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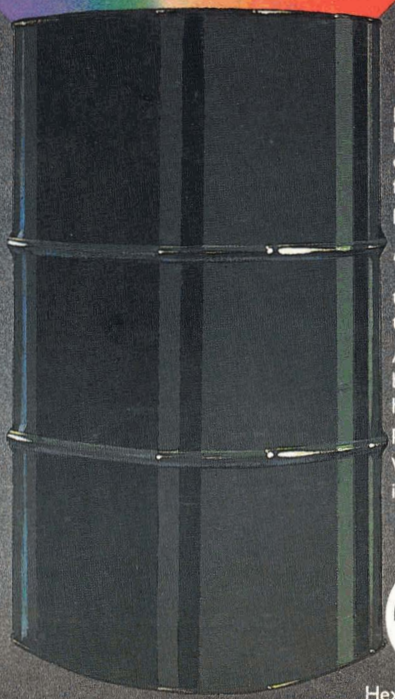

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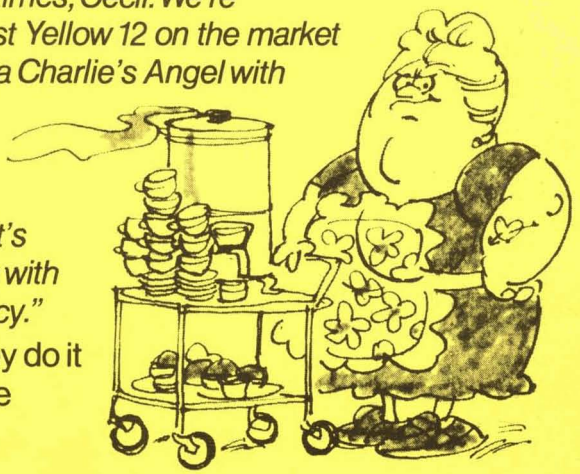

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Transactions and Communications

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Transactions and Communications

A surface coating based on dehydrated castor oil. Part 1: Physical and mechanical properties

By B. M. Badran, I. M. El-Anwar, M. S. Ibrahim and N. A. Ghanem

National Research Centre, Dokki, Cairo, Egypt

Summary

Castor oil was dehydrated and the resulting dehydrated castor oil (DCO) was styrenated and then epoxidised *in-situ* under established conditions. Epoxidised styrenated DCO was mixed with melamine resin (30 per cent by weight). A small amount of $SnCl_4.5H_2O$ was added as a catalyst. Films were made on glass and tin plate and stoved at 130-180°C for 1-2 hours. Films of good appearance were obtained. An outstanding property was that the films were resistant to alkalies, a property lacking in oil containing resins such as the conventional oil-modified alkyd resins.

Key words

Types and classes of coatings and allied products

electrical insulting coating

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

adhesion
elasticity
acid resistance
alkali resistance
water resistance
impact resistance

Raw materials for coatings

binders (resins, etc.)

epoxy resin
melamine resin

oils

epoxidised oil
dehydrated castor oil
styrenated oil

Un revêtement de surface à base d'huile de ricin deshydratée. 1ére. Partie caractéristiques physiques et mécaniques

Résumé

L'huile de ricin fut déshydratée et l'huile de ricin déshydratée qui en résultait fut styrénée et puis époxydisée *in situ*, sous les conditions bien établies. Le produit fut mélangé avec 30% par poids de résine mélamine. Une faible proportion de $SnCl_4.5H_2O$ fut ajoutée en tant que catalysateur. Les films ayant un bon aspect furent obtenus lorsque le mélange fut appliqué sur verre ou sur fer blanc et séché au four à 130-180°C pour 1-2 heures. Une caractéristique exceptionnelle de ces films était leur résistance aux alcalis, cette caractéristique est absente dans le cas des résines contenant d'huile, telles que les résines alkydes modifiées à l'huile.

Ein auf Ricinenöl gegrundetes Beschichtungsmittel. Erster Teil physische und mechanische Eigenschaften

Zusammenfassung

Ricinusöl wurde dehydriert, das daraus entstehendes Ricinenöl wurde unter aufgestellten Bedingungen, in situ, styrolisiert und dann epoxydiert. Das epoxydierte styrolisierte Ricinusöl wurde mit 30 Gewichtsprozent von Melaminharz vermischt. Eine geringe Proportion von $SnCl_4.5H_2O$ wurde als Katalysator zugesetzen. Filme auf Glas und auf Weissblech wurden für 1 bis 2 Stunden bei Temperatur von 130 bis 180°C eingebrannt. Filme mit gutem Aussehen wurden erhalten. Eine hervorsteckende Eigenschaft war die Akalibeständigkeit dieser Filme, eine Eigenschaft welche die Ölerhaltenden Harze wie die konventionellen Ölalkydharze fehlen.

Introduction

Refs. 1-10

Formerly, the main applications of epoxidised esters were as plasticisers and stabilisers for chlorine containing polymers[1]. Now their use has been extended into the field of surface coatings by modifying them with various reagents. The work in this field was concentrated on the preparation of epoxy alkyd resins from: epoxidised soya bean oil and phthalic or maleic anhydride[2], epoxidised linseed oil and phthalic anhydride[3], epoxidised soya bean oil containing 0.8 OH radicals[4], and a mixture of epoxidised linseed oil and soya bean oil with pentaerythritol[5]. Also, water soluble alkyd resins were prepared from epoxidised linseed oil and fumaric acid followed by the neutralisation of the product with ammonia[6].

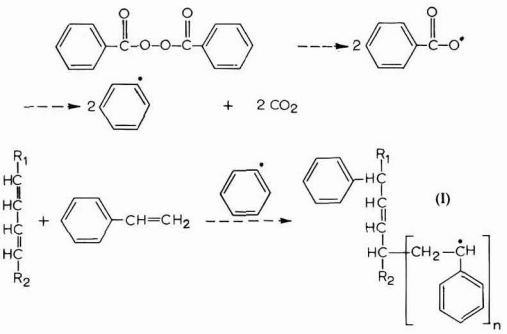
Surface coatings other than epoxy alkyd resins were also prepared, epoxidised linseed oil was mixed with styrene-maleic anhydride copolymer and methyl-oleated

benzoguanine, with toluene sulphonic acid as a catalyst[7]. Corrosion inhibiting coatings were made from a mixture of casein epoxidised linseed oil with 5.0 per cent oxirane content and ammonium dichromate[8] in the ratio 1 : 0.5 : 0.2. Another modification was made by treating epoxidised linseed oil, 2.4 to 5.4 per cent oxirane content, with acrylic resins (Mol. Wt. 3000-6000) using $SnCl_4.5H_2O$ as a catalyst[9]. A more recent modification for the preparation of insulating surface coatings was made by mixing epoxidised maleinised DCO, 3.65 per cent oxirane content, with melamine resin and $SnCl_4.5H_2O$ as a catalyst[10].

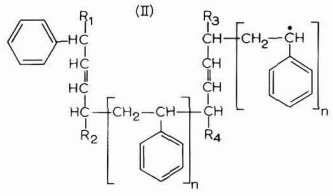
Mechanism

Refs, 11, 12

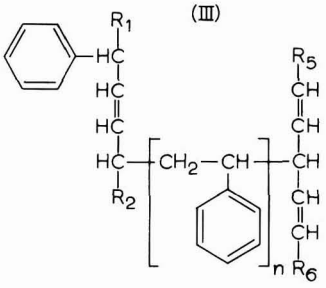
This work is based on the fact that, the conjugation in the unsaturated part of the DCO is about 30 per cent[11]. Thus, DCO could be styrenated using benzoyl peroxide as initiator[12]:



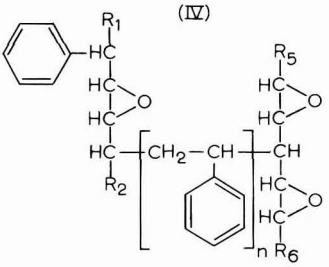
The copolymerisation of styrene and DCO takes place at the conjugated part of the latter in a 1,4– or 1,2– addition reaction; the 1,4– addition is predominant[12]. During styrenation, the styrene chain may link with another oil chain as follows:



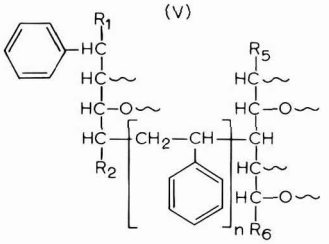
and/or:



The adduct's residual double bonds could easily be epoxidised to give products with the following structure:



The epoxidised styrenated DCO, although complex and highly branched, would be expected to dissolve in aromatic and aliphatic solvents; and, in fact, it was completely compatible with a 60 per cent solution of a melamine resin precondensate in xylene and butanol, giving a free flowing fluid of suitable viscosity. $SnCl_4.5H_2O$ was added as a catalyst. A completely polymerised epoxidised styrenated DCO molecule would have the following structure:



Experimental

Materials

Refs, 13-18

1. Dehydrated castor oil: Egyptian castor oil was dehydrated at 270°C in an inert atmosphere using sodium bisulphate as catalyst. It had the following characteristics:

   Acid value 8.5
   Iodine value (Woburn) 142.0
   Colour (Gardner) 13-14
   Viscosity (Gardner) J (2.5 stokes)

2. Melamine resin: (Reichhold Chemie AG, Hamburg). Trade name Super-Beckamine 851, 60 per cent solution in xylene and butanol.
3. Dowex 50W-8X: A sulphonated poly(styrene-divinylbenzene); dark yellow colour, particle size −20+50 mesh.
4. Hydrogen peroxide: Its strength was precisely determined by the sodium thiosulphate method[13] and was found to be 30 per cent.

Methods

Styrenation

DCO, dissolved in xylene, was reacted with a styrene

monomer at 160°C for 16 hours using benzoyl peroxide as a catalyst. Xylene was evaporated under vacuum until the weight was constant. Styrenated DCO's were prepared in the concentrations 5, 10, 15 and 30 per cent styrene, on the weight of oil.

Epoxidation

Styrenated DCO was epoxidised by preparing the peracid *in-situ*[14] using one mole H_2O_2 per double bond and 15 per cent, on the weight of oil, Dowex 50W-8X was used as a catalyst.

Oxirane content

The oxirane content was determined volumetrically by titrating the sample, dissolved in benzene, directly against 0.1N HBr in acetic acid solution, using crystal violet as an indicator[15,16].

Varnish films

The films were prepared by pouring onto glass and tin plates[17]. After stoving, the film thickness was determined with a special thickness gauge[18]. A König pendulum was used for measuring the hardness. Other properties of the films, mechanical, physical and chemical were determined using standard methods wherever available.

Results

Castor oil was dehydrated and the resulting DCO was styrenated with four different concentrations (5, 10, 15 and 30 per cent styrene, on the weight of oil). The styrenated DCO's were epoxidised *in-situ* under established conditions. The adducts were mixed with melamine resin in the ratios 10, 20 and 30 per cent on the weight of oil and the proper amount of $SnCl_4.5H_2O$ was added. Films were prepared by pouring on glass tin plates.

Epoxidised styrenated varnish films

I – Five per cent styrene

The oxirane content of this oil was 1.6 per cent. Three series of experiments were carried out to find suitable stoving conditions. The parameters studied were the amount of catalyst ($SnCl_4.5H_2O$), stoving temperature and stoving time.

Effect of catalyst In the following series of experiments,

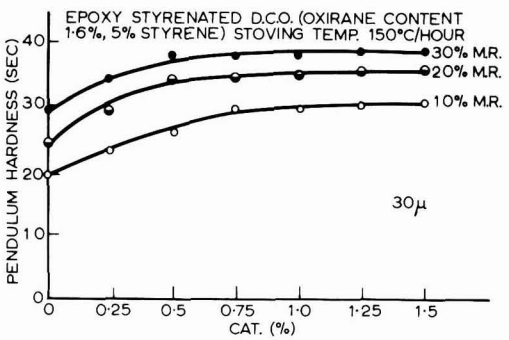


Figure 1. The effect of catalyst on hardness (MR = melamine resin in all figures)

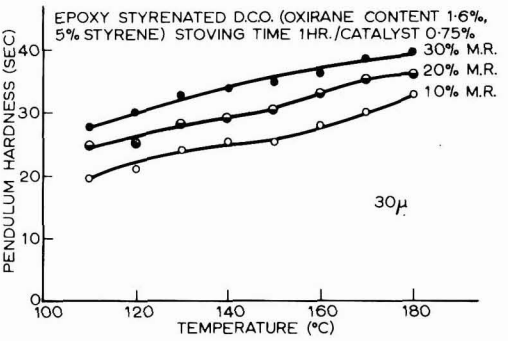


Figure 2. The effect of temperature on hardness

the amount of catalyst was varied from 0 – 1.5 per cent on the weight of oil. The films were stoved at 150°C for one hour. It was found that the use of 0.75 per cent $SnCl_4.5H_2O$ produced the ultimate film hardness as shown in Figure 1. Also, it was found that the optimum content of melamine resin in the modified oil was 30 per cent, without having any detrimental effect on the properties such as adhesion, flexibility and impact strength.

Effect of stoving temperature It is well known that full film hardness is produced by increasing temperature, but that over-stoving may cause darkening and brittleness. Thus, a series of experiments were performed to find a suitable stoving temperature at fixed catalyst concentration (0.75 per cent) and stoving time (one hour). Figure 2. shows that the hardness increases gradually with temperature up to 170°C; beyond this temperature any further increase in hardness is marginal and yellowing occurs.

Effect of stoving time The films of this series were stoved at 170°C for different periods using 0.75 per cent catalyst. Figure 3. shows the relationship between pendulum hardness and stoving time. Examination of this figure suggests the use of one hour as a stoving time.

Physical and mechanical properties The appearance of the films from these three series were excellent; all the films were glossy and colourless, except those stoved above 180°C and those stoved for two hours. They passed impact and bending tests indicating good elasticity, flexibility and adhesion. They had good water, acid (5 per cent H_2SO_4) and alkali (5 per cent Na_2CO_3, 5 per cent NaOH and 5 per cent KOH) resistance especially when the films were stoved at above 130°C for longer than 30 minutes.

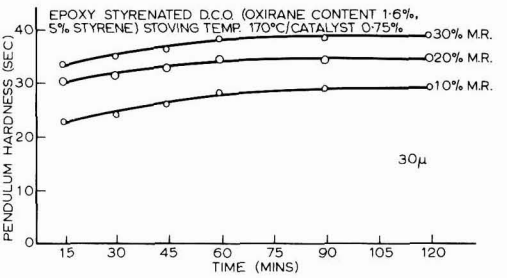


Figure 3. The effect of time on hardness

II – Ten per cent styrene

The same systematic study was carried out with epoxidised styrenated DCO (10 per cent styrene and 1.0 per cent oxirane content). Three series of experiments were carried out.

The films of the first series were stoved at 150°C for one hour and it was found that 0.75 per cent catalyst ($SnCl_4.5H_2O$) was suitable.

In the second series, where the effect of stoving temperature on the hardness of the varnish films was studied, it was found that 180°C is the optimum stoving temperature, as shown in Table 1.

Table 1

Effect of stoving temperature on the hardening of epoxidised styrenated DCO/melamine resin combinations ($SnCl_4.5H_2O$ 0.75%, stoving time 1h, melamine resin 30%

Stoving temp. (°C)	Pendulum hardness (sec) at film thickness (μm)			
	20	30	40	50
120	20.0	18.5	17.8	15.5
130	21.8	20.1	20.1	18.0
140	22.0	22.2	22.0	19.8
150	29.0	27.5	23.7	22.5
160	41.5	38.3	35.5	30.0
170	43.5	40.0	37.1	33.5
180	60.3	58.2	50.2	42.2
190	62.8	60.0	51.5	43.1

With respect to the third series, 60 minutes stoving time was most suitable.

Physical and mechanical properties The appearance, impact, bending, water, acid and alkali resistance of the films of Ten per cent styrene were the same as the corresponding films prepared with Five per cent styrene.

III – Fifteen per cent styrene

Three series of experiments were carried out on epoxidised styrenated DCO (15 per cent styrene and 1.1 per cent oxirane content) to select the optimum stoving conditions for this type of varnish.

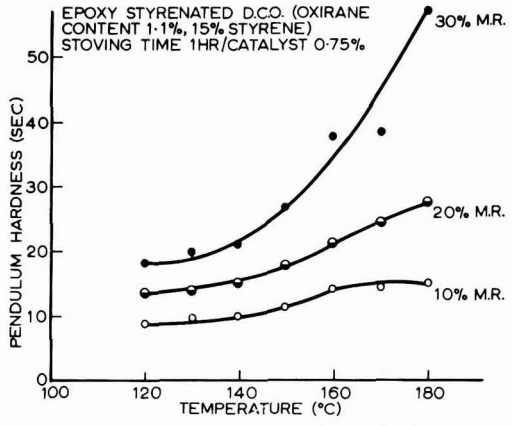


Figure 4. The effect of temperature on hardness

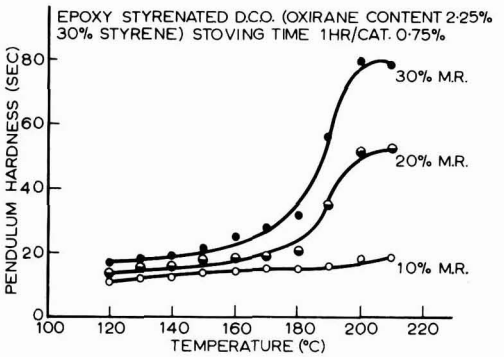


Figure 5. The effect of temperature on hardness

In the first series, it was found that 0.75 per cent $SnCl_4.5H_2O$ is a suitable amount of catalyst. With respect to the second series, 0.75 per cent catalyst was chosen and the films were stoved for one hour at different temperatures. The results are shown in Figure 4. The hardness increased sharply as the temperature rose, from 150 – 180°C, but the films also became darker.

The third series of experiments investigated the effect of stoving time. It was found that one hour is a suitable stoving time.

Physical and mechanical properties The same physical and mechanical tests were carried out and the films of this varnish type showed the same properties as the above two series.

IV – Thirty per cent styrene

Styrenated DCO (30 per cent styrene) was epoxidised and the oxirane content of the epoxidised styrenated DCO was found to be 2.25 per cent. Three series of experiments were carried out to find the optimum stoving conditions of this varnish type.

In the first series, it was found that 0.50 – 0.75 per cent catalyst was suitable. In the second one stoving temperature was studied; the films of this series contained 0.75 per cent catalyst and were stoved for one hour. It is clear from Figure 5. that the pendulum hardness increases sharply in the range 180 – 200°C. Beyond 200°C the

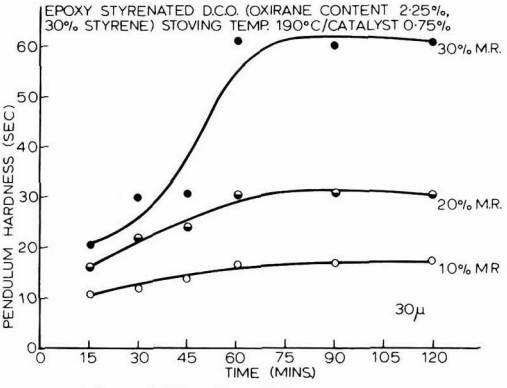


Figure 6. The effect of time on hardness

increase in hardness is very slight. On the basis of this series a stoving temperature of 190°C was chosen.

The last series is concerned with the effect of stoving time and the results are represented graphically in Figure 6. It is clear that one hour is a suitable stoving time to produce films of excellent physical and mechanical properties.

Physical and mechanical properties The films of this type (30 per cent styrene) were excellent in appearance; they were glossy and colourless, except when the stoving time exceeded two hours and 200°C stoving temperature. They passed impact and bending tests. The films resisted water (cold and hot) but their adhesion to glass substrates was slightly affected, especially when stoved below 150°C for less than 30 minutes. The films showed outstanding resistance to acid and alkalis at normal concentrations at room temperature.

Conclusions

A systematic study on styrenated dehydrated castor oil which was further epoxidised and reinforced with a melamine resin gave varnish films of improved physical and mechanical properties. The properties were generally enhanced by increasing the styrene and the oxirane content; 30 per cent styrene and 2.25 per cent oxirane content were optimal. The melamine resin content required was 30 per cent. The stoving conditions of the varnish films were significant; films of acceptable hardness were obtained at a stoving time of one hour and a stoving temperature of 190°C.

The outstanding property of these films is their acid and alkali resistance.

[*Received 18 March 1980*

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The corrosion consultant at large

By J. E. Fowles-Smith

John Fowles-Smith, Corrosion Consultant, 96 Ley Lane, Manfield Woodhouse, Notts. NG19 8JX, England

The life of a corrosion consultant is one full of interest, at times completely absorbing technically, although frequently heartbreaking. The greatest satisfaction is obtained from 'drawing board' assignments, specifying a total protective scheme for a major project at the design stage. The greatest difficulties are invariably associated with maintenance and repair assignments where such parameters as down-time, accessibility, equipment limitations, environment and cost factors can each limit surface preparation techniques and the choice of coating systems.

Commercial incompetence and dishonesty on the part of both applicators and manufacturers of protective coatings create the heartbreak experienced from time to time by the consultant, usually when called in to salvage a plant affected by the premature onset of corrosion. Very occasionally, the guilty parties can be called to account by the consultant, but they are usually well protected by the small print in their conditions of sale or contract.

On the manufacturing side of the industry there is always a dichotomy between the technologist and the sales effort. The paint technologist is generally a free-thinking introvert, a theorist and problem solver, not at all at home in the wide world in which his developed products have to perform. Technologists have developed a variety of products and systems capable of protecting most substrates for their effective working lives, such that there is a choice in almost every direction. Unfortunately technologists are also required to re-formulate to cost parameters set for commercial reasons to the detriment of product performance. The salesman can well be happy with his 'boffins' for attaining a competitive price, but who pays in the long run?

Premature failure of coating systems is traditionally the fault of the applicator. It is, generally, taken for granted that the applicator has very little technical knowledge of the coatings he is applying, that he only uses second grade labour and that he uses his wits to beat any specifications, if he has read them, to achieve his profits. The applicator frequently gives his field teams engaged in contract work a 'price for the job', a practice which does tend to encourage specification trimming.

It is so easy in making such generalisations to condemn the applicator. His function is labour intensive, both on surface preparation and product application, and his manpower has to develop skills in both areas. Additionally, he has to learn the individual characteristics of the various products. This is a complex area indeed. The paint technologist has an interest in application only so far as to be able to claim that a product can be applied by such and such a method, and to detail maximum and minimum application temperatures, relative humidities etc. The applicator has to make it work in the real world, not the laboratory spray booth.

Case histories generally bring the whole field of corrosion protection into focus, certainly as far as coating manufacturers and applicators are concerned.

Case 1.

A power station was in the course of being erected and painted, with all roof steelwork being fully coated at ground level under the control of an inspector. Within twelve weeks of installation the structure was visibly rusting badly. The supplier blamed the applicator, the applicator called in a consultant.

A synopsis of the specification is as follows:

1. Abrasive blast steel surfaces to BS 4232 Second Quality.
2. Apply 2 coats of manufacturer X's red lead chlorinated rubber primer to a minimum total dry film thickness of 90 microns.
3. Apply 1 or 2 coats of manufacturer X's chlorinated rubber finish, white, to obtain an additional minimum 75 microns dry film thickness.

The site was on an estuary some miles from the open sea. The steel itself was in good condition for blasting, roughly SIS 05 59 00 – 1967 Grade B.

An initial survey indicated that the total film build was as specified, although there were under-thickness and over-thickness areas. Breakdown affected both. Minor blasting grit inclusion and some other foreign bodies were present in places, inevitable under site conditions, but these were not active sources of this early failure.

A survey of the site records revealed that each piece had been approved after blasting by the power station inspector, who had stood by on each occasion to ensure priming was undertaken immediately so as to preserve the prepared surface. There had been no storms to bring in salt-laden air from the time of the delivery of steel to the site, to the erection of the roof structure.

A more detailed survey of the roof structure was undertaken using an Elcometer Paint Inspection Gauge. This revealed the following:

1. There was considerable film thickness variation between the primer and the finish. The primer varied from 30 to 120 microns, the finish from 40 to 110 microns.
2. Wherever the finish exceeded 60 microns there was no breakdown, regardless of the primer thickness.
3. The primer film had a minute honeycomb structure.
4. Although designated 'red lead chlorinated rubber' the primer was in fact pink, indicating a low proportion of red lead.

In order to assess the coatings a trial was made up on site using steel from the same delivery, and the same abra-

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235 pbw.	Nitrocellulose E 510 (Wolff, Walsrode, Germany) solution of 40% nitrocellulose, 40% butyl-acetate and 20% butanol
180 pbw.	Alkydal® E 41 (Bayer, Germany) groundnut-oil type, 40% oil content, 70% in xylene
15 pbw.	Di-butyl phthalate
15 pbw.	EDENOL® BS 20 N
185 pbw.	Toluene
120 pbw.	Isopropanol
110 pbw.	Spirit 110/140
100 pbw.	Butyl acetate
40 pbw.	Silicone Oil A, 1% in toluene (Bayer, Germany)
1000 pbw.	

Solid substance 25%
Viscosity 32–36 DIN 4 sec.

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sive as used on the structure. A section was blasted and two-thirds of the section primed in accordance with the specification, half of this section having a second coat of primer applied in accordance with the specification. Two coats of finish were similarly striped across the primed surfaces after lightly wire-brushing the bare steel area which was showing degradation at this stage.

It was intended that the prepared panels be subjected to accelerated testing, but as the single coat primer rust-rashed overnight, and the double coat within forty-eight hours there was little point. The single coat of chlorinated rubber finish over bare steel was still sound after three months, but the full primer with a single finish had broken down within six weeks.

Further enquiry revealed that the manufacturer involved had "sold-in" this specification to other authorities in the country concerned, not the UK. Another major installation in the vicinity had already been prepared and recoated twice within a year by a contractor at his own expense, having been blamed for bad workmanship. It also was found that another power station of the same authority was in the same condition, but it had not been noticed as the base colour was a bronze-green and not white.

This situation could, of course, result in a discussion on the value of red lead in chlorinated rubber primer, but this would be a side issue. The main point is that a major manufacturer, controlled in practice if not in theory from the UK from a highly respected base, had sold-in a specification to public authorities that was unsound. The authorities write their working specifications around this advice and are immediately liable for any costs of failure. When the inevitable failure occurred the manufacturer became expert witness for the authorities in question; and the contractor, from a far weaker technical background, repeated the operation, buying yet more unsatisfactory product.

Case 2

A very large fabrication shop had been erected on a coastal site. The structure had an all-over roof, but was only seventy per cent clad so that one side was totally open, but a shielding cladding line in parallel with the open side ran 50 per cent of the length of the building down the centre line (Figure 1). All steelwork was prepared and primed "in works" and a site applicator made good all mechanical damage after erection and applied the finishing coat. Within eight weeks of completion the top coat was literally falling off in some areas, and roof trusses, cladding rails, cross braces and other "internal" steelwork was corroding badly. The site applicator was blamed by the engineering consultant and the paint supplier. The applicator called in a corrosion consultant.

A synopsis of the specification is as follows:

Exposed steelwork (i.e. columns and beams on the open side).

1. Blast to BS 4232 Second Quality.
2. Apply 2 coats of manufacturer Y's high-build primer, each at 70-80 microns dry film thickness.
3. Apply 1 coat of manufacturer Y's high-build finish on site at 70-80 microns dry film thickness.

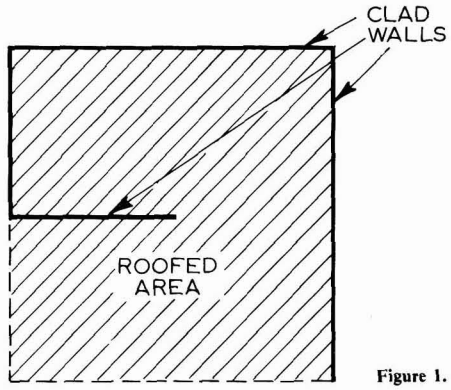

Figure 1.

General Steelwork (including roof structure).

1. Wire brush to remove loose millscale and rust.
2. Apply 1 coat of manufacturer Y's quick-drying red lead primer at 30-40 microns dry film thickness.
3. Apply 1 coat of manufacturer Y's high-build primer.
4. Apply the site finish as above.

A site survey revealed the following:

1. All steelwork, which had been blast-cleaned, was in good condition, although some detachment of the finish coat was in evidence.
2. The adhesion of the finish coat in all areas was not merely bad, but virtually non-existent.
3. Most of the failure was due to lifting millscale, although many areas were subject to osmotic blistering.
4. The roof structure and upper cladding rails were wet with condensation.
5. The film "build" was generally below specification, although an independent site inspector had checked and passed all the work during the contract period.

The final painting of this project had been undertaken in early winter (October to December). As the supplier claimed in the product data sheets that the materials concerned can be applied down to 0°C, the applicator was not at fault in respect of application at that time of year. On completion of painting the roof structure the glazing panels were dropped in and secured. There followed a period of night frosts and sunny days, with considerable fog.

Detachment of millscale from a steel surface is a well known problem in the construction industry. Differential expansion of the base steel and the glassy scale with temperature changes will inevitably cause the scale to craze and lift, regardless of any applied coating system, allowing the atmosphere access to the steel surface below the scale. In this particular instance the steel was new and well scaled. Frost and sun accelerated the process.

The specification itself is clearly at fault. There is,

however, a similarity to Case 1. in that in both cases the specification and the products were advised by a manufacturer. The consulting engineer should have known better and is a great deal wiser now.

Of far greater technical interest was the inter-coat adhesion failure for which the applicator was being held responsible. It was necessary to discover more about the products to explain or understand such a phenomenon.

The manufacturer states that the high build primer and finishing products involved are "based on a special synthetic resin". His technical sales staff in the UK knew no more than the data sheet information. This manufacturer has a large UK market, but is based on the European mainland.

It did not take much time using an infrared spectrograph and a gas chromotography unit etc. to ascertain that the "special synthetic resin" was indeed special, being a blend of tung-oil phenolic and chlorinated polyethylene. There was a trace of chromate in the primer, but not sufficient to be really effective. The pigmentation level was high.

Chlorinated polyethylene (CPE) is an interesting raw material, in many ways similar to chlorinated rubber (CR), but with far wider tolerances in some respects. Although it may out-perform CR on marine work in some circumstances, it can create problems in others. It is a typical CPE problem area with which this project is troubled.

CPE is compatible with a number of other media well beyond the scope of CR. In this instance, the manufacturer blended the resin with tung-oil phenolic to create a tough, hard and serviceable system for marine conditions. Under the conditions which existed in the paint technologist's mind when formulating the product it should have behaved extremely well.

CPE dissolves in aromatic hydrocarbons, but unlike CR it has a tremendous tolerance towards aliphatic solvents once it is in true solution. Unfortunately, it does not necessarily release aliphatic solvent with ease. CR can cause problems with solvent release, but these are only a shadow compared to those of CPE. Both systems can give a similar false impression of being dry at the surface.

When blended with tung-oil phenolic the CPE still apparently dries at the surface, sufficiently so as to enable the modifying resin to cure to hardness. The surface then becomes insoluble in mild aromatic solvents. Retained aliphatic solvents will then leach-out eventually – maybe.

In this particular case history the works-applied coatings were surface hard prior to the application of the site coat. The aliphatic-rich solvent system used in the product formulation was far too weak to key-blend into the cured system, and inter-coat adhesion was, therefore, at a minimum.

False dry film thickness readings, obtained after twenty-four hours, were the cause of the low film thicknesses eventually recorded. Experimentally it was demonstrated that after forty-eight hours the coating still retained in excess of thirty per cent by volume of aliphatic solvent, although feeling fully hard and cured.

Ideally this coating product should be built-up from successive lower build films of say 50 microns each, applied within a strictly limited period. It would then undoubtedly perform extremely well. The formulating technologist almost certainly knew this, but his employer and sales staff did not. The company claims indefinite recoatability in its literature.

Both of these case histories show a total lack of ethics on the part of major coatings manufacturers. It would be difficult to ascertain whether the selling-in of these systems was due to ignorance or expediency. It is certainly not the consultant's task to determine which. The loading of the blame onto the applicator cannot be excused.

It has not been the intention of this paper to totally denigrate the paint industry, but merely to indicate that its image is not exactly white. It is no better morally, and runs far less commercial risk, than the application industry. The consultant has to know each in depth, he has to know the strengths and weaknesses within each and he has a worthwhile objective, which should reflect credit on both – the lasting protection which these industries can achieve.

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Epoxy esters of rosin

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Summary

Rosin is widely employed in various industrial applications such as varnishes, printing inks, synthetic resins, adhesives etc. Unmodified rosin is not well suited for most coating applications. Nowadays unmodified rosin is used almost exclusively as a raw material for the preparation of modified rosin and rosin derivatives. This paper deals with the modification of rosin with epoxy resins for the purpose of eliminating the undesirable properties encountered in the unmodified form.

The epoxy esters of rosin are prepared by using rosin and epoxy resin in different proportions. These epoxy esters of rosin find wide application in the paint, varnish and coating industries.

Keywords

Processes and methods primarily associated with manufacturing or synthesis

esterification

Raw materials for coatings binders (resins, etc.)

epoxy resin

used in manufacture or synthesis of ingredients for coatings

drying oil fatty acid
fatty acid
rosin

Les esters époxydes de colophane

Résumé

La colophane est fortement utilisée en diverses applications industrielles, telles que vernis, encres d'imprimerie, résines synthétiques, adhésifs etc. La colophane non modifiée n'est pas convenable à être utilisée en beaucoup de revêtements. A l'heure actuelle, la colophane non modifiée est utilisée presqu'en exclusivité en tant que matière première dans la fabrication de colophane modifiée et des dérivés de colophane. Cet article traite de la modification de colophane par les résines époxydes, en vue d'éliminer les caractéristiques peu désirables que met en évidence la colophane brute.

On prépare les esters époxydes de colophane en utilisant de diverses proportions de colophane et de résine époxyde. Ces esters époxydes sont utilisés pour une gamme étendue d'applications aux industries de peintures et vernis etc.

Die Hauptepoxydester

Zusammenfassung

Das Kolophonium wird in solchen verschiedenen industriellen Anwendungen als Lacken, Druckfarben, Kunstharzen, Klebstoffen, usw., weit benutzt. Zur meisten Anstrichanwendungen eignet unmodifiziertes Harz sich nicht. Heutzutage wird unmodifiziertes Harz fast ausschliesslich als Rohstoff vor der Herstellung von modifiziertem Harz und seinen Derivaten benutzt. Dieser Aufsatz befasst sich mit dem modifizieren des Harzes mit Epoxydharzen um die im Rohharz stehenden unerwunschten Eigenschaften zu beseitigen.

Die Harzepoxydester werden von verschiedenen Verhältnissen des Harzes und Epoxydester hergestellt. Diese Harzepoxydester finden weitreichende Anwendungen in der Lack- und Beschichtungsmittelindustrien.

Introduction and discussion

Refs, 1-3

Epoxy resins[1] are long chain polymers which may be formed by the reaction between epichlorohydrin and a dihydric phenol such as bisphenol-A. These resins will react with carboxylic acids to form esters. A reaction takes place between the carboxyl group of the acid, and both the epoxy group and the hydroxyl group on the second carbon atom, as can be seen from the following:

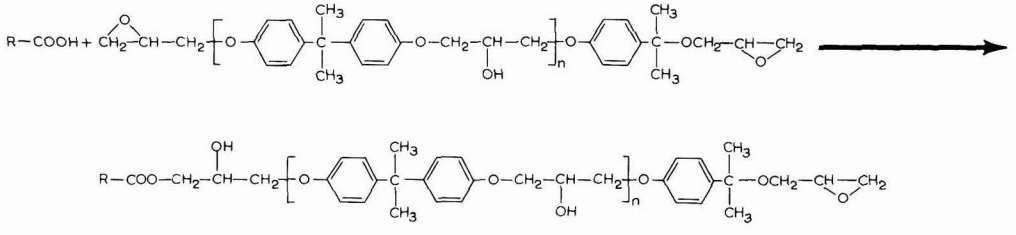

Table 1
Raw material specifications

Rosin	Epoxy resin
Source – The Indian Turpentine & Rosin Co. Ltd	Source – Research & Development Lab. ITR Co. Ltd
Acid value 170 mg KOH/g	Colour on Gardner Scale 6
Melting point (cap.) 60-65°C	Melting point (cap.) 55°C
Softening point (ball and ring) 75-77°C	Softening point (ball and ring) 75°C
Abietic acid 33%	Infrared spectra values 8629, 4543, 3000,
Grade – N	1250, 917, 830, 570, 370 cm^{-1}
Ash content – 0.05%	Epoxide equivalent – 2000
Unsaponifiable matter – 6%	Epoxy content – 0.05
Solubility	Solubility
Soluble in turpentine, alcohol and aromatic solvents	Soluble in ketones and alcohols
	Insoluble in aromatic solvents

Table 2
Experimental data

Sample No.	Rosin (g)	Oleoresin (g)	Epoxy resin (g)	NaOH (g)	ZnO (g)	Temperature (°C)	Bisphenol-A (g)	Epichlorohydrin (cc)
1.	–	–	–	30	–	100	115	50
2.	45	–	67	–	–	270±5	–	–
3.	45	–	67	–	0.45	270±5	–	–
4.	60	–	47	–	0.6	270±5	–	–
5.	–	90	10	–	–	Low	–	–
6.	80	80	10	–	–	Low	–	–
7.	–	60	10	–	–	Low	–	–
8.	–	50	10	–	–	Low	–	–
9.	–	40	10	–	–	Low	–	–
10.	–	30	10	–	–	Low	–	–
11.	–	20	10	–	–	Low	–	–
12.	–	20	10	–	–	270±5	–	–
13.	–	10	10	–	–	Low	–	–

This hydroxyl group can then react normally with another carboxyl group with the elimination of water. The epoxy resins are esterfied with fatty acids, although other acids such as rosin, or P-tertiarybutylbenzoic acid can be used in special cases.

Rosin is classified as a natural resin. Oleoresin is obtained by tapping living pine trees and collecting the exudation. The material is collected and distilled to obtain gum rosin. Rosin is obtained as a solid residue by the above process. It contains about 90 per cent rosin acids which includes abietic acid, levo-pimaric acid and its other isomers. The remaining 10 per cent consists partially of rosin esters with fatty acids and partly unsaponifiable material, all the acids present are mono-basic and unsaturated. The composition varies slightly from grade to grade depending upon the source and method of preparation.

As would be expected, esterification with drying oil fatty acids such as linseed oil, dehydrated castor oil (DCO) or soya bean oil, produce esters which will air dry, although these can also be stoved. Another[1] method of making air drying varnishes involves the esterification of rosin with epoxide resins and subsequent "cooking" of the resultant ester in oil.

Esterification is carried out at a temperature of 275°C in an inert atmosphere to an acid value of about 20. Lower temperatures may be employed for the esterification. The rosin ester can then be dispersed in unbodied and boiled linseed oil at a temperature of 290°C, certain rosin esters of this type are compatible with nitrocellulose and their use imparts a number of desirable properties on the lacquer, amongst which are improved print resistance, sanding properties and resistance to cold checking.

The epoxy esters also bear similarities to alkyds but exhibit superior performance[2]. They are prepared by reacting long chain unsaturated[1] fatty acids with epoxy resins in the n=5 to n=10 range. Cooks are conducted by solvent or fusion techniques at temperatures of about 210°C to 290°C, higher temperatures being used with esters containing higher fatty acid concentrations. The products are soluble in aromatic solvents and in some cases in mineral spirits, they are formulated with metallic driers and may be used in dry or baking finishes.

Modification with saturated fatty acids is carried out by blending with urea or melamine resins for use in baking finishes. Techniques are available for production from liquid resins, bisphenol-A and fatty acids.

The structure of epoxy polymers[3] shows that they are not suitable for air drying coatings as is the structure shown in Figure 1.

Table 3
Analytical Data

Sample No.	Acid value mg KOH/g	IR values (nm)	m.p. (cap) °C	s.p. (R & B) °C	Colour on Gardner Scale
2.	15–16	2.95,3.5, 7.44,9.05	75	95	15–16
3.	19–20	2.95,3.5, 7.44,9.05	65	75	17–18
4.	19–20	2.95,3.5, 7.44,9.05	65	75	18
5.	110	2.95,3.5, 7.44,9.05	75	95	11–12
6.	110	2.95,3.5, 7.44,9.05	72	94	11–12
7.	95	2.95,3.5, 7.44,9.05	78	98	11
8.	73	2.95,3.5, 7.44,9.05	78	98	11
9.	61	2.95,3.5, 7.44,9.05	80	98	10–11
10.	53	2.95,3.5, 7.44,9.05	80	98	10
11.	34–35	2.95,3.5, 7.44,9.05	87	100	9
12.	10	2.95,3.5, 7.44,9.05	90	108	11
13.	5	2.95,3.5, 7.44,9.05	98	125	8–9

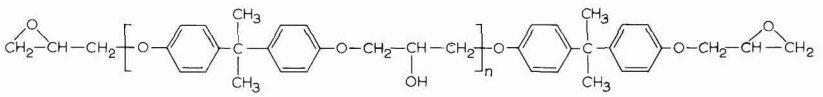

Figure 1.

However, if the hydroxyls are esterified with unsaturated fatty acids the product should air dry in a manner similar to the drying oils, varnishes and alkyds. Since the epoxy polymers have a higher functionality than glycerol and a considerably higher molecular weight, it would be expected that the epoxy fatty acid esters would have better alkali resistance than drying oils, varnishes and alkyds because of the ether linkages and the phenolic nuclei, they should not discolour greatly because the colour forming phenolic hydroxyls have been replaced with unreacted ether linkages.

Experimental and results

Material used

Refs, 1, 3, 4, 6

All the chemicals used in these experiments were of the purest grade available. The specifications of raw materials are given in Table 1.

Method of preparation

Epoxy resins[1,4,6] and rosin esters[1,3] were prepared according to methods described in the literature. The reaction conditions and other parameters are given in Table 2.

The analytical data given in Table 3. were determined by the standard methods as described in the Indian Standards Institution (ISI), ASTM etc.

The spectoscopy of the samples was carried out with the aid of a Perkin-Elmer Spectrophotometer (infrared spectra). From infrared spectra of the samples of epoxy esters it was observed that the peak at 10.5 nm disappeared which shows the presence of esters.

Conclusion

From the experimental data it is evident that if the epoxy resin is esterified with gum rosin then the ester thus obtained has better properties than other rosin derivatives. It is interesting to note that the esters prepared directly from oleoresin had better properties, for example, melting point, softening point, colour etc. than the esters prepared from rosin. These rosin esters (from oleoresin) were prepared at a lower temperature and in a shorter time than other rosin esters.

