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JOCCA

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MICACEOUS IRON OXIDE ON AN EDGE

ANTIFOULING PAINTS

CHLORINATED RUBBER AND W W ROSIN

CADMIUM SULPHOSELENIDE PIGMENTS

SURFEX 86 REVIEW

Journal of Oil and Colour Chemists' Association,
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Transactions and Communications

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

The orientation of micaceous iron oxide particles in organic coatings applied to edges

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Summary

This paper describes the properties and orientation of micaceous iron oxide (MIO) particles in various generic types of applied organic coatings. Scanning electron microscopic examination of dried paint film cross-sections clearly illustrate a strong tendency for the MIO particles to lie with their thinnest cross-section approximately parallel to the paint film substrate, even on substrate edges. This parallel orientration results in an increase in resistance to permeability of water and corrosive agents through the paint film, provides mechanical reinforcement of the paint film and shields the medium from degradation by UV radiation.

Experimental work also demonstrated the need to build-up the paint thickness on edges independent of the generic type of paint and pigment used. Ensuring that edges received the required paint thickness would thus minimise the possibility of early coating failure.

Introduction

Micaceous iron oxide (MIO) pigmented paints have been successfully used for nearly a century in Europe and many other parts of the world to provide long term corrosion prevention for structural steelwork such as bridges, harbour installations, electricity transmission towers and general steelwork exposed to all types of marine and industrial environments[1-3]. However, there are some proven instances in Australia where applicators have given their customers a misleading explanation for early coating failures especially on the edges of protected steel structures.

Where such early failures occur, the applicators involved have tended to blame the orientation of MIO particles in the applied coating for the failure. The theory adopted by some applicators is that MIO platelets in coatings applied to edges are randomly orientated and that such pigment orientation leads to accelerated corrosion by capillary flow of water along the pigment surface to the substrate.

To examine this theory, research work was carried out by the Corrosion Prevention Department of Australian Iron and Steel Pty Ltd at Port Kembla.

Experimental work demonstrated that during normal painting practice by either brushing or spraying, it is practically impossible to apply the specified coating thicknesses to sharp edges, and attention must be given when applying paint to any edges, independent of the generic type of paint and the pigment used. Such insufficient coating thicknesses are directly responsible for early coating failures especially in corrosive environments. When rounded edges, the thin platelets of the pigment orientate themselves in a plane roughly parallel to the substrate. Interleaving and overlapping takes place in multi-layers depending on the paint film thickness and the pigment volume concentration.

Micaceous Iron Oxide Pigment

Micaceous Iron Oxide (MIO) is essentially a type of haematite (Fe_2O_3) similar in crystal structure to mica, hence the term "micaceous" is used. Its distinguishing feature is the tabular crystal structure (Figure 1), which can be fractured to give very thin platelets of lamellar fragments (Figure 2). When used as a pigment in paints the platelets orientate themselves into overlapping and interleaving layers roughly parallel to the substrate (Figure 3)[1-5].

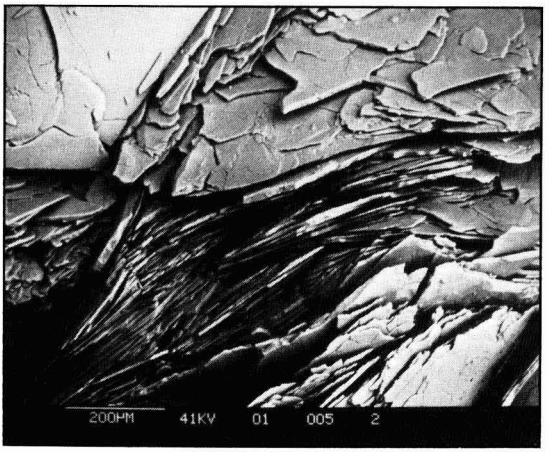

Figure 1. SEM of Austrian crude iron oxide ore showing very thin platelets which appear free of gangue material.

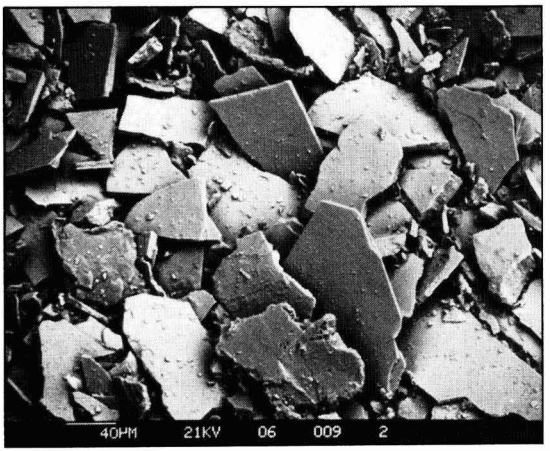

Figure 2. SEM of Austrian MIOX pigment Standard Grade. The particles (except for a very small proportion of fines) possess the lamellar structure.

This orientation produces an increase in resistance to water permeation through paint films (and hence increased corrosion prevention), shields the medium from the degradation effect of UV radiation (Figures 4, 5, 6 and 7) and provides mechanical reinforcement of the paint film[1-5].

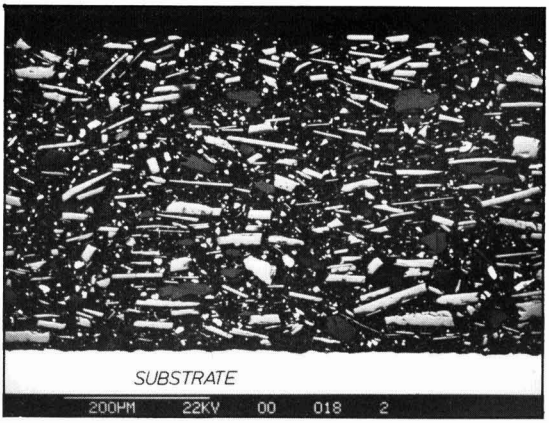

Figure 3. Cross-section of epoxy resin based MIO pigmented coating on the steel substrate, illustrating the distribution and orientation of lamellar Fe_2O_3.

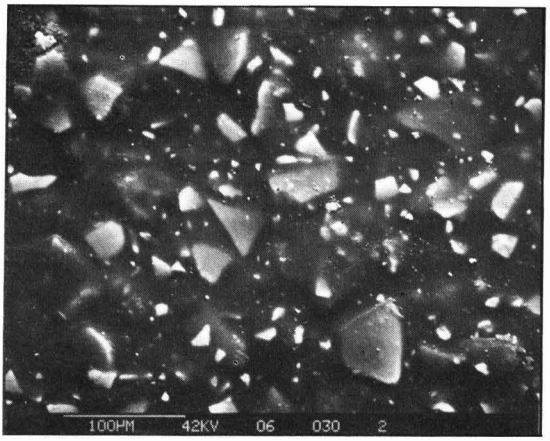

Figure 4. The surface appearance of epoxy resin MIO pigmented coating before exposure.

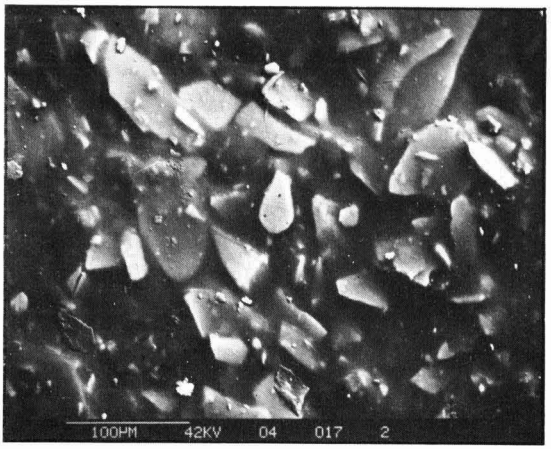

Figure 5. The surface appearance of alkyd resin MIO pigmented coating before exposure.

Figure 6. MIO pigmented epoxy surface after exposure*.

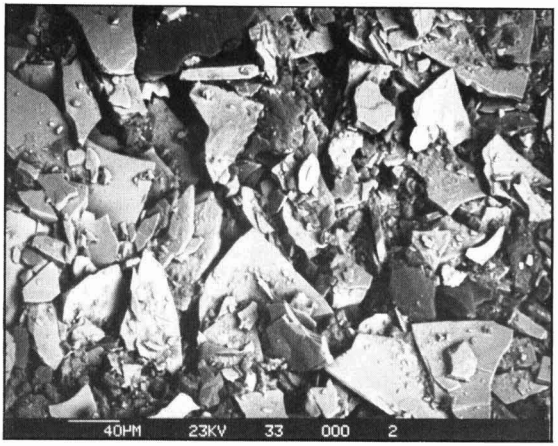

Figure 7. MIO pigmented alkyd resin surface after exposure*.

* SEM (Figures 6 and 7) illustrate the surface appearance of epoxy and alkyd resin based MIO pigmented coatings after exposure in QUV accelerated weathering tester for 1,000 hours using wet and dry cycles of four hours steam condensation and four hours UV radiation.

This is especially important for coatings which are exposed to aggressive industrial environments such as those experienced at the Port Kembla Works of Australian Iron and Steel Pty Ltd, where MIO pigmented coatings have been successfully used for the long term protection of various types of steel structures and miscellaneous equipment. In most applications, MIO pigmented coatings are applied over a suitable primer or directly to the substrate as a barrier coating.

Although micaceous iron oxide had been found in various parts of the world[1-7] the true micaceous structure may be doubtful[1, 3, 5]. Depending on the location of ore deposits, MIO pigments can differ considerably in size, shape and purity, but the ore used in protective coatings must contain at least 85 per cent Fe_2O_3, be extremely low in water-soluble salts and have a fully developed lamellar structure[1, 3, 5].

When a bulk test portion of the pigment is viewed under a scanning electron microscope (SEM) (using a magnification of, say, ×250), the structure should be lamellar, not granular or amorphous. In addition, when particles of the pigment are viewed under an optical microscope in transmitted light mode (using a magnification of, say, ×200), they should be seen to consist of angular ruby red cyrstals with clearly defined fracture planes[8, 9].

The largest and most well-known deposits of micaceous iron oxide are found in Waldenstein, Austria, where the quality of the ore is unique (Figures 1 and 2)[1, 3, 5].

A fairly good quality MIO was also produced in South Devon, England, until the mine was closed for economic reasons in 1969, and this pigment became unavailable.

In the last few years several alternatives have become commercially available, but with obvious differences in their physical properties which in most cases cannot meet the requirements of internationally recognised standards.

Experimental procedure

Preparation of specimens

Mild steel strips 13 mm wide and 5 mm thick were used for the laboratory experimental work. One edge of each steel strip was rounded with a radius of approximately 1 mm while the opposite parallel edge was left sharp. Steel strips were then abraded to white metal and painted.

Application of coatings

One coat of a two-pack epoxy resin based red lead primer was applied by spray to some of the steel strips. After 24 hours drying time a coat of micaceous iron oxide pigmented paint was applied by spray to primed and unprimed steel strips. Four different generic types of micaceous iron oxide (MIOX Standard Grade) pigmented finishing paint were included in this experimental work, namely:

1. Epoxy resin based MIO
2. Alkyd resin based MIO
3. Acrylic water-borne MIO
4. Chlorinated rubber based MIO

After the full drying time, small sections of each specimen were cut and prepared by standard metallographic polishing techniques for cross-sectional microscopic examination (Figure 8).

Microscopic examination

All cross-sections and coating surfaces (Figures 1-17) were examined with a scanning electron microscope (SEM), using the back-scattered electron imaging mode.

Cross-sectional examination of coated specimens supplied evidence that, independent of the generic type of paint and pigment used, it is practically impossible to build up the required thickness of paint to sharp edges in a single application. (Figures 8, 9, 11, 13, 15 and 17).

However, with some care there is no great difficulty in achieving a satisfactory thickness of paint on sufficiently rounded edges (Figures 8, 10, 12, 14 and 16).

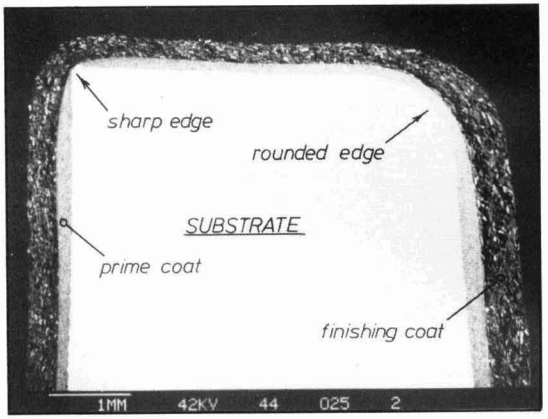

Figure 8. Example of cross-section specimen used during examination of MIO pigment orientation.

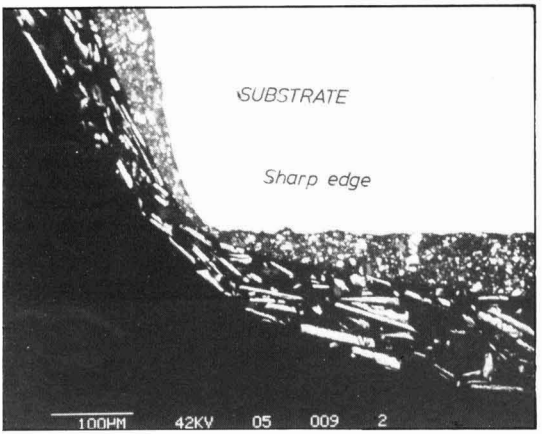

Figure 9. SEM showing the coating thickness and the orientation of MIO pigmentation on a sharp edge†.

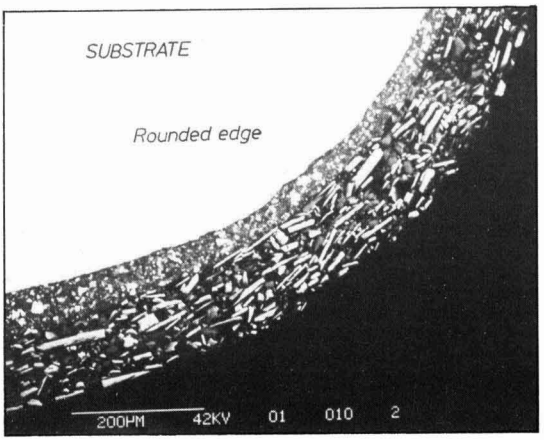

Figure 10. SEM illustrating the coating thickness and the orientation of MIO pigment on a rounded edge†.

† The coating system illustrated by Figures 9 and 10 consisted of one coat of epoxy red lead primer and one coat of epoxy MIO pigmented finishing paint.

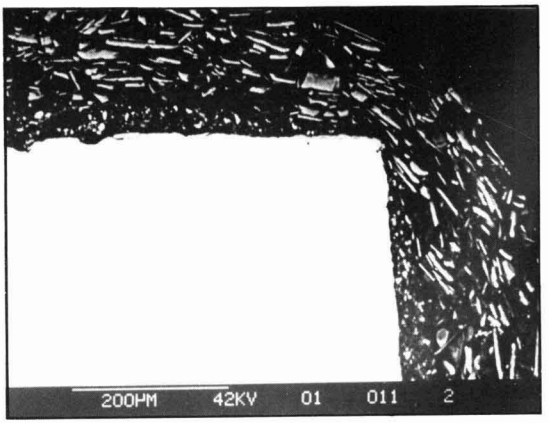

Figure 11. SEM illustrating the coating thickness and the orientation of MIO pigment on a sharp edge‡.

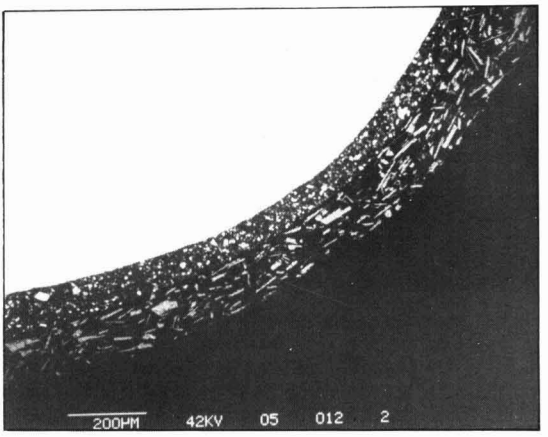

Figure 12. SEM illustrating the coating thickness and the orientation of MIO pigment on a rounded edge‡.

‡ The coating system illustrated by Figures 11 and 12 consisted of one coat of epoxy red lead primer plus one coat of alkyd resin MIO pigmented finishing paint.

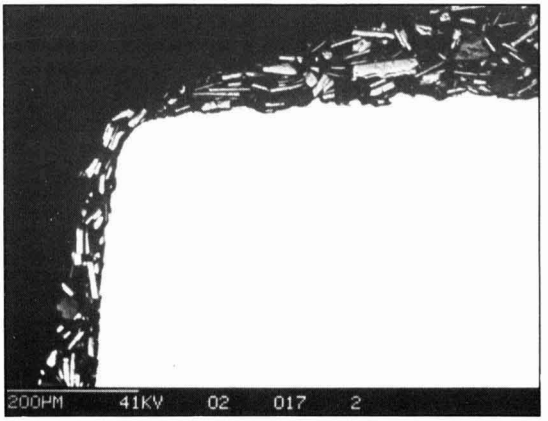

Figure 13. SEM illustrating the coating thicknesses and the orientation of MIO pigment on a sharp edge△.

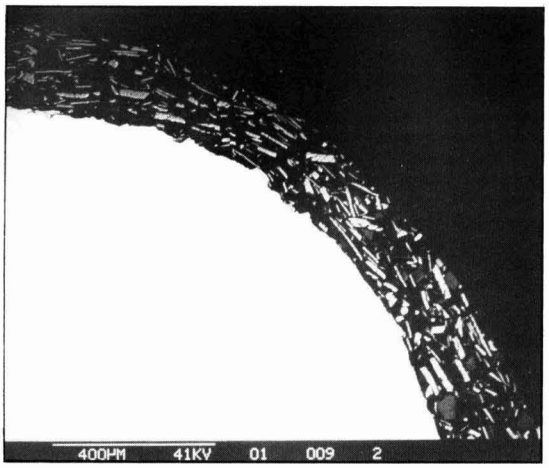

Figure 14. SEM illustrating the coating thickness and the orientation of MIO pigment on a rounded edge△.

△ The coating system illustrated by Figures 13 and 14 consisted of one coat of MIO pigmented alkyd resin based finishing paint.

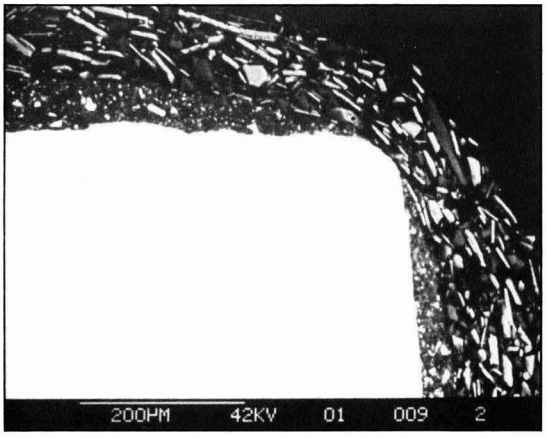

Figure 15. SEM illustrating the coating thickness and the orientation of MIO pigment on a sharp edge□.

As it can be observed on Figures 8, 9, 11, 15 and 17, the first coat of paint flowed around sharp edges to the degree that each subsequent coat of paint could be built up to the required total thickness.

Finally, the orientation of micaceous oxide in all cases considered was roughly parallel to the substrate, as illustrated by Figure 17 was not as good as expected due to the tearing out of chlorinated rubber particles during preparation of specimens for cross-sectional examination.

Conclusion

Sharp edges are poor design features for any paintwork, and all such edges should be sufficiently rounded prior to painting. In addition, all edges should be painted with care. An extra coat of paint should be applied to edges, especially light sections of steel structures. Such practice

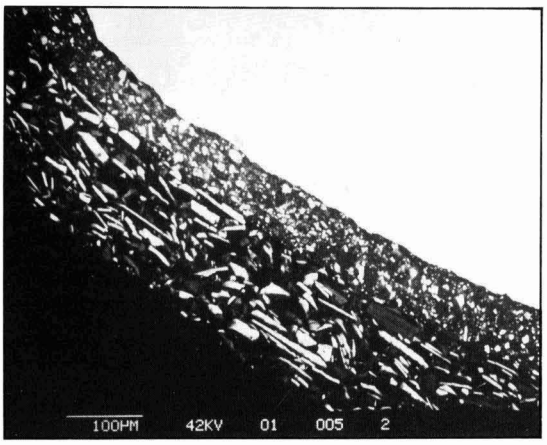

Figure 16. SEM illustrating the coating thickness and the orientation of MIO pigment on a rounded edge□.

□ The coating system illustrated by Figures 15 and 16 consisted of one coat of epoxy resin red lead primer plus one coat of MIO pigmented water-borne acrylic based finishing paint.

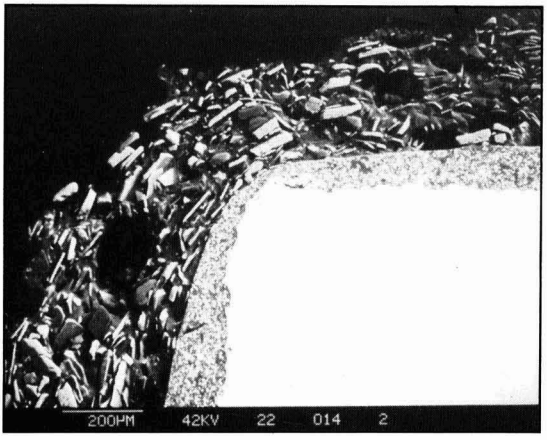

Figure 17. SEM illustrating the coating thickness and the orientation of MIO pigment on a sharp edge. The coating system consisted of one coat of epoxy red lead primer plus one coat of high build MIO pigmented chlorinated rubber finishing paint.

would assist in building up the required thickness of paint on edges and would minimise the possibility of early coating failures.

When fully lamellar micaceous iron oxide is used in paint at the required pigment volume concentration and when such paint is applied to the specified thickness, long term performance can be achieved. However, it has been shown that when so-called micaceous iron oxide which possesses granular shaped particles and/or fines is used in protective coatings, early coating failures can be expected[5]. Consequently such inferior pigments should be avoided.

The results of the experimental work show in all cases a strong tendency for the orientation of the MIO particles to lie with the thinnest cross-sections parallel to the paint film substrate, including edges. Any early coating failures would

probably be due to either insufficient coating thickness or unsuitable paint used for a particular environment.

Acknowledgements

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[Received 15 August 85

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Antifouling paints based on WW rosin and chlorinated rubber; influence of binder composition and content

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Summary

This paper is concerned with the raft trial behaviour of different antifouling paints based on WW rosin and chlorinated rubber grade 20. The influence of WW rosin/chlorinated rubber ratio, binder content and dry film thickness were studied. The specific dissolution rate and the acid value of binders both of the freshly manufactured and of those extracted from the paints after pigment dispersion were determined. Antifouling efficiency values were statistically treated according to the factorial design 5 × 6 × 2 (30 samples of two paint thicknesses).

Introduction

The surface of fixed or movable structures submerged in sea water is strongly colonized by vegetable and animal species (biological fouling) and this may result in damage caused by corrosion, and therefore an increase in fuel consumption for example in the case of ships.

The methods for avoiding such growths are fundamentally based upon the use of antifouling paints. These products release toxicants at a given rate and form a laminar coating on the painted surface, killing animal and vegetable species in their larval stages. Regardless of the conditions arising in service, these paints must maintain adequate biocide characteristics during long periods.

In a soluble matrix type antifouling paint, the toxicant and the binder are dissolved simultaneously. In this form, particles of the biocide material that were initially located in the film make contact with the sea water. The rate at which the toxicant is released (an aspect that has a direct influence upon the bioactivity of antifouling paints) depends on its content in the film and also on matrix solubilization. Efficient paints must provide an adequate toxicant concentration in the film/sea water interphase, so as to avoid fouling settlement.

The objective of this paper is to establish the behaviour in raft test of the experimental antifouling paints prepared with binders based on WW rosin and chlorinated rubber grade 20.

Composition of the samples

Taking into account previous results[1-4], cuprous oxide was selected as the fundamental toxicant and only one level in volume was used for all the formulations. Zinc oxide as reinforcing toxicant in a 10 per cent proportion by weight (related to cuprous oxide), and calcium carbonate as extender were used. Extender content was established as a function of the amount of the binder in the sample. The paints, composition is presented in Table 1.

Variables under analysis

The following variables were analyzed:

Influence of WW rosin/chlorinated rubber ratio

The WW rosin is an important contributor to the acidity of the binder, due to its high content of saponifiable materials. In order to obtain binders of different dissolution rate, compositions with an increasing content of chlorinated rubber were considered. The following WW rosin/chlorinated rubber ratios were employed 2:1, 1.5:1, 1:1, 1:1.5 and 1:2 by weight. Both the acidity and the dissolution rate decreased as the content of WW rosin in the formulation was reduced.

Binder content in the paint

In order to evaluate the influence of this variable for each one of the above mentioned WW rosin/chlorinated rubber ratios, six percentages of binder in the composition were selected: 15.4, 20.3, 25.9, 31.2, 36.4 and 40.7, all of them calculated by weight for the total solids in the paint.

These different fractions in the paint allowed the defining of two experimental coefficients, respectively resulting from the product of the above mentioned binder content and the acid value of the binder in one case, and with the specific dissolution rate of the binder, in the other. These coefficients acquire a significant role, since they allow evaluation of the influence of this variable on the bioactivity.

Thickness of the dry film

The several dissolution rates of the studied samples, due to their different composition and content of binder in the paint, produce a variable thickness reduction in the service life of the applied film.

According to the above considerations, panels with two dry film thicknesses were prepared (55-60 and 100-120 μm), thus allowing a comparison of the toxic characteristics of the studied paints.

Experimental

Samples preparation

In previous papers[5-7] operative variables affecting the dispersion efficiency in antifouling paints, using ball mills of different capacity, were studied.

In the present work porcelain ball mills with jars of 3.3 litres capacity were employed; both the mill load and the operational conditions were as previously mentioned[3]. The paints were manufactured by dispersing calcium carbonate and zinc oxide in the vehicle for 24 hours; the cuprous oxide was then added to the charge, and the dispersion time continued for three hours. Each of the samples was prepared in duplicate.

Table 1

Composition of the antifouling paints (W/W)

Paint	1	2	3	4	5	6	7	8	9	10
Cuprous oxide	28.0	29.3	31.0	32.4	33.8	34.9	28.0	29.3	31.0	32.4
Zinc oxide	2.8	2.9	3.1	3.2	3.4	3.5	2.8	2.9	3.1	3.2
Calcium carbonate	51.7	45.3	37.7	30.8	23.9	18.3	51.7	45.3	37.7	30.8
WW rosin	8.8	11.6	14.8	17.8	20.8	23.2	7.7	10.1	12.9	15.5
Chlorinated rubber	4.4	5.8	7.4	8.9	10.4	11.6	5.2	6.8	8.6	10.4
Chlorinated paraffin	2.2	2.9	3.7	4.5	5.2	5.9	2.5	3.4	4.4	5.3
Additives	2.1	2.2	2.3	2.4	2.5	2.6	2.1	2.2	2.3	2.4
Paint	11	12	13	14	15	16	17	18	19	20
Cuprous oxide	33.8	34.9	28.0	29.3	31.0	32.4	33.8	34.9	28.0	29.3
Zinc oxide	3.4	3.5	2.8	2.9	3.1	3.2	3.4	3.5	2.8	2.9
Calcium carbonate	23.9	18.3	51.7	45.3	37.7	30.8	23.9	18.3	51.7	45.3
WW rosin	18.1	20.3	6.1	8.1	10.3	12.4	14.5	16.2	4.7	6.2
Chlorinated rubber	12.2	13.6	6.1	8.1	10.3	12.4	14.5	16.2	7.1	9.4
Chlorinated paraffin	6.1	6.8	3.2	4.1	5.3	6.4	7.4	8.3	3.6	4.7
Additives	2.5	2.6	2.1	2.2	2.3	2.4	2.5	2.6	2.1	2.2
Paint	21	22	23	24	25	26	27	28	29	30
Cuprous oxide	31.0	32.4	33.8	34.9	28.0	29.3	31.0	32.4	33.8	34.9
Zinc oxide	3.1	3.2	3.4	3.5	2.8	2.9	3.1	3.2	3.4	3.5
Calcium carbonate	37.7	30.8	23.9	18.3	51.7	45.3	37.7	30.8	23.9	18.3
WW rosin	8.0	9.6	11.2	12.5	3.8	5.1	6.4	7.7	9.0	10.1
Chlorinated rubber	12.0	14.4	16.8	18.8	7.6	10.2	12.9	15.4	18.0	20.2
Chlorinated paraffin	5.9	7.2	8.4	9.4	4.0	5.0	6.6	8.1	9.4	10.4
Additives	2.3	2.4	2.5	2.6	2.1	2.2	2.3	2.4	2.5	2.6

Mechanical laboratory tests

In order to determine the characteristics of the films, the following tests were performed for each one: *elongation*, with a conical mandrel (ASTM D-522-41); *adhesion*, with an Elcometer Model 106; and *abrasion resistance*, with Taber Abraser (ASTM D-1044-78, 500 turns, load 500 g and abrasive CS-10).

SAE 1010 steel plates were used for the tests, previously sanded to A Sa 2½ (SIS Specification 05 59 00/67), with 40 μm maximum roughness (Rm). The thickness of the plates was 0.5 mm for the elongation test and 1.8 mm for adhesion and abrasion resistance determinations.

Before applying the antifouling paints, the panels were protected with an anti-corrosive coating based on zinc tetroxychromate as the inhibiting pigment and chlorinated rubber-phenolic varnish (in 1:1 ratio W/W) as the binder film (150-180 μm of dry film). After 24 hours drying, antifouling paints were applied by brush, forming a 25-30 μm dry film; mechanical tests were performed 24 hours after the application of the antifouling coat.

Both application of paints and laboratory tests were carried out under controlled conditions (20 ± 2°C temperature and 70 ± 5% relative humidity).

Binder dissolution rate and acid value

Dissolution rates (V_i) and acid values (I_i) of each of the freshly manufactured binders were determined in triplicate; the same determinations were performed for the binders extracted from the paints, after pigment dispersion (these values were called V_f and I_f, respectively).

Techniques used are described in previous papers [8-10]

Bioactivity determination in raft trial

In order to establish the toxic behaviour of the paints in the natural environment (sea water), an 18 months immersion test was carried out on a raft anchored at Puerto Belgrano (38° 54′ S; 62° 06′ W), an area whose hydrological and biological conditions were previously studied[11-15].

SAE 1010 steel plates (20 × 30 × 0.3 cm), with the same surface treatment as that mentioned in the laboratory test, were selected for these tests. Panels were protected with the anticorrosive paint previously described (150-180 μm dry film thickness) and finally with the experimental antifouling paint of two toxic dry film thicknesses (55-60 and 100-120 μm).

In all cases, paints were brush applied with an interval of 24 hours between coats. Drying time of the last coat prior to immersion was 48 hours. The test panels were placed vertically on the frames of the raft, at about 30-60 cm under the water surface.

In order to establish the bioactivity of the toxic samples, observations were made after 7, 12 and 18 months immersion. Photographic controls were performed in order to compare fixation with pattern records and to adjust the different values at the end of the tests.

Results

Mechanical laboratory tests

All the paint samples showed satisfactory values of

Table 2

Acid value and dissolution rate of tested paints

Paint†	1	2	3	4	5	6	7	8	9	10
I_i (mg KOH/g)	87.1	87.1	87.1	87.1	87.1	87.1	76.7	76.7	76.7	76.7
I_f (mg KOH/g)	38.4	41.3	44.3	47.1	50.5	54.1	32.8	35.7	38.2	40.0
V_i (μg . cm^{-2} . day^{-1})	15.4	15.4	15.4	15.4	15.4	15.4	13.8	13.8	13.8	13.8
V_f (μg . cm^{-2} . day^{-1})	12.0	12.2	12.4	12.6	12.7	12.9	11.3	11.4	11.5	11.7
WW rosin (%)*	3.8	5.4	7.4	9.5	11.9	14.3	3.2	4.6	6.2	8.0
Paint†	11	12	13	14	15	16	17	18	19	20
I_i (mg KOH/g)	76.7	76.7	62.0	62.0	62.0	62.0	62.0	62.0	48.5	48.5
I_f (mg KOH/g)	43.3	46.7	27.4	30.1	31.6	33.8	37.0	38.9	20.8	23.0
V_i (μg . cm^{-2} . day^{-1})	13.8	13.8	12.3	12.3	12.3	12.3	12.3	12.3	11.0	11.0
V_f (μg . cm^{-2} . day^{-1})	11.8	12.0	10.7	10.8	10.8	10.9	11.0	11.0	10.0	10.1
WW rosin (%)*	10.1	12.1	12.6	3.8	5.1	6.6	8.5	10.0	2.0	2.9
Paint†	21	22	23	24	25	26	27	28	29	30
I_i (mg KOH/g)	48.5	48.5	48.5	48.5	39.6	39.6	39.6	39.6	39.6	39.6
I_f (mg KOH/g)	24.9	26.4	28.7	30.4	18.1	20.2	21.0	22.2	24.0	25.4
V_i (μg . cm^{-2} . day^{-1})	11.0	11.0	11.0	11.0	10.4	10.4	10.4	10.4	10.4	10.4
V_f (μg . cm^{-2} . day^{-1})	10.2	10.3	10.3	10.4	9.7	9.8	9.9	10.0	10.1	10.1
WW rosin (%)*	4.0	5.1	6.5	7.7	1.6	2.4	3.2	4.1	5.2	6.2

* WW rosin corresponding to uncombined rosin remaining after pigment dispersion, expressed by weight in solids of paint
† I_i = Acid value of freshly manufactured binder
I_f = Acid value of binder extracted after paint preparation
V_i = Dissolution rate of freshly manufactured binder
V_f = Acid value of binder extracted after paint preparation

elongation (minimum 14.2%; maximum 30.2%), adhesion (4 kg cm^{-2}; 13 kg cm^{-2}) and abrasion resistance (287.0 mg; 101.6 mg) in all the tests performed on the film of the various samples. On the other hand, the anticorrosive paint employed in these tests showed 31.5% elongation and 14 kg cm^{-2} adhesion to the metallic substrate.

Binder dissolution rate and acid value

A WW rosin solution in a neutralized solvent mixture of white spirit/toluene (1:1 W/W) required 150 mg of potassium hydroxide per gram of rosin, while chlorinated rubber and chlorinated paraffin required, respectively, 2.0 and 6.0 mg/g. The results obtained with the freshly manufactured binders were directly related to the composition of each one.

The acid values of the binders extracted from the paints showed a significant reduction as compared with the unpigmented ones (lower consumption of potassium hydroxide) (Table 2).

The specific dissolution rates of the freshly manufactured binders showed a reduction when the WW rosin/chlorinated rubber ratio decreased. Specific dissolution rates of the binders extracted from the paints are also considerably lower in each case to that of the binders before pigment dispersion (Table 2).

The reduction of the acid values and of the specific dissolution rates of the binders extracted from paints is due to the neutralization reactions which take place during dispersion and storage between resinic acids of rosin and divalent cations present in the pigment. The content of non-combined rosin remaining after the elaboration process is shown in the same table (Table 2).

Acid values and specific dissolution rates of the binders extracted from paints, multiplied by the respective binder contents (I_f.L and V_f.L, respectively), showed a direct proportionality with rosin content in the formulation, both considering binders with similar rosin/chlorinated rubber ratio or with equal fraction of binder in the composition (Figures 1 and 2, respectively).

A simultaneous analysis of these figures show a direct proportionality between acid values and specific dissolution rates of the binders extracted from paints. This has been ratified by the high correlation coefficient calculated[9] which has reached the value 0.93 in this case. This type of relationship has also been recorded between acid value and specific dissolution rate in the case of freshly manufactured binders (coefficient 0.96).

Bioactivity determined in raft trial

In judging the results of the immersion test, fouling fixation was evaluated employing a scale which ranges from 0 (surface without settlement, 100% effectiveness) to 5 (surface completely fouled, 0% effectiveness). Results are shown in Tables 3 and 4, for inspections carried out at 7, 12 and 18 months immersion. Fixation value 1 (little or rare, 80% efficiency) was considered as the maximum acceptable limit for a good antifouling formulation. Values obtained were statistically treated using a factorial design of the 5 × 6 × 2 type (30 samples painted with two different thicknesses, that is 60 combinations). Each combination included replicas.

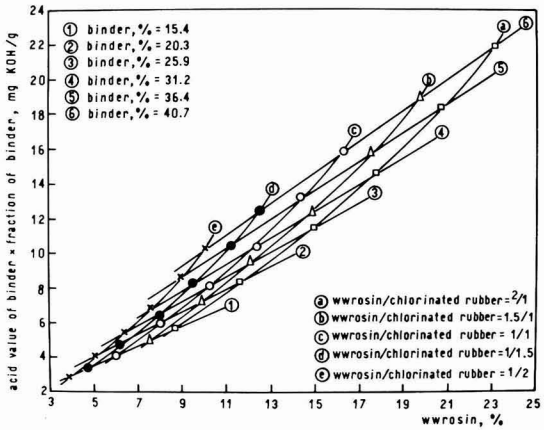

Figure 1. Influence of WW rosin amount in the paint on binder acid value, for each binder composition and content.

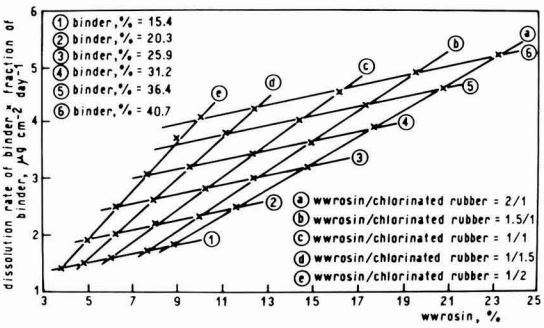

Figure 2. Influence of WW rosin amount in the paint on binder dissolution rate, for each binder composition and content.

After 18 months and with the values shown in Tables 3 and 4 (expressed as efficiency and substracting 50 to each of them, which is close to the efficiency average), the sum of squares and the degrees of freedom of each effect were calculated. By dividing each sum of squares by the corresponding degrees of freedom, the estimated variance was calculated (Table 5).

Zero hypothesis, implying that all the effects shown in Table 5 are equal to zero, is accepted. Thus all the variance estimations would be independent and would refer to the same amount estimated by means of the residual variance, that is the magnitude of the experimental error.

If the variance of the mentioned sources is bigger than that based on the residual error (experimental), the F test indicates that it is little probable that the observed variances ratio occurred randomly.

If test F provides a positive result, hypothesis zero fails. In such case, it will be evident that the variance does not simply arise from the experimental error but also from an additional variance introduced by the fact that the design modification was significant.

It was deduced that the second order interaction (ELR) provides a 2.6 variance ratio (F = 124.55/48.33) for 20 and 60 degrees of freedom. Consultation of the relevant table[16] proves that the interaction is significant, since it shows a 2.2 variance ratio at the 1 per cent level.

Since the second order interaction is significant, so are the first order interactions (EL, ER and LR) and the main

Table 3

*Fouling settlement (Samples applied with 55-60 µm dry film thickness)**

Paint	1	2	3	4	5	6	7	8	9	10
7 months	0-1	0	0	0	0-1	1	0-1	0-1	0	0
	1	0-1	0	0	1	1	1	0	0	0
12 months	2	0-1	0	0-1	1-2	2-3	1-2	0-1	0	0-1
	1-2	1	0-1	1	2	3	2	1	0-1	1
18 months	3-4	1-2	0-1	2-3	3-4	4-5	3-4	2	0	1-2
	3-4	2	1	3	4	5	3	1-2	0-1	2
Paint	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
7 months	0-1	1	0-1	0-1	0	0	0-1	0-1	1	0
	1	1	1	0	0	0	0	0-1	1	0-1
12 months	1-2	2-3	1-2	1	0	0	1-2	2	2-3	1-2
	2	3	2	1	0	0-1	2	2	3	2
18 months	3-4	5	3-4	2	1	0-1	2-3	4	5	2-3
	4	4-5	4	2	0-1	1	2-3	3-4	5	3
Paint	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
7 months	0	0	0-1	0	0-1	0-1	0	0	0-1	0-1
	0	0	0	0-1	0-1	0	0	0	0	1
12 months	0-1	0	1-2	2	2-3	1-2	1	0	1-2	2
	0-1	0	2	2-3	3	2	1-2	0-1	2	2-3
18 months	1	0-1	2-3	4	4-5	2-3	1-2	0-1	2-3	3
	0-1	0	3	4-5	5	2-3	2	0-1	3	3-4

* Key to the table: 0, panel without settlement; 0-1, very rare; 1, rare; 2, common; 3, very common; 4, abundant; 5, completely fouled.

Table 4

*Fouling settlement (Samples applied with 100-120 μm dry film thickness)**

Paint	1	2	3	4	5	6	7	8	9	10
7 months	0-1	0	0	0	0	0	0-1	0	0	0
	0	0	0	0	0	0	1	0-1	0	0
12 months	1-2	0-1	0	0-1	0	0	2-3	1-2	0-1	0
	2	1	0-1	0	0	0	3	2	1	0
18 months	3-4	1-2	0-1	0-1	0-1	0-1	4	2-3	1	0-1
	4	2	0-1	1	0	0	4-5	3	1	1
Paint	11	12	13	14	15	16	17	18	19	20
7 months	0	0	0-1	0-1	0	0	0	0	1-2	0-1
	0	0	0-1	0-1	0-1	0	0	0	2	1
12 months	0	0	2-3	1-2	0	0-1	0-1	0	4-5	3-4
	0	0	2	1-2	0-1	1	0	0	5	3
18 months	0-1	0	4-5	3	0-1	1	0-1	0-1	5	4
	0-1	0	5	3	1	1	0-1	0	5	3-4
Paint	21	22	23	24	25	26	27	28	29	30
7 months	0	0	0	0	1-2	1-2	0	0	0	0
	0-1	0	0	0	1	1	0-1	0	0	0
12 months	0-1	0	0	0	2-3	2	1-2	0	0	0
	0-1	0-1	0	0	3	2-3	1-2	0-1	0	0
18 months	1	0-1	0-1	0-1	4-5	3-4	2	0-1	0-1	0-1
	1	1	0-1	0	5	3-4	2	1	0-1	0-1

* Key to the table: refer to Table 3

effects (E, L and R). This is also demonstrated by the F tests (Table 5).

In order to interpret the experimental results, the main effects must be considered. The mean values are the following:

L_1	L_2	L_3	L_4	L_5	L_6
- 35.5	- 1.0	31.0	30.0	14.5	6.0

R_1	R_2	R_3	R_4	R_5
9.2	8.8	10.4	5.0	4.2

E_1	E_2
- 1.7	16.7

Where each one of the values of effects L, R and E are the average of 20, 24 and 60 elements, respectively. As a consequence, it is concluded that in order to reach the best bioactivity in an 18 months immersion raft test, in the area of Puerto Belgrano selected for this study, it is necessary to take into account binder L_3 (25.9 per cent by weight on paint solids), radio R_3 (WW rosin/chlorinated rubber 1:1) and thickness E_2 (100-120 μm dry film).

However, due to the significant influence shown by film thickness E upon samples efficiency, after 18 months, a separate analysis by thickness was made.

Consequently, further calculations were performed for the sum of squares, degrees of freedom and later the estimated variance for each one of the quoted effects and, individually, for each E level (Table 6). Previously, in order to facilitate calculations, 40 and 60 were deduced from each experimental value for levels E_1 and E_2, respectively. The mentioned Table 6 shows that for both E thicknesses, the pair interaction RL is significant and consequently significant factors are R and L.

In order to interpret the results, consideration is now given to the main effects, for each level of the effect E. The experimental samples applied with film thickness E_1 (55-60 μm) and E_2 (100-120 μm), show the following mean values:

	L_1	L_2	L_3	L_4	L_5	L_6
Level E_1	-21.0	17.0	43.0	36.0	-2.0	-23.0
Level E_2	-50.0	-19.0	19.0	24.0	31.0	35.0

	R_1	R_2	R_3	R_4	R_5
Level E_1	2.5	8.3	15.0	7.5	8.3
Level E_2	15.8	9.2	5.8	2.5	0

Where each one of the L and R effects are the average from 10 and 12 elements, respectively.

Consequently, it is concluded that the most efficient coatings, applied with the E_1 film thickness, after 18 months immersion, were those prepared with binder L_3 (25.9 per cent by weight on paint solids) and ratio R_3 (WW rosin/chlorinated rubber 1:1). The same conclusion had been reached when all effects were simultaneously analyzed.

Considering effect L, in order of importance, binder L_3 was followed by L_4, L_2, L_5, L_1 and L_6. With regard to effect R, subsequently to R_3 it must be considered R_2 and R_5 (similar behaviour), then R_4 and finally R_1.

Concerning the tests of samples applied with E_2 thickness, and also after 18 months immersion, it is concluded that the best binder and rosin/chlorinated rubber ratio were respectively L_6 (40.7 per cent W/W on the paint solids) and R_1 (1:1 ratio). After L_6 are placed L_5, L_4, L_3, L_2 and L_1, in this order of efficiency. In the case of effect R, antifouling paints elaborated with ratios R_2, R_3, R_4 and R_5 showed in this order a decrease in the bioactivity.

Table 5

Analysis of variance

Nature of the effect	Source*	Sum of squares	Degree of freedom	Estimated variance	F test	Type of influence
Main effect	E	10083	1	10083.00	208.6	significant
	R	725	4	181.25	3.8	significant
	L	60620	5	12124.00	250.8	significant
Interaction between pair of effects	EL	36467	5	7293.40	150.9	significant
	ER	2059	4	514.75	10.6	significant
	LR	8205	20	410.25	8.5	significant
Interaction among three effects	ELR	2491	20	124.55	2.6	significant
Replica	Residual	2900	60	48.33		
	Total	123550	119			

* E, dry film thickness; R, WW rosin/chlorinated rubber ratio; L, binder content, by weight, in paint solids

Table 6

Separate analysis of variance for different dry film thickness

Nature of the effect	Source*	Sum of squares	Degree of freedom	Estimated variance	F test	Type of influence
1. Thickness E_1						
Main effect	R	950	4	237.50	5.9	significant
	L	39913	5	7982.60	199.6	significant
Interaction between pair of effects	RL	8570	20	428.50	10.7	significant
Replica	Residual	1200	30	40.00		
	Total	50633	59			
2. Thickness E_2						
Main effect	R	1833	4	458.25	17.2	significant
	L	57173	5	11434.60	428.7	significant
Interaction between pair of effects	RL	2127	20	106.35	4.0	significant
Replica	Residual	800	30	26.67		
	Total	61933	59			

* R, WW rosin/chlorinated rubber ratio; L, binder content, by weight, in paint solids

The behaviour of interaction RL, for each E level, is shown in Figures 3 and 4. For thickness E_1, the highest value was obtained from R_2L_3 and R_4L_4; in order of efficiency, they were followed by R_5L_4 and then by R_3L_3. A discrepancy may be observed concerning the last mentioned pairs, since they show a maximum value above the theoretical R_3L_3, although this difference is not significant and may be considered as accidental. Besides, it must be noted that the values for pairs R_3L_3 and R_3L_4 are similar.

From a study of interaction RL for the E_2 thickness it may be concluded that the highest value is that corresponding to pair R_2L_6 and that the latter is followed by pairs R_1L_6, R_1L_5, R_3L_6 and R_4L_6 with similar efficiency. In the last case, there is not a significant discrepancy with the selection performed when the main effects were individually studied.

Conclusion

Correlation between bioactivity and the specific dissolution rate of the binder (V_f), for both thicknesses considered and for 18 months immersion time, is scarcely significant. Thus, for example, for film thickness E_1, those coefficients were -0.03 and -0.06 and for E_2 they were 0.06 and 0.19 (12 and 18 months respectively).

Concerning the value $V_f.L$ (specific dissolution rate × binder content on the paint) this was shown to be

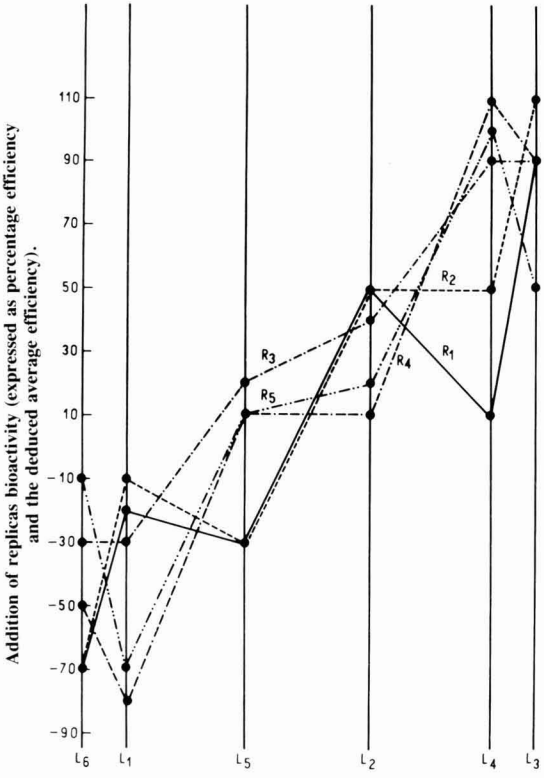

Figure 3. Interaction between WW rosin/chlorinated rubber ratio (effect R) and binder content (effect L), for E_1 film thickness (55-60 μm).

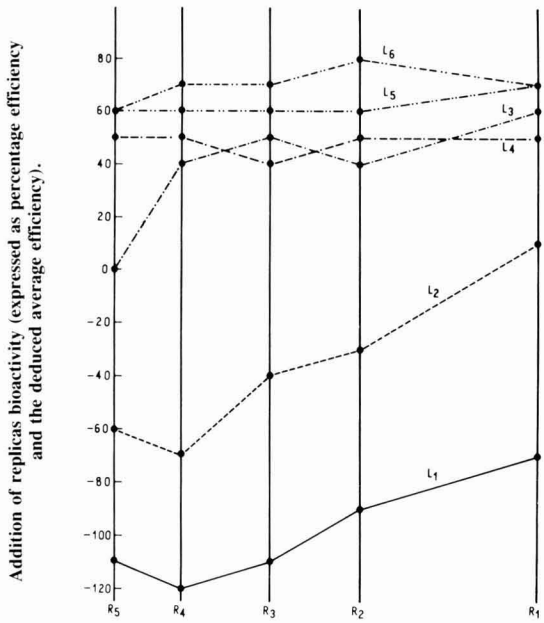

Figure 4. Interaction between WW rosin/chlorinated rubber ratio (effect R) and binder content (effect L), for E_2 film thickness (100-120 μm).

important. In the raft test, after 18 months immersion, samples based on binders of low dissolution rate (V_f.L lower than 2.5 μg . cm^{-2} . day^{-1}) and applied with the two thicknesses considered showed a poor toxic efficiency (fixation above 1). This behaviour may be due to the slow dissolution rate of the matrix and consequently to a reduced toxicant release, which permits fouling settlement. Film analysis made afterwards in the laboratory showed a high content of cuprous oxide undissolved.

On the other hand, binders with a V_f.L between 2.5 and 3.5 μg . cm^{-2} . day^{-1} exhibited good biocide characteristics (fixation 1 or lower) for both thicknesses selected after 18 months immersion.

Experimental results showed a different behaviour among paints manufactured with binders of V_f.L higher than 3.5 μg . cm^{-2} . day^{-1}, depending on the dry film thickness considered. After 18 months immersion, samples tested with 100-120 μm thick fulfilled the trial requirement, while those applied with the lower thickness, that is 55-60 μm, exhibited abundant fouling settlement. It must be noted that in the case of the lower thickness coat and after 12 months immersion, the high value of V_f.L led to accelerated exhaustion of the film, corroborated by the reduced residual thickness and by the low remaining content of cuprous oxide.

The correlation coefficients calculated between the factor V_f.L and the bioactivity, for the samples applied with the lower thickness, the values obtained indicate a very low correlation (-0.15 and -0.13 for 12 and 18 months, respectively). However, the same coefficients for higher dry film thickness show a significant correlation (0.77 and 0.86 for 12 and 18 months, respectively).

These results stress the important of the thickness variable on the bioactivity as demonstrated by the statistical analysis presented in this paper.

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Effect of calcining temperature on the properties of cadmium sulphoselenide pigments

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Abstract

The effect of calcining temperature on the properties of cadmium sulphoselenide pigments obtained by thermal treatment of a mixture of cadmium sulphide and selenium at constant temperatures over the range of 300° to 600°C has been investigated; for comparision some DSC curves were recorded. The pigments obtained were characterised by measuring their colour coordinates, bulk density, tinting strength and opacity. The colour changed from dirty red to clean red to dark red with increase in calcining temperature. The tinting strength and opacity decreased with calcining temperature over the range of temperatures studied.

Introduction

Cadmium sulphoselenides are important materials in the group of orange, red and maroon inorganic pigments. The colour of the pigment is governed by the amount of selenium in the pigment composition. Major reasons for large scale commercial synthetic production are their exceptional heat stability and brightness.

These pigments are used in colouring all kinds of plastics, and have many high temperature applications. Being calcined pigments they possess excellent heat resistance, have good light fastness and alkali resistance.

They are prepared commercially by either a dry or a moist process. The dry process involves the calcination of a mixture of cadmium sulphide and selenium or either cadmium carbonate or cadmium oxide, sulphur and selenium. In the moist process, selenium is incorporated before the precipitation stage. Selenium is dissolved in the sulphide solution to form the alkali sulphide selenide. Cadmium sulphoselenide is then precipitated by reaction of the selenide sulphide solution with a cadmium salt solution; the precipitate is washed, dried and calcined. The pigment prepared using cadmium carbonate has poor pigmentary properties and is therefore seldom used. The dry process using cadmium sulphide gives a good pigment and is still practiced. The moist process has the advantage of reduced selenium losses. In view of this, part of selenium is introduced prior to the precipitation stage and part is mixed with the precipitate just before the calcination stage.

