42×10^{-6}	2.28×10^{-12}	1.04×10^{-7}
I_0 , after correction for I_0 , at -1 volt	-1.06×10^{-9}	-2.50×10^{-6}	-2.18×10^{-12}	-1.05×10^{-7}

Table 4
Influence of measurement voltage on the volume resistivity

Samples	Volume resistivity (ohm. cm) measured at		
	1 volt	10 volt	100 volt
Sample A			
before immersion	4.9×10^{13}	4.7×10^{13}	4.5×10^{13}
after 160 hours seawater immersion	6.4×10^{11}	4.9×10^{11}	3.6×10^{11}
Sample B			
before immersion	7.3×10^{15}	4.5×10^{15}	3.6×10^{15}
after 160 hours seawater immersion	1.3×10^{13}	4.8×10^{12}	1.9×10^{12}

tinuous decrease of volume resistivity of more than sixty-fold, proved to be a special case. This sample showed two conspicuous corrosion spots after about 60 days of seawater immersion, while the dielectric constant of this system had risen to a value of about 40 compared with 80 for water.

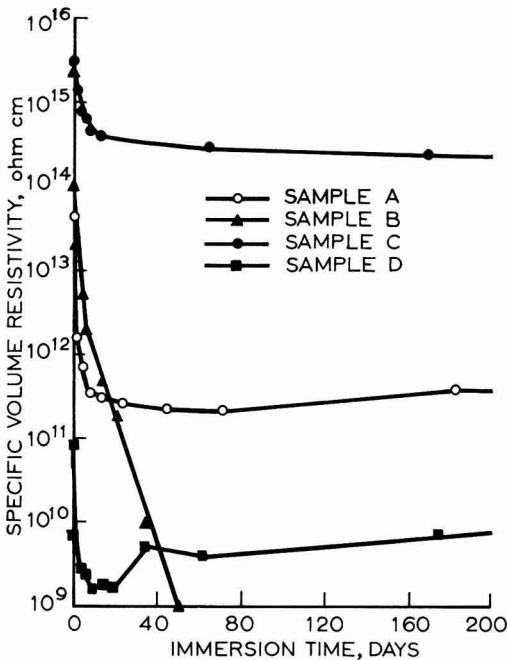


Fig. 8. The specific volume resistivity (at 100 volt) as a function of the immersion time in synthetic seawater

After only 14 days of seawater immersion, the charging currents, measured at 100 volt, seemed to be influenced by these "weak" spots. During these tests it was found that the charging current, which normally decreases steadily, started to increase after longer electrification times. The magnitude of this effect increased with the immersion time until, after about 60 days, a normal resistance measurement became impossible.

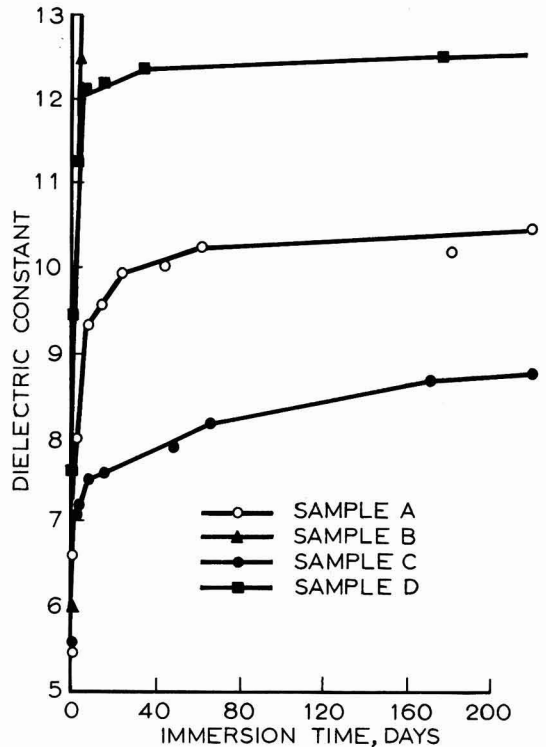


Fig. 9. The dielectric constant (at 1000Hz) as a function of the immersion time in synthetic seawater

Immersion in kerosine or crude oil only slightly influenced the electrical properties of all the samples, as shown by the values in Table 5. During these measurements, in particular, the paint film thickness was carefully monitored but no swelling was detected.

The time dependency of charging and discharging currents is a common phenomenon for polymers⁷. For paint films, however, this effect is scarcely mentioned in literature although

Table 5
Results of kerosine/crude oil immersion experiments (100 volt measurement voltage)

Sample	Immersing liquid	Properties before immersion		Average value of electrical properties after immersion		
		Spec. volume resistivity ohm. cm	Dielectric constant at 1000Hz	Immersion time hours	Spec. volume resistivity, ohm. cm	Dielectric constant at 1000Hz
A	Crude oil	7.8×10^{13}	5.28	1300	7.2×10^{13}	5.30
B	Kerosine	4.0×10^{15}	6.29	250	3.0×10^{15}	6.30
C	Kerosine	8.4×10^{15}	5.63	1300	9.0×10^{15}	5.60
D	Kerosine	2.2×10^{12}	7.26	800	1.3×10^{12}	6.70

DC and AC methods for paint film resistance measurements were studied recently⁸.

In the course of the present investigation, both the DC and the AC properties of various samples were measured. Hence, the results of both types of measurements can be compared to see if they provide the same or complementary information. The connection between AC and DC resistance is conveniently described by the relation between dielectric loss factor (ϵ_r'') and frequency. The loss factor of most polymers stems from the dielectric relaxation and the DC conductivity, i.e.

$$\epsilon_r'' (total) = \epsilon_r'' (dielectric) + \epsilon_r'' (conductivity)$$

The dielectric relaxation effect stems from the glass-rubber transition of the resin. For short time scales this transition takes place at a temperature of a few tens of degrees Celsius but, when the time scale is longer, the onset of the glass-rubber

transition can occur at lower temperatures, even around ambient temperature. This transition is accompanied by an increase in the dielectric constant, which is responsible for the observed relaxation behaviour. In terms of transport of charge through a polymeric coating, only the conductivity term is of interest.

The contribution of this term to the total loss factor, however, is inversely proportional to the frequency at which it is measured, see eq. 5. Hence, above a certain frequency, the conductivity term becomes negligible with respect to the dielectric term. AC measurements then, give a false impression of the DC conductivity.

This is illustrated by Figure 10 in which the separation of the contributions at low frequencies has been achieved by using the approximate relationship between the currents measured during the DC volume resistivity measurements and the frequency:

$$\epsilon_r'' (total) = \frac{I_c(t_1)}{2\pi f_1 C_0 U} = \frac{I_d(t_1)}{2\pi f_1 C_0 U} + \frac{I_s}{2\pi f_1 C_0 U} \dots (7)$$

where $I_c(t_1)$, $I_d(t_1)$ are the charging and discharging currents, respectively, at time t_1 ; whilst according to Hamon⁹ the corresponding frequency is given by

$$f_1 = \frac{0.1}{t_1} \dots (8)$$

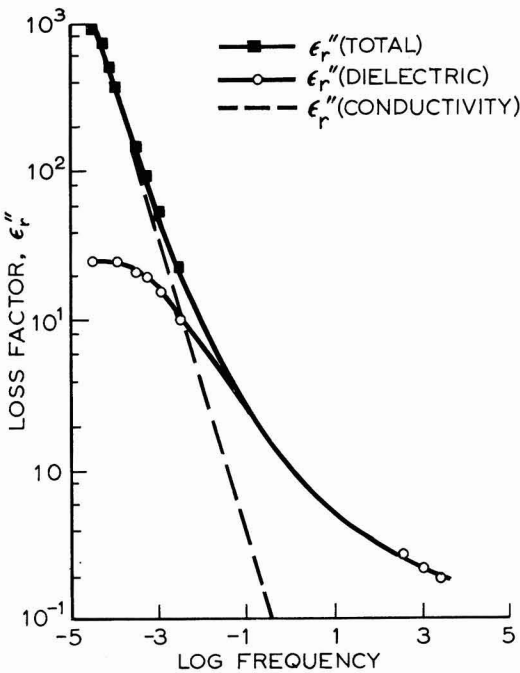


Fig. 10. AC and DC components of the loss factor of sample A (before immersion) versus frequency

In Figure 11 the results of the AC measurements at 400, 1000 and 2500Hz and the DC measurements (obtained at 100 volt measuring potential) are combined to compare the properties of the four samples before immersion. It clearly shows that, for these samples, the loss factor measured at frequencies of about 10Hz or higher mainly consists of the $\epsilon_r'' (dielectric)$ part. The ratio $\epsilon_r'' (dielectric) / \epsilon_r'' (conductivity)$ is relatively high for the samples B and C (at frequencies corresponding to the time scale of the DC resistivity measurement, 10^{-2} Hz to 10^{-5} Hz) and low for sample D. Hence, the charging currents, as measured for the samples B and C, are strongly time-dependent, whilst those measured for sample D are almost non-time-dependent. Sample A shows an intermediate behaviour. During seawater immersion both $\epsilon_r'' (dielectric)$ and $\epsilon_r'' (conductivity)$ contributions changed, although to differing extents, as is seen in Figure 12. After a relatively short immersion time, the conductivity term of this sample mainly determined the total effect and the time-dependency of the charging current disappeared.

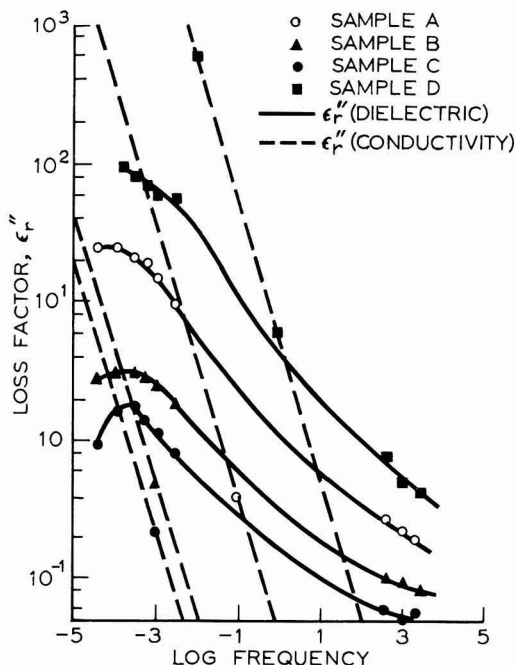


Fig. 11. AC and DC components of the loss factor versus frequency for samples before the immersion experiments

The above work showed that immersion in seawater had a much greater effect on the electrical properties of these typical coatings than immersion in crude oil or kerosine. Since, in practice, such coatings are likely to be exposed alternately to both materials, the effects of such cycling are expected to be of considerable interest and will be the subject of future investigation.

Conclusions

The currents measured during charging and discharging of a paint coating system are time-, and to a certain extent, voltage-dependent.

The measurement procedure and calculation method discussed in this paper enable a consistent evaluation of charging and discharging currents, as well as derivation of the specific volume resistivity, from non-stationary measurements.

Seawater exposure causes a pronounced decrease in the resistivity, whose extent depends on the type of coating and the immersion time. Exposure to kerosine or crude oil, however, hardly affects the electrical properties of the coating at all. Alternating current measurements in the conventional frequency range are not very suitable for the measurement of resistivity in connection with the sustained transport of electrical charge.

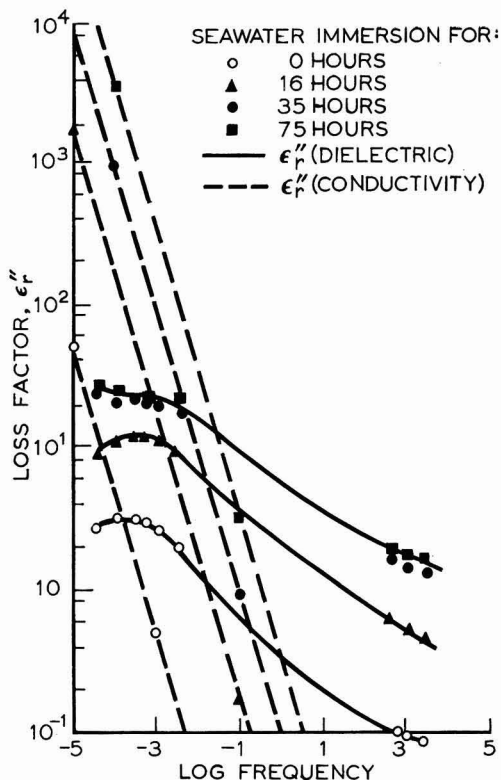


Fig. 12. Loss factor components versus frequency for sample B during immersion in synthetic seawater

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The realistic prediction of primer performance— A case history*

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Summary

The development of somewhat novel testing methods for the prediction of primer performance which commenced in 1960 is reviewed.

Their development over the years is such that, by 1975, they could be claimed to have been fully vindicated over a wide

range of products.

This vindication is illustrated by means of the examination of a wide range of conventional primer types, and the special case of the development of a new wide range of primers based on zinc phosphate pigment.

Keywords

Types and classes of coatings and allied products
primer

Types and classes of structures or surfaces to be coated
steel

Raw materials
prime pigments and dyes
zinc phosphate

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

weather resistance
exterior durability

La prédiction fiable du rendement de peintures primaires—un dossier

Résumé

On passe en revue la mise au point, commencée en 1960, de certains assez nouvelles méthodes d'essai pour prédire le rendement de peintures primaires.

Le développement des méthodes au cours des années était arrivé à tel point à 1975 que l'on pouvait prétendre que leur fiabilité a été

entièrement justifiée dans le cas d'une gamme de produits étendue.

Cette justification est démontrée par l'investigation d'une gamme étendue de types de peintures ordinaires, et par le cas exceptionnel du développement d'une nouvelle série de peintures primaires basées sur le phosphate de zinc en tant que pigment.

Die realistische Voraussage des Verhaltens von Primern—ein beobachteter Fall

Zusammenfassung

Die Entwicklung ziemlich neuartiger, in Jahre 1960 begonnenen Prüfmethode für die Voraussage des Verhaltens von Primern wird besprochen. Diese Arbeiten hatten bis zum Jahre 1975 so gute Fortschritte gemacht, dass Erfolg bei einer grossen Zahl von Produkten mit gutem Recht gefordert werden konnte. Dieser

Anspruch wird mit Hilfe der Prüfung einer grossen Zahl von konventionellen Primertypen klar gemacht, sowie des Spezialfalls der Entwicklung einer neuen auf Zinkphosphat basierenden Reihe von Primern.

Introduction

Ref. 1

In 1962 a paper was published in *JOCCA*¹, which had been read by the author to the London and Manchester Sections of O.C.C.A. earlier in that year. Its title was "New aspects of atmospheric corrosion of steel and their implications", and covered the importance and effects of atmospheric ammonium contamination on the initial corrosion of structural steel, and the subsequent behaviour of paint coats applied to the weathered wire brushed steel.

It also stressed that the adequate removal of corrosion products or control of the corrosion potential of the wire

brushed or grit blasted substrate surface was essential for reliable paint performance.

The paper also stressed and exemplified the unreliability of conventional salt (sodium chloride) spray accelerated tests and the need to incorporate some factors corresponding to the effect of ammonium salt contaminants, present in the atmosphere and profoundly affecting the residual corrosion product on weathered steel, before a salt spray test giving reliable prediction of ultimate primer performance could be expected or realised.

It is not proposed to repeat all the experimental details and arguments of that paper. It is sufficient to state that the crux

*Lecture presented to the three branches of the former South African Section in the autumn of 1975

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of the argument was that "ammonium sulfate" corrosion product was the determining factor affecting the subsequent performance of primers on prepared weathered steel surfaces. Furthermore, accepting grit blasting as the now recognised ultimate of the preparation of structural steel prior to painting, and the more usual practice of painting on to wire brushed rusty steel, then the unreliability of the 3.5 per cent sodium chloride salt spray test was explainable. Also, it was reported that a 0.5 per cent ammonium salt spray test had been found to correlate much more closely in practice with the actual performance of a given primer.

Subsequently, this aspect was most thoroughly investigated and by using a wide range of primer types of known and proved relative performance, a spray composition of 3.25 per cent ammonium sulfate and 0.25 per cent sodium chloride is now recommended as representing the closest possible approach to correlation with actual performance in practice.

A further important outcome of the work described in the 1962 paper¹ was the development of what is now accepted in the U.K. as the Girder Testing method. Again, the details of the development of this technique are fully documented in the paper, and experience has proved that this method of test for primers provides a means of prediction, whereby the primer formulations are tested on wire brushed six month rusted (at Kirkby, Liverpool) structural steel. This provides a means of observing and assessing the comparative performance of single coats of primer on the north facing back of the girder. Furthermore, it had been found consistently that the time to breakdown in months on the back of the girder gave a prediction of the time to breakdown in years, of the full system, on the south facing weather face of the girder.

It will be noted that, in the above paragraph, the site and time of weathering is specifically mentioned. This is a most important point for the consideration of anyone wishing to develop this technique as a testing method. The important point to be established on any testing site is the weathering time necessary to ensure that, after subsequent wire brushing, all the initial mill scale on the steel is removed. Further, the weathering must not be unduly prolonged beyond this stage; otherwise pitting occurs, whereby, after wire brushing, a repeatable surface for test cannot be guaranteed. Therefore, careful testing of the intensity of site weatherability is essential before adopting the test. It would be imagined that in a country where there is a wide range of atmospheric and corrosion intensities, the pre-weathering time for the girders used in the test will vary over wide limits.

The further evaluation of the new testing techniques

Refs. 1, 2

At this stage it must be explained that the 1962 paper¹ was part of a deliberate company strategy to explain and report to the paint industry as a whole that the previously accepted methods of accelerated and laboratory methods of testing of anticorrosive primers were dubious and required rigid reappraisal. There was a factor, not disclosed in the 1962 paper, but nevertheless of overriding importance, namely that a new, non-toxic, anticorrosive pigment, zinc phosphate, had been discovered and whilst showing excellent promise under outside and girder testing conditions, this order of performance had not been revealed initially by the conventional accelerated salt spray testing.

Thus the development of the testing methods described in the paper is inextricably bound up with the development of the potential of this new pigment. Of necessity, zinc phosphate is the basis of many of the formulations reported in the remainder of this paper tested in comparison with many of the established primer types in general use then and at the present time.

In 1965 a further paper² was presented to the London Section of O.C.C.A. By now the continuing development of zinc phosphate was common knowledge, and this paper was the first in which details had been publicly disclosed. The technical service department of Goodlass Wall & Co. were engaged in the practical development of primers based on zinc phosphate and had devised and put into operation controlled practical tests of a range of zinc phosphate primers in comparison with all the recognised standard primers then in current use in the paint field.

The tests were carried out on a number of new six ft. diameter 25 ft. high tanks in the Company's tank farm. There were 28 different types of primer in the series as a whole, but of particular significance were the following:

Zinc phosphate, oil based

Zinc phosphate, alkyd based

50:50 by volume Zinc phosphate/red lead in a fortified oil medium

Standard BS.2523 Type A Red Lead

Cheap Extender opacified by red oxide in an alkyd medium.

These are specifically mentioned as they are part of a series of paints which over a number of years had been thoroughly tested by the accelerated salt spray tests, both the 3.5 per cent sodium chloride, 3.25 per cent ammonium sulfate and 0.25 per cent sodium chloride tests, the girder test, and now the practical tank trials.

The practical tank tests commenced in May-June 1961. Thus, as far as the present paper is concerned, the results of 14 years of outdoor practical exposure can be reported and compared. The application work for these was carried out by the Company's maintenance painters. Preparation was by scraping, and wire brushing, followed by a solvent wipe. The tanks had been thoroughly weathered and were free from mill scale. No wire brushed steel was left overnight before priming. All the primers were applied in strips round the circumference of each tank. In order to eliminate any differences in behaviour that could be associated with height, the positions of the primers were varied from tank to tank. They were tested as one coat "holding" coats, and as three multicoat systems.