Table 4
Solubility characteristics

Sample No.	Dioxane	Benzene	Xylene	$CHCl_3$	CCl_4	Ethanol	Acetone	Ether	Petroleum ether	Turpentine
2.	S	S	S	S	S	I	S	S	I	S
3.	S	S	S	S	S	I	S	S	I	S
4.	S	S	S	S	S	I	S	S	I	S
5.	S	S	S	S	S	S	S	S	I	S
6.	S	S	S	S	S	S	S	S	I	S
7.	S	S	S	S	S	PS	S	S	I	S
8.	S	S	S	S	S	PS	S	S	I	S
9.	S	S	S	S	S	PS	S	S	I	PS
10.	S	S	S	S	S	PS	S	S	I	PS
11.	S	S	S	S	S	I	S	S	I	I
12.	S	S	S	S	S	I	S	S	I	I
13.	S	S	S	S	S	I	S	S	I	I

Notation: S = Soluble, PS = Partially soluble, I = Insoluble

Table 5(a)
Film properties

Sample No.	Flexibility	Scratch hardness (g)	Drying time (air dry) (h)	Durability
13.	Excellent	1500–2000	15	Excellent
12.	Excellent	1800–2000	14.5	Excellent
2.	Excellent	1500–1900	15	Excellent
3.	Excellent	1400–1800	15.5	Excellent
4.	Excellent	1500–1800	16	Excellent
11.	Good	1200–1600	19–20	Good
10.	Good	1200–1500	20.5	Good
9.	Good	1000–1500	20.5	Good
8.	Good	1000–1200	22	Good
7.	Good	900–1000	23.5	Good
6.	Good	800–1000	24.5	Good
5.	Good	800–1000	25	Good

Table 5(b)
Chemical resistance, time to the first sign of breakdown in the following reagents

Sample No.	5% Water in IMS (days)	2% Acetic acid (days)	10% HCl (days)	10% HNO_3 (days)	10% H_2SO_4 (days)	2.5% NaOH (days)
13.	150	145	200	125	150	200
12.	147	141	198	126	145	200
2.	149	142	193	125	143	197
3.	146	146	195	123	149	195
4.	147	142	197	124	145	196
11.	120	110	180	110	160	180
10.	122	109	176	108	157	176
9.	115	110	170	105	150	170
8.	116	111	172	107	146	169
7.	100	90	150	90	120	150
6.	98	91	148	87	117	148
5.	98	92	147	89	119	145

These epoxy esters of rosin when used in varnishes had better chemical resistance than other esters, their varnishes are fast drying and had better film properties.

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The application of acoustic emission to the study of paint failure

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Summary

Acoustic emission represents a simple, non-destructive technique for monitoring the onset of failure of materials under mechanical strain, whether under laboratory conditions or in actual service. When release of strain in a material takes place, for example, by cracking in the bulk material or failure at a bonded interface, some of the strain energy released generates stress waves which travel through the bulk of the material and may be detected by sensitive transducers which respond to the consequent surface displacements.

This paper describes the novel application of this technique to monitoring the failure mechanisms in paint films during service. Illustrative examples show the application of the technique to the study of weathering and failure in decorative paints and to the detection of failure in car paint systems.

Keywords

Properties characteristics and conditions primarily associated with

dried or cured film

failure
humidity resistance

Process and methods primarily associated with analysis, measurement or testing

acoustic emission

L'application de la technique d'émission acoustique à l'étude de la détérioration de systèmes de peinture

Résumé

La technique d'émision acoustique est une méthode facile et non destructive pour surveiller le début de la détérioration des matériaux soumis à des contraintes mécaniques, soit sous les conditions au laboratoire, soit en service. Lorsque la relaxation de ces contrainte se produit au sein d'une substance, par exemple, à la suite de la formation de fissures dans l'ensemble, ou par la perte d'adhérence à l'interface impliquée, une certaine quantité de l'energie si dégagée amorce les ondes des efforts qui traversent l'ensemble de la substance et qui peuvent être contrôlées par les traducteurs sensibles et aptes à répondre aux déplacements superficielles qui en résultent.

Cet exposé décrit l'utilisation nouvelle de cette technique pour contrôler les mécanismes de détérioration en service des films de peinture. On donne des exemples pour indiquer l'emploi de cette technique à l'étude du vieillissement et de l'altération des peintures décoratives, et à la découverte de l'insuccès des systèmes de peinture pour automobiles.

Die Anwendung der Schallemission auf die Untersuchung der Anstrichschäden

Zusammenfassung

Die Schallemission darstellt eine leichte zerstörungsfreie Technik, entweder unter Laboratoriums- oder Gebrauchsumständen, den Anfang der unter mechanischer Beanspruchung stehenden Materialschäden, zu kontrollieren. Wenn, zum Beispiel, durch das Reissen des ganzen Materials oder den Haftungsverlust an der betreffenden Grenzfläche, die Beanspruchungsfreisetzung in einem Material stattfindet, erzeugt ein Teil der Beanspruchungsenergie Spannungswellen, die die Gänze des Materials durchläuft. Von empfindlichen Messwandlern, die auf folgenden Oberflächenverschiebungen reagieren, konnen diese Spannungswellen entdeckt werden.

Dieser Vortrag beschreibt die neuartige Anwendung dieser Technik auf die Kontrolle über die Schallmechanismus in Lackfilmen, die während Gebrauchsumstände vorkommen. Erklärende Beispiele zeigen die Anwendung auf die Untersuchung der Bewitterung und der Schäden von Dekorationsfarben, und auf die Entdeckung der Fehler in Automobillacksystemen.

Introduction

Present situation

A new paint undergoes a variety of tests before it is put on the market. These fall into two basic categories, namely: the application properties and the performance properties. In the latter category, a broad group of tests concern weathering (assessment of performance on exposure of painted substrates to actual service or simulated service conditions) and, for paints on metal substrates, corrosion (frequently with some artificially created damage on the test panels). These tests may be made under natural or artificial (accelerated) environmental conditions and may last for considerable periods of time. Assessment of performance can vary from simple visual observation of panels during test, through simple cutting or bend tests to instrumental methods of determining gloss changes, changes in mechanical properties ("hardness" by micro-indentor, stress-strain curves on detached films) etc.

In all these performance tests, there is a considerable

need for sensitive experimental techniques, particularly during natural weathering tests, which will give early indications of film breakdown, initiation of corrosion, etc., long before these are apparent from existing assessment methods (frequently visual inspection only). Such methods would lead to considerable savings in performance test times and, hopefully, expenditure of less experimental time in preparing and assessing test panels, as well as improving the reliability of performance testing. Of prime importance in such tests is the identification of the initiation of paint failure by cohesive failure and by paint/substrate debonding and, less frequently, the occurence of debonding between individual constituent coats of the paint film, as a result of weathering or corrosion processes.

This paper reports the results of a study of the feasibility of using acoustic emission for monitoring such failure processes in various paint/substrate systems. The acoustic responses for various paint/substrate systems are presented, but it is not the intention of this paper to correlate the responses with specific failure mechanisms.

Acoustic emission

Refs. 1, 2

When a dynamic process such as cracking occurs in a material, some of the released elastic strain energy can generate stress waves, i.e. vibrations within the material[1]. These stress waves propagate through the material and eventually reach the surface, so producing small temporary surface displacements. In extreme cases, for example in the well known cracking of ice, the stress waves may be of high amplitude and low frequency and consequently easily audible. This is the origin of the term "acoustic emission". However, in most cases, the stress waves are of low amplitude and high frequency and sensitive transducers are required to detect and amplify the very small surface displacements. The transducers which are generally used are piezo-electric crystals which convert a surface displacement into an electrical signal. The electrical signal is subsequently amplified and, as the crystals are left undamped, the signal resulting from a single surface displacement will be similar to that shown in Figure 1. In the idealised case the voltage V versus time t relationship for such a signal approximates to a decaying sinusoid:

$$V = V_p \sin 2\pi f\ t \exp(-t/\tau) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where: f is the resonant frequency of the transducer, 2 is the decay time, t is time and V_p is the peak voltage. The problem is then one of quantifying the numerous signals which may be detected during a test. A number of signal analysis techniques may be used but only those employed in the present feasibility study will be described.

The simplest method to obtain an indication of acoustic emission activity is to count the number of amplified pulses which exceed an arbitrary threshold voltage V_t. This is ring-down counting and the signal in Figure 1. would correspond to three ring-down counts. If the signal approximates to a decaying sinusoid equation it follows that the number of ring-down counts N_R depends on the peak voltage and is given by:

$$N_R = f\ t \ln \frac{V_p}{V_t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

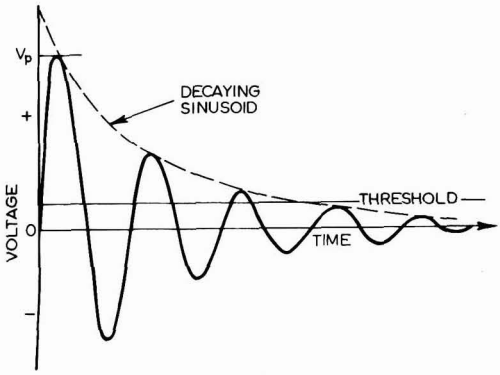

Figure 1. The signal from a piezoelectric transducer resulting from a single surface displacement

As the signal shown in Figure 1. was produced by a single surface displacement, which in turn may be assumed to be the consequence of a single source event inside the material, it is sometimes conveninent to record a count of unity rather than the multiple count obtained by ring-down counting. This may be easily achieved electronically by the judicious choice of dead-times and this mode of analysis is known as event counting.

The peak voltage is a function of the acoustic emission energy E and for a resonant transducer with narrow band instrumentation, the appropriate relationship is:

$$E = gV_p^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where g is a constant. The acoustic emission energy is related to the energy of the source event although the exact partition function is generally not known.

Because of the relationship between V_p and E, and the more ring-down counts are recorded the greater V_p (Equation 2), the ratio of ring-down counts to event counts is a measure, albeit crude, of the acoustic emission energy. However, it is clear that more detailed and comprehensive information on the acoustic energy emitted over a period of time may be obtained from histograms of the number of events against peak voltage (in practice, this is normally quoted in dB where: dB = 20 log (V_p/V_o)). This is shown in Figure 2. If only one type of source event is occurring over the monitoring period the histogram, or amplitude distribution, is often found to obey a power law[2] namely:

$$n_a = \left(\frac{V_a}{V_o}\right)^{-b} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where n_a is the fraction of the emission population whose peak voltage exceeds V_a, V_o is the lowest detectable voltage and the exponent b is a constant which characterises the distribution. The amplitude distribution is replotted as log n_a versus log V_a and yields a single straight line of slope –b, in accordance with Equation 4. (See Figure 2.).

In certain situations, the source events are taking place so rapidly that the acoustic signals overlap and in extreme cases an almost continuous signal may result. Significant overlapping of signals can lead to errors with the previously described counting modes, particularly if the

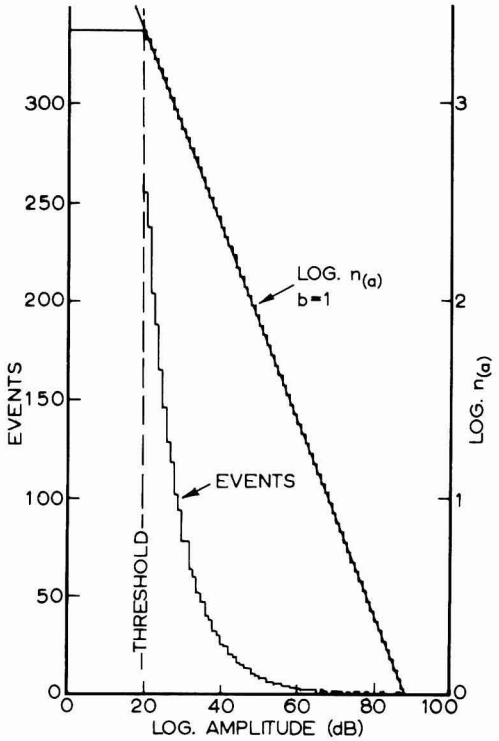

Figure 2. The amplitude distribution and the corresponding log-log plot giving a b-value of 1

signals are of low energy (low V_p). In these circumstances the measurement of the root mean square voltage (RMS) or the true mean square voltage (TMS) is advisable, provided the voltage is changing relatively slowly with time as the response time of most RMS/TMS meters is of the order of 100 ms. The RMS of a time dependent voltage V_t, over the time interval O to T, is given by:

$$\text{RMS} = \left(\frac{1}{T} \int_O^T V^2(t)\, dt \right)^{\frac{1}{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The TMS is simply the square of the RMS and, as acoustic energy E is proportional to V^2 (see for example Equation 3.), it is apparent that:

$$E \propto \int_O^T V^2(t)\, dt = \text{TMS} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Experimental procedure

Equipment

Strip specimens (nominal width 20 mm and nominal gauge length 100 mm) of decorative finishes on aluminium, and automotive finishes on steel were tensile tested to fracture at a cross-head speed of 0.2 cm/min in an Instron Tensile Tester. A PZT transducer with a resonant frequency of 150 kHz was coupled to the mid-point of the tensile specimens and the resulting signals analysed using standard acoustic emission equipment supplied by Dunegan-Endevco and Acoustic Emission Consultants.

Finishes

Solvent based alkyd decorative paints were examined by acoustic emission either as single coat wood primer, undercoat or topcoat paint films or as multicoat paint films composed of various combinations of these single coat systems. Freshly painted films were studied, but the main aim of the work was to study failure mechanisms during weathering, using both natural and artificial (accelerated) weathering. Also of interest is the effect of exposure to water on the failure mechanisms of both fresh and weathered paint films, as well as effects due to pigment type and concentrations.

Because of the high noise emission on tensile testing and great variability of the wood substrate normally used as a substrate for decorative paints, all the work was carried out on an artificial substrate, in that a soft aluminium foil substrate (0.5 mm thickness) was used for all the work. This material fails at around 20 to 25 per cent tensile strain and is characterised by very low acoustic emission up to the failure point.

The complete multicoat automotive finish of steel substrate/phosphate/electrocoat/sealer/topcoat together with the constitutent sub-systems, e.g. steel, steel substrate phosphate, steel substrate/phosphate/electrocoat, etc., were tested. These tests were carried out on finishes with different phosphates and electrocoats and also as a function of time of water soaking.

In this paper only a selection of the data which have been obtained on decorative and automotive finishes will be presented, sufficient to illustrate the scope and potential of acoustic emission in this field.

Results and discussion

Decorative finishes

In Figure 3., some results are shown for the acoustic emission (cumulative) ring-down counts against percentage strain for an experimental decorative alkyd paint system. This is a full system, i.e. topcoat applied to undercoat on aluminium foil. Samples were exposed to accelerated weathering for up to 600 hours in an Atlas XWR machine. Samples were tested under dry conditions and after equilibration with 100 per cent humidity atmosphere. "Wet" testing was done because under these high humidity conditions, wooden substrates change dimensions rapidly and, therefore, subject the paint film to strain. In the dry condition the substrate may be stable in dimensions, but if it is part of for example a window frame, strain in the substrate will occur due to flexure by wind pressure, shock waves from doors or windows slamming etc. As these two conditions represent extremes of performance, good performance under both conditions indicates desirable robustness in the product under test.

The most striking feature of the results in Figure 3. is the difference between the acoustic emission behaviour of the wet and the dry paint films. Also important is the indication of major failures in the film after only a moderate weathering period at low strains in the dry. Whilst the paint is apparently softened by the presence of water, it is too hard and brittle to be satisfactory under dry

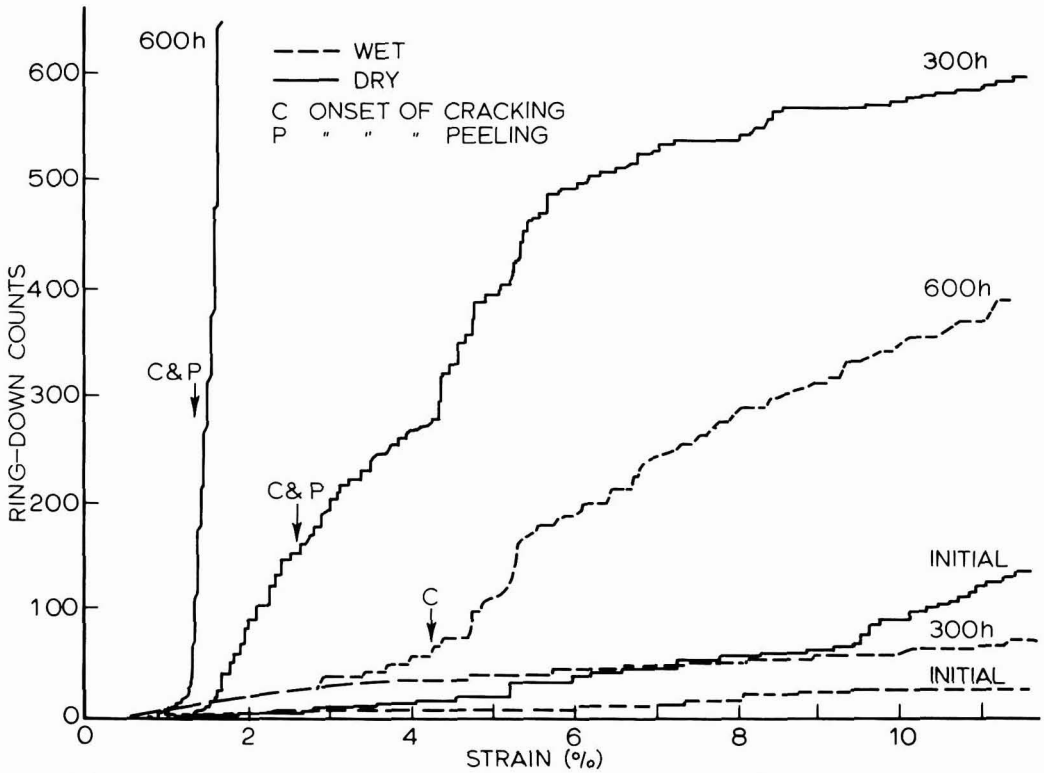

Figure 3. Cumulative event count as a function of strain for an experimental decorative topcoat/undercoat paint system showing the effects of weathering and humidity

conditions. As a rough guide, strains of 8-10 per cent are appropriate for wooden substrates expanding under change from dry to wet conditions. Changing the undercoat system changes the shapes of the curves, but does not change the conclusions from the data illustrated.

By studying individual coats as well as different combinations of component coats in full systems, useful information can be gained on the interactions of component coats on the failure properties of whole decorative paint systems and how these change with weathering. Whilst this information is being built up gradually with a wide variety of decorative paint systems, the effect of these interactions has been studied for a single paint system and its component coatings in a typical car paint system.

Automotive finishes

Figure 4. shows the accumulative event count as a function of strain for three sub-systems, namely: steel, steel/phosphate and steel/phosphate/electrocoat which are designated S, S/P and S/P/E respectively. The phosphate was a heavy weight zinc phosphate and the electrocoat was applied cathodically. The acoustic response from the steel was so low that its contribution to the event count for the other two sub-systems was negligible. It follows that the events recorded for the S/P and S/P/E sub-systems may be attributed to failure mechanisms, such as adhesion failure in each sub-system rather than to processes occurring within the steel substrate.

The amplitude distributions at the end of tensile tests for the S/P and S/P/E sub-systems are given in Figure 5. The main difference in these distributions, other than the number of events, was the large number of high amplitude events for the S/P/E sub-system. Clearly the addition of the electrocoat was associated with the onset of a different, higher energy, failure mechanism. Further evidence for an additional failure mechanism was obtained when the distributions were analysed using a log-log plot in accordance with Equation 4. (Figure 6.). A reasonably linear relationship, with the b-exponent equal to 2.6, was found for the S/P sub-system consistent with one dominant failure mechanism. In contrast the log-log plot for the S/P/E sub-system consisted of at least two linear regions indicating that more than one important failure mechanism was operative.

The effect of water soaking is demonstrated by the plots of stress, ring-down count rate and RMS as a function of strain for a dry, complete multicoat finish (Figure 7.) and the same system after 94 hours soaking (Figure 8.). In none of the paint systems investigated did the acoustic signals overlap to give a continuous signal, the strain dependence of which could be monitored by changes in the RMS level. However, in the case of the automotive finishes, the acoustic signals, although not continuous, were of sufficient energy and occurred frequently enough to produce "spikes" on the RMS output. These RMS "spikes" cannot be considered to be quantitative as it is difficult to ascribe an exact meaning to an RMS output

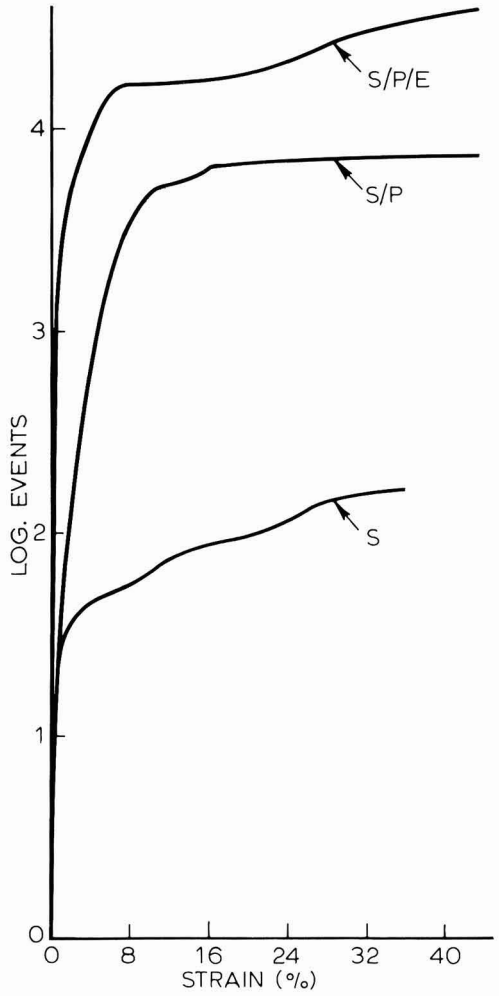

Figure 4. Cumulative event count as a function of strain for S, S/P and S/P/E subsystems, showing an increasing number of counts as coats are added

associated with a number of individual voltage bursts and also the "spike" height will, in general, be limited by the speed of response of the recording system. Nevertheless, as can be seen from Figures 7. and 8. the RMS "spikes" correlate well with the ring-down count rate, in that high densities of large "spikes" occur over the same strain ranges as high ring-down count rates. It is therefore concluded that useful acoustic emission data, certainly of a preliminary nature, may in some cases be obtained by simply employing an RMS meter.

The most noticeable feature of Figures 7. and 8. is the marked increase in the RMS "spike" output and ring-down count rate at about 35 per cent strain for the dry system and at the much lower strain of 20 per cent for the soaked system. Clearly the acoustic emission equipment is detecting a high strain failure mechanism(s) and water soaking causes the onset of the mechanism(s) at lower strains.

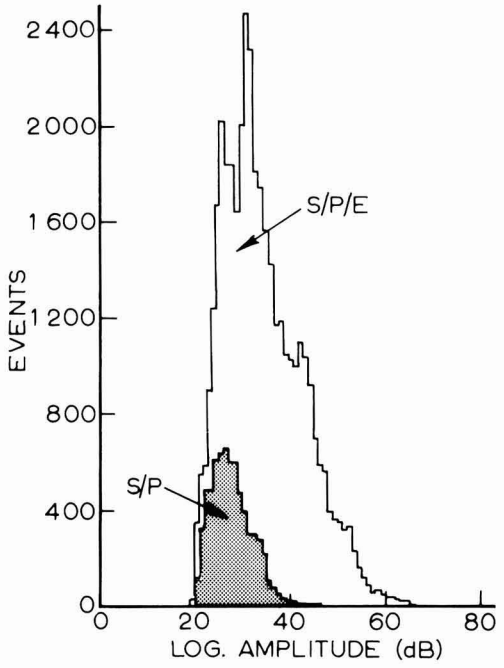

Figure 5. End of test amplitude distributions for S/P and S/P/E subsystems showing the large number of high energy events for S/P/E

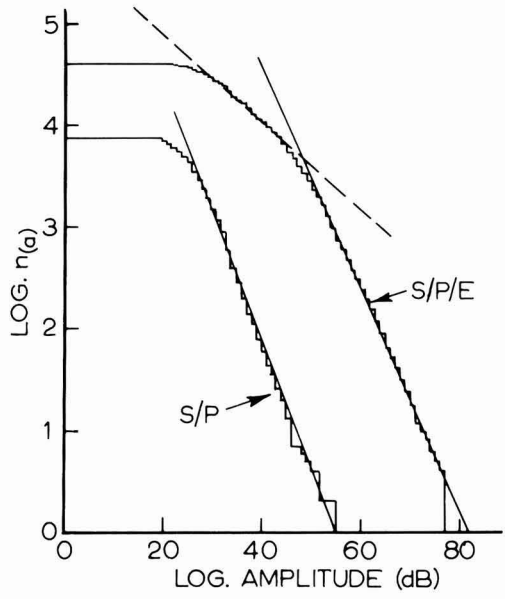

Figure 6. Log-log plot of amplitude distributions for S/P and S/P/E subsystems, showing the complex nature of the S/P/E distribution

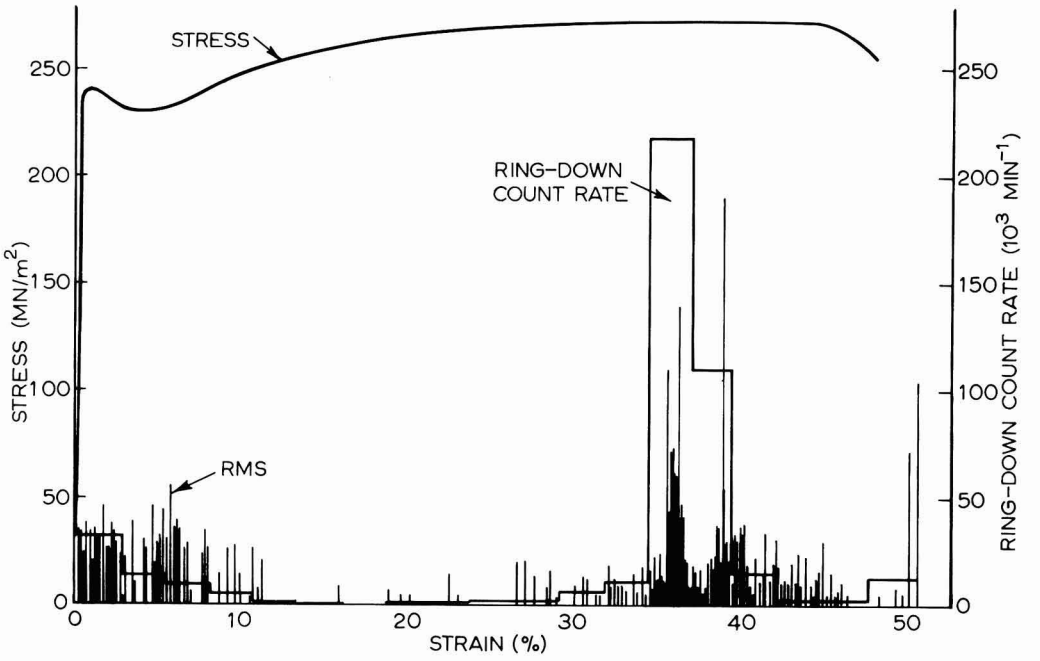

Figure 7. Stress, ring-down count rate and RMS as a function of strain for a full automotive system, tested dry

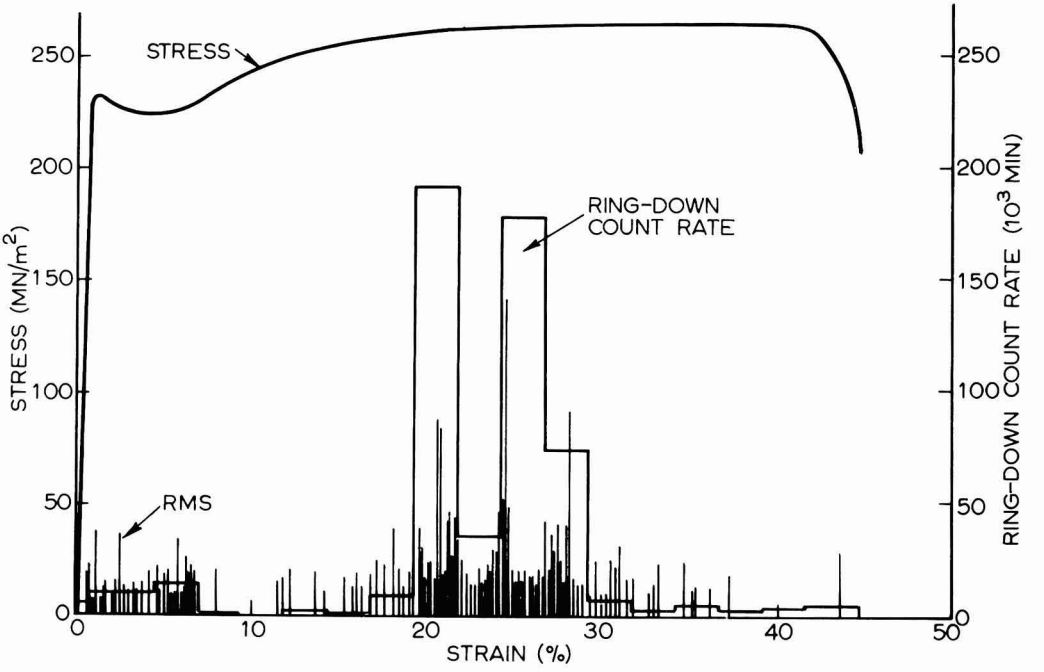

Figure 8. Stress ring-down count rate and RMS as a function of strain for a full automotive system, tested after soaking for 94 hours

Conclusions

Acoustic emission has been studied as a possible technique for detecting the initiation of cohesive or interfacial failure during performance testing of paint films on substrates. Two classes of paint films have been studied and it has been shown that failure initiation of hard paint films may be detected in advance of visual failure. The effects of different mechanical and failure properties of individual component films on the properties of the whole system may be isolated using this technique. Finally, the technique has shown the strong effect that humidity has on the failure properties of paint systems.

[*Received 17 June 1980*

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Next month's issue

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

A surface coating based on dehydrated castor oil. Part 2: Dielectric properties *by B. M. Badran, I. M. El-Anwar and M. S. Ibrahim*

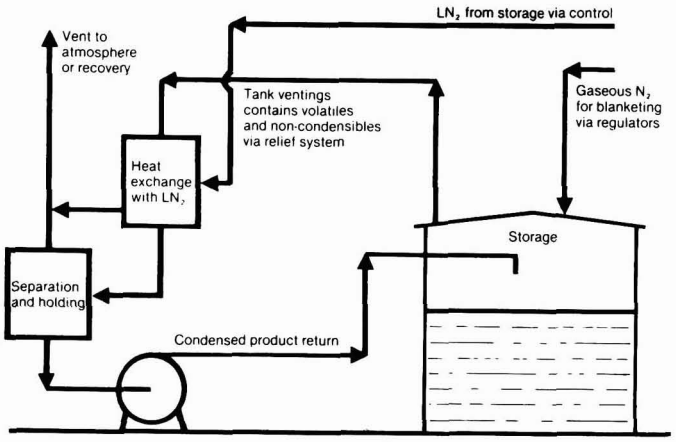
The evaluation of protective coatings on rusty steel with the use of electrical resistance probes as substrates *by R. R. Bishop and M. A. Winnett*

Effect of pigmentation level on the efficiency of triple roll milling *by W. Carr, D. Patterson and M. Tonge*

Industrial nitrocellulose *by A. W. E. Staddon*

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

news



BOC's new process for the recovery of volatile chemical vapours

New BOC process for chemical recovery

BOC Limited has developed a new system to recover chemical vapours by condensation.

The new process will use liquid nitrogen and is designed to cope with a very wide range of flow rates and mixture compositions. It recovers the vapour as a liquid for re-use, without the need for expensive separation techniques and the nitrogen also provides a safety blanket in the storage tank.

The main uses for the process will include blanketing volatile materials, drying liquids and solids, and purging vessels at plant start-up or shut-down.
Reader Enquiry Service No. 44

Powders into pellets

Bipel hydraulic pelleters, well known and widely used in the plastics industry according to the makers BIP Engineering Division, are now being used in other industries for compacting a wide variety of powders. Bipel pelleters have been successfully used with explosives, dehydrated foods, red lead, porcelain, powdered copper, calcinated soda, PTFE and even salt blocks for cattle.
Reader Enquiry Service No. 36

Raw materials information system

A worldwide computer based information system for rapid enquiries of the technical properties of raw materials used in ink and associated chemical manufacturing, has been developed by CMG Computer Management Group for the Technical Development Department of Coates Brothers & Company Ltd.
Reader Enquiry Service No. 34

Receiver appointed to Burrell & Co.

The Directors of Burrell & Co. Limited regret to announce that on 4 August 1980 they requested the company's principal bankers to appoint a receiver. Mr Ian McIsaac of Touche Ross & Co. was appointed.
Reader Enquiry Service No. 42

PRI Urethane Medal

Professor Otto Bayer, the acknowledged father of polyurethane chemistry, is the first overseas recipient of the Urethane Medal of Merit awarded by the Plastics and Rubber Institute for services to the urethanes industry.
Reader Enquiry Service No. 40

Reckitt's Colours investment

Customer advisory and research services at Reckitt's Colours, the world's largest producer of ultramarine, have been expanded following a £160,000 re-equipment and refurbishing programme at the company's Hull (Humberside) headquarters.

Plans are well advanced for further investment totalling £75,000 in the laboratory.
Reader Enquiry Service No. 38

New organisation

Peirson Process Equipment has been formed as a sales organisation representing certain well-known manufacturers of storage tanks, pumps, positive displacement flowmeters, solvent recovery plant, as well as a pipework fabricator and builder.
Reader Enquiry Service No. 37

Electron microscope service

Pyrene Chemical Services Limited is now able to undertake scanning electron microscope investigations on behalf of any company throughout general industry. An ISI40 scanning electron microscope has been installed in the company's Customer Service Laboratory and a fully qualified operator recruited though principally for Pyrene's own R & D work, spare capacity will be offered to others at competitive rates.
Reader Enquiry Service No. 35

New safety laws for industry

Criminal prosecutions could follow failure to comply with new regulations which come into effect on 1 January 1981. The regulations entitled "Notification of Accidents and Dangerous Occurences Regulations 1980" have been introduced by the Government to ensure that all accident and "mishaps" are recorded and reported to "the appropriate safety law enforcement agencies".

The British Safety Council, in an effort for industry to understand the regulations, has produced a booklet which answers more than 120 important questions raised by them and which is essential for all of Britain's employers who wish to avoid criminal proceedings.
Reader Enquiry Service No. 39

SPL/Nigeria

The Chief Executive and three directors of the new company Home Charm Paints (Nigeria) Ltd have visited the West Yorkshire based Silver Paint & Lacquer Co. Ltd, top of the agenda were international relations and a new overseas factory.
Reader Enquiry Service No. 52

Hercules expansion

Hercules has announced a major expansion of their Natrosol (hydroxyethylcellulose) plant at Zwijndrecht, Holland. The increased capacity will be ready in early 1982.
Reader Enquiry Service No. 43

Brazilian aquisition

International Paint has acquired a controlling interest in Supertintas SA of Sao Paulo, Brazil, this increases their number of factories to 38 in 24 countries.
Reader Enquiry Service No. 31

news

Agent for Paint Chemicals Inc.

Capricorn Chemicals has recently been appointed sole UK agent for Paint Chemicals, Inc. of Illinois.

The Paint Chemicals Inc. product range consists of various additives to prevent flooding, floating, silking and bubbling and to improve mar resistance and levelling in a variety of paint systems.
Reader Enquiry Service No. 33

new products

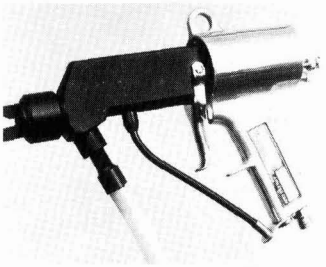
BP Chemicals launches new range of polyester gelcoats

Following extensive industrial trials, BP Chemicals has launched Cellogel, a new range of five polyester gelcoat resins, specifically formulated to complement the Cellobond range of lay-up polyester resins. A full range of Cellogel technical data is now available to the processing industry.
Reader Enquiry Service No. 45

New digital thermometer

Northern Instruments (Leeds) Ltd have introduced a new series of hand-held, battery-powered digital thermometers. Known as the 8000 series, these low-cost instruments are housed in a low profile, smooth, impact-resistant case. Twelve versions of the 8000 series are available. These cover an over-all operational temperature range from −150°C to +1,750°C.
Reader Enquiry Service No. 51

The new 8000 series



The Speedflor electrostatic cartridge gun

Self-powered electrostatic spray gun

The first completely self-powered electrostatic spray gun has been introduced by the Speeflo Manufacturing Corporation. The new electrostatic cartridge gun which is marketed in the UK by Gray-Campling Ltd, weighs only two pounds and produces 55 kV from a self-contained nine ounce cartridge.

Available in both air atomising and airless systems, the new range provides a choice of models for any electrostatic product application.
Reader Enquiry Service No. 46

Anti-corrosion materials recycled

Current interest in the conservation of resources and the recycling of materials has stimulated renewed interest by Carrier Engineering Company, into the recovery of overspray products. Using their patented Hydrospin paint spray booth, they recently demonstrated the viability of the recovery of waxes used for spraying internal box sections.
Reader Enquiry Service No. 47

New BASF pigment and binder

Paliotol Yellow KO965 is a new quinophthalone pigment that has been placed on the market by BASF. It has a pure greenish shade and is highly transparent. Its extremely high colour strength ensures great economy in colouring. It is particularly recommended for colouring PVC, polyolefines and other thermoplastics.

Suprapal A 954 F, supplied by BASF, is a styrene/acrylic copolymer that drys by physical means and contains carboxyl groups. It is a suitable binder for road marking paints and paints for metal and mineral substrates. The hard binder can be dissolved rapidly and can tolerate large proportions of plasticisers. Suprapal A 954 F has high resistance to yellowing at high temperatures and good resistance to oil.
Reader Enquiry Service No. 50

New salt spray cabinet

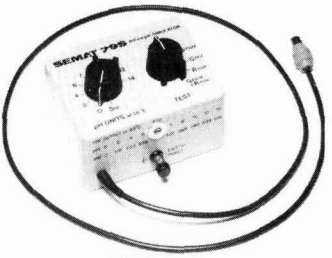
Elcometer has introduced the new Erischen Salt Spray Cabinet Model 606. New features include 200 litre storage to ensure several days operation a new type of resistance surface heating (electrically controlled and guarded against overheating), easily accessible but protected control console which is integral with the unit and constant spray vapour volume achieved by use of a new design of spray jet.
Reader Enquiry Service No. 53

QS. in-line filters

Stockdale Engineering Ltd has introduced the QS. Cartridge Filter to the European market. The company claims considerable savings can be made in the time taken to change or replace a cartridge in an in-line filter. The cartridge has an extended core with an integral "O" ring seal eliminating the need for holding rings, springs, tie rods or bolts. The cartridge need only be guided into the funnel shaped housing and pushed home.
Reader Enquiry Service No. 49

Semat pH/mV simulator and colorimeter

Semat (UK) have introduced a pocket-sized portable pH/mV simulator which can be used to rapidly check the calibration of instruments on-site or in the laboratory.



mV/pH simulator

Also introduced is the C065 colorimeter. It is constructed in a rugged metal case with solid state electronics and uses a double wound transformer to stablise supply to the lamp thus avoiding errors due to changes in light intensity.
Reader Enquiry Service No. 54

The C065 colorimeter

literature

Albright & Wilson brochure

"International in Chemicals" is the title of Albright & Wilson's new publication, which describes the range of products and services available from the company.
Reader Enquiry Service No. 55

Standards for paint pigments

New British Standards which implement ISO work from the British Standards Institution have been published. They relate to paint pigments, several tests under BS 3483 "Methods of testing pigments for paints" and a specification, BS 3982 "Zinc dust pigment". BS 3483 Part B9 "Determination of density relative to water (using a centrifuge)" (ISO 787/23). Part C1 "Determination of matter soluble in water (hot extraction method)" (ISO 787/3). Part C7 "Comparison of resistance to bleeding" (ISO 787/22). BS 3982 "Zinc dust pigment" (ISO 3549) specifies the required characteristics and tolerances for zinc dust pigment manufactured by a distillation process.
Reader Enquiry Service No. 56

New business report on paints and varnishes

Although increased raw material costs and the effects of the recession have placed pressure on margins and volume growth, the British paint industry is in a generally healthy state according to business information specialists, Key Note Publications. In their latest report on the industry, Key Note expects volume growth of around 1.5-2 per cent and highlight industrial powder paints and DIY paints as probable growth areas.

"Paints and Varnishes" is the second edition of Key Note's work on the subject and covers both industrial and decorative paints.
Reader Enquiry Service No. 57

Dominion Colour

Dominion Colour have announced their new DCC brochure "Pigments for Coatings, Inks and Plastics". The publication describes the complete range of inorganic and organic pigments manufactured by DCC, together with colour chips to give an indication of the colour of each grade. Prices of all grades are available on request.
Reader Enquiry Service No. 58

Applied Science Publishers Ltd

Applied Science Publishers Ltd have published the following new books in the surface coatings field: "FRP Technology", "Developments in Polymer Stabilisation – 2", "Photochemistry of Dyed and Pigmented Polymers", "Developments in Rubber and Rubber Composites – 1".
Reader Enquiry Service No. 59

meetings, etc.

7th annual conference

The 7th annual conference in Organic Coatings Science and Technology will be held in Athens, Greece on 13-17 July 1981. Anyone interested in participating should contact the conference director, Prof A. V. Patsis, School of Chemistry, State University of New York, Coykendall Science Building, Room 209, New Paltz, New York 12561, USA.

news

appointments

Christine A. Morrell has been appointed Technical Representative by Vinyl Products Ltd.

Mr Rex Chester has been appointed to the main board of Trincentrol as a non-executive director.

Mr John Bickers has been appointed as a director of Lead Industries Group Ltd. Mr Bickers was previously Managing Director of Goodlass Wall & Co. Ltd at Speke.

Mr R. B. Horton is to be appointed Managing Director of BP Chemicals International Ltd and BP Chemicals Limited and also a director of BP Trading Limited on 1 November 1980.

