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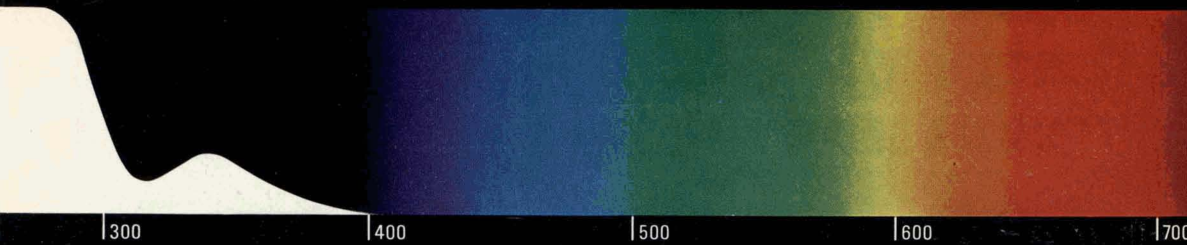

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Transactions and Communications

A new versatile lead free pigment*

By S. L. Davidson

N.L. Industries Inc., P.O. Box 700, Hightstown, N.J. 08520 USA

Summary

With the development of latex paints for use on exterior wood substrates, it was found necessary to control the staining caused by coloured bodies in certain types of wood. Lead pigments were found to give the required performance, so that when subsequent coats of paint were applied the discoloration was contained.

Recent legislation in the United States stipulates the use of lead free materials for this purpose. Compounds with metallic ions, other than lead, have been studied and found to be useful for this purpose.

Further studies of the product indicate that other properties, such as corrosion resistance for metal substrates, are imparted by one of the products developed. Detailed studies have been made to establish the composition of this new product, which has been found useful as an anticorrosive pigment in both oleoresinous and water reducible type of metal primer, and in finishes to be applied by electrodeposition. Correlation of actual performance and theoretical composition is demonstrated, and this illustrates that sometimes performance is better than theory.

Keywords

Types and classes of coatings and allied products

anticorrosive coating
electrocoating
latex coating
lead free paint
primer
water base paint
wood finish

Types and classes of structures or surfaces to be coated

board and batten
cedar
siding
steel
wood

Raw materials: prime pigments and dyes

basic lead silicate
basic lead chromate
lead silico chromate
lead phosphite
zinc phosphite

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

corrosion resistance
nail head staining
stain resistance
weather resistance

Un nouveau pigment exempt de plomb et polyvalent

Résumé

En raison de la mise au point des peintures-émulsions pour application aux subjectiles en bois, il est devenu nécessaire à maîtriser la saignée provoquée par les agents colorés qui se trouvent en certaines espèces de bois. On a trouvé que des pigments à base de plomb donnaient le comportement exigé, de façon que l'altération de couleur est retenue au minimum au course de l'application des couches de peinture subséquentes.

Les règlements recents aux Etats Unis exigent l'emploi des pigments exempts de plomb pour cette application. On a étudié des composés qui incarnent des ions métalliques autres que ceux de plomb et l'on les a trouvés utile pour cet usage.

Des études supplémentaires indiquent que d'autres caractéristiques, telles que la résistance à la corrosion des subjectiles métalliques, sont accordées par l'un des produits mis au point. Des études circonstancées ont été effectuées en vue d'établir la constitution de ce nouveau produit qui s'est démontré utile en tant que pigment anti corrosion et aussi dans les primaires soit à base de vernis gras, soit du type diluable par l'eau, et d'ailleurs dans les finitions destinées à être appliquées par électrodéposition. On démontre la corrélation entre le rendement observé et la constitution théorique, ce qui met en évidence de temps en temps que le rendement dépasse les prévisions théoriques.

Ein Neues Vielseitigen Bleifreies Pigment

Zusammenfassung

Die Entwicklung von Latexfarben für Anwendung aussen auf Holzsubstraten machte es notwendig, die durch in gewissen Holzarten enthaltenen Farbstoffe auftretende Fleckenbildung zu kontrollieren. Bleipigmente erfüllten diese Erfordernis, sodass Verfärbung von darüber aufgebrachten Anstrichen verhindert wurde.

Neuere Gesetzgebung in den Vereinigten Staaten schreibt für diesen Zweck bleifreies Material vor. Metallionen enthaltende Verbindungen, ausser Blei, wurden untersucht und als für diesen Zweck brauchbar befunden.

Weitere Untersuchungen deuten darauf hin, dass Verwendung eines der entwickelten Produkte weitere Verbesserungen, z.B. Korrosionsschutz für Metallsubstrate mit sich bringt. Es wurden ins einzelne gehende Studien gemacht, um die Zusammensetzung dieses als antikorrosives Pigment, sowohl in Metallprimern auf Öl- als auch wassergetragener Basis und in mittels Elektrophorese angewandten Primern nützlichen neuen Erzeugnisses, festzustellen. Korrelation des Benehmens in Praxis mit der theoretischen Zusammensetzung wird aufgezeigt, woraus hervorgeht, dass praktisches Verhalten mitunter besser als Theorie ist.

*Paper presented at the Association's Biennial Conference held at the Grand Hotel, Scarborough, Yorks, England, from 17 to 21 June 1975.

Introduction

The general subject of this Conference is the performance of surface coatings and the question whether reality matches the theory.

Before the reason why there should be a lead free pigment and why the author was concerned about developing one is discussed, a short history of the coatings industry in the United States is of interest.

After World War II, the coatings industry started marketing an interior wall paint in which the major volatile material was water. The solid portion of the vehicle was butadiene-styrene. It is to be noted that these were intended for interior use only. It was possible to formulate paints and predict their performance with a good degree of accuracy; the only doubtful property or properties being those which result from ageing of the paint. Butadiene-styrene was the first latex to be used because of the facilities that were still available from producing large amounts of this latex (used as synthetic rubber) during the war. These new latex paints were received enthusiastically by the home owner because the use of solvent was not required and water, or soap and water, could be used to clean up the tools used for its application. (At the same time, other latices for this purpose were under investigation. These were the polyvinyl acetate and acrylic latices.)

Concurrently, studies were being made to discover whether or not paints of this type could be used on exterior surfaces. The major problem that delayed their use as acceptable exterior coatings was the lack of knowledge of their performance on various substrates when exposed to the weather.

The initial paints based on polyvinyl acetate, either the plasticised polymer or copolymer, showed very good results on masonry surfaces. There were still doubts whether or not these paints could withstand the distortion of the substrates when this was wood. Further, because of the use of water as the solvent, the problem of "grain raising" had to be overcome when the water thinned paints were applied to these exterior wood substrates.

When it was found that these types of latex paints could be applied successfully to wood, with a resulting surface that was durable, the market for this type of finish started to grow. If the problem of painting over surfaces that had been painted previously is disregarded, there remained nevertheless one particular problem with these types of coatings which marred their otherwise excellent performance.

This problem was staining by tannin. This staining was limited and occurred primarily when the coatings were applied directly to cedar or redwood. Whilst studies have been made on this subject, not all of the water soluble materials in these woods have been isolated and identified. It can be said, however, that the water soluble materials found in these woods are reactive pyrocatechol derivatives. Because they are water soluble, they are extracted from the wood and because of the porous nature of the latex film, it is possible for them to be leached to the surface. The concentration of these water soluble materials, which are usually referred to as "tannins", may vary within a particular piece of wood as well as from piece to piece, and the general result has been an unsightly appearance because of uneven staining.

When these exterior paints were first introduced to the market, the usual recommendation was to prime the surface with an oleoresinous primer. This was particularly applicable to a previously painted house where the coating was "chalking". It was felt that the use of this type of primer would "tie the chalk down", so that adhesion between the latex paint and the chalky surface would be maintained. It should be realised that because of the nature of the film formation of latex paints, they do not penetrate the substrate to any degree and accordingly do not adhere to the surface.

Whilst the use of an oleoresinous primer eliminated or certainly minimised most of the problems, including tannin staining, there was a desire to market a water reducible primer so that the same ease of clean up could be obtained as when a latex topcoat was used.

It was found possible to obtain the desired adhesion by modifying the priming coat with an oleoresinous binder, but the problem of "tannin staining" or "cedar staining" still remained.

Studies indicated that lead compounds formed complex chelates with the coloured compounds so as to render them insoluble in water.

There is some doubt whether this insolubilisation is the result of physical absorption or chemisorption, and it is felt that both may occur simultaneously, depending on the particular lead compound involved in the reaction. From a practical point of view, it is enough to say that once the water soluble coloured bodies have been immobilised in the primer, the stain does not migrate into the finishing coat and, as a result, the unsightly appearance of these finishes is eliminated.

Whilst several lead compounds were investigated, the most economical ones were found to be either the basic lead silico type or of the basic lead phosphite type.

The paint manufacturer usually does not know the surface on to which his product will be applied or under what conditions, so he attempts to formulate his coating so that any possible problem will be avoided. As a result, a rather large market in lead compounds to control cedar staining was developed.

Public Law 91-965 "Lead Paint Poisoning Prevention Act" was passed on 13 January 1971. In essence, it banned the use of lead containing compounds in those paints with which children could come into contact. The industry was aware that such legislation would be enacted and had started work to develop other compounds or, in one case, a different vehicle that would perform the same function in controlling "cedar stain", a function that the lead pigments had done so well. This legislation reflected the growing concern of the government over the necessity to control those products which adversely affected the ecology. Whilst the immediate need was to find a replacement for the lead pigment used to control cedar staining in paints, it was also obvious that other materials would be required to perform the functions of lead pigments. The major function of lead pigments, other than their use as colorants, is to protect metal from corrosion, so there are really two problems. The one which appeared to need an immediate solution was to develop a material to control cedar stain, the other was to develop an anticorrosive pigment. Whilst the legislation was directed primarily to minimising or eliminating the use of lead in paints, it also indicated the undesirability of using other heavy metals, such as antimony, arsenic, cadmium and mercury and water soluble barium. The industry was also aware of a strong possibility that within the not too distant future, chromium in the form of chromate would be considered an undesirable ingredient for paint.

Experimental

At the time when lead based compounds were used to control cedar stain, the problem of obtaining reproducible results arose because cedar is not uniform. The amount of coloured bodies in wood can vary from piece to piece and, therefore, the amount of control required will vary. In order to test for cedar stain control, the method of extracting the coloured bodies from cedar by boiling in water has been adopted. This concentrate is adjusted so that the coloured bodies will be eliminated by a definite amount of lead based pigment. Details of the preparation of the test solution are given in Appendix 1. A test procedure utilising this solution is used for rapid screening. If the test pigment shows control of cedar stain by eliminating the coloured bodies (which is indicated by a clear supernatant solution), then a second test, the "bull's eye" test (Fig. 1), is used. In those cases where

Fig. 1. Results of the "bull's eye" test to show degree of efficiency in controlling cedar stain

the pigment shows control of cedar stain, it is made into a water based or latex based primer and applied over cedar panels using standard formulae. In all cases a control containing a lead based pigment and a control with no lead pigment are used for purposes of comparison. After the cedar panel is primed, a top coat is applied and allowed to dry overnight. The amount of discoloration after exposure to high humidity conditions, illustrated in Fig. 2, gives the amount of control of cedar staining. All of these tests listed in Appendix 1 have been used for screening. If satisfactory control of "cedar stain" is shown, then cedar shakes, cedar panels and redwood siding are primed and top coated with a latex paint and exposed on test fences in Hightstown, NJ. After about ten days' weathering, the stain, if not controlled properly, will show through on the top coat of the panel. These panels are allowed to continue to weather after the cedar stain resistance has been determined, so that other weathering characteristics can be found (Fig. 3).

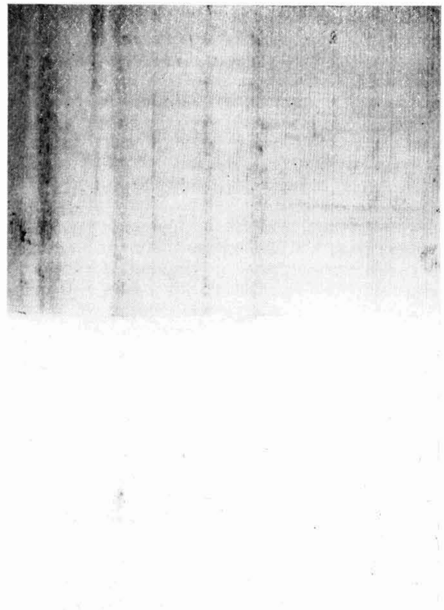


Fig. 2. Results of tests to show degree of efficiency in controlling cedar staining after coatings' exposure to high humidity conditions

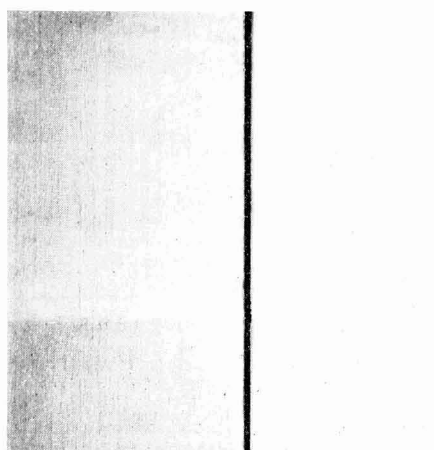


Fig. 3. Test panels being allowed to weather after stain resistance has been determined in order to measure other weathering parameters

Because of ecological considerations and the legislation limiting the use of lead based pigments in paint, it was very desirable to obtain a lead free anticorrosive pigment equivalent to lead anticorrosive pigments. The salt fog resistance of an oil-alkyd paint with and without anticorrosive pigments and over steel panels has been used for a number of years in order to determine whether or not a pigment will impart corrosion resistance to a coating. The panels are exposed to salt fog using ASTM method B117-73. Limitations on the type of solvents that can be used for metal protective coating has provided further impetus for developing coatings that provide corrosion resistance and are made from water reducible vehicles or latices. The same test for solvent thinned paints is used to determine the corrosion resistance of these paints. As these films can be porous, the effect of moisture vapour transmission must be determined and the paints are consequently exposed to high humidity conditions. These tests are used for screening purposes and if the paints with the test pigments show promise, they are exposed at Ocean City, NJ and at test fences in Hightstown. Dramatic differences between water based paints can be demonstrated after short periods of exposure, because the conditions that exist at Ocean City are quite drastic because of the marine environment. The exposure conditions at Hightstown are very moderate compared with those at Ocean City and as a result longer periods of time are required to determine whether or not satisfactory anticorrosive properties have been incorporated into the paint. In order to determine whether or not good results will be obtained over various types of ferrous substrates, the paints are exposed at Ocean City and Hightstown on sandblasted steel panels as well as panels which are sandblasted and subsequently rusted. Experience has shown that performance on rusted panels is not the same as that obtained from paints applied to freshly sandblasted panels. The latter panel is much more active and can lead to another problem when using paints that are water reducible, that of "flash rusting". Freshly sandblasted panels will determine whether or not the anti-corrosive pigment in a particular system will stop the "flash rusting". The test coatings and methods of application are given in detail in Appendix 2.

Coatings applied by electrodeposition fall into the anti-corrosive category, so pigments used in them are tested in this type of coating for this property.

Further consideration of today's ecology has indicated the need not only for a lead free pigment, but also for a pigment that does not contain chromate ions. In the future there will be severe limitations on the discharge of any waste materials that contain chromate ions.

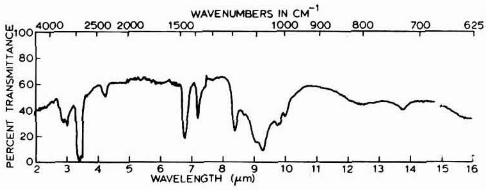
Results

It might be assumed from the methods described previously that each sample went through the entire battery of tests. This is not so. The author's objective was to obtain a pigment that would control cedar staining and contain no lead. With experience of the type of lead compound that gave satisfactory results, namely basic silicate white lead and dibasic lead phosphite, it became apparent that the pigments would have to be basic in nature and that it might be possible to find pigments which were based upon metallic cations other than lead but which might have different anions.

After a study had been made of several pigments that met the requirements of being basic and containing a divalent cation, a compound made from zinc as a cation and a phosphite anion was developed. Each test described above indicated that this compound (called "Nalzin (TM) SC-1") would control cedar staining. The physical properties of the product are shown in Table 1.

Table 1
Nalzin (TM) SC-1

Description	Nalzin SC-1, a zinc phospho oxide complex is a rust inhibitive pigment for metal protective paints and a cedar and redwood stain control agent for use in exterior latex wood paints.	
Typical properties	Form	Fine white powder
	Specific gravity	4.06
	Zinc content	61 %
	Average particle size	less than 1 μm
	Water solubility	0.1 % maximum
	Oil absorption	50-70 (kg of oil/100 kg of pigment)
	Apparent density	0.16-0.24 kg dm^{-3}
	Light sensitivity	Excellent (no change 24 hours fadometer)
Fields of application	Nalzin SC-1 is suggested for use in medium voltage electrocoating primers, where a lead free pigmentation is indicated. Throwing power and can stability are excellent.	
	In latex paints Nalzin SC-1 minimises flash rusting.	
	As a cedar stain control agent, Nalzin SC-1 is similar in performance to the very satisfactory lead compounds which have been used. As with lead based pigments, the effectiveness of Nalzin SC-1 is proportional to the concentration. Somewhere between 0.06 and 0.11 kg dm^{-3} is suggested. In latex paints, incorporation can be by a method similar to that used for other pigments. Because of product's high oil and water demand, sufficient quantities of the proper types of surfactants must be used to disperse satisfactorily Nalzin SC-1. Tamol 850 or equivalent is suggested for optimum dispersion and viscosity stability.	
	In solvent based systems (i.e. oil/alkyd), Nalzin SC-1 has proved to be excellent. In weak vehicles of this type, the improvement in performance is proportional to concentration. Due to the high oil absorption of Nalzin SC-1, however, care must be taken to keep the PVC below that of the pigmentation critical PVC. It is suggested, therefore, that a "ladder" of Nalzin SC-1 be made in 0.05 kg dm^{-3} steps to find the optimum level.	



IR curve

Electron micrograph

In all the screening tests, control of cedar stain was demonstrated. Exposures were made at Hightstown and good control of cedar stain was verified. In these exposure tests, woods other than cedar were used to determine whether any deleterious effects on the performance of the paint would result from continued weathering. In testing for (nail head) rusting, it was found that the paint containing Nalzin SC-1 showed no rusting, whilst paints without it did.

These results indicated that Nalzin SC-1 might have anticorrosive properties and indeed it was found to have all the properties that were sought for in a lead-free anticorrosive pigment. This was established using laboratory screening tests and tests in Ocean City. Exposures are still in progress at Hightstown. Comparisons were made using other lead free anticorrosive pigments as well as basic lead silico chromate in all types of systems and in all these, the new product demonstrated the desired anticorrosive properties and a general equivalence to lead based pigments.

Because of the corrosion resistant properties of the water reducible coatings made with the pigment, the effectiveness of the product when used as an anticorrosive pigment was determined in coatings applied by electrodeposition. Several objects, having a wide variety of shapes, were coated and the pigment was found to have excellent throwing properties as well as imparting corrosion resistance to the coating.

Whilst panels were being prepared for exterior exposure, it was found that latex paints containing Nalzin SC-1 eliminated "flash rusting" when compared with a paint applied on the same type of panel not containing anticorrosive pigment.

Discussion

Control of cedar staining by Nalzin SC-1 is satisfactory in most cases. Where it is not, it has been determined that the amount of coloured bodies present in the wood is extremely high, and in these cases other cedar stain control pigments have also failed to be effective.

The performance of Nalzin SC-1 as an anticorrosive pigment seems to outweigh its performance as a cedar stain control agent. In all the author's tests, it has shown good resistance to corrosion when used in oleoresinous, latex or water reducible alkyd systems. It is unique in that whilst it controls corrosion, its colour is white so there is no limitation on the colour of the coating that can be made from it. It can be used in coatings for electrodeposition to cover completely objects with complicated shapes. It has been found that the coating bath is very stable. Equally good coatings have been obtained after the bath has been stored in the diluted form for periods of two to three months.

Whilst "flash rusting" is only a minor problem, because it occurs only on a very active iron surface, nevertheless Nalzin SC-1 in the coating eliminates the problem.

Conclusion

The subject of this conference asks whether reality matches the theory. It has been deduced that a product similar in chemical composition to existing materials could perform in surface coatings as well as these. In the case of Nalzin SC-1, however, it is difficult to propound a theory that will explain its overall mechanism as an anticorrosive pigment. That a unique compound had been developed was established using modern analytical tools and techniques. Theoretically, it can be said that because there is no reaction with the vehicle in spite of the basicity of the chemical and because of its capability of reacting with metal substrates, the properties it shows are to be expected. It must be concluded, therefore, that in the performance of these surface coatings, reality does indeed match the theory.

Acknowledgment

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[Received 29 April 1975

Appendix 1

Preparation of test solution

Cedar shake shingles are cut into strips one cm wide and ten to twelve cm long. The strips are placed vertically in a three-litre beaker and the beaker is filled with deionised water until the strips are covered. The beaker is covered with a watch glass and the water boiled gently for three hours. The coloured solution is poured off and more water is added and boiled again. The coloured solution is standardised by adding 1g of standard Nalzin SC-1 to five millilitres of the solution at 25°C in a test tube. This is shaken vigorously and then centrifuged until the pigment has completely settled. If the supernatant liquid is "water white", the test solution has the correct strength. If the supernatant liquid is still coloured, more Nalzin SC-1 is added in 0.5g increments until the supernatant liquid is water white. The test solution is concentrated until the addition of 1g of Nalzin SC-1 results in a supernatant liquid that is water white.

Cedar stain control

Rapid screening method

Add 1g of the pigment under test to five millilitres of test solution in a test tube. Shake vigorously. Prepare another mixture in a test tube in the same manner using a standard sample of Nalzin SC-1. Centrifuge both tubes until pigment is completely settled and supernatant liquid is clear. Compare the supernatant liquids in both tubes. If both are water white, then the test pigment shows control of cedar stain.

"Bull's eye" test method

A 10-cm diameter circle is drawn on a white sealed paper chart. The circle is coated with the stain solution and allowed to dry for 24 hours. Standard white paints are prepared using the pigment under test and the control pigment. (If no control pigment is available, a blank paint is used.) The formulae for the paints are shown after the third method. The two test paints are applied over the coated and uncoated test panel using a 75μm film applicator, 7.5cm wide. The film is allowed to dry for 24 hours and a commercial white latex house paint is then cast across the prime coat using (the same film applicator) and allowed to dry. When dry, the areas over the coloured "bull's eye" are compared. No bleeding of the test solution into the topcoat indicates good stain control.

High humidity exposure method

The paints used in the "bull's eye" test are used as the primers on one cedar siding panel (15cm × 1m). All tests shall include areas having primers with no "cedar stain" control pigment, the pigment under test and the standard stain control pigments, in turn. The panel primed with the different paints is allowed to dry 24 hours. A commercial white latex house paint is applied over the entire panel leaving an uncoated strip approximately 2-5cm wide.

After drying for 24 hours the cedar panel is placed face down on a Cleveland humidity box and exposed for 72 hours. The panel is allowed to dry and the panel examined for staining of the topcoat.

White acrylic latex house paint primer (no stain control pigment)
T-21379

Materials	100 US gallon batch Pounds	US gallons
Kronos RNCX titanium dioxide ..	145	4.25
Amorphous silica—Silver Bond R ..	86	3.90
Bentone LT gellant	4.5	0.30
Tamol 850 (Rohm & Haas) dispersing agent	12	1.25
Triton X-100 (Rohm & Haas) wetting agent	5.5	0.62
Potassium tripolyphosphate	1.8	0.12
Super Ad-It (Tenneco) can preservative	1.6	0.20
Nopco NXZ (Nopco) defoamer ..	2	0.26
Rhoplex AC 388 (Rohm & Haas) latex	400	45.45
Aroplaz 1271 + drier* (Ashland) alkyd	30	3.61
Tributyl phosphate	14	1.71
Ethylene glycol	36	3.88
Water	295	35.41
	1033.4	100.96

*Driers: 0.5% cobalt 6%; 0.5% manganese 6%; 1.4% lead 24%.

PVC (%) 25.3 Weight/gallon, lbs: 10.24
Pigment (%) 22.8

White acrylic latex house paint primer (with stain control pigment)
T-21265

Materials	100 US gallon batch Pounds	US gallons
Kronos RNCX titanium dioxide ..	145	4.25
Nalzin (TM) SC-1 stain control pigment	130	3.90
Bentone LT gellant	4.5	0.30
Tamol 850 (Rohm & Haas) dispersing agent	12	1.25
Triton X-100 (Rohm & Haas) wetting agent	5.5	0.62
Potassium tripolyphosphate	1.8	0.12
Super Ad-It (Tenneco) can preservative	1.6	0.20
Nopco NXZ (Nopco) defoamer ..	2	0.26
Rhoplex AC 388 (Rohm & Haas) latex	400	45.45
Aroplaz 1271 drier* (Ashland) alkyd ..	30	3.61
Tributyl phosphate	14	1.71
Ethylene glycol	36	3.88
Water	295	35.4
	1077.4	100.96

*Driers: 0.5% cobalt 6%; 0.5% manganese 6%; 1.4% lead 24%.

PVC (%) 25.3 Weight/gallon, lbs: 10.67
Pigment (%) 25.9

Appendix 2

Panel preparation for corrosion test exposures

Sand blasted and rusted steel panels

Sand blast hot rolled steel panels (15cm × 30cm × 2.5cm) with commercial blast using aluminium oxide grit. Coat immediately with basic lead silico chromate primer (US Specification TT-P-615 Type II). When primer is dry, sand blast the other side to white metal. Expose panels facing south at 5° from the vertical. Spray exposed panels daily with water. Expose until 100 per cent rusting of the base side is obtained. (Approximately 60 to 90 days required: this time varies with the temperature and humidity during the exposure period.) Just prior to application of paint, wire brush lightly and remove all loose particles of rust. Apply primer.

Sand blasted panels

Prepare panels as above. Do not expose after blasting to white metal. Coat immediately if possible. Observe for rust stains if priming coat contains water as the volatile part of the vehicle.

Typical formulae used for testing corrosion resistance

White AC primer latex-alkyd modified type T-21710

Materials	100 US gallon batch Pounds	US gallons
Bentone LT	5	0.33
Nalzin (TM) SC-1 stain control pigment	100	2.96
Kronos RNCX titanium dioxide ..	100	2.93
Mica 325 mesh WG	35	1.49
Nytal 300 magnesium silicate ..	89.75	3.78
Tamol 850 (Rohm & Haas) dispersing agent	8	0.81
Triton X100 (Rohm & Haas) wetting agent	5	0.56
Ethylene glycol	20	2.16
NXZ defoamer (Nopco)	5	0.66
Ucar 4341 (Union Carbide) latex ..	420	49.07
Aroplaz 1271 (Ashland) