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REPORT OF AGM Page 320

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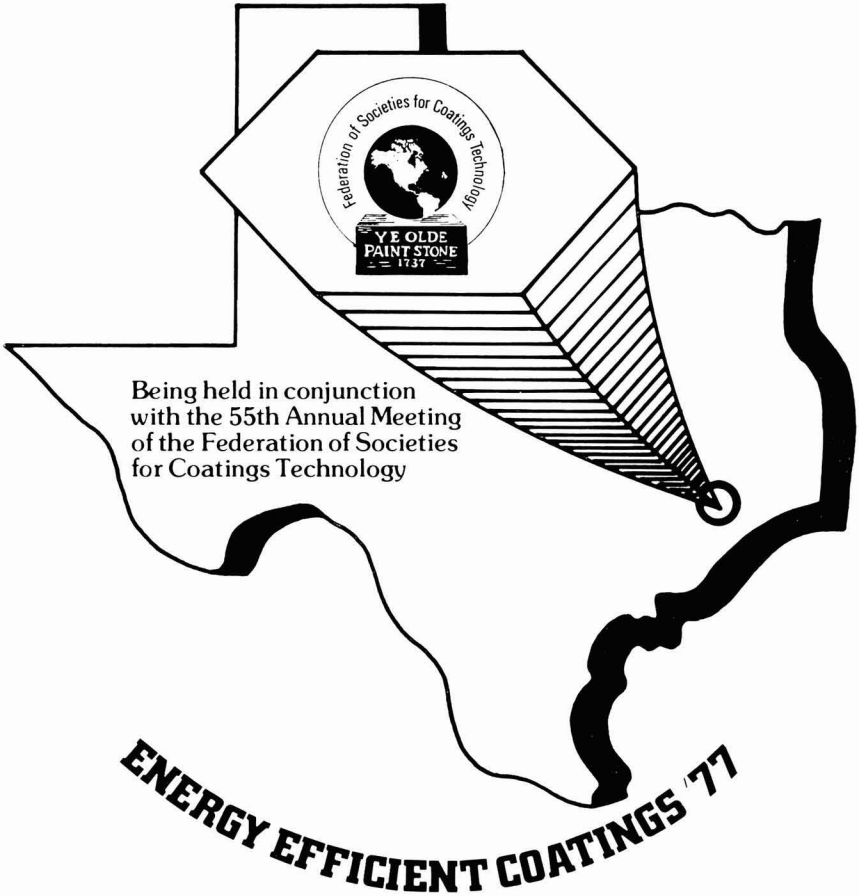

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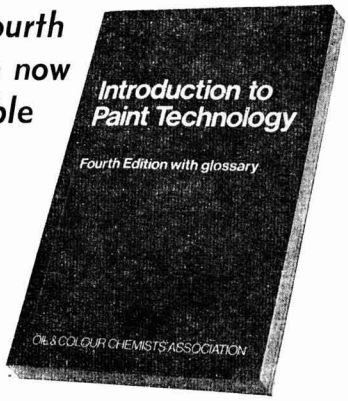

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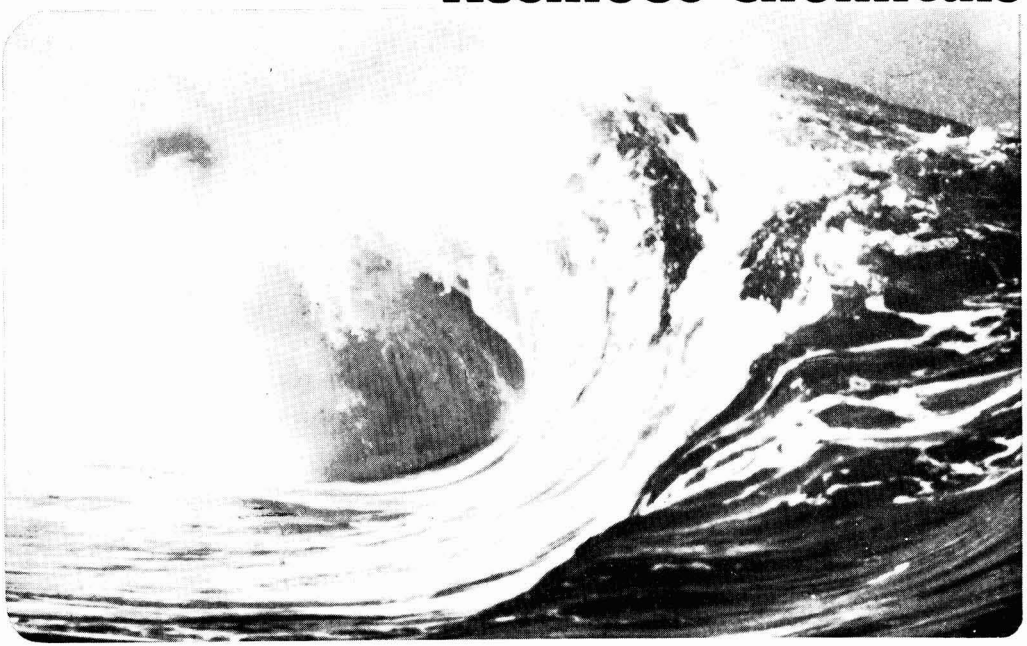

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Transactions and Communications

New methods of determining the throwing power of electrodeposited (ED) paints*

By Dr H. Hönig

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Summary

An equation connecting voltage and time with throwing power during the electrodeposition of a paint film at an anode was found. This equation allows the deduction of a throwing power constant (throwing power value) which is independent of test conditions.

The possibility of independent, and thus objective, recording of the throwing capacity of ED paints, the development of new measuring methods and the application of statistical computing methods allow the determination of paint parameters which influence the throwing power value.

These paint parameters are the specific conductivity, the coagulation tendency and the speed with which the film builds up resistance.

Thus the throwing power value of a paint can be analysed and this in turn gives hints for the application and development of ED paints.

Keywords

Types and classes of coatings and allied products

electrocoating

Properties, characteristics and conditions primarily associated with coatings during application

throwing power

Nouvelles méthodes pour déterminer le pouvoir de pénétration des peintures pour électrodéposition

Résumé

On a établi une équation qui met en rapport la tension, le temps et le pouvoir de pénétration lors du processus d'électrodéposition à l'anode d'un film de peinture. Grâce à cette équation on saurrait déduire un constant du pouvoir de pénétration (la valeur du pouvoir de pénétration) qui est independant des conditions d'essai.

La possibilité de chiffrer indépendamment et ainsi objectivement le pouvoir de pénétration des peintures pour électrodéposition, la mise au point de nouvelles méthodes d'évaluation, et aussi l'utilisation des méthodes statistiques et des ordinateurs permettent la détermination des paramètres d'une peinture qui exercent une influence sur la valeur du pouvoir de pénétration.

Ces paramètres comprennent la conductivité spécifique, la tendance à coagulation et la rapidité d'augmentation de la résistance électrique du film.

Par ce moyen on peut doser la valeur du pouvoir de pénétration d'une peinture qui donne naissance à des idées pour l'utilisation et l'évolution des peintures pour électrodéposition.

Neue Methoden zur Bestimmung des Umgriffes von ET-Lacken

Zusammenfassung:

Das Auffinden der gesetzmässigen Zusammenhänge, die zwischen Abscheidungsspannung, -zeit und Reichweite der Beschichtung auf einer Testanode herrschen, gestattete das Ableiten einer von Testanordnungen und Testbedingungen unabhängigen Umgriffskonstante, des Umgriffswertes.

Diese Möglichkeit der testunabhängigen und daher objektiven Beurteilung des Umgriffsvermögens von ET-Lacken durch den Umgriffswert, zusammen mit der Entwicklung neuer Messmethoden, sowie der Einsatz statistischer Rechenmethoden führten zur Ermittlung der Lackparameter, die den Umgriffswert selbst beeinflussen.

Es handelt sich bei diesen Parametern um die spezifische Leitfähigkeit, die Koagulationsbereitschaft des Lackes und die Geschwindigkeit, mit der ein Lackfilmwiderstand aufgebaut wird.

Ebenfalls auf statistischem Wege konnte eine mathematische Funktion gefunden werden, mit der aus diesen Umgriffsparametern der Umgriffswert errechnet werden kann.

Man wird dadurch in die Lage versetzt, das Umgriffsverhalten eines Lackes zu analysieren und dadurch Hinweise für die Anwendung und Entwicklung von ET-Lacken zu erhalten.

Electrodeposition nowadays is a common, much used method for priming metallic objects, particularly car bodies. The advantages over other methods are the more uniform film thickness, reduced drip losses and considerably reduced cost owing to less touch up or treatment before the finish is applied.

However, electrodeposition has one disadvantage over dip application, which is described by a term totally unknown in the vernacular of dipping: it is the term "throwing power". Throwing power is defined as the capacity of an electrodeposited paint (ED-paint) to deposit in the interior or in holes, that is at places which are shielded from the counter electrodes.

Contrary to dip coating, such places are not easily coated or they are coated to an insufficient extent and, in many cases, additional equipment, such as auxiliary electrodes (cathodes), are required.

Thus, paints suitable for electrodeposition call for binders with a maximum throwing power in order to run the bath satisfactorily without such costly additional installations.

Producers and users of new binder systems, therefore, take great care in testing the throwing power, and the producers of the binder system develop increasingly more subtle testing and measuring methods.

*Paper presented at the Conference on "Current trends in industrial finishing" held jointly by the London Section OCCA and the Institute of Metal Finishing at Warwick University on 20-22 September 1976.

So far there are no standardised test methods, and moreover, whilst lacking a knowledge of the mathematical relationships governing electrodeposition, resin producers are forced to adopt the test methods of their customers, even of prospective ones.

This profileration of testing procedures led Vianova, who are engaged in the development of synthetic resins, including those for ED-paints, to carry out intensive basic research to determine, amongst other things, the laws governing the throwing power of ED resins and paints. In this work, it was evident that once these laws had been found all the empirical methods could be discarded and development work could be done more efficiently, faster and cheaper.

The paint film deposited by the current flow during electrodeposition builds up an electrical resistance. This resistance prevents current flow at the places where the film already covers the substrate and causes the current to divert to and deposit a film (building up resistance) at more remote places.

Attempts were made in vain to deduce an equation from the progress of electrodeposition and so far nobody else seems to have succeeded.

Therefore, an attempt was made to solve this problem in some other way: In doing so it was evident that the problem must be divided into two parts.

Firstly, what is the influence of exterior conditions, such as deposition voltage and deposition time on the throwing power of an ED paint?

Secondly, what are the characteristics of the ED paint itself responsible for the maximum throwing power under any given conditions?

Each of these two aspects calls for a different mode of study:

With regard to the second question, statistical methods will probably be the most successful in determining the mathematical relationships, should other methods fail due to the complexity of the problem.

Experimental methods may be successful in answering the first question, such as finding a suitable testing procedure. In order to be able to design an adequate testing programme, a knowledge of the history of the process is necessary.

Fig. 1 shows the simplest arrangement for measuring the throwing power. The anode is a narrow iron strip positioned at right angles to the cathode.

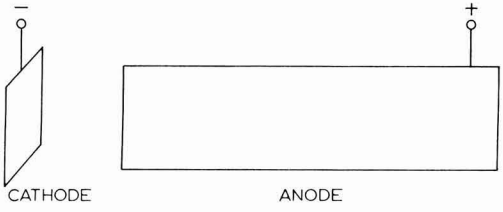

Fig. 1. Principle of throwing power determination

In this set-up, deposition takes place in the following way: The deposition current, at the beginning, only flows at that edge of the anode which is directly opposite and nearest to the cathode. To some extent the deposited film builds up resistance; the current is thus forced to flow on to still uncovered parts of the anode, which, as is evident, are more distant from the cathode. Deposition proceeds in this way along the anode.

Experience has shown that on increasing the deposition voltage, the deposition speed is accelerated and when prolonging the deposition time, the film travels further along the anode. Further, it is known that the speed of film formation is not constant during the process, but that it is very high at the beginning, and decreases continuously towards the end.

Thus, if the first question regarding the influence of the voltage applied and time on the throwing power is to be answered, the profile of the deposition speed has to be recorded.

For this there are two possibilities. Either to measure the length of the deposited film obtained after a predetermined time, or to record the time required for the deposition of a predetermined length of film. In the first case there is the disadvantage that each strip has to be stored to determine the exact distance to which deposition actually reaches and this is subject to the personal interpretation of the tester.

It was concluded that since times can be recorded quite accurately and recording can, moreover, be automated, and because the anode strip can be re-used (after cleaning it), the test arrangement shown in Figure 2 was adopted.

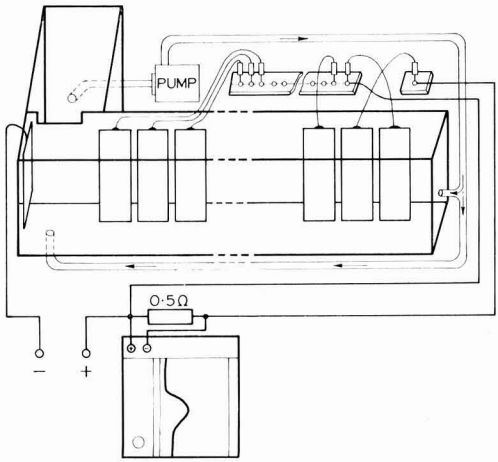

Fig. 2. Special arrangement for testing the laws governing throwing power

The anode steel strip (42 × 8cm) is divided into 21 strips, each 2cm wide. Each of these little steel panels is wired and insulated from its neighbours and is fixed to a board. The whole board is immersed into a miniature deposition tank (46cm long, 3·5cm wide and 8cm high). The cathode is mounted at one end of the tank. The paint in the tank is circulated and the bath temperature is regulated. The mini-panels are connected individually to the + pole of the rectifier by separate leads via a distribution board. In each of the 21 runs, one panel, in numerical order, is not connected to the distribution board but is connected to the positive pole through a measuring resistance (about 0·5Ω) Parallel to the resistance, there is a potentiometer recording the current

flow in the resistance. On paint deposition the following occurs:

At the beginning of deposition, no current flows through the measuring resistance (unless the first segment had been previously connected). When deposition approaches the test segment, current starts to flow and increases rapidly to reach a maximum. At this moment film deposition starts on this particular segment. The depositing film builds up a resistance, which reduces the current flow to almost zero (see Figure 3).

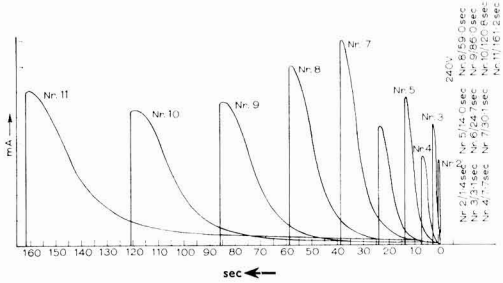

Fig. 3. Current flow through the various anode segments (the differences in deflection are due to the selection of different sensibility grades of the recorder)

The maximum in the current shows that that deposition must have reached this particular segment. The recorder gives the time which has elapsed from the beginning of deposition, that is (when the current is switched on) to when the maximum is attained. If for all 21 segments, these times are recorded and plotted in a diagram against the segment numbers, the resulting curve is the time history of deposition along this anode set-up, ie the speed profile sought (Figure 4). (It is evident that the whole anode set-up has to be cleaned between each individual recording.)

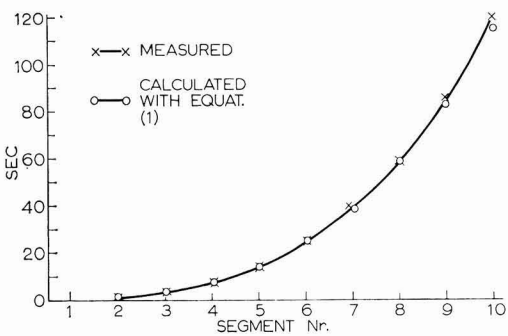

Fig. 4. Length of deposit (= segment number) time diagram of the results of Fig. 3.

Mathematical analysis of this curve leads to the following equation:

$$t = A.s^3 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

This means that time increases with the third power of deposition distance (since the number of the segment reflects also the length of the deposition).

For example: if it takes 1 second to deposit a length of 2cm then it would take 8 seconds for 4cm.

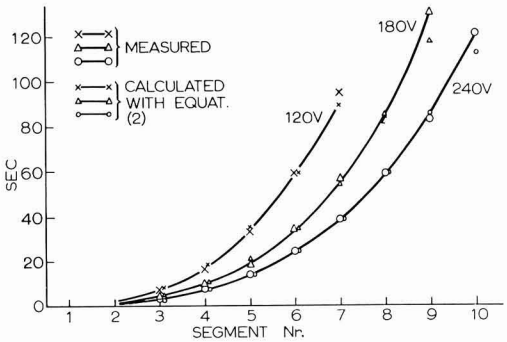

Fig. 5. Length of deposit (= segment number) time diagram at various deposition voltages

From a series of speed profiles (Figure 5) at various deposition voltages, and with various paint systems, the following relation can be found between deposition voltage, deposition time and the paint system:

$$t = A.\frac{s^3}{P.V^{4/3}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where

A = proportionality constant (depending on the form of the tank and the lay-out of the electrodes)
s = length of the deposit obtained (or segment number)
P = throwing power
V = deposition voltage
t = deposition time

This equation which is called "Throwing power equation I" contains a proportionality constant P.

Since P is independent of the individual results of the test series, it represents the contribution to throwing power of the paint system itself.

If the equation (2) is transformed to read

$$P = A.\frac{s^3}{V^{4/3}.t} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

this provides a measure for the quality or value of the "throwing power" of an EC paint, independent of test conditions and arrangements.

For this reason the constant P is called the "throwing power value".

Most of the test methods for throwing power record the length of a deposited film on a test anode (here methods using the film thickness as criterion are excluded). Therefore, the throwing power equation can be transformed to give deposition lengths:

$$s = \sqrt[3]{\frac{P.V^{4/3}.t}{A_T}} - a \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

A_T and a are coefficients which have to be determined by experiment for each testing arrangement. (Coefficient, a, is a correction factor already contained in s in equations

(1) to (3), and as it is constant when depositing the same predetermined lengths of film in a test series, it can be omitted).

With equation (4) it is possible, for instance, to calculate the length of the deposit for a given deposition voltage or deposition time. Alternatively, the time required to obtain a certain length of deposition at a given voltage, etc. can be calculated.

Since it could be proved in a great number of experiments that throwing power equation I is valid for all test methods which use the length of the deposit to evaluate the throwing power, the results can be calculated for any such test method.

Two important comments may be made on the use of these equations:

(1) The equations are no longer valid if deposition is carried out at a voltage close to the maximum. This can be seen from the deviation of the experimental values from the calculated values in a test series with gradually increasing voltages.

(2) The equations are not valid for extremely long deposition times and low deposition voltages, if the maximum current density in the position to be coated is below 0·5–1mA/cm². At this current density, deposition no longer occurs.

Now that the way the throwing power of an ED paint responds to exterior conditions, such as deposition time and voltage has been clarified and it becomes possible to calculate a figure which is a measure of the throwing power, irrespective of the test conditions, the question of the properties inherent in an ED paint which are responsible for good throwing power arise. In other words: what paint parameters influence throwing power and in what way?

The answer to this question is the most difficult task in the whole ED coating field, both in theory and in practice. It is much less difficult to find the laws governing the influence of deposition time and voltage on throwing power, than to deduce any laws from the process of deposition which would allow any conclusions as to throwing power parameters to be drawn. The problem is too complex.

Some experimental approaches were made to examine the influence of specific conductivity and film resistance on throwing power for a given set-up necessary to achieve optimum tank operation. For this purpose the final current in the course of a deposition at constant voltage was used.

The results, however, always apply only to the specific paint system under test. If an attempt is made to make the same calculations for a similar deposition with a different paint system, the results are different and partly contradictory.

The final solution was afforded by statistics.

Since statistics require large numbers, a large test series of 200 paints was prepared with a variety of pigmentations and degrees of neutralisation with the most widely differing binder systems.

The neutralising agent was always ammonia. For each of these paints various parameters were recorded: namely specific conductivity, deposition equivalent, film resistance (by various methods, such as final current at constant voltage deposition, specific film resistance calculated from deposition curves, final voltage after a determined time at various constant current densities, time required by paint to build up a certain resistance at a given constant current) and finally, the time elapsing until coagulation sets in at a constant current. Furthermore, throwing power of each paint determined according to the method outlined above was recorded. All these paint variables, 9 independent and one dependent one, ie a total of 2000 figures were keyed into a computer.

By the statistical means of regression analysis, an attempt was made to find the variables which have a significant influence on the throwing power.

Of the 9 variables, 3 turned out significant: these are

(1) the specific conductivity

(2) the time which elapses at a constant current density, before the paint film starts to coagulate.

(3) the speed with which a pre-determined level of resistance forms (also at a constant current density).

At this point it is necessary to describe in more detail the conditions prevailing on deposition with the current maintained at a constant level. Under these conditions the two last parameters, that is time and speed, can be easily obtained in a simple manner. These two parameters can be called "throwing power parameters".

It is known that precipitation and coagulation of an ED paint is a consequence of the pH-value falling at the anode and causing the binder to become water insoluble in the acidic medium. Cathodic deposition of paints is not considered here, but presumably the laws applying to anodic deposition must have some equivalents in cathodic deposition.

The fall in pH is due to electrolysis of the water to hydrogen ions and oxygen by the current flow. The speed with which the hydrogen ions form (and with which the pH falls) is directly proportional to the current density. If a source of constant current is connected to a deposition system and the deposition voltage measured by means of a potentiometric recorder, the curves obtained are like those plotted in Figure 6.

At the start of the deposition, prior to coagulation, the recorder records a voltage which is proportional to the bath resistance. The moment coagulation starts, that is, when the current density has produced enough hydrogen ions to reduce the pH-value to a level where the paint binder precipitates and coagulation (at the anode) sets in, the resistance and thus the voltage rises considerably. The time elapsing between the switch-on of the current and the set-in of coagulation reflects the tendency or readiness of a paint to coagulate.

From these curves it can also be seen that coagulation is the faster, the higher the current density.

By these experiments the following relation between current density (mA/cm²) and the time (t_B) elapsing until precipitation starts was found to be:

$$t_B = \frac{C}{(\mathrm{m}A/\mathrm{cm}^2)^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

This equation is quite accurate within a current density range of from 0·5 to 1mA/cm² to 30mA/cm². Below the lower limit the diffusion speed carrying away the hydrogen ions is such that they cannot concentrate sufficiently to coagulate the paint.

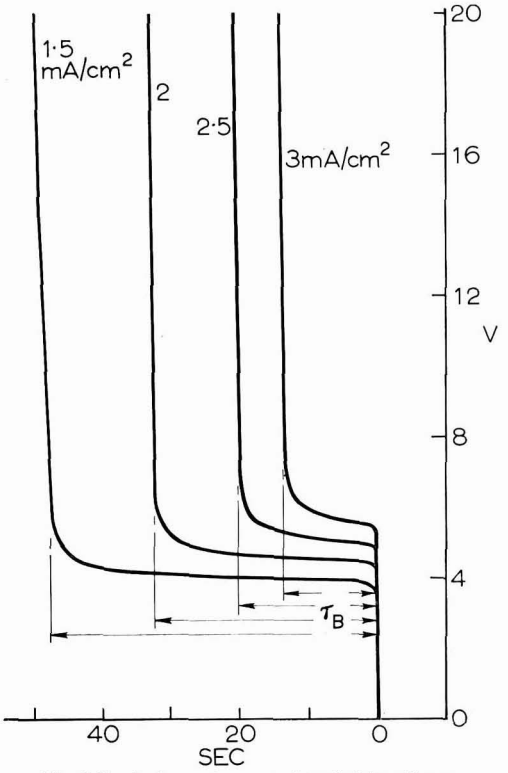

Fig. 6. Constant current curves and onset of deposition t_B

If the equation is transformed to read:

$$C = t_B.(\text{mA/cm}^2)^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

a constant is obtained which is a measure for the coagulation of a paint at given conditions, or, in other words, its coagulation tendency. C is therefore called the "coagulation tendency".

The speed with which a resistance develops, that is, the third throwing power parameter, can be measured easily by recording the further history of deposition after the on-set of coagulation (see Figure 7).

When the current is kept constant during deposition, the deposition voltage is directly proportional to the film resistance; the build up of film resistance is reflected by the voltage history. If, in consequence of this, the deposition voltage after on-set of coagulation is allowed to rise to a value which corresponds to a determined film resistance and if the time elapsing until that moment is recorded, the quotient of voltage reached and time elapsed is a measure of the speed for the build up of the film resistance measured.

Once it had been discovered which of the many parameters are responsible for the throwing power, it became possible to start to build new measuring devices and adapt the old ones to the new findings and thus to improve the testing methods.

A recording device has been developed for electrodeposition at constant current.

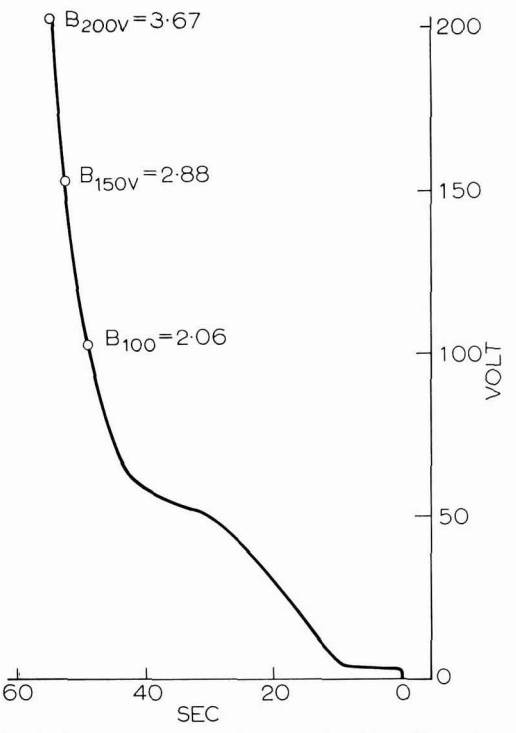

Fig. 7. Effect of voltage and resistance on deposition with constant current

The constant current is provided by means of thyristors according to the principle of compensation. A regulating switch switches the phase section of the alternating current, such that the same amount of current flows through the thyristors so that the voltage falling at a measuring resistance is equal to a given predetermined voltage which is set with a potentiometer and which corresponds to the chosen deposition current.

The coagulation tendency and the speed of resistance build-up is recorded with an electronic compensation circuit connected to a small computer.

The compensation circuit measures the voltage at the deposition bath at the beginning, adds to it two values which can be set out at discretion; it starts the action of the computing unit, and, when the sum if the two values is reached, it switches off the current to end the deposition process.

One measuring point, a voltage lying just beyond the bend where the voltage rises is chosen, and the time elapsing until that rise is recorded. This, multiplied by the square of the current density, gives the coagulation tendency as defined by equation (6).

If, as the second measuring point, that voltage is preset which corresponds to the film resistance to be attained, the device records the time elapsing until that voltage (or resistance) is reached. This time is divided by the pre-selected voltage and thus constant, B, is obtained which is proportional to the speed of resistance build-up.

It will be seen that with this device the two throwing power parameters can be measured exactly within a few minutes and almost automatically.

The measurement of the throwing power has been thus improved so that the time elapsing until the same length of anode is coated with varying voltages may be measured.

A modification of the recording apparatus mentioned at the beginning, inasmuch as the anode is divided not into 21 segments but into three segments only is shown in Figure 8.

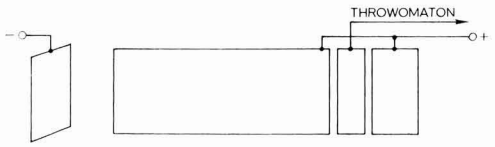

Fig. 8. Schematic test arrangement for determining the throwing power value

Furthermore, the potentiometer recorder reflecting the current flow through the test segment has been replaced by a gadget called "throwomaton". This gadget automates throwing power determination. It consists of a digital clock starting to count as soon as the deposition voltage is switched on, and it stops when the current flow through the test segment has attained the maximum.

In this way the annoying handling of the recorder paper and the time consuming and inexact measurement of deposition time are avoided. Test history and evaluation are governed by the somewhat transformed equation (3):

$$P = \frac{10^6}{V^{4/3}.t} \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Note: s designates a constant segment distance. For the purpose of calculation the product of $A.S^3$ has been equated to 10^6.

The evaluation is now carried out the following way: In a series with varying voltages, the deposition time is recorded, the product $V^{4/3}.t$ is found and the mean value is calculated from the values which are just slightly variable.

The throwing power value is obtained by dividing 10^6 by this average.

After the testing procedure had been simplified in this way, (by the construction of a constant current device and the modification of the determination of the throwing power value) a new test series was started, this time with 66 paints. For these, just the three throwing power parameters were recorded:

specific conductivity: ($\mu S.\ cm^{-1}$)

coagulation tendency: (C)

speed of resistance build up by the film: (B)

and, moreover, the throwing power value: (P).

The binders of these paints were quite different, with different degrees of neutralisation and pigmentation. In all cases ammonia was the neutralising agent. Therefore the results apply to ammonia neutralised paints only. The statistical computer programme used was the "multiple linear regression programme" of the computer type HP 9830 A. A linear relation between the throwing power parameters was not expected, so the logarithms of the throwing power parameters (the variables) was used. The result is shown in the logarithmic form of the throwing power equation.

The regression equation gave the following results:

$$\ln P = B(O) + 0.9928 \ln B(1) + 0.3344 \ln B(2) - 0.9965 \ln B(3)$$

with variables (B) having the following meaning:

$B(0)$ = (K) constant depending on the set-up

$B(1)$ = specific conductivity ($\mu S \cdot cm^{-1}$)

$B(2) = B^* = B.\mu S \cdot cm^{-1}$
(speed of resistance build-up)

$$B(3) = C.\sqrt{\frac{HFK}{10}}_{\mu S.cm^{-1}} = C^*$$

($C = t_B \cdot (mA/cm^2)^2$ = coagulation tendency)

(HFK = resin solids in %)

If the logarithmic regression is reduced to antilogarithms and if in place of variables B, the throwing power parameters are inserted, throwing power equation II reads.

$$P = K \cdot \frac{\mu S \cdot cm^{-1}\ \sqrt[3]{B^*}}{C^*} \quad \ldots\ldots\ldots\ldots (8)$$

This equation has been deduced by statistical means and therefore, in principle, it only applies to those ED paints subject to the regression analysis, *viz.* only to those paints neutralised with ammonia, Although no deviations have been noticed so far, it is highly possible that paints not included in the regression analysis may not correspond to the relationship governing equation II. In this case, such paints would have to be included into the analysis. The evaluation of the influence of the parameters of throwing power would then change somewhat, for instance:

$$\sqrt{B^*} \quad \text{instead of} \quad \sqrt[3]{B^*}$$

However, the fact that three parameters determine the throwing power of an ED paint remains, independently of this.

Throwing power equation II reflects the extent of the effect of the "parameters of throwing power" on the "throwing power value" and shows in which direction the development of new ED paints must proceed.

The paint users, by recording the throwing power parameters, can find out why a paint or binder has a good or bad throwing power and if and where improvements are feasible, or if there have been failures in the manufacture of the paint binders. For this purpose the throwing power value obtained from equation II must be compared with the values obtained from equation I. This is a test according to the principle: Confidence is good, control is better.

But, the parameters of throwing power themselves give a hint to the performance of an ED paint.

The coagulation constant, C, reflects the solubility of a binder system, that is, changes and the type of changes, for instance on storage of a paint or a grinding paste, can be seen.

The resistance constant, B, and its behaviour allows conclusions, for instance on the viscosity or solvent content of a deposited film, etc. to be drawn.

Summarising, it can be said that:

By means of the throwing power value, the throwing power parameters and the throwing power equations, throwing power can be controlled.

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The painting of inter-city trains*

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Summary

The appearance of British Rail Inter-city passenger trains frequently provokes criticism, generally in explicit terms, such as "dirty coaches".

Commercially orientated paint and equipment suppliers readily dismiss railway paints and application techniques as outdated.

This paper reveals that lack of enthusiasm and progress does not offer a simple explanation for these criticisms.

An effective and economic compromise is attained by using conventional paints formulated to take advantage of modern technology and capable of satisfying the many restrictions imposed by considerations of design, production and safety factors.

The future trend of railway painting is discussed and techniques which are well in advance of any existing transport painting system are currently under test.

Keywords

Types and classes of coatings and allied products

primer
undercoater
top coat

Types and classes of structures or surfaces to be coated

steel

Raw materials for coatings binders (resins, etc)

epoxy resin
urethane alkyd
vinyl toluene resin

Processes and methods primarily associated with:

application of coatings and allied products

brush coating
paint roller
airless spray

Le peinturage des trains "Inter-City"

Résumé

L'aspect des trains "Inter-City" de British Rail provoque très souvent des observations critiques et généralement en termes explicites tels que "voitures sales".

Les fournisseurs commerciaux de peintures et de matériel sont fortement disposés à estimer comme démodées les peintures et les techniques d'application utilisées par les chemins de fer.

Cet article révèle que le manque d'enthousiasme et de progrès n'offre pas d'explication simple pour ces mauvaises observations.

On parvient à un compromis et effectif et économique en utilisant les peintures conventionnelles dont les formules ont été mises au point en vue d'en profiter de la technologie moderne et d'être capables à rendre des peintures qui répondent aux diverses contraintes que s'imposent les considérations de construction, de production et des facteurs de sécurité.

On discute à la fois la tendance à venir dans le domaine du peinturage des trains et des techniques qui sont bien en avance de tout autre système de peintures pour matériel roullant faisant actuellement l'object d'un essai.

Der Anstrich der "Inter-City" Eisenbahnzüge

Zusammenfassung

Das Aussehen der British Rail "Inter-City" Passagierzüge wird vielfach kritisiert und sehr oft wird von "schmutzigen Wagen" gesprochen. Die kommerziell orientierten Farben-und Geräteerzeuger sind immer bereit die Eisenbahnlacke und Auftragsmethoden als altmodisch zu bezeichnen. Diese Arbeit zeigt, dass die Abwesenheit von Enthusiasmus und der Mangel an Fortschrittlichkeit keine einfache Erklärung dieser Kritiken ermöglicht. Ein effektives und auch wirtschaftliches Kompromiss wird durch die Anwendung konventioneller Farben erreicht, die alle Vorteile der modernen Technologie benützen und dadurch in der Lage sind den Beschränkungen, die durch Konstruktions-, Produktions- und Sicherheitsfaktoren auferlegt werden, gerecht zu werden.

Die zukünftige Entwicklung des Anstriches von Eisenbahnzügen wird diskutiert und Methoden, die beträchtliche Fortschritte gegenüber den gegenwärtigen Beschichtungssystemen aufweisen, bilden den Gegenstand von Untersuchungen die momentan im Zuge sind.

Introduction

Ref. 1

This paper deals with the painting of modern rail coaches and apart from occasional comparisons, refrains from nostalgic reflections on past liveries.

It affords an opportunity to discuss the "public image" of an industrial painting system, which is based on traditional methods of application using conventional formulations.

The appearance of railway vehicles is freely criticised. Why is this?—are the painting practices and paints too old fashioned? In comparison with sophisticated production schedules for motor cars and domestic appliances it may appear so, but circumstances may exist where simple manual

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operations are more adaptable and economic than mechanised methods.

The paper describes the restrictions imposed on painting due to problems associated with design, health and safety requirements and service cleaning.

Metal substrate and pretreatment

Apart from a few vehicles, such as the Advanced Passenger Train which incorporates aluminium alloy bodyside panels, the vast majority are steel. This steel is purchased "cold rolled—scale free" and is phosphated by immersion in the workshops, prior to spray priming in a booth.

Recent complications necessitate a review of the practice *viz:*

(i) Modern automatic welding is sensitive to primed/phosphate coatings.

(ii) Health and Safety precautions impose stricter control of weld fumes.

(iii) Variation in steel supplies has resulted in the occasional use of pickled hot rolled steel. Acid residues or unsuitable oils have adversely affected the particle size and weight of the phosphate coating. A recent BR investigation emphatically confirmed the critical balance between the quality of the phosphate coatings and paint adhesion[1].

As an alternative to immersion phosphating individual components, the technique of assembling a vehicle in bare steel is under evaluation. Using an inhibitive oil, it is hoped to determine an acceptable balance satisfying "operator handling and resistance to rust staining" during the assembly period.

Owing to the difficulties of coordinating vehicle progression with washing and drainage facilities, pretreatment prior to priming necessitates the use of a detergent shampoo.

Workshop painting

(a) Environment

Centralisation of rail workshops has strained their capacity to the extent that large workshops deal continuously with hundreds of vehicles. These vehicles, new and repaired, involving a range of trade operations, do not permit ideal production schedules based on the principle one trade—one shop.

Painting commences before fabrication and continues during the progress of the vehicle throughout the various workshops. The method of application may be brush, airless spray or roller. It can vary from coat to coat and according to the preference of the individual workshop.

There are many valid reasons, engineering and economic, why it is preferable to take the painting operation to the vehicle, not the reverse.

This established method of painting restricts formulations to those with white spirit type solvents and flash points above 90° *F.*

(b) Painting process

Prior to nationalisation, all railways purchased pigment pastes, mixing varnishes etc. and milled their own oleoresinous paints (Appendix *A*, dated 1935). Livery schemes were enhanced by attractive lining designs and several coats of varnish. Appendix *B* illustrates the significant reduction in painting time from the 1935 varnish system to the existing enamel process *viz:* from 15 days to 6 days. Welding and subsequent heat spotting operations are required to reduce panel distortion. As a result of this, time consuming stopping, filling and rubbing is necessary.

A previous attempt to minimise defects in the body panel profile by reducing the gloss coincided with the introduction of airless spray painting. For obvious technical reasons, vinyl toluenated alkyd medium was selected, but although its overall durability and adhesion properties were excellent, it failed badly as a semi-gloss coach enamel. Poor film formation due to solvent release, excessive orange peel and softness resulted in increased dirt and stain retention, which eventually stimulated public criticism.

It was replaced by the present urethane oil/alkyd, with a full gloss finish possessing substantially superior film formation and cleaning resistance, It is possible that interest in a reduced gloss finish may be revived.

Formulation

The three basic coats are:

Primer	L.8 Epoxy Ester
Undercoat	Urethane oil/alkyd/modified phenolic
Finish	Urethane oil/alkyd

Alkyd paints are well established as exterior coach finishes in many countries. British Rail's preference for urethane/alkyd blend is due to two factors:

(i) Faster "set-up" and superior "through dry" time to facilitate production.

(ii) Increased chemical resistance to reduce cleaning problems.

A possible disadvantage *ie* severe chalking is not a significant factor providing vehicles are kept in traffic.

Criticism of appearance rarely involves paint failures. With few exceptions, "dirty coaches" is the usual comment. The major cause is staining, due to an insoluble reaction product formed by iron brake block dust and residues of oxalic acid cleaning solution.

The difficulties presented by cleaning in traffic are immense and outside the scope of this paper.

An alarming increase in spot adhesion failures due to ballast impact coincides with two significant trends:

(i) Increased speeds up to 120 mile/h.

(ii) Frequent repainting at intervals of 2–3 years instead of 5–6.

The uncontrollable stress developed by oxidising media is creating a major problem in all circumstances where regular recoating is carried out.

A research project aimed at stress relieving oxidising media is already in progress. The consequence of failure to eliminate ballast impact failures will be the inheritance of wholesale stripping back to the substrate. The resulting impact on workshop accommodation, economics and health and safety requirements would be disastrous.

Conclusions and future trends

Refs. 2, 3

British Rail's coach exterior process has progressed from the workshop's oleoresinous mixtures to the present urethane oil/alkyd (UROALKYD) via alkyd and vinyl toluenated alkyd (VTA) resins.

Whilst influences, such as design and workshop facilities, have restricted advances to the conventional media, precise specifications have not ignored relevant progress in paint technology (Appendix *C*).

In co-operation with the paint industry, British Rail have pioneered the establishment of airless spray painting, rheological control[2], structured high build paints and the elimination of lead[3].

The uroalkyd system offers at least six years' durability, which is considered adequate since mechanical damage is the operative factor. A fully cured polyurethane is intrinsically superior, *but under prevailing circumstances, its use would not effectively reduce staining which is the basis of public crticism.*

The expression "horses for courses" aptly describes British Rail's present painting policy. There are valid reasons why it could be changed:

(i) Spot adhesion failures due to ballast impact must be eliminated for aesthetic reasons. It is even more important to avoid complete stripping to bare metal. A "tailor made" formulation is essential to control the initial system and the repainting cycle during the life of the vehicle (30 + years).

(ii) A drastic reduction in new build or repair schedule times may demand a one to two day process. Providing improvements were possible in panel profile and application installation, this could be achieved by a primer and chemically cured epoxy coating or polyurethane coating.

(iii) The replacement of the existing oxalic acid cleaning solution by a strong mineral acid or strong alkali.

Finally, the above changes, although speculative, are covered by laboratory investigation. Looking towards the near future, it is practically certain a modified uroalkyd will be retained.

Looking still further ahead and bearing in mind that new vehicles are greatly outnumbered by the existing painted vehicles, the choice of an ultra modern coach finish will still be subject to restrictions. It is likely to comprise a single coat (75 microns) applied directly to finely abraded bare metal or the existing uroalkyd finish.

Preferably, it will be solvent free capable of manual or automatic spray application and possibly dried by moderate heating. It is essential that it is chemically resistant in order to take advantage of advances in cleaning techniques.

In conclusion an entirely new approach to surface pretreatment and single coat finishes, such as solvent free epoxy and powder coating, is currently under investigation by Research Division, Surface Coatings Laboratory.

Although visionary in comparison with established practices, it will satisfy all relevant aspects, in particular application simplicity, health and safety considerations and long life durability.

Acknowledgments

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Appendix A

London, Midland & Scottish Railway Company

Schedule

Covering the treatment and painting of the company's rolling stock, together with the materials to be used for same

Mixture No. 1, Primer for steel	*Catalogue No.*	*Quantity*
Oxide of iron, in oil, type R, Red shade	28/595	88lbs
Zinc oxide white, in oil	28/625	2lbs
Aluminium powder (fine varnish powder)	28/213	10lbs
Raw linseed oil	27/856	10lbs
Mixing varnish	28/1840	26lbs
Genuine turpentine	27/1421	16-20lbs
Liquid drier	28/1201	Not more than 4lbs
Mixture No. 1A, Primer for welded joints		
Mixture No. 1		80lbs
Aluminium powder (fine varnish powder)	28/213	10lbs
Mixing varnish	28/1840	10lbs
Mixture No. 2, Brush filling		
Enamel filling	28/1375	112lbs
Gold size, type A (dark)	28/1608	4 to 7lbs
Mixing varnish	28/1840	4 to 7lbs
Genuine turpentine	27/1421	14 to 18lbs
Raw linseed oil	27/856	Not more than 4 lbs
Mixture No. 3, Lead colour undercoat		
Protective white paint paste	28/1050	112lbs
Liquid drier	28/1201	9 to 12lbs
White spirit	27/1434	26 to 30lbs
Black in oil	28/510	9 to 10lbs
Raw linseed oil	27/856	4lbs
Mixture No. 3A, Wood primer		
Mixture No. 3		80lbs
Aluminium powder (fine varnish powder)	28/213	10lbs
Mixing varnish	28/1840	10lbs

Mixture No. 4, Brown undercoat

Oxide of iron, in oil, type R, Red Shade	28/595	100lbs
Liquid drier	28/1201	4 to 6lbs
Mixing varnish	28/1840	28-30lbs
Genuine turpentine	27/1421	12-14lbs

Mixture No. 4A, Undercoat for lake

Mixture No. 4		95lbs
Black in oil	28/510	5lbs

Mixture No. 5, Standard lake

Standard LMS lake (paste form)	28/575	12lbs
Mixing varnish	28/1840	4lbs
Genuine turpentine	27/1421	3-5lbs
Liquid drier	28-1201	1-3lbs

Appendix B

Exterior process (steel vehicles)

Days	LMS 1935	Rail Executive 1949	British Rail 1976
1	Mixture No. 1	Mixture No. 1	Post fab. prime 71-1
2	Stop up—mixture 24	Stop up—fill joints	Stopping—filling
3	Mixture No. 2—Stop up—mix 24	Face down—"touch in" No. 1	Rubbing—filler
4	Face down—repeat 3	Face down	Surfacer 71-
5	Face down—mix No. 3	1st coat carriage crimson undercoat	Undercoat
6	Mixture No. 4	2nd coat carriage crimson undercoat	Finishing
7	Mixture No. 4A	Carriage crimson body colour	
8	Mixture No. 5	Carriage crimson glaze	
9	Mixture No. 5A	Varnish	
10	Line-mixs No. 25, 26, 27	Line-transfer	
11	Varnish	Varnish	
12	Allow varnish to harden		
13	Flat with pumice second varnish		
14	Allow varnish to harden		
15	Flat with pumice third varnish		
18	Apply waxing composition		

Appendix C

BR Specification No. 71 Item No. 40

Material Rail blue uroalkyd finishing paint

Part I. Composition of material

Component	Specification requirements
Non-volatile media	Approved qality alkyd modified urethane oil
Volatile	Approved quality. Benzene free
Pigment	Approved quality

Part II. Properties of liquid material

Property	Specification requrement	Method of test
Spraying		
Brushing	No abnormal defect	Normal spreading rate
Setting off time	To retain a good wet edge	BS 3900 Part C1
	10 minutes after application	Single coat. Normal spreading rate. 3-4 mils (75-100 microns)
Opacity (Pfund)		
(Contrast Ratio)	Not less than 90%	BS 2525 Appendix G
Drying Surface	2 hours	BS 3900 Part C2
Hard	4 hours	BS 3900 Part C3
Overcoating time	Satisfactory after 24 hours	Appendix 3
Spreading rate	with no excessive softening of preceding coat	Procedure I
Sag resistance	No sagging when applied at a wet film thickness of 4 mils (100 microns)	Visual inspection of applied film
Cone penetration		
Viscosity	2.3-2.8 poises. Not more than 5 poises after 5 minutes	BS 3900 Part A7 @20°C (68°F) and Appendix 2
Daniell flow		
Flash point	Appropriate range to be included on formulation card	BS 3900 Part A8. See General Clauses
Fineness of grind		
Potlife		

Part III. Properties of dried film

Property	Specification requirement	Method of test
Finish	Smooth free from sagging and wrinkling or other surface defect	Visual inspection
Gloss	Not less than 80%	45° gloss head. BS 3900 Part D2 but using panel prepared in accordance with Appendix 1
Adhesion		
Surface hardness (scratch resistance)		
Impact resistance	No cracking or flaking	BS 3900 Part E3
Flexibility	No cracking or flaking	BS 3900 Part E1
Colour	BR Standard panel. Class A	Visual inspection
Acid resistance	No softening or marked discolouration after 24 hours	BS 3900 Part G3 Liquids A+B+C
Alkali resistance		
Fuel oil resistance	No softening after 5 mins	BS 3900 Part G3 Liquid D

Part IV. Durability colour fastness, corrosion resistance

Property	Specification requirements	Method of test
Colour fastness	To show no greater difference before and after weathering then No. 3 of the Geometric Grey Scale	Visual inspection
Humidity resistance	No severe chalking, checking, cracking or adhesion failures	BS 3900 Part F3
Salt spray resistance		
SO_2 resistance		
Accelerated weathering		
Natural weathering	No failures after 2 years	Appendix 1

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Disposal methods for hazardous wastes*

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Summary

Methods most commonly employed for the disposal of hazardous wastes are described. For economic reasons disposal to land is most common, but it is explained why this needs to be supported by such methods as processing, incineration and/or deep sea disposal.

Keywords

Miscellaneous terms

waste disposal
incineration
hazardous waste

Les méthodes d'élimination des déchets nuisibles

Résumé

On décrit les méthodes les plus souvent utilisées pour éliminer les déchets nuisibles. Pour les raisons économiques la décharge à la terre est la plus commune, mais on explique la raison pour laquelle il faut la suppléer par d'autres méthodes telles que transformation, incinération et/ou décharge en mer profonde.

Die Methoden für die Beseitigung gefährlicher Abfallsprodukte

Zusammenfassung

Eine Beschreibung der Methoden, die allgemein zur Beseitigung gefährlicher Abfallsprodukte verwendet werden. Aus wirtschaftlichen Gründen ist es allgemein üblich diese Produkte am Land abzulagern. Es wird erklärt warum zur Ergänzung dieser Methoden auch chemische Prozesse, Einäscherung und Versinken auf hoher See benötigt werden.

Methods for the disposal of hazardous wastes may be classified as follows:

(1)(a) Tipping on land

(b) Disposal in deep mines

(c) Disposal to sea

(2)(a) Chemical, electrochemical or biological processing

(i) to recover materials for re-use

(ii) to reduce hazard prior to land disposal

(b) Incineration.

Undoubtedly, the most widely practised form of disposal is by tipping on the land. This is largely because it is the cheapest method of disposal although, particularly with the more innocuous wastes, the land reclamation aspect may be valuable.

However, in highly industrialised countries land is often intensively used and so are the water resources it contains. Even tips proposed for normal household refuse are looked at warily by water authorities in many parts of the country as the leachate may lead to contamination of sources of potable water. Tips proposed for hazardous wastes are potentially an even greater danger and care must be taken to ensure they are safe. The number of conveniently situated geologically safe sites in the UK appears to be small and it would appear prudent to use their capacity wisely.

If disposal is to be on land, the first requirement is a safe tip, although how this is defined in practice is a difficult point. Some experts query whether such a thing exists suitable for all toxic and other hazardous waste—even the best tips are liable to show some leakage or percolation. With some sites this may not matter within limits for many types of waste. For instance, according to the nature of the strata, biological or chemical action may cause breakdown of some organic matter and chemical action may hold back certain toxic ions. The amount of rainfall, the rate of evaporation plus transpiration through vegetation and nature of surface run-off may also be important considerations.

The Department of the Environment is currently carrying out a programme of research into the behaviour of hazardous wastes in landfill sites to clarify and, where possible, quantify the principles involved. An interim report on progress to September 1975 has already been published and it does appear likely that some tips which show limited percolation may be suitable for some deposition of hazardous waste.

In practice, therefore, the safest tips available have to be used and their use planned accordingly. What cannot be placed in the tips safely will need to be disposed of otherwise eg, by methods to be described later. The safest type of tip will be a saucer shaped clay tip, and one of the most useful methods of increasing its safety is to restrict the water flow. Since much industrial waste consists of aqueous liquids and sludges, there is clearly a problem in depositing them in tips. This may be dealt with in a number of ways. In very large tips it is common

*Paper presented at the Conference on "Current trends in industrial finishing" held jointly by the London Section OCCA and the Institute of Metal Finishing at Warwick University on 20-22 September 1976.

to absorb the water on waste material of suitable absorbency, commonly ordinary household refuse. This is a simple and cheap method, but does mean that valuable safe space is used for household refuse rather than industrial waste. Safe tips are commonly relatively small in volume and cannot afford to allow space for household refuse. It is, therefore, becoming common to dehydrate sludges and treat aqueous liquids to make them fit for sewerage disposal. These processes will be discussed later in the paper. Another process which can be used and will be discussed later, is a polymer encapsulation process. This has the added advantage that the wastes are rendered suitable for deposition in less safe tips.

In practice, however, lagoons or ponds are often present in tips, eg, prior to filling with household refuse, to enable the drying out of aqueous wastes difficult to dehydrate, etc. In some cases, synthetic impermeable pond liners of butyl rubber for example, are used to increase the safety of the tip. It is also becoming more common to tip aqueous wastes on to trenches formed in household refuse rather than for temporary lagoons to be formed prior to filling with household refuse.

Generally speaking, it is not good practice to put substantial amounts of oily waste in tips, since it degrades very slowly and is difficult to contain. If it cannot be economically recovered, this is best destroyed by incineration, a method which is also recommended for many other organic wastes, particularly of the persistent toxic kind.

Toxic metal wastes are also commonly tipped, since in most cases it is not economic to recover the metals. However, some treatment may be given to render the metals less soluble or toxic (eg the reduction of chromates to the trivalent state) and it is not unusual to segregate the metallic wastes in a safe part of the tip to enable them to be recovered later should this prove desirable.

Where tips are not safe enough for certain wastes, these wastes must either be processed to reduce the hazard or else disposed of in some other way.

One possible alternative is to use a permanently dry deep mine below the level of the groundwater and isolated from it. This certainly seems a safe method to dispose of many hazardous wastes, although some experts express the fears that geological structures may not remain perfectly safe and that the various wastes deposited underground may eventually react in an unpleasant manner. The answer seems to be that such deep mines should be operated with discrimination to minimise any danger. Although such mines generally have a large capacity, it has been suggested that their use should be limited to intransigent wastes otherwise difficult to deal with. However, the only such deep mine (a disused coal mine), used for wastes in the UK also took rather large quantities of aqueous acid and alkali wastes (which are not particularly difficult to deal with) and it is claimed this formed part of the safe operation of the mine. At the time of writing, the mine is closed due to a blockage resulting from the formation of crystals. In Germany and elsewhere, disused salt mines are also used for the bulk disposal of cyanide wastes. This is often cheaper than chemical detoxification, and deep sea disposal is not always a practical alternative because of the distances involved.

The other main alternative is to dispose the wastes at sea. The dumping of wastes in shallow seas is now usually controlled to fairly innocuous wastes (in the UK by the Ministry of Agriculture, Fisheries and Food), because of the limited dilution and rich marine life often used as a source of food. Disposal to deep ocean (ie, off the continental shelf) is less rigorously controlled, although many countries, particularly the NE Atlantic countries observe the 1972 Oslo and London Conventions, which aim to control sea disposals so that they are effected in a safe manner.

These Conventions require that all dumping from ships should be licensed and there are three annexes. Annex 1 lists materials that should not be dumped apart from necessity, Annex 2 lists materials that should only be dumped under carefully controlled conditions and Annex 3 lists provisions to be considered in establishing criteria governing the issue of permits.

The main classes of material forbidden are organo-halogen compounds, mercury and mercury compounds, cadmium and cadmium compounds, persistent plastics, various types of mineral oil, materials for biological and chemical warfare and high level radioactive wastes. Disposal of most other wastes are permitted provided proper care is exercised. Such wastes may include toxic metals (other than mercury and cadmium), cyanides, pesticides (other than organo-halogen compounds etc.)

In practice, the usual methods adopted for toxic wastes is to drop the drums of waste off the continental shelf, at least 150 nautical miles from land and in deep water (eg at 2,000 fathoms or more). The drums are so constructed and loaded that they reach the bottom in an intact state. Through the slow process of corrosion of the drums, the contents should be released only gradually. The theory appears to be that little harm should occur because of the immense dilution which occurs. Most permitted materials would also be expected to degrade over a period. The main exceptions would be toxic metals, but such dumping should not increase their concentration significantly in the ocean generally.

The controls based on the Conventions are administered in the UK by the Ministry of Agriculture, Fisheries and Food and the Dumping at Sea Act 1974 embodies the recommendations.

Because of the cost of transportation, deep sea dumping is considerably more expensive than landfill, but it may be cheaper than processing. It is widely used for the disposal of cyanides in the UK and other maritime countries.

Various methods of processing or treating wastes can now be considered. One reason for processing wastes is to recover useful materials from them and, helped by much publicity, this is usually carried out when it is economic to do so. Such waste, in effect, ceases to be waste. This type of waste is not considered in this paper, but only wastes that are to be discarded.

Many industrial wastes have a high water content and are unsuitable for placing in most tips, because they will seriously increase the percolation rate or else fill the tip. An essential part of the operation of many tip sites, therefore, is processing to remove water. This dewatering need not be carried out at the tip site, but at suitably placed "collection stations", to save the unnecessary transport of large quantities of water.

One simple way of treating sludges is by settlement in tanks and decantation, but this is often not particularly efficient, except as a preliminary separation. The water arising would not usually be suitable for disposal to sewer, but treatment with a flocculating agent and further settlement may often remedy this.

The most efficient methods for inorganic wastes are filter presses or vacuum filters, and this can rid sludges of nearly all their water. Wastes containing organic matter (often of an oily character) are not suitable for filtration methods. Centrifuging is often a good method, where by spinning at high speed in a drum (which forces the heavier materials to the outside), the water can be separated and run off in a different channel from the organic material. The separation achieved is not normally very sharp or clean. The centrifuged sludge will still contain a fair quantity of water and the separated water may contain traces of organic matter and inorganic matter.

Assuming that the residual organic matter is the important contaminant preventing discharge to sewer, a flocculating agent can be added and the liquid passed through a vacuum filter. Alternatively, the separated water can be settled in special large tanks which taper at the bottom. The thick sludge which collects at the bottom taper can be run off and the supernatant can be discharged to sewer, possibly after passing through filter cloths, if necessary.

Where the separated water is acid or alkaline or contains cyanides, toxic metals or other harmful substances in solution, further treatment will be necessary before discharge to sewer. Similar considerations will also apply to wastes, which are simply aqueous solutions and contain no insoluble matter.

Acid wastes arise in very large quantities mainly from engineering firms and chemical industries. Much arises from various metal treatments and will contain metals such as iron, zinc, copper, barium, nickel, chromium, cadmium, tin, lead etc. Although metal recovery is practised, usually at the point of its arising, much is uneconomic to recover and is sent for disposal. The best method for treatment of acid wastes is to neutralise them with alkali in suitable tanks. Most metals will separate as a sludge and the effluent will frequently be safe for disposal to sewer.

Alkaline wastes are also fairly common, arising from engineering and chemical industries and can often be used to neutralise the acid wastes.

Where there is a very large safe site for hazardous wastes, it is not unusual practice for acid and alkaline wastes to be tipped into suitably sited lagoons where some neutralisation can take place. The metals will sink to the bottom and the lagoons can be filled with household refuse to absorb the water. Care needs to be exercised in the choice of site, not only from the hydro-geological point of view, but because hazards may be produced through the reaction of these wastes on other substances deposited or present in the ground.

Another fairly common toxic ingredient of aqueous wastes is cyanide. Most aqueous cyanide wastes arise from plating shops (either as rinse water or sludge from the plating tanks) and, therefore, will also contain toxic metals. Detoxification can be quite simple. The most usual process is to treat the aqueous cyanide waste in a tank first with sufficient alkali to make the mixture alkaline and then with a suitable oxidising agent. The most common oxidising agents used seem to be sodium hypochlorite or chlorine. These oxidising agents are usually satisfactory if a correct procedure is followed, but under some conditions (eg, if the temperature is too high or if certain organic compounds such as phenol are present) undesirable toxic products may be produced. The Degussa process avoids this problem by using hydrogen peroxide, permonosulfuric acid or perdisulfuric acid as the oxidising agent.

Chromate waste is also sometimes used for oxidising cyanides, but there is a danger that excess chromate may be discharged to drain unless care is exercised. However, chromate wastes are fairly common; the chromium being present in the toxic hexavalent form and not precipitated by alkali. By chemical reduction to the trivalent or chromic state a much less toxic form is obtained which can be precipitated from solution by alkali. A suitable reducing agent is sodium hydrogen sulfite, a convenient form of sulfur dioxide, in effect.

The processing considered so far has been mainly concerned with reducing the need to tip water and this has included the neutralisation of acids and alkalis and the detoxification of cyanides and chromates. Even if such processing is carried out, it still leaves a large amount of hazardous waste, which may be a lot less wet than it was, but still needs to be disposed. Most of the inorganic waste gets tipped. The toxicity is mostly associated with heavy metals and unless a lot of money is spent to recover them there is not much that can be done other than deposit such wastes in a safe part of the tip (encapsulation may be necessary if there are doubts on the safety of the tip), or else to deep mine or deep ocean.

Organic waste is different. Its toxicity and hazard are more varied. Frequently it is of an oily nature and in quantity difficult to contain. Very importantly, most of it can be burnt, which not only destroys its hazard, but very much reduces its volume, thus saving valuable tipping space. Thus, although substantially more expensive than landfill (about five times or so, depending on the nature of the waste), incineration is a fairly widely employed technique for treating hazardous organic wastes.

Such incinerators need to be able to cope with a wide variety of wastes, which include wet sludges, dry materials, those oils and solvents which are not suitable for recovery, etc. Combustion must normally be complete, and the discharge of acidic components and particulates should be at a low level. This means that a single cell incinerator will be limited in scope, and two or more cells are usually combined in a single installation depending on what it is intended to treat. This may be followed by electrostatic precipitators, gas washing equipment, tall chimneys and/or other techniques to prevent damage to the environment.

Although the author knows of no examples in the UK, a rotary kiln furnace seems one of the best methods of dealing with wet organic sludges. In this an almost horizontal cylindrical kiln with a smooth hearth rotates slowly. The waste is fed in at one end (eg, by a grab crane through a hopper) and, as the cylinder is on a slight incline to the horizontal, slowly makes its way to the other end. The rotation of the kiln exposes a large surface area of waste which enables it to absorb heat and thus dry and ignite better. It is also used for dry waste, of course, and the smooth interior surface eliminates grate clogging (eg by plastics). The residue passing out of the rotary hearth may not always be completely burnt and therefore, it is passed into a chamber which, in effect, acts as an after burner to complete the combustion. This secondary chamber will also be fitted with injector sprays for introducing liquid solvents and oil wastes for burning. Where much of these latter wastes are to be burnt, they will need to be "balanced" to avoid large variations in the calorific value which would result in overheating.

Incinerators in the UK seem normally to be equipped with fixed hearths or grates, although at least one operator appears to burn wastes in bins or trollies which are inserted into the

furnace and then removed when combustion is complete. One UK incinerator is rather novel. Its operators have a small plant for treating liquid wastes and sludges and do not accept dry material. Solid matter from the sludges and chemical treatment of the wastes is settled after the addition of flocculating agent to yield a rather wet sludge (after the clear supernatant is run off). Therefore, their incinerator needs only to deal with liquid hydrocarbon wastes and the wet sludges. The incinerator has a primary combustion chamber in which liquid hydrocarbon wastes (solvents, oils, etc.) are burnt. This produces a temperature of 1200°C in a secondary chamber into which the aqueous sludges can be injected, thus flashing off the moisture and destroying the organic content. Both inorganic and organic sludges are treated, the incinerator in effect, being used to dry the sludges completely. The resultant gases pass through four high efficiency cyclones which removes the solid matter—now all inorganic—prior to discharge of the gases through a tall chimney. Because of the high temperature of the discharged gases, no plume is formed. The incinerator has a capacity of 300 gallons/hour of hydrocarbons and 1,000 gallons/hour of wet sludges.

Some incinerators also make provision for the destruction of chlorinated hydrocarbons, such as dry cleaning fluids, paint removers, polychlorinated biphenyls, etc. These are very difficult to burn, but can be destroyed at very high temperatures (eg, 1100°C) using auxiliary fuels (eg, diesel oil waste hydrocarbons, etc.). Such a facility is costly because of the need to control the large quantities of hydrochloric acid vapours released.

In order to minimise the cost of such destruction, some countries make use of special destructors on sea-going vessels, the idea being that scrubbing equipment to remove the hydrochloric acid vapours is not necessary if the vapours are released at sea. Such a view has not gone uncriticised and the UK seems to have sufficient land based facilities available for destroying chlorinated hydrocarbons safely. Waste Management Paper No. 6 (Department of the Environment) on polychlorinated biphenyl wastes indicates that there are at least four incinerators in the UK which can do so. Two are capable of handling both liquids and solids, but the other two can handle liquids only.

Earlier in the paper, when discussing methods for dealing with water, polymer encapsulation processes were mentioned eg, processes involving the formation of complex silicates. In this method the two liquids of the process are first well mixed in the correct proportions and then the aqueous liquid or sludge to be treated is added, also in the correct proportion, and the whole well mixed. At first the mixture remains liquid and can be piped to a suitable tip. It gradually hardens, however, and within a few days can be walked upon. Once hardened, the mixture is claimed to be a solid rock-like substance, resistant to environmental breakdown, leaching, etc. The method is suitable only for aqueous liquids and sludges since the water plays an essential part in the polymer formation (although in many cases it may be practical to transform wastes into aqueous sludges if desired). Besides eliminating the water problem it will also eliminate many other hazards (eg, toxic metals and many organic wastes) and this is an important reason for such treatment.

Such methods need close control by specialists, but at least two processes of this type are operated commercially in the UK, apparently with success. It is hoped that the resistance to environmental degradation of the solid formed is confirmed over the years.

One disadvantage of such processing is that it does need more tip space than other methods. This really involves adding material for tipping and then reducing it. On the other hand, there is less need for the tip to be of an impervious nature and so the range of suitable tips may well be extended.

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Electrical aspects of radiation curing*

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Summary

The commercial availability of efficient electric radiant emmiters, combined with the advances in performance of polymerisable coatings has substantially increased the use of radiation curing systems in industry. The basic principals of electron beam, ultraviolet and infrared systems and control gear are explained, as well as their capabilities in terms of production rates, higher quality and the reduction of atmospheric pollution. The measures taken to protect operators from radiation, ozone and high voltages are described.

Photochemical curing of inks, varnishes and wood fillers is now commonplace, whilst paint and powder coating drying systems are increasingly employing infrared radiation.

The economic and energy saving aspects of each system are summarised and an assessment is made of the value of pilot scale drying tests on coated specimens.

Keywords

Processes and methods primarily associated with drying or curing of coatings

radiation curing
infrared drying
electron curing
ultraviolet curing

Equipment primarily associated with analysis, measurement or testing

electrical equipment

Miscellaneous terms

energy requirement

Les aspects électriques de durcissement par irradiation

Résumé

La disponibilité en commerce des émetteurs électriques éfficaces de radiation en combinaison avec les avances dans le domaine du rendement des revêtements polymérisables ont fortement augmenté à l'échelle industrielle l'emploi des systèmes de peintures capables à être durcies par irradiation. On explique les principes fondamentaux des systèmes entraînant les faisceaux d'électrons, les rayons ultra violets ou infra rouges, ainsi que leurs possibilités au point de vue des cadences de production, de qualité améliorée, et de la diminution de pollution atmosphérique. On décrit les mesures effectuées pour la protection de la main d'oeuvre contre la radiation, l'ozone et la haute tension.

Le durcissement par des processus photochimiques d'encres, vernis et bouches-pores est actuellement commun, tandis que l'on fait un appel croissant à la radiation infra rouge pour les systèmes de séchage des peintures et des peintures en poudre.

On donne un résumé des aspects économiques et de conservation d'energie à l'égard de chaque système, et l'on fait une appréciation de la valeur des essais de séchage à l'échelle pilote sur les objets peints.

Elektrische Gesichtspunkte in der Strahlungshärtung

Zusammenfassung

Die Kommerzielle Verfügbarkeit leistungsfähiger Strahlenquellen und die verbesserte Qualität polymerisierbarer Beschichtungsstoffe haben die Anwendung der Strahlungshärtung beträchtlich vergrössert. Die Grundlagen der Elektronen- strahlungs-, der UV-und ultraroten Systeme und der Kontrollgeräte werden erläutert. Die Fähigkeit dieser Systeme höhere Produktionsgeschwindigkeit, bessere Qualität und geringere atmosphärische Verunreinigungen zu erzielen, wird beschrieben. Die Massnahmen, die zur Beschützung der Arbeiter gegen Einwirkung der Strahlung, Ozon und Hochspannung nötig sind, werden dargelegt.

Das photochemische Trocknen von Druckfarben, Firnis und Spachtelmassen fur Holz ist jetzt schon sehr weitverbreitet und Lacke und Pulverbeschichtungen werden in immer grösserem Umfang durch ultrarote Bestrahlung getrocknet.

Die Wirtschaftlichkeit und Energieeinsparung der verschiedenen Systeme werden zusammengefasst und der Wert von in kleinem Massstab durchgeführten Trocknungsprüfungen wird beurteilt.

Introduction

The use of radiation curing techniques in finishing processes has increased considerably over the past 10-12 years. There are a number of reasons for this, for example, the development of more efficient emitters in both the infrared and ultraviolet fields, the availability of ink, varnish and paint formulations which react to radiation of certain wavelengths, and the introduction of anti-pollution legislation in various countries.

In addition, there is the constant need in industry to obtain higher productivity at less cost, to produce better quality products competitively and with fewer rejects, and to break into new markets with new products manufactured with the aid of the very latest equipment.

Radiation curing not only goes a long way towards meeting these criteria, it also uses the nation's energy efficiently and wisely. Thus, the Electricity Supply Industry's programme is to stimulate the interest of industrialists in modern radiation systems and to assist suppliers of coatings and radiation equipment in their negotiations with potential customers.

The main object of this paper is to review the basic principles involved in radiation curing equipment, how these principles are applied in the finishing industries and to show examples

*Paper presented at the Conference on "Current trends in industrial finishing" held jointly by the London Section OCCA and the Institute of Metal Finishing at Warwick University on 20-22 September 1976.

of the scope of applications. It is essential that the safety aspects of the equipment should be considered from the point of view of those who have to use it.

Finally, the role of the Electricity Supply Industry in the promotion of radiation techniques will be discussed.

Industrial radiation curing equipment

There are three main types of radiation equipment commercially available, these being: electron beam, ultraviolet and infrared systems:

Electron beam curing

It is felt that the amount of discussion on each system should be related to its present position in the industrial "league table" and for this reason the electron beam method will be briefly considered. It is the fastest, but the most expensive curing equipment now commercially available. Capital costs in the region of £100 000 to £200 000 are often quoted. It employs the principle of electron bombardment of a coated workpiece to cause polymerisation reaction by a free radical mechanism (see Figure 1).

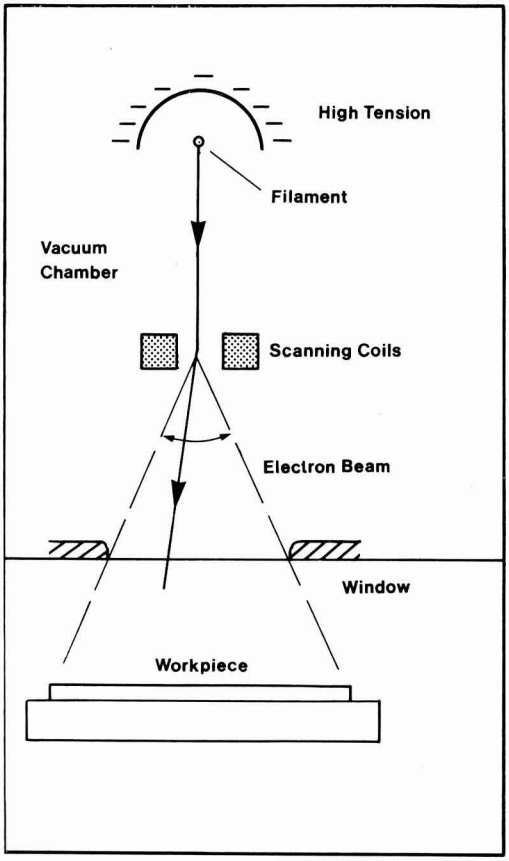

Fig. 1. The principle of electron beam curing

The electron beam from the emitter or gun is arranged to scan the entire coated area of the work piece as it is carried on a conveyor belt beneath the gun. This oscillatory sweeping action of the beam is sufficiently rapid to avoid streaking, but only flat or products of low profile can be irradiated effectively. As the system produces ionising radiation (X-rays), shielding in the form of concrete and lead enclosures are necessary for the protection of personnel. In addition, high voltages are employed, eg. up to 300 kV, for electron acceleration which means that special safety precautions have to be taken. The result is that electron beam equipment can be bulky and expensive and needs to be utilised at its maximum throughput capacity to justify the capital cost. The vehicle, furniture, steel and plastics industries are possible candidates. Linear conveyor speeds of 200 ft/min can be achieved on tinplate, plastic or chipboard coating lines, with no restriction on coating weights or colours. Moreover, no heating of the product takes place, so that no warping or distortion is caused by moisture removal and there is no damage to heat-sensitive substrates. The energy consumption can be as low as 5 per cent of a combined hot air/infrared system on a typical wood coating line of similar productive capacity.

At the present time there are no electron beam systems in full scale commercial production in the UK, but there are a few in the American motor industry and there are also units in use in Japan, Brazil, Germany and Switzerland.

The growth rate of electron beam curing is unlikely to be dramatic, but the flat board coating industries in Europe are now showing much interest, mainly because of the absence of heat in the curing process.

UV curing

This is generally regarded as the next best process to the electron beam concept. The development stems mainly from the atmospheric pollution problems and the shortage of natural gas in the USA. These factors stimulated the development in the late 1960s of electrically powered UV curing systems in conjunction with a new range of photo-sensitive litho inks containing 100 per cent solids. The aim was to supersede gas flame impingement ovens and their afterburners in web offset presses. As an added bonus, the energy demands were reduced dramatically, so that on a therm for therm basis reductions of between 10 and 16 to one were quoted in favour of UV. One quite popular rule of thumb is that a good web offset UV system consumes about the same amount of electrical energy as the auxiliary fan motors on a gas oven of comparable throughput.

Offset litho experience

UV curing is a photochemical reaction resulting in very rapid polymerisation of a coating. The inks contain monomers, pre-polymers and photoinitiators and when the printed surface is exposed to UV energy, free radicals are formed which react with the monomers and pre-polymers. This starts a very rapid chain reaction with the result that cross linking takes place in a fraction of a second. The general layout of the equipment is shown in Figure 2.

Because the coating weights used in litho printing are comparatively low the printed material is immediately ready for stacking, cutting and creasing, or re-winding. The big advantage is that rapid drying can take place on non-absorbent substrates, such as tinplate, plastics and coated stock. The first UV installation in the UK was commissioned in 1971 and since then over 70 units have been installed. The growth

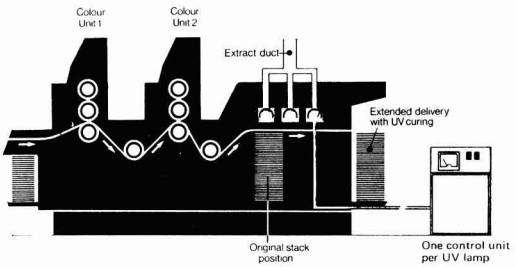

Fig. 2. Schematic of a sheet fed offset litho press incorporating UV drying

rate is still affected by the lack of investment in new processes, by the higher cost of UV inks, (up to 80 per cent more than conventional inks), and to a lesser extent by the slightly lower gloss level obtainable on certain substrates.

UV Equipment

The equipment has undergone continual development during the last five years, mainly to make it more compact for mounting at the delivery end of sheet presses. The majority of installations to date use the medium pressure quartz tube with an electrical rating of 200W per linear inch, and with a spectral output in the region of 200–400 nm, see Figure 3.

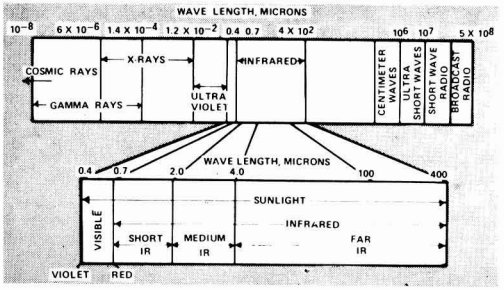

Fig. 3. The electromagnetic spectrum showing the infrared and ultraviolet wavebands

A semi-elliptical reflector concentrates the lamp output into a band of high intensity UV radiation at the work surface. A considerable amount of unwanted heat is also developed by the lamp, which necessitates a blower unit to keep it at an optimum working temperature of around 600°C and to protect the quartz to metal seals which form the electrode connections. The blower unit also ensures that the small amount of ozone produced in the vicinity of the lamp is led away to the outside atmosphere. During machine stoppages or standby periods the lamp is shuttered to prevent the radiation from damaging the printed material. At the same time the lamp is switched to half power, this being sufficient to maintain its working temperature and thereby ensuring an immediate return to full output on re-starting the press. A typical lamp housing is shown in Figure 4.

Protection of personnel against UV radiation and high lamp voltage is provided in the form of electro-mechanical interlocks on the shielding and key switches on access doors. A constant wattage ballast unit containing all the control functions, indicator lights and instruments completes the typical UV curing system.

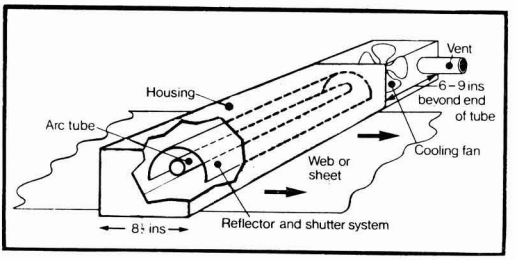

Fig. 4. UV tube, reflector and shutter system

Recent devlopments in allied fields

In June 1975 the first public demonstration of UV curing of clear overprint varnish was seen at the National Printing Exhibition at Olympia as a joint venture by Donald Macpherson Ltd, Steinemann-Beadon Ltd and the Electricity Council. This was so successful that three varnishing lines were installed in the UK in the following months. This process is ideal for imparting a high gloss finish on LP record sleeves, post cards, book covers and high quality packaging materials. The object here is to offer an in-line process, which is cheaper and faster than plastic lamination, and which uses less space and energy than conventional varnishing systems. A typical layout of a two headed roller coater and UV curing system is shown in Figure 5.

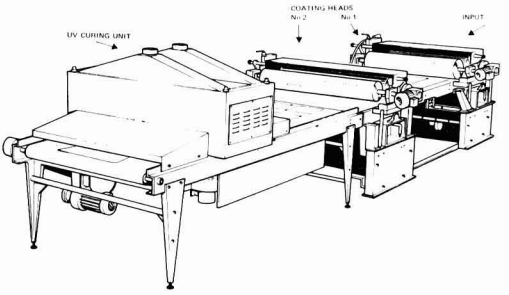

Fig. 5. A 2-headed roller coater and UV curing line capable of speeds up to 45 metres per minute (Courtesy: Steinemann Beadon Ltd)

Typical performance figures of the twin roller coating machines already in use are quite impressive, for example running speeds of up to 40 metres per minute are possible with only a two lamp 20 kW UV conveyor unit of 2 metres overall length. Two layers of varnish having a high solids content are applied wet on wet giving a dry film weight of 6–10 g/m².

Tremendous interest is being shown in this process by commercial and in-house printers, carton manufacturers and trade finishing companies.

Another development in the printing field was announced in January 1976 when UV curable pigmented inks became available for silk screen printing. This is in addition to the acid and solder resists already used in printed circuit board production. Despite the heavy coating weights used in the process, it is claimed that the ink can be dried at linear speeds of up to 150 ft per minute. Other advantages include higher ink spreading rates, complete screen stability,

and the elimination of solvents, The general layout of a screen press with UV curing unit is shown in Figure 6.

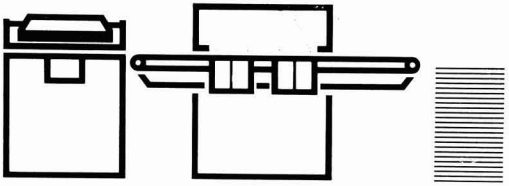

Fig. 6. Schematic of a UV drier for screenprinting

This development is expected to be of great interest to the smaller printing firms who may, at present, be using valuable floor space for many hours to accommodate rack drying frames.

Uses in the furniture industry

The familiar materials such as plywood and veneers have become very expensive over the past 10-12 years, so that chipboard is now being used increasingly in the manufacture of a wide range of furniture products and kitchen fitments. To give this material a smooth surface for the subsequent application of a durable and attractive finish, UV curable polyester resin fillers are being used with great success. Curing times of 20-30 seconds for coating weights of 100g/m² are typical and the board can be passed immediately to the sanding unit. Subsequent coatings to simulate wood grains can be followed by a final coat of UV curable lacquer to produce a high gloss, durable finish. Alternatively, melamine board coatings can be used for kitchen or bedroom furniture.

The development of UV curable opaque white pigmented fillers has now reached a stage where curing times of 10-20 seconds for coating weights of 100 g/m² can be achieved. The electrical loadings in the wood finishing field can be estimated on the basis of one lamp for every 3 metres per minute of conveyor speed.

Summary

Some of the particular benefits of UV curing in each field of application have been shown and every potential user would need to consider these in relation to his own mode of operation. But in the majority of cases the following benefits could be expected from a UV curing system: energy savings; rapid throughput; shorter drying tunnels; less rejects; easier handling; easier maintenance; freedom from pollution.

Infrared curing systems

The domestic infrared bathroom heater is well known. Basically, industrial infrared heaters are equally simple in operation. In the manufacturing process industries, heating of some sort is used in the production of almost all commodities. Electric infrared heating is applied in industry in three main fields, namely for mass heating, moisture removal, and paint drying. Taking these in turn, mass heating includes metal heat treatment, plastics moulding and glass bending. Moisture removal techniques are applied to the drying of paper, ceramics and wood. Paint drying and stoving covers the wide range of finishing materials and coatings available to industry today. Clearly, this is a field which is quite important. It accounts for about 45 per cent of the number of infrared installations in the UK, so it is a strong competitor for forced convection ovens. This is because the high rate of heat transfer enables the equipment to be more compact and consequently, the treatment times are significantly shorter. For example, a typical infrared lamp oven can cure powder coatings on metal components in a fraction of the time taken by convected heat. Electric infrared heating is not only fast, it is clean, safe and inexpensive to install.

Basic principles of infrared heating

Having listed a few of the benefits of infrared heating, the properties of the basic equipment available to industry can be considered. The heart of an infrared system is the radiant emitter, but this is where infrared technology is complex and requires careful study. Emitters are manufactured in various forms, depending upon their operating temperature, which in turn decides their spectral output or the waveband emitted. These parameters are important when selecting emitters for particular applications.

The electro-magnetic spectrum, Figure 3 shows the infrared region occupying a band of wavelengths from 0.7 to 400 microns, which is sub-divided into the long, medium and short wave bands. The finishing industry normally operates with emitters between 0.7 and 6 microns, which is equivalent to a temperature range of from 2200°C down to 500°C.

There are three fundamental points to be borne in mind when selecting infrared emitters. Firstly, the transfer of heat does not depend on the temperature of the air surrounding the workpiece as radiant energy is scarcely affected by air movement. Secondly, the radiant heat output increases rapidly as the emitter temperature is increased, being proportional to the fourth power of the absolute temperature. Thirdly, the nature of the surface of the workpiece and its colour will affect its emissivity value, k, or its ability to absorb radiant heat. This is shown mathematically by the Stefan Boltzmann law, $E = kT^4$ where E is the radiated energy, T the absolute temperature and k a constant. The best absorbers are matt black bodies and the worst are brightly coloured or highly polished metallic surfaces.

When infrared energy strikes a body some of it will be reflected (R), some absorbed (A), and some may pass through and be transmitted (T).

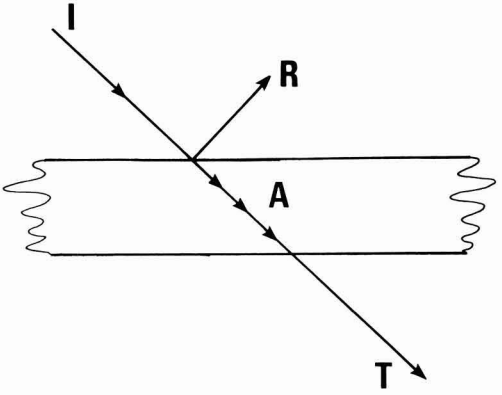

Fig. 7.

This concept is shown diagramatically in Figure 7 and although, in theory, the reflected and transmitted energy make no contribution to the heating of the workpiece, in

practice this energy is often re-directed by reflective enclosures to maintain a high heating efficiency. The main characteristics from industrial emitters can now be examined in a little more detail.

Infrared emitters

Starting at the short wave, high temperature end of the scale there are radiators in the form of lamp bulbs, Figure 8.1. They have a boro-silicate, hard glass envelope with an internal reflecting surface, which can never tarnish. The filaments are usually of tungsten operating at 2200°C, with a peak wavelength of 1.2 microns. Ratings can go up to 375W and power densities up to 1 kW per sq ft. A cone-shaped beam of short wave radiation is obtained and when the lamps are arranged in banks, they are capable of providing process heating of up to about 300°C. (See Figure 8.2). The heat output is quite penetrating and as much as 80 per cent of the input power is converted into infrared radiation. Normal life is up to 10,000 hours which is at least 2.5 years when based on a 40-hour working week. Rapid heating and cooling is a feature of this heater which means that a lamp oven can be up to working temperature in a matter of seconds after switching on. The capital cost of this type of equipment is relatively low and it is easily installed.

Moving up a stage in the power ratings there is the short wave quartz tubular lamp (Figure 8.3). This is a sealed unit with its tungsten spiral supported on metal discs inside the walls of the tube to reduce heat loss by conduction and convection. About 86 per cent of the input power is reproduced as radiation, with the quartz envelope contributing some medium wave energy because it runs at a lower temperature than the filament. Filament temperatures are about the same as the bulbs already discussed, that is, 2200°C. These units can have parabolic gold plated reflectors or flat anodised aluminium reflectors in modular form (Figure 8.4). Power densities up to 8kW per sq ft are obtainable for processes up to 600°C. Lamp life is up to 10,000 hours. If water cooled units are used power densities up to 100kW per sq ft can be obtained for such duties as stress relieving of welds, materials testing and billet heating.

For really high temperatures over a small work area, the short wave infrared spot radiator or gun is used (Figure 8.5). This comprises a 150 W or 1 kW tungsten halogen lamp mounted at the first focus of a semi-elliptical reflector. The energy is concentrated at the second focus where the work piece is moved into position. Process temperatures up to 1000° C can be obtained for such jobs as brazing, soldering or glass to metal sealing. Cleanliness and energy savings are a very noticeable feature of this heater.

The quartz tube radiator operates in the medium wave length region (Figure 8.6). The tube is not sealed, so it is essentially the same as a bathroom heater. The spiral reaches about 950° C which is bright orange, having a peak wavelength of 2.6 microns. The radiation efficiency is about 55 per cent and the back of the tube can be gold plated to form a reflector, or external reflectors can be used. Ratings go up to 8 kW for an 8 ft length, giving power densities of up to 5 kW ft^{-2}. One manufacturer uses a figure of eight cross-section for the quartz to give the high rigidity necessary for long unsupported spans. Normal life of these units can be several years, but the larger mass means that the heating and cooling time can be up to half a minute.

Long wave emitters take the form of metal sheathed elements and ceramic radiators. Metal sheathed elements, (Fig. 8.7) are the same as the red ring boiling plates on domestic cookers. A nichrome spiral element is embedded in a mineral insulation (magnesium oxide) which is compacted inside an Inconel or stainless steel sheath. This construction makes the unit extremely rugged for industrial use, so that it can withstand thermal and mechanical shocks and it does not lose its efficiency if the surface becomes tarnished. The temperature range is from 400 to 800°C, so they are less efficient as radiant emitters, but they are "colour blind" which means they can heat all coloured objects equally well. About 50 per cent of the input power is dissipated as convected heat, which is sometimes desirable for certain drying processes. This is because the surrounding air is in direct contact with the hot surface of the heater. Anodised aluminium reflectors are normally used to form long wave projector units and this, of course, improves the directional efficiency. One disadvantage is that the heating and cooling times are of the order of minutes, so that heat baffles may be necessary on conveyorised lines to avoid damage to sensitive products during hold ups.

The other type of long wave emitter is the ceramic radiator (Fig. 8.8). A nichrome spiral element is embedded in a glazed ceramic body. This gives protection against corrosion, and minimises thermal shock from liquid splashes. Aluminium reflectors improve the forward radiation and a high emissivity value is claimed. They are often used for vacuum forming of thermoplastics, as they provide an even blanket of heat from 300 to 700°C. For this reason they are often called dull emitters. Another feature of this type of element is that a thermocouple can be embedded into the element for temperature measurement and control functions. As with metal sheathed elements, the thermal mass is fairly high so that the heat retention must be allowed for on conveyor lines which are subject to stoppages. Power densities up to 4 kW/ft^2 can be obtained.

With a choice of four basic types of emitter, the prospective user of infrared heating is faced with a problem of selecting the best wavelength for his particular application. In many cases it is not easy or reliable to calculate the loading of an oven or the best operating temperature as many assumptions have to be made. The Electricity Council is, therefore, looking into the design of a versatile test unit to enable pilot tests to be carried out at any temperature and wavelength. This is now in prototype form and will be first demonstrated in the EIA exhibition programme, and may be available for use by Electricity Boards in due course.*

Infrared applications

Two examples of the use of infrared radiation in surface finishing can be given. The first example is a short wave lamp oven being used to dry powder coatings on metal shelf components for supermarket shop fittings. The oven uses the screw-in type infrared lamp with a total loading of 50 kW. The light construction and the absence of thermal insulation means that this type of mono-rail oven can be situated near the roof to save floor space. It supersedes a gas oven which operated at 1 ft/minute, a quarter of the present speed and consumed four times as much energy. The electric oven provides immediate start-up and requires very little maintenance. This clean form of heating has improved the product quality and reduced the number of rejects.

The second example concerns an infrared oven designed for stoving the paint and primer on car window hinge units. A medium wave quartz tube system of 47 kW was installed for less than the cost of repairing an existing gas oven.

*Since the presentation of this paper, twelve portable test units have been supplied to area electricity boards throughout the UK for heating trials on customers' products *in situ*.

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Texaphor® 963	Anti-settling, dispersing, anti-flooding and anti-floating agent				Incorporation before or after grinding	0.2 – 2.0 %	pigments and fillers
Texaphor® 963 S	Anti-flooding and floating, dispersing, anti-settling agent and grinding aid				Incorporation during grinding	0.5 – 2.0 %	pigments and fillers
Texaphor® 277	Anti-settling and wetting agent, pre-dispersing agent for Bentone*) gellants *(see data sheet)*				Incorporation before *or after grinding*	0.1 – 0.5 %	finished paint
Product 100	Wetting agent and dispersing agent				Incorporation before grinding	0.2 – 0.5 %	finished paint
Rilanit® Special	Thickening and thixotropic agent; Anti-settling and anti-sagging agent				Grinding Temp. 35 – 55 °C	0.2 – 2.0 %	finished paint
Rilanit® HT	Heat-resistant thickening and thixotropic agent; Anti-settling and anti-sagging agent				Grinding Temp. 40 – 75 °C	0.2 – 2.0 %	finishing paint
Dehysol®	Thickening and anti-sagging agent				Allows grinding temps. over 60 °C	0.5 – 2.0 %	finished paint
Dehysol® R	Thickening, thixotropic, wetting and dispersing agent				Incorporation before or after grinding	0.2 – 1.0 %	finished paint
Perenol® E 1	Air release agent					0.05 – 1.0 %	finished paint
Texaquart® 253	Conductivity improver				For electrostatic spray paints	0.2 – 2.0 %	finished paint
Edenol® BS 20 N, MS 20 N, IBS	Improve sandability, stackability, scratch resistance and "touch"				Non-gelatinizing plasticizers	see data sheet	
Edenol® LFW 101	Improves sandability, stackability of fast sanding primers				Non-gelatinizing *plasticizer*	see data sheet	
Edenol® LFW 100, LFW 104	Improve sandability, stackability of fast sanding primers				Bi-functional special phthalic acid esters	see data sheet	
Edenol® 344	Plasticizer with migration resistance, low volatility				For foil coatings	see data sheet	
Edenol® D 81, B 316, B 35	Stabilizers, plasticizers and dispersing agents				Epoxidized oils	see data sheet	
Tetrahydronaphthalene	Solvent, flow promotion agent, suspending agent for alu-bronze powder				Avoids cratering	5.0 – 10.0 %	solvents
Decahydronaphthalene	Solvent, flow promotion agent				Avoids cratering	5.0 – 10.0 %	solvents
Dehydril® NRC, NRL, N Special	Anti-skinning agents				Methylethylketoxime	0.2 – 3.0 %	drying binder
Alcophor® AC	Corrosion inhibiting agent				Inactivates rust residues	2.0 – 3.0 %	finished paint
Perenol® F 3	Flow promoter, especially for epoxy, acrylic and polyester powder finishes and coil coatings				Incorporation before grinding	0.5 – 1.0 %	binder

*) Bentone® = Registered trademark of NL Industries Inc., USA

We have taken your problems to heart and developed additives which have become recognized "trouble-shooters" in the paint world, i.e.:

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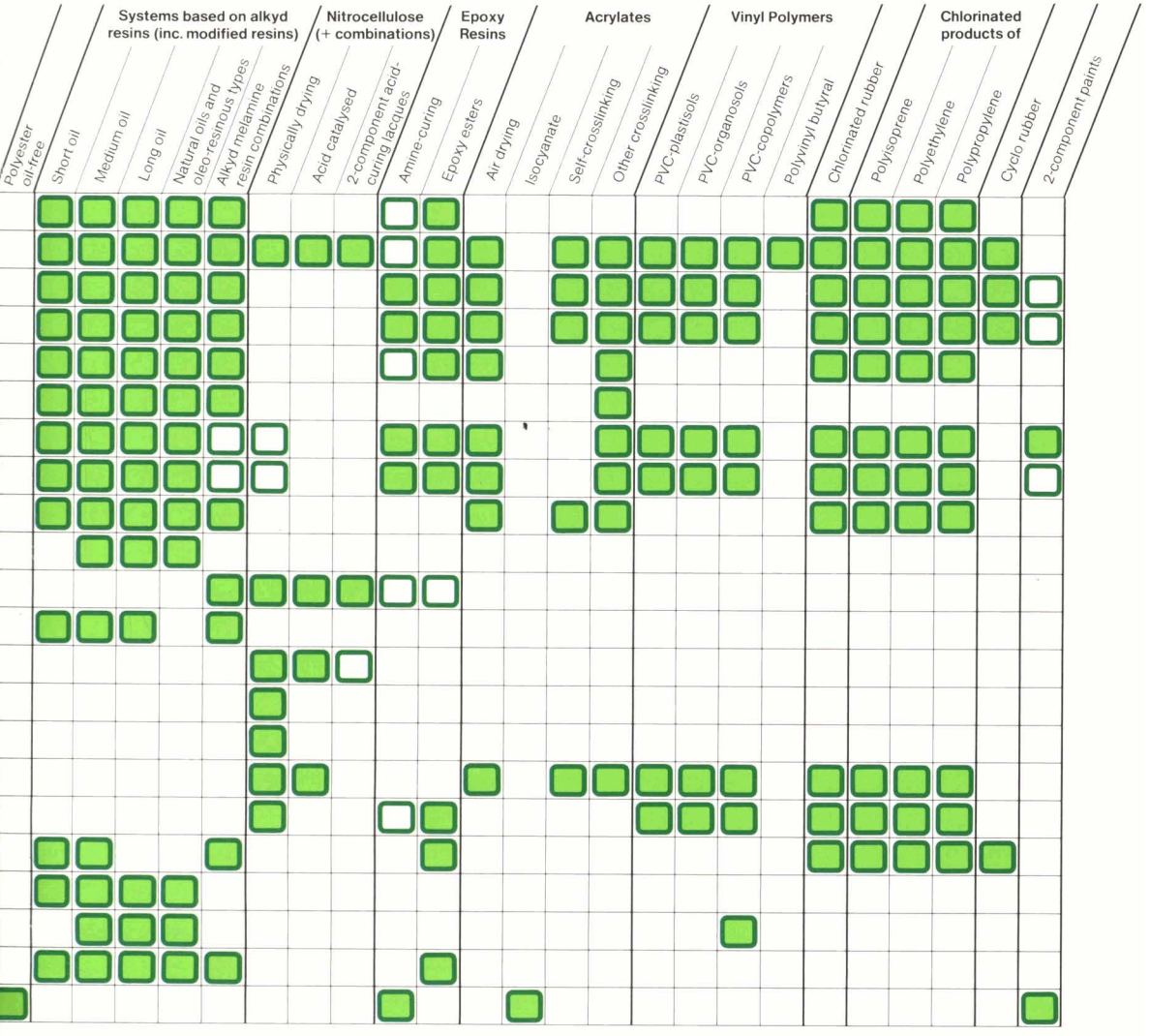

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TEXAPHOR® 963 S is highly suitable for use with the "difficult" pigments: phthalocyanine blue, iron oxide yellow, carbon black and chromoxide green.

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Slip-agent for solvent-containing and solvent-free finishes. Improves the scratch and soiling resistance and flow properties. Suitable for paints based on air-drying alkyd resins, alkyd/melamine resin combinations, air-drying, self and other cross-linking polyacryl resins, polyurethanes, nitrocellulose, oil-free polyesters. Dosage 0.1–0.5%, calculated on the finished paint.

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Heat resistant thixotropic bodying, anti-sagging and settling agent in powder form for traffic and marine paints.

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Silicone-free **air release agent** for nitrocellulose lacquers. Particularly suitable for curtain coating.
Transporting speed of the chip-boards from 20–150 m/min. possible. Also prevents cratering in alkyd melamine stoving enamels.

ALCOPHOR® AC

Corrosion passivator for use in primers and one-coat finishes intended for direct application to metal substrates.
a) inactivates rust deposits still remaining after wire-brushing and hinders new rust formation.
b) absorbs remaining moisture, so that it can have no negative affect on the paint adhesion.
c) absorbs the minute fat and grease residues on the film, also preventing adhesion problems.

PERENOL® F 3

Liquid silicone-free **flow agent** for powder and coil-coatings. Cratering, fish-eyes and orange-peel effects, etc. will be prevented. It ensures a smooth surface finish resulting in increased gloss. No reduction in film hardness, delay in drying time or deterioration in adhesion.

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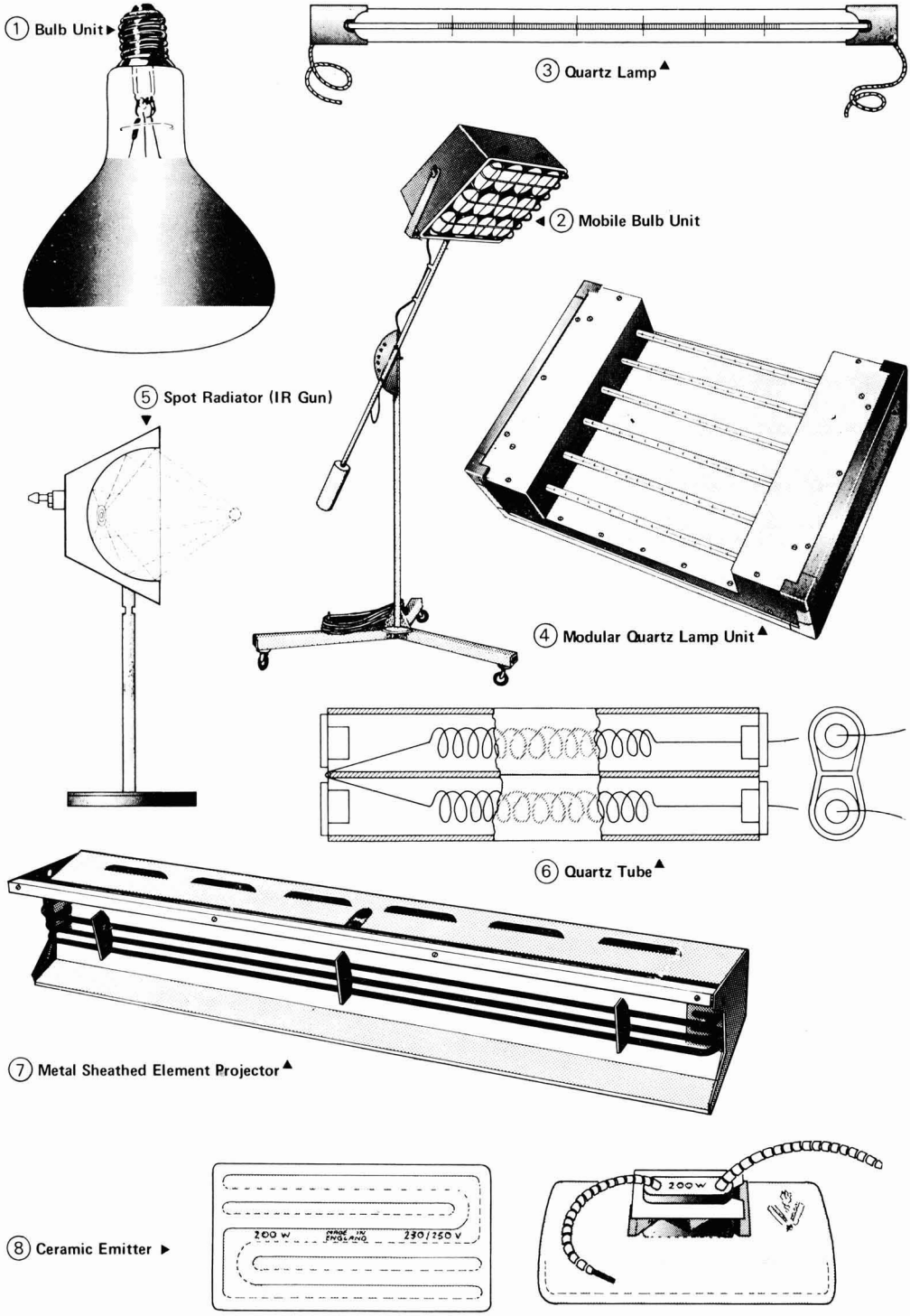

Fig. 8. Types of infrared emitters

The capital outlay was recovered in as little as six weeks and production costs were reduced by increasing throughput by more than 250 per cent and by dispensing with the night shift. This represented an internal saving of 65 per cent on the cost of finishing each component and underlines the significant economic benefit that electric infrared can offer to industry.

Control systems

For the whole range of heaters discussed, coarse temperature control is often adopted for simplicity and economy, and usually involves utilisation of banks or zones of infrared heaters switched in series or parallel or combinations of the two arrangements according to the heat profile required.

On three-phase supply systems star/delta switching can be used not only to provide two levels of radiation but, also, to minimise starting surges on lamp ovens.

Pulsed energy regulators can also be used on long wave systems, such as metal sheathed elements or ceramic elements where the thermal mass of the heater is adequate for smoothing the on/off periods.

An important economic factor of short wave, low mass, lamp ovens is that they can be switched up or down automatically according to the demand of the production line. So energy can be saved even during short production stoppages.

With conveyorised products, the regulation of speed and hence the dwell time of the product provides a further means of temperature control. With batch ovens, the distance between the emitters and the work pieces can be varied.

Maintenance of infrared equipment

Infrared heaters cannot, of themselves, produce atmospheric pollution as no combustion takes place. There are no naked flames involved. This helps to prevent spoilage and contamination of the product. It also means that the heaters stay clean for long periods in a clean working environment, therefore, maintenance is minimal and extremely simple. Replacement of electric infrared heaters is usually a straightforward job for any maintenance electrician. Fortunately, the type with the shortest working life is easiest to replace, that is, lamp bulbs. No tools are required for this task. But even this is seldom an urgent job as the battery of lamps would not normally lose efficiency with the failure of a few lamps here and there. Furthermore, a continuous flow of air around the lamps prevents the ingress of pollutants and combustible materials.

Quartz tubes take a little longer to replace, depending upon the type and structure of the oven. But with an element life of the order of years, this task should not occur often.

Metal sheathed elements should last for several years even under arduous working conditions.

Ceramic emitters are normally trouble-free for similar periods, but are not quite so rugged. The point to remember is that the lost time of a production line should be negligible.

Summary of advantages

The advantages of electric infrared systems can be summarised as follows:

Rapid heating, therefore, faster throughput.

Shorter drying tunnels saving valuable floor space.

Heat is easily controlled.

Heat can be evenly spread or highly concentrated.

Wavelengths to suit the majority of industrial processes.

No products of combustion.

Fewer rejects with cleaner heating.

Faster start-up and shut-down.

Simple maintenance—minimum lost time.

No health hazards—better environment.

Low capital and installation costs.

Heat recovery is often feasible.

[*Received 27 November 1976*

Next month's issue

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

Microvoid coatings—materials and energy savers? *by J. A. Seiner*

Recent developments in antifoulings *by Dr A. O. Christie*

Conserving human resources through innovation *by M. A. Glaser*

The cost of flocculation *by J. G. Balfour*

J. Oil Col. Chem. Assoc. 1977, 60, 307-310

Short Communication

A two-dimensional colour diagram based on the sensitivity functions of cone vision

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Summary

A two-dimensional combined lightness and chromaticity diagram, which is visually uniform, has been derived from a computer model which uses the colour matching functions of the 1931 CIE standard observer, weighted by the spectral sensitivity function, as pigment data in a modified colour matching algorithm. Any colour can be uniquely defined in the diagram by two points related to lightness and chromaticity and from which Munsell hue, value, and chroma can be calculated. The computer model behaves spontaneously as a spectrally opponent response system.

Keywords

Equipment primarily associated with analysis, measurement or testing

colour difference computer

colour standard

colorimeter

Processes and methods primarily associated with analysis, measurement or testing

colorimetry

Miscellaneous terms

Munsell system

chromaticity scale

Un diagramme de couleur bidimensionnel basé sur les fonctions de sensibilité de la vision en cône

Résumé

Un diagramme bidimensionnel, quasi-uniforme au point de vue visuelle, réunissant la clarté et la chromaticité a été dérivé d'un modèle établi au moyen d'un ordinateur et qui utilise, en tant que données pigmentaires à l'égard d'un algorithme modifié pour contretypage de couleur, les fonctions de contretypage de couleur de l'obsevateur standard établi par la C.I.E. de 1931. Toute couleur peut être définie uniquement sur le diagramme au moyen de deux points qui ont un rapport avec la clarté et la chromaticité et à partir desquels on peut calculer la teinte Munsell, la valeur et la chromie. Le modèle ordinateur fonctionne spontanément comme un système de réponse spectralement opposant.

Ein Zweidimensionales, auf den Empfindungsfunktionen der Bündelsicht Beruhendes Farbschema

Zusammenfassung

Von einem Computer Modell wurde ein zweidimensionales Helligkeitsund Sättigungsdiagramm abgeleitet das visuell einheitlich ist und das die Farbtoneinstellungsfunktionen des 1931 CIE Normalbeobachters, mit zusätzlichen spektralen Funktionen, als Pigment Eigenschaften in einem modifizierten Farbtoneinstellungssystem verwendet. Jede Farbe kann eindeutig durch zwei Punkte, die mit Helligkeit und Sättigung verbunden sind, festgelegt werden. Aus diesen Daten konnen dann die Munsell Farbton-, Helligkeit- und Sättigungswerte berechnet werden. Das Computer Modell benimmt sich ungezwungen wie ein spektrales Gegenwirkungssystem.

Introduction

The purpose of this work was to develop a visually uniform colour space, by means of a computer model incorporating some of the known facts concerning colour perception, as the first step in the derivation of an accurate colour difference formula. The degree of uniformity of the colour space developed was assessed by describing the MacAdam ellipses and the Munsell colour system in terms of the new colour space.

Method

Refs. 1, 2

A computer colour matching algorithm, similar to that described by Allen[1], was modified by replacing the Kubelka-Munk function of reflectance, which relates the reflectance of pigment mixtures to the absorption (K) and scattering (S) characteristics of the individual pigments, by the Ladd and Pinney cube root function to account for the sensitivity of cone vision to differences in lightness:

$$V = 2{\cdot}468R^{\frac{1}{3}} - 1{\cdot}636 \quad \ldots\ldots\ldots\ldots (1)$$

As pigment data, the model used the colour matching functions of the 1931 CIE standard observer, which were assumed to describe the equal energy spectral response characteristics of the cones. These were converted into tristimulus functions X_λ, Y_λ, Z_λ, for illuminant C to simulate adaption to daylight. The X_λ and Z_λ functions were weighted by the Y_λ function to account for the sensitivity of cone vision to differences in wavelength of radiant energy in the visible spectrum as follows:

$$R_\lambda = X_\lambda \cdot Y_\lambda / Y_m \quad \ldots\ldots\ldots\ldots (2)$$

$$G_\lambda = Y_\lambda \quad \ldots\ldots\ldots\ldots (3)$$

$$B_\lambda = Z_\lambda \cdot Y_\lambda / Y_m \quad \ldots\ldots\ldots\ldots (4)$$

where λ = wavelengths at intervals of 20nm in the range 400-700

and Y_m = maximum value of Y at wavelength 560nm

The algorithm was further modified to accept, as input, a set of tristimulus values thus making large quantities of colorimetric data available for analysis[2]. This modification necessitated the use of a more powerful technique for convergence than that employed by Allen.

The weighted tristimulus functions, now named R_λ, G_λ, and B_λ, were converted to additive coefficients by equation (1) and used by the algorithm to calculate the amounts of *R*, *G*, and *B* needed to match various colours characterised by a set of tristimulus values.

Results

The amounts of *R*, *G*, and *B* predicted for a Munsell hue circle at value 5 and chroma 6 are given in Table 1.

Table 1
Predicted amounts of RGB for Munsell hue circle

Munsell colour	*R*	*G*	*B*
R 5/6	3.18	−0.43	3.28
YR 5/6	2.30	−0.20	2.40
Y 5/6	1.42	0.01	1.73
GY 5/6	0.95	0.11	2.25
G 5/6	0.49	0.16	3.04
BG 5/6	0.71	0.11	4.00
B 5/6	1.04	0.00	4.67
PB 5/6	1.76	−0.12	5.04
P 5/6	2.76	−0.28	4.74
RP 5/6	2.76	−0.34	4.09

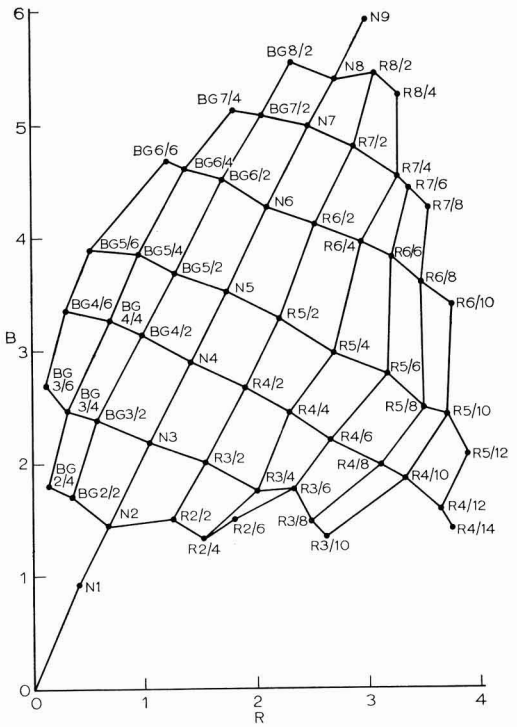

Fig. 1. Munsell *R* and *BG*

Because the amount of *G* is always small in relation to *R* and *B*, it was found convenient to plot the predictions of the algorithm in a two-dimensional diagram with *R* and *B* as coordinates. Some planes through the Munsell colour solid, in *RB* diagrams, are shown in Figs. 1, 2, and 3. The filters closest to the major and minor semi-axes of MacAdam's smallest and largest ellipses in the CIE chromaticity diagram[3] are shown in Fig. 4, drawn to the same scale in the *RB* diagram.

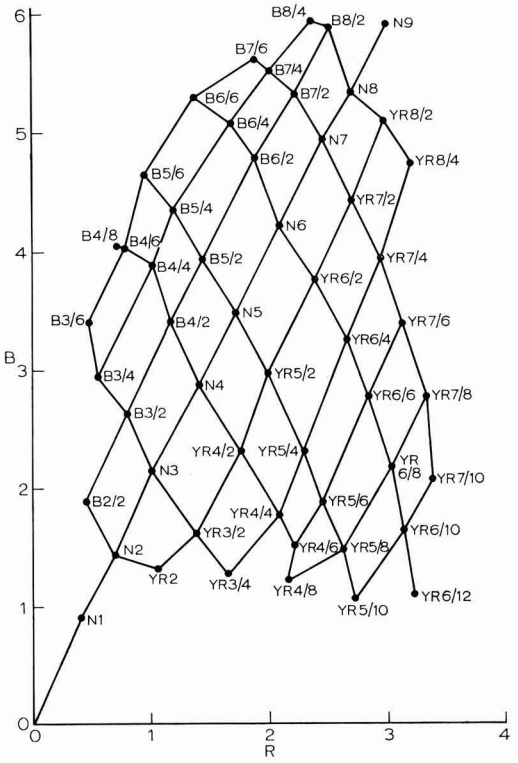

Fig. 2. Munsell *YR* and *B*

Discussion

Refs. 4, 5, 6

When matching colours, the model spontaneously chose combinations of *R*, *G*, and *B* according to a spectrally opponent response system and the behaviour in matching pure, saturated colours, and greys, can be summarised as:

—Achromatic greys were predicted by quantities of *B* and *R* in the ratio 2.02:1. The amount of *G* was close to zero and lightness was directly proportional to the amount of *R* and *B*.

—Yellow was predicted by *R* large, *B* small, and *G* zero.

—Blue was predicted by *R* small, *B* large, and *G* zero.

—Red was predicted by *R* large, *B* small, and *G* negative.

—Green was predicted by *R* small, *B* large, and *G* positive.

This opponent response pattern can be accounted for by the fact that the weighting of the X_λ and Z_λ functions causes a

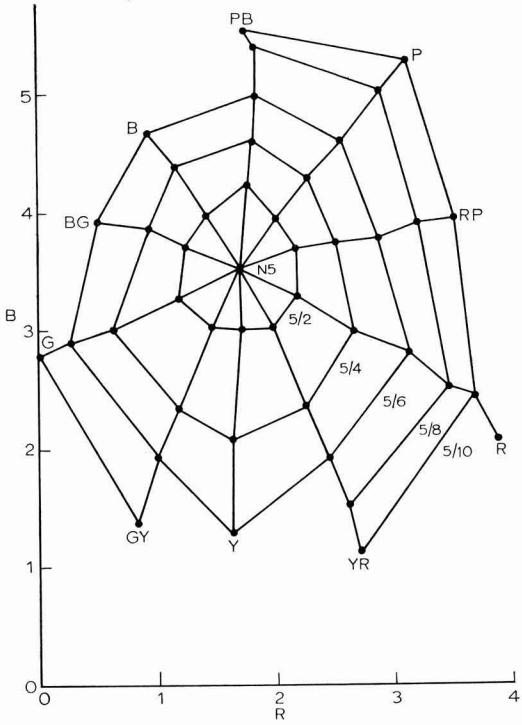

Fig. 3. Munsell hue and chroma at value level 5

diagram in which each colour can be uniquely defined in two dimensions by values of R and B and by a neutral point N which lies on the achromatic diagonal of the diagram and which is related to the Y tristimulus value of the colour as follows:

$$N_B = 2.5Y^{0.27} - 1.95 \quad (5)$$

$$N_R = N_B/2.02 \quad (6)$$

Functions relating R and B values to tristimulus values X, Y, Z, (2 degrees C) have also been derived, thus simplifying the calculation, and these are given below:

$$R = 1.803V_X - 1.439V_Y \quad (7)$$

$$B = 0.851V_Z - 0.209V_Y \quad (8)$$

where V_X, V_Y, and V_Z, are the cube root functions of the tristimulus values X, Y, Z, from equation (1).

From this information, the Munsell attributes of hue, value, and chroma, for pairs of colours, can be calculated and used in a colour difference formula, such as that of Godlove-Munsell[4]. The problem of suitable scaling factors remains and although the RB diagram appears to be equally spaced with respect to Munsell step differences, a preliminary analysis of the MacAdam ellipses indicates that these ellipses expand linearly in the RB diagram with increasing lightness. Further, the shape of the ellipses in the RB diagram appears to carry significant information concerning the sensitivity of cone vision to hue and chroma differences. The scaling factors for the Godlove-Munsell equation could, therefore, be based on an analysis of the behaviour of the MacAdam, Brown-MacAdam[5] and Wyszecki-Fielder[6] ellipses at different lightness levels in the RB diagram.