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

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Obituaries

Arthur de R. Penfold

Arthur Penfold was born in Sydney in 1890 and died in Canberra after a period of illness, on 16 June 1980 within six weeks of his ninetieth birthday.

He was for many years Curator of The Museum of Technology and Applied Science (as it was then called), in Sydney and he retired from that position in 1955.

He was a very distinguished scientist and was author or co-author of many papers concerned with the chemistry of the essential oils of the eucalyptus and other species of native trees. He was a member of the Royal Society of NSW and was awarded the Society's Medal in 1951.

Arthur Penfold's connection with the Oil and Colour Chemists' Association, in Australia, dates from November 1944 when he was elected Chairman of an interim committee formed at a meeting called by Mr Frank Adams at the request of Dr H. W. Keenan, the then President of OCCA in England, with the objective of forming a Section of the Association in Australia. This Interim Committee consisted of Arthur Penfold and five others who were already members of the English Association, and it worked steadily on with that objective in view. In July 1945, Arthur Penfold, in person, was able to present to the Council of the Association in London a Petition containing some fifty names of persons including two from Victoria and one from South Australia, who desired to become members of an Australian Section and this Petition was speedily acceded to, Arthur Penfold being made an Honorary Member of OCCA in England in appreciation of his efforts in this matter.

In January 1946, Mr H. Clayton, then a Vice-President of OCCA visited Sydney and at a meeting with Members of the Interim Committee, details for the inauguration of the new Section were discussed and clarified.

Finally on 9 August 1946 the Inaugural Meeting of the Section was held in Sydney, it being agreed that it should be known as "The Australian Section" and Arthur Penfold was elected Foundation Chairman, a position he held as well as that of Chairman of the New South Wales Branch during 1947 and 1948. During these years the Section, which later consisted of a Victorian as well as a NSW Branch, continued to grow in strength, morale and numbers. For some years afterwards he continued to show keen interest in OCCA affairs and was able to attend some of the technical and social events until prevented by ill health.

Arthur Penfold was an ideal Foundation Chairman and although he did not actually belong to the paint manufacturing industry he was widely and favourably known in it through his

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participation as a member of the Scientific Liaison Bureau and on various committees associated with it during the War. Moreover his high standing in scientific circles and his position as Curator of the Museum of Technology and Applied Science gave added prestige to the new Section.

He was also very well versed in the rules covering conduct of both General and Committee meetings. In Committee Meetings under his chairmanship he kept a firm hold on discussions and so invariably a large volume of business was able to be completed in a reasonable time. As Chairman of the Monthly Technical Meetings he set a very high standard for punctuality etc., and was meticulous in his handling of the business of the meetings. He was highly respected by all members and no doubt the subsequent growth and success of the Sections of OCCA Australia is in no small measure due to the sound foundations laid during his years of office as Foundation Chairman.

L.C.

Maurice Tapin

Mr H. C. Worsdall writes:

Readers, particularly those of the London Section, will be saddened to hear that Maurice Tapin died in June after a long illness.

Maurice Tapin was one of my closest friends. I first met Maurice in 1950 in connection with business, the encounter leading to a deep personal friendship which developed into a family relationship. My family will miss the visits of "Uncle Maurice", as much as I will.

Maurice was a native of the Auvergne and during the last war was an officer in the artillery, being captured near Rennes in Brittany whilst making his way to the coast. Can I say anything to honour him more than to say he finished up in Colditz?

When it came to AFTPV and OCCA Maurice was a real enthusiast after being secretary, vice president and president of the former and a member of the London Section Committee of OCCA, only ceasing his activities two years ago when he became ill. His wife Marcelle supported him in these activities and was a guest speaker at a London Section Ladies' Night in 1958 and with Maurice and their children came to the Hastings Conference, Marcelle reading her paper. Many London members will remember the joint London Section meeting with AFTPV when the two groups visited the BTP plant at Calais and Maurice led the French delegation.

Those of the Association who are not London members will no doubt remember his visits to the exhibition – I don't think he missed one from 1951 to 1978.

To those who would like to pay a tribute to his memory may I ask them to do what Marcelle and his children have requested – send a donation to L'Institut de Recherche sur le Cancer.

The sympathy of OCCA members is with Marcelle and the children.

News of members

Robert Goodman, an Ordinary Member attached to the General Overseas Section has had to retire from his company, Glasurit SA, Madrid, through illness.

Mr Goodman, who has been working in the paint industry for the last 17 years and has mainly specialised in the R&D of anti-fouling coatings, is now prepared to offer advice on a consultative basis and can also offer a technical and commercial translation service for Spanish/English.

The President's Page

The views expressed here are those of the President and are therefore not necessarily always official policy.

Members should be aware of the important events in the OCCA calendar, and the significant discussions which are continually taking place. As your President, I have to be involved in most of these and, for the second time in my two years of office, I should like to share them with you.

Conference

The year opened with the Scottish Ladies' Night which maintained its usual high standard. At that time we were able to explore the possibilities of holding the 1981 Conference in Edinburgh; we were reluctantly forced to the conclusion that, even using the Assembly Rooms for the official events, there was just not sufficient suitable hotel accommodation available in tourist-popular Edinburgh in June. We shall, in the event, be holding the 1981 Conference in Bath, and we look forward to good support at this new and attractive venue.

The venue for the 1983 Conference has not yet been fixed, but we plan to hold the 1985 Conference in Aviemore to coincide with the Scottish Section's 50-year Celebrations. Travel and hotel facilities are very good, so be prepared for this event.

Education

The Conference has a basis in new technology and education, two of the most important of our activities. To emphasise this we have appointed Arthur Rudram as our new Honorary Technical Education Officer, to head and pioneer our activities in the new situation in which we find ourselves. This situation results from the disappearance of the HNC and City and Guilds qualifications, and their replacement by TEC and SCOTEC qualifications; in addition, the low demand for more advanced courses and cuts in education spending threaten the very existence of such courses. Here is a clear opportunity for OCCA to act as sponsor for appropriate courses for technicians and diploma candidates at appropriate colleges, whilst working closely with the Technical Education Committees of the Paintmakers Association and the British Printing Ink Manufacturers Association.

We are also keen to support distance-learning facilities and, above all, to give recognition to successful candidates through the Professional Grade qualifications of OCCA. We hope also to be able to give recognition to technicians' qualifications.

Exhibition

The new venue was a great success and, financially, the result will be helpful to the Association. We believe exhibitors and visitors alike were reasonably satisfied, although a threatened transport strike on the middle day, and the final day being Ascension Day, will have deterred some Continental visitors. Next year we should be free from these problems: 28, 29 and 30 April – Cunard International Hotel.

We have met all the demands of our critics, except in reducing the frequency of the Exhibition, and this we now feel unable to do in view of increasing competition on the Continent and our own need to maintain continuity. It is not true that we had anything to do with the burning down of Alexandra Palace!

We had considered the possibility of linking in with FATIPEC by taking our Exhibition to the Continent on alternate years and showing with their Congress. Unfortunately we did not get an encouraging response to our overtures, and they will run a commercial venture at Liege in 1982.

International

During the FATIPEC Congress in Amsterdam, the third meeting of the International Co-ordinating Committee (ICCATCI) was held.

Taken at the New Zealand Division Annual Convention, Rotorua, 1st-3rd August, 1980. Standing (from left to right) Owen Brett, Ray Bell, Bill G. Paul (Chairman, Auckland Section), Bob Bettison (Vice-President Designate), Graham Willis (Chairman, Wellington Section), Peter F. Sharp, R. Ness, Tom W. Slinn, Roger Meek. Seated) from left to right) Dr F. M. Smith, President, OCCA, Colin Gooch, Vice-President, New Zealand Division

Good progress has been made for the production of a bibliography on automated paint production by the American FSCT as the first step towards an international investigation. These meetings are useful to maintain contact between the organisations concerned.

Australia

OCCA Australia was formed on 1 January, 1968 and, since then, has proved that it can stand very successfully on its own feet. It has maintained the professional qualifications, runs a bi-monthly publication, Proceedings and News, and produces a Raw Materials Index. Individual State Committees run a Convention in their turn. The Convention is not only a technical conference (at which I was able to present a paper), but an annual gathering where members from all over Australia come together for a reunion and to hold the Annual In-Person Meeting of the Australian Federal Committee. It is ably guided by a 4 man Advisory Committee of Past Presidents.

When the Constitution was drawn up, it far-sightedly envisaged and referred to OCCA International, of which it would be a part. I believe the time has come for the formation of such a body, and I shall be proposing this through the appropriate channels. I see a non-governing titular body which can act very much like the AFC.

Our friends in Australia are conscious of the support given to Australia by OCCA UK in its early years, and are very keen to join in an international arrangement with us. Your President and his wife were very well received, and I was invited to speak at their Convention Dinner. They extended their highest honour by making me an Honorary Member of their Association, a gesture which I was proud to accept.

I hope we can expedite a federal system whilst all the conditions are favourable.

New Zealand

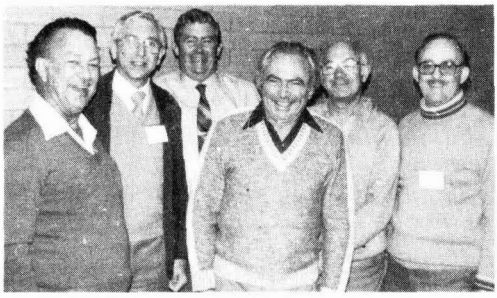
It is well known that discussions have been in hand for some years on the subject of a constitution for the New Zealand Division, and a means of making them more autonomous from a financial point of view. Their constitution is effectively agreed, and it is established that they can fix their own subscription rates, subject to ratification by Council. One outstanding problem was the method of calculating the remittance from New Zealand to the UK. It has been proposed that they should pay a marginal cost for the Journal and 20 per cent of the average administration costs per member.

This proposal is probably not unreasonable considering the New Zealand economy and the fact that a heavy burden of responsibility falls on their honorary officers. They have their own local activities and, in addition, are dealing with local education affairs in the same way as ourselves. They have a Professional Grade Advisory Committee and deal with all local administration. But, above all this, they run their own Convention, the Auckland and Wellington Sections taking the responsibility alternately. Not unnaturally they feel they are entitled to carry the cash surplus over from one year to the next.

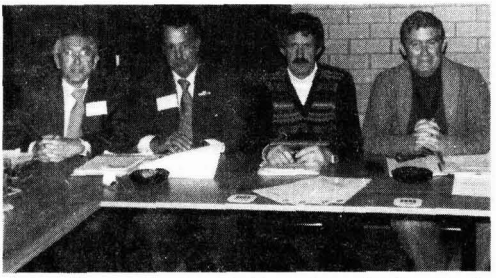
I believe we should give all the support we can to their hard working members, and congratulate them on their successes. I was able to give a lecture at this year's Convention, run very successfully by the Wellington Section, at Rotorua, and was invited to speak at their Convention Dinner. My wife and I were extended the most kind hospitality by all, including the New Zealand Vice-President, Mr Colin Gooch and his wife, and the Wellington Chairman, Mr Graham Willis and his wife. At the conclusion of the Convention I was presented with a Maori ceremonial Mere (a defensive weapon pronounced "meri").

Past Presidents

This year the Past Presidents were invited to a discussion of the Association's



The President of OCCA, with the President of OCCAA, Russel Craig (third from left), and the AFC Advisory Committee, John H. Foxton, E. T. Backous, Ted Collins, Mal Stewart



From left to right Dr F. M. Smith, President, OCCA, John H. Foxton, Immediate Past President, OCCAA, Brian Lourey, President Elect, OCCA, Russel Craig, President, OCCAA. At the OCCAA AFC In-Person Meeting, Tanunda, 16 July, 1980

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affairs, in June, prior to the official Lunch held this year in place of the official Dinner. This was followed by the Biennial lecture given by Professor Sir Herman Bondi on "Energy in the World" which, in turn, was followed by the AGM.

In conclusion, my wife and I were very pleased to attend the Thames Valley and Newcastle Sections' Ladies' Nights in February, and the Bristol Section Ladies' Night in March. The important Biennial Dinner was held at the Savoy in April and was an enjoyable success, with Professor Norman, President of the Royal Institute of Chemistry as our Chief Guest. As President, I attended the 15 year celebrations of Kenroy Dispersions Ltd, the Society of Dyers and Colourists' Annual Dinner, and proposed a toast at the Hydrocarbon Solvent Association's Annual Dinner.

F. M. Smith
President

Motif designed by Robert Hamblin

OCCA-33 Exhibition

28-30 April 1981

Cunard International Hotel Hammersmith, London W6

CLOSING DATE FOR APPLICATIONS 30 NOVEMBER 1980

General information

Applications have already been received, both from United Kingdom and overseas organisations, for the 33rd Annual Exhibition of the Oil and Colour Chemists' Association (OCCA-33) for all the various types of Exhibition facilities being offered.

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

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

OCCA-33 will take place at the Cunard International Hotel, Hammersmith, London, W6 on 28, 29 and 30 April 1981 from 9.30 a.m. to 5.30 p.m. The closing date for applications to exhibit will be 30 November 1980 but those organisations intending to exhibit are urged to submit their applications as quickly as possible.

Any organisation which has not previously shown at an OCCA Exhibition and would like to do so should write to the **Director & Secretary** of the Association at **Priory House, 967 Harrow Road, Wembley, Middlesex, HA0 2SF, England.** Telephone: **01-908 1086,** Telegrams: **OCCA Wembley** Telex: **922670 (OCCA G).**

The main part of the Exhibition will be in two sections. The entrance to the Exhibition will be on the ground floor in the new Exhibition Hall, in which exhibitors of heavy machinery, plant and equipment or those wishing to have the traditional style of stand will be situated. **For OCCA-33 it is intended to arrange for a licensed bar to be available in the New Hall.**

On the first floor, additional exhibitors, mainly of raw materials, laboratory equipment or other small exhibits, will be accommodated in the Queen Mary Suite, in which the stands will be of a modular design. The Queen Mary suite is a large pleasant room which is decorated and carpeted as an integral part of the hotel.

Access between the two Exhibition areas will be through the intermediate Mezzanine floor, on which a small number of rooms will be available for exhibitors to display free standing exhibits.

In addition, several suites and rooms will be available for those companies who wish to use that type of facility to exhibit, or to entertain their visitors in addition to their stands in the main halls.

The Cunard International Hotel is able to offer both exhibitors and visitors to the Exhibition a selection of restaurants, a coffee shop, bars, shopping facilities and other services available in most hotels.