While much has been reported on the effect of calcining temperature on the properties of cadmium sulphide[1-4], very little is known about cadmium sulpho-selenides. Eroles and Friedberg[5] reported the thermal decomposition of the cadmium sulphoselenide pigments. The decomposition involves the reappearance of cadmium sulphide and cadmium selenide, with subsequent transformation (decomposition) of these resulting compounds. Saburo Akagi and Seiichi Karino[6] have studied the thermal discolouration from 450 to 1000°C. They confirmed that the discolouration is due to oxidation of the cadmium sulphide to cadmium sulphate or cadmium oxide and, as a consequence, to a decrease in the ratio of cadmium sulphide to cadmium selenide in the solid solution.

The aim of the present investigation was to study the preparation of cadmium sulphoselenide pigments from cadmium sulphide and selenium. Especially, the effect of calcining temperature on the characteristics of the pigments was investigated.

Experimental

Cadmium sulphide was prepared by reaction of cadmium nitrate (reagent grade) and sodium sulphide in aqueous medium at 80°C. Elemental selenium (purity, 99.5+%) was obtained from Aldrich Chemical Co. A mixture of cadmium sulphide and selenium in the proportion 88:12 was prepared by dispersing in methanol and stirring using a magnetic stirrer. The mixture was sieved through a 325 mesh sieve.

Five gram samples of the cadmium sulphide/selenium mixture were isothermally calcined in a muffle furnace inside a 15 cm^3 porcelain crucible under static air atmosphere. The mixtures were calcined for one hour at 300, 400, 500 and 600°C. Temperature was measured inside the furnace near the sample with an accuracy of ±5°C. The resulting pigments were ground and sieved through a 325

mesh sieve to effect dispersion to primary particles. The composition of the product was verified by X-ray diffraction.

Test methods

Colour

The colour was measured in CIELAB colour scale using a ACS-SPECTRO-SENSOR spectrometer. The measurements were made on polyethylene chips pigmented at 1% with pigments at full strength.

Tinting strength

The values of relative tinting strength were calculated from the reflectance values using the software provided by the ACS-SPECTRO-SENSOR. The measurements were done on polyethylene chips pigmented at 1% with 40% pigment at full strength and 60% titanium dioxide (rutile).

Opacity

Opacity of the pigments (pigmented polyethylene chips) was judged visually using a colour matching panel from Morest Coroporation. The opacity was judged by the contrast of the black-white interface.

Thermal analysis

The samples were studied by Differential Scanning Calorimetry using a DuPont 1090 thermal Analyser. The thermograms were recorded from 160 to 450°C, in closed sample pans, at 20°C/min, in an atmosphere of flowing nitrogen. A blank sample pan was used as a reference.

Results and discussions

Figure 1 shows the thermograms of cadmium sulphide/selenium mixture and the pigments obtained by calcining the cadmium sulphide/selenium mixture at 300 and 400°C for one hour respectively. Cadmium sulphide shows a baseline change[7] around 260°C and selenium shows a sharp endotherm at 220°C corresponding to its melting. The mixture shows a sharp endotherm at 220°C and a broad endotherm at 275°C. The sharp endotherm at 220°C in the mixture is due to the melting of selenium. The broad endotherm at 275°C represents the reaction between cadmium sulphide and selenium, i.e. the formation of the solid-solution CdS.CdSe. The reaction starts at ca 240°C as indicated by the descending baseline, and can be considered practically complete at 320°C. The thermogram of the pigment formed at 300°C shows a small but definite endothermic peak at 220°C and a baseline change at 290°C. This indicates that the reaction between cadmium sulphide and selenium was not complete at 300°C and that part of the selenium had remained unreacted in the calcined product. The thermogram of pigment formed at 400°C runs parallel to baseline with no noticeable changes, indicating completion of the reaction and thermal stability up to 450°C.

The X-ray powder patterns of pigments formed at 300, 400, 500 and 600°C are shown in Figure 2. The powder patterns of cadmium sulphoselenides maintain the profile of cadmium sulphide, but the lattice spacings are slightly expanded to accommodate cadmium selenide. The variation in the intensities of the peaks with increase in

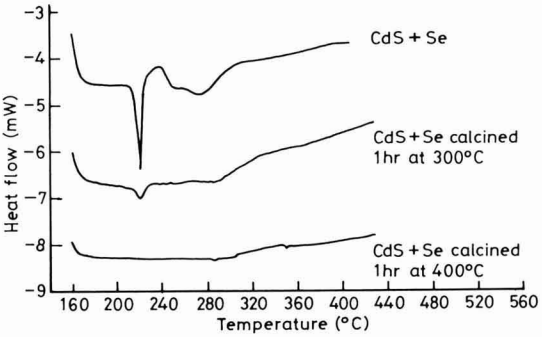

Figure 1. DSC thermograms of cadmium sulphide/selenium mixture and pigments formed at 300 and 400°C.

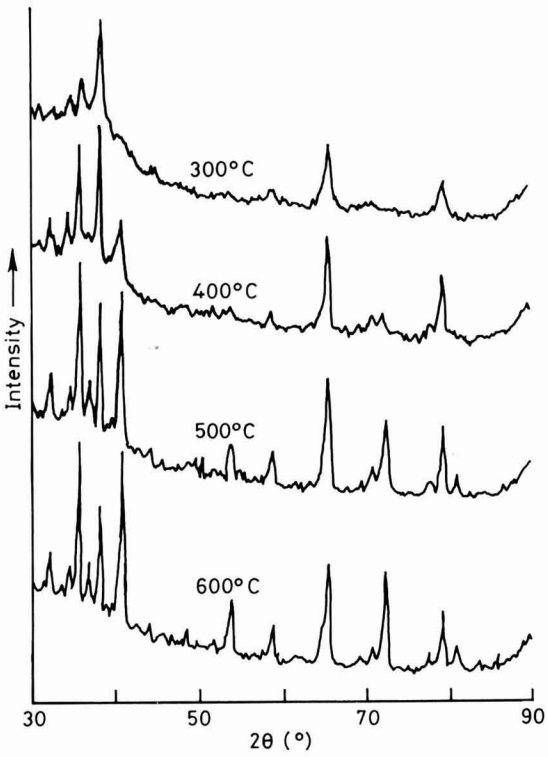

Figure 2. X-ray diffraction patterns of cadmium sulphoselenide pigments formed by calcining cadmium sulphide/selenium mixture at the temperatures indicated.

temperature and the appearance of new peaks suggests transformation of cubic to hexagonal structure. The powder pattern of pigments formed at 500 and 600°C indicate the presence of small amounts of cadmium selenide, formed as a result of thermal decomposition of the sulphoselenide.

Colour

Table 1 gives the calcining conditions, qualitative description of the dry colours at full strength and properties of the pigments. Table 2 gives the colour coordinates and

Table 1.

Colours of cadmium sulphoselenides at full strength

Calcination temp (°C)	Description of colour	Bulk density	D	P (%)	RTS
300	Dirty red	0.87	602	44	
400	Red orange	1.07	605	63	100
500	Red orange	1.32	606	67	62
600	Light maroon	1.76	601	46	19

D = dominant wavelength, P = purity or saturation, RTS = relative tinting strength

Table 2.

Colour coordinates and colour differences of pigments in CIELAB colour scale

Colour difference calculations
Large Area View Spec. Included

CIELAB	ILL	X	Y	Z	L*	a*	b*	C*
300°C	D	12.22	9.24	5.40	36.45	26.50	16.61	31.28
	A	18.25	11.64	1.78	40.64	29.68	23.74	38.01
	F	12.25	9.45	3.49	36.84	18.78	17.34	25.56
400°C	D	20.87	13.62	5.27	43.68	44.64	29.69	53.61
	A	33.03	18.91	1.73	50.58	46.66	41.50	62.45
	F	20.57	14.02	3.40	44.26	33.31	30.74	45.33
500°C	D	25.23	15.81	5.29	46.72	51.22	34.85	61.95
	A	40.14	22.49	1.73	54.54	51.99	48.30	70.97
	F	25.27	16.54	3.42	47.67	39.43	36.50	53.73
600°C	D	28.41	21.46	12.23	53.45	35.18	22.81	41.93
	A	41.54	26.87	4.04	58.85	37.50	31.85	49.20
	F	30.09	22.70	7.87	54.76	27.69	25.25	37.47

CIELAB	ILL	DL*	Da*	Db*	DE*	DC*	DH*
400°C	D	7.23	18.13	13.08	23.50	22.33	1.11
	A	9.95	16.98	17.76	26.51	24.44	2.54
	F	7.42	14.53	13.41	21.12	19.77	-0.01
400°C is 7.23 lighter than 300°C							
400°C is 22.33 brighter than 300°C							
500°C	D	10.28	24.72	18.24	32.39	30.67	1.65
	A	13.91	22.31	24.56	35.98	32.96	3.84
	F	10.83	20.65	19.16	30.18	28.17	0.06
500°C is 10.28 lighter than 300°C							
500°C is 30.67 brighter than 300°C							
600°C	D	17.01	8.68	6.20	20.07	10.65	0.55
	A	18.22	7.83	8.11	21.42	11.20	1.27
	F	17.92	8.91	7.91	21.52	11.91	-0.19
600°C is 17.01 lighter than 300°C							
600°C is 10.65 brighter than 300°C							

colour differences in CIELAB colour scale of the pigments formed at 300, 400, 500 and 600°C. The results show that the increase in purity/saturation and brightness with higher calcination temperatures is accompanied by a corresponding increase in the dominant wavelength. However at 600°C, there is a sudden fall in all these properties. The hue is yellower with increase in temperature; then like all other properties, there is a sudden drop in yellowness at 600°C. This is because with increase in calcining temperature there is an increasing loss in selenium. Thus the pigment formed is less red or yellow. However at 600°C the oxidation and decomposition of the solid-solution results in a dirtier pigment.

Table 3.

Strength determination and strength adjusted colour differences

Strength calculation
Strength determination
Large Area View Spec. Included

		WL	%R	K/S	Batch Unadjusted	Strength (%) Adjusted
400°C	Tint	500.0	27.30	0.96816		
500°C	Tint	500.0	35.09	0.60020	61.99	100.00
600°C	Tint	500.0	54.73	0.18725	19.34	100.00

Standard and adjusted batch colour differences:

CIE	ILL	X	Y	Z	SX	SY
400°C Tint	D	45.71	38.69	29.63	4008	3393
500°C Tint	D	46.52	38.62	30.04	4039	3353
600°C Tint	D	41.39	35.38	29.89	3880	3317

FMC-II Units	ILL	DCRG	DCYB	DC	DL	DE
500°C Tint	D	6.69	-0.78	6.74	0.18	6.74
600°C Tint	D	-8.04	-6.75	10.49	-6.06	12.12

The bulk density values increase with calcining temperature, indicating that the pigment is less bulky at higher calcining temperatures.

The opacity of the pigment decreases gradually up to 500°C, and drastically from 500 to 600°C. This is due to an increase in particle size with calcining temperature.

Tinting strength

The values of relative tinting strength and strength-adjusted colour differences are shown in Table 3. The results indicate that the tinting strength decreases with calcining temperature. No evaluation was made on the pigment formed at 300°C. The pigment formed at 400°C was treated as reference and the colour differences are reported for pigments formed at 500 and 600°C. The pigment formed at 500°C has a slighly bluer tint, while the pigment at 600°C is distinctly bluer and less saturated.

Acknowledgement

The authors are grateful to Mr Dave Puryear of Harrison Paints, Canton, USA, for his valuable help in characterisation of the pigments.

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next month's issue

The Honorary Editor has accepted the following papers for publication in the August issue:

Pakistani lacquerwork: The modernisation of a craft coating technique *by M. H. M. Arnold, Arnold Services, Warrington, UK*

Poly (alkoxysiloxane) carrier vehicles for high temperature coatings *by S. S. Bhatia, N. K. Chakavarty, S. D. Sharma and L. M. Pande, Defence Materials & Stores Research and Development Establishment, Kanpur, India*

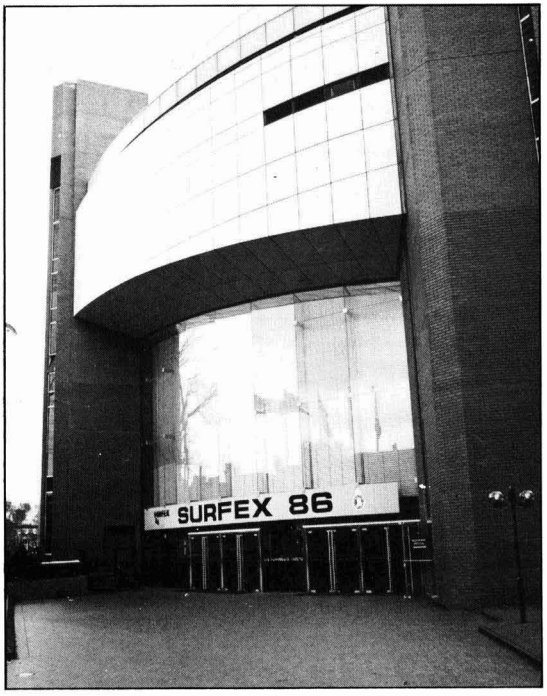
A consultant remembers *by A. S. Freeborn, Bromley, UK*

DC electrical measurements on painted steel in relation to corrosion prevention mechanisms *by D. J. Mills, Engineering Department, Trent Polytechnic, Nottingham, UK*

exhibition review

SURFEX 86

AN OUTSTANDING SUCCESS



The impressive entrance to the Harrogate Conference Centre.

All visitors were asked to register in the Reception Area.

The Oil and Colour Chemists' Association is pleased to announce that its latest exhibition (SURFEX 86) was an outstanding success, satisfaction being expressed by exhibitors and visitors alike.

The exhibition, the first OCCA exhibition organised outside the London area, was held at the Harrogate International Conference Centre on 14 and 15 May, 1986. By arranging the exhibition in the hall adjoining the main reception area, in the reception area itself and in the gallery, together with hospitality suites for exhibitors in the adjacent International Hotel, OCCA was able to combine the simplicity of a hotel room exhibition and the more open accessibility of a theatre-style display. This was achieved by the use of modular stand construction throughout, enabling exhibitors to use cost-effective self-assembly display units.

Registrations

Registrations for the exhibition numbered 1,694 including 109 foreign visitors. Twenty-five countries were represented including Australia, Belgium, Brazil, Canada, Denmark, Eire, Finland, France, Germany, India, Israel, Italy, Korea, Malta, Mauritius, Netherlands, New Zealand, Nigeria, Norway, Portugal, S. Africa, Spain, Sweden, Switzerland and USA.

Forty-three per cent of registrations were directors or managers accounting for the high level of good quality enquiries received by exhibitors. A breakdown of visitors and industries represented is as follows:

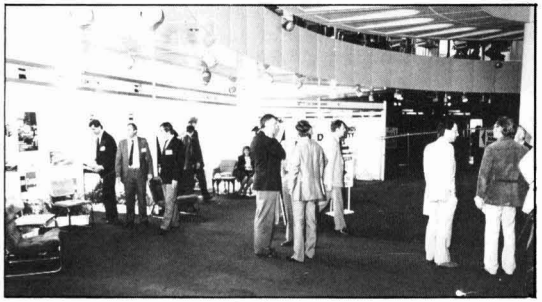
Analysis of Employment

Managing Director	128
Technical Director	83
Sales and Other Directors	82
Technical/Production Manager	179
Sales/Marketing	457
Chief Chemist/Laboratory Manager	195
Chemist/Laboratory Worker	417
Buyer	69
Others	85
Total Attendance	1,694

Employer Categories

Adhesives	21
Leather/Fabric	28
Paper/Textiles	8
Paint/Varnish/Wood	490
Plastics	36
Powder Coatings	22
Print/Printing Ink	92
Consultants/Agents	38
Pigments/Dispersions	324
Resin	144
Solvents/Additives	205
Equipment/Machinery	48
Fillers/Extenders	59
Miscellaneous	179
	1,694

From a survey of exhibitors it was clear the vast majority were satisfied with the venue, the cooperation of the staff of the contractors, the Centre and the hotel and most



Some stands in the Reception Area.

A view from the OCCA Information Centre showing one of the seating areas, a refreshment bar and some of the stands in Hall D.

The spiral staircase connecting the stands in Hall D and the Reception Area with those in the Gallery Area.

A corridor view in Hall D.

Some stands in the Gallery Area.

The Foscolor Stand in Hall D.

The ICI Stand in the Gallery Area.

Part of the Hoechst Stand in Hall D.

expressed the wish to exhibit again at the same venue and with similar arrangements.

Exhibition Dinner

On the evening of the first day a dinner organised by the West Riding Section of the Association was held at the Majestic Hotel and over 370 persons attended.

The Chairman of the Exhibition Committee, Mr F Morpeth, welcomed the exhibitors, their guests and other visitors extending a special welcome to the guest speaker (Canon the Rev. J. R. Smith), the President (Mr F. B. Redman) and Mrs Redman, Mr C. N. Finlay (Immediate Past President) and Mrs Finlay, Director and Secretary (Mr R. H. Hamblin) and the Chairman of the West Riding Section (Mr T. Wright) and Mrs Wright.

Stand Design Awards

He announced that the committee had instituted an award of inscribed plaques for the two stands (one small and one large) which had been adjudged to have made the most effective use of their display areas. The awards for SURFEX 86 were then made to:

Small stand—Kenroy Dispersions Ltd.

Large stand—Blythe Burrell Colours Ltd.

The Kenroy Dispersion Stand showing the plaque awarded for the best design of a small stand.

Blythe Burrell Colours Stand showing the plaque awarded for the best design of a large stand.

Mr Morpeth expressed particular thanks to Mr Don Komrower for his assistance in making the exhibition such a success and to Mr Terry Wright and Mr Godfrey Alderson of West Riding OCCA for organising the dinner. In conclusion, Mr Morpeth announced that the next SURFEX Exhibition would be again held at the Harrogate Conference Centre (15-16 June, 1988).

The guest speaker (Canon the Rev. J. R. Smith) entertained the company with a sparkling speech, full of humorous stories and reflections on his experiences. To conclude the proceedings the Chairman of the West Riding Section (Mr T. Wright) assisted by his wife, made the prize ticket draw, the first prize of a weekend holiday being won by Mr Bill Jones. The curtain was brought down on a most enjoyable evening by the presentation of a cheque to Canon Smith to be allocated to the charity of his choice (the Church Missionary Society). It was agreed that this function was so successful that it would be repeated at SURFEX 88.

Canon Smith and Terry Wright (Chairman, West Riding Section).

Symposium

On the two days preceding the Exhibition, the Paint Research Association had held a Symposium on "Coatings for Plastics" at the Cairn Hotel, Harrogate. This was well-attended and afforded those present the opportunity of combining a visit to SURFEX with attendance at the Symposium.

Surfex Exhibition 1988

Detailed layout plans for SURFEX 88 will be available in October/November 1986. A larger area has been reserved in order to accommodate more exhibitors. In addition to the areas occupied by stands at SURFEX 86 the auditorium wil also be brought into use and it is expected that this will be particularly suitable for heavy exhibits such as machinery as access and floor loading are excellent.

All exhibitors at SURFEX 86 are already on the mailing list and others interested should write to: SURFEX 88 PO Box 161, Wigan WN2 5TG.

Official Guide to Surfex 86

Those readers who are not regular subscribers to JOCCA and were unable to visit Surfex 86 but would like to obtain a copy of the Official Guide should note that this was contained in the April issue of the Journal. Some copies of this issue are still available from the Association's headquarters (Priory House) at £5.50 sterling each **(pre-payment only).**

Photographs by
Tennant Brown Photography, Harrogate.

Ontario Section

Incorporation of wax in inks and coatings

The last meeting of the season was held by the Ontario Section on 21 May 1986, at the Cambridge Motor Inn, with 33 members and guests in attendance. The speaker for the evening was Dr Chacko Thankachan, Resin Laboratory Manager of *Inmont BASF* in Toronto, who spoke on "Incorporation of Wax in Inks and Coatings—A Necessity and a Dilemma".

Dr Thankachan listed the various types of waxes available (petroleum, natural, mineral, and synthetic), and described their uses and characteristics. He emphasized that the method of incorporation of the wax into the ink or paint is not only critical, but will vary considerably from one system to another. Several case histories of problems in various systems were presented and lessons were drawn.

The chairman, Mr Purnell thanked the speaker for his excellent presentation which was both humorous and informative.

P. Marr

Thames Valley Section

A commonsense approach to fluid mixing

The Thames Valley Section met on 13 March, 1986. Mr W. M. Charlesworth gave a talk to members and guests entitled "A Commonsense Approach to Fluid Mixing", at the Crown Hotel, Amersham.

The speaker introduced the subject with a detailed account of the history of fluid mixing which has led to recent development in modern mixing equipment.

The era of "the propellor age" as it is known in the industry typified by the coupling together of an electric motor, a shaft and a marine propellor has given way to a greater technical awareness of the problems incurred in fluid dynamics.

Clarification of the terms used in the description of fluid mixing were necessary and are as follows:

- Agitation—a method of creating a state of activity.
- Mixing—an intermingling of two or more materials to the required degree of uniformity.
- Stirring—a relatively gentle form of agitation.

Of the many types of available impeller heads, they can be categorised under the following headings:

"The marine type propellor" well-known from many illustrations; a section of the screw in theory displaces during each revolution a quantity of fluid equal to the diameter of the propellor multiplied by the pitch. The flow is axial and creates a stream of fluid flowing down the agitator shaft, outward at the bottom, upwards at the sides and falls back around itself to be recirculated through the propellor.

Such an impeller would be used for fluids up to 1,000 centipoise viscosity for such operations as:

1 Mixing two or more relatively miscible fluids of varying specific gravity or viscosity.

2 Dissolving solids in liquids.

3 Washing insoluble solids prior to filtration.

4 The maintenance of light solids in suspension.

The speaker then explained the role of the "Turbine Impeller", a major development in the history of fluid mixing.

Such a design differs from propellors in that the basic flow pattern created is radial and not axial, hence the vigorous centrifugal action of the impeller with corresponding induced flow into the eye or the centre of the impeller and is particularly useful for:

1 Producing a rapid and intimate dispersion of liquid or powder in a continuous process.

2 Agitation of heavy slurries and suspensions.

3 Stirring and mixing of semi-viscous fluids with or without fluid suspensions.

Having covered the general range of turbo impellers, mention was made of the paddle type stirrers designed to operate at low rpm, but nevertheless they do form an important part of the range of mixing equipment in areas of special application.

To conclude the talk, Mr Charlesworth explained the importance of co-operation between suppliers of variou component parts and the fluid mixing specialist necessary to assist with tomorrow's customer problems.

The meeting closed with a vote of thanks by the Chairman, Mr A. Fell.

J. A. Gant

London Section

AGM

The 48th Annual General Meeting of the London Section was held at PC plc, Britannic House, Moor Lane, EC2 on 24 April, 1986.

Following the AGM, some 35 members and their guests enjoyed a most interesting and absorbing talk on "English Cheeses". The talk was given by Mrs W. P. Hicks, formerly of the National Dairy Council and her obvious knowledge of the subject combined with a background of practical experience was evident in her enthusiasm for the topic.

Samples of many of the cheeses mentioned were available and members and their guests were able to discriminate immediately the various flavours and textures in some cases, suitably enhanced with a glass of red wine.

London Section have, of course, to offer a large vote of thanks to BP for their hosting on this occasion, not only for the use of one of their lecture rooms but also for the refreshments which were as excellent as they were liberal.

The evening became quite extended with the BP facilities being used extensively whilst further debate on a variety of subjects was indulged by, at this time, a very appreciative membership and guests.

D. Bannington

Midlands Section

Palmistry

The Newton-Friend ladies' invitation lecture of the Midlands Section, was held on 15 May, 1986, at the Clarendon Suite, Stirling Road, Edgbaston, Birmingham. The audience heard Mrs Monica Belcher give a talk on "Palmistry".

Mrs Belcher opened her talk by saying that the signs in the palms of left-handed people are the reverse of right-handed ones and that during her talk she would just mention those characteristics of right-handed people. A person's potential is all shown in the right-hand while the left one shows just how much of this potential has been achieved.

Hand-shakes also show a person's character. Someone with a soft "wet fish" type hand-shake is usually a non-achiever while the strong "bone-crusher" type is from a person who is going to succeed; then there are various intermediate types as well.

The speaker went on to describe how the shape of the hand and the length of the fingers also showed a person's character; even the texture of the skin played an important part.

Mrs Belcher then went on to describe the significance of the various lines on the hands such as the marriage and life lines, but because of the restriction on time she could only briefly outline these. A full palm reading can take up to 4½ hours.

After a short question time Mrs B. Kimber proposed a vote of thanks to the speaker thanking her for a most interesting and informative talk.

B. E. Myatt

Analysis of Oils and Fats

Edited by R. J. Hamilton and J. B. Rossell
Elsevier Applied Science Publishers
pp441, £52 hardback, ISBN 0-85334-385-3

This comprehensive treatise on the analysis of oils, fats and other lipids is the combined work of nine contributors to the field. The emphasis is on modern instrumental techniques but there is a very useful first chapter on the classical methods of analysis that have been established in industry for the quality control of oils and fats. Here the discussions are based on standardised procedures and include a wealth of information on practical problems that may be encountered whether they be related to techniques or to the condition of the material under test. Because classical methods are often empirical the analytical results and accuracy of the test depend on the experimental conditions. Many practical examples are given to illustrate this point.

The second chapter reviews national and international standardisation of analytical methods stressing the need for harmonisation and how this could be realised through harmonisation in the conducting of collaborative studies.

A chapter on packed-column gas chromatography (GC) gives an insight into the theory and practice of the technique with examples of typical applications in the analysis of fatty acids and derivatives, triglycerides and partial esters of glycerol.

The method of wall-coated open-tubular (WCOT) capillary gas-liquid chromatography is described in detail. Examples of applications illustrate the greater sensitivity of this technique compared with the packed column. They include the separation of complex mixtures of fatty acids using a polyglycol liquid phase.

Then is followed a chapter on the joint application of gas chromatography and mass spectrometry (GC-MS) for the analysis of mixtures and the determination of structure in lipid research. Problems encountered in combined GC-MS are related to the coupling of instruments, monitoring methods and choice of derivatives. A few selected examples of GC-MS include triglycerides of vegetable and animal fats, wax esters and fatty acids in biological specimens. There is a very useful section on derivatisation of functional groups in triglyceride derived compounds.

Theoretical and practical aspects of Thin Layer Chromatography (TLC) and High Performance Liquid Chromatography (HPLC) in lipid analysis are discussed in detail. Information on silver nitrate TLC for separating fatty acids of different unsaturation, cis and trans isomers, triglycerides and partial esters of glycerol will be of interest to workers who may be investigating, for example, drying oils and oil-modified resin systems in surface coating technology.

HPLC for lipid analysis is attracting increasing attention. It has one special advantage over GLC in that it can separate lipids that are decomposed by the high temperatures or the active sites of GLC columns. There is detailed tabulated data with an associated bibliography, on the separation of triglycerides using a variety of columns and packing materials, detectors and solvent systems.

In the last 20 years or so, much has been added to our knowledge of the positional distributions of fatty acids in triglycerides, so that the chapter on advances in analytical methods will be welcomed. The techniques of pancreatic lipase hydrolysis and use of stereospecific analysis procedures for determining the complete positional distributions of fatty acids, are reviewed. There is useful data on the positional distributions of fatty acids in triacyl glycerols of seed oils and animal fats.

Two chapters covering, respectively, principles and applications of wide-line nuclear magnetic resonance (NMR) and high resoltuion NMR reveal the growing importance of the technique as an industrial tool. Applications are described for the smaller wide-line instruments in the determination of the oil content of seeds, fat levels in foods and one especially important use, the determination of solid phase content in partially solidified fats, to replace the classical dilatation method.

The value of this informative work is enhanced by the extensive bibliography at the end of most of the chapters, totalling some 1,000 literature references. For work comprising much analytical data and notes on experimental procedures this is a most readable book made the more interesting by the critical appraisal of the various techniques and the advice given by contributors on practical problems.

Bearing in mind the interests of OCCA members it is disappointing that no information is given on quality control of raw, refined and processed drying oils used in the surface coating and allied industries. The applications mainly concern the fields of food chemistry and technology, nutritional and biochemical studies. Even so, many of the instrumental techniques described are equally applicable to the unsaturated triglycerides and derivatives that are used for surface coating media. This work will be of considerable value to students as well as experienced workers, so it is unfortunate that it is somewhat high in price.

G. H. Hutchinson

£7m paint plant opened

Princess Alexandra recently opened *Buckingham Coatings* new £7m paint plant. *C H Industrials PLC* and *Petrofina (UK) Ltd* have jointly financed the new factory as part of the planned expansion by their respective subsidiary companies, *Cementone-Beaver* and *Sigma Coatings*, who together are equal joint owners of Buckingham Coatings Ltd, formed to operate the new factory. The new factory has an initial capacity of 18 millions litres per year, and has advanced computer controlled automated equipment for the production of both companies' range of oil and water based paints.

Princess Alexandra with BCL Works Manager, Mike Hodges (left) and Chairman, John Warner.

Lankro buy-out

Lankro Chemicals Ltd of Eccles, near Manchester, has announced that a management group consisting of its present directors has purchased from *Diamond Shamrock Chemicals* Company of Dallas, USA, its 75% shareholding in Lankro. The remaining 25% of the shares have been distributed to or are held in trust for employees throughout Lankro. The Lankro group of companies has its headquarters and main manufacturing site at Eccles, with further manufacturing sites at Drogenbos, near Brussels, and Frankfurt.

Commercial Shearing acquisition

Commercial Shearing Inc has acquired *AMF Cuno*, worldwide manufacturer of process filtration and separation products from *Minstar Inc* of Minneapolis. The transaction is valued in excess of $100 million. Cuno is headquartered in Meriden, USA, with its European headquarters in Paris.

Scott Bader collaboration

Scott Bader of Wollaston have joined with *SOAB* in the manufacture and marketing of Scott Bader's *SOBRAL* range of urethane alkyds and oils. SOAB will manufacture these products at their plant in the North West and marketing will be carried out by Scott Bader.

Du Pont elastomer expansion

Du Pont has announced construction developments for the manufacture of its *"Viton"* fluoroelastomers. In Japan, Du Pont will build near Tokyo a plant with 500 tonnes yearly capacity. Whilst in Europe, Du Pont de Nemours (Nederland) BV has started up a new "Viton" plant at the Dordrecht Works in The Netherlands. The new facility will nearly double the company's worldwide capacity to 5,000 tonnes annually.

HSC new controls for vinylidene chloride and rubber fume

A control limit for vinylidene chloride (1,1-Dichloroethylene) has been adopted by the Health and Safety Commission (HSC) acting on the recommendations of its Advisory Committee on Toxic Substances (ACTS). With effect from 1 March, 1987, occupational exposure to vinylidene chloride should be controlled so as not to exceed 10 parts per million (8-hour time weighted average). In line with Commission policy for all toxic substances, exposure should be reduced below the control limit as far as is reasonably practicable. No specific short-term exposure limit has been agreed but the general guideline recommendations of ACTS is that exposure over any 10-minute period should not exceed three times the level of the 8-hour limit. ACTS also recommended that health surveillance measures should be instituted for workers exposed to vinylidene chloride. The control limit replaces the existing recommended limit at the same value.

Several thousands of tons of vinylidene chloride are used in the UK annually but production and use are for the most part

limited to six plants. Vinylidene chloride is used commercially as a polymer or co-polymer in the manufacture of paints and water-based adhesives, for giving an impermeable coating to food packaging, and in the production of flame-resistant fibres.

A control limit for occupational exposure to rubber fume has been adopted by the Health and Safety Commission on the recommendation of its Advisory Committee on Toxic Substances and the Rubber Industry Advisory Committee. From 1 January, 1987, emissions of rubber fume into a workplace atmosphere should be controlled so that a worker's exposure to it does not exceed 0.75 milligrammes per cubic metre of air (as a time-weighted average over 8 hours). This limit will be reduced to 0.6 mg/m^3 from 1 January, 1990.

Fumes are emitted from rubber at various stages of manufacture, particularly where the material becomes hot. The control limit applies to fume evolved in the mixing, milling and blending of natural rubber and/or synthetic elastomers, or of these materials combined with chemicals, and to the processes which convert the resultant blend into finished products or parts thereof, and to any subsequent inspection procedures where fume continues to be evolved.

Sachtleben huge plant investment

Sachtleben Chemie GmbH of Duisburg, W. Germany has officially applied for planning permission in Nordrhein Westfalen, FDR, to build a large spent-acid recycling plant (*JOCCA* April 1986, p.113). The plant, which will reconcentrate the spent or dilute acid arising from the production of titanium dioxide, became a necessity after a Government decision was taken to only allow spent-acid to be dumped in the North Sea until the end of 1989. This plant will mean an investment by Sachtleben of 125 million D-Mark. The importance to Sachtleben of this single investment can be judged from their usual annual investment budget of roughly DM.35 million. A plan of the proposed plant is show in the diagram below. The recycling of spent-acid to give sulphuric acid takes place in five separate steps: evaporation, ripening, filtration, mixing and re-concentration. A 102 megawatt power station will supply the energy, as heat, necessary for the recycling process. The station will be equipped with the most up-to-date technology, for example the vortex combustion chamber. The operation of this spent-acid recycling plant will mean the end of spent-acid dumping from three German producers, namely Sachtleben, Kronos Nordenham and Kronos Leverkusen.

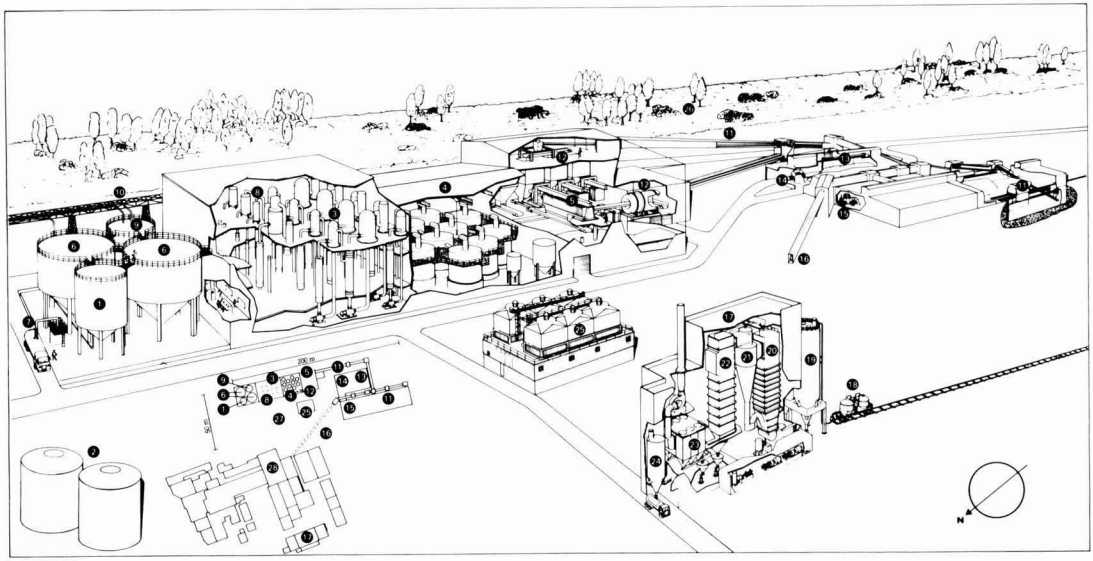
products

Abrasion resistant tile adhesive

BP Chemicals Ltd of South Glamorgan has available a new flexible epoxy resin adhesive called *Epron Tilebond* formulated for permanent bonding of surfaces subject to impact, vibration or deflection. The prime use for this adhesive is for bonding abrasion resistant tiles or linings to steel or concrete substrates in the bulk solids handling industries. Eprom

Plan of Sachtleben's spent-acid recycling plant

1 Spent-acid (23%)
2 Spent acid (23%) Kronos
3 Spent-acid evaporation plant
4 Salt ripening
5 Filtration
6 Sulphuric acid (70%)
7 Loading of sulphuric acid (70%) back to Kronos Leverkusen
8 High concentration evaporation plant
9 Sulphuric acid (80%)
10 Sulphuric acid (80%) to Sachtleben's Titanium Dioxide plant
11 Iron pyrites delivery
12 Mixing of pyrites and filter salt
13 Storage of pyrites-filter salt mixture
14 Filter salt delivery from Kronos
15 Loading pyrites-filter salt mix to oven
16 Belt feed to decomposition oven
17 Power station ZWF 102 MW
18 Delivery and off-loading of brown coal powder
19 Brown coal silos
20 Vortex combustion chamber
21 Cyclone
22 Secondary heat exchanger
23 Gas washing
24 Ash transport to coal supplier
25 Cooling towers
26 Dump no.1
27 Ground plan
28 Sulphuric acid plant with decomposition plant



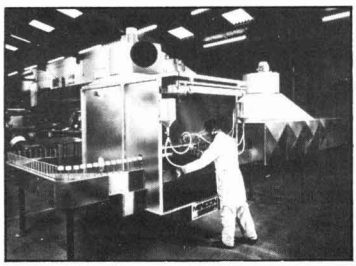
Tilebond is a thixotropic two-part epoxy resin employing a chemical system which allows flexibility after cure. This enables impact energy to be absorbed and dissipated along the bond line. Use at elevated temperatures (ca.150°C) does not lead to the increased post-cure crosslinking. Surface preparation is similar to that required for traditional adhesive systems.

Reader Enquiry Service No. 40

New automatic wet spray painting machine

Mindon Engineering of Nottingham have recently designed and manufactured an automatic wet spray painting machine for aerosol caps. The machine can handle up to 5,000 units an hour and is designed to cope with the need for rapid colour changes. The machine uses a conveyorised 44 metre circuit of 3 inch pitch hollow bearing pin chain on edge. Two fixed sprayguns are directed at the caps which rotate at about 150 rpm to ensure all-round coating.

Reader Enquiry Service No. 41



Mindon Wet Spray Painting Machine

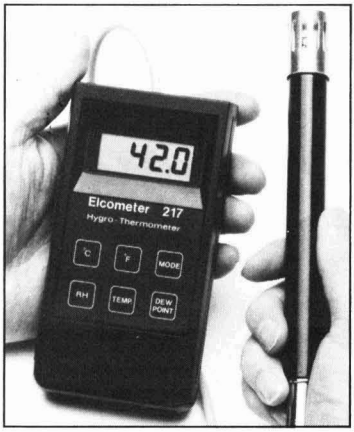
Anti-slip coatings

Wailes Dove Bitumastic of Tyne and Wear has available a new decorative, anti-slip coating called *Super Trident.* This can be applied in one day without priming and provides safe, anti-slip conditions in warehouses, factories etc. "Super Trident" is a single-pack system based on the *Haloflex* vinyl acrylic copolymer made by ICI of Mond Division. Being waterborne, Haloflex imparts to Super Trident low toxicity, and fire retardancy. Super Trident (red, green, grey or white) can be applied to asphalt, concrete surfaces and onto pre-primed wood and metallic surfaces.

Reader Enquiry Service No. 42

New climatic condition testing instrument

Elcometer Instruments of Manchester have extended their range of climatic condition testing instruments to include a simple-to-use microprocessor instrument. The



Elcometer 217

Elcometer 217 gives instantaneous digital read out of temperature, relative humidity and dew point. In certain temperature/humidity conditions, moisture can form on a surface and may be trapped between the coating and the substrate which can lead to premature corrosion, poor adhesion and coating failure. Thus before applying any protective coating it is imperative to ascertain the relative humidity and the air temperature from which the dew point can be calculated. The dew point is the temperature at which air with a specific relative humidity will condense moisture on to that surface.

Traditionally it has been time consuming to measure relative humidity and dew point accurately, Elcometer's instrument offers RH values from 0-97% and dew point calculation instantly.

Reader Enquiry Service No. 43

New UV-curing resins

Ancomer, part of the Anchor Chemical Group of Manchester has recently added two new water-based resins to its Actocryl range. *Actocryl WB500* is a water-based acrylic polymer concentrate designed for the manufacture of flexographic and gravure ink for use on porous and non-porous substrates. WB500 dries under UV or heat. LP1060 is a water-based aliphatic acrylate resin designed for use in UV-curing applications. Dilution with minimal quantities of water leads to significant viscosity reduction.

Reader Enquiry Service No. 44

UV radiometer

Able Instruments & Controls Ltd of Maidenhead has introduced a new battery operated UV Radiometer for measuring the intensity of UV light sources. Called the *IL 390 Light Bug* this radiometer is designed for use in UV curing ovens. Detection capability is centred on 365 nanometers in the UV with an overall detection range of 230-430 nanometers. The instrument has an irradiance operating range of 0.001 to 2.5 watts per square centimetre.

Reader Enquiry Service No. 45

Impeller

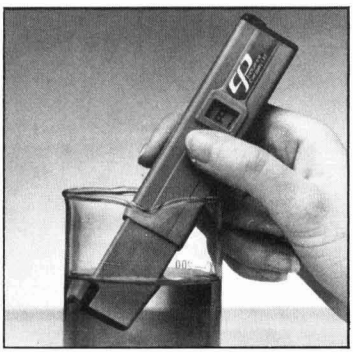
Akato Mixing Technology Ltd of Slough have introduced the *Intermig* impeller, a multi-stage interference flow mixer. The Intermig can solve especially difficult suspension, homogenising, dispersion and heat transfer tasks due to the power input being evenly distributed throughout the entire volume and having a large diameter ratio.

Reader Enquiry Service No. 46

pH meter

CP Instruments Co Ltd of Bishops Stortford has available a new indicator called *pHep.* This is a pocket sized meter designed as an alternative to pH indicator paper. The electronics ensure accurate measurement to ±0.1pH.

Reader Enquiry Service No. 47



pHep pH meter

meetings

International lead conference

The ninth International Lead Conference will be held at Goslar, W. Germany, from 19-22 October, 1986. The keynote speaker will be Heinz Schimmelbush, Metallgesellschaft, W. Germany, who will review the major structural changes taking place in the world of metals and their impact on lead. The preliminary programme for "Pb86" and details of supporting events are available from: Lead Development Association, 34 Berkeley Square, London W1X 6AJ.

Coatings courses

Two coatings courses will be held at Kent State University, Ohio, USA, (sponsored by the Chemistry Department) on "Painting Processes: Industrial Paint Application Technology" on 15 & 16 October, 1986, and "Introduction to Coatings Technology" on 20-23 October, 1986. For further information contact: Carl J. Knauss, Kent State University, Chemistry Department, Kent, Ohio 44242, USA.

literature

Literature from Crown

A new coloured brochure featuring Crown's Nubond range of film to board laminating adhesives is available. The brochure outlines the type of adhesive needed by a laminator for a print/packaging finish.

Crown's Industrial Division has also updated its booklet on health and safety information. This explains recent legislation and its implications for the labelling of coatings and solvents, and presents in simple terms relevant health and safety facts.

The brochures are available from: David Parkinson, Marketing Manager, Crown Paints Industrial Division, PO Box 37, Hollins Road, Darwen, Lancashire BB3 0BG.

Crown Health and Safety Booklet

people

Dr Guenter Metz, a Member of the *Hoechst AG* Board of Management, has taken on regional responsibility for the UK following the retirement of Dr Wolfgang von Poelnitz. Dr Metz is a Main Board Member responsible for fibres, fibres raw materials, for the worldwide Group's sales organisation.

Tony Mapp, Director of Non-Metals Research at *Metal Box R & D,* Wantage, will take over as the new Chairman of the Packaging Divisional Committee of the *Printing Ink Research Association.*

Keith Shaw has been appointed Export Sales Manager of *Thomas Swan & Co Ltd,* of Consett, Co. Durham, manufacturer of speciality chemicals.

Roger Bexon, CBE has been appointed Chairman of *Laporte Industries plc.* Mr Bexon was formerly Deputy Chairman of BP plc.

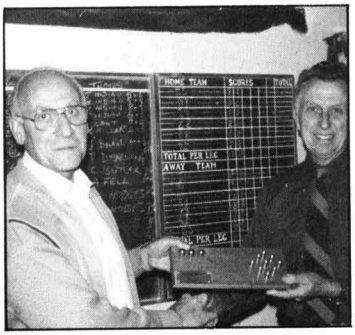
Thames Valley/ Bristol Section

Inter-section skittles

Thames Valley Section met Bristol Section at the Cross Keys Inn, Great Bedwyn, Wilts., for a skittles match on 25 April, 1986. Thames Valley won this first fixture and the "Walton Trophy" made by Mr Walton of Bristol. Due to the fixture's success both teams have agreed to make this an annual event.

J. L. Inshaw

Thames Valley/Bristol Sections' skittles match: (on the right) M. Prigmore (chairman, Bristol Section) presenting J. L. Inshaw (chairman, Thames Valley with the Walton Trophy.



West Riding/ Manchester Section

Roses games evening

On the evening of 20 May, 1986, 27 members of the Manchester and West Riding Sections again competed for the Roses Games Shield at the Scotland pub, Birstall.

The heavy, late afternoon rain relented to allow five bowls double matches to be played and helped by a strong contingent from Crown Paints, the Manchester Section went quickly into a 4-1 lead.

Upon returning to the warmth and bar refreshments, however, the cunning and skill of the Yorkshiremen promptly the ascendancy in the traditional bar of cribbage, dominoes etc., and again finished overall clear winners.

Following a convivial bar supper the evening concluded with the usual friendly banter; the card, liar dice and domino schools all continuing well after closing hours.

All present agreed it was another excellent meeting and we all look forward to next year's return encounter.

T. Wright

Bristol Section

Skittles with BPVLC

The annual skittles match between Bristol Section OCCA and the Birmingham Paint Varnish & Lacquer Club was again held at the "Hobnails", Little Washbourne on 9 May, 1986, and attended by 46 members, families and friends from both associations. The "Alkyd Cup" was won this time by the BPVLC and was presented to their President, Mr Ron Jukes, by Mr Maurice Prigmore, Chairman of Bristol OCCA—the previous holders. The knockout competition which follows was won by Mr Mike Ramsden of Haeffner Group Ltd. The event was, as usual, a very enjoyable occasion and very well organised by Mr Ken Chippington the Bristol OCCA secretary.

M. Prigmore

Bristol Section/BPVLC skittles match: (on the right) M. Prigmore (Chairman, Bristol Section) presenting R. Jukes (President, BPVLC) with the Alkyd Cup.

Natal Section

AGM

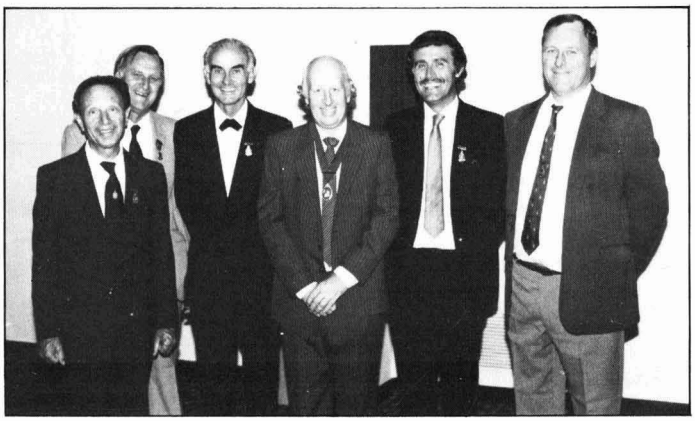
On Friday, 11 April, 1986, the 10th Annual General Meeting of the Natal Section was held at The Westville Hotel, Durban.

The Chairman, Mr T. Say, tabled his report for the past year and advised that a total of seven meetings had been held with an average attendance of 31. The one-day symposium held in August, 1985, attracted 46 participants.

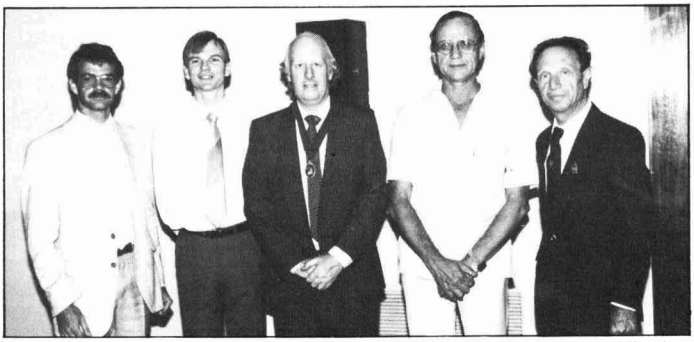
At the close of the meeting the members then joined the ladies who had been entertained with a talk by Jeanine Goosen of *Plascon Evans (Natal) (Pty) Ltd* on Colour Co-ordination in the home.

The evening was concluded with a most enjoyable dinner.

R. Philbrick



Natal Section past office bearers and new Chairman at the recent AGM (left to right): Mr K. Englebert (Hon. Life Member and SA Vice President 1968-70), Mr R. Eglington (SA Vice President 1979-81), Professor D. E. A. Williams-Wynn (Natal Section Chairman 1979-81), Mr R. H. Philbrick (Chairman), Mr T. Say (Natal Section Chairman 1984-86), Mr P. Draper (SA Section Chairman 1968-70).



Natal Section Committee for 1986 (left to right): Mr B. Rijkmans (Hon. Publications Secretary), Mr R. Archer (Hon. Secretary), Mr R. Philbrick (Chairman), Mr H. van der Marwe, Mr K. Englebert (Treasurer). Not present, Mr G. Myers, Mr E. Putterman.

new members

The Sections to which new members are attached are shown in italics, together with the country, where applicable.

Ordinary Members

Bielby, T W (*West Riding*)
Cirisoglu, M C, BSc (*General Overseas — Turkey*)
Halter, C E, B Tech, CCol, ASDC (*Scottish*)
Maxwell, F G (*Scottish*)
Tasker, N R, BSc (*London*)

Associate Members

Armstrong, R A (*General Overseas — Zimbabwe Branch*)
Blakeley, A D (*Manchester*)
Clarke, J P (*Irish*)
Ebrahim, M (*Cape*)
Gwynn, R W (*Cape*)
Hyden, K J (*Wellington*)
Jenkinson, I (*West Riding*)
Johnson, B R, BComm (*General Overseas — Zimbabwe Branch*)
Leisegang, H K (*Transvaal*)
Mangan, T (*Midlands*)
McWilliam, D G (*Transvaal*)
Ndiraya, C (*General Overseas — Zimbabwe Branch*)
Osborne, P (*Wellington*)
Pettit, R M (*Transvaal*)
Winter, B P (*Auckland*)

OCCA Ties are now available from the Association's offices, with a single Association Insignia on either a blue or maroon background. The price is £4.25 each (including VAT) and orders **(prepayment only)** to Priory House should state clearly the number and colour(s) required.

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Tony Guertin, Jr., President, Guertin Bros. Coatings and Sealants Ltd., 50 Panet Road, Winnipeg, Manitoba R2J 0R9, Canada

Guertin

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PRODUCTION MANAGER

The candidate should have a minimum of five years' experience in the manufacturing of coatings and/or sealants for Industrial Markets.

Please send résumé in confidence to

Mr. George Hawranik, Plant Manager, Guertin Bros. Coatings & Sealants Ltd., 50 Panet Road, Winnipeg, Manitoba R2J 0R9, Canada

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SITUATIONS VACANT

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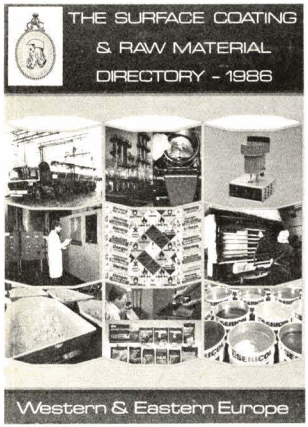

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Annual Report of the Council, 1986

Note: The Annual Report of the Council will NOT be reproduced in the Journal

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Oil and Colour Chemists' Association

ANNUAL REPORT OF THE COUNCIL FOR 1986

To be presented to the Twenty-Fifth Annual General Meeting of the Incorporated Association, to be held on Friday 19 June 1987 at the Grand Hotel, Eastbourne, England at 4.15 p.m. or as soon thereafter as the fourth technical session of the Biennial Conference, entitled "Advances and Application of Science and Technology in Surface Coatings" shall terminate.

General

By far the most significant event in the year under review was the holding of the first Association Exhibition outside the London area. The Exhibition, known as SURFEX 86, took place at the Harrogate Conference and Exhibition Centre on 14 and 15 May. As well as exhibitors in one of the halls of the Conference Centre, stands were also arranged in the Reception Area and the Gallery, from which visitors were able to cross by a footbridge to the International Hotel, where some exhibitors occupied hospitality suites. From the exhibitors' point of view the emphasis was on ease of construction and display, coupled with the opportunity to discuss with customers their technical problems, in both the hospitality suites and the many seating areas. The Exhibition Committee appointed a special Management Sub-Committee drawn from three of the Association's Sections to organise the Exhibition with full supporting facilities from the Association's Headquarters. The Chairman of the Management Committee was Mr F. Morpeth (Manchester Section), the other members being Mr L. Morpeth (Newcastle Section) and Mr D. Komrower (West Riding Section). The general consensus of opinion amongst exhibitors and visitors alike was that the Exhibition was an outstanding success and arrangements have been made to hold a further Exhibition on the same lines, but with additional exhibition space, at the same venue in June 1988.

On the first evening, the West Riding Section organised a dinner for exhibitors and visitors at the Majestic Hotel. During the dinner plaques were presented for the first time at an OCCA Exhibition to exhibitors who had been adjudged to make the best use of the area allocated to their stands. A full report of the Exhibition and the dinner appeared in the July issue of the *Journal.*

In alternate years the Council Reunion takes the form of a luncheon preceding the Annual General Meeting. At the request of the Council, the Bristol Section undertook the arrangements for the 1986 Annual General Meeting which took place at the Unicorn Hotel, Bristol on 18 June. In the morning a party visited the *S.S. Great Britain Project.* At the Reunion Luncheon the President welcomed as guests Mr C. N. Finlay (President 1983/85), Mr D. S. Newton (Honorary Editor 1962/65, Honorary Secretary 1969/71 and currently Honorary Editor), Mr G. W. Fowkes (Honorary Secretary 1983/84 and currently President, Birmingham Paint, Varnish and Lacquer Club), Mr J. R. Bourne (Honorary Secretary 1980/83 and the Council's appointee as President Designate 1986/87) and Mr H. C. Worsdall (Honorary Member). He also expressed the thanks of the Association to Mr R. Saunders (the Immediate Past Chairman of the Bristol Section and currently a Vice-President) for making the arrangements for the visit to the *S.S. Great Britain* and the lecture. Following the Luncheon Mr R. J. Bradbury of the Project gave an illustrated lecture on the progress which had been made on the restoration of this historic vessel. A full report of the occasion appeared in the August issue of the *Journal.*

At the conclusion of the lecture the Association's Twenty-Fourth Annual General Meeting was held. Mr J. R. Bourne was appointed President Designate and the following were elected Vice-Presidents:

Mr G. R. Robson
Mr R. Spargo
Mr R. Saunders
Prof. D. E .A. Williams-Wynn
Mr G. W. Fowkes
Mr K. Arbuckle
Mr H. J. Clarke

The Honorary Officers of the Association were elected as follows:

Honorary Secretary	Mr L. J. Brooke
Honorary Treasurer	Mr B. F. Gilliam
Honorary Editor	Mr D. S. Newton
Honorary Research and Development Officer	Mr J. R. Taylor
Honorary Technical Education Officer	Mr A. J. Newbould
Honorary Overseas Secretary	Mr W. Borrell
Honorary Conference Officer	Mr A. C. Jolly

Under Article 43(ii) of the Association where the number of persons nominated for the three elective places did not exceed this number, then the persons so nominated were declared elected. At the closing date for nominations, one member (Mr L. Morpeth) had been nominated and, accordingly, he was elected to serve on the Council for the period 1986-88. The other two places, therefore, had to be filled by the Council as its first act at the meeting on 16 July in accordance with Article 50. More than two nominations from Council having been received, it was necessary to hold a ballot, as a result of which Mr B. E. Myatt and Mr D. W. N. Clayton were declared elected to serve on Council for the period 1986-88.

A report of the Annual General Meeting appeared in the August issue of the *Journal.*

The President and Mrs Redman visited the FATIPEC Conference in Venice (21-27 September). The President attended a meeting of ICCATCI on 22 September which was attended by representatives from FSCT, SLF, OCCAA and JSCM. He was able to report that the Association had sent information to assist Mr J. Roire who was compiling a history of paint manufacture and on the new publications which the Association had produced since the last meeting of this international liaison committee. Mr and Mrs Redman and Mr J. R. Bourne, President Designate, visited the South African Division's Convention at Durban, 21-25 October, when both Mr Redman and Mr Bourne presented papers. The Association was pleased that Mr D. W. N. Clayton, an Elective Member of Council, was able to present a paper at the FSCT Convention at Atlanta, Georgia, USA on 5-7 November.

In 1986 the Paint Research Association celebrated its Sixtieth Anniversary and the President of this Association presented a congratulatory scroll to the Annual General Meeting of the Paint Research Association on the 27 November. The London Section held a well-supported Symposium on "Health and safety in the coatings and user industries" at the Royal Institution on 10 April. The Manchester Section held a highly successful seminar on "Printing Inks for the packaging industry — recent changes and future developments" at Salford University on 10/11 April. The Thames Valley Section held a one-day conference at Brunel University on "Reactive surface treatments for concrete" on 4 July which was well attended. The New Zealand Division held its annual Convention at Rotorua on 25-27 July. During the year considerable discussion had taken place on the future

arrangements for the New Zealand Division, which will come into being on 1 January 1987.

On his retirement in May, Dr Leslie Valentine was granted a Commendation Award by Council which was presented to him by the Chairman of the London Section, Mr K. Arbuckle, on 10 September, the first meeting of the Section's session.

The Director & Secretary was pleased to welcome visitors to Priory House, including Mr R. Purnell, Chairman of Ontario Section and Mrs Purnell.

Council was saddened to learn of the death of members who had held office in the Association. Mr A. R. H. Tawn, a former Honorary Editor and Honorary Research and Development Officer died on 27 February and Dr J. O. Cutter, a former Honorary Research and Development Officer and a former Chairman of the London Section died in February. Mr E. L. Farrow, a former Chairman of the Newcastle Section died in July.

During the year the death of the following members or former members of the Association was also notified:

Mr L. Hopwood	—	Committee member — Bristol
Mr E. Oakley	—	Auditor — Newcastle
Mr. D. Power	—	Chairman — Irish
Mr J. F. Rule	—	Committee member — Manchester

Obituary notices have appeared in the *Journal* during 1986.

The thanks of the Council are recorded to the Director & Secretary and staff for once again maintaining the high standard of administration during a most difficult period in the industry and finding new sources of income through handling sales of books for other publishers.

Membership of the Association

The decrease in the total number of members is not as great as in the previous year and it is hoped that the position has now stabilised in the United Kingdom Sections and that there will be an increase in membership as a result of candidates being successful in passing the modules of the Paintmakers' Open Tech courses. All members of the Association are urged to encourage younger personnel to join the Association.

The figures given below at 31 December 1986 relate only to those whose 1986 subscriptions have been received; the names of those in arrears with subscriptions have been removed.

Section	*Ordinary*	*Associate*	*Honorary*	*Reg. Students*	*Total*
Bristol	49	7	—	1	57
Hull	29	—	—	—	29
Irish	32	16	—	1	49
London	303	29	5	—	337
Manchester	269	27	1	3	300
Midlands (including Trent Valley Branch)	126	19	—	2	147
Newcastle	82	4	—	—	86
Scottish (including Eastern Branch)	70	7	—	1	78
Thames Valley	78	7	—	—	85
West Riding	84	10	1	1	96
General Overseas	256	19	2	—	277
Nigerian Branch	39	7	—	—	46
Zimbabwe Branch	22	11	—	—	33
Ontario	106	9	—	—	115
South African Division					
Cape	43	23	—	1	67
Natal	92	33	2	—	127
Transvaal	137	40	—	1	178
New Zealand Division					
Auckland	144	54	—	—	198
Wellington	64	34	—	—	98
Total 1986	2025	356	11	11	2403
Total 1985	2041	356	11	20	2428
Net increase/decrease during 1986	16			9	−25

The Council

Four meetings of the Council took place during the calendar year, the average attendance being 26. All meetings were held in London.

Committees of Council

The Committees of Council met as set forth below:

Finance Committee	2
Executive Committee	4
Professional Grade Committee	3
Jordan Award Committee	—
Technical Committee	1
Technical Education Committee	—
Publications Committee	—
Exhibition Committee	2
Working Group on Overseas Development	1

Finance Committee

Chairman: Mr B. F. Gilliam (Honorary Treasurer)

The Finance Committee is pleased to report that the improved financial situation of the Association shown in the last two Annual Reports has continued during 1986. Although a substantial amount of the surplus was derived from the Exhibition, an increased significant contribution has also been made by *Journal* subscriptions, advertising in the *Journal* and the sale of publications. Members will have noted that the Association is not only advertising its own publications, such as the two new monographs available in 1986, but is also taking orders for books published elsewhere. The Finance Committee draws the attention of members to the fact that the Exhibition will be held biennially so that the surplus expected in alternate years will depend upon other factors, including the Conference.

In the last two Annual Reports attention was drawn to the way in which balances held overseas affected the Association's consolidated accounts which are given in sterling. In 1984 a provision of £4,948 and in 1985 a provision of £8,142 had to be made for this purpose, thus reducing the overall surpluses for those years. It was not necessary to make such a provision for this purpose in 1986 and a gain of £1,462 was recorded. The Association's investments in the equity market changed as a result of two takeovers, which resulted in a small cash surplus of £607 for the Association. Some further investment has been made during the year. The market value of the investments held at the end of the year showed that the equities stood at £10,576 above their purchase price and British Government Securities stood at £366 above their purchase price.

Executive Committee

Chairman: The President

The Executive Committee consisted of the President, Immediate Past President/President Designate, the Honorary Officers of the Association and the Chairman of the Exhibition Committee. The Committee met before each Council meeting and then adjourned to reconvene after the Council meeting to agree upon ways in which to implement the decisions reached at Council meetings.

A Working Group was formed to report to the Executive Committee to consider the modernisation of the headquarters' offices consisting originally of the President, President Designate, Honorary Treasurer, Dr F. M. Smith and the Director & Secretary. In October the Honorary Secretary, the Honorary Editor and the Honorary Research & Development Officer agreed to serve on this Working Group also.

By the end of the year the Working Group had advertised for a General Secretary (it being understood that Honorary Officers would play a more active part) as a successor to the Director & Secretary who would be retiring after the 1987 Conference/AGM after more than 36 years as the Association's chief executive officer.

Professional Grade Committee

Chairman: The President

During the year the Committee has been pleased to note that members in the Professional Grade have been progressing from Licentiateship to Associateship and from Associateship to Fellowship, since it has always been expected that this pattern would develop and become the usual practice. The Committee noted with interest that candidates for the Open Tech course had completed several modules and urged all senior members to encourage junior personnel who were engaged on Open Tech courses to become Registered Students of the Association, since it is expected that those who completed module 8 of the Open Tech courses in 1988 should be able to apply for admission to the Licentiateship grade. The Committee once again wished to remind members that the regulations were amended some years ago so that candidates for LTSC would be able to provide "written evidence" of their technical competence in place of the original mandatory dissertation. The statistics for the Professional Grade are shown in a table on page 5.

Publications Committee

Chairman: Mr D. S. Newton (Honorary Editor)

Papers this year have included a number from the Manchester Section's Symposium on Printing Inks and Packaging as well as those from the Health and Safety lectures given at the London Section's Symposium. These account for the imbalance in the geographical distribution of the contributors in 1986.

The Honorary Editor was pleased to be able to publish contributions from Nigeria and New Zealand, the former indicating that those in this country are well aware of the economic necessity to produce their own raw materials.

Correspondence on wet adhesion has continued (and will probably still continue), and the Honorary Editor is always pleased to publish letters on contentious issues!

His thanks, as always, are due to the Assistant Editor, Dr P. Fyne, who has now managed to get at least three months future issues into galley form. His thanks are also due to the Director & Secretary, the Senior Secretary and those other members of the Priory House staff who have eased his responsibilities in many ways.

Subjects and Classification (inc. correspondence) — *Number of papers*

Solvent Based Coatings	3
Natural Products and Derivatives	2
Adhesion	4
Corrosion and Corrosion Inhibiters	3
Colour	4
Surface Preparation	1
Dispersion	1
Wood Finishes	3
Analysis	2
Moisture Cured Coatings	1
Pigments	4
Antifouling Paints	2
Lacquer Work	1
High Temperature Coatings	1
Electrodeposition	1
Health & Safety	4
Thickeners	1
UV Curing	1
Inks	1
Miscellaneous	1
	41

Origin

Argentina	1
Australia	3
Denmark	2
France	1
Germany (West)	1
India	4
Netherlands	3
New Zealand	1
Nigeria	1
United Kingdom	22
USA	2
	41

Jordan Award Committee

Chairman: Mr J. R. Taylor (Honorary Research and Development Officer)

This Award is made biennially and the Committee did not meet in 1986. The next Award would be made at the Annual General Meeting in June 1987.

Technical Committee

Chairman: Mr J. R. Taylor (Honorary Research and Development Officer)

The Committee has been engaged during the year on the arrangements of papers for the 1987 Conference which will take place at Eastbourne on 17-20 June 1987 under the title "Advances and Application of Science and Technology in Surface Coatings".

Technical Education Committee

Chairman: The Honorary Technical Education Officer Mr H. J. Clarke until 18 June; then Mr A. J. Newbould

The Associatioin has continued to co-operate with the Paintmakers Association's Open Tech Project and reports have been made at each Council meeting by the Honorary Technical Education Officer. The Professional Grade Committee has also been notified of the progress of the Open Tech Project and it is understood that the South African Division has made arrangements with the Paintmakers Association to utilise the modules for the programme of "distance learning".

Exhibition Committee

Chairman: Mr F. Morpeth

In the Annual Report for 1985 it was stated that the first Exhibition to be held at a venue outside the London area would be SURFEX 86 on 14/15 May 1986 at the Harrogate International Conference and Exhibition Centre. The number of visitors attracted to the event was highly satisfactory and included a considerable number from the southern part of the United Kingdom as well as more than 100 from overseas. Disappointment was felt at the attendance from the Scottish Section in view of the venue. The Management Committee, which consisted of Mr F. Morpeth (Manchester Section), Mr L. Morpeth (Newcastle Section) and Mr J. Hemmings (West Riding Section) met during the second part of the year to discuss the arrangements for the next Exhibition, SURFEX 88, which will be held at the same venue on 15/16 June 1988 but with additional accommodation for stands.

The Council considered that the importance of the exhibition was such that the Chairman of the Exhibition Committee should be nominated as an Honorary Officer of the Association in future years and the nomination will be confirmed at the Annual General Meeting in 1987.

	Applications received	*Applications transferred between grades*	*Successful*	*Awaiting fulfilment of regulations*	*Not accepted*	*Resignations and deaths*	*Upgradings*	*Totals as shown in December 1986 Journal*
Fellowship	304	*Less* 49 *Add* 32	254	10	4	72	—	182
Associateship	432	*Less* 44 *Add* 64	418	28	20	122	40	256
Licentiateship	64	*Less* 15 *Add* 12	33	22	11	5	13	15
Totals	800	—	705	60	35	199	53	453

Note: Including the United Kingdom and Ireland, 34 countries are represented in the list of successful candidates published in the December 1986 issue of the *Journal*.

Working Group on Overseas Development

Chairman: The President

As stated in the last Annual Report, a Working Group (comprising the President, the Immediate Past President, the Honorary Overseas Secretary, the representatives of the Auckland and Wellington Sections and the Director & Secretary) was appointed by Council to consider the questions of future organisation of the Association in New Zealand. The Study Group made proposals which were accepted by the Council and by the Committee of New Zealand Division as a result of which the New Zealand Division sent a questionnaire to its members asking if they would be willing to form a separate New Zealand Association, but retaining the right to apply to the Association, as an affiliated body, for the Professional Grade and certain other services.

At the end of the year it seemed likely that the proposal would be acceptable.

Representation on other organisations

The Association was represented on other organisations as follows:

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

The British National Committee for Chemistry: Mr N. Casson.

The Association of Exhibition Organisers: The Director & Secretary.

The Paintmakers' Association Hazardous Substances Advisory Panel: Mr W. J. Wenham.

The Paintmakers' Association Open Tech in Surface Coatings Management Board: Mr A. J. Newbould.

The Society of Dyers & Colourists' Terms & Definitions Committee: Mr A. G. Abel.

The Society of Dyers & Colourists' Review of Coloration Progress Committee: Mr A. G. Abel.

The Colour Group (Great Britain): Mrs E. Stretton.

Institution of Corrosion Science and Technology Technical Education and Training Co-ordination Committee: Mr D. S. Newton.

Institute of Metal Finishing Technical Education Committee: Mr D. H. Clement with Mr H. J. Clarke as alternative representative.

National Council of Corrosion Societies: Mr D. S. Newton.

National Council for Vocational Qualifications: The Director & Secretary.

British Standards Institution:

PVC Pigments, Paints & Varnishes Industry Committee: *Mr R. G. J. Toms*

PVC/1 Pigments: *Mr G. R. Robson until July then Mr G. W. Fowkes*

PVC/1/5 Red Lead: *Mr R. Barrett*

PVC/1/6 White Pigments: *Mr S. A. Ray until July then Mr T. Entwistle or Mr. R. Blakey*

PVC/1/8 Chrome Pigments, Prussian Blue and Zinc Phosphate: *Mr. M. Dickinson and Mr T. Harbottle*

PVC/1/10 Miscellaneous Pigments: *Mr D. S. Newton*

PVC/1/13 Methods of Test for Pigments: *Mr D. S. Newton*

PVC/3 Paints Media and Related Products: *Mr G. H. Hutchinson*

PVC/4 Lac: *Dr B. S. Gidvani*

PVC/10 Test Methods for Paints: *Mr A. W. Fell*

PVC/11 Glossary of Paint Terms: *Mr G. V. G. Hill*

PVC/14 Colour Schedules: *Mrs E. Stretton until June then Mr R. J. Woodbridge*

PVC/21 Surface Preparation of Steel: *Mr D. S. Newton*

PVC/25 Organic Finishes for Aluminium: *Mr D. S. Newton*

PVC/27 Paint Systems for Metallic Substrates: *Mr R. Lang and Mr P. Munn*

PVC/27/ – /1 Metallic zinc priming paints: *Mr P. W. Munn*

PVC/27/ – /2 Revision of BS 3416: *Mr D. Tate*

PVC/27/ – /3 Zinc Phosphate and MIO Paints: *Mr D. S. Newton*

PVC/28 Paint Systems for Non-Metallic Substrates: *Mr W. O. Nutt and Mr W. Phillips*

PVC/28/1 Priming Paints for Wood: *Mr W. Phillips*

PVC/28/ – /1 Exterior wood coating systems: *Mr W. Phillips*

PVC/28/ – /4 Interior emulsion paints: *Mr W. Phillips*

PVC/28/ – /5 Undercoat and gloss paints: *Mr W. Phillips*

LGL/9 Artificial Daylight for Colour Matching: *Mrs E. Stretton*

GME/29/1 Test Sieves: *Mr D. S. Newton to represent as required*

GME/29/2 Test Sieving and other Sizing Methods: *Mr D. S. Newton to represent as required*

CIC/4 Solvents and Allied Products: *Mr A. R. H. Tawn until February then Mr G. H. Hutchinson*

CIC/6 Glycerol: *Mr W. A. Ledger*

GEL/16/3 Varnishes: *Mr N. H. Seymour*

ACE/44 Aircraft Finishes: *Mr R. G. Booth until July then Mr R. L. Herbert*

BDB/7/1 Protection of Iron & Steel Structures from Corrosion: *Mr P. W. Munn*

BDB/7/2 Painting (sub-committee of BDB/7): *Mr A. Lageu*

RDB/25 Road Marking Compounds: *From July Mr A. J. Gant*

DOS/3/10 Chemistry and Chemical Technology (UDD54 & 66): *Mr G. Wood until July then Dr J. W. Nicholson*

CMP/11 Viewing Conditions: *Mrs E. Stretton*

M/2 Colour Difference Equations: *Dr D. A. Plant*

Overseas Representation:

South African Association of Scientific and Technical Societies: Mr R. H. Philbrick (Natal Section).