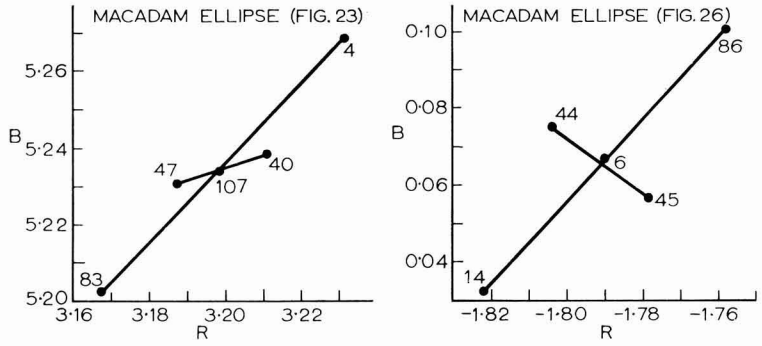

Fig. 4. Filters closest to major and minor semi-axes of MacAdams largest and smallest ellipses drawn to the same scale in the RB diagram

shift in their peak wavelengths towards that of the Y_λ function. In effect, this appears to be equivalent to combining individually the X_λ and Z_λ functions with the Y_λ function thus converting the violet Z_λ function to a blue perceptual response and the red X_λ function to a yellow perceptual response. Subtraction of the green function from yellow and addition of the green function to blue then results in the perception of red and green respectively.

Examination of the representation of Munsell planes in the RB diagram indicated that the diagram is, in fact, an approximately equally spaced combined lightness and chromaticity

Conclusions

Ref. 7

It has been found possible to define any colour uniquely by two points, related to lightness and chromaticity, in a combined lightness and chromaticity diagram which approaches visual uniformity with respect to Munsell steps and which should considerably simplify the derivation of an accurate colour difference formula.

The spontaneous behaviour of the computer model suggests a possible way in which information is encoded in

the visual pathways, particularly when related to the work of De Valois *et al*[7].

Acknowledgments

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Annual Report of the Council for 1976

Adopted at the Fifteenth Annual General Meeting of the Incorporated Association held at the Grand Hotel, Eastbourne, at 4.05 p.m. on 18 June 1977.

General

During the year several important events took place which the Council feels will be of value in advancing the aims and activities of the Association, particularly overseas.

In South Africa and New Zealand new Divisions of the Association were created and the Ontario Branch was granted Section status after operating successfully for only one year as a Branch. In South Africa the three Branches of the former South African Section were each given Section status and at the close of the year the Cape Section were due to form a Port Elizabeth Branch.

Tentative suggestions were also made for the formation of a Branch in Nigeria and Council hopes that this will be brought into operation in 1977.

The twenty-eighth Technical Exhibition took place at Alexandra Palace, London, N.22, from 23 to 26 March; a report appears later under the heading "Exhibition Committee" and a review appeared in the May issue of the *Journal*.

Council was pleased that it was possible for them to arrange for papers to be presented on behalf of the Association at Conferences held by the three other members of the international alliance. In May Mr J. C. Bax presented a paper on "Formulation of gloss emulsion paints" to the Conference organised by the Federation d'Associations de Techniciens des Industries des Peintures, Vernis, Emaux et Encres d'Imprimerie de l'Europe Continentale which was also attended by the President of the Association, Mr A. T. S. Rudram. In September Mr Rudram attended the Convention organised by the Skandinaviska Lackteknikers Forbund, when a paper was presented on behalf of the Association by Dr L. A. O'Neill entitled "Analysis, monitoring and abatement of effluent from industrial paint stoving ovens". At the Washington Convention of the Federation of Societies for Coatings Technology in October a paper was presented on behalf of the Association by Dr M. L. Ellinger entitled "Correlation of weathering results".

The Fourteenth Annual General Meeting of the Incorporated Association took place at the Crown Hotel, Harrogate, Yorkshire, on 25 June 1976. The President, Mr A. T. S. Rudram, who was in the Chair reported with regret that Mr A. A. Duell, who would have been appointed President-Designate at the meeting had died on holiday in Malta on the preceding Sunday. The members stood in silent tribute to Mr Duell's memory and the President reported that the Council would appoint another member as President-Designate after a further election.

The following Vice-Presidents were elected:

Mr J. Beachen
Mr D. E. Hopper
Mr A. McLean
Mr D. Pienaar
Dr H. Rechmann
Dr F. M. Smith
Mr A. R. H. Tawn

The Honorary Officers were elected as follows:

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

The President announced Honorary Membership had been conferred upon Dr S. H. Bell, OBE (President 1965-67) in recognition of his outstanding work on behalf of the Association. Dr Bell was unable to be present but the scroll was presented to him at the Reunion Dinner in October.

The report of the Auditors on the scrutiny of the postal votes was received and it was announced that the following members had been elected to the Council for the year 1976-1977:

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

Votes of thanks to retiring Council members, Honorary Officers and the Director & Secretary were carried with acclamation. It was noted that the Director & Secretary had completed 25 years as the Association's Chief Executive Officer and, on behalf of the members, the President presented him with a print by John Piper.

The A.G.M. was then adjourned until 4.00 p.m. on 13 October when the President reported that the result of the further ballot for the office of President-Designate had resulted in the appointment of Mr A. McLean of the Scottish Section.

During the year Commendation Awards were made to Mr G. F. Jones of the Irish Section and Dr W. Carr of the Manchester Section in recognition of their work on behalf of the Association over a long period.

In the course of the year Sections of the Association have held Symposia and other special meetings, including the West Riding Section's Symposium on "Exporting paints and similar products" at Harrogate preceding the Annual General Meeting in June, the Manchester Section's Symposium on "Films—formation and behaviour" in April, the joint London Section and Institute of Metal Finishing Symposium on "Current trends in industrial finishing" in September and the Manchester Section's Student Symposium in September. In addition the London Section held a one-day Symposium at the Thames Polytechnic in November on "Water thinned anti-corrosion products" in conjunction with the Institution of Corrosion Science and Technology and in March held a one-day Symposium at the University of Surrey on "Printing ink and paper". On the day preceding the former event, the London Section held a special luncheon and meeting at the Sheraton-Heathrow Hotel to welcome a lecturer, Professor H. P. Schreiber, from the University of Montreal.

The thirteenth New Zealand Convention was held in August and the South African Division held a Conference at Port Elizabeth on 8/9 October.

On 14 May the Association held its biennial Dinner and Dance at the Savoy Hotel and the Association's guests on that occasion included six Presidents and two Chairmen of other societies and the Master of the Worshipful Company of Painter-Stainers. A report appeared in the July issue of the *Journal*.

The London Section instituted a prize in commemoration of the late Leslie Kekwick, Chairman of the Section 1949-51 and President of the Association 1951-53. The presentation of the prizes was made by Mr Kekwick's son, Dr Kekwick, at the Section's Annual General Meeting on 22 April.

During the summer recess, Vinyl Products Ltd made a presentation to the Association in memory of the late James Miller who had been employed by them; the presentation being in the form of a Scottish Thistle worked in semi-precious stones, which was added to the Presidential insignia.

In September on the occasion of the dinner commemorating the fiftieth anniversary of the foundation of the Paint Research Association, the President presented a congratulatory scroll to the President of the Paint Research Association (Dr F. M. Smith, a former Chairman of the Manchester Section and currently a Vice-President). The framed message is now displayed in the entrance hall of the Paint Research Association building at Teddington.

During the year Council was saddened to learn of the death of three members of the Association who had made considerable contributions to its activities—Professor G. M. Hamilton of the South African Section, Mr R. A. Brett of the London Section and Mr E. McDougall, the Honorary Publication Secretary of the recently formed Ontario Section.

Since the Association moved its offices from the City of London at the end of 1972 with the loss of all the trained staff, it has been necessary to recruit and train staff, many of whom work on a part-time basis. It has not been possible for some time to employ an Assistant Secretary or an Administrative Assistant, so that a very heavy work-load has of necessity been undertaken by the Director & Secretary whose contribution to the progress of the Association over 25 years service has already been noted. Mr C. A. Tayler (Assistant Editor) who joined the Association's staff at the time of the move to Wembley and whose work has been of considerable benefit in the publication field will be leaving the Association early in 1977 and carries with him the thanks and best wishes of Council.

Membership of the Association

Section	*Ordinary*	*Associate*	*Honorary*	*Student*	*Total*
Bristol	56	11	—	—	67
Hull	58	5	—	—	63
Irish	42	14	—	—	56
London	537	56	3	7	603
Manchester	333	32	2	11	378
Midlands (including Trent Valley Branch)	169	21	—	2	192
Newcastle	113	7	—	6	126
Scottish (including Eastern Branch)	90	16	—	5	111
Thames Valley	96	13	—	3	112
West Riding	64	10	—	4	78
Auckland	106	41	—	2	149
Wellington	62	26	—	2	90
Cape	36	14	—	—	50
Natal	85	20	1	2	108
Transvaal	103	22	—	2	127
General Overseas	365	24	2	3	394
Ontario	70	9	—	—	79
Total 1976	2385	341	8	49	2783
Total 1975	2429	354	8	58	2849
Net increase/decrease during 1976	−44	−13		−9	−66

The Council

During the calendar year the Council has met four times, the average attendance being 21. All meetings were held in London.

Committees of the Council

The Committees of Council met as set forth below:

Exhibition Committee	3
Finance Committee	2
Liaison Committee	—
President's Advisory Committee ..	4
Professional Grade Committee ..	3
Publications Committee	1
Technical Committee	—
Jordan Award Committee	—

Exhibition Committee

Chairman: The Honorary Treasurer

(Mr F. Cooper until June, Dr H. R. Hamburg since June)

The Twenty-Eighth Technical Exhibition was held at Alexandra Palace, London N.22, the venue for the Exhibition from 1965-1969. Exhibitors were drawn from 15 overseas countries and visitors from nearly 40 overseas countries. A full report of the Exhibition, including a review of the stands, appeared in the May issue of the *Journal* and the Exhibition Committee recorded its thanks to Mr S. R. Finn, the Hon Editor, who prepared the review, and to Mr G. H. Hutchinson who again helped with the visits by school parties.

Some exhibitors commented favourably on the move to Alexandra Palace where the Association, being the only tenant, has the full use of the facilities, which include two restaurants, a cafeteria, and several bars. The improvement in the motorway system since the Association's last tenancy and the unlimited amount of free car parking space available also received favourable mention by both exhibitors and visitors, and it is hoped that the Piccadilly Line link to Heathrow Airport will be completed shortly, which will enable visitors arriving at Heathrow to travel direct to Turnpike Lane Station, from which the Association operated a free bus shuttle service.

Finance Committee

Chairman: The Honorary Treasurer

(Mr F. Cooper until June, Dr H. R. Hamburg since June)

In the 1975 Annual Report the Committee recorded its gratitude to the Newcastle Section for making the first contribution to the Premises Fund. During 1976, the Manchester Section remitted £1,000 for this purpose from Symposia surpluses and the Committee hopes that further funds will be forthcoming from other Sections, since the possibility of the Association owning its own headquarters building is one which will have the support of many members.

It was forecast in the Annual Report for 1975 that the surplus for 1976 could not possibly be of the same order as for 1975, which had depended to a great extent on the surplus from the Exhibition in that year. The new Association publications in 1976 appeared rather later in the year than originally expected and their contribution to the Association's revenue is expected to be greater in 1977.

The attention of members is drawn to the market value of investments at the end of the year. The equities then stood at £9,486 above their purchase price compared with £13,452 above their purchase price at the end of 1975. The increase in the total holding arises from the sale of one holding and re-investment in right issues. The market value of the British Government securities was £219 below their purchase price compared with £2,121 at the end of 1975.

Jordan Award Committee

Chairman: The Honorary Research & Development Officer, Mr C. N. Finlay

The Jordan Award Committee did not meet during the year since the award is made on a biennial basis but applications had been received for the award by the end of the year and these were being considered by the Committee for the purpose of making the award at the forthcoming Annual General Meeting.

Liaison Committee

Chairman: The President

The Liaison Committee has not met in the United Kingdom during the year but the President has attended both the Congress of the Federation d'Associations de Techniciens des Industries des Peintures, Vernis, Emaux et Encres d'Imprimerie de l'Europe Continentale at Cannes in May and the Convention of the Scandinaviska Lackteknikers Forbund at Helsinki in September/October. On both occasions the opportunity was taken of discussing with the Presidents of the other members of the alliance points of common interest involving the Association.

As already noted in the earlier part of this report a paper was presented on behalf of the Association not only at the two conferences mentioned above but also at the Convention of the Federation of Societies for Coatings Technology at Washington in October.

President's Advisory Committee

Chairman: The President

For the 1976-77 session Mr Rudram invited the Chairmen of the Bristol Section, Mr L. J. Brooke, the London Section, Mr J. T. Tooke-Kirby, and the Newcastle Section, Mr K. V. Hodgson, all of whom were in their second year of office, to serve on the Committee, together with the Honorary Officers of the Association. Mr A. McLean became a member of the Committee after his appointment as President Designate on 13 October.

Professional Grade Committee

Chairman: The President

As noted in the 1975 report of the Council, the number of applications for admission to the Professional Grade from overseas has been one of the most encouraging aspects of this Association's activity, and this trend continued during 1976.

The Council particularly wishes to urge senior members of the Association to encourage younger members to submit their applications for the Licentiate Grade wherever possible.

The Professional Grade has now been in existence for a little more than five years and it will be recalled that under the regulations approved by the Council in 1971 it was not to be expected that there would be many transfers from the Associateship to Fellowship until a period of eight years had elapsed. Some members had submitted applications for transfer during the year and it is expected that this aspect of the Committee's activities will become increasingly important in due course.

Technical Committee

Chairman: The Honorary Research & Development Officer, Mr C. N. Finlay

The Technical Committee did not meet formally this year since it had already prepared the format for the 1977 Biennial Conference and its activities were carried out by correspondence. Full details of the programme for the Conference, together with summaries of the papers and biographies of the lecturers appeared in the November 1976 issue of the *Journal*.

Technical Education Committee

Chairman: The President

Liaison has been maintained with various technical colleges who are helping Registered Students to prepare dissertations for Licentiateship, and the Committee has maintained its interest in the work of the new Technician Education Council.

	Applications received	*Applications transferred between grades*	*Successful*	*Awaiting fulfilment of regulations*	*Not accepted*	*Resignations and deaths*	*Upgradings*	*As shown in December 1976 Journal**
Fellowship	208	*Less* 44 *Add* 4	159	5	4	7	—	152
Associateship	278	*Less* 15 *Add* 47	267	25	18	10	2	255
Licentiateship	37	*Less* 3 *Add* 11	15	22	8	—	2	13
	523	—	441	52	30	17	4	420

*As well as United Kingdom and Ireland, 33 countries are represented in the list of successful candidates published in the December 1976 issue of the *Journal*.

Publications Cammittee

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

The policy of sending tehnical papers to the printer three months in advance of the date of publication has been continued during 1976 and has enabled the average despatch date of the issues of *JOCCA* to be reasonably early in the month. A few numbers were somewhat delayed when reports of meetings or essential notices had to be awaited.

It was possible to publish only twelve of the papers given at the Scarborough Conference in the 1975 volume of *JOCCA* and three of the papers accepted for publication had to be held over until 1976.

The number of pages in volume 59 (1976) was 472, almost the same as in 1975 (474). The number of pages occupied by Transactions and Communications in 1976 was 308, which is 65 per cent of the total and about the same proportion as in other recent years. Twenty-four Book Reviews and one Student Review were published, but once again the Correspondence with the Honorary Editor was disappointing and amounted to only four letters.

The Honorary Editor wishes to thank the Honorary Publications officers for their accounts of Section Proceedings and all those who have contributed to Book Reviews.

Following the decision to prepare a new edition of the "Introduction to Paint Technology", the necessary revision and rewriting was carried out by Dr W. M. Morgans and Mr J. R. Taylor. The Association is greatly indebted to these gentlemen who completed the work so expeditiously that the new volume became available early in October. The original aim of having a volume which could be understood by those with little knowledge of chemistry is becoming increasingly difficult; an attempt to overcome this problem has been made by adding a glossary explaining many of the technical terms mentioned in the text.

The Publications Committee met on one occasion during the year. In addition to considering the papers in hand or likely to become available, the Committee discussed the future of the Paint Technology Manuals, of which only Part VII (Works Practice), produced by the Association, is now available. The work on the revision of Part IV (The Application of Surface Coatings) has been completed and the text is ready for submission to the publishers. It is felt, however, that the latter may not wish to publish a single volume of a series of six when none of the others is available.

The Committee discussed the difficulties inherent in the revision of a volume which may involve something in the order of ten authors. The alternative policy of bringing out a series of monographs on suitable topics, each involving one, or possibly two, authors would greatly simplify the work of revision, and was one which the Committee would consider further in due course.

It was also agreed at the meeting to continue the procedure used in recent years for writing the Exhibition Report in 1977.

Survey of Published Papers Forty-five technical papers and one Student Review (which was based upon a Section lecture) were published during the year. Three papers arose from the Scarborough Conference. Nine papers were directly submitted by authors in the UK and ten by overseas authors. In all overseas authors were involved with sixteen papers. A feature of this year's papers was the publication of those given at the Newcastle Section's Symposium on UV curing. A start has also been made on the papers presented at the Manchester Section's Symposium on Films—Formation and Behaviour.

Papers originating from Section symposia and lectures:	1974	1975	1976
Bristol	—	—	—
Hull	—	—	2
Irish	1	—	—
London	1	4	1
Manchester	4	—	6
Midlands	6	—	—
Newcastle	1	—	13
New Zealand	1	—	1
Scottish	—	—	—
South Africa	—	5	—
Thames Valley	—	—	—
West Riding	1	2	1
	15	11	24
Papers submitted directly:			
United Kingdom	2	8	9
Overseas	26	9	10
Conference	—	12	3
Association Symposium	—	3	—
	28	32	22
Total	43	43	46

Representation on other organisations

The Association was represented on other organisations as follows:

Technical Training Board for the Printing Ink and Roller Making Industry: Mr H. C. Worsdall and Mr N. Locke.

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

The British National Committee for Chemistry: Dr R. C. Denny.

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

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

Association of Exhibition Organisers: The Director & Secretary.

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

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

The Society of Dyers and Colourists Terms and Definitions Committee: Dr J. Toole until October 1976, Mr J. T. Tooke-Kirby from October 1976, and Mr J. T. Hurst.

The Society of Dyers and Colourists "Review of Coloration Progress" Committee: Mr H. D. Brearley until July 1976, Mr J. T. Tooke-Kirby from July 1976.

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

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

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

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

British Standards Institution:

PVC Pigments, Paints and Varnishes Industry Committee: *Dr J. B. Harrison*
PVC/1 Pigments: *Mr H. G. Cook*
PVC/1/11 Extenders: *Mr S. A. Ray*
PVC/1/18 Zinc Dust Pigments: *Mr D. S. Newton*
PVC/3 Paints Media and Related Products: *Mr G. Hutchinson*
PVC/3/5 Test Methods for Paint Media: *Dr L. A. O'Neill*
PVC/4 Lac: *Dr B. S. Gidvani*
PVC/4/1 Lac (Method & Test): *Dr B. S. Gidvani*
PVC/6 Cement Paints: *Mr W. O. Nutt*
PVC/8 Plastic Wood: *Mr V. P. Gellay*
PVC/10 Test Methods for Paints: *Mr A. N. McKelvie*
PVC/11 Glossary of Paint Terms: *Mr S. A. Ray*
PVC/14 Colour Schedules: *Mr A. B. Lock*
PVC/15 Water Paints and Distempers: *Mr T. W. Wilkinson*
PVC/16 Ready Mixed Oil Paints: *Mr A. T. S. Rudram*
PVC/19 Bituminous Paints: *Mr J. Rogers*
PVC/20 Calcium Plumbate Priming Paints: *Mr M. Pettit*
PVC/23 Zinc Rich Primers: *Dr D. Atherton*
PVC/24 Water Thinned Wood Priming Paints: *Mr J. H. Sparrow*
PVC/25 Organic Finishes for Aluminium Windows: *Mr D. E. Hopper*
LGL/9 Artificial Daylight for Colour Matching: *Mr I. Ford*
C/17 Viscosity: *Mr A. N. McKelvie*
C/17/2 Revision of BS188 (Drafting): *Mr A. N. McKelvie*
CHE/43/1 Sieves, Sieving & other Sizing Methods: *Mr M. J. F. Meason*
CHE43/2 Test Methods for Power Properties: *Mr D. S. Newton*
CIC/4 Solvents and Allied Products: *Mr A. R. H. Tawn*
CIC/6 Glycerol: *Mr W. A. Ledger*
OFC/7 Sampling Oilseeds, Oils & Fats: *Mr N. F. Lythgoe*
OFC/12 Vegetable Oils: *Mr N. F. Lythgoe*
OFC/24 Analysis of Oilseeds, Oils & Fats: *Mr N. F. Lythgoe*
GEL/16/53/6 Varnishes: *Mr N. H. Seymour*
ACE/44 Aircraft Finishes: *Mr J. B. G. Lewin*
BLCP/18 Code of Practice—Painting: *Mr J. E. Mitchell*
RDB/25 Road Marking Compounds: *Mr T. R. Bullett*
DOS/3/10 Chemistry & Chemical Technology: *Mr J. Orpwood*

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

The Association was also represented on overseas organisations as follows:

South Africa

Council of the National Association of Scientific and Technical Societies . . . Mr L. F. Saunders.
Natal College for Advanced Technical Education, Science and Education Advisory Committee . . . Mr A. B. Spargo.
The Plastics Institute of South Africa . . . Mr G. Warman.
SABS Specifications—Two-pack Chemical Resisting Finishes . . . Mr H. I. Bosman.
SABS Specification—Non-toxic Coatings . . . Mr. L. Lancaster.
SAPMA Technical Education Committee . . . Mr R. Johannsen.
Witwatersrand College for Advanced Technical Education, Advisory Committee for Paint Science . . . Mr P. A. J. Gate and Mr R. E. Rouse.

Appendix

Report of the Council in accordance with the Companies Act 1967

1. The Council presents herewith the audited accounts of the Association for the year ended 31 December 1976.

2. *Results*

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

3. *Principal activities of the Association*

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

4. *Changes in fixed assets*

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

5. *The Council*

The following were members of Council at 31 December 1976:

A. T. S. Rudram, FTSC
D. J. Morris
S. R. Finn, BSc, FRIC, FTSC
L. J. Brooke, ATSC
W. J. Nunn (co-opted as President of the Oil & Colour Chemists' Association Australia, July 1976)
R. F. Meek
O. W. Brett, BSc
H. C. Worsdall, FTSC
M. J. Heavers
C. Butler, FTSC
J. F. Beachen, MSc, ATSC
R. J. King, BSc, AWP, ATSC
T. Entwistle, FTSC
M. H. Prigmore
M. J. Cochrane
T. W. Wilkinson, AMCT, FTSC
D. J. Pienaar, MSc
J. T. Tooke-Kirby, F Inst Pet, FTSC
J. E. Mitchell, BSc, FRIC, FTSC
D. E. Hopper, ACT (Birm), ATSC
C. N. Finlay, ATSC
K. V. Hodgson, FTSC
A. McLean, BSc, ARCST, FRIC, FTSC
J. L. Inshaw, MRIC, ACTC, FTSC
J. D. W. Davidson, FIPE, FIWM
R. P. Bartrum
F. Sowerbutts, BSc (Tech), FTSC
G. Willison, FRIC
F. M. Smith, BSc, PhD, MRIC, FTSC (*elected 25 June* 1976)
A. R. H. Tawn, FRIC, FInstPet, FTSC (*elected 25 June 1976*)
H. R. Hamburg, PhD (*elected 25 June 1976*)
J. R. Bourne, FTSC (*elected 25 June 1976*)
F. B. Redman, ATSC (*elected 25 June 1976*)
J. Smethurst, AMCT, FTSC (*elected 25 June 1976*)
P. Magee (Miss) (*elected 26 March 1976*)
D. J. House (*elected 7 April 1976*)
E. G. Warman (*elected 7 April 1976*)
E. P. Wright (*elected 7 April 1976*)
P. Birrell, BSc, FCIC, FTSC (*elected 28 April 1976*)
E. N. Harper (Mrs) (*elected 30 April 1976*)
R. Brooks (*elected 5 April 1976*)
R. C. Somerville (*elected 26 March 1976*)
D. Bayliss (*elected 13 July 1976*)
L. P. Goodale (*elected 23 April 1976*)
F. Hellens (*elected 2 April 1976*)
I. R. McCallum (*elected 8 April 1976*)
H. G. Cook, MA, FTSC (*elected 18 June 1976*)
H. Rechmann, PhD, FTSC (*elected 25 June 1976*)

In addition, the following were members of Council at 1 January 1976 and served during the year; the date shown after each name denotes when during 1976 service on Council terminated:

L. H. Silver (*25 June 1976*)
F. Cooper, BSc (*25 June 1976*)
A. G. Holt, FTSC (*25 June 1976*)
W. F. McDonnell, FRIC, AMBIM (*25 June 1976*)
L. F. Saunders, FTSC (*25 June 1976*)
H. G. Clayton (*9 April 1976*)
F. D. Robinson, BSc, ATSC (*25 June 1976*)
P. McCrudden (*26 March 1976*)
H. A. Hipwood, FTSC (*18 April 1976*)
F. Armstrong, AMBIM, ATSC (*5 April 1976*)
J. R. Taylor, BSc, FRIC, FTSC (*25 June 1976*)
N. H. Seymour, FTSC (*25 June 1976*)
A. A. Duell, MRIC, FTSC (*deceased 20 June 1976*)
G. R. Duckett (*30 April 1976*)
D. P. Power (*26 March 1976*)
F. D. H. Sharp (*25 June 1976*)
A. S. Gay, ATSC (*25 June 1976*)

6. *Auditors*

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

By Order of the Council

ROBERT HAMBLIN
Director & Secretary

1 January 1977

OIL AND COLOUR CHEMISTS' ASSOCIATION

BALANCE SHEET as at 31 December 1976

1975 £	£		1976 £	£
		ACCUMULATED FUNDS—		
61,642		GENERAL FUND		71,308
3,000		PREMISES FUND		4,000
64,642				75,308
		CURRENT LIABILITIES—		
398		Provision for Paint Technology Manuals	—	
52,198		Receipts in advance	76,938	
12,649		Creditors and accrued liabilities	21,704	
65,245				98,642
		A. T. S. RUDRAM *President*		
		H. R. HAMBURG *Hon. Treasurer*		
		R. H. HAMBLIN *Director & Secretary*		
£129,887			£173,950	

1975 £	£		1976 £	£
		FIXED ASSETS— (Note 1)		
10,912		Furniture, Fittings, Office Machines and Motor Car at cost	10,926	
7,278		*Less* Accumulated Depreciation	8,420	
3,634				2,506
8,128		Leasehold Property at cost ..	8,128	
1,356		*Less* Accumulated Amortisation	1,808	
6,772				6,320
10,406				8,826
		QUOTED INVESTMENTS—		
12,110		British Government Securities at cost .. .. .. (Market value £11,891) *Market value 1975 £9,989*	12,110	
27,810		Other Investments at cost .. (Market value £37,688) *Market value 1975 £41,262*	28,202	
39,920				40,312
		CURRENT ASSETS—		
309		Stock of unsold publications .. .. (Note 8)	5,221	
3,576		Paper stock in hand (Note 8)	3,723	
—		Stock of ties .. (Note 8)	38	
10,771		Debtors & Payments in Advance	10,621	
64,905		Balance at Bankers & Cash in Hand in United Kingdom & Overseas Sections ..	105,209	
79,561				124,812
£129,887				£173,950

REPORT OF THE AUDITORS TO THE MEMBERS

1. We report on the accounts set out on pages 7 to 10. These have been prepared according to the historical cost convention.
2. The accounts incorporate the unaudited accounts of United Kingdom and overseas sections for the year ended 31 December 1976. We have not verified any of the accounts prepared by these sections which, at 31 December 1976, reported net assets amounting in total to £13,853 (1975 £8,946), the only figures of significance being cash which amounted to £15,366 (1975 £10,268) and creditors which amounted to £1,518 (1975 £2,207).
3. With this reservation, in our opinion, the accounts give a true and fair view of the state of the Association's affairs at 31 December 1976 and of its results and source and application of funds for the year ended on that date, according to the historical cost convention, and comply with the Companies Acts 1948 and 1967.

COOPERS & LYBRAND

London, 23 February 1977

Chartered Accountants

Note: The page references given in the paragraph above are equivalent to pages 316 to 319 in this *Journal*.