Travel facilities

The Cunard International Hotel is situated near Hammersmith Station on the Piccadilly Underground Line, between Heathrow Airport and the centre of London. Visitors from overseas may board the Piccadilly Line at Heathrow Central station in the Airport complex, which will take them direct to Hammersmith station or to central London where they may be staying.

Car parking space at the hotel will be limited, but there is a large NCP car park close by in Kings Mall. However, those travelling to the Exhibition by car are advised to leave their vehicles outside central London and to travel to the Hotel by the Underground system.

Official Guide

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

Advertising space in the *Official Guide* will be offered to those companies participating at the Exhibition. Advertising space in the 1981 *Official Guide* will not be restricted solely to those to whom space is allocated for the 33rd Annual Exhibition, and companies who will not be applying for stand space may well wish to secure advertising space in this important medium. Full details of the availability of advertising space, rates, special positions etc., may be obtained from the Assistant Editor at the address given opposite.

new 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

ANONEN, DAVID WAYNE, BSc, 111 Raglan Avenue, Apt. 1708, Toronto, Ontario, Canada M6C 2K7. (*Ontario*)

BAMBER, GEOFFREY MALCOLM DAVID, BSc, CChem, MRSC, 4 Pheasant Drive, High Wycombe, Bucks HP13 5JH. (*Thames Valley*)

BELLUNGHI, RAUL ANDRES P., Edificio Miraciolos, Apartamento 63, Torre Sur, El Trigal, Valencia, Venezuela. (*General Overseas*)

OWEN, TIMOTHY GEOFFREY, MSc, "Springwood", 31 High Street, Pattingham, Staffs. (*Midlands*)

PEPLOW, GEORGE, BSc, Pearl Paints Mediterranean Ltd, Factory RL7, Ricasoli Industrial Estate, Kalkara, Malta. (*General Overseas*)

RIGBY, JOHN, BTech, CEng, MIChemE, 10 Starfield Avenue, Littleborough, Lancs OL15 0NG. (*Manchester*)

ROLLINS, KEITH, BTech, GradRIC, 17 Arden Close, Simmondley, Glossop, Derbys. SK13 5PD. (*Manchester*)

SIM, RICHARD ALASTAIR, BSc, Universal Milling Co. Pty. Ltd, Box No. 15, Bentley 6102, W. Australia. (*General Overseas*)

Jordan Award

This award was instituted by the late Mrs M. R. Jordan in memory of her husband Dr L. A. Jordan, who was President of the Association 1947-49 and an Honorary Member, and who died in December 1964. The Committee invites applications for the sixth award of £100.

The rules of the Award are:

1. The Award will be made for the best contribution to the science or technology of surface coating by a Member of any nationality working in either the academic or industrial field who is under the age of 35 at the date of application.

2. The final date for submission of applications will on this occasion be 31 December 1980 and it is hoped to present the award at the Bath conference in the following June.

3. The selection of the recipient of the Award will be made by a Committee under the chairmanship of the Association's Hon. Research and Development Officer.

4. There will be two methods of application. First, by the submission of a paper describing original work by the candidate which is offered for publication in the *Journal* or has been so published during application. The alternative method will be by recommendation by a superior for work which for reasons of commercial secrecy cannot be published; in this case the candidate will be expected to submit a dissertation on a topic relating to his work and demonstrating his superior knowledge of the principles thereof. The Award is for individual merit and clear evidence of the candidate's own contribution will be required if a paper is offered under joint authorship.

5. Applications should be addressed to the Director & Secretary at the Association's offices.

occa diary

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

October

Thursday 2 October

Newcastle Section: "Maintenance and Protection against Corrosion of North Sea Structures", by F.M. Small, Berger, at the Students Common Room, St. Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m.

Thames Valley Section: "Modern Coatings a curse or a blessing" by D. A. Bayliss of BIE (Anti-Corrosion) Ltd, at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing at 6.30 p.m. for 7.00 p.m.

Friday 3 October

Hull Section: Annual Dinner Dance to be held at the Willerby Manor Hotel, Willerby, Hull, details to be announced.

Monday 6 October

Hull Section: "Handling and Process Control in a Paint Factory" by H. Houben of TBMA Holland. Joint meeting with S. Humberside Chemical Engineers' Association to be held at the Humber Bridge Hotel, Bolton-on-Humberside, S. Humberside.

Tuesday 7 October

West Riding Section: "Chip Dispersions - Manufacture and Uses" by F. J. Morpeth of Foscolor Ltd, at the Mansion Hotel, Roundhay Park 8, commencing at 7.30 p.m.

Thursday 9 October

Scottish Section: "Searching for Oil in Alaska" by J. R. Taylor, BSc, FRIC, FTSC, at the Albany Hotel, Glasgow, commencing at 6.00 p.m.

Thursday 9 October

Midlands Section – Trent Valley Branch: "Iron Oxides and their production over the past 150 years" by S. N. Hawley of W. Hawley & Son Ltd, at the Derby Crest Motel, Pasture Hill, Littleover, Derby, commencing at 7.15 p.m.

Friday 10 October

Manchester Section: Lecture "Plastics for Buildings – 13 Years on" by B. Wade of Leeds Polytechnic, at the Manchester Polytechnic, New

occa diary

Administration Building, All Saints, commencing at 6.30 p.m.

Thursday 16 October

Midlands Section: "Powder Coatings" by L. Whitfield of BIP Ltd, at the Calthorpe Suite, County Cricket Ground, Edgbaston, Birmingham, commencing at 6.30 p.m.

Friday 17 October

Manchester Section: Annual Dinner Dance, at the Piccadilly Hotel, Manchester. *Details to be announced.*

Scottish Section – Eastern Branch: Annual Skittles Match, in the Carousel Inn, 145 Ferry Road, Edinburgh.

Thursday 23 October

London Section: "A lone-eyed view of the last half century of paint" by J. J. Froggatt, at the Rubens Hotel, Buckingham Palace Road, SW1, commencing at 7.00 p.m.

Friday 24 October

Irish Section: "Latest British Standards" by F. Timmins, sponsored by ICI Ireland Ltd, at the Clarence Hotel, Dublin, commencing at 8.00 p.m.

Friday 31 October

Bristol Section: Ladies' Evening, followed by informal supper Traffic Management, Chief Inspector R. Stone.

Midlands Section - Trent Valley Branch: Halloween Buffet and Dance at the Cross Keys Inn, Turnditch. *Details to be announced.*

November

Monday 3 November

Hull Section: "Marketing in the Paint Industry" by L. F. McCulloch of Blundill-Permoglaze Ltd, at the Queens Hotel, George Street, Hull, commencing at 6.45 p.m.

Tuesday 4 November

West Riding Section: Lecture by a speaker from Shell Chemicals (UK) Ltd. *Details to be announced.*

Thursday 6 November

Thames Valley Section: "Application methods and in particular automatic systems" Lecture and films - DeVilbiss Co. Ltd, at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing at 6.30 p.m. for 7.00 p.m.

Newcastle Section: "Some training considerations for R & D". C. Murray, CAPITB, at the Students Common Room, St. Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m.

Friday 7 November

Irish Section: Annual Dinner Dance, to be held at the Clarence Hotel, Dublin, commencing at 8.30 p.m.

London Section: Ladies' Night to be held at the Selsdon Park Hotel, Sanderstead, Surrey, commencing at 7.00 for 7.30 p.m.

Monday 10 November

Manchester Section: Lecture "Formulation of Lead Free Paints" by W. Kelch of BASF Ltd, Woodcourt Hotel, commencing at 6.30 p.m. *Details to be announced.*

Tuesday 11 November

Midlands Section - Trent Valley Branch: "Recent technical developments in chlorinated rubber paints" by G. Humphreys of ICI, at the Derby Crest Motel, Pasture Hill, Littleover, Derby, commencing at 7.15 p.m.

Wednesday 12 November

London Section: "Plastics & Paints against Corrosion". A one-day joint symposium with the Plastics & Rubber Institute, at the Thames Polytechnic, Woolwich, SE18, commencing at 10.00 a.m.

Thursday 13 November

Scottish Section: Joint Lecture with the Society of Dyers and Colourists, Albany Hotel, Glasgow, at 7.30 p.m. "Effluent Problems" by W. G. Warwick, BSc, Project Engineering Manager, Ciba-Geigy P & A Company. "Toxicology" by J. Craig, Product Safety Executive, Ciba-Geigy Paints & Adhesives Company.

Wednesday 19 November

Manchester Section: Student Lecture "Pigment Packing and the Optimum Use of Extenders" by Manchem Ltd, at the Manchester Polytechnic, New Administration Building, All Saints, commencing at 4.30 p.m.

Scottish Section - Eastern Branch: "Organic Pigment Developments for the Printing Ink and Paint Industries" by Adrian Abel, of Hoechst (UK) Ltd, at the Murrayfield Hotel, 18 Corstorphine Road, Edinburgh, commencing at 7.30 p.m. It is hoped to arrange a light buffet at this function.

Thursday 20 November

Midlands Section: Student Lecture "General Corrosion Protection" by E. V. Carter of Miox Ltd, at the Calthorpe Suite, County Cricket Ground, Edgbaston, Birmingham, commencing at 6.30 p.m.

Friday 28 November

Bristol Section: "Pigments", D. Austin, Sun Chemical Corporation, *details to be announced.*

West Riding Section: West Riding Ladies' Evening Dinner and Dance to be held at the Crown Hotel, Harrogate.

December

Monday 1 December

Hull Section: "Appreciation and Application of Microprocessors" by H. Dempsey, Senior Lecturer, Hull College, at the Queens Hotel, George Street, Hull, commencing at 6.45 p.m.

Tuesday 2 December

West Riding Section: "Colour Measurement and Surface Coatings" by Dr D. A. Plant, at the Mansion Hotel, Roundhay Park, Leeds 8, commencing at 7.30 p.m.

Thursday 4 December

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

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

Friday 5 December

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

Thursday 11 December

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

Friday 12 December

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

OCCA CONFERENCE 1981

ALTERNATIVE TECHNOLOGIES IN COATINGS

The next OCCA Biennial Conference will be held at the Beaufort Hotel, Bath from 17 – 20 June 1981 with the theme "Alternative technologies in coatings".

The future holds both opportunity and challenge for alternative technologies and topics covered by the Conference should include, EEC regulations covering the introduction of new chemicals, alternative means of obtaining opacity, the impact of microprocessors and computers on processing and application methods, high solids coatings, aqueous systems, radiation curing and powder coatings.

A departure from the usual conference format will be the inclusion of a "Discourse" session with the sub-title "Alternatives to coatings", where the use of techniques such as cathodic protection and substitution of coated items by plastics could be discussed.

The Hon. Research & Development Officer now invites offers of papers for presentation at this Conference. Anyone wishing to submit a paper for consideration should notify his intention as soon as possible to: **The Director & Secretary, Oil & Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF, England (Tel: 01-908 1086; Telex: 922670 OCCA G).**

CLASSIFIED ADVERTISEMENTS

Classified Advertisements are charged at the rate of £5.00 per single column cm. Advertisements for Situations Wanted are charged at £1.50 per line. A box number is charged at £1.00. They should be sent to D. N. Buddles, Assistant Editor, Oil & Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF. JOCCA is published EVERY month and Classified Advertisements can be accepted up to at least the 12th, and in exceptional circumstances the 20th of the month preceding publication. Advertisers who wish to arrange for an extension of the copy deadline should contact the Assistant Editor, D. N. Buddles, at the address given above (telephone 01-908 1086, telex 922670 OCCA G).

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This position provides an opportunity for a suitably qualified person to build up his/her own department without unnecessary interference and in congenial surroundings. A suitable car would be provided and membership of a pension scheme offered, but there would be no other fringe benefits, as the salary paid would be above average for this type of position.

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MISCELLANEOUS

MANCHESTER SECTION – OCCA
Annual Dinner Dance

The Annual Dinner Dance of the Manchester Section will be held in The Peacock Suite, Hotel Piccadilly, Manchester on Friday, 17 October 1980.

Reception at 7.00 pm for dinner at 7.45 pm. Tickets are £14.95 per person, inclusive of VAT, and dress will be formal.

Applications for tickets should be made to:

D. J. Wilcox,
Manchem Limited, Ashton New Road,
Clayton, Manchester M11 4AT

WEST RIDING SECTION – OCCA
Dinner Dance

The Twenty-Second Annual Dinner and Dance of the West Riding Section will be held on Friday 28 November 1980 at the Crown Hotel, Harrogate. The ticket charge will be £13.50. Special concessionary rates have been arranged for those wishing to stay overnight at the Crown Hotel.

Applications for tickets should be made to:

E. H. A. Bishop,
145 Wakefield Road,
Garforth,
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Journal of the Oil and Colour Chemists' Association

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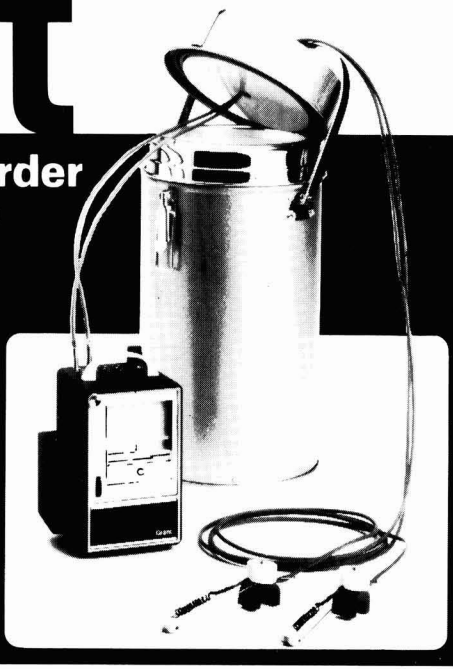
Grant

Oven Temperature Recorder



Grant oven recorders solve the problem of recording the temperature of objects passing through conveyor ovens. A miniature chart recorder travels through the oven in a vacuum flask with its sensors attached to the object being heated. Applications include: Paint-stoving ovens, Bread-baking ovens, Impregnation ovens for electrical components, Shoe-welding ovens and food and drinks pasteurisation.
Other recorders in the Grant range are the Cassette data recorder, Memory temperature recorder, Miniature temperature and humidity chart recorders. In common with the Grant range of laboratory equipment the oven temperature recorder is backed by a 48-hour turn-round on repairs in the unlikely event of a malfunction.

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

BLOCK LETTERS PLEASE