(a) Two coats primer, one coat undercoat and one coat alkyd gloss

(b) Two-coats primer and two coats aluminium paint.

(c) Two coats primer and two coats micaceous iron ore paint.

Painting was carried out during May-July 1961.

A year after these tests had been in progress, an assessment of the "holding coats" was made, and the best of these, *viz*:

Zinc phosphate in an oil medium

Zinc phosphate in an alkyd medium

Red lead BS.2523 Type A

were used in the painting of other new well weathered tanks. In this case, contract labour was employed, and no effort was made to control their standard of preparation or painting. A standard painting system of two coats of primer and two coats of micaceous iron ore finishing paint was adopted.

A review of comparative results comparing accelerated salt spray tests, girder tests, and tank tests on various paint primer formulations

Refs. 2-4

It is seldom that there is an opportunity to generate new ideas of accelerated and site testing, and over a wide series of primer types, to be in a position to compare predictions of performance with 14 year practical tank tests over a total period of

testing spanning some 16-17 years. It has to be realised that the correlation claimed is based on the results of all these tests, and it is submitted that the claims are valid and real.

With all temerity, the author claims that the accelerated ammonium salt spray test, backed by subsequent girder tests, gave almost without exception, a true prediction of ultimate primer performance. Selected comparative results are listed in Tables 1, 2 and 3.

*Table 1
Comparison of accelerated spray tests
All applications to controlled weight*

Primer type	3.5% Sodium chloride salt spray 500 hrs.	3.25% ammonium sulfate 0.25% sodium chloride spray 500 hrs.
Zinc phosphate in an oil medium	<i>b</i>	<i>g</i>
Zinc phosphate in an alkyd medium	<i>f</i>	<i>f-g</i>
Zinc phosphate in a styrenated alkyd medium	<i>f</i>	<i>g</i>
Zinc phosphate in a quick drying phenolic medium	<i>f</i>	<i>f-g</i>
50:50 by volume Red lead/zinc phosphate in fortified oil medium	<i>vg</i>	<i>vg</i>
Red lead BS.2523 Type A	<i>vg</i>	<i>g</i>
Red lead in an alkyd medium	<i>f</i>	<i>p</i>
2 pack red lead in an epoxy medium	<i>vg</i>	<i>f-g</i>
Cheap alkyd red oxide primer	<i>b</i>	<i>p-b</i>

Key *vg* very good
 g good
 f fair
 p poor
 b bad

*Table 2
Comparison of accelerated spray tests and girder tests*

Primer type	Accelerated test rating		Girder tests		Ranking
	Sodium chloride	Ammonium sulfate	Time to break down in months Single coat on back of girder	Time to break down in years of full systems on weather face of girder	
Zinc phosphate in oil medium	<i>b</i>	<i>g</i>	12	12	<i>vg</i>
Zinc phosphate in alkyd medium	<i>f</i>	<i>f-g</i>	*5	*6	<i>f</i>
Zinc phosphate in styrenated alkyd medium	<i>f</i>	<i>g</i>	*8	*9	<i>f-g</i>
Zinc phosphate in quick-drying phenolic medium	<i>f</i>	<i>g</i>	5	5	<i>f</i>
50:50 by volume red lead/zinc phosphate in fortified oil medium	<i>vg</i>	<i>vg</i>	12	12	<i>vg</i>
Red lead BS.2523 Type A	<i>vg</i>	<i>g</i>	10	11	<i>g-vg</i>
Red lead in alkyd medium	<i>f</i>	<i>p</i>	4	3	<i>p</i>
2 pack red lead Epoxy medium	<i>vg</i>	<i>f-g</i>	—	—	—
Cheap alkyd red oxide primer	<i>b</i>	<i>p-b</i>	—	—	—

* These were experimental paints known to give thin films on application

*Table 3
Comparison of girder test ratings with the tank tests*

Primer type	Ammonium sulfate ranking	Girder test ranking	Tank tests based on the M.I.O. finished systems after 14 years' exposure
Zinc phosphate in oil medium	<i>g</i>	<i>vg</i>	Still in good condition
Zinc phosphate in alkyd medium	<i>f-g</i>	<i>f</i>	*Still in good condition
Zinc phosphate in styrenated alkyd medium	<i>g</i>	<i>fg</i>	—
Zinc phosphate in quick drying phenolic medium	<i>f-g</i>	<i>f</i>	Breaking down in 7-8 years
50:50 by volume red lead/zinc phosphate in fortified oil medium	<i>vg</i>	<i>vg</i>	Still in very good condition
Red lead BS.2523 Type A	<i>g</i>	<i>g-vg</i>	Still in good condition
Red lead in alkyd	<i>p</i>	<i>p</i>	—
2 pack Red lead epoxy	<i>f-g</i>	—	Breaking down in 14 years
Cheap alkyd red oxide primer	<i>b</i>	—	†Breaking down after 3 years

*Compare Table 2
 †Compare Table 1

It will be seen that, as claimed, there is an amazingly good agreement between prediction and actual practical performance; it is, therefore, claimed that at one and the same time the 16 years tests have:

(1) Vindicated the reliability of ammonium salt spray tests, and/or girder tests as a means of predicting primer performance

(2) Confirmed the true promise of zinc phosphate pigment as a new, non-toxic pigment for consideration for use by the paint industry. It will be realised that on this aspect there is a much more detailed and cogent story to be revealed, and this forms the basis of a paper presented to the South African Corrosion Institute while the author was in South Africa³.

With further reference to Tables 1, 2 and 3, a few gaps will be noticed. These were unavoidable as, as has been already indicated, the comparison spans 17 years and unfortunately, human foresight is not such that when gathering data of this nature at the end of the work, every eventuality has been covered during the years.

However, it is claimed that the arguments and claims already expressed are fully tenable. The data in Tables 1, 2 and 3 is a combination of reported results through the years^{2,4} and the assessment (1975) of the results is taken from the still proceeding practical tank tests.

It is hoped a study of the tables will be accepted as justifying the claim that the ammonium sulfate test and the girder test are useful and improved means of predicting the ultimate primer performance in practice.

As already reported, the tank tests covered 28 different primer systems, many of them proprietary ones and some of them representing sophisticated formulations, covering both one and two pack products. In the event, the holding coat tests, since followed by the observation of the performance of the full systems, have given many surprises. Many products have proved much poorer in relative performance than originally claimed by the suppliers, thus showing the danger of the acceptance of suppliers' claims at face value. It must also be stressed that this inferior performance was not confined to obviously cheap formulations, but also included some high priced products, for which exaggerated claims of performance were being made at the time of their application for these tests.

Particular attention is drawn to the comparative results recorded for 2 pack Red lead epoxy. This product during its development had shown excellent salt spray (sodium chloride) resistance, but was not included in the girder tests. However, tests in use confirmed the promise of the salt spray test and the product was confidently recommended for sale by the author, and it became a favourite with the sales force. When the ammonium salt spray test was instituted as recorded, this test showed the product to be only "fair to good" compared to "good" for Type A Red lead. At the time this was attributed to the quirks of accelerated testing, and, in fact, it could be argued to cast doubt on the reliability claimed for the ammonium salt spray test. It is interesting to note that this product is now breaking down after 13 years on the tank tests, normally considered to be a good performance but, nevertheless, inferior to Red lead Type A under the same conditions.

A survey of the tests in retrospect

Ref. 4

The claims that more reliable tests for the prediction of primer performance had been developed has already been recorded, and, it is hoped, now exemplified. It will be realised that this

paper attempts to summarise a vast amount of information in as concise a form as possible. However, apart from the aspects already considered, there are important points that have been observed during the years, and which are of considerable significance. They are:

(1) The tests to date are fully establishing the supreme durability of micaceous iron ore paints and their usefulness in structural steel protection when used over a good quality primer. After 14 years they are clearly superior to the aluminium finish and to the undercoat and alkyd gloss finishes used in the testing series, both of which are now severely eroded, with a consequent adverse effect on the present rating of the full system.

(2) Initially, tests on the holding coat, and subsequently, on the full systems, emphasised the importance of the siting and orientation of the tests as affecting the rate of breakdown.

Without exception the first onset of breakdown was noted on sheltered or stagnant areas. At the Speke, Liverpool, site, with prevailing weather from Liverpool Bay in a W.-SW. direction, the first onset of breakdown occurred on the ENE side of the tanks i.e. the areas that had the shortest drying rate or, put in another way, which always stayed wet longer. This factor clearly agrees with the efficacy of the north facing face containing the single primer coats in the Girder Tests, and their usefulness for rapidly predicting the performance of the full system on the southern weather face.

It is still, generally, world wide practice to conduct outdoor corrosion tests facing south, either in a vertical position or at 45°. Much more reliable and quicker results would be achieved by reversing this and using north facing exposures. These points have previously been forwarded to responsible authorities in the U.K. The paper⁴ published in 1969, was based on a paper presented, by invitation, to the Joint Services Non-Metallics Materials Board Standing Committee on Paints and Varnishes on 11 April 1967. It is known that, since this time, many of the important basic implications of the accelerated tests and the girder tests have been duly noted and incorporated in the internal testing methods of many of the committee members then present.

(3) The obvious usefulness of the ammonium sulfate spray test was never intended to mean the elimination of the established sodium chloride salt spray tests. In actual fact, careful practice dictates the use of both tests. The ammonium sulfate test is particularly relevant for industrial environments and areas well away from the sea coast, particularly in the U.K. There are many areas e.g. sea coasts, and marine sites, and off-shore installations where the conventional salt spray test must have significance and require its due consideration.

Conclusions

It is hoped that this survey of comparative corrosion testing over the last 17 years will meet with wide acceptance and consideration. Throughout the whole period, the author has freely circulated his ideas and discussed his results with all responsible specifying and research authorities in the U.K. paint field, and through this and his publications had hoped that time would bring about more realistic and reliable methods of testing. It must be stated that after attending the O.C.C.A. Conference in June 1975 there are some doubts. Some papers, both from U.K. and abroad, made it all too

obvious that old customs die hard. As a consequence, the author predicts that many of the claims for new primer performance in the papers presented will not be realised.

With the now established usage and efficacy of grit blasting, more and more researchers are basing their original development and sorting tests on hot rolled plate panels which have been grit blasted prior to paint application. There are dangers in this technique for several reasons.

(1) The justification for the claims made in this paper are to a large extent due to the fact that the appraisal testing (girder tests) carried out on 6" channel section girders, similar to the material used on actual structures. During the course of this work it was hoped to save on the expenditure of steel by using 4" channel and 2" angle hot rolled sections. This had to be abandoned due to the fact that, on the Kirkby, Liverpool, site, whereas 6 months' weathering was adequate for millscale removal in the case of 6" channel girders, in the case of 4" channel and 2" angle sections, even after a year's weathering, large areas of the millscale were still intact. Thus, the extra hot rolling of the steel to produce the smaller sections had resulted in a thicker and much more adherent millscale layer. It is universally accepted that to try to paint on mixed millscale/bright steel areas or millscale/wire brushed rusty steel areas is fatal. Therefore, in the use of grit blasted hot rolled $\frac{1}{4}$ " thick black plate, there is a high possibility that:

(a) The millscale will be very adherent.

(b) After grit blasting, without the most careful and sophisticated examination of every panel, it is virtually impossible to be sure that all the millscale has been removed. In fact, grit blasting can cause the embedding of particles of millscale in the steel matrix.

(c) Visual examination after grit blasting is of no use for determining whether a 100 per cent steel surface remains. Grit blasted steel and abraded millscale appear very much the same to the eye.

At the Conference mentioned, one of the authors expressed his surprise at the anomalous results he had obtained when using primers of known and predictable performance on his grit blasted hot rolled panel tests. In view of the above considerations, this is not entirely surprising.

Acknowledgments

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Readers may be interested to know that this paper is pertinent to sections of a paper to be presented by Dr Harrison at the Association's Conference to be held at Stratford-upon-Avon on 20-23 June 1979.

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Protection by organic coatings

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Summary

This is a review of research work undertaken in this laboratory on the development of coating systems for marine and industrial environments. Studies were carried out with oleoresinous vehicles and inhibitive pigments to determine their individual characteristics and they were then combined to get the best combinations of inhibitive pigment, extenders and vehicle which should give very effective inhibitive primers for industrial and marine environments. These studies resulted in the development of: (a) an inhibitive primer with a red lead content as low as 13 per cent, (b) inhibitive primers of zinc chromate in modified phenolic stand oil and epoxy ester and (c) calcium chromate/iron oxide primer which is as good as the zinc chromate primer in marine environments. Although cashew nut shell liquid is abundantly available in India, the present studies lead to the conclusion that oleoresinous vehicles based on it give primers which are poor in protective value because of their high permeability to aggressive anions.

Keywords

Types and classes of coatings and allied products

primer
anticorrosive coating

Types and classes of structures or surfaces to be coated

steel

Raw materials for coatings

prime pigments and dyes

iron oxide chromate

chemically active pigments

strontium chromate
barium chromate
red lead chromate

The primers developed were combined with undercoats and finishing paints and the complete protection systems subjected to accelerated corrosion tests and field exposures at three stations and the conclusion is drawn that the best results are obtained with zinc chromate in epoxy ester and calcium chromate/iron oxide in epoxy ester.

Studies with various metal coatings as bases for painting show that sprayed aluminium coating was best followed by sprayed zinc coating.

Currently work is in progress on protection by metal pigmented primers which can give good protection under marine and industrial conditions in India.

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

weather resistance
corrosion resistance

Protection à l'aide des revêtements organiques. Une étude effectuée au Central Electrochemical Research Institute, Karaikudi

Résumé

C'est une revue des travaux de recherche entrepris dans ce laboratoire sur le développement des systèmes de peintures pour les environnements industriels ou marins. Les études ont été effectuées, sur des véhicules à base de vernis gras et des pigments inhibitifs, en vue de déterminer leurs caractéristiques individuelles. Alors ils étaient combinés afin de donner la meilleure combinaison de pigment inhibitif, de matières de charge et de véhicule pour assurer des peintures primaires inhibitives qui sont très efficaces pour les environnements industriels ou marins. Ces études ont abouti au développement de (a) une peinture primaire inhibitive dont la teneur en minimum de plomb n'est que de 13%, (b) une peinture primaire inhibitive à base de chromate de zinc, de résine phénolique modifiée, de standolie et d'ester époxydique, (c) une peinture primaire à base de chromate de calcium/oxyde de fer qui, aux environnements marins, se montre aussi efficace que la peinture primaire à base de chromate de zinc.

Bien que l'huile de coquille de noix d'acajou soit abondante à l'Inde, les études actuelles amènent à la conclusion que les véhicules à vernis gras basés sur cette huile rendent les peintures

primaires de faible pouvoir protecteur à cause de leur perméabilité aux anions agressifs.

Les peintures primaires mises au point étaient alliées avec des peintures intermédiaires et des peintures de finition, et les systèmes intégraux de protection ont été soumis à des essais d'exposition aux intempéries à trois emplacements. On tire la conclusion que les meilleurs résultats sont rendus par les peintures primaires à base de chromate de zinc et d'ester époxydique ou à base du mélange chromate de calcium/oxyde de fer et d'ester époxydique.

Les études sur de divers revêtements métalliques en tant que bases pour peintures montrent qu'un revêtement d'aluminium appliqué par pistolet à chaud est le meilleur, un revêtement de zinc également appliqué par pistolet est en seconde place.

A présent une étude est en cours sur la protection fournie pour peintures primaires pigmentées par métaux qui pourraient offrir de bonne protection à l'Inde sous des conditions industrielles ou marines.

Schutz durch organische Beschichtungsmittel

Zusammenfassung

Dies ist ein Überblick über in diesem Laboratorium für die Entwicklung von Anstrichsystemen für Seeluft- sowie Industrieatmosphären durchgeführten Forschungsarbeiten. Untersuchungen schlossen Bindemittel auf Ölbasis und inhibierender Pigmente ein um deren individuellen charakteristischen Eigenschaften zu bestimmen. Als dann wurden diese kombiniert, um die beste Kombination von inhibierendem Pigment, Extendern und Bindemittel zu erhalten, d.h. die wirkungsvollsten inhibierenden

Primer für Seeluft- und Industrieatmosphären. Auf Grund dieser Untersuchungen wurden entwickelt: (a) ein inhibierender Primer mit einem Blei mengengehalt von nur 13 Prozent, (b) ein inhibierender Zinkchromatprimer in mit Phenolharz modifiziertem Standöl und Epoxyester und (c) Kalziumchromat Eisenoxid Primer welcher sich ebenso gut in Seeluft verhält, wie Zinkchromat Primer.

Obwohl Cashew nut shell liquid in Indien im Überfluss zur Verfügung steht, führten die derzeitigen Untersuchungen zu dem Schluss, dass dieses in Bindemitteln auf Ölbasis Primer ergibt, welche wegen ihrer hohen Durchlässigkeit für aggressive Anionen schlechte Schutzwerte zeigen. Die entwickelten Primer wurden als Anstrichsysteme mit Grund- und Deckfarben Kurzkorrosionsprüfungen, sowie der Aussenwitterung in drei Stationen unterworfen. Daraus wurde der Schluss gezogen, dass die besten

Resultate mit Zinkchromat in Epoxyester erhalten werden.

Untersuchungen mit verschiedenen Metallsubstraten unter den Anstrichen zeigte, dass gespritztes Aluminium sich am besten verhielt, wenn darüber eine Zinkbeschichtung gespritzt werden war. Gegeuwartig schreiben Arbeiten voran über die Qualität des Schurtzes durch Metallpigmente enthaltende Primer unter Seeluft und Industriatmosphären-Bedingungen in Indien.

Introduction

Paint coatings are widely used for the protection of metals against corrosion, in spite of the fact that several types of corrosion resistant metal alloys have been developed. This is not because of the inherent versatility of paints, but the ability of the technologists to develop tailor-made products to suit a particular substrate or the environment.

In this paper the research work done in developing new formulations for the protection of metals which are used in marine and industrial environments, at the Central Electrochemical Research Institute, Karaikudi, is reviewed.

Pigments

Refs. 1-10

In finishing coats the primary function of the pigments present is to produce decorative shades and colour, but in primers they contribute to the protective properties of the paint in a number of ways, depending on the nature of the substrate. Until recently lead oxide pigments have been used mostly for giving chemical inhibition to the corrosion reactions at the substrate. Such pigments in linseed oil vehicle have always been regarded as producing the most reliable primers for iron and steel structures when preparation and pretreatment of the substrate is not of a high order. Lead pigments react with fatty acids present in the binder (oil) and form lead soaps. The products produced by the degradation of lead soaps act as corrosion inhibitors in protecting metals. The restriction on the import of lead and its health hazards led to an interest in replacing lead pigments by indigenously available pigments and extenders in formulations of primer paints which have better drying properties than the paints of lead oxide in linseed oil.

The protective action of lead oxide primers in conjunction with various types of extenders was studied in different vehicles¹. A few paint formulations in which lead oxide pigment content was as low as 13 per cent together with 47 per cent iron oxide in doubly boiled linseed oil and linseed alkyds were found to have good corrosion inhibition².

The chromate pigments inhibit corrosion primarily because they gradually release chromate ions which passivate the substrate by oxidising the ferrous ions. The criterion of using chromate pigments in paints as corrosion inhibitors is mainly associated with their solubility in water and the nature of the vehicle used in their formulation. On account of their low solubility, basic zinc chromate pigments (Zinc tetroxy chromate: $ZnCrO_4 \cdot 4Zn(OH)_2$) do not release chromate ions as sufficiently as required for primer coats, and hence they are used in metal pretreatment (wash primer). Strontium chromate pigments are more soluble, but less soluble than zinc yellow (composition approximating to $4ZnO \cdot 4CrO_3 \cdot K_2O \cdot 3H_2O$) and therefore they are used in primer coats where a steady release of chromate ions over a long period is required. Experiments on the corrosion inhibition properties of the aqueous extracts of various types of chromate pigments showed that zinc chromate pigments ($4ZnO \cdot 4CrO_3 \cdot K_2O \cdot 3H_2O$) have better properties than others. An extract of one gram of this pigment in 100 ml water gives

protection to steel in a solution containing 100 ppm sulfate ions and 10 ppm chloride ions³.

The inhibitive character of chromate pigments depends on the type of vehicle in which they are used. It has been observed that inhibitive capacity of zinc chromate pigments is reduced considerably when they are used in oil based vehicles⁴. Primer paints were prepared using zinc chromate in various vehicles and the dependence of the quantity of chromate extracted on the type of vehicle used was studied⁵. The quantity of chromate ions extracted in aqueous solution was found to be the maximum in the case of paints based on epoxy ester and phenolic modified stand oil⁶. Although the amount of chromate extracted from the primer paints is much smaller than that from the pigment alone, the amount of zinc chromate extracted from the primers in the above two vehicles was sufficient to give better corrosion resistance inhibition to the substrates exposed in weatherometer and other accelerated tests. The amounts of chromate leached out from zinc chromate primers prepared in double boiled linseed oil, linseed stand oil, a long oil penta alkyd and a rosin modified long oil penta alkyd were not sufficient to protect steel substrates from corrosion. It is believed that the formation of soaps by the free acids present in these vehicles with the metallic part of the pigment prevents chromate from leaching. Barium chromate pigment in a linseed alkyd and phenolic hardener exhibited inhibition to corrosion although no chromate ions were found to be present in the aqueous extract from the primer coat. This indicates the formation of soaps of barium with the vehicle which then act as inhibitors.

In a separate series of experiments, calcium chromate was used as an inhibitive pigment. Calcium chromate is available indigenously in India and is cheaper than the other chromate pigments. The main disadvantage of using calcium chromate as a pigment in paints is its high solubility in water. However, in a series of formulations, using this pigment together with various extenders in different types of vehicle it was found that the quantity of chromate extracted from the primer paints can be reduced to a reasonably low value⁷. The best results were obtained with 1:1 ratio of iron oxide and calcium chromate in epoxy ester⁸. A reference in the literature considers the use of calcium chromate as a pigment in enamel paints based on epoxide, acrylic and other resins⁹. In this laboratory calcium chromate was prepared by a neutralisation method and the properties of the pigment, so obtained, were found suitable for the formulation of primer paints¹⁰.

Vehicles

Refs. 11-14

Coating systems are conventionally selected on the basis of performance of the vehicle rather than that of the pigments. For instance, in a cold weather country, preference is given to vehicles that dry by solvent evaporation for exterior coating formulations over those which are slower drying. The choice of vehicles for primers is flexible. They can be made from drying oils, synthetic resins such as alkyds, phenolics, vinyls, epoxies, and many other film forming materials. The proper selection depends on the availability of raw materials, the price, the requirements for performance and durability etc.



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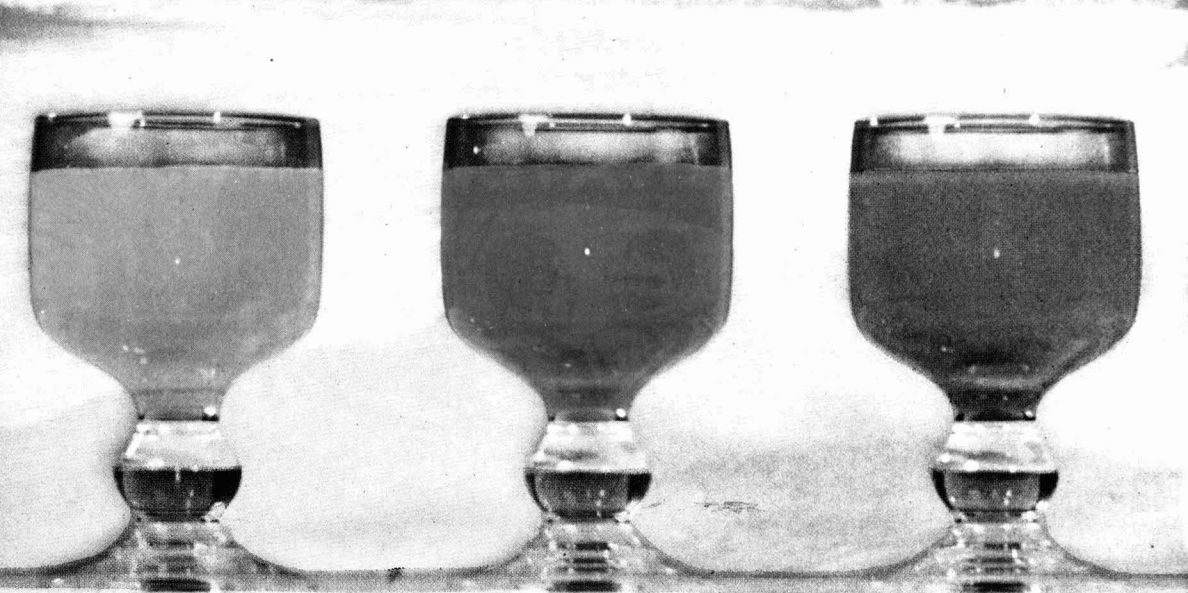
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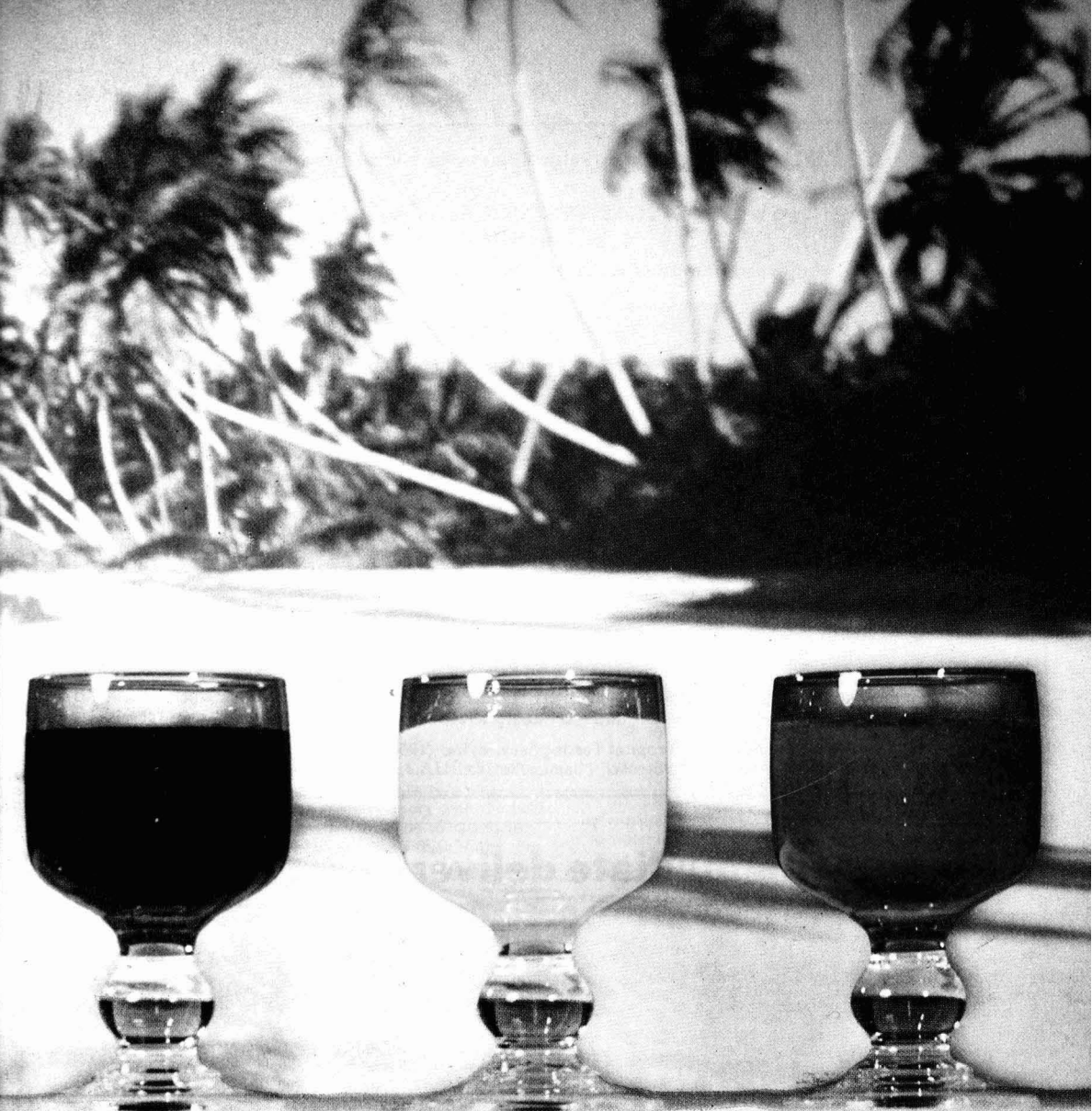
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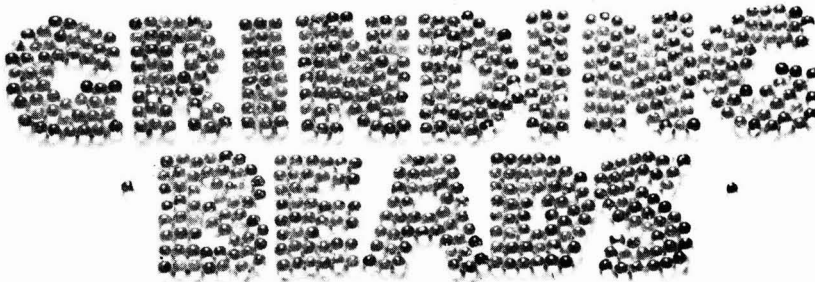
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Cashew nut shell liquid (CNSL) is an abundantly available raw material in India and emphasis is being given to its application in the formulation of resins, varnishes, in laminated products etc¹¹. An oleoresinous varnish prepared by reacting CNSL with hexamine/formaldehyde and then heating the reaction mixture with drying oils, was used as vehicle for primer paints¹². Paints based on this vehicle give poor corrosion protection because they have low resistance to the diffusion of corrosive anions and have a high water absorption. In a subsequent study of primer paints based on calcium chromate and iron oxide pigments in various proportions in this vehicle, it was found that the performance of the primer, which contains pigments in the ratio of 1:3 in CNSL medium, has corrosion resistance properties comparable to the most commonly used zinc chromate-iron oxide (1:4) primer in modified phenolic stand oil and linseed alkyd¹³. However, the former gave inferior protection to steel in comparison to calcium chromate-iron oxide primer (1:1), prepared with other media¹⁴.

The quantity of chromate ions in the aqueous extract of a primer paint is as important a parameter as the nature of the vehicle, because both play dominant roles in the anti-corrosive behaviour of the primer paints. It was observed in the case of barium-potassium-chromate primer paints in CNSL that although the leaching rate of chromate from the primer coat was restricted to the level required for corrosion protection, the paint failed to give sufficient protection to the metal against corrosion.

Evaluation of corrosion protection

The laboratory evaluation of paint systems by direct corrosion tests has certain limitations, because the test duration is often arbitrarily fixed. The correlation of the performance tests conducted on paint systems in the laboratory with the field performance tests has not been found to be so satisfactory. Whilst field tests or the service tests are valuable, the time involved in such tests is often fairly long and the rapid developments in the field of coating and application technology demand a good correlation between field and laboratory tests. The best way of evaluating a paint system appears to be to take into account the mechanism of protection by paints and to use tests to evaluate the paint system in terms of those properties which are essential from the point of view of corrosion protection.

Experimental procedure

Studies on aqueous extracts

(i) One gram of chromate pigment was shaken for six hours in 100 ml of distilled water. The suspension was left undisturbed for twenty-four hours and then filtered. In some experiments, known amounts of chloride and sulfate ions were also added to the water.

(ii) Glass plates (5×7.6 cm) coated on both sides with a paint or a vehicle were dried for a week. The coated plates were then immersed in 400 ml distilled water for the extract of water soluble matters. The aqueous extracts obtained in the above two types of experiments were tested for the following:

(a) pH, (b) chromate ion concentration, (c) potential-time curves, (d) polarisation.

The chromate content of the extract was determined by an iodometric method. Mild steel specimens were used for potential-time and polarisation studies. The anodic and cathodic polarisations were determined by a galvanostatic method.

Studies on coated metals

(i) Stainless steel plates, 5×7.6 cm, were coated with the paints and vehicles and dried for a week. The plates were weighed before and after coating. They were immersed in 300 ml distilled water, removed periodically from the beaker, dried with filter paper, weighed and then replaced. The percentage of water absorbed by the paint film was determined.

(ii) The mild steel specimens (6.25 sq cm) coated with the paint or the vehicle were air dried for a week and then suspended individually in distilled water and one per cent aqueous sodium chloride solution. The potential of each test specimen was measured at regular intervals of time.

(iii) The resistance of coated mild steel panel immersed in one per cent sodium chloride solution was measured periodically using a Phillips conductivity bridge.

Accelerated corrosion tests

(i) Mild steel panels (5×7.6 cm) were pickled and given two coats of a primer. They were allowed to dry for a week and then scratched diagonally. Panels coated with a primer and a top coat were also prepared in this way. The scratched and unscratched specimens in duplicate were subjected to the following tests:

(a) Immersion in distilled water for 30 days

(b) Immersion in 3 per cent sodium chloride solution for 30 days

(c) Salt fog tests for 30 days or A.R.E. salt spray tests.

(ii) Mild steel specimens (6.2×15 cm) having two coats of a paint were exposed in a twin arc Atlas Weather-o-meter to water spray once every hour at 10-12 psi, for ten minutes, and to arc light for 15 hours out of 24 hours.

Field exposure of protective coating systems

Six primers were selected from a large number of formulations based on the various pigments, extenders and vehicles studied earlier. Six commercially available paints were used as top coats. Two coats of primer paint on pickled mild steel panels (15×10 cm) followed by one undercoat and top coat formed one protective coating scheme. Thirty-six such protective coating schemes were evaluated by the field exposure tests at three marine stations, Madras, Mandapam Camp and Mangalore Harbour. The weather conditions at these exposure sites and their locations are described below:

Madras

The site is at a distance of 90 metres from the sea and exposure racks are erected on the terrace of Madras Port Trust Canteen Building.

Mandapam Camp

The site is 45 meters away from the Gulf of Mannar and exposure racks facing the sea are erected on the ground.

Mangalore Harbour

The site is 61 meters away from the sea and exposure racks are on the ground.

Details of the climatic conditions at these sites are given in Table 15.

The performance of each protective system was assessed by ASTM standards for the deterioration of painted surface and the Swedish scale was used for assessing the corrosion of metal. The following merit values were given for each of the different properties studied:

Blistering	25
Chalking	10
Checking	10
Cracking	10
Flaking	10
Rusting	25
Spread of rust from scratch	10

Since six different types of top coats were used individually with each primer in the protective coating schemes; the performance of each primer was evaluated in terms of total merit value 600. The estimated life of the paint corresponds to the period during which the merit value does not fall below 50 per cent of the total merit value. Test panels were exposed on stands facing south and inclined at an angle of 45°.

Results

Studies on pigments

The formulations of primer paints are listed in Table 1. The concentration of chromate ions in the extracts from various chromate pigments, the inhibitive or the corrosive character of the extracts assessed by a polarisation method and their pH values are given in Table 2. The same characteristics of zinc chromate extracts in the presence of various concentrations of corrosive ions are reported in Table 3. The zinc chromate extracts containing less than 100 ppm sulfate and 10 ppm chloride ions are shown to have an inhibitive effect.

Studies on vehicles

The pH value of the extract from clear coating of oleoresinous vehicle is almost neutral, whereas that of those from the coatings of drying oils, and others are rather acidic and their aqueous extracts are corrosive (Table 4). The amount of water absorbed in the coatings of these vehicles is less than 2 per cent.

Table 1
Primer paints

Paint	Vehicles
1. Zinc chromate	L.S.O.
2. Zinc chromate	L.L.A. + M.P.S.
3. Zinc chromate	M.P.S.
4. Zinc chromate	Epoxy Ester
5. Zinc chromate	M.P.S. + D.B.O.
6. Red oxide/Zinc chromate	L.L.A. + M.P.S.
7. Red oxide/Zinc chromate	M.P.S. + R.M.L.A.
8. Zinc chromate	L.L.A. + M.P.S.
9. Zinc chromate Red oxide 2846	M.P.S. + R.M.L.A.
10. Epoxy zinc chromate	Epoxy Ester
11. Barium potassium chromate paint	L.S.O.
12. Barium potassium chromate paint	M.P.S. + D.B.O.
13. Barium potassium chromate paint	M.P.S.
14. Barium potassium chromate paint	L.A. + Ph.H.
15. Red oxide/Barium potassium chromate	L.A. + Ph.H.
16. Barium chromate paint	L.A. + Ph.H.
17. Red oxide/Barium chromate paint	L.A. + Ph.H.
18. Zinc chromate paint	L.A. + Ph.H.
19. Red oxide/zinc chromate	L.A. + Ph.H.
20. Red oxide paint IS:123-1962	D.B.O.
21. Lead chromate primer	D.B.O. + M.P.S.
22. Red lead primer IS:102-1962	D.B.O.
23. Red lead graphite primer	L.L.A. + P.B.O.
24. Red lead reduced primer	D.B.O.
25. Red lead R/M paint 55-60%	D.B.O.
26. Lead & Zinc chromate primer	L.A. + M.P.S.
27. Red lead/Red oxide primer	D.B.O.
28. Red lead/Red oxide primer	L.A.
29. Red lead/Red oxide primer	M.P.S.
30. Red mud paint	C.N.S.L. + D.B.O.
31. Red mud/Red oxide paint	C.N.S.L. + D.B.O.
32. Red mud/Zinc chromate paint	C.N.S.L. + D.B.O.
33. Barium potassium chromate paint	C.N.S.L.
34. Red oxide/Barium chromate paint	C.N.S.L.
35. Zinc chromate paint	C.N.S.L. + D.B.O.
36. Red oxide/Zinc chromate paint	C.N.S.L. + D.B.O.
37. Calcium chromate/Iron oxide	Epoxy Ester

L.S.O. = Linseed stand oil, M.P.S. = Modified Phenolic stand oil, D.B.O. = Doubly boiled linseed oil, Ph.H. = Phenolic hardner, L.L.A. = Long oil linseed-penta alkyd, R.M.L.A. = Rosin modified long oil alkyd, L.A. = Linseed alkyd, P.B.O. = Pale boiled oil, D.C.O. = Dehydrated castor oil, C.N.S.L. = Cashew Nut Shell Liquid.

Table 2
Studies with pigment extracts

Name of pigment	CrO ₃ in mg/100 c.c. in distilled water	pH of the extract	Corrosive or Inhibitive
1. Zinc chromate	97	6.2	Inhibitive
2. Zinc tetroxy chromate	5	6.8	Corrosive
3. Barium potassium chromate	112	6.5	Inhibitive
4. Barium chromate	1.4	7	Corrosive
5. Strontium chromate	66	6.5	Inhibitive
6. Calcium chromate	860	6.5	Inhibitive
7. Lead chromate	0.2	6.5	Corrosive
8. Lemon chrome	0.8	6.1	Corrosive
9. Orange chrome	0.4	8.0	Corrosive
10. Scarlet chrome	0.2	5.25	Corrosive
11. Red lead	1.42 (Pb)	6.2	Corrosive
12. Red oxide	Nil	7.1	Corrosive

Table 3
Zinc chromate in various salt solutions

Medium	pH of the medium	pH of the extract	Nature of the extract	CrO ₃ mg/100 c.c.
1. 10 ppm chloride	6.1	6.2	Inhibitive	104
2. 10 ppm sulfate	6.1	6.3	Inhibitive	93
3. 100 ppm chloride	6.2	6.27	Corrosive	0.111
4. 100 ppm sulfate	6.2	6.5	Inhibitive	90
5. 1000 ppm chloride	6.15	6.3	Corrosive	111
6. 1000 ppm sulfate	6.05	6.28	Corrosive	162
7. Synthetic sea-water	4.65	6.2	Corrosive	257

Table 4
Studies with vehicle extracts

Name of the vehicle	pH of extract	Inhibitive or corrosive	Percentage of water absorption after 15 days
1. Linseed stand oil	4.3	Corrosive	1.8
2. Modified phenolic linseed stand oil	4.5	Corrosive	1.9
3. Epoxy ester	5.2	Corrosive	1.5
4. Doubly boiled linseed stand oil	3.9	Corrosive	1.5
5. Long oil linseed-penta alkyd solids	3.7	Corrosive	—
6. Cashew nut shell liquid	6.2	Corrosive	2.0

Table 5
Studies with paint extracts in distilled water

Paint	pH of extract in distilled water	Corrosive or Inhibitive for 10 days	CrO ₃ in mg/100 c.c. 15 days	Water absorption % 15 days
1. Zinc chromate in L.S.O.	5.8	Corrosive	4.4	73
2. Zinc chromate M.P.S.	6.2	Inhibitive	28	18
3. Zinc chromate epoxy ester	6.3	Inhibitive	31.8	18
4. Zinc chromate L.A. + Ph.H.	7.0	Corrosive	3.2	47
5. Barium potassium chromate L.A. + Ph.H.	7.5	Corrosive	9.8	70
6. BaCrO ₄ L.A. + Ph.H.	7.7	Inhibitive	Nil	41
7. Zinc chromate red oxide/ I.S.2074	6.2	Corrosive	Nil	20
8. Zinc chromate in C.N.S.L.	6.0	Inhibitive	59	64
9. Red oxide/Zinc chromate C.N.S.L.	6.0	Corrosive	3	78
10. Red mud in C.N.S.L.	6.7	Corrosive	—	20
11. Red lead/red oxide D.B.O. (13% Pb ₃ O ₄)	5.3	Inhibitive	traces lead	11.5
12. Red lead/Red oxide in alkyd (14% Pb ₃ O ₄)	6.7	Inhibitive	traces lead	19
13. Calcium chromate/ Iron oxide Epoxy(1:1)	7	Inhibitive	4.2	22

Studies on primer paints

The results of the determinations conducted on the aqueous extracts from primer paints are shown in Table 5. The chromate ion contents in the extracts from primer paints in drying oils are very low and were found to vary with the type of the vehicle. An inhibitive extract from the coating of lead oxide primer in linseed oil is obtained whereas the extract from lead oxide pigment alone does not show any

inhibitive action. Some soaps, such as lead azelate etc, are suggested as being formed by the reaction of lead oxide and the free fatty acids present in the drying oil. The results in Table 5 also indicate that the anti-corrosive behaviour of the primer paints depends mainly on the concentration of chromate ions in the extract. The amount of water absorbed in some of the primers is very high, and the degree of corrosive attack, to some extent, depends on the quantity of water absorbed by the primer coats.

The electrical resistance values of the primer coats given in Table 6, are very low. These results indicate that all the primer coats absorb a sufficient amount of water to make electrolytic resistance of the coating very low.

Table 6

Resistance of primer paint after 24 hours in 1% NaCl solution

Paint No. as in Table 5	Resistance in Ohms/sq.cm., $\times 10^3$
1	2.7
2	9.3
3	4.4
4	3.0
5	3.0
6	3.0
7	1.8
8	—
9	—
10	3.0
11	2.4
12	4.2

Results of accelerated tests¹⁵

Ref. 15

In the assessment of primers, it is necessary that conclusions drawn from basic studies, are also confirmed by conventional

and field tests. The accelerated test results summarised in Tables 7 and 8 show that the primers in which zinc chromate pigment is used give good protection to the metal substrates in all types of tests and that the performance of zinc chromate epoxy ester primer is the best. The performance of calcium chromate-iron oxide in epoxy medium is also good. The protective potentiality of lead oxide (13 per cent) and iron oxide (47 per cent) primer in double boiled oil is confirmed by the accelerated tests.

The performance of the protective coating system was found to depend significantly on the finishing coat. Therefore, a good inhibitive primer in combination with water and weather resistant finishing coat should give good corrosion protection.

Results of field exposure tests¹⁶

Ref. 16

The results of the tests conducted on protective coating systems at the three marine stations are given in Tables 9 and 10 respectively. The formulations which are found to be most effective in preventing the corrosion of metals have been patented in India¹⁷.

Table 7
Accelerated tests for primer paint

Paint No. as in Table 5	A.R.E. Salt Spray Test for 30 days	Immersion tests in distilled water for 15 days	Immersion tests in 1% NaCl for 15 days	Weather-o-meter tests for 2000 Hours
1.	No blisters, rust did not spread through scratch. The specimen was bright after removing the paint	No rust at scratch. Bright surface	Small blisters	Film was in good condition bright surface
2.	—do—	—do—	No blisters. Bright surface	—do—
3.	—do—	—do—	—do—	—do—
4.	—do—	Small blisters all over. Bright surface	—do—	—do—
5.	—do—	Big blisters. Bright surface	Big blisters. 20% surface area rusted	—do—
6.	—do—	Small blisters. No rust at scratch	Blisters at edges and 20% area rusted	—do—
7.	50% film affected with blisters. Rusted	Blisters all over and rusted	Blisters all over and rusted	Loss of gloss and chalking after 1000 hours
8.	Small blisters were observed. Rust extends through scratch 25% surface rusted	Small blisters. Bright surface	Blisters and 20% surface rusted	Few rust spots after 1000 Hours. 10% rusted after 2000 Hours
9.	Blisters and rusted	Small blisters and rusted	Blisters all over and rusted	Loss of gloss and chalking after 300 Hours. 25% rust
10.	Few small blisters no rust at scratch	Small blisters 50% surface rusted	Small blisters, rusted	Loss of gloss and chalking after 1500 Hours. Bright surface
11.	Scratched area rusted. No blisters. Bright surface	Few small blisters no rust at scratch. Bright surface	Small blisters. Bright surface	Loss of gloss and chalking after 1500 Hours
12.	—do—	No blisters and no rust at scratch	No blisters bright surface	—do—
13.	No blisters and no rust at scratch. Bright surface	Few fine blisters. No rust at scratch bright surface	Few blisters rust at scratch. Bright surface	—

Table 8
Salt spray tests for 2000 hours

	Finishing paint	Alkyd medium pigment TiO ₂	Alkyd medium pigmented carbon black	Bitumen with Aluminium flakes	Chlorinated rubber	Epoxy resin pigment TiO ₂	Heavy coal tar pitch
1.	Zinc chromate in MPS	Few blisters. Rust at edges and scratch RC 7	Large number of blisters. Rust spreads at edges and scratches. RC 5	Fine blisters all over. Rust at edges and scratch RC 5	Few blisters. Rust at edges and scratch RC 5	Fine blisters. Rust extends at scratch and edges RC 3	No blisters and no rust at scratch RC 9
2.	Zinc chromate L.A. + Ph.H	Few blisters. Rust at scratch and edges RC 7	Few blisters no rust at scratch RC 7	Fine blisters all over. Rust extends at scratch and edge RC 5	Few blisters. Rust at edges and scratch RC 5	Few blisters. Rust at scratch RC 7	No blisters and no rust at scratch RC 9
3.	Barium chromate L.A. + Ph.H	Blisters. Rust extends at scratch and edges RC 3	Few blisters all over. Rust extends at scratch and edges RC 3	Few blisters all over. Rust extends at scratch and edges RC 3	Few blisters. Rust extends at scratch and edges. RC 5	Few blisters all over. Rust extends at scratch and edges RC 3	"
4.	Red lead Red-oxide in in D.B.O.	No blisters. Rust at scratch and edges RC 5	Few blisters. Rust at scratch RC 5	Fine blisters all over. Rust extends at scratch and edges. RC 3	Few blisters. Rust extends at scratch and edges RC 5	Few blisters all over. Rust extends at scratch and edges RC 3	No blisters and no rust at scratches RC 9
5.	Red oxide zinc chromate I.S.	Medium dense blisters. Rust extends at scratch and edges RC 5	Medium dense blisters. Rust extends at scratch and edges RC 3	Blisters all over. Rusted RC 1	Blisters and Rust all over. RC 3	Medium dense blisters. Rust extends at scratch and edges. RC 4	"
6.	Epoxy ester based zinc chromate	Few blisters. Rust at scratch RC 5	Few blisters Rust at scratch and edges RC 5	Few blisters. Rust at scratch (edges) RC 7	Few blisters. Rust at scratch RC 7	Few big blisters. Rust at scratch RC 5	"

Table 9
Exposure studies of complete paint scheme at Mandapam Camp after 24 months

Finishing paint primer	Epoxy resin pigmented TiO ₂	Alkyd medium pigmented TiO ₂	Alkyd medium pigmented carbon black	Bitumen with Aluminium flakes	Chlorinated Rubber	Heavy Coal tar pitch
1. Zinc chromate in M.P.S.	<i>G</i>	<i>G</i>	<i>G</i>	<i>F</i>	<i>G</i>	<i>VG</i>
2. Zinc chromate L.A. & Ph.H	<i>G</i>	<i>F</i>	<i>G</i>	<i>B</i>	<i>F</i>	<i>VG</i>
3. Barium chromate L.A. & Ph.H	<i>F</i>	<i>F</i>	<i>G</i>	<i>B</i>	<i>G</i>	<i>E</i>
4. Red lead - Red oxide in D.B.O.	<i>G</i>	<i>G</i>	<i>G</i>	<i>F</i>	<i>F</i>	<i>VG</i>
5. Red oxide-zinc chromate I.S. 2074	<i>G</i>	<i>F</i>	<i>G</i>	<i>B</i>	<i>G</i>	<i>VG</i>
6. Epoxy zinc chromate	<i>G</i>	<i>G</i>	<i>VG</i>	<i>F</i>	<i>VG</i>	<i>VG</i>

E = Excellent
VG = Very good
G = Good
F = Fair
B = Bad

Merit Value
 80-100
 61-80
 41-60
 21-40
 0-20

Paint Schemes
 Two coats of primer plus one under-coat and one finishing paint

Table 10
Life of the protective scheme for the different primers in months

No.	Primer	Mandapam Camp		Madras		Mangalore	
		Hand cleaned	Pickled	Hand cleaned	Pickled	Hand cleaned	Pickled
1.	Red lead-red oxide	15	24	22	18	20	20
2.	Zinc chromate-red oxide	6	18	12	12	20	Not failed
3.	Zinc chromate in phenolic hardener and linseed alkyd	12	18	12	22	20	Not failed
4.	Zinc chromate in M.P.S.	12	18	12	18	20	Not failed
5.	Zinc chromate in epoxy	12	24	12	22	20	Not failed
6.	Barium chromate in Ph.H. and L.A.	12	18	12	18	20	Not failed

Surface preparation and economy of paint systems

Refs. 18-20

The effect of surface preparation on the performance of protective coating schemes was studied on a comparative basis. The surface preparations included anodic phosphating, chemical phosphating or wash primer on a pickled surface. The coated plates were exposed at three marine stations. The performance of the system was determined by the merit value, described earlier. A detailed study on the cost of production per year was made and the findings in terms of annual expenses for the protective coating system, on hand cleaned and pickled surfaces, are given in Table 11. The epoxy zinc chromate based system is found to be economical

on the pickled surface, and the lead oxide and iron oxide primer based protective coating scheme is the best on hand cleaned surface¹⁸.

The life of the primer paints and also that of the protective coating system is considerably increased when it is applied on chemical phosphated or anodic phosphated surfaces¹⁰ (Tables 12 and 13). The protective capacity of the paints does not show any significant improvement when the substrate is treated with a wash primer. The application of wash primer has been suggested for protecting steel structure during the interval between cleaning and painting. In this respect, unlike phosphating, it is itself a paint system.

Table 11
Annual expenditure on protective painting for the different primers

Name of the Primer	Rs	Comparative protective scheme including cost of application per 100 sq ft		Cost of protective scheme per year for 100 sq ft (average of the three marine stations)	
		Rs		Rs	
		Hand cleaned	Pickled	Hand cleaned	Pickled
1. Red lead/red oxide	9.50	56.50	58.50	36.00	33.00
2. Red oxide/zinc chromate	7.50	54.50	56.50	50.00	45.00
3. Zinc chromate in Ph.H. + L.A.	9.00	56.00	58.00	45.00	35.00
4. Zinc chromate in M.P.S.	10.00	57.00	59.00	46.00	39.00
5. Zinc chromate epoxy	15.50	62.50	64.50	51.00	34.00
6. Barium chromate in Ph.H. + L.A.	8.50	55.50	57.50	45.00	38.00

Table 12
Duration of protection—Primer paints
(Period in months to reach 300 marks, average of 6 primers)

Name of primer	Pickled			Wash primer			Chemically phosphated			Anodically phosphated		
	MC	MS	MH	MC	MS	MH	MC	MS	MH	MC	MS	MH
1. Red lead-red oxide	24	18	20	34	27	24	30	30	30	34	30	24
2. Zinc chromate-red oxide	18	12	24	30	18	24	30	30	33	34	30	27
3. Zinc chromate in Ph.H. and L.A.	18	22	24	30	30	27	30	30	33	30	30	30
4. Zinc chromate in MPS	18	18	24	27	30	18	30	30	33	30	30	30
5. Zinc chromate in epoxy	24	22	32	34	30	18	30	30	33	30	30	30
6. Barium chromate in Ph.H. and L.A.	18	18	24	24	27	30	21	27	30	21	27	30

MC = Mandapam Camp, MS = Madeas, MH = Mangalore Harbour.

Table 13
Duration of protection—Finishing paints
(Period in months to reach 300 marks)

Name of finishing paint	Pickled			Wash primer			Chemically phosphated			Anodically phosphated		
	MC	MS	MH	MC	MS	MH	MC	MS	MH	MC	MS	MH
1. Epoxy TiO ₂	15	18	27	15	27	18	15	27	27	15	27	24
2. Alkyd TiO ₂	18	18	27	15	18	18	15	27	27	15	27	24
3. Alkyd carbon	15	28	27	30	27	30	30	30	33	30	30	30
4. Bituminised aluminium	21	18	27	34	18	24	30	27	24	30	27	30
5. Chlorinated rubber	18	28	27	34	30	30	30	30	33	30	30	30
6. Epoxy Coal tar	33	28	27	34	30	33	34	30	33	34	30	33

The performance of metallic coatings in combination with paint systems was also studied²⁰. Here aluminium, aluminium-zinc (50:50) alloy and zinc were sprayed on sand blasted mild steel panels. Chromium and zinc were electroplated on pickled mild steel substrates. In certain cases the metal coated specimens were given phosphate and chromate treatment before painting. The paint schemes together with the results of exposure study are given in Table 14. Paint schemes on

metals sprayed with aluminium or aluminium-zinc have shown the longest durability at all the three marine stations. The life of the tin plated paint scheme was the shortest both at Mangalore and Mandapam Camp. The protection given by the paint scheme on zinc sprayed steel was inferior when an alkyd-TiO₂ based finishing coat was used, but its performance with an epoxy coal tar based finishing coat was better and equal to the paint system on aluminium sprayed substrates.

Table 14
Period in months for 50% deterioration*

Metallic Coatings	Mangalore				Madras				Mandapam Camp			
	Alkyd TiO ₂		Epoxy coal tar		Alkyd TiO ₂		Epoxy coal tar		Alkyd TiO ₂		Epoxy coal tar	
	P ₁	P ₂	P ₁	P ₂	P ₁	P ₂	P ₁	P ₂	P ₁	P ₂	P ₁	P ₂
1. Hot dip galvanizing	30	30	30	30	32	32	36	36	28	32	30	34
2. Hot dip galvanizing and chromate treated	30	30	36	36	32	32	36	42	28	34	32	34
3. Hot dip galvanizing and phosphated	24	30	36	36	32	36	36	42	34	34	34	34
4. Chromium plated	24	24	36	36	36	36	42	36	21	34	28	36
5. Tin plated	21	21	21	21	37	42	42	46	17	28	17	25
6. Tin plated and chromate treated	21	21	21	21	42	36	36	42	17	28	17	25
7. Cadmium plated	24	24	36	36	24	24	27	27	24	24	30	34
8. Aluminium sprayed	48	48	48	48	36	36	48	48	48	48	48	48
9. Aluminium zinc sprayed	48	48	48	48	36	36	48	48	48	48	48	48
10. Zinc sprayed	30	30	48	48	32	42	32	48	30	34	30	34
11. Zinc sprayed and chromate treated	36	36	48	48	32	48	32	48	30	34	30	34
12. Zinc sprayed and phosphated	36	36	48	48	32	48	32	48	30	34	36	36
13. Zinc plated	36	36	36	36	36	48	36	48	30	30	36	36
14. Zinc plated and chromate treated	36	36	36	36	36	48	36	48	32	32	36	36
15. Zinc plated and phosphated	36	36	36	36	48	48	48	48	32	32	36	36

P₁ = Red oxide/zinc chromate I.S. 2071.

P₂ = Zinc chromate primer in modified phenolic stand oil medium.

*The duration of protection given in the table only refers to 50% paint deterioration and the metallic coatings remain intact.

Table 15
Climatic data at exposure stations

Particulars	Mandapam		Madras		Mangalore	
	Max	Min	Max	Min	Max	Min
Temperature °C	30	25	38	30	33	28
Total rain fall per year (mm)	1248		1248		750	
Average RH%	80		80		85	
Salinity (mg/m ² /day)	4000		325		250	
SO ₂	Traces		99mg of SO ₃ sqcm/month		Traces	

Metal pigmented paints²¹

Refs. 21-22

Metal pigmented paints are becoming of great importance because they protect a metal in two ways, i.e. barrier protection together with cathodic protection. The metal pigments being in physical contact with the metal substrate, give cathodic protection, whilst the paint, being impermeable, provides barrier protection.

At present two types of metal pigmented primer are being studied, namely, zinc rich silicate primer and Zn-Mn-rich epoxy polyamide primer. In both cases electrochemical methods of evaluation of the primer have been used. Potential-time measurements show the period after which the potential of the test panel rises above the protective potential required for cathodic protection. Current-time measurements using a zero resistance ammeter between painted steel and bare steel indicate the period during which sufficient current is generated for cathodic protection by the paint. Using these methods, it has been found that in an organic coating formulation, 20 per cent zinc can be replaced by using graphite or manganese in its place. The results obtained from tests conducted on the coatings in which zinc content is reduced by 20 per cent, show that the performance of these coatings are comparable to 90 per cent zinc rich paints²².

In the case of an inorganic vehicle, it has been observed that good protection even on wet surfaces can be obtained by incorporating zinc, 1:3 in sodium silicate by addition of suitable accelerators or by incorporation of zinc in ethyl silicate²². In the former case a two pack system has already been developed and in the case of the latter, a single pack system is in the developmental stages.

Conclusion

The methods discussed in this review have often been used in both exploratory and quantitative work for the evaluation of protective properties of paints. The degradation of paint films was found to depend on factors determined by the climatic and seasonal changes at the test site. Several electrochemical and electrometric methods are discussed where simulation of environmental condition is possible. It is concluded that the measurement of capacitance and resistance

as a function of frequency may be found quite promising for the evaluation of coating performance²³. It is, however, still not clear to what extent such data can be used to characterise corrosion protection.

Acknowledgment

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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 February issue of the *Journal*:

Retention properties of a phenoxy resin in the region of glass transition and softening temperatures by P. Alessi, I. Kikic, R. Lapasin, A. Papo and G. Torriano

The cracking of finishes on birch plywood materials by A. J. Sparkes

UV cured acrylic coatings for wood by P. Dufour

Corrosion tests for organic coatings—A review of their usefulness and limitations by W. Funke

Resource problems in the downstream chemical industry by D. S. Davies and I. J. Lawrenson

Short Communication

A method for testing the mould resistance of paint films

By S. Barry, A. F. Bravery and L. J. Coleman

Department of the Environment, Building Research Establishment, Princes Risborough Laboratory, Princes Risborough, Aylesbury, Bucks, HP17 9PX

Summary

A method developed as a result of international collaborative work under the auspices of the International Biodegradation Research

Group is briefly described and reference to the complete published methodology and results is made.

Une méthode pour déterminer la résistance aux moisissures de films de peinture

Résumé

On décrit brièvement une méthode mise au point par des travaux internationaux collaboratifs sur l'égide de l'International Bio-

degradation Research Group et l'on fait référence à toute la méthodologie et à tous les résultats qui ont été publiés.

Eine Methode zur Prüfung des Widerstandes von Anstrichfilmen gegen Schimmelsatz

Zusammenfassung

Kurze Beschreibung einer als Resultat internationaler Zusammenarbeit unter den Auspizien der International Biodegradation

Research Group entwickelten Methode. Auf die vollständige Methodologie, sowie Resultate wird Bezug genommen.

Introduction

The method described was developed as a result of extensive international collaborative experiments carried out by 10 members of the Paints Working Group of the International Biodegradation Research Group. Although *Cladosporium sphaerospermum* was the only test organism used in the collaborative work, the test is considered valid for mixed cultures. Similarly, although only air-drying and artificial weathering techniques were used as methods of preconditioning, other relevant treatments may be employed before the microbiological work is carried out. The test should be performed in an air-conditioned laboratory by competent microbiologists.

are applied to the previously prepared plastered tubes leaving one hour between coats.

Normally at least two tubes of each paint under test should be prepared. A linseed oil-based paint known to be susceptible to mould growth is used as a control throughout the test.

Preconditioning of painted tubes

Refs. 3, 4

After drying in the laboratory for 7 days, paints for exterior use are exposed in an artificial weathering machine for 500 hours (eg Xenotest⁴ or the type described in BS 3900, Part F3³). The tubes are rotated through 180° daily. Paints for interior use are subjected only to laboratory air-drying for a suitable period, eg 2 days for water-based paints and 21 days for oil-based paints.

Scope

This method is intended primarily to test the mould resistance of water-based paints, either with or without fungicides, but may be used for other types of paints, varnishes and lacquers.

Microbiological tests

Test fungi

A spore suspension of not less than 10⁴ spores per ml, in distilled water containing an appropriate wetting agent, is prepared from a well sporulating culture of the test organism(s).

Test procedure

Preparation of test specimens

Lipped glass test tubes are abraded to give a roughened finish. When water-based paints are to be tested the roughened glass tubes are coated with a paste made from calcium sulfate hemi-hydrate, plasticised vinyl polymer and distilled water, to give a coat of plaster 1-2 mm thick after 24 hours drying at room temperature.

Inoculation of test specimens

After suitable preconditioning, the test pieces are inoculated on one side with 1 ml of the spore suspension. This is followed by the application of either artificial or sterilised natural soil, not only to simulate the high biological hazard of natural conditions, but also providing both a support and nutrient to the spores.

Application of test paints

Two coats of the test paint are applied to the roughened glass tubes leaving 24 hours between coats. Water-based paints

Incubation

All inoculated tubes are normally left for a test period of four weeks in a mould growth cabinet. The cabinet consists of a glass or plastic tank, fitted with a means of controlling the temperature of a layer of water, at the base of the tank. Conditions in the cabinet should be appropriate to the paint under test, ie approximately 3°C above the ambient for solvent-based paints and 2°C for water-based paints. The temperature should be carefully controlled so that excessive condensation does not cause wash down of spores and soil.

Assessment of results

Refs. 1, 2

Each tube is removed from the test cabinet and examined by both normal vision and under the microscope at a magnification of $\times 25$ –30.

Mould growth is assessed using the following scale:

- 0 — No growth
- 1 — Trace of growth
- 2 — 1–10 per cent coverage of total test area
- 3 — 10–30 per cent coverage of total test area
- 4 — 30–70 per cent coverage of total test area
- 5 — More than 70 per cent coverage of total test area.

Contaminant species should be reported and photographs $\times 1$ and $\times 25$ –30 should be provided whenever possible.

Note: For detailed information on the construction of a cabinet, formulation of a control paint, rules for preconditioning, soil preparations, test fungi and biological safety precautions see Barry, Bravery and Coleman¹.

For results and development of the methodology see Bravery, Barry and Coleman².

Acknowledgments

The authors wish to acknowledge the contributions of their co-workers:

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Correspondence

Improved Standards for cleaning steel prior to protective coating

Sir,

Existing standards for cleaning steel such as the British Standard 4232, the Swedish Pictorial Standards, the American Steel Structures Painting Council Standards and the Japanese Standards etc. are not adequate, mainly because they do not recognise the problems associated with the cleaning of rusty steel, although it is fair to say that the very recently issued German Standard DIN55928 Part 4 goes some way towards recognising the need for additional test methods.

A paper given to the Newcastle branch of the Institution of Corrosion Science and Technology in October 1976 by A. N. McKelvie under the title "Steel cleaning standards—a case for their reappraisal" and published in June 1977 in the *Journal of the Oil and Colour Chemists' Association* has had a prompt response, and has been the catalyst to trigger off the revision of steel cleaning standards internationally and on 16 October 1978 the first meeting took place of a new International Standardisation Committee called I.S.O. TC35/SC12 at Montecatini in Italy. The Secretariat of this new committee is vested in the British Standards Institution and its membership so far consists of ten participating members, Canada, France, Germany, Israel, Netherlands, Poland, Rumania, Republic of South Africa, Sweden and the United Kingdom and five observer members, Australia, Austria, India, Ireland and Saudi Arabia. The Chairman elected was K. A. Chandler, Manager, Corrosion and Coated Products Advisory Service of the British Steel Corporation and current President of the Institution of Corrosion Science and Technology.

The official title of the Committee is "Preparation of Steel Substrates before Application of Paint and Related Products" and the scope has been defined as: "Standardisation in the field of preparation of Steel Substrates

previously coated or otherwise, before application of paint and related products."

The programme of work agreed will include the following main subjects:

- (a) Establishment of a necessary and sufficient series of test methods for assessing surface qualities required for acceptable performance of coatings
- (b) Establishment of acceptable standards for surface quality related to the types of coating, and as assessed by the test methods in (a)
- (c) Means of achieving the surface qualities established in (b).

Three working groups of I.S.O. TC35/SC12 are in the process of being set up to carry out the programme of work.

Working Group 1. Surface Profile, will be led by the United Kingdom.

Working Group 2. Surface Cleanliness, will be led by Sweden and will give consideration to setting up at least two task groups, one on visual standards of cleanliness and the other on chemical and physical test methods for cleanliness.

Working Group 3. Surface Preparation Techniques, will mostly probably be led by Germany.

Both the United States of America and Japan are being urged to become participating members and to nominate experts to join the working groups.

Yours faithfully,
A. N. MCKELVIE

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30 November 1978

Review

Surface Coatings A Complete Handbook of Paint Technology

New South Wales University Press

Pages 486 + xv. First published 1974, reprinted 1978.

This book was prepared jointly by OCCA Australia and the Australian Paint Manufacturers' Federation. It contains 54 chapters, written by various authors and covers the whole field of paint technology from raw materials, paint formulation, manufacture, testing, defects and application etc. to technical service. There are also chapters on printing ink technology, printing processes, paint removal, metal pre-treatment, tables and useful information.

As is to be expected in a single volume covering such a wide range of subjects, the text is concise and limited to essentials. The knowledge of chemistry and physics necessary for a student to follow some of the chapters is listed. Nevertheless, it is not an easy book for a student to read because it tends to lack explanations and historical background. On the other hand, it does not deal with specific topics in sufficient detail or at a high enough level to be useful to the specialist.

For the practical paint technologist, it provides useful summaries and would act as an *aide-memoire* on many aspects

of paint formulation, manufacture, application and usage. Examples of typical formulations for various types of paint are provided.

A list of the principal topics covered by each chapter is given in the Index, but there is no general alphabetical index. The absence of this makes quick reference to a specific detail difficult to locate. Most chapters give a list of references and/or sources of further reading, which, in general, refer to other books on paint technology. There are few references to original scientific papers or sources.

There are a number of curious omissions, for instance, the chapter on titanium dioxide mentions that two crystalline forms, anatase and rutile, exist and deals with properties such as tinting strength, hiding power, dispersion and rheology, but there is no discussion of any differences in behaviour of the two types on exterior exposure. Similarly, although bubble tubes, efflux cups and several types of viscometers are described, there is no mention of the cone and plate type, which is probably the most efficient instrument for many purposes.

The book was obviously written before 1974 and the reprinted version does not appear to have been up-dated. There are a few errors, probably typographical, which could well have been rectified when reprinting.

S.R.F.

Newcastle

PRA and the surface coatings industry

The third meeting of the 1978/79 session was held at St. Mary's College, Durham on 7 December 1978 when 25 members and guests assembled to receive a paper entitled 'Paint Research Association and the surface coatings industry' presented by D. Dasgupta of the P.R.A. Mr Dasgupta reviewed the history of the P.R.A. and outlined some of the inventions of the Association over the years, many of which had been highly successful. The lecturer described some of the current research items and then spent some time on his own specialist subject of information. Mr Dasgupta concluded his talk with a plea that all members should consider the Teddington laboratories as an extension of their own. Following a question and discussion period, the Vice Chairman of the Section, Mr J. Clarke proposed a vote of thanks.

T.H.

Hull

The practical problems of painting and maintaining large industrial plant

The first ordinary meeting of the 1978-79 session was held at the Humber Bridge Hotel, Barton-upon-Humber, South Humberside, on Monday 2 October. This was a joint meeting held with the Institution of Chemical Engineers, South Humberside Branch.

The lecture was presented by Mr D. A. Bayliss of B.I.E. Anti-Corrosion Ltd., and was entitled, "The practical problems of painting and maintaining large industrial plant".

Mr Bayliss opened his talk by stating the three points he would be presenting to illustrate, according to his experience, the most important areas of industrial painting practice. These were surface preparation, quality control, and specifications.

In terms of the surface preparation, he suggested that the preparation of mill scaled and rusted panels to Swedish Standard SA3 was only a fraction of the requirement necessary to ensure that subsequent painting would result in the desired protection. He stated that it was essential to remove all surface contaminants; that is, loose scale, powder and dust debris and organics, principally grease and oil. For the latter, he strongly recommended the use of an efficient emulsifying solvent. In particular, he expressed concern with respect to failure to remove all ferrous salts from the grain boundaries and the micro fissures on the metal surface. The hygroscopic nature of these salts lead to subsequent re-corrosion under the film. An I.S.O. Standard is in preparation, under a U.K. Secretariat, which extends the Swedish Standards to cover the points raised.

On minimum and maximum profiles, he suggested up to 50 microns between the minimum and maximum, with the minimum to be 25 per cent of the maximum. He also commented on the lack of agreement between surface measuring gauges and between the methods of measurement. The breakdown at welds, due to high profiles, and to alkaline residues was mentioned.

Quality control required a continuous observation of the surface preparation and of the subsequent painting 100 per cent of the time. Examples of bad painting practice over

corrosion were amply illustrated by means of coloured slides. The instruments used by inspectors covered film thickness meters, low magnification lenses and a telescopic mirror to view inaccessible areas in complex steel structures. It was also recommended that a detailed record of all stages of the preparation and painting was essential.

Against specifications, the question was posed, "were they of value?"—and equally in the case of guarantees "could they be held?". These questions promoted a discussion period almost as long as the lecture itself; after which, Mr B. Bell, the Chairman of the Chemical Engineers, gave the vote of thanks on behalf of the 30 members of both societies and their guests present.

F.D.R.

London

Marketing with reference to the EEC and developing countries

The first evening technical meeting of the 1978-79 session was held at the "Princess Alice", Romford Road, E7 on Thursday 21 September. Mr D. Bayliss, Chairman, introduced Mr R. I. Farr, Commercial Manager, Cowan Colours Ltd, who presented a talk on "Marketing with reference to the EEC and developing countries" to an audience of 30 members and guests.

In his lecture Mr Farr discussed the concept of marketing and offered a definition as that of the 5 Ps—the Provision of the right Product at the right Price during the right Period Profitably. He went on to itemise the part played by various disciplines within the company involved in marketing—market research, product development, distribution, advertising, sales and after sales service etc. The Marketing department could be seen as the coordinating group for all other departments within the company.

Dealing more specifically with marketing abroad, Mr Farr described the various ways in which companies could export their products and the role and involvement of marketing within these approaches. At the crudest, exporting was seen as an outlet for surplus goods, with no market research and haphazard sales and product mix. The overseas marketing concept was more refined using marketing to maximise world sales. Finally, the international business operation went one step further by maximising investment world wide using whatever method was appropriate (e.g. importing, local manufacture or capital investment).

Mr Farr went on to offer a number of sources of information (Board of Trade, London Commercial Library, foreign embassies) which could help the potential exporter obtain relevant advice and background about his chosen markets. The market also needed to be well screened before entry and eight factors which had to be considered were discussed. Political, geographical and language factors were examples.

Finally, Mr Farr spent time discussing some of the pitfalls into which exporters had fallen through not researching their markets carefully enough. White false teeth will not sell in the Far East as only black stained teeth are prized. Foods sold in Africa will be more accepted if packed in tins rather than cardboard as the former have important secondary uses such as building materials or household utensils. "Bone China" implied the use of sacred cow bones in the Indian sub-continent. Bottled beer displaying one company's trade mark which contained two elephants would not sell in Africa

as this was a symbol of bad luck. A 50 per cent increase in the number of elephants brought the brewery good luck!

Despite suffering from the effects of flu, Mr Farr finished his lecture and withstood the ensuing question time. The vote of thanks was proposed by Dr T. Banfield and warmly applauded.

Following the meeting a buffet and cash bar was provided, enabling members to socialise after the lecture.

A.J.N.

Newcastle

Solvent recovery

The first meeting of the 1978-79 session was held at St Mary's College, Durham on the 5 October when 30 members and guests assembled to hear a paper by Mr I. Smallwood of Fraser McNaughton Ltd entitled "Solvent recovery for the surface coatings industry".

Some 6-7m litres of solvent arises each year from paint mill washings, resin kettle cleaning and spray gun and pipeline cleaning. The surface coatings industry is second only to the pharmaceutical industry in the production of waste solvent. The value of this waste solvent is estimated as £0.5m a year out of a total value of £3m for all solvent available for recovery. The speaker explained how the economics of solvent recovery had changed over the last 30 years due to legislation, the Middle East war and other factors. He described the methods of disposal of waste solvents which included incineration, dumping, burning for fuel value and recovery. After discussing the problems associated with disposal, Mr Smallwood then described the methods used for the recovery of waste solvent produced by the paint industry. Various forms of distillation were satisfactory for single solvents, but fractionation was needed when mixtures of solvents arose. The speaker described the problems of separation of xylene/white spirit and also mixtures where azeotropes were formed. Problems which still had to be solved included the disposal of some 250 tonnes of pigments which were left as a residue after distillation and the treatment of waste paint. Following a discussion period the Chairman, Mr F. Hellens, proposed a vote of thanks for a well presented and interesting paper.

The members and guests partook of buffet and bar facilities and engaged in useful discussion.

Advances in pigment dispersion

The second meeting of the 1978-79 session was held in St Mary's College, Durham on 2 November when over 50 members and guests attended to receive a paper entitled "Recent

advances in pigment dispersion and dispersion equipment" by R. W. English and J. S. Perkins of Mastermix Engineering Co Ltd.

The lecturers reviewed current high speed dispersion equipment as used to manufacture paint and pointed out the problems of high labour cost, high energy requirement and the difficulty of maintaining safety in operation without restricting access to the equipment. The ideal equipment would be capable of producing larger batches in an enclosed vessel using automated techniques in a compact installation. In addition, a low energy input would be needed and the equipment would be self cleaning. The lecturers described the use of a peripheral scraper blade in conjunction with an offset central shaft to create a vortex using less energy than the conventional central dispersing shaft and defined the main problem as maintaining the height of the disperser disc in the correct position for addition of pigments, dispersion etc. without the use of skilled labour. A system of audio electronics to maintain the dispersion impeller at the correct height was then described and demonstrated by the authors. The incorporation of spray nozzles to allow vessel cleaning as part of the production programme was also described.

Production facilities where one tonne of pigment could be added in 15-75 seconds and 4 tonnes in 10 minutes by one person using a fork lift truck were illustrated. The lecturers concluded that totally new philosophies were required for the future manufacture of paint by high speed dispersion techniques.

Following a lengthy question period the Chairman, Mr F. Hellens, proposed a vote of thanks for a thought provoking paper. Members and guests then partook of a buffet meal and bar facilities.

T.H.

Ontario

The Ontario Section held its first Technical Meeting of the 1978-79 session on Wednesday 13 September at the Constellation Hotel.

On this occasion we were visited by Mr J. D. W. Davidson, Past Chairman of the Scottish Section and Member of Council.

The subject of the lecture was "Compounds and additives for printing ink" and was given by Mr J. Dyer of the Dyal Chemical Company.

The presentation mainly dealt with various types of waxes and their particular applications.

After the question period, a vote of thanks was made by Mr W. Fibiger, the Section Chairman.

D.S.W.

Information Received

Australian expansion

Albright & Wilson (Australia) Ltd have opened a new continuous sulphonation plant on an 11 acre site in Sydney which marks the latest stage in the parent company's worldwide phased investment programme. The new Australian expansion adds to Albright & Wilson's international strength in the field of surfactants.

New paint laboratory

Pyrene Chemical Services Ltd, a member of Brent Chemicals International Group, has opened a new paint laboratory at its headquarters in Iver. This comprehensively equipped facility has been separated from the Company's already extensive product development and customer service laboratories and considerably expanded, to

ensure that Pyrene's advanced metal pre-treatment processes continue to keep pace with the rapid development of new painting processes for the metal finishing industries.

New company formed

Tofte & Jorgensen UK Ltd and Compact Vacuum Systems Ltd have rationalised their association by founding a jointly

owned company, In-Place Cleaning Ltd, to design, supply and install both manual and/or automatic systems incorporating pipework, pumps and chemical holding tanks for many industries including chemicals, paint and plastics.

Sachtleben centenary

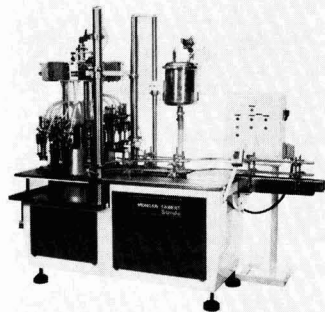
Sachtleben Chemie GmbH, the well known West German producer of Lithopone and Blanc Fixe white pigments, are celebrating their 100th Anniversary. Lithopone- und Permanentweiss-Fabrik Schöningen AG, the forerunner of the present day company, first produced the products 100 years ago. Sachtleben Chemie is now one of the world's leading specialist chemical companies and produces large ranges of titanium dioxide pigments under the name Hombitan. Lithopone and Sachtolith, zinc sulphide pigments, are still manufactured and the group also supplies a range of graded barium sulphates. The selection of natural fillers includes a range of barytes—Albaryt and EWO amongst others. These fillers and zinc sulphide pigments find application mainly in the paint and varnish industries.



An aerial view of the Sachtleben Chemie GmbH plant at Duisburg-Homberg am Rhein

Manufacturing agreement

Morgan Fairest have signed an agreement with Mecano Quimica of Spain to manufacture under licence in the UK, a new range of filling machines to complement their already extensive range of Albro Fillers. The Sonda system of level filling enables viscous and foaming products to be filled into many types of containers including flexible plastic bottles, overcoming the problems of container distortion and product foaming with a unique system of variable pressure filling.



The new 10 head Sonda filling machine available from Morgan Fairest Ltd.

Research and development facility

A new research and development block representing an investment of £750,000 has been opened by Allied Colloids Ltd. The expanded facilities give the opportunity for increased activity in new product synthesis and increased product development. The range of equipment and machinery which simulate on a small scale the action of the company's products when used in a customer's plant will be substantially extended.

New products

New pigment dispersions

Ciba-Geigy's Pigments Division has introduced a newly-developed range of pigment dispersions for non-aqueous decorative paint systems. Irgaspere-S is a range of stabilised, free flowing, highly pigmented liquid dispersions based on pigments which have technically proven, all round performance in decorative paint systems. The pigments are finely dispersed in a white spirit base. The new pigment dispersions are very stable and, therefore, have an excellent shelf life and are resistant to skinning and settling.

New methacrylate resins

The Chemical Division of Degussa has extended its range of isocyanate cross-linking pure methacrylate resins by introducing two new types developed for the manufacture of polyurethane/acrylic paints. These two methacrylate resins are known as Degalan LS 75/151 and Degalan LS 100/201 and are supplied as 60 per cent solutions in butyl acetate. Cold or warm hardening of two-component systems incorporating these products yields scratch-resistant, flexible paint films on metal, wood, plastics and other substrates.

Yellow pigment

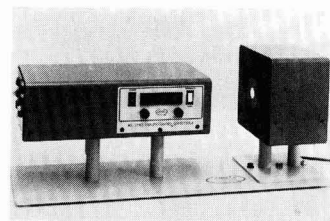
Luconyl Yellow 137 is a new pigment dispersion being marketed by BASF for colouring aqueous systems. In full shade and in medium reductions it produces yellow paints with outstanding fastness properties. The good opacity of Luconyl Yellow 137 makes it particularly suitable for use in mass-tone.

New spray booths range

Binks-Bullows Ltd has launched a new range of higher velocity Nopump water-swash and disposable dry filter spray booths that meet the recommendations of EH9 of the Health and Safety Act, and offer increased extract and energy efficiency. Named the '150 Range' the Nopump now provides the 0.7 metres per second specified.

Appearance measurement

Elcometer Instruments has announced a further addition to its range of appearance measuring instruments from Gardner Laboratory Inc. The XL200 is one of a series of radically new instruments with the capability of measuring transmittance, reflectance and haze for clear, translucent and opaque materials. The XL210 also provides tristimulus colour, or single function readings, for example luminous transmittance.



The XL210 Hazegard system available through Elcometer Instruments

Horizontal grinding mill

Molteni of Italy have introduced a new addition to their range of grinding plant which is the latest and most advanced design of horizontal microsfera. It gives better distribution of the ballottinis in the grinding chamber which permits a higher ratio of ballottinis to free volume in comparison with the vertical grinding mills. This results in a reduction of voids, giving high output and excellent grinding results. As the grinding vessel is of a sealed construction it is possible to grind products of high viscosity and eliminate solvent evaporation.

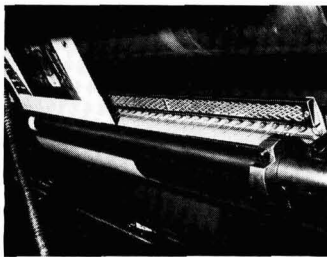
High dirt capacity filter

Pall Process Filtration Ltd has announced a significant technical advance by introducing a range of high dirt capacity, non-fibre

releasing disposable cartridges. Field tests have shown that these cartridges have a dirt capacity several times greater than comparable existing cartridges.

Air-ionising bars

A series of devices designed to control problems caused by static electricity in industry is now available from The Radiochemical Centre, Amersham. Making use of a sealed low-activity radioactive source to ionise the air close to the charged surfaces, the components are compact and easily installed, require no power supply connections, contain no moving parts and are themselves safe in hazardous environments.



The low-activity radioactive air-ionising bar

New light fastness tester

Original Hanau Quarzlampen GmbH has now added another light fastness testing and weathering machine to their Xenotest range available in the UK from John Godrich. The Xenotest 250 operates on the same principle as the Suntest and Xenotest 1200 and has a sample table 28 x 40 cm, giving an approximate area of 1,100 sq. cm. It has an ozone-free xenon light source with three different filter systems and two different intensities. The machine has a controlled humidity and will simulate rain by giving five different spraying cycles.



The Xenotest 250 light fastness testing and weathering machine

New water-based coatings

International Paint Industrial Coatings have introduced a number of new water-based coatings which have in-built benefits of

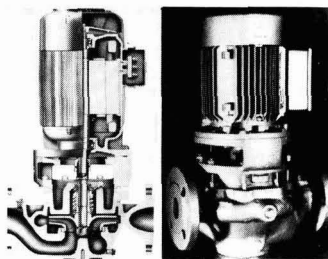
energy saving and health and safety features for the film, paper and board converting industry.

New air powered pump

Kingdom Engineering Co. Ltd has available a new safe air powered pump, the VIP Sandpiper, which will handle easily almost every type of aggressive chemical or solvent used in the paint manufacturing or finishing industries. The Sandpiper has a liquid sealed pumping chamber design with Teflon diaphragm and valves which eliminates the problem of leakage.

New in-line pumps

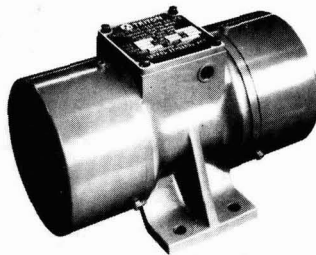
For processing applications involving clean or slightly contaminated non-corrosive liquids, a new range of close coupled in-line centrifugal pumps has been introduced by SPP. Known as the Instream range, they provide capacities up to 60 litre/sec. The in-line configuration gives a very compact pumping unit, ideal for installations where there are space limitations and pipework bends are undesirable.



The Instream range of in-line pumps from SPP

Electric vibrator motors

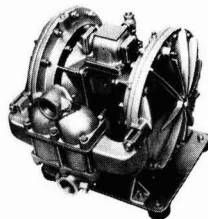
The Triton Engineering Co. Ltd has available the 'J' series of base mounted frame vibrator motors which have synchronous speeds of 3000 and 1300 r.p.m. for use on light and medium duty vibrating screens/separators, conveyors, grids and feeders.



The new electric vibrator motors from Triton Engineering

Plastic containers

Polythene Drums (Lancashire) Ltd has introduced an easy fill open top plastic container into its free standing range. It is available in sizes from 5 to 25 litres and is claimed to have a number of distinct advantages over conventional open top lacquered steel drums, particularly for the carriage of powders, gels and greases.



VIP Sandpiper air powered pump from Kingdom Engineering

Conferences, courses etc.

Federation annual meeting

The 1979 Annual Meeting of the Federation of Societies for Coatings Technology will have the theme "Progress through innovation" and will be held in conjunction with the Paint Industries' show at the Convention Centre, St. Louis, Missouri from 3-5 October 1979.

British Standards

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

BS4289 Part 1 (Reduction of contract samples to analysis samples) and

Part 3 (Determination of moisture & volatile matter content) 1978

BS5629 Part 1 (Insulating varnishes containing solvent—Part 1 Definitions and general requirements) 1978

Infrared catalogue

Perkin-Elmer have available the latest issue of their Infrared Accessories Catalogue which carries information on the company's latest developments. Sections of the publication deal with liquid, gas and solid sampling accessories together with details of infrared accessory kits etc.

Organic intermediates

SSF Dottikon of Switzerland have published a catalogue on organic intermediates which lists their latest developments in the field of aromatic nitro and amino compounds.

Raman spectra recommendations

The International Union of Pure and Applied Chemistry, Physical Chemistry Division, have published provisional recommendations for the presentation of raman spectra in data collections and copies are available for comment.

Hoechst Award

Hoechst (UK) Ltd has agreed to provide the sum of £150 annually, to be awarded to the best student in the final year of the Undergraduate Course in Colour Chemistry and Colour Technology in the University of Bradford.

Turbula shaker-mixers

Glen Creston Ltd has published a leaflet describing their range of Turbula shaker-mixers which are capable of mixing heavy metal powders and other difficult mixtures.



OCCA-31 Exhibition

Alexandra Palace, London, 3-6 April 1979

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

The international focal point for the surface coatings industries

Allocation for space

The Exhibition Committee of the Oil and Colour Chemists' Association announces that the allocation of space for OCCA 31 (the thirty-first Annual Exhibition of raw materials, plant and equipment for the paint, varnish, printing ink, colour, adhesive and allied industries) has now taken place. It is particularly pleasing to note the return of many exhibitors from previous years as well as new exhibitors, thus showing the strength of the support for this annual focal point for the surface coatings industries.

At present there will be participation by organisations in the following 15 countries:

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

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.

First list of Exhibitors

Exhibits from the following organisations from the UK and fourteen overseas countries will be shown at the Exhibition. The main stand-holders are marked by an asterisk:

Product classifications are given in parentheses.

ACNA—Italy (*resins, pigments, chemical intermediates*)

*Allunga Exposure Laboratory—Australia (*services*)

*Amoco Chemicals—Switzerland (*resins, chemical intermediates*)

Atlas Electric Devices Co.—USA (*laboratory apparatus*)

BASF—Germany (*chemical intermediates*)
Bachofen, Willy—Switzerland (*manufacturing equipment*)

*Baird & Tatlock Ltd (*laboratory apparatus*)

*Banner, Samuel & Co. Ltd (*chemical intermediates*)

*Ciech—Import & Export of Chemicals Ltd—Poland (*pigments, chemical intermediates*)

*CIRP—France (*manufacturing equipment*)

Colora (*laboratory apparatus*)

*Chemolimpep—Hungary (*resins, additives*)

*Contraves Industrial Products Ltd (*laboratory apparatus*)

Contraves AG—Germany (*laboratory apparatus*)

*Cornelius Chemicals Ltd (*resins, pigments*)

*Cox's Machinery Ltd (*manufacturing equipment*)

Daltrade Ltd (*pigments, chemical intermediates*)

Daniel—USA (*speciality products*)

*Diaf A/S—Denmark (*manufacturing equipment*)

*Diano Corporation—USA (*laboratory apparatus*)

*Dow Chemical Co.—Switzerland (*resins, additives*)

Dow Corning—USA (*laboratory apparatus*)

*Draiswerke GmbH—Germany (*manufacturing equipment*)

*Eiger Engineering (*manufacturing equipment*)

*Elcometer Instruments Ltd (*laboratory apparatus*)

*Erich, G. J. Ltd (*manufacturing equipment*)

*Feco—Germany (*manufacturing equipment*)

*Ferranti-Instrumentation Ltd (*laboratory apparatus*)

Filter Specialists Inc—USA (*manufacturing equipment*)

Gardner—USA (*laboratory apparatus*)

Ge-Halin—Germany (*manufacturing equipment*)

*Glen Creston Ltd (*manufacturing equipment*)

*Godrich, John (*manufacturing equipment, laboratory apparatus*)

Haake (*laboratory apparatus*)
Haltermann (*chemical intermediates*)
*Health & Safety Executive (*services*)

Hispania ACNA—Italy (*pigments*)

Hopkin & Williams Ltd (*laboratory apparatus*)

*IBM United Kingdom Ltd (*laboratory apparatus*)

ICI Ltd (*pigments*)

*IMC Chemie—Germany (*chemical intermediates*)

*Industrial Colours Ltd (*pigments*)

*Industrial Dispersions Ltd (*pigments, additives*)

*Instrumental Colour Systems Ltd (*laboratory apparatus*)

*Italtinto Industria Vernici—Italy

*Joyce Loeb Ltd (*laboratory apparatus*)

*K & K Greeff Industrial Chemicals Ltd (*resins, pigments, additives*)

*KWR Chemicals Ltd (*manufacturing equipment*)

*Karcher, Alfred—Germany (*manufacturing equipment*)

*Kemira Oy—Finland (*pigments*)

*Kirklees Chemical Co. (*resins*)

Koehler, H.G., KG—Germany (*laboratory apparatus*)

*Libra Chemicals (*manufacturing equipment*)

*MSE Scientific Instruments Ltd (*laboratory apparatus*)

*Macbeth Color & Photometry Division of Kollmorgen (UK) Ltd (*laboratory apparatus*)

*Marchant Brothers Ltd (*manufacturing equipment*)

Maschinenfabrik Heidenau—East Germany (*manufacturing equipment*)

Mearl (*pigments*)

*Meca-Inox—France (*manufacturing equipment*)

MacNab, Wm. J. (*resins, pigments, chemical intermediates*)

*Microscal Ltd (*laboratory apparatus*)

*Millroom Accessories & Chemicals Ltd (*manufacturing equipment*)

*Molteni (UK) Ltd (*manufacturing equipment*)

*Montedison Group—Italy (*resins, pigments, chemical intermediates*)

*Nagama, Veb Kombinat—East Germany (*manufacturing equipment*)

*Netzsch—Germany (*manufacturing equipment*)

*OBS (*manufacturing equipment*)

Oliver & Battle—Spain (*manufacturing equipment*)

Original Hanau Quartzlampen GmbH—Germany (*laboratory apparatus*)

Oulu—Finland (*chemical intermediates*)

PPG Industries Inc—USA (*chemical intermediates*)

*Paintmakers Association (*services*)
*Paint Research Association (*services*)
*Polymers Paint & Colour Journal (*services*)
Portcullis Press (*services*)

- *Porter Chadburn (Plastics) Ltd (*manufacturing equipment*)
- Porter Lancastrian Ltd (*manufacturing equipment*)
- *Precision Valve Corporation—USA (*manufacturing equipment*)
- *Pye Unicam Ltd (*laboratory apparatus*)
- *Q-Panel Co—USA (*laboratory apparatus*)
- *R. K. Print-Coat (*laboratory apparatus*)
- ROL—Italy (*chemical intermediates*)
- Research Inc.—USA (*laboratory apparatus*)
- Rio Beer—Switzerland (*manufacturing equipment*)
- *Roban Engineering Ltd (*manufacturing equipment*)
- SCM Schelde Chemische Maatschappij—Italy (*adhesives*)
- *Society of Dyers & Colourists (*services*)
- Schwerdtel, Ludwig—Germany (*manufacturing equipment*)
- *Silberline Ltd (*pigments*)
- *Smith, Herbert (*manufacturing equipment*)
- *Strazdins, A.—Australia (*manufacturing equipment*)
- *Sub-Tropical Testing Service Inc—USA (*services*)
- Sussmeyer, Ateliers—Belgium (*manufacturing equipment*)
- Sweco—Belgium (*manufacturing equipment*)
- *Synres—Holland (*resins*)
- Teledyne Taber—USA (*laboratory apparatus*)
- *Tiszamenti Vegyimuvek—Hungary (*pigments*)
- UPA—USA (*laboratory apparatus*)
- *Vibropower, T. K.—Holland (*manufacturing equipment*)
- *Werner & Pfleiderer (*manufacturing equipment*)
- *Westlairs (*equipment*)
- *Wheatland Journals Ltd (*services*)
- *Winter Oy—Finland (*manufacturing equipment*)

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.

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.

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 next year. These improvements will add to the pleasantness of the venue, set in extensive parklands, and will provide an excellent setting for this international focal point for the surface coatings industries.

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

This unique publication contains descriptions of all companies and their exhibits at the Exhibition and is issued to each member of the Association at home and abroad as well as to all visitors to the Exhibition with their admission tickets. Copies are also sent to members of relevant trade associations, foreign embassies and all organisations exhibiting receive complimentary copies.

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.

The *Official Guide* is published several weeks in advance of the dates of the Exhibition to allow visitors the maximum opportunity to plan the itinerary of their visits. In 1978, for the first time, the *Official Guide* contained a chart classifying the products on show into the various types, and it is intended to produce a similar chart for the *Official Guide* to OCCA-31. This chart is invaluable to visitors, especially those who have only a limited amount of time available, as it provides a quick, easy reference of all the companies present who are displaying the products in which they are interested.

Advertising facilities

Advertising space is available in the *Official Guide*, both to companies who will be exhibiting at the Exhibition, and also to other organisations. This important publication is constantly referred to both before the Exhibition and afterwards as a convenient record of the latest developments in the industry. Consequently, organisations wishing to take advertising space in the Guide should book their requirements as soon as possible in order to ensure a prominent position. Details of the advertising rates and media data are available from Mr D. M. Sanders at the Association's address.

News of Exhibitors

Stand 41

Health & Safety Executive

The *Health and Safety* stand will provide an information facility, where the requirements of the *Health and Safety at Work Act* are explained and where problems relating to health and safety in the chemical industry can be discussed with specialist inspectors. A full range of both free and on sale literature will be available.

Stand 31

Allunga Exposure Laboratory

Allunga Exposure Laboratory is a natural weathering station, situated at Townsville in tropical North Queensland, Australia. Townsville (19 S, 146 W) is accepted as a reference location for natural weathering tests within Australia and is included in Australian standards. It is now being recognised as a world reference point for natural weathering tests.

Products currently under tests include: paints, plastics, rubbers, fabrics, dyestuffs, pigments, resins, polymers, UV absorbers, decals, adhesives, building and packaging materials, twine and fibres.

In addition to the wide range of exposure and reporting services (natural, under glass, black box, gloss readings, electron microscope and probe, weather date), *Allunga* has developed two new services: Accelerated natural weathering (*Altrac*) and a Natural mould growth test site.

Altrac uses natural solar radiation, multiplied by mirrors that follow the sun all day, such that exposure years are reduced to months. Testing options include *Dry Mode* (concentrated solar radiation with indirect moist conditions from rain or condensation), *Wet Mode* (in addition to the above a fine spray of rainwater saturates the sample for 8 minutes in each hour during the day time), and *Under Glass Mode* (solar radiation is received through a protective glass window).

The *Natural Mould Growth Test Site* has been established at Tully (260 kilometres north of Townsville). The area has exceptionally high rainfall spread over the whole year with high relative humidity. Mould, fungi, bacteria and algae flourish under these conditions, allowing products to be tested for resistance to these agents.

Stand 29

Diano Corporation

On display will be the new *Diano Match-Mate 3000 system* with the revolutionary high speed *Match-Scan* spectrophotometer. The *Match-Scan* is the latest of the new generation of American colour spectrophotometers. The design philosophy behind the *Match-Scan* is a blend of the best classical features of the renowned *Diano*/

Hardy spectrophotometer together with the very latest in microprocessor technology and software control.

Features from the *Diano|Hardy* include polychromatic diffuse sphere illumination, true dual beam geometry, optional reversible optics and a continuously scanning monochromator with constant bandwidth. The microprocessor is a powerful *Digital Equipment Corporation LSI-11* with software to control all functions of the spectrophotometer and to perform colour Q.C. calculations. The result of this blend is the most accurate and versatile colour spectrophotometer presently available.

The *Match-Mate 3000* is a complete and truly integrated colour matching system based on the *Match-Scan. Match-Mate* systems reduce costs by producing cost optimised formulations and production corrections. *Diano*'s well organised and easy to use software includes many outstanding features. One is the automatic calculation of optimum pigment loading to achieve any desired hiding power. Another is the superior production correction routine which calculates colorant addition for the best compromise of acceptability and economy.

Stand 43

Samuel Banner & Co. Ltd

The *Samuel Banner* display features a comprehensive range of solvents and vegetable oils and encompasses over 100 years' experience serving the paint trade.

Vegetable Oils Division

Samuel Banner are independent refiners of drying and semi-drying oils. From their own refinery based in Liverpool is supplied:

Linseed Oil—Refined, boiled, blown linseed stand oils and a range of putty mediums.

Soya Bean Oil—Alkali refined soya bean oil and soya bean stand oils.

Castor Oil—Castor oil to BSS specifications and to Brazilian No. 1 specification, and a range of castor oil derivatives including hardened castor oil, 12 hydroxy stearic acid, dehydrated castor oil and castor oil fatty acid.

Wood Oil.

Hydrocarbon Solvents Division

A wide range of hydrocarbon solvents, which includes white spirit distillate, special boiling point solvents, xylene, toluene and BAS aromatic and aliphatic naphthos, will be featured and a specialist blending service of chemical hydrocarbon solvents will be provided to suit individual customer requirements.

Banner Chemicals

Industry is supplied with alcohols, ketones, esters, glycols, glycol ethers, plasticisers, normal and iso paraffins, nitro paraffins, emulsion dispersants and chlorinated solvents from three strategically placed depots at Liverpool, London and Glasgow.

Banner are UK distributors for *BASF*—for C4 alcohols, esters and glycol ethers.

Haltermann—for normal and iso paraffins.

PPG Industry Inc.—for trichlorethylene, perchlorethylene and 111 trichloroethane.

IMC Chemie—for nitro paraffins, nitro hydroxy and aminohydroxy compounds.

Contract Packing

A comprehensive manufacturing and small pack filling service for blended solvents, and speciality chemicals is provided from the London factory.

Technical Information

Data sheets, samples and quotations will be available from the Stand and the *Banner* technical staff will be delighted to discuss problems.

Stand 13

Sub-Tropical Testing Service Inc.

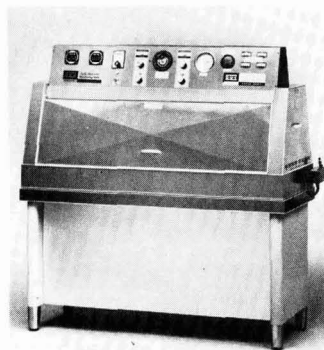
A pictorial display of the facilities and services offered by *Sub-Tropical Testing Service Inc.* will be exhibited. Of particular interest will be examples of the variety and severity of failures which can occur on wood, plastic, fabric and metal panels exposed to natural weathering in Southern Florida. Also featured will be the *Sub-Tropical* originated drawing board rack with its special features which can be adjusted to any angle and in any direction.

Stand 57

The Q-Panel Company

The *Q-Panel Co.* exhibit will feature a range of products for research and quality control.

The *QCT Condensation Tester* tests finishes for resistance to moisture in the form of rain or dew. Condensation tests are faster than humidity, and more representative than salt spray. Advantages include simplified control of critical variables, minimal maintenance, and low cost.



The QUV cyclic ultraviolet weathering tester from Q-Panel Co.

The *QUV Accelerated Weathering Tester* tests resistance to both moisture and sunlight. A condensation system simulates rain

and dew. Eight fluorescent UV lamps simulate the effects of sunlight. This new approach has replaced traditional methods of accelerated weathering in over 400 research labs. Users report excellent correlation with outdoor performance, along with substantial reductions in operating costs and operating effort.

Q-Panels are standardised steel and aluminium panels for coating tests, sales samples, or bath records and quality control. Several types and sizes are available, covering a variety of applications.

Stand 25

Draiswerke GmbH

Draiswerke will be showing their highly successful *Drais STS* triple cooled mill which is used for both paste and liquid inks. Most major ink companies have installed the *STS* because of its simplicity of operation and design together with its ability to achieve high heat transfer figures on the cooling side together with excellent dispersion from larger diameter media which enables a more secure operation.

Its price is very competitive and it can use either glass, Zirconium or steel beads without any change being necessary.

The *Draiswerke RSV "Star"* head pre-mixer with scraper blade will also be shown. This machine in many cases is allowing predispersion to replace many *Perl Mill* operations due to its high efficiency and unique head design. The vacuum created beneath the rotor head causes a high transfer of heavy inks with the required vortex to enable many paste inks to be taken below 20 microns which no other machine can achieve.

The *Draiswerke TEX Mills*, which can operate in either a horizontal or vertical attitude, will also be on display. *Draiswerke* are the only company who can offer a machine which can operate in either attitude, which is important as there is now a swing-back towards mills operating in the vertical position.

A complete diagrammatical description of the *Drais* direct feeding *Perl Mill* will be featured on the stand. The use of such direct feeding for carbon black beads and other pigments is now gaining considerable interest throughout the paint and ink industry.

Stand 33

Montedison Group

Dyestuffs and Auxiliary Products Division

The recently established *Dyestuffs and Auxiliary Products Division* of the *Montedison Group* manufactures and markets "fine chemicals". Through its subsidiary company *ACNA*, it produces organic pigments and dyestuffs for end use in such diverse areas as: textiles, paper, leather, plastics, inks, paints, rubber, etc., together with organic intermediates for dyestuffs and for the chemical industry in general.

In addition, the Division's product range also includes a broad range of resins and

adhesives, for use in water-bound paints, wood, paper textile, etc., and important intermediates for the paint industry.

Research Centres at Cesano Maderno (Milan), Castellanza (Varese), and Villadossola (Novara) make a major contribution to the Division's activity, developing many original pigments and dyestuffs and also resins, adhesives and auxiliary products.

As this research area is especially complex, the division also relies on a special group of research workers, located at *Montedison's* "G. Donegani" Research Institute in Novara, and devoted to the study and development of new dyestuffs.

Other subsidiaries operating within the division's sphere are, *ROL* (lubricants and textile auxiliaries), *S.C.M. Schelde Chemische Maatschappij* (urea adhesives), *ACNA U.K.* (organic intermediates) and *ACNA Hispania* (organic dyestuffs).

At the OCCA-31 Exhibition, the *Montedison Dyestuffs and Auxiliary Products Division* will feature the wide and varied product range of its ACNA subsidiary, and the various resins, emulsion and intermediates which it manufactures for use in the paint and varnish industries.

Stand 44

IMC Chemie GmbH

From production facilities in Germany and the United States, *IMC Chemie GmbH*, will present, for the first time at OCCA, its full line of versatile nitroparaffins and derivatives.

Nitroparaffins provide problem solving and product improving benefits for a wide range of industrial and domestic coatings as well as inks. A wealth of technical literature will be available on all products.

The *IMC Chemie* Exhibit will highlight:

AMP (2-amino-1-methyl-1-propanol): A catalogue of solutions in one product. As an excellent pigment dispersant and pH buffer in emulsion paints, *AMP* is very useful for improving colour acceptance and reproducibility, scrub resistance, and viscosity stability. *AMP* is also a most efficient resin solubiliser for water-based oven and air-dry coatings and ink systems.

Nitropropane Solvent*: A strong, versatile additive that, when incorporated into solvent blends, imparts a host of benefits to solvent based industrial coatings. These benefits include: faster dry time, improved solvent release, better flow and film integrity, better dispersion in electrostatic spray and reduced resin precipitation. These benefits also apply to solvent based inks both in manufacturing and as a press side thinner for rotogravure and flexographic inks.

Other nitroparaffins for coatings include *Bioban CS-1135*, a bacteriostat for emulsion paints, and *Alkaterge E & T* for solvent-based tinting pastes and corrosion inhibition.

*Sold in most countries outside UK as "NiPar Solvent".

IMC Chemie GmbH is a subsidiary of *International Minerals & Chemical Corporation*, a US based company whose businesses include agriculture, animal health, energy, industrial products and chemicals. *IMC* has mining, manufacturing, processing and marketing facilities worldwide.

Stand 47

Pye Unicam Ltd

Pye Unicam SP8 Series Colour Measurement Systems

Pye Unicam have introduced a range of systems based on the *SP8-100* and *SP8-200 UV/visible scanning spectrophotometers* which merit serious consideration by those laboratories which need both a precision, general purpose instrument and a colour measurement device for a modest outlay.

The *SP8-100* is of modular design and has a wide range of plug-in accessories which enable the instrument to be tailored to suit many different applications. In the short time since its launch, the *SP8-100* has established an excellent record for performance and reliability and is now the UK's best-selling UV/visible scanning spectrophotometer. The *SP8-200* offers an even higher standard of optical performance largely due to a unique master, blazed holographic grating. The *SP8-200* also features keyboard operation and microprocessor control and data handling. It is, therefore, ideal for applications where computer control of the entire measuring process is desirable. For colour measurements, a unique integrating spheroid can be fitted into the cell compartment of *SP8 Series* spectrophotometers in a matter of a few minutes. Outputs are available which enable on or off-line processing of the raw data.

simple questions asked by the calculator. The software is self-explanatory, easy to use and enables comparatively unskilled operators to undertake colour measurement on a routine basis.

Stand 10

Libra Chemicals Ltd

Libra Chemicals have an exclusive distributorship for the UK of all the *Filter Specialists Inc.*, Michigan City, product range.

FSI are the leading manufacturers of filter bags and allied filtration equipment with improved designs on a proven concept.

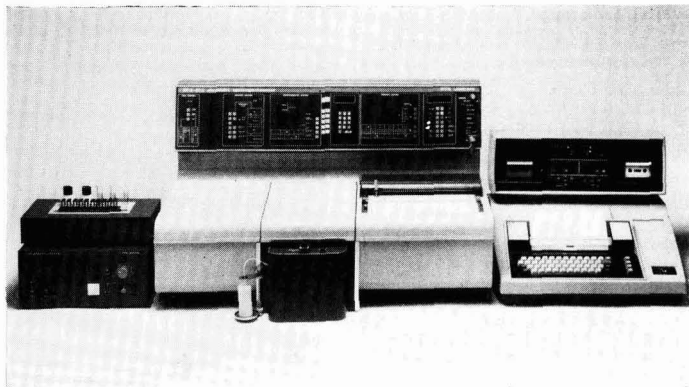
The basic system includes a pressure vessel, restrainer basket and a filter bag. The pressure vessels are designed from laboratory scale up to large production batch sizes with flow rates of up to 1400 GPM. Flow is through the filter bag, contaminants are collected inside the bags which are available in all sizes for vessel selected as well as in a complete range of fibres with micron ratings from 1 to 800.

Changing of the filter bag is accomplished quickly, and the vessels are designed for simplicity of operation and ease of cleaning, with the following features:

One "O" ring seal. Positive sealing. 100 per cent cleanable. Low "O" ring usage. Permanent piping—cover opens without any disconnection of plumbing. Heavy duty stainless steel basket standard.

Other features of the system include high flow rates combined with depth filtration and low pressure drop.

Newly designed filter bags with self



The SP8-200 ultraviolet spectrophotometer system from Pye Unicam Ltd.

Pye Unicam market a combination of the *SP8-100* spectrophotometer, an *HP9815A* programmable calculator and a versatile software package for colour applications. The system gives printout of chromaticity co-ordinates, T-values and Lab specifications (Ciel*a*b* or Anlab), together with colour differences, for a range of conditions; various illuminants, gloss or non-gloss, etc. The system is set up by answering

sealing ring and handles for ease of bag change. Trade name *Polyloc* filter bags.

The system incorporates a unique evacuation float system which displaces the liquid in the filter bag, and when the lid of the vessel is opened, the evacuation float pops up and is easily removed. The removal of the float eliminates spillage, product loss and bag weight.

OCCA Biennial Conference 1979

Stratford
-on-
Avon

20-23 JUNE 1979 STRATFORD HILTON HOTEL

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.

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

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.



Mr W. K. H. Lakin, who will be jointly presenting a paper with Mr J. H. W. Turner at the Association's Stratford Conference. (See p483, December JOCCA)

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).



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

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 membership application form at the same time as they submit their Conference registration

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 is a new venue for

Professional Grade

The Technical Training Board of the Society of British Printing Ink Manufacturers, recognising that the Association's Professional qualifications could play a part in maintaining the scientific, technological and professional standards in the Printing Ink Industry have made the following declaration:

"The Technical Training Board of the Printing Ink and Roller Making Industry recognises the need to maintain scientific, technological and professional standards in the printing ink and roller making industries. It recommends Members to encourage their technologists and technicians to apply for admission to the Optional Professional Grade for Ordinary Members of the Oil and Colour Chemists' Association".

Hull Section

Annual Dinner Dance

The Annual Dinner and Dance of the Hull Section was held on Friday 6 October 1978 at the Willerby Manor Hotel, Willerby, near Hull.

The top table guests included the Chairman of Hull Section, Mr R. Brooks and Mr F. Hellens (Chairman, Newcastle Section), Mr M. Cochrane (Chairman, West Riding Section), Mr I. R. McCallum (Chairman, Scottish Section), and Mr R. H. Hamblin (Director & Secretary).

After introducing all his top table guests, the Chairman, R. Brooks mentioned in his speech that he was sorry that the President, A. McLean would not be able to attend due to ill health.



Top Table guests at the Hull Section Dinner Dance (l-r): Mr T. W. Wilkinson, Mrs Wilkinson, Mr P. W. Munn, Mrs Munn, Mr R. Brooks, Mr R. H. Hamblin, Mrs Van Spall, Mr A. R. Van Spall

However he was pleased to welcome Mr R. H. Hamblin who had been thwarted many times in the last few years from attending the Hull Section Dinner and Dance, but was glad that he could attend this year.

The Chairman also sent best wishes to Geoff Christon on a speedy recovery, Geoff and his wife having been present at the Hull Section Dinner and Dance for as long as he could remember! A Card was sent on behalf of all at the Dance.

Mr Brooks also mentioned Mr Wynn's long service as a member of O.C.C.A.

At the last moment Mr R. H. Hamblin very ably stepped in and replied on behalf of the guests.

Dancing continued enthusiastically to Frank Cleveland, accompanied by Rosemarie until 1.00 a.m. and even later for some guests.

Just as the evening was coming to a close a comment was made about a "purple" shirt that seemed to be missing this year??

A.R.V.S.

London Section

Kekwick Prize

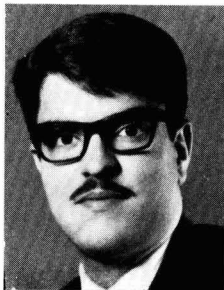
At the evening technical meeting held on 21 September 1978 at the "Princess Alice", Romford Road, E7, the 1978 Kekwick Prize for the most successful paint technology student at London colleges was presented to Ms S. Hancock, Berger Paints, Dagenham.

Ms Hancock, who has successfully completed the LRIC course in Paint Technology at East Ham College of Technology, received a cheque for £25 and one year's membership of OCCA from London Section Chairman Mr D. Bayliss.

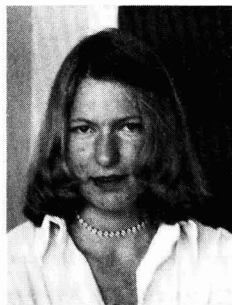
A. J. N.

News of Members

Mr A. M. Khider, an Ordinary Member attached to the Thames Valley Section and an Associate in the Professional Grade, has been appointed Factory Manager of the Modern Paints Industries S.A., Baghdad.



Mr A. M. Khider



Ms S. Hancock, winner of the Kekwick Prize

Dr E. Inman, an Ordinary Member attached to the London Section, has been appointed as Technical and Production Director at Burrell Colours Limited.

Obituaries

Dr H. A. Hampton

Dr H. A. Hampton, a long-serving and Honorary Member of the Association, died suddenly on 11 November, aged 71, at his home near Bournemouth.

Horace Hampton was elected to membership in 1940, initially as a member of Manchester Section and became Section Treasurer and Chairman (1948-50). His service on Council from 1945 led to his election as Association Hon. Treasurer (1957-60) and then President in 1961-63. He was a Vice-President 1951-53 and again in 1968-70 and he represented the South African Section for many years. In 1970 Council conferred Honorary Membership on Dr Hampton for his long and distinguished service in furtherance of the Association's interests.

Dr Hampton graduated from Birmingham University with first-class honours, and researched there on polysaccharides. He joined the Dyestuffs Division of ICI (later Organics Division) in 1930, where he spent all his professional life. His early years in the Research Department saw the introduction into the UK of alkyl and solution acrylic resins. Later he moved to the technical service function, becoming, in due course, Head of Resins Service Department, and then of the larger Polymer and Chemicals Service Department, which served all the polymer-using industries. Horace Hampton was widely known and respected throughout the resin and paint industries for his knowledge, experience and integrity.

Dr Hampton leaves a wife and two sons, to whom we extend our sympathy. With his passing, the Association has lost a loyal and colourful senior member.

C. Barker

Anthony McWilliam, C.Chem., MRIC,

AMCST, FTSC

Chairman of the Manchester Section of OCCA, Tony McWilliam, died suddenly, at work, on Monday 13 November 1978, at the age of 50 years.

Liverpool born, he attended St. Francis Xavier's College prior to studying at both Liverpool and Burnley Technical Colleges followed by attendance at the Manchester College of Science and Technology. 'Mac', and he was affectionately known by his many friends and colleagues, commenced his industrial career at Goodlass Wall before conscription into the R.A.O.C. as an Ammunition Examiner. On return from a Gibraltar posting he enjoyed short spells at both Goodlass Wall and Albright & Wilson before joining Beck Koller at Liverpool in 1951 as a Works Chemist/Synthetic Resins. 'Mac' made many friends at Beck Koller before leaving in 1954 to work at Titanine, London, then to T. & R. Williamson, Ripon. His four years at Ripon were spent as Chemist I/C Resin/Paint Media Development, and during this period he

served as Hon. Sec. to the West Riding Section for three years.

Returning to his native Lancashire in 1958, he joined England Hughes Bell as Assistant Chief Chemist and was made Chief Chemist in 1961, the position he held at the time of his death.

Since transfer to the Manchester Section, 'Mac' became Publications Officer for five

years before appointment as Vice-Chairman in 1977.

A devoted family man, his hobbies included dinghy sailing, bridge and a particular interest in mathematical subjects.

His Requiem Mass was attended by many friends and colleagues. Our sympathy is extended to his widow Sheila and his five children.

F. B. Windsor

Mrs C. E. Friend

Members of the Association will be saddened to learn that Mrs Cathleen Emily Friend, wife of the late Dr J. Newton Friend, Past-President of the Association, died on the 25 October 1978 aged 84 yrs after a long illness. A memorial service was held at St Mary's Church, Moseley on Monday 30 October.

Association Notices

Binding of Journal

Members will be pleased to know that J. S. Wilson & Son, 14a Union Road, Cambridge CB2 1HE, will undertake the binding of back volumes of the Association's *Journal* sent in by individual Members at a cost of £7.00 (including postage and packing) per volume.

Members wishing to avail themselves of this facility should send the parts, securely wrapped, direct to J. S. Wilson & Son, enclosing a remittance of £7.00 (including postage and packing) per volume, and ensuring that notes bearing their names and addresses are enclosed with the parcels. It is particularly important that packets are sufficiently wrapped to negate the possibility of damage in the post.

1979 Members' subscriptions

Members are reminded that 1979 Membership subscriptions to the Association are payable on 1 January 1979. Forms were despatched to all Members in October or November, depending upon address.

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

objects of the Association are relevant to such office or employment.

Members resident in the United Kingdom are reminded that if there is any change in the standard rate of Value Added Tax announced before they send in their 1979 subscription, the VAT payable on membership subscriptions is the amount which applies on the date of payment.

1979 library subscriptions

The *Journal* subscription rate to non-Members, including libraries, for 1979 will be £30.00 (\$70) post free by surface mail, home and abroad. Individual copies can be purchased for £3.00. Remittance should be sent with order to the Association's offices.

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

ARMISHAW, RICHARD FARNSWORTH, PhD, 50 Palmerston Road, Birkenhead, Auckland, New Zealand (*Auckland*)

BIGGS, REGINALD PAUL, GRIC, Berger Paints, PO Box 20, Pether-ton Road, Bristol BS99 7JD (*Bristol*)

BURNETT, CHRISTOPHER ROBERT, Berger Paints, PO Box 20, Pether-ton Road, Bristol BS99 7JD (*Bristol*)

CATTELL, HAROLD GEORGE, 16 Hammerton Drive, Garforth, Leeds (*West Riding*)

CUMMINGS, ROBERT ALLAN, 57 Meadow Road, Kingswood, Wat-ford, Herts (*Thames Valley*)

DODD, GEOFFREY, 89 Earnsdale Avenue, Darwen, Lancs (*Manchester*)

HALL, JOHN EDWARDS, BTP Tioxide Ltd, Central Labs, Portrack Lane, Stockton on Tees (*Newcastle*)

LISTER, JOSEPH WILLIAM, BTech, 76 The Drive, Ilford, Essex (*London*)

MARRON, JOHN JAMES, BA, LRIC, 20 Juniper Grove, Marton, Middlesbrough, Cleveland TS7 8DW (*Newcastle*)

MIKKELSEN, BORGE HOLVIG, MSC, Fuglebakkevej 22, DK-2000 Copenhagen F, Denmark (*General Overseas*)

MORRIS, KEVIN, BSC, 13 Woodstock Drive, Tottington, Bury, Lancs BL8 4BW (*Manchester*)

MURRAY, HUGH LIVINGSTON, 51 Millerneuk Drive, Lenzie, Kirkin-tilloch, Glasgow G66 5JE (*Scottish*)

PATTANAIK, PRATAP, BSC, 451 The West Mall, Apt 902, Etobicoke, Ontario M9C 1G1, Canada (*Ontario*)

RANSING, SVEND, MSC, Rudegaards Alle 27B, 2870 Holte, Denmark (*General Overseas*)

RICKELL, DAVID, 48 Walker Road, Chadderton, Oldham, Lancs (*Manchester*)

ROBSON, MATTHEW WILLIAM, BSC, 19 Newmin Way, Clavering Park, Whickham, Newcastle upon Tyne NE16 5RE (*Newcastle*)

ROWSON, DOUGLAS PONT, GRIC, 88 Pixmore Way, Letchworth, Herts SG6 3TP (*London*)

SWART, NICO JOHANN, PO Box 51, Strand, South Africa (*Cape*)

VARDIGANS, PETER GLENDENNING, 76 Meadowside Drive, Bristol BS14 0NS (*Bristol*)

ZIERVOGEL, HAMILTON MAXWELL, Box 2495, Cape Town 8000, South Africa (*Cape*)

ZOBEL, FRANK GEORGE REINHARDT, PhD, BSc, FRIC, CChem, Railway Technical Centre, London Road, Derby DE2 8UP (*Midlands*)

Associate Members

BROSH, ODED, 46 North Park Grove, Leeds 8 (*West Riding*)

CAMPBELL, JAN DUNCAN, Buckley & Young Ltd, PO Box 5641, Auckland, New Zealand (*Auckland*)

HAMILTON, BRIAN, 2/16 Downing Street, Glenfield, Auckland, New Zealand (*Auckland*)

HEINTZMANN, HERMANN GEORG, Bayer UK Ltd, Bayer House, Richmond, Surrey TW9 1SJ (*Thames Valley*)

MCKINNEY, DAVID, PO Box 1298, Port Elizabeth 6000, South Africa (*Cape*)

SMET, FRANZ WILLI, 38 Gossmore Lane, Marlow, Bucks (*Thames Valley*)

STARMER, GARY STEPHEN, 8 Troy Place, Glendowie, Auckland 5, New Zealand (*Auckland*)

VOERMAN, WYTZE JAN, PO Box 1808, Cape Town 8000, South Africa (*Cape*)

Registered Students

BROUGH, GORDON DAVID, 8 Gorsefield Drive, Swinton, Manchester M27 1SY (*Manchester*)

DEIGHTON, STEPHEN JOSEPH, 85 Holderness Road, High Howdon, Wallsend, Tyne and Wear NE28 0DJ (*Newcastle*)

EARNSHAW, ANTHONY JOHN, 229 Bury New Road, Whitefield, Manchester, Lancs (*Manchester*)

ELLWOOD, PAUL STEPHEN, 229 Bury New Road, Whitefield, Manchester, Lancs (*Manchester*)

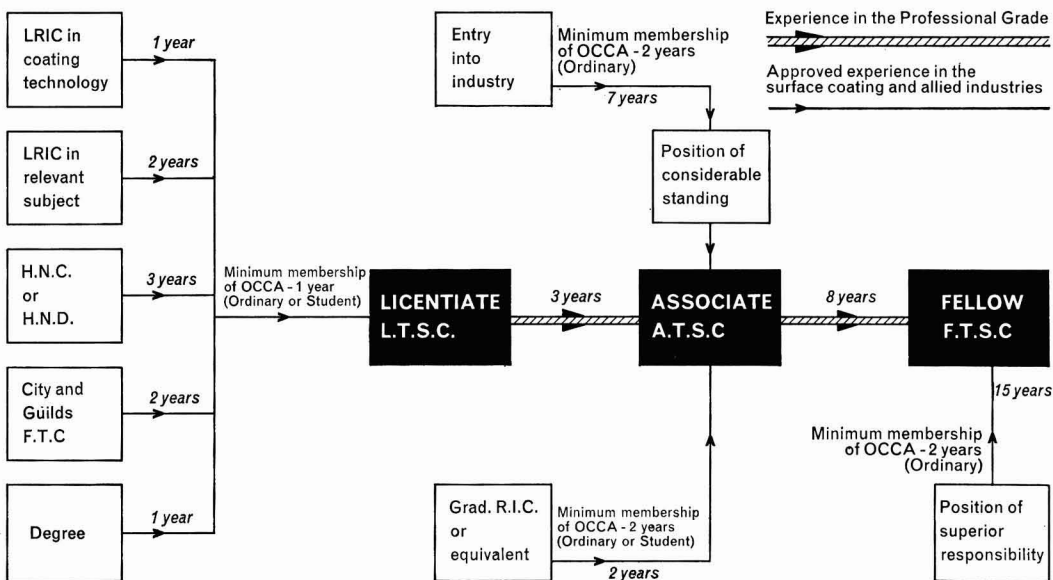
GOLDSMITH, ALAN, 186 Hawthorn Road, Strood, Kent ME2 2HS (*London*)

KATRIR, SASAN, Flat 28, Thorne House, Wilmslow Road, Manchester 14 (*Manchester*)

Optional Professional Grade for Ordinary Members

The innovation of the Professional Grade has proved to be most successful, as evidenced by the impressive list of names in the December 1978 issue of the *Journal*. For the convenience of potential applicants, a chart indicating different routes to the various grades is shown below.

Routes to the Professional Grades



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

Regulations for admission to the Professional Grade

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

A. Licentiate

1. Shall be an Ordinary Member of the Association and have been an Ordinary Member or Student of the Association for not less than one year.
2. Shall have attained the age of 22.
3. (a) Shall be a Licentiate of the Royal Institute of Chemistry in Coatings Technology (*viz.* Higher National Certificate + Endorsement in coatings technology + 1 year approved experience in the science or technology of coatings after passing the endorsement examination).

OR (b) Shall be a Licentiate of the Royal Institute of Chemistry in another relevant subject such as advanced analytical chemistry, colour chemistry or polymer science, and shall

have two years' approved experience of coatings since so qualifying.

OR (c) Shall hold the Full Technological Certificate of the City and Guilds of London Institute in a relevant subject as approved by the Professional Grade Committee and shall have two years' approved experience in the science or technology of coatings since gaining the FTC.

OR (d) Shall have passed Higher National Certificate or Higher National Diploma with three years' approved experience in the science or technology of coatings since qualifying, but two years' approved pre-qualification experience shall be deemed equivalent to the third post-qualification year.

OR (e) Shall be graduate in relevant subject with not less than 1 year's approved experience.

OR (f) Shall have passed such other qualifications as approved by the Professional Grade Committee from time to time.

4. Shall be required to satisfy the Professional Grade Committee, or some other body approved by the Professional Grade Committee in a *viva voce* examination and submit a dissertation on a topic previously approved by the Professional Grade Committee.

5. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.

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

B. Associate, being already a Licentiate

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

C. Associate, not already a Licentiate**EITHER**

1. Shall be not less than 24 years of age.
2. Shall be an Ordinary Member of the Association and have been an Ordinary Member or Student of the Association for not less than two years.
3. Shall hold the Graduateship of the Royal Institute of Chemistry or Council of Physics or a University or Council of National Academic Awards degree recognised by the Royal Institute of Chemistry or Institute of Physics as giving full exemption from the Graduateship examination.
4. Shall have not less than two years' approved post-graduate experience in the science or technology of coatings.
5. Shall normally be required to satisfy the Professional Grade Committee or some other body approved by the Professional Grade Committee, at a *viva voce* examination.
6. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.
7. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

OR

8. Shall be not less than 30 years of age.
9. Shall be an Ordinary Member of the Association and have been an Ordinary Member of the Association for not less than two years.

10 Shall have been engaged in practising the science or technology of coatings for not less than seven years and shall have attained a position of considerable standing in the industry.

11 Shall normally be required to satisfy the Professional Grade Committee in *viva voce* examination of his professional competence.

12 Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.

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

D. Fellow

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

1. Shall be not less than 33 years of age.
2. Shall have been an Ordinary Member of the Association for not less than two years.
3. Shall be engaged in a position of superior responsibility in the coatings industry.
4. EITHER (a) shall have been an Associate of the professional grade for at least eight years;
OR (b) shall have not less than fifteen years' experience of the science or technology of coatings in a position of superior responsibility.
5. Shall submit, with his application, an account of his experience, with due reference to scientific and technological interests, achievements and publications.
6. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade, all of whom must be Fellows.
7. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

The fees payable with applications are as follows:

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

Application

Completed application forms should be returned, together with the appropriate remittance, to the Director & Secretary at the Association's offices (except in the case of those Members attached to the Auckland,

South African and Wellington Sections who should address their forms to their Section Hon. Secretaries).

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

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

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

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

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

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

Where practical work is described, some attempts should be made to draw theoretical conclusions or to form some provisional hypothesis, together with an outline of what further work would be required to confirm the views put forward or further to advance the knowledge of the subject.

Where the dissertation is a review or a theoretical treatment, there should be an attempt to contrast and compare any opposing views expressed in earlier works, to examine the views critically, to suggest any compromise interpretation, to account for all the known facts and to outline any further work by which the opposing views could be tested.

Where applicable, references should be given to published work, graphs, diagrams etc. to be appended.

Length: Text should be approximately 5 000 words.

Applicants should refer to the paper by Moss which appeared in the January 1973 issue; the Professional Grade Committee feels that candidates for the Licentiate grade could with advantage use this paper as a model for their dissertations.

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.

January 1979

Tuesday 2 January

West Riding Section: Chairman's Lecture to be held at the Mansion Hotel, Roundhay Park, Leeds 8, commencing at 7.30 p.m. *Details to be announced.*

Thursday 4 January

Newcastle Section: Management paper, to be held at St. Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m. *Details to be announced.*

Monday 8 January

Hull Section: "Training" by T. A. Fillingham of Marfleet Refining Co. Ltd, to be held at the "George Hotel", Land of Green Ginger, Hull, commencing at 6.30 p.m.

Manchester Section: "Titanium dioxide in coloured stoving enamels" by Dr R. Schwindt of Kronos Titanium Pigments Ltd, to be held at the Woodcourt Hotel, Sale, commencing at 6.30 p.m.

Friday 12 January

Scottish Section: Ladies' annual evening to be held at the Albany Hotel, Glasgow, commencing at 6.00 p.m.

Wednesday 17 January

Ontario Section: MacLean Hunter Tour by S. P. Wyszowski.

Thursday 18 January

London Section: "Permeability of paint films to chloride ions" by Mr A. Roberts, CEGB, Scientific Services Dept. at the Princess Alice, Romford Road, E.7, commencing at 7.00 p.m.

Scottish Section: "New developments in azo pigments" by A. G. Abel of Hoechst UK Ltd, to be held at the Albany Hotel, Glasgow, commencing at 6.00 p.m.

Friday 19 January

Irish Section: Ladies' evening—Wine/cheese at the Clarence Hotel, Dublin, commencing at 8.00 p.m.

Midlands Section: Dinner Lecture in conjunction with Trent Valley Branch "Protection of structures involved in North Sea oil operations" by Mr J. R. Bourne of Mebon Ltd and Mr F. H. Palmer of BP Ltd, to be held at Chamber of Commerce & Industry, Harborne Road, Birmingham.

Wednesday 24 January

Manchester Section: Student Lecture "Paints for electrodeposition" by W. G. Topham of Goodlass Wall Ltd, at Manchester Literary & Philosophical Society, George Street, Manchester, commencing at 4.30 p.m.

Scottish Section—Eastern Branch: "Dispersion techniques" by J. Davidson,

at the Murrayfield Hotel, 18 Corstorphine Road, Edinburgh at 7.30 p.m.

Thursday 25 January

Thames Valley Section: "Quinacridone pigments" by Dr R. Zabel of EI du Pont de Nemours & Co. Inc., to be held at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing at 6.30 p.m. for 7.00 p.m.

Friday 26 January

Bristol Section: "Water reducible printing inks" by Mr R. C. Coates of Coates Brothers Inks Ltd, to be held at the Royal Hotel, College Green, Bristol, commencing at 7.15 p.m.

February

Thursday 1 February

Newcastle Section: Joint meeting with the Plastics and Rubber Institute. "Glass fibre polyester as a substrate for painting" by Mr F. E. Bassford of Cray Valley Products Ltd, at St Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m.

Friday 2 February

Scottish Section—Eastern Branch: Burns Supper to be held at the Commodore Hotel, Marine Drive, Edinburgh.

Monday 5 February

Hull Section: "Developments in milling and dispersing equipment" by a speaker from Herbert Smith & Co Ltd. *Details to be announced.*

Manchester Section: "Inks for packaging" by Mr Duffin of Irlam Inks. Joint lecture with Institute of Printing Inks at Woodcourt Hotel, Sale, commencing at 6.30 p.m.

Tuesday 6 February

West Riding Section: "Some aspects of corrosion in CEGB installations" by Mr R. Umpleby of CEGB Scientific Services Department at the Mansion Hotel, Roundhay Park, Leeds 8, commencing at 7.30 p.m.

Thursday 8 February

Midlands Section—Trent Valley Branch: "Printing of food packaging materials" by a speaker from Bemrose Packaging at the Crest Hotel, Pastures Hill, Littleover, Derby, commencing at 7.00 p.m.

Scottish Section: "Fundamentals of modern emulsion paint formulation" by J. Clark of BTP Ltd. Student invitation lecture at the Albany Hotel, Glasgow, commencing at 6.00 p.m.

Friday 9 February

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

Wednesday 14 February

Ontario Section: TBP by Mr L. Horn of Lawter to be held at the Saturn Room, Constellation Hotel, Toronto, commencing at 6.00 p.m.

Thursday 15 February

Midlands Section: "Case for chromes" by lecturer from ICI Ltd, at the Calthorpe Suite, County Ground, Birmingham, commencing at 6.30 p.m.

Friday 16 February

Irish Section: "Solvent recovery in the paint industry" by Mr I. Smallwood of Frazer McNaughton Ltd, at the Clarence Hotel, Dublin, at 8.00 p.m.

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

Wednesday 21 February

London Section: "Novel ink systems" by P. G. Richardson, Fishburn Printing Ink Co Ltd, at Rubens Hotel, Buckingham Palace Road, SW1, at 7.00 p.m.

Manchester Section: Student Lecture "Powder versus water based paints, a comparison of properties" by K. H. Dodd of Carrs Paints at Manchester Literary & Philosophical Society, George Street, Manchester, commencing at 4.30 p.m.

Thursday 22 February

Thames Valley Section: "Aqueous based printing inks" by Mr Mullahd of Harlow Chemicals, at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing at 6.30 p.m. for 7.00 p.m.

Friday 23 February

Bristol Section: "Surface active agents in surface coatings" by Dr A. Pryce of ABM Chemicals Ltd. Joint meeting with the Birmingham Paint Varnish and Lacquer Club at the Royal Hotel, College Green, Bristol, at 7.15 p.m.

Wednesday 28 February

Scottish Section—Eastern Branch: "Acrylic emulsions in and on paper" by J. B. Tait of Rohm & Hass. Joint meeting with the B.P.B.M.F., in the Maybury Hotel, Maybury Road, Edinburgh, at 7.30 p.m.

March

Auckland Section: Annual General Meeting. *Details to be announced.*

Wednesday 14 March

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

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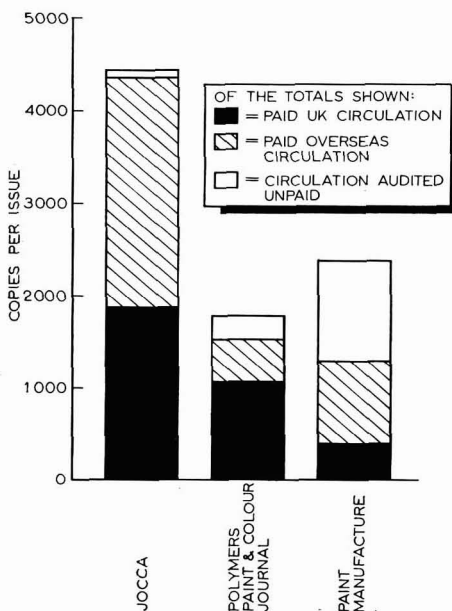
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(Reference Audit Bureau of Circulations Reviews. Jan-Dec 1977)

For full details of advertising in this, and other Association publications, contact D. M. Sanders, Assistant Editor

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

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OIL & COLOUR



CHEMISTS'

ASSOCIATION



TECHNICAL EXHIBITION

3-6 APRIL 1979

The motif for OCCA-31, designed by Robert Hamblin, emphasises the unique aspect of the OCCA Exhibitions, which annually provide an international focal point for the surface coatings industries. In 1978, exhibitors were drawn from sixteen countries and visitors from over fifty countries.

TRAVEL ARRANGEMENTS FOR VISITORS TO OCCA-31

For those travelling to the Exhibition by car, ample free parking space is available in the grounds of Alexandra Palace, and recent improvements to the road system include the extension of the southbound carriageway of the M1 Motorway to the North Circular Road and the flyover on that road by the new Brent Cross Shopping Centre. The extension of the Piccadilly Underground line to the Heathrow Airport Terminal gives a direct line to Wood Green station from where the Association runs a free bus shuttle service to the Exhibition. The journey from central London to Wood Green takes approximately 18 minutes.