STATEMENT OF SOURCE AND APPLICATION OF FUNDS FOR THE YEAR ENDED 31 DECEMBER 1976

	Year ended 31.12.76		*Year ended 31.12.75*	
	£	£	£	£
SOURCE OF FUNDS				
Unappropriated surplus for year		10,666		*43,837*
Adjustment for item not involving the movement of funds:				
Depreciation and amortisation		1,594		*1,659*
TOTAL GENERATED FROM OPERATIONS		£12,260		*£45,496*
FUNDS FROM OTHER SOURCES				
Book value of investments disposed during year		307		*4,500*
		£12,567		*£49,996*
APPLICATION OF FUNDS				
Purchase of fixed assets	14		*505*	
Purchase of investments	699		*5,816*	
		713		*6,321*
INCREASE IN WORKING CAPITAL		£11,854		*£43,675*
INCREASE IN WORKING CAPITAL comprises—				
Increase/(decrease) in stocks		5,097		*(543)*
Increase/(decrease) in debtors and payments in advance		(150)		*(6,576)*
(Increase)/decrease in current liabilities		(33,397)		*50,315*
Movement in net liquid funds:				
Increase/(decrease) in balance at bankers and cash		40,304		*479*
		£11,854		*£43,675*

OIL AND COLOUR CHEMISTS' ASSOCIATION

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1976

1975 £	1975 £	1975 £		1976 £	1976 £	1976 £
			INCOME			
			MEMBERSHIP AND GENERAL INCOME—			
		20,538	Subscriptions	30,552		
		165	Professional Grade Certification fees	123		
		689	Entrance fees	1,111		
		824	Publications	2,306		
		735	Sundry Income	1,410		
		—	Profit on sale of investment	421		
		2,521	Section Surplus (Note 5)	2,462		
		865	Conference	—		
		7,451	Investment Income	8,028		
	33,788				46,413	
			JOURNAL RECEIPTS—			
		17,492	Advertising	16,509		
		19,457	Sales	24,736		
		3,460	OCCA Australia	3,018		
		863	Reprints	1,123		
	41,272				45,386	
	109,026		EXHIBITION RECEIPTS		41,466	
184,086						133,265
			EXPENDITURE			
			MEMBERSHIP AND GENERAL EXPENSES—			
		12,750	Administration expenses (Note 4)	14,791		
		15,077	Journal	14,668		
		7,203	Postage, printing and stationery	7,893		
		526	Publications	441		
		74	Council Reunion Dinner	7		
		2,888	General expenses, inc. accountancy	4,026		
	38,518				41,826	
			JOURNAL EXPENSES—			
		12,750	Administration expenses (Note 4)	14,792		
		18,433	Printing and Publication	17,929		
		586	Reprints	874		
		5,306	Postage and stationery	5,925		
		1,095	General expenses	1,266		
	38,170				40,786	
			EXHIBITION EXPENSES—			
		49,981	Direct expenses	23,929		
		12,751	Administration expenses (Note 4)	14,792		
		1,093	General expenses	1,266		
	63,825				39,987	
140,513						122,599
43,573						10,666
264			Profit on Exchange			—
43,837			Surplus for the year			10,666
			APPROPRIATION—			
3,000			Surplus on Manchester Symposium 1976 (Newcastle Section 1975) transferred to Premises Fund (Note 6)			1,000
£40,837			Surplus for the year carried forward			£9,666

STATEMENT OF RETAINED RESERVES

1975 £		1976 £
40,837	Surplus for the year	9,666
20,805	Balance at 1 January	61,642
£61,642	Balance at 31 December	£71,308

NOTES ON THE ACCOUNTS

1. *Fixed Assets*

	Furniture, Fittings Office Machines and Motor Car		*Leasehold Property*	
Cost	£	£	£	£
At 1 January 1976	10,912		8,128	
Additions	14		—	
Disposals	—		—	
		10,926		8,128
Depreciation				
At 1 January 1976	7,278		1,356	
Disposals	—		—	
Charged to Income and Expenditure Account	1,142		452	
		8,420		1,808
Net book value at 31 December 1976		£2,506		£6,320

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

2. *Foreign Currencies*

Overseas Section income, expenditure, assets and liabilities have been converted to Sterling at the following rates ruling at 31 December 1976:

New Zealand	$1.7927
South Africa	R1.4805
Canada	$1.7194

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

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

4. *Administration Expenses*

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

1975 £		1976 £
20,987	Salaries, including pensions and National Insurance	25,606
7,396	Agency staff	9,104
366	Welfare	472
6,646	Rent, rates, lighting and telephone	6,716
600	Audit fee	500
250	Provision for dilapidations	—
—	Administration of pension fund 1975 and 1976	480
1,658	Depreciation and amortisation of fixed assets	1,594
258	Bad debts	303
90	Legal charges	—
—	*Less* provision released for Paint Technology Manuals	(400)
£38,251		£44,375
	The charge to each heading is therefore:	
12,750	Membership	14,791
12,750	Journal	14,792
12,751	Exhibition	14,792
£38,251		£44,375

5. *Section Surplus*

The Section surplus is as follows:

1975 £		1976 £
19	*Bristol	72
(27)	†Hull	18
(144)	†Irish	(208)
(172)	†London	892
(2,025)	†Manchester	2,278
(196)	*Midlands	(14)
(14)	†(Trent Valley Branch)	16
3,550	†Newcastle	(200)
455	†Scottish	335
60	Thames Valley	(184)
157	West Riding	344
(235)	†Auckland	(234)
91	†Wellington	(250)
1,004	*Natal	269
	†Cape	(282)
	Transvaal	22
(2)	*Ontario	(412)
£2,521		£2,462

NOTES:
(1) *unaudited returns incorporated in the accounts 21.1.77
(2) † estimated returns included in the accounts 21.1.77
(3) Nett surpluses are shown without brackets
Nett deficits are shown inside brackets

6. *Premises Fund*

This distributable reserve has been set aside by a decision of the Council to provide a fund for a future building programme. Negotiations were opened early in 1977 for the purchase of Priory House, by means of the realisation of certain investments and a bank loan; the expected purchase price would be in the order of £65,000.

7. *Limited by Guarantee*

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

8. *Stocks*

The value is determined on the basis of the lower of cost and net realisable value. Cost is determined on a first-in, first-out basis.

ETHEL BEHRENS FUND

INCOME & EXPENDITURE ACCOUNT TO 31 DECEMBER 1976

1975 £	Expenditure	1976 £	1975 £	Income	1976 £
100	Income Tax on Investment	103	*239*	Interest on Investment (Gross) ..	245
29	Surplus	142			
110	Dr W. Carr (travelling to Canada)..	—			
£239		£245	*£239*		£245

BALANCE SHEET as at 31 December 1976

1975 £	Liabilities	1976 £	1975 £	Assets	1976 £
2606	Accumulated Fund	2635	*2446*	British Government securities at cost (Market value £2,279)	2446
29	*Add* surplus	142			
			189	Balance at bank	331
£2635		£2777	*£2635*		£2777

JORDAN AWARD FUND

INCOME & EXPENDITURE ACCOUNT TO 31 DECEMBER 1976

1975 £	Expenditure	1976 £	1975 £	Income	1976 £
100	Awards	—	*65*	Interest on Investment (Gross) ..	65
—	Surplus	73	*35*	Deficit	—
			—	Profit on sale of investment ..	8
£100		£73	*£100*		£73

BALANCE SHEET as at 31 December 1976

1975 £	Liabilities	1976 £	1975 £	Assets	1976 £
1187	Accumulated Fund	1152	*1000*	British Government securities at cost (Market value £945)	1007
35	Less deficit	—			
—	*Add* surplus	73	*152*	Balance at bank	218
£1152		£1225	*£1152*		£1225

Proceedings of the Annual General Meeting

The Fifteenth Annual General Meeting of the Incorporated Association was held on 18 June 1977 at 4.05 p.m. at the Grand Hotel, Eastbourne, Sussex, with the President (Mr A. T. S. Rudram) in the Chair.

There were 44 members present. The notice convening the meeting was read.

Apologies

Apologies for absence were received from Mr L. J. Brooke, Mr A. C. Jolly, Mr I. Moll, Mr D. S. Newton, Mr E. Oostens, Mr D. J. Silsby and Mr L. H. Silver.

Minutes

The President asked the Meeting to take as read the Minutes of the Fourteenth Annual General Meeting held on 25 June 1976, as printed and circulated in the *Journal* pp 306–308 inclusive, August 1976, and the adjournment held on 13 October 1976, as printed and circulated in *JOCCA*, p. 418, November 1976. There being no comments on the Minutes, the adoption of the Minutes was put to the meeting and carried unanimously. The President then signed the Minutes.

Report of the Auditors to the Members

The Report of the Auditors to the Members was read.

Annual Report of the Council for 1976

Mr D. J. Morris (Honorary Secretary) moved the adoption of the Annual Report of the Council and the Statement of Accounts for 1976, seconded by Dr H. R. Hamburg (Honorary Treasurer). Before putting the adoption of the Annual Report of the Council and the Statement of the Accounts for 1976 to the meeting, the President referred to note 6 on the accounts—Premises Fund—and stated that it gave him very great pleasure to be able to record that the negotiations had now been completed for the freehold of Priory House at the purchase price of £65,000, without the necessity of arranging a bank loan. He felt that Members of the Association would be pleased that they now owned their own headquarters building. There being no other comments on the Report of the Council and the Statement of Accounts for 1976, these were then put to the meeting and carried unanimously.

Election of President (1977–79)

Mr Rudram stated that, as indicated on the Agenda, Mr Angus McLean had been nominated by the Council as

President of the Association and he now asked the Annual General Meeting to accept the nomination.

This was carried unanimously with acclamation. Mr McLean thanked the meeting for the high honour bestowed upon him and assured the meeting that he would use his utmost endeavours to advance the high standing of the Association.

Mr McLean asked Mr Rudram to preside for the remainder of the Annual General Meeting.

Election of Vice-Presidents of the Association

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

(i) Mr P. F. Sharp
(ii) Mr D. E. Hopper
(iii) Mr D. S. Newton
(iv) Mr D. Pienaar
(v) Dr H. Rechmann
(vi) Dr F. M. Smith
(vii) Mr A. R. H. Tawn

Election of the Honorary Officers of the Association

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

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

Presentation of the Jordan Award

The President indicated that he now had the pleasant duty of presenting a certificate and cheque of £100 to the winner of the 1976 Jordan Award.

Mr Rudram presenting the Jordan Award to Dr J. C. Reid at the Annual General Meeting

He explained that the Jordan Award was instituted in 1967 by Mrs Marjorie Jordan, in memory of her late husband, Dr L. A. Jordan, who was President of the Association from 1947–49 and became an Honorary Member in 1955. Mrs Jordan, who had since died, wished the Award of £100 to be made for the best contribution to the science or technology of surface coating by a member, under the age of 35, of any nationality, working in either the academic or industrial field.

On this occasion the Jordan Award Committee has decided to make the Award to Dr J. C. Reid for his paper "A fracture mechanics approach to lacquer cracking" which had been published in the August 1976 issue of the *Journal*. The President then presented the Certificate and cheque to Dr J. C. Reid.

Announcement of election of three Elective Members to Council 1977–79

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

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

L. H. SILVER D. E. EDDOWES A. C. JOLLY

Eleven voting papers were rejected as not being in order including five of which were received after the closing date of first post on 3 June 1977.

London,
10 June 1977

COOPERS & LYBRAND
Chartered Accountants

Chairmen of Sections for the coming session

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

Bristol	Mrs E. N. Harper
Hull	Mr T. W. Wilkinson
Irish	Miss P. Magee
London	Mr D. A. Bayliss
Manchester	Mr J. E. Mitchell
Midlands	Mr R. J. King
Newcastle	Mr F. Hellens
Scottish	Mr J. D. W. Davidson
Thames Valley	Mr M. G. Prigmore
West Riding	Mr M. J. Cochrane
Auckland	Mr R. A. Ness
Wellington	Mr C. Gooch
Ontario	Mr W. Fibiger
Cape	Mr E. G. Warman
Natal	Mr L. F. Saunders
Transvaal	Mr E. P. Wright

Membership subscription rates

The Honorary Treasurer proposed that, in accordance with Article 11, the following resolution having been passed by the Council at two successive Council Meetings on 23 February 1977 and 6 April 1977 be confirmed by the Annual General Meeting:

That, with effect from 1 January, 1978, the annual

membership subscription rates in the various categories of membership shall be as follows:

Ordinary or Associate Member £15.00 per annum.

There will be no increase in the rates for Retired Members or Registered Students.

By resolution of the Council, Value Added Tax will be applicable to membership subscriptions paid by members resident in the United Kingdom.

Mr J. E. Mitchell seconded the motion and it was agreed unanimously without comment.

Reappointment of Auditors and fixing the remuneration thereof

It was proposed by Mr A. G. McKay that Coopers and Lybrand (Chartered Accountants) be reappointed Auditors of the Association and that their fee for 1977 be £500. This was seconded by Mr K. H. Arbuckle and carried unanimously.

Vote of Thanks to retiring Council Members

The President called upon Mr H. G. Clayton to propose a vote of thanks to those members retiring from Council and not serving in another capacity in the forthcoming Session. On behalf of the members Mr Clayton proposed a vote of thanks to all those members, both at home and overseas, who had given so willingly of their service in furthering the aims and activities of the Association.

The vote of thanks was then carried with acclamation.

Vote of Thanks to Honorary Officers of the Association

Mr J. D. W. Davidson in proposing a vote of thanks to the Honorary Officers of the Association, wished to thank them for their strenuous efforts on behalf of the Association and for the time they had so willingly given for this purpose. He wished also to mention in the vote of thanks the work of the Director & Secretary of the Association.

The vote of thanks was carried with acclamation.

Vote of Thanks to retiring President

In proposing the vote of thanks to the retiring President, Mr Frank Sowerbutts, President 1967–69, paid a tribute to the very considerable contribution which Mr Rudram had made to the Association during a particularly onerous period of service. He had not only fulfilled his duties as President in an admirable manner, had represented the Association at functions held by other societies in the United Kingdom, but had also represented the Association at the FATIPEC, FSCT and SLF conferences. He was particularly delighted that during Mr Rudram's term of Presidency the negotiations had been completed for the purchase of the Association's Headquarters property, since this was the realisation of a wish long expressed by members during the many years that he had been a member of the Association. He felt also that in proposing a vote of thanks to Arthur Rudram for the excellent way in which he had discharged his duties as President, the Association should also record its thanks for the support given by his firm, Donald McPherson Group Ltd.

The vote of thanks was carried with acclamation.

Mr Rudram thanked Mr Sowerbutts for the kind way in which he had proposed the vote of thanks and the members for the way in which they had received it.

Any other competent business

There being no other competent business, the President thanked Members for their attendance and declared the meeting closed at 4.27 p.m.

Reviews

Concise paint technology

By J. Boxall and J. A. von Fraunhofer

London: Elek Science

Pp. 214. Price £4.95

This is a well organised book and the information and ideas it contains are up to date and presented in a concise fashion.

The first two chapters deal with basic polymer chemistry, the properties of pigments, and with the polymers used in paint. The reader is introduced here to the idea of cross links and their influence on the mechanical properties of the polymer film is discussed. In these chapters some considerable knowledge of organic chemistry is assumed. The third and fourth chapters deal with the properties of specific pigments and other paint components. Subsequent chapters deal with formulation, methods of applying paint, substrates, durability (a very welcome chapter), and the testing of paints and paint films.

The authors occasionally make misleading statements. For example, they suggest that polyamides are produced from amines and fatty acids of vegetable oils. The reviewer would have preferred also that the authors qualify their statements that zinc chromate and cadmium pigments are non-toxic. Nevertheless, they have produced a very readable account of their subject which should prove particularly useful to young people entering the paint manufacturing industry.

J. A. HASNIP

Shipbuilding painting manual

By A. M. Bernendsen

De Boer Maritiem/Verfinstituut TNO, 1975

Pp. 197

It is inevitable that this book will be compared with "Recommended practice for the protection and painting of ships" which was prepared by Dr Hudson for the British Ship Research Association and published some five years earlier. Both books have been produced by committees with the detailed drafting undertaken by their respective authors, and both cover the same subject for the same class of reader. Guidelines are suggested for the most efficient way of protecting ships from corrosion and the work is directed at ship owners, ship builders, ship repairers, painting contractors or, in fact, anyone concerned with surface preparation, painting and selection of suitable marine protective systems.

"Ship building painting manual" is clearly printed and includes several illustrations, some of which in the reviewer's opinion are superfluous. The class of reader for whom the book is intended hardly needs to see pictures of a ship under construction, power tool cleaning equipment, and blasting or welding in progress. Nevertheless, photographs of paint failures effectively remind the unwary of the pitfalls waiting for those unwilling to pay attention to detail. The subject matter is systematically arranged, the tables are easily followed and the comprehensive index allows efficient use of the book as a reference work.

There are points of detail about which paint technologists could undoubtedly take issue, because it is clear that in an attempt to give positive and clear cut opinions several "grey" areas, in terms of paint performance, appear as "black or white" in the book. Some technical problems which are mentioned are not fully covered and leave the reader with doubt as to their importance or solution. However, the fact that they are raised will alert the reader to seek technical advice. Nevertheless, the manual presents a tour de force of a complicated subject and treats it in a very practical way. It was disappointing, however, to find no reference to the Japanese Standards of Surface Preparation* which are unique as pictorial standards for shop primed surfaces.

It would be difficult to justify inclusion of both "Ship building painting manual" (197 pages) and "Recommended practice for the protection and painting of ships" (332 smaller pages) in a limited library, but perhaps even more difficult to choose one in preference to the other. Anyone interested in delving more deeply into a particular aspect of the subject will find the literature references in the BSRA book an asset.

E. G. ELPHINSTONE

*Standard for the Preparation of Steel Surface Prior to Painting (S.P.S.S.) 1975. Shipbuilding Research Association of Japan.

Section Proceedings

Natal

Prepainted aluminium sheet

A meeting of the Natal Section was held on Tuesday, 26 April 1977 at the Ocean Terminal Restaurant, Durban, when 23 members and guests were present to hear a lecture "Prepainted aluminium sheet" presented by E. J. Morley of Huletts Aluminium Ltd.

Mr Morley stated that the main markets for prepainted aluminium are for caravans, mobile homes, van bodies, architectural cladding, louvres and sun controlled fascias, and domestic appliances and cold storage applicators, approximately 2,000 tons annually being imported into South Africa.

The various types of coatings available were discussed, these being alkyds, polyester-acrylics, acrylics, silicone modified acrylics and polyesters, PVCl coatings and fluorocarbon coatings. It was shown by tables of the results of extensive laboratory tests and field trials that no single type of coating would satisfy all demands for the resistance required. In forming and bending some alkyd systems crack, PVCl's suffer severe colour change in natural outdoor exposure tests, and dirt retention is a problem with silicone polyester. The polyvinylidene-acrylics seem to give best results over the widest test range.

From a worldwide exposure programme, it appeared that Durban was one of the worst sites, and highlighted the need to obtain local exposure data before introducing new systems on to the market.

The vote of thanks to the speaker was proposed by Mr R. A. Eglington.

Phosphate coating

A meeting of the Natal Section was held on Tuesday, 24 May 1977 at the Ocean Terminal Restaurant, Durban, when 38 members and guests were present to hear a lecture "Phosphate coating of metal surfaces for protection against corrosion" presented by Mr L. F. Houseman of the Metal Treatment Division of Chemical Services (Pty) Ltd.

Mr Houseman stated that phosphate pretreatments (conversion coatings) consist of treating a metal surface with a solution that will convert the surface to a non-metallic, insoluble coating that is receptive to organic finishes, strengthens the adhesion of the organic finish, and also improves the corrosion resistance.

The lecturer dealt with the history of the development of commercial phosphate coatings, from the original Coslett process of 1908 needing two and a half hours, to the modern 1–2 minutes process today.

The functions of phosphate coatings can be summarised as: (1) to insulate against electrochemical corrosion; (2) to ensure non-alkaline surfaces; (3) to create a better key for paint coating adhesion; (4) to prevent corrosion from spreading laterally from damaged areas; (5) to provide chemically inert surfaces; and (6) to provide clean, grease-free surfaces. Coating weights and type of coating are regulated depending on the end use—light to medium zinc phosphate (30 to 800 mg/ft^2) for paint base, heavy (800 to 2,500 mg/ft^2) for corrosion protection without paint, and heavy manganese deposit for wear resistance.

The usual zinc dihydrogen phosphate solution will produce a zinc phosphate coating on steel containing some ferrous phosphate. Equations were given illustrating the reactions of phosphates in solution and in contact with iron. Control of the rate and type of insoluble phosphate deposit is effected by acid balance, concentration, temperature and the presence of accelerators. In addition, nuceating agents are present to ensure fine-grained, dense and adherent coatings.

The conversion coating is only one of several stages in pretreatment—(1) cleaning, usually alkaline, (2) conditioning rinse, (3) conversion coating, (4) post rinsing with deionised water, and (5) drying. This type of pre-treatment forms an ideal base for paint by contributing to the durability, by increasing the adhesion and reducing corrosion. The improved adhesion is dramatically illustrated on zinc surfaces. Modern formulations allow mixed metal production ensuring consistent surfaces for finishing, zinc/calcium phosphating being of particular interest.

The lecture was concluded with a description of methods and processes for applying phosphate coatings.

The vote of thanks to the speaker was proposed by Mr A. Wymer.

Scottish

An evaluation of exterior wood primers—a report on the Cooperative Research Project

On 10 March 1977, Mr T. L. M. Humphrey of CIBA-GEIGY, Pigments Division, presented the interim report of the Scottish Section Co-operative Research Project on "Wood primers".

Mr Humphrey reviewed the many topics suggested, some of which were associated with the Scottish scene, such as, "Surface coatings related to the North Sea oil developments". The studies carried out by Whitely at the Building Research Station on commercially available wood primers interested the Section because, as far as they were aware, no attempt had been made to correlate film performance with primer composition. The project team therefore considered such a topic as suited to the personnel and experimental facilities available.

The experimental format was presented under the following headings:

(1) What information on wood primers was available.
(2) Formulations: suitable PVC ladders.
(3) Raw materials.
(4) Manufacture of the primers.
(5) Wood substrate: shape, size, quality.
(6) Method of application to substrate.
(7) Weathering.
(8) Physical testing.
(9) Collation of results.

Using transparencies and colour slides, detailed information was presented in a concise fashion.

Results obtained over the last five years were summarised.

Non-aqueous primers (80 formulations; 10 media; 3 extenders; titanium dioxide). All complete systems, i.e. primer, undercoat, and finishing coat showed no signs of breakdown after 26 months outside exposure. There was, however, considerable breakdown in the primers themselves; two media stood out from the rest:

(1) Long oil linseed alkyd.
(2) Urethane alkyd.

The urethane alkyd series was considered to give the best overall result.

Two points emerged from this work:

(*a*) In all the series except one, the extender favoured was either talc alone or in conjunction with the other two extenders, barytes and whiting.

(*b*) Except for two series, the PVC level favoured was 10 per cent less than the CPVC, i.e. when the PVC drops to 15 per cent less than CPVC, performance appears to be reduced.

Aqueous Primers (18 fomulations; 6 media; 1 extender; titanium dioxide). The complete system, regardless of primer, showed no signs of breakdown after 26 months outside exposure. The one coat primed surface exposed with all formulations showed some erosion and leaching of the pigment from the film.

The general pattern for each type of medium was to give improved performance with a decrease in PVC from 45 per cent to 30 per cent. There were two anomalies to this: a primer based on vinyl acetate/versatate emulsion with a 45 per cent PVC was best of the three PVC levels examined (30 per cent, 37 per cent, 45 per cent); a primer based on an acrylic copolymer emulsion with a 37 per cent PVC was the best of the three levels of PVC examined.

The general conclusion on aqueous primers were:

(1) Acrylic copolymer emulsion series gave the poorest results.

(2) Vinyl acetate homopolymer emulsion gave the best series of results.

(3) Vinyl acetate/versatate emulsion at a 45 per cent PVC level was considered the best primer of all formulations examined.

The project members considered that there was sufficient information now available to justify the continuation of the project for a further two years.

A copy of the interim report was presented to the Scottish Section Chairman, Mr J. Davidson by Mr Humphrey, the Honorary Research Officer and Chairman of the Cooperative Research Project, on behalf of the 10 members involved in the project.

A lively question and answer time was chaired by Mr B. Gardner who instigated the idea that a research project should be undertaken by the Scottish Section.

A vote of thanks was accorded to the project team and to Mr Humphrey in particular. The enthusiasm to continue with the project was noticeable.

G.H.R.

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

GOLDSBROUGH, KEITH, BA, MRIC, BTP Tioxide Ltd, Central Laboratories, Portrack Lane, Stockton-on-Tees, Cleveland. (*Newcastle*)

HATHAWAY, RODERICK DONALD GRIC, 3 Duxford Road, Hinxton, Nr. Saffron Walden, Essex. (*London*)

HUANG, WU-TONG, BSc, Eternal Chemical Co. Ltd, 220 Chien-King Street, Kaohsuing, Taiwan, China. (*General Overseas*)

HUDSON, ANDREW, Autotype International Ltd, Grove Road, Wantage, Oxon OX12 7BZ. (*Thames Valley*)

INNES-JONES, EVAN DUNCAN, 22 Fitzwilliam Drive, Torbay, Auckland, New Zealand. (*Auckland*)

Associate Members

BEEKEN, KENNETH ERNEST, 9 Shaftesbury Avenue, Hornsea, North Humberside. (*Hull*)

OULD, WILLIAM LESLIE, 6 David Avenue, Manurena, New Zealand. (*Auckland*)

WHELDON, KEITH RODGER NORMAN, "Shen", Gloucester Road, Thornbury, Bristol. (*Bristol*)

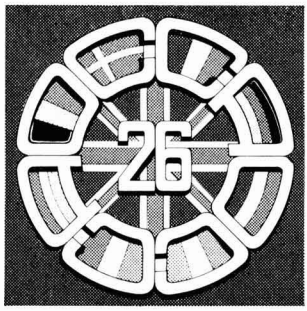
Registered Students

LEONARD, MICHAEL WILLIAM, 8 Cowden Road, Sandycroft Estate, Orpington, Kent BR6 0TR. (*London*)

O'BRIEN, STEPHEN JOHN, Hoechst UK Ltd, 48 Seymour Grove, Old Trafford, Manchester. (*Manchester*)

"The OCCA"

The annual technical exhibition of the Oil and Colour Chemists' Association (known to many simply as "The OCCA") has become the world's most important event for all those connected with the paint, printing ink, polymer, adhesive colour and allied manufacturing industries. The OCCA exhibition is held every year in London, England. The symbols for the 1974-78 exhibitions were specially designed by Robert Hamblin, Director and Secretary of the Association, to emphasise the very wide coverage which all the Association's activities attract:



The motif for OCCA–26 used the flags of the enlarged EEC converging on the British flag to symbolise the welcome extended to visitors from overseas to the Exhibitions for more than 25 years.

This theme was continued for OCCA–27 by showing the world-wide interest aroused by the Association's annual Exhibitions in London which attract visitors from all parts of the globe.

The motif for OCCA–30, designed by Robert Hamblin, uses the symbol of a moving indicator on a calendar to emphasise the importance of the continuous dialogue year by year between suppliers and manufacturers. The inward pointing letters recall the international aspect of this unique annual focal point for the surface coatings industries, which in 1977 attracted visitors from 50 countries.

The motif for OCCA–28 emphasised, that the target for 1976 was London where all the Exhibitions have been held, and continued the theme of its international aspect.

In 1977 the motif for OCCA–29 used inward pointing arrows to show the many places from which people came to the Exhibition, and these arrows formed outward pointing arrows to show the subsequent spreading of knowledge.

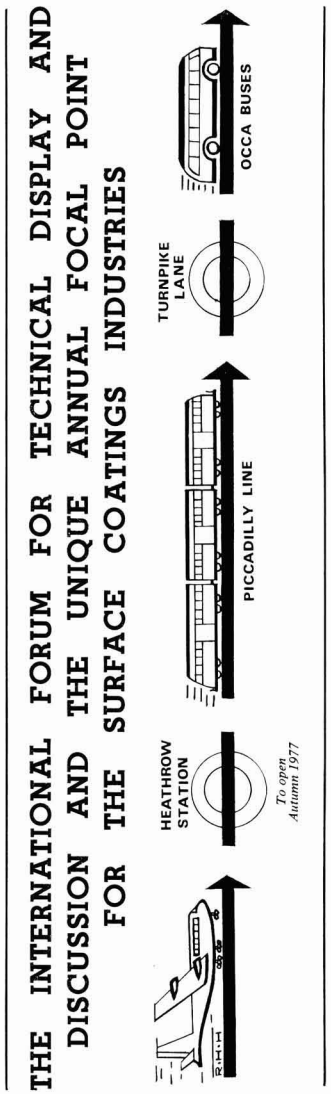
OCCA-30 Exhibition

Alexandra Palace, London. 18-21 April 1978

Many enquiries received from home and overseas

Closing date for applications for stand space: 1 OCTOBER 1977

Applications for stand space now being taken



Arrangements for OCCA-30

The thirtieth Annual Exhibition of raw materials, plant and equipment for the paint, printing ink, colour, adhesive, polymer and allied industries will be held at Alexandra Palace, London N.22 from 18–21 April 1978.

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 there are occasions when this is not possible. Accordingly, the Committee draws attention to the fact that new technical data on existing products are regarded as acceptable subject matter.

Motif for the Exhibition

The motif, designed by Robert Hamblin, uses the symbol of a moving indicator on a calendar to emphasise the importance of the continuous dialogue year by year between suppliers and manufacturers. The inward pointing letters recall the international aspect of this unique annual focal point for the surface coatings industries which in 1977 attracted visitors from 50 countries. The colours of the motif shown on the advertisement on the back outside cover of this issue will be carried throughout the publicity leading up to the Exhibition. The two main colours of the motif, royal blue and yellow, will be incorporated on the facias of the stands and it is intended to organise complementary flower displays in the Exhibition Hall. The use of these colours will create a pleasing contrast as visitors move from corridor to corridor at the Exhibition, as the royal blue colour will be used from east to west and the yellow colour from north to south.

Invitations to Exhibit

Invitations to Exhibit at OCCA-30 were dispatched at the end of May to organisations both in the United Kingdom and abroad and already many enquiries have been received, not only from those who exhibited at OCCA-29, but from organisations which had shown at earlier Exhibitions or are considering exhibiting for the first time.

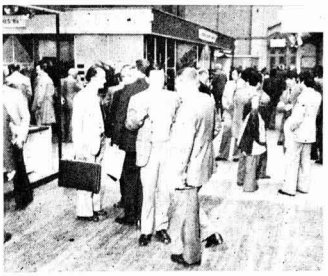
The cost effective Exhibition

The value of showing at OCCA Exhibitions can hardly be better demonstrated than by the following quotation from an article appearing in the June issue of *Paint Manufacture*, and the Association acknowledges with thanks the kind permission of the editor to reproduce it—

> *The encouraging conclusion which may be drawn from this experience is that visitors to exhibitions are interested in new developments and an unknown company can attract attention if it brings genuine new technology to work on tasks which are important to the industry. It is a measure of the effectiveness with which the OCCA Exhibition is conceived, promoted and administered that we at Pilamec are able to regard the considerable cost of participation as an excellent investment.*

In the May issue of the *Journal*, the following quotation appeared from another Exhibitor—

> *I think you would like to know that this was without doubt the most successful Exhibition in which we have participated; the interest was absolutely enormous . . . We have simply never known anything like it.*



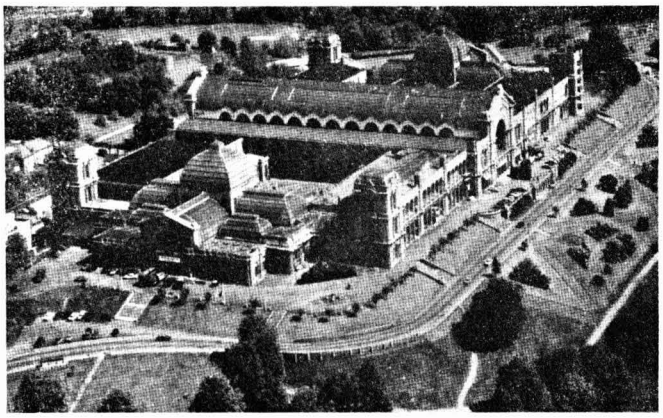
Visitors to OCCA-29 came from 50 countries

The Exhibition Committee was particularly pleased to see the large number of overseas companies showing at OCCA-29, both directly and through their British associates, and this emphasises the international character of the function.

The crowd puller

Visitors at OCCA-29 are known to have come from at least 50 countries and admissions of over 10,000 were recorded at the entrance. Any organisation wishing to exhibit at OCCA-30 should write immediately for details to the Director and secretary of the Association to receive a copy of the Invitation to Exhibit.

All OCCA Exhibitions have been held in London, which affords excellent travel and hotel facilities for visitors from both overseas and the United Kingdom. In pursuance of the theme of the Exhibition—**The continuous dialogue**—it is felt that Exhibitors will like to know that the Exhibition Committee has also **reserved Alexandra Palace for April 1979 and will hold its annual Exhibitions there subsequently in April each year.**



An aerial photograph of Alexandra Palace taken some years ago

Facilities at Alexandra Palace

The Association has full use of the facilities at Alexandra Palace during the period of the Exhibition which include restaurants, two bars, a cafeteria and an 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 and the major routes to Alexandra Palace can be seen on page 271 of the July issue of the *Journal*.

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 from Turnpike Lane Station on the London Underground Piccadilly Line. It is hoped that by the time of the Exhibition the extension of the Piccadilly Line to Heathrow Airport will be completed so that visitors flying into the country will be able to travel direct from the Airport.

Exhibitors were allowed for the first time in 1977 to serve alcoholic refreshments on their stands and this innovation will be continued at OCCA-30. Many exhibitors expressed their appreciation of this as it allowed their personnel to remain on the stands with visitors for the whole period of the Exhibition.

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 together with season admission tickets. As in 1977, several Sections will be organising coach parties to visit the Exhibition and any Members interested should contact their local Section Hon. Secretary. (Full Section Committee lists for 1978 are published in this issue of the Journal.) It is also hoped that several parties will be organised from overseas to visit the Exhibition.

Advertising space is available in this important publication to both exhibitors and other organisations which are not able to show at the 1978 Exhibition. The Official Guide will be published early in 1978 so that visitors can obtain copies and plan the itinerary for their visits. Clearly, the Official Guide is a publication that will constantly be referred to both before and after the Exhibition and consequently any company wishing to advertise in the Guide should book space as soon as possible. Details of the advertising rates are available from Mr D. M. Sanders (Assistant Editor) at the address on the contents page. As in previous years the Official Guide and season admission tickets will be available several weeks in advance of the Exhibition (pre-payment only) from the Association's offices but they will also be available for purchase at the entrance to the Exhibition Hall. A charge is made for both the Official Guide and the season admission tickets to the Exhibition. The policy was introduced several years ago to deter casual visitors who otherwise collected large quantities of technical literature from exhibitors stands; the policy has been welcomed by exhibitors and has in no way acted as a deterrent to bona fide visitors to the Exhibition.

Companies wishing to exhibit are reminded that application forms which were enclosed in the Invitation to Exhibit have to be lodged with the Director & Secretary of the Association **not later than 1 October 1977** and further copies can be obtained from the Association's offices at the address on the contents page.

Obituaries

T. Drummond Kerr

The news of Drummond Kerr's death whilst on vacation in California a short time ago came as a sad blow to his many friends everywhere.

Drummond entered the Colour Industry after serving with distinction in the Great War; few people were aware that he had been decorated for bravery at what would now be considered as under school-leaving age, being awarded the Military Medal as a member of the Tank Corps. He joined the then well-known firm of W. Symonds and remained with them for the whole of his working life, retiring as Chief Executive some 20 years ago.

As many older members will recall, Drummond played an active part in OCCA affairs but perhaps he will be best remembered for his work with the Borough and East Ham Student Associations. Lecturing at both colleges he realised that, in the days when all studies connected with surface coatings were undertaken in the evenings, some form of outside, and less formal, social and technical contact was essential. The success of these twin bodies owed a good deal to him.

Drummond passed his last years with his wife in their much loved Essex cottage and it was on St George's Day in the parish church of Finchingfield that we gave thanks for his life, a life which was truly devoted to the service of his fellow men.

F. B. MORTIMER-FORD

D. Holmes

The sudden death of Mr David Holmes, 47, has been noted with regret. He was a founder Member of the Trent Valley Branch of the Midlands Section and had contributed greatly to the industry. He joined Joseph Mason & Co. Ltd in 1958, and in 1970 was appointed as Technical Service Manager, the position which he had held until his death.

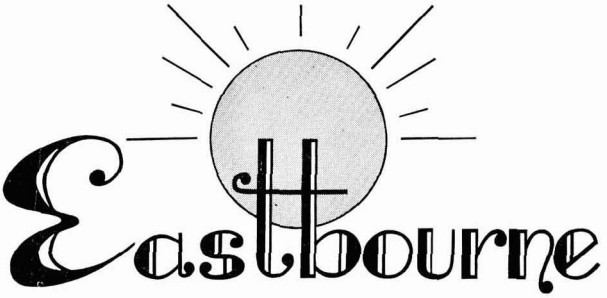
The loss of Mr Holmes will be felt deeply by his many friends all over the country.

Reunion Dinner for past and present members of Council

Following the successful innovation in 1973 of a Reunion Dinner for those members who have served on Council at any time, Council has decided to hold a similar event this year. The Dinner will take place on Wednesday, 12 October 1977 at the Piccadilly Hotel, London W.1. at 6.30 for 7.00 p.m. and informal dress will be worn.

The price of the ticket for the Dinner and wine will be £8.64 inclusive of VAT and a cash bar will be provided at the reception and after the Dinner. Past Presidents, Past Honorary Officers, Honorary Members and Founder Member have been invited as guests of the Association. All other past and present members of Council must send the necessary remittance with their completed application form. Any member with service on Council who has not received an application form and wishes to do so should write to the Director & Secretary at the Association's offices.

OCCA Conference Diary



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

The Association returned to Eastbourne this year to hold its Biennial Conference from 16-19 June at the Grand Hotel, which was the headquarters for the Conference, the other hotel used for accommodation being the Burlington Hotel.

Following requests from a number of Members, Council decided on this occasion to organise the Conference so as to incorporate a weekend as an experiment rather than to disperse on the Saturday morning as on previous occasions. The problems involved in travel on a Sunday meant that some delegates from overseas could not remain until the end of the Conference and many Members in the United Kingdom had to undertake journeys by rail on a day when services are restricted. It is likely that the Conference will revert to its more traditional weekday timing. Although the dates for the Conference had been announced in the Journal in January 1976, unfortunately a clash of dates subsequently arose with the Paintmakers Association Conference at Bournemouth in the same week and this may have affected the total attendance which was lower than in 1975.

Nevertheless, the occasion was truly international in character with delegates from the UK and ten overseas countries.

Fourteen papers were presented in four technical sessions with the theme "The conservation of energy, materials and other resources in the surface coatings industry" and the topics proved to be of great interest and a lively discussion period followed each presentation; in fact, such was the enthusiasm generated that Session Chairmen had to terminate the discussions in order to move to the next paper on schedule. The sessions took place in the mornings and afternoons of the Friday and Saturday and all were well attended.

The comprehensive Association arrangements made for the delegates and their families have always been a feature of OCCA Conferences and this year included coach tours to the surrounding area, golf, table tennis and a ladies' lecture on jewellery. These events once again proved to be popular and, with the highly successful lecture sessions, constituted one of the happiest and most successful Conferences the Association has organised.

Thursday 16 June

The Conference assembled at Eastbourne during the afternoon and the first function of the Conference was a reception by the President together with Honorary Officers and the Director and Secretary of the Association for overseas Members and overseas visitors held in the Princes Room, Grand Hotel at 6.30 pm. Delegates from Belgium, Canada, Denmark, Finland, France, Germany, Japan, Norway, Sweden and the United States had registered for the Conference and the Association was pleased to welcome them.

After dinner, a meeting of session Lecturers and Chairmen was held to discuss the way in which the technical part of the Conference would be conducted. In the evening a theatre party was also arranged for delegates.

Friday 17 June

At 9.30 am the President declared the Conference open and handed over to the Honorary Research and Development Officer, Mr C. N. Finlay, ATSC (who had arranged the papers for the Conference), who acted as Chairman of the first session.

Papers from the Conference, together with the ensuing discussions, will be published in the Journal later this year and no attempt at reportage will be made here. It must be noted, however, that the discussions were both lively and long, reflecting the interest aroused by the speakers. Compliments are due both to the contributors to the discussions and to the Chairmen who encouraged, controlled and, in many cases, closed the discussions in a prudent and tactful manner.

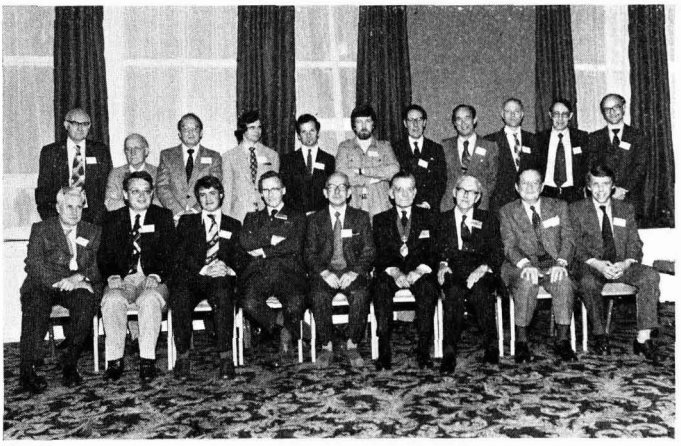
During the morning the ladies' talk, "All that glitters", was presented by Mr J. I. Woodhams of Wm. Bruford & Son Ltd, Jewellers of Eastbourne, which was very well attended and received.

After the first technical session the President and Mrs Rudram welcomed all those attending the Conference at an informal reception before lunch.

In the afternoon the ladies went on a coach tour to Southdown and Glynde Place via Upper Dukes Drive, Beachy Head, Girling Gap, East Dean, Friston, Exceat, Seaford High and Over and Alfriston.

Three papers were presented in the technical session that afternoon with Dr L. Valentine, FTSC, Director of Research and Development, Berger Jensen and Nicholson Ltd and a former Member of Council, in the Chair.

In the evening the Deputy Mayor of Eastbourne, Councillor A. G. S. Enser, and Mrs Enser welcomed delegates at a Civic Reception at the Grand Hotel which was followed by dancing until midnight.



A group photograph of the lecturers and chairman of the technical sessions. *Top row (L to R):* **D. J. T. Howe, Professor K. Hamann, Dr J. L. Mondt, Mr K. Winterbottom, Mr N. S. Moss, Mr M. A. Parrish, Mr A. G. Holt, Dr L. Valentine, Mr J. R. Massy, Professor W. Funke, Dr S. Haagenrud**

Bottom row (L to R): **Mr A. F. Sherwood, Dr G. R. Joppien, Mr J. G. Balfour, Mr A. McLean (President Designate), Mr C. N. Finlay (Hon. Research & Development Officer), Mr A. T. S. Rudram (President), Mr S. R. Finn (Hon. Editor), Mr M. A. Glaser, Dr A. O. Christie**

Saturday 18 June

Dr F. M. Smith, President of the Paint Research Association and a Vice-President of OCCA; chaired the technical session on Saturday morning when four papers were presented.

At 12.30 the President held a reception for Council Members, overseas Presidents, Session Chairmen and lecturers.

In the afternoon Mr A. G. Holt, FTSC, a former Vice-President of OCCA, chaired the technical session when the final three papers were presented. For the ladies there was a coach tour to Michelham Priory via Willingdon, Polegate, Nightingale Hill to Arlington Lane and Michelham Priory.

After the final paper of the afternoon session, the Association held its Annual General Meeting at 4.05 pm, a full report of which appears elsewhere in this issue.

The evening saw the final event of the Conference, the Association Dinner and Dance held at the Grand Hotel. Prior to the dinner the guests were received by the President Mr A. T. S. Rudram and Mrs

Mr Rudram during his speech to the delegates and guests at the Dinner

Rudram. After the dinner, following the Loyal Toast by the President, the toast to the Association was proposed by Mr Neil Estrada, President of the Federation of Societies for Surface Coatings, who drew attention to the close relationships which had long existed between the two Societies. The President replied on behalf of the Association and thanked Mr Estrada for his congratulatory remarks. He welcomed delegates, lecturers and Chairmen of sessions and thanked them for their work in running the Conference and also the Honorary Research and Development Officer Mr C. N. Finlay for organising the papers. He welcomed the Mayor, Councillor Mrs Kathleen Raven, and Mr Raven and thanked the Borough for the Civic Reception it had provided on the Friday evening. He extended a welcome to the ladies who added grace and charm to the occasion and then proposed a toast to the Mayor and the Association's other guests. In her reply the Mayor of Eastbourne extended the thanks of all the guests and ladies for the hospitality shown by the Association at the dinner and expressed her hopes that some of the

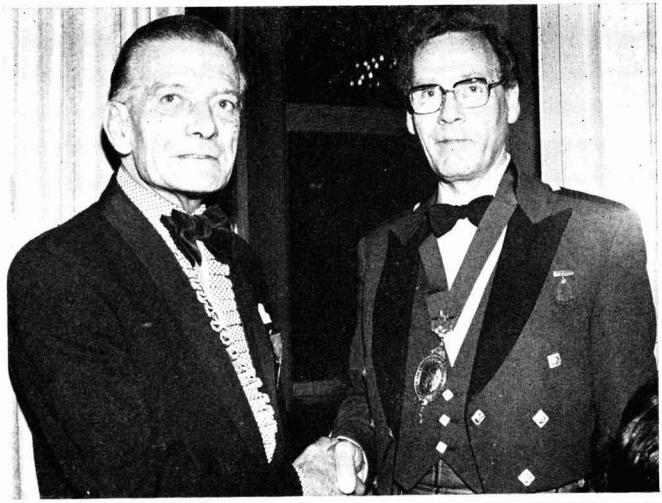
Representatives from the member societies of the international alliance present at the Conference. *From left to right:* **Mr A. McLean (President Designate, OCCA), Mrs McLean, Mr H. K. R. Nielsen (Past-President, SLF), Mrs Rudram, Mr A. T. S. Rudram (President, OCCA), Mrs Estrada, Mr N. Estrada (President, FSCT)**

delegates had enjoyed the Federation Cup tennis which had been taking place in Eastbourne during the week. The Mayor concluded her speech by inviting the Association to return to Eastbourne in the near future for another Conference.

Following the Mayor's speech the investiture as President of Mr A. McLean, who had been elected President of the Association at its Annual General Meeting that afternoon, took place. Mr A. T. S. Rudram, investing Mr McLean, used the traditional form of words:

> *Angus McLean, in accordance with the resolution passed at the Annual General Meeting this afternoon, it is now my duty to invest you with the insignia as President of this Association and I charge you to guard well the interests of our Association and at all times to uphold the dignity of your high office.*

Mr McLean then presented Mr Rudram with his Past President's medallion engraved with his years of office and paid tribute to the fine way he had carried out his duties during his time as President. In this, of course, he had been ably supported by Mrs Rudram, and Mr McLean thanked Mrs Rudram for her efforts, particularly in her visits to the various functions of the Sections of the Association, where she had charmed everybody. Mr McLean explained that in recognition of the considerable part she had played in helping the President during his term of office, a gift of her choice



Mr Rudram (left), wearing his Past-President's medallion, congratulates Mr McLean after installing him as President of the Association with the Presidential Insignia

Mrs Rudram making her speech at the Dinner

had earlier been presented to Mrs Rudram on behalf of the Association.

Mrs Rudram thanked Mr McLean and the Members of the Association for their kindness in making this presentation. She had very much enjoyed herself during the past two years, visiting the Sections of the Association and other organisations and meeting so many Members and their ladies and would be reminded of them by their gift to her. During this period she had been greatly helped by many Members of the Association; she wished to express her personal thanks to the Director and Secretary for his guidance and assistance.

Following the speeches the Top Table party left the dining room and the assembled company made their way to the ballroom for the dance. Later that evening Mrs McLean presented the prizes for the various tournaments and thanks were extended to Mr S. Duckworth, Mr D. M. Sanders, and Dr M. L. Ellinger for organising the golf, men's table tennis and ladies' table tennis respectively. The winner of the golf tournament was Mr S. T. Harris.

Mr N. Estrada (President, FSCT) proposing the toast to the Association

The President, Mr Rudram, the Mayor of Eastbourne, Councillor Mrs K. Raven, Mrs Rudram, and Mr Raven

The Mayor of Eastbourne, Councillor Mrs Kathleen Raven, welcoming the Association to Eastbourne during her speech at the Dinner

Mr D. J. Kerrison won the men's table tennis, with Mrs H. G. Clayton winning the ladies' table tennis.

Dancing continued in the ballroom until after 1 o'clock.

Sunday 19 June

Sunday saw the dispersal of delegates after breakfast. Once again, the verdict was that an enjoyable and successful Conference had been held.

D.M.S.

News of Members

Mr C. Williams, an Ordinary Member attached to the Manchester Section, has been appointed a marketing manager with Urachem International, moving from his post of marketing manager of the Surface Coatings Division of Synthetic Resins Ltd. Based at SRL headquarters in Liverpool, Mr Williams will manage resin sales in the Americas and some East European countries.

Mr G. L. Holbrow, an Ordinary Member of the London Section, has been awarded the Silver Jubilee Medal. Mr Holbrow has been at the Paint Research Association since 1936, and was appointed head of the Chemistry Division in 1971.

Papers to be presented on behalf of the Association

The Council is pleased to inform Members that papers will be presented on behalf of the Association at two forthcoming conferences organised by members of the international alliance.

In October this year at Houston, USA, the Chairman of the Ontario Section, Mr W. Fibiger, will present a paper entitled "Oil absorption of organic pigments" to the 55th Convention of the Federation of Societies for Coatings Technology, and next year, Dr G. D. Parfitt of the Newcastle Section will present a paper on "Pigment dispersion in principal and practice" at the FATIPEC Congress in Budapest, Hungary (June 1978).

Professional Grade

At a meeting of the Professional Grade Committee held on 7 July 1977, the following Members of the Association were admitted to the categories shown. The Section to which each Member is attached is shown in brackets. A full list of members admitted to the Professional Grade appeared in the December issue of the *Journal*, and some further additions were published in the February and April issues.

Fellows

Turner, John Harry Wallice (*Manchester*)
Giesen, Mathias Franz (*Overseas—Germany*)
Bailey, John Noel (*Newcastle*)
White, Robert Arthur (*Auckland*)
Faulkner, Raymond Noel (*London*)
Stoodley, Keith Herbert (*London*)
Raaschou Nielsen, Hans Kristian (*Overseas—Denmark*)
Kalewicz, Zdzislaw (*Overseas—France*)

Associates

Taylor, Richard Anthony John (*London*)
Young, Hugh (*West Riding*)
Windsor, Frederick Barry (*Manchester*)
Campbell, Douglas Shaw (*Transvaal*)
Tape, Brian William Charles (*Overseas—USA*)
Malik, Javed Haider (*Overseas—Pakistan*)

Transfers from Licentiate to Associate

Canterford, Barry Albert (*London*)
Moss, Noel Sydney (*London*)

The full details of the Optional Professional Grade were last printed on pp 157/8 of the April issue of the *Journal*, and the routes to membership are shown on page 334 of this issue.

Information Received

Protective coatings award

Information has been received that Professor H. P. Schreiber whose paper "Measurement and use of surface tension data in the film-forming polymers" appeared in the July issue of the *Journal* has been granted the first Protective Coatings Award. The Award aims to stimulate R & D by recognising outstanding contributions to, or practitioners of, the science, art and practice of the industry.

New production capacity

Sonneborn & Rieck have a new factory at Chesterfield in operation significantly to increase the company's capacity for the manufacture of specialised industrial finishes. The factory will also provide an important and more localised supply service for all of the company's products in the northern half of the United Kingdom.

Degussa expand

The Chemicals Division of Degussa, Frankfurt am Main, has supplemented its palette of multi-functional methacrylates that includes butanediol dimethacrylate (BDMA), triethylene glycol dimethacrylate (TEDMA) and trimethylol propane trimethacrylate (TRIM) by commencing the production of ethylene glycol dimethacrylate (EDMA). Among other things, this product is used as a cross-linking agent in rubber compounds and for the production of glass fibre-reinforced plastics and ion exchange resins. Simultaneously developed were a number of monomers and prepolymers for the production of UV and electron beam-curable lacquers. Further products are in the development stage.

Powder fillings systems

Albro Fillers and Engineering Co. Ltd, a subsidiary of Morgan Fairest Ltd, have purchased the patent rights to the Freeflow powder filling system. The new system, which will fill many difficult powders with extreme accuracy, will extend the Albro range of powder fillers which are already well established throughout the world.

Buss acquire Conball dryer

Buss-Hamilton Ltd have announced that their parent company, Buss AG, have acquired patent and manufacturing rights from Ecal Nateka AB of Sweden for the Conball convection dryer. The acquisition of the Conball dryer extends further the range of Buss equipment for the chemical and plastics manufacture and process industries.

New products

Anti-vandal paints

C-Cure Coatings Ltd has negotiated a marketing agreement to improve supply and distribution throughout England for its range of graffiti resistant anti-vandal and fungicidal hygenic coatings. The agreement is with Hill Son & Wallace Ltd, of Manchester, a long established manufacturer of decorative paints, lacquers and wood finishes.

Suitable for both interior and exterior use, C-Cure's AV systems have been used extensively throughout Scotland and have proved a successful defence against the ubiquitous graffiti artist. Six polyurethane and epoxy based systems cover the range from a clear lacquer for brickwork and masonry to a heavily textured treatment for maximum protection in areas of high vulnerability. Aerosol paint and ball point pen markings can be easily removed with the use of a special cleaning agent.

New slide-gate valves

A new range of heavy-duty slide-gate valves in four sizes and adaptable to six different modes of actuation has been introduced by Newman Industrial Controls Ltd. Designed for controlling the flow of dry powders or granules, the new F & R 77 series valves have principal applications in the outlets of hoppers, silos, mixers, screw conveyors, weighers etc. The main feature of the new design, which allows both economy of construction and ready adaptability of customers' requirements, is the use of a standard valve body and slide assembly for the 24 size/actuation options available.

Colour pill

BASF Farben + Fasern AG have available the Folor-Herbol-tint system colour pill, with which virtually any conceivable shade of dispersion can be obtained without mixing apparatus. It consists of a water soluble pigment concentrate in a water soluble plastic film. Both are designed so as not to affect or react with each other. The finely dispersed pigment concentrate can be packed and sealed in the plastic film in varying quantities. As soon as the colour pill is immersed in a dispersion colour it dissolves without trace within 10 to 15 minutes and the released pigment concentrate mixes easily with the dispersion colour. As the film pack dissolves completely the pigment concentrate is totally used. The effect of this is that small quantities of paint can be tinted at the point where they are to be used and larger quantities can be mixed in the workshop or store, always with uniform results and without any special cost outlay.

Literature, courses etc.

Textured coatings

Textured Coatings (UK) Ltd have available a new brochure outlining the advantages and support services available for its range of Tex-Gard textured coatings systems for exterior and interior application.

Printing ink resin index

A new publication listing the recently announced new range of resins formulated for printing ink manufacturers has been issued by Synthetic Resins Ltd, Liverpool. The index tabulates the physical and chemical properties of 29 resins in the categories of hard resins, alkyds and polyurethane elastomers.

Printing ink lecture

Mr A. R. H. Tawn, an Ordinary Member of the London Section, a Vice-President and a former Hon. Research and Development Officer, will be presenting the annual lecture on 14 November 1977 to the Technical Training Board of the Society of British printing ink manufacturers entitled "Putting colour in its place—the role of polymer science in ink technology". The lecture will be held at the Royal Institution, London W.1.

Money flows

The Chemical and Allied Products Industry Training Board have arranged a training course entitled "Money flows" which deal with cash, profits, and value added in a company in a simple form that shop floor people will be able to understand. The package is designed to improve communications between the management and workers by giving the shop floor an insight into basic company economics.

Section Programmes for the 1977-78 session

Main Association Events

1977

Wednesday 12 October Reunion Dinner for past and present members of Council. The Hotel Piccadily, London W1. 6.30 for 7.00 p.m. Informal dress.

1978

Tuesday 18—Friday 21 April OCCA—30 Technical Exhibition, to be held at Alexandra Palace, London N22.

60 Anniversary Celebrations.

Thursday 11 May Commemorative Lecture and Dinner, to be held at the Painters' Hall, Little Trinity Lane, London EC4. *Details to be announced.*

Friday 12 May Commemorative Dinner Dance, to be held at the Savoy Hotel, London WC2. *Details to be announced.*

June Annual General Meeting, to be held *in conjunction with* a London Section luncheon and lecture. *Details to be announced.*

Bristol

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

1977

Friday 30 September "D.I.Y. Adhesives" by J. Pritchard of Dunlop Semtex Ltd.

Friday 28 October *Ladies' Evening. Details to be announced.*

Friday 25 November "Film for packaging" by Dr C. R. Oswin of British Cellophane Ltd.

1978

Friday 27 February "Abatement of paint stoving effluent" by Mr N. A. R. Falla of the Paint Research Association.

Friday 24 February "Painting aircraft" by Mr A. R. Peppitt of British Aircraft Corporation Ltd.

Friday 31 March Annual Dinner Dance at the Mayfair Suite, New Bristol Centre.

Friday 14 April "Uses of solar energy" by Professor B. J. Brinkworth of University College, Cardiff.

Friday 28 April Annual General Meeting.

Hull

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

1977

Monday 3 October "Agitation—a state of the art review" by Dr M. F. Edwards, Senior Lecturer at Bradford University. Joint meeting arranged by the Institution of Chemical Engineers. *Venue to be announced but taking place on the South Bank.*

Friday 7 October Annual Dinner Dance to be held at the Willerby Manor Hotel, Willerby, nr. Hull.

Monday 7 November "De-foamers" by Mr R. W. Harrison of Diamond Shamrock Chemicals (UK) Ltd.

Monday 5 December "Subjective comparisons—what does influence you?" by Dr W. E. Craker, Laporte Industries Ltd.

1978

Monday 9 January "Prediction of performance: fact or fiction" by Mr D. M. Bishop, the Railway Technical Centre, Derby.

Monday 6 February "Exterior wood finishes" by Mr P. Whiteley of the Building Research Establishment, Garston.

Monday 6 March *Ladies' Evening* Visit to the Ferens Art Gallery, Hull, conducted by Mrs L. Dunn, Senior Keeper at the gallery.

Monday 3 April Annual General Meeting.

Irish

Unless otherwise stated all meetings will take place at the Clarence Hotel, Dublin 2, commencing at 8.00 p.m.

1977

Friday 16 September "New developments in Azo pigments for paint and printing inks" by Mr A. Abel, Hoechst UK Ltd.

Friday 21 October "Printing ink lecture"—*details to be announced.*

Friday 4 November Annual Dinner Dance, Clarence Hotel at 8.30 p.m.

Friday 9 December "Up to date position of EEC legislation on dangerous substances/preparations" by Mr. F. Shaughnessy, BSc, Department of Labour.

1978

Friday 20 January *Ladies' Evening* "Interior design" by Mrs A. Dalton, RIDipl, AIDP, of Andrian Interiors.

Friday 17 February "The influence of emulsions on paint properties" by Mr D. Wallace, Vinyl Products Ltd.

Friday 31 March "Organic versus inorganic coatings" by Mr J. R. Lyon, Goodlass Wall Ltd.

Friday 21 April Annual General Meeting.

June Golf Outing—*details to be announced.*

London

1977

Thursday 22 September *Chairman's Evening.* "Customers' point of view" by D. Bayliss, at the "Princess Alice", Romford Road, E.7, commencing at 7.00 p.m.

Thursday 20 October "Corrosion and conservation" by Mr H. Barker, Keeper of Conservation and Technical Services, British Museum, at Rubens Hotel, Buckingham Palace Road, SW1, commencing at 7.00 p.m.

Friday 28 October *Ladies Night* to be held at the Piccadilly Hotel.

Wednesday 16 November "The influence of solar radiation on paint films", a day meeting in association with Thames Polytechnic, Woolwich, commencing at 10.00 a.m.

1978

Thursday 19 January "Finishing of exterior timber" by Dr E. R. Miller, Princes Risborough Laboratory, at the "Princess Alice", Romford Road, E.7, commencing at 7.00 p.m.

Thursday 16 February "*Overseas luncheon lecture*" in association with Thames Polytechnic, Woolwich. "Evaluation of the corrosion performance of organic coatings" by Professor Dr Werner Funke, Furschungsinstitut fur Pigments und Lacke e.v. Stuttgart, West Germany, commencing at 12 noon—Lunch at the Polytechnic followed by the lecture.

Wednesday 15 March "Metal decorating in the paint and printing industries", a day meeting at the University of Surrey, Guildford, commencing at 10.00 a.m.

Thursday 13 April Annual General Meeting, at Rubens Hotel, Buckingham Palace Road, S.W.1.

Thursday 11 May Afternoon visit to the Paint Research Association, Waldegrave Road, Teddington, Middlesex TW11 9LD, commencing at 2.30 p.m.

Manchester

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

1977

Wednesday 7 September Golf Tournament at Stockport Golf Club.

Monday 10 October "Silicone protective coatings" by J. G. Price, Dow Corning Ltd.

Friday 21 October Annual Dinner Dance to be held at Piccadilly Hotel.

Friday 11 November "Theory versus practice is vacuum pressure and centrifugal filtration" by Dr A. Rushton, UMIST, to be held at the Manchester Literary and Philosophical Society, Manchester, commencing at 6.30 p.m.

Thursday 17 November "Epoxidised resins for anticorrosive coatings" by Mr A. McKay, Ciba Geigy Plastics and Additives Co. to be held at the Manchester Literary and Philosophical Society, Manchester, commencing at 4.30 p.m. *Student Lecture.*

Monday 5 December Joint Institute of Printing/OCCA Manchester Section Meeting, *details to be announced.*

1978

Friday 13 January "Modern paint manufacturing techniques" by Mr B. Lucas, Joseph Mason Ltd., to be held at the Manchester Literary and Philosophical Society, Manchester, commencing at 6.30 p.m.

Thursday 26 January "Urethane media for heavy duty coatings" by Mr C. Barker, ICI Ltd, Organics Division, to be held at the Manchester Literary and Philosophical Society, Manchester, commencing at 4.30 p.m. *Student Lecture.*

Friday 10 February "Purchasing strategy in the chemical industry with reference to paint" by Mr D. F. Brocklehurst, Berger Group Supplies, to be held at the Manchester Literary and Philosophical Society, Manchester, commencing at 6.30 p.m.

Thursday 23 February *Student film evening* to be held at the Manchester Literary and Philosophical Society, Manchester, commencing at 4.30 p.m.

Wednesday 8 March *Student Works Visit* to Donald Macpherson Ltd.

Monday 13 March "Toxiocological problems in the pigment using industry" by Mr M. T. Hobbs, ICI Ltd, Organics Division.

Friday 14 April Annual General Meeting.

Midlands

Unless otherwise stated all meetings will take place in the Calthorpe Suite, County Ground Edgbaston, Birmingham, commencing at 6.30 p.m.

1977

Friday 16 September Annual Dinner Dance to be held at the Botanical Gardens, Birmingham. *Ladies' Night.*

Thursday 22 September 'Modern methods of ink drying' by Mr D. Bissett of Coates Brothers—Joint Meeting with Printing Institute.

Thursday 27 October 'Estey Dynamics tunnel coating unit, a new development in powder coating plant' by Electropaint Ltd.

Friday 25 November "Training technologists" by Mr D. Clements. *Content to be discussed with lecturer. Student Lecture.*

1978

Friday 20 January 'Export/import of technology' by Mr A. G. North of Cray Valley Products to be held at the Birmingham Chamber of Industry and Commerce.

Thursday 23 February "Surface defects in surface coatings and their remedy" by Mr Horst Vltavsky of Byk Mallinkroft (W. Germany).

Wednesday 8 March One day Symposium entitled 'Modern methods of paint manufacture'. *Venue to be confirmed.*

Friday 17 March Newton Friend Lecture 'Jewellery through the ages' by Mr C. Reichsollner to be held at Birmingham Chamber of Industry and Commerce, commencing at 7.00 p.m.

Friday 14 April Annual General Meeting. *Venue and time to be announced.*

Trent Valley Branch

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

1977

Thursday 8 September Possible speaker from Bayer Ltd. Alternative speaker from British Rail.

Thursday 13 October "Acrylamide pigments" by R. M. W. W. Wilson of Burrell Colours.

Friday 8 October Halloween Dance at Cross Keys Inn, Turnditch.

Thursday 10 November "Production control" by M. J. Murray of Crown Decorative Products.

1978

Thursday 9 February Speaker from Cray Valley Products.

Thursday 9 March Joint Meeting with Institute of Corrosion Science and Technology. Suggested title "Why Paint It?"

Friday 7 April Annual General Meeting.

Newcastle

Unless otherwise stated all meetings will take place at St Mary's College, University of Durham, Elvet Hill Road, Durham.

1977

Thursday 6 October "Corrosion control and sensible methods of test—at last" by Mr F. D. Timmins, British Rail, Derby.

Thursday 3 November "External pipe line coatings" by Mr D. Grey, Gas Board.

Thursday 1 December "Some aspects of the marketing of paint" by Mr G. Campbell, Crown Decorative Products.

1978

Thursday 5 January "The Central Electricity Generating Board requirements for surface coatings" by Mr D. A. Bayless, Scientific Services Dept, CEGB.

Thursday 2 February "Water, water everywhere . . . " by Mr G. W. Rothwell, Building Research Establishment.

Friday 17 February *Ladies' Night.* Five Bridges Hotel, Gateshead.

Thursday 2 March "The vinyl approach to marine and maintenance coatings" by Mr J. Benson, Union Carbide.

Thursday 6 April Annual General Meeting.

Ontario

Unless otherwise stated all meetings will be held at the Skyline Hotel, Toronto, at 6.00 p.m.

1977

Wednesday 21 September "ED pigments-European and US experiences" by Mr K. Bruce of Worsdall Chemicals Ltd.

Wednesday 19 October "Novel ink resins" by L. P. Horn of Lawter Chemicals.

Wednesday 16 November "New approaches to the development of properties in paint films" by Prof Schreiber of University-Polytechnic of Montreal.

Wednesday 14 December "Wallpaper design". *Ladies' Evening.*

1978

Wednesday 18 January "Anticorrosive functional pigments" by Dr P. Marr of Reed Ltd.

End of January Annual Dinner Dance, The Old Mill, Toronto.

Wednesday 15 February Plastics—a plant tour of CIL, Brampton.

Wednesday 15 March "TBA" by P. Wyskowski of McLean Hunter.

Wednesday 19 April Annual General Meeting.

Monday 8 May "New technologies in printing ink resin systems" by J. Roberts of Hercules. Joint Meeting with Toscot, Towne and Country Inn, Toronto.

Scottish

Unless otherwise stated, all meetings will be held at the Bellahouston Hotel, Glasgow, commencing at 6.00 p.m.

1977

Thursday 13 October "The use of microvoids as pigments" by Dr N. Reeves, BTP Tioxide Ltd.

Tuesday 8 November Joint Meeting with Society of Dyers and Colourists. "Dispersion—The key factor in pigment theory" by Dr W. Carr, to be held in North British Hotel, Glasgow, commencing at 7.30 p.m.

Thursday 8 December "Chemical waste disposal" by J. Smith, Re. Chem. International Ltd.

1978

Friday 13 January Ladies' Annual Evening—Dinner Dance in Albany Hotel, Glasgow.

Thursday 19 January "Sophisticated coatings: do they create more problems than they solve?" by Dr D. Atherton, Sigma Coatings Ltd.

Thursday 9 February "Microscopic studies of gloss of surface coatings" by Dr S. G. Lawrence, Ciba Geigy (UK) Ltd.

Thursday 9 March *Title, subject and lecturer still to be advised* by National Corrosion Service.

Wednesday 12 April AGM followed by demonstration of hypnotism by A. M. Hearne, MBE, at 7.30 p.m.

Eastern Branch

Unless otherwise stated all meetings will be held at the Afton Hotel, 6 Grosvenor Crescent, Edinburgh 12, at 7.30 p.m.

1977

Friday 21 October Annual skittles match

vs Scottish Section for the Newton Cup, to be held in the Murrayfield Indoor Sports Club, Roseburn Street, Edinburgh, commencing at 7.00 p.m.

Wednesday 23 November "Pigment dispersion techniques—chipping" by Messrs P. J. Holland and D. Bradshaw of Foscolour Ltd.

Wednesday 14 December "Hot stamping foils and gold leaf" by Mr B. J. Sitch of George M. Whiley Ltd.

1978

Wednesday 18 January "Printing inks for paper—present and future developments" by Mr G. H. Hutchinson, Croda Inks Ltd. Joint meeting with the BPBMF Scottish Section, Technical Division, to be held at the King Malcolm Hotel, Dunfermline, at 7.15 p.m.

Friday 3 February Burns Supper to be held at the Commodore Hotel, Marine Drive, Edinburgh.

Wednesday 22 March Annual General Meeting followed by a Ladies' Evening which by the kind permission of John Haig & Co. Ltd will involve "whisky tasting".

Sunday 4 or 11 June Car rally and barbecue. *Details to be announced.*

Thames Valley

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

1977

Thursday 6 October "Offshore painting" by a speaker from B.I.E. Anti-Corrosion Ltd.

Thursday 10 November "Infologistics for individuals" (How to cope with the information explosion) by Dr D. Moody of OCCAM.

Thursday 8 December "Steel blasting—recent developments" by Mr T. W. Kelsall of KUE Engineering Ltd.

1978

Thursday 26 January "Chemical colouring of metals" by Mr G. Pollock of Osro Ltd.

Friday 10 February Buffet Dance at Great Fosters, Egham.

Thursday 23 February "Cathodic protection" by Mr J. H. Morgan of Morgan, Berkeley & Co. Ltd.

Thursday 16 March "Rheology of pigmented systems. A new low-shear instrument" by Dr M. L. Colclough of ICI Paints Ltd.

Thursday 20 April Annual General Meeting and talk on "Beekeeping" by Mr H. Aplin.

West Riding

Unless otherwise stated, all meetings will be held at The Mansion Hotel, Roundhay Park, Leeds 8, commencing at 7.30 p.m. and *Not* at the Griffin Hotel as in previous years. Would members also please note that meetings will take place on the *First* Tuesday in every month, instead of the second Tuesday as formerly.

1977

Wednesday 14 September West Riding Chairman's Golf Trophy tournament, Knaresborough Golf Course.

Tuesday 4 October "Disposal of waste solvents" by Mr A. Molyneux of Chemstar Ltd.

Tuesday 1 November "Wood preservatives" by Dr Gavin Hall of TRADA.

Friday 25 November Annual Dinner Dance at the Crown Hotel, Harrogate.

Tuesday 6 December "Printing ink systems for textile colouration by sublimation and diffusion transfer methods" by Mr F. D. Hough of Coates Bros. Inks Ltd.

1978

Tuesday 3 January "Flexible liquid epoxy resin systems" by Mr A. G. McKay and Mr P. T. Brown of Ciba-Geigy, Plastics Division.

Tuesday 7 February "Fundamentals of modern emulsion paint formulation" by Mr J. Clark of BTP Tioxide Ltd.

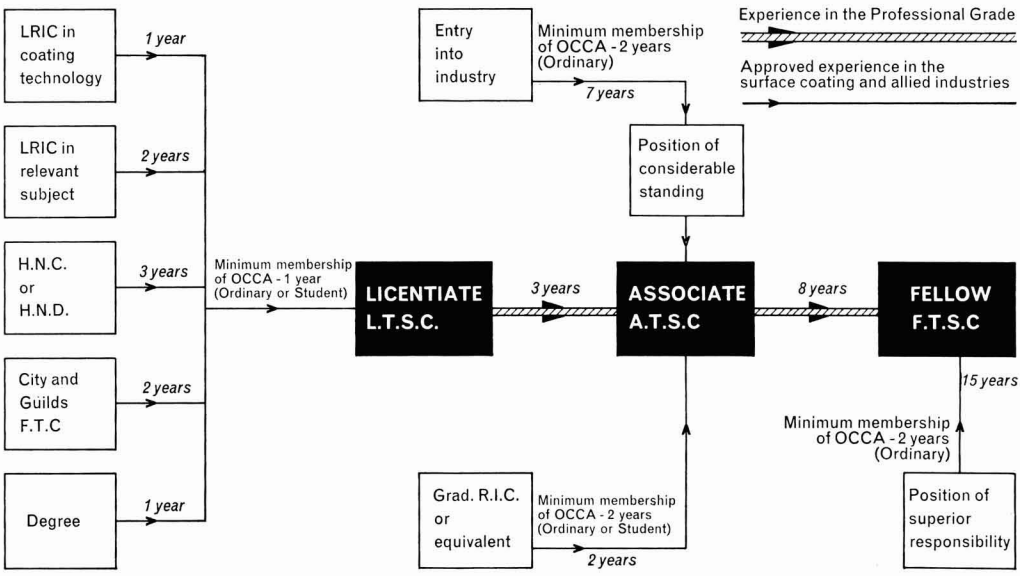
Tuesday 7 March "Calcium ferrite and zinc ferrite—two new active anti-corrosion pigments" by Dr P. Kresse of Bayer, West Germany.

Tuesday 4 April Annual General Meeting.

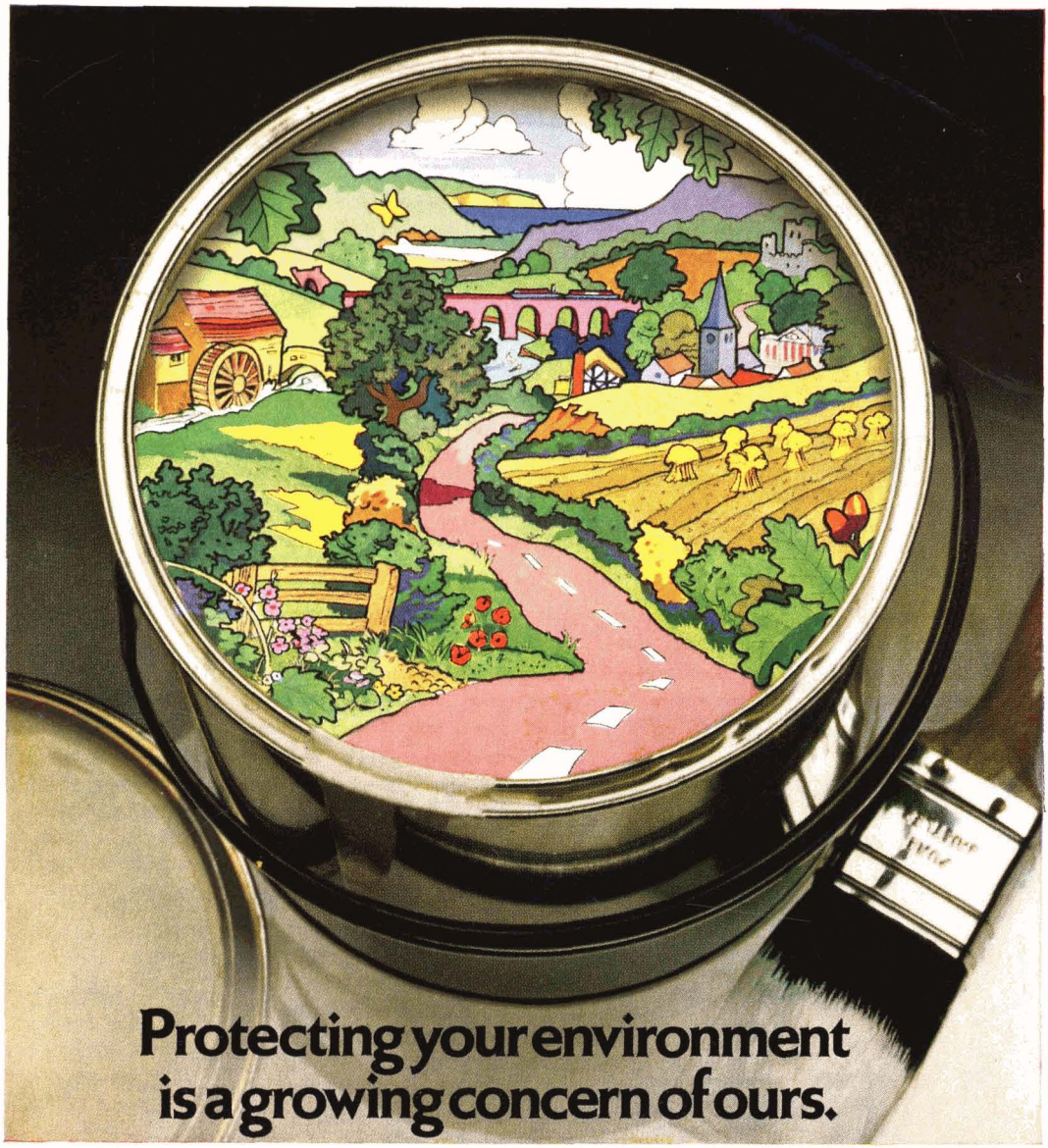
Optional Professional Grade for Ordinary Members

Routes to the Professional Grades

The innovation of the Professional Grade has proved to be most successful. Recent admissions are shown on page 331 of this issue. For the convenience of potential applicants, a chart indicating different routes to the various grades is shown below.



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.**



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The range includes:

Proxel XL (latest liquid formulation, free from amines, completely non-yellowing in all systems);

Proxel CRL (liquid, based on ethylene-diamine solvent);

Proxel HL (liquid, based on mixed amine solvents) and

Proxel AB (original fluid dispersion).

Get Proxel protection now—for further information contact your local ICI Sales Office or

ICI Organics Division

Hexagon House, Blackley, Manchester M9 3DA

OD 121

1975 Increased DPP capacity, Stanlow, UK.

1976
Opening of Polymers Research Centre, Amsterdam.
New VeoVa plant, Moerdijk, Netherlands.
New DPP plant, Pernis, Netherlands.
New Versatic acid capacity, Pernis, Netherlands.

1977
Increased Epikote capacity, Stanlow, UK.
Increased Epikote capacity, Pernis, Netherlands.
Increased Epikote capacity, Clyde, Australia.

WHY THE LEADER IN EPOXY RESINS IS EXPANDING AGAIN

This year, Shell Chemicals will be making even more Epikote epoxy resins, because the success of our resins for paint has increased demand from all over the world.

Epikote resins are helping to produce tough primers, marine paints and protective coatings to stand up to every environment.

We don't stop at epoxy resins. VeoVa is forming the basis of resin systems for high quality emulsion paints. And Cardura is being used to make high-quality industrial finishes.

All Shell resins are backed by the resources of the research and technical support groups based at Shell Polymers Centre, Amsterdam, and by the world's largest manufacturing capacity for epoxy resins.

And in 1977, we'll be making even more. Your Shell company will be happy to tell you more of the reasons why.

Better resins make better paints

Shell Chemicals

CLASSIFIED ADVERTISEMENTS

Classified Advertisements are charged at the rate of £3.00 per cm. Advertisements for Situations Wanted are charged at 80p per line. A box number is charged at 50p. They should be sent to D. M. Sanders, Assistant Editor, Oil & Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF. JOCCA is published EVERY month and Classified Advertisements can be accepted up to at least the 12th, and in exceptional circumstances the 20th of the month preceding publication. Advertisers who wish to arrange for an extension of the copy deadline should contact the Assistant Editor, D. M. Sanders, at the address given above (telephone 01-908 1086, telex 922670 OCCA Wembley).

APPOINTMENTS VACANT

POWDER COATINGS SPECIALIST

Midlands c. £5,000 + car

Our clients wish to make the new appointment of a Technical Specialist/Product Manager within the Industrial Division of a well known high quality paint company.

The successful candidate, male or female, will have good technical qualifications and practical knowledge of powder technology plus obvious management potential.

There will be immediate involvement in production and quality problems and an interesting, constructive relationship with suppliers and with customers, through a well developed salesforce.

The Division's continued growth will provide personal opportunities leading to a Senior Management role within a short time. Salary is negotiable but not less than £5,000 p.a. plus car, and all the fringe benefits associated with a major company including pension and life assurance schemes.

Please telephone for application form and job specification, or write briefly and in confidence to:—

James Allen

PERSONNEL SELECTION

46 Drury Lane, Solihull, West Midlands B91 3BJ.
Tel: 021-705 7399 or 704 2851

TECHNICAL SERVICE MANAGER

Joseph Mason & Co. Ltd, an expanding Company in the surface coating industry, have a vacancy for a Technical Service Manager.

Age: 30–50

Qualifications: HNC minimum (or equivalent). Sound knowledge of Paint Technology essential. Experience of modern paint application methods. Must be able to communicate with customers on technical and practical levels.

Job specification: To manage a team of trade qualified Technical Service Representatives in the commercial vehicle, decorative, and industrial fields. To issue reports to, and liaise with, sales management and customers on specifications, demonstrating and problem solving.

The above senior staff position which is directly responsible to the Managing Director, carries an attractive salary and fringe benefits normally associated with a forward looking and expanding Company.

Reply in strict confidence to Managing Director, Joseph Mason & Co. Ltd, Nottingham Road, Derby DE2 6AR.

LIQUID INK

Johnson & Bloy of Crawley in Sussex currently produce hundreds of tonnes of Liquid Ink. We have expanding business for paper, board, films and foil in both flexo and gravure print houses.

We wish to interview any technical people whether senior or junior who may wish to consider us as employers. We have a young technically orientated management and the opportunity to expand your involvement into other areas of our company will be given.

We are approximately 30 minutes by train both from London and the south coast in a new town area.

Our expansion is progressing at a very rapid rate and we will endeavour to offer suitable applicants a happier and more successful future than they feel they have at present.

If you are interested please telephone or write in confidence to:

Mr. V. A. Lewis
General Manager (Liquid Inks)
JOHNSON & BLOY LTD.
57, Gatwick Road, Crawley, Sussex
Telephone Crawley (0293) 23152

TECHNICAL MANAGER

for polymer laboratory required by important company in **Venezuela,** a licensee of The Sherwin Williams Co.

Applicants should have good academic qualification in chemistry, with 10–15 years industrial experience in development of resins for use in paints.

Salary for person of suitably wide experience, from $25,000. Preliminary interviews in London.

Box No. 446

MISCELLANEOUS

All types of handicapped children
are helped by the
INVALID CHILDREN'S AID ASSOCIATION

ICAA

Funds are urgently needed for its special schools, professional socialwork services, pre school play-groups and research and information services.

Donations, legacies to:

ICAA, 126 Buckingham Palace Road, London SW1W 9SB. 01-730 9891

CLASSIFIED ADVERTISEMENTS

APPOINTMENTS VACANT

BRITISH EXPORTER OF THE YEAR AWARD 1976-77 (Smaller Manufacturers-Runner-up)

We are the parent of a young International Group of Companies, based in the South West of Scotland, manufacturing a successful range of paints and specialist surface coatings for application to masonry or structural steelwork.

WE OFFER: membership of a young team of executives, each enthusiastically co-operative and crisply efficient in his own sphere.

Modern laboratory and works premises and equipment.

Attractive salary, bonuses, company car, pension and life assurance. Four weeks' holiday per annum.

JOB SATISFACTION AND FREEDOM TO BE EFFECTIVE

WE NEED: **a SENIOR PAINT CHEMIST**

CHIEF CHEMIST/TECHNICAL MANAGER DESIGNATE

having appropriate academic qualifications and the wide practical experience of all aspects of paint formulation and manufacture to enable the successful candidate to rapidly assimilate the needs of the group and take full control of our technical operations.

A PERSON WHO CAN GROW WITH US AND THE JOB

THE JOB: offers much scope for originality, imagination and progressive advancement. May ideally suit ambitious chemist whose promotion is presently blocked.

Write in confidence, stating qualifications and experience to Managing Director.

STEWART WALES, SOMERVILLE LTD.

GLENBURN RD., COLLEGE MILTON, EAST KILBRIDE, GLASGOW G74 B5A

Paint Technologist
South Africa

The Organic Coatings Division of the South African Bureau of Standards, Pretoria, has a vacancy for an experienced paint chemist.

Applicants should have a university or equivalent qualification plus a substantial number of years experience in the paint field. Professional Grading in O.C.C.A. will be a strong recommendation. The post offered covers a varied and interesting field including drawing up specifications for all types of coatings, investigating field complaints of coating failure, and developing test methods.

Salary according to experience in the range R8514-R12870 per annum. Pension, medical aid, group life insurance and generous leave facilities available.

Written applications, giving full particulars, should reach the Scientific Counsellor, S.A. Embassy, Chichester House, 278 High Holborn, London WCIV 7HE, within 4 weeks.

Donald Macpherson & Company Limited is the largest independent manufacturer of paint and surface coatings in the U.K. We have opportunities for two experienced

PAINT TECHNOLOGISTS

to work in the Industrial Development Laboratories at the Bury Site. The unit is responsible for the development of new products and processes for all sectors of industry. The scope of the technology involved is very broad and ranges from radiation curable products to conventional coatings.

Applications are invited from candidates (men and women) educated to B.Sc., HNC or equivalent, with experience of the formulation of industrial coatings and a sound knowledge of polymer chemistry.

Conditions of employment are those associated with a progressive company. Relocation assistance will be paid, where appropriate.

Please apply in writing, giving full career details, to: The Personnel Manager, Donald Macpherson & Co. Ltd., Radcliffe Road, Bury, Lancashire.

UV polymerisation

Newcastle Section Symposium 1975

The bound copies of the twelve papers presented covering many aspects of this rapidly expanding field are available from the Association offices at the address on the contents page. **Price £5.00**

CLASSIFIED ADVERTISEMENTS

APPOINTMENTS VACANT

James Ferguson
A PERSTORP COMPANY

TECHNICAL SALES REPRESENTATIVE
POLYMER EMULSIONS

This is a new appointment as part of our expansion programme.

The successful candidate will be responsible for the introduction, marketing, and sales of polymer emulsions (PVAs, Acrylics, and Styrene-acrylics) in the U.K.

A background in technical sales in the chemical and allied industries is essential, and a basic knowledge in chemistry would be an advantage.

Salary negotiable according to experience. Company car provided.

Initial location is flexible, and can be from a home base.

Write or ring for application form to:

Emulsion Dept, James Ferguson & Sons Ltd., Prince Georges Road, London, S.W.19 2PS. Tel: 01-648 2283.

FOR SALE

Flame-proofed Lansing Bagnall reach-type forklift truck

Now being thoroughly overhauled. Supplied with a load test certificate and guaranteed.

Full details on request.

Speed Electrics, The Wells Road, Nottingham. Tel: 0602-609782

SITUATIONS WANTED

Marine Paint Chemist, 29, in-depth experience of technical, commercial, marketing aspects of marine/industrial paint on world-wide basis, requires management position with prospects for rapid advancement.

Box No. 445

AT ANY TIME
DAY OR NIGHT

TELEX
YOUR CLASSIFIED

FOR

JOCCA

Telex 922670 (OCCA Wembley)

See page x for details of rates for Classified Advertisements.

INDEX TO ADVERTISERS

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OIL & COLOUR CHEMISTS' ASSOCIATION

TECHNICAL EXHIBITION

18-21 APRIL 1978

The motif, designed by Robert Hamblin, uses the symbol of a moving indicator on a calendar to emphasise the importance of the continuous dialogue year by year between suppliers and manufacturers. The inward-pointing letters recall the international aspect of this unique annual focal point for the surface coatings industries, which in 1977 attracted visitors from 50 countries.

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

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

We are interested in exhibiting at OCCA-30 (18-21 April 1978, Alexandra Palace, London). Please send us a copy of the Invitation to Exhibit.

BLOCK LETTERS PLEASE