South African Bureau of Standards: Mr K. M. Engelbert (Natal Section).

Appendix

Report of the Council in accordance with the Companies Act 1985

1. The Council presents herewith the audited accounts of the Association for the year ended 31 December 1986.

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

3. *Principal Activities of the Association*
The Association has continued in its work for furthering the development of the science and technology of the oil and colour industries.

4. *Change in fixed assets*
The movements in fixed assets during the year is set out in the table on page 10.

5. *The Council*
The following were members of Council at 31 December 1986:

F. M. Smith, BSc, PhD, FTSC
B. F. Gilliam, ATSC
J. R. Taylor, BSc, CChem, FRSC, FICorrST, FTSC
T. Entwistle, FTSC
C. Butler, LRSC, MBIM, FIWM, FTSC
P. Birrell, FTSC
D. S. Newton, AMCT, CGIA, FICorrST, FTSC
L. J. Brooke, ATSC
F. B. Windsor, FTSC
G. R. Robson, BSc, ARSC, FTSC
H. Young, FTSC
H. J. Clarke, FTSC
R. Saunders
B. A. Canterford, ATSC
F. Morpeth, CChem, FRSC, FTSC (co-opted)
R. Spargo, ATSC
E. C. Wallace
T. M. Wright, BSc, ARCS
F. B. Redman, FTSC
A. C. Jolly, BSc, FPRI, FTSC
M. H. Gamon
M. Prigmore, FTSC
K. Arbuckle, MA, FTSC
R. G. Carr, ATSC
R. Barrett, BSc, CChem, MRSC
J. Inshaw, ARSC, ACTC, FTSC
M. F. Newton
Mrs C. J. de Villiers
G. J. Lewis, BSc, PhD, ARSC, ATSC
R. Purnell
S. A. Lawrence, BA, PhD, ATSC
R. E. Elliott
J. Hemmings, LRSC, ATSC
J. Calderbank, AssIOP, MIST, ATSC
P. L. Gollop, FTSC
P. J. Quorn, LRSC, ATSC *(elected 21 March 1986)*
A. Taylor *(elected 25 April 1986)*
A. J. Newbould, BSc, CChem, MRSC *(elected 18 June 1986)*
W. Borrell, LRIC *(elected 18 June 1986)*
R. H. Philbrick *(elected 11 April 1986)*
J. R. Bourne, FTSC *(elected 18 June 1986)*
L. Morpeth *(elected 18 June 1986)*
G. W. Fowkes *(elected 18 June 1986)*
Prof. D. E. A. Williams-Wynn, MSc, PhD, CChem, FRSC *(elected 18 June 1986)*
J. C. Shaw *(elected 29 April 1986)*
N. Reeves, PhD, CChem, MRSC *(elected 14 April 1986)*
B. E. Myatt *(elected 16 July 1986)*
D. W. N. Clayton, ATSC, MIQA, DMS, MBIM *(elected 16 July 1986)*
N. Seymour *(elected 25 April 1985)*
D. Pountain *(elected 25 April 1986)*
B. J. Gregory *(elected 10 April 1986)*
S. Lynn, CChem, MRSC *(elected 3 April 1986)*

The following were members of Council at 1 January 1986 and served during the year; the date shown after each name denotes when during 1986 service on Council terminated:

D. D. Kimber, BSc, ARSC *(18 June 1986)*
A. W. Fell, BSc, LRSC, ATSC *(10 April 1986)*
Mrs E. Stretton, FTSC *(18 June 1986)*
P. Holmes *(25 April 1986)*
S. G. Heyes, BSc *(25 April 1986)*
P. McCrudden *(25 April 1986)*
C. N. Finlay, ATSC *(18 June 1986)*
R. P. Johannsen, FTSC *(18 June 1986)*
D. B. Bannington, ATSC *(18 June 1986)*
R. L. Devenish *(18 June 1986)*
T. Say, BSc, CChem, MRSC *(11 April 1986)*
C. G. Crawforth, BSc, DPhil *(14 April 1986)*
Mrs H. Gaynor, BSc, ATSC *(21 March 1986)*
I. B. Bolam, ATSC *(3 April 1986)*

Council members do not receive any remuneration from the Association. All positions held are honorary.

6. *Auditors*
In accordance with Section 384 of the Companies Act 1985, a resolution will be proposed at the Annual General Meeting to reappoint the auditors, Coopers & Lybrand.

7. (a) Membership Subscriptions include amounts received during the year by overseas sections in local currencies. The sterling equivalents of these amounts have again been affected by exchange rate fluctuations during 1986.
(b) The sterling value of overseas sections net assets rose by £1,462 *(1985 loss £8,142)* during the year due to exchange rate fluctuations. This gain has been included in sundry income in the income and expenditure account.

By Order of the Council
ROBERT HAMBLIN
Director & Secretary

2 January 1987

OIL AND COLOUR CHEMISTS' ASSOCIATION

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1986

1985 £		1986 £
	INCOME	
53,604	Membership subscriptions	55,259
59,861	Journal sales	63,155
38,810	Advertising	49,630
5,263	JOCCA — Australia	4,896
5,077	Sundry income	11,846
5,728	Conference surplus 1985/Exhibition surplus 1986	39,114
1,258	Section surplus — Note 11	2,899
7,042	Investment income	9,986
4,004	Reprints	2,935
1,170	JOCCA — New Zealand	800
552	Publications	5,187
523	Entrance fees	739
1,712	Surface Coatings	896
354	Professional Grade	211
184,958		247,553
	EXPENDITURE	
101,928	Administration and general expenses	115,833
64,051	Journal expenses	69,195
2,127	Bulletin	1,915
1,993	Cost of reprints	1,777
170,099		188,720
£14,859	Surplus for the year	£58,833

STATEMENT OF RETAINED RESERVES

1985 £		1986 £
14,859	Retained surplus for year	58,833
82,416	Retained surplus at 1 January 1986	97,275
£97,275		£156,108

The notes on pages 9 to 11 form part of these accounts.

AUDITORS' REPORT TO THE MEMBERS OF OIL AND COLOUR CHEMISTS' ASSOCIATION

1. We have audited the accounts on pages 7 to 12 in accordance with approved Auditing Standards except that the scope of our work was limited by the matter referred to below.

2. The accounts incorporate the unaudited accounts of United Kingdom and overseas Sections for the year ended 31 December 1986. We have not verified any of the accounts prepared by these Sections which, at 31 December 1986, reported income of £17,861 *(1985 £15,156)* and net assets of £45,442 *(1985 £38,935)* the only figures of any significance being cash which amounted to £48,893 *(1985 £44,337)* and receipts in advance which amounted to £4,932 *(1985 £6,479)*.

3. Subject to the effects of any adjustments that might have been shown to be necessary had these accounts been audited, in our opinion the accounts give a true and fair view of the state of the Association's affairs at 31 December 1986 and of its surplus and source and application of funds for the year then ended and comply with the Companies Act 1985.

London 18 March 1987

COOPERS & LYBRAND
Chartered Accountants

OIL AND COLOUR CHEMISTS' ASSOCIATION

BALANCE SHEET as at 31 December 1986

	Notes	1986		*1985*	
		£	£	*£*	*£*
FIXED ASSETS –					
Tangible assets	5		67,580		*68,395*
CURRENT ASSETS –					
Stocks	6	8,253		*4,160*	
Debtors	7	9,457		*15,425*	
Investments	8	14,825		*14,597*	
Cash at bank and in hand	9	144,506		*97,994*	
		177,041		*132,176*	
CREDITORS –					
Amounts falling due within one year	10	(88,513)		*(103,296)*	
NET CURRENT ASSETS –			88,528		*28,880*
			£156,108		*£97,275*
CAPITAL AND RESERVES –					
Accumulated fund			156,108		*97,275*
			£156,108		*£97,275*

F. B. REDMAN *President*
B. F. GILLIAM *Hon. Treasurer*
R. H. HAMBLIN *Director & Secretary*

Auditors' Report — Page 7

OIL AND COLOUR CHEMISTS' ASSOCIATION

STATEMENT OF SOURCE AND APPLICATION OF FUNDS FOR THE YEAR ENDED 31 DECEMBER 1986

	Year ended 31.12.86		*Year ended 31.12.85*	
SOURCE OF FUNDS	£	£	£	£
Surplus for the year		58,833		*14,859*
Adjustment for items not involving the movement of funds:				
Depreciation		1,193		*1,208*
TOTAL GENERATED FROM OPERATIONS		60,026		*16,067*
APPLICATION OF FUNDS				
Purchase of fixed assets	378		*934*	
Purchase of investments	228		*348*	
		(606)		*(1,282)*
		£59,420		*£14,785*
INCREASE/(DECREASE) IN WORKING CAPITAL COMPRISES —				
Increase/(decrease) in stocks		4,093		*(3,117)*
Increase/(decrease) in debtors		(5,968)		*591*
(Increase)/decrease in current liabilities		14,783		*(15,431)*
Movement in net liquid funds:				
Increase in cash balances		46,512		*32,742*
		£59,420		*£14,785*

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OIL AND COLOUR CHEMISTS' ASSOCIATION

NOTES TO THE ACCOUNTS as at 31 December 1986

1. PRINCIPAL ACCOUNTING POLICIES

A summary of the more important accounting policies of the Association, which have been applied consistently, is set out below.

(a) *Tangible fixed assets*

Tangible fixed assets are stated at their purchase price, together with any incidental expenses of acquisition.

Provision for depreciation is made so as to write off the cost or valuation of tangible fixed assets on a straight line basis over the expected useful economic life of the assets concerned. The principal annual rates used for this purpose are:

	%
Freehold buildings	2
Fixtures and fittings	10

Freehold land is not depreciated.

(b) *Stocks*

Stocks are stated at the lower of cost and net realisable value. In general, cost is determined on a first in first out basis and includes transport and handling costs. Net realisable value is the price at which stocks can be sold in the normal course of business after allowing for the costs of realisation and, where appropriate, the cost of conversion from their existing state to a finished condition. Provision is made where necessary for obsolete, slow moving and defective stocks.

(c) *Foreign currencies*

Trading transactions denominated in foreign currencies are translated into sterling at the exchange rate ruling when the transaction was entered into. Monetary assets and liabilities denominated in foreign currencies are translated into sterling at the exchange rate ruling at the balance sheet date. Exchange gains or losses are included in sundry income. Total exchange gains in the year amounted to £1,462 (*1985 loss £8,142*). The exchange rates at 31.12.86 were SA Rands 3.42, NZ $2.79, Canadian $2.05 and Zimbabwean $2.47 to the pound sterling.

(d) *Investment income*

Income from investments is included, together with the related tax credit, in the income and expenditure account of the accounting period in which it is received.

(e) *Basis of preparation*

Due to the nature of the business of the Association, the Council consider that it would be inappropriate to present the income and expenditure account in either of the formats recognised by the Companies Act 1985. The format adopted has been selected as it presents the categories of income and expenditure in the detail required by the members of the Association.

2. RESULTS FOR THE YEAR

The surplus for the year is stated after charging:

1985 £		1986 £
4,400	Auditors' remuneration including accountancy	4,831
1,208	Depreciation of tangible fixed assets	1,193

3. EMPLOYEE INFORMATION

(a) The average number of persons employed by the Association during the year is analysed below:

1985		1986
2	Full-time	2
5	Part-time	5
7		7

All employees operate in an administrative function.

(b) Employment costs of all employees included above are as follows:

1985 £		1986 £
45,701	Gross wages and salaries	52,269
3,756	Employers' national insurance and state pension contributions	4,531
11,652	Employers' pension contributions under the Association pension scheme	12,104
£61,109		£68,904

(c) No employee earned more than £30,000 in either 1986 or 1985.

4. THE ETHEL BEHRENS FUND, JORDAN AWARD FUND AND ELLINGER-GARDONYI AWARD FUND

The Ethel Behrens Fund, the Jordan Award Fund and the Ellinger-Gardonyi Award Fund (Note 13) have not been incorporated in the Association's Income and Expenditure Account and Balance Sheet but have been shown as separate accounts.

5. TANGIBLE FIXED ASSETS

	Freehold land and buildings £	*Motor vehicle, fixtures and fittings* £	*Total* £
Cost			
At 1 January 1986	73,631	20,221	93,852
Additions	—	378	378
At 31 December 1986	£73,631	£20,599	£94,230
Accumulated Depreciation			
At 1 January 1986	6,900	18,557	25,457
Charge for the year	800	393	1,193
At 31 December 1986	£7,700	£18,950	£26,650
Net book value at 31 December 1986	£65,931	£1,649	£67,580
Net book value at 31 December 1985	£66,731	£1,664	£68,395

The Council is satisfied that the open market value of freehold land and buildings at 31 December 1986 does not vary significantly from the net book value of £65,931 (*1985 £66,731*) stated above. Freehold land and buildings includes land of £40,000 (*1985 £40,000*) which is not depreciated.

6. STOCKS These comprise:

1985 £		1986 £
2,182	Paper	4,336
1,978	Publications	2,659
—	Ties	1,258
£4,160		£8,253

7. DEBTORS

1985 £		1986 £
415	Other debtors	418
13,817	Trade debtors	6,465
1,193	Prepayment and accrued income	2,574
£15,425		£9,457

All the above amounts are due within one year of the balance sheet date.

8. INVESTMENTS

Investments represent listed investments on the London Stock Exchange. The market value of these investments at 31 December 1986 was £25,767 (*1985 £20,902*).

9. CASH AND BANK BALANCES These comprise:

1985 £		1986 £
39,042	Amounts on deposit	91,262
58,952	Current accounts and cash in hand	53,244
£97,994		£144,506

10. CREDITORS: AMOUNTS FALLING DUE WITHIN ONE YEAR

1985 £		1986 £
79,102	Receipts in advance	69,019
7,424	Trade creditors	6,361
8,858	PAYE, social security and VAT	4,377
7,912	Accruals and deferred income	8,756
£103,296		£88,513

11. SECTION SURPLUS **Estimated*

1985 £		1986 £
106	Bristol	(92)
(135)	Hull	(142)
(19)	Irish	(277)
111	London	1,993
3,277	Manchester	1,782
(267)	Midlands	(772)
98	Trent Valley	39
890	Newcastle	897
398	Scottish	564
(161)	Thames Valley	1,161
908	West Riding	877
(1,323)	Auckland	(725)
(639)	Wellington	(122)
29	Natal	(424)
(519)	Cape	(641)
(746)	Transvaal	(151)
*—	Ontario	*—
*(300)	Zimbabwe	(1,068)
*(450)	Nigeria	*—
£1,258		£2,899

NOTES ON SECTION SURPLUS:

1. Unaudited returns are incorporated into the accounts in some cases.
2. Net surpluses are shown without brackets. Net deficits are shown inside brackets.
3. The figures reflect the net increase/(decrease) in assets, including cash, held by the Sections during the year.

12. LIMITED BY GUARANTEE
The liability of members is limited by guarantee.

13. BEQUEST
In the last Annual Report mention was made of the bequest under the Will of the late Dr. Marianne Ellinger (obit. 9.10.84) for the establishment of a fund in memory of her late husband and father. The executors have now released these funds which are shown as a separate account. Mention was also made of a sum of US $500 which was received in 1985 from DSET Laboratories Inc. and this Corporation has now agreed that this amount shall be used for the provision of a suitably inscribed Chairman's Chair for the Committee room at Priory House as a permanent memorial to the late Dr. Marianne Ellinger.

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OIL AND COLOUR CHEMISTS' ASSOCIATION

JORDAN AWARD FUND

INCOME & EXPENDITURE ACCOUNT for the year ended 31 December 1986

1985 £	*Expenditure*	1986 £	*1985* £	*Income*	1986 £
100	Award — B. Canterford	—	*138*	Interest on Investments (Gross) ...	138
20	Certificate	—			
—	Application forms	85			
18	Surplus	53			
£138		£138	*£138*		£138

BALANCE SHEET as at 31 December 1986

1985 £	*Liabilities*	1986 £	*1985* £	*Assets*	1986 £
	Accumulated Fund Balance		*1,007*	Securities at cost	1,007
2,013	1 January 1986	2,031		(Market Value £1,429)	
18	Surplus	53		*(1985 £1,679)*	
			1,024	Balance at OCCA bankers	1,077
£2,031		£2,084	*£2,031*		£2,084

ETHEL BEHRENS FUND

INCOME & EXPENDITURE ACCOUNT for the year ended 31 December 1986

1985 £	*Expenditure*	1986 £	*1985* £	*Income*	1986 £
	Corporation Tax on		*345*	Interest on Investments (Gross) ...	345
103	Investment income	102			
	President's visits:				
242	SLF Convention (1985)	—			
—	FATIPEC (1986)	248			
—	Deficit	(5)			
£345		£345	*£345*		£345

BALANCE SHEET as at 31 December 1986

1985 £	*Liabilities*	1986 £	*1985* £	*Income*	1986 £
	Accumulated Fund Balance		*2,582*	Securities at cost	2,582
2,587	1 January 1986	2,587		(Market Value £2,995)	
—	Deficit	(5)		*(1985 £2,952)*	
			5	Balance at OCCA bankers.....	—
£2,587		£2,582	*£2,587*		£2,582

ELLINGER-GARDONYI AWARD FUND

INCOME & EXPENDITURE ACCOUNT for the year ended 31 December 1986

Expenditure	1986 £	*Income*	1986 £
Surplus	5,079	Interest on bank deposit	5,079
	£5,079		£5,079

BALANCE SHEET as at 31 December 1986

Liabilities	1986 £	*Assets*	1986 £
Accumulated Fund Balance 1 January 1986	—	Bank deposit	132,084
Receipt of funds on 8 July 1986	127,005		
Surplus	5,079		
	£132,084		£132,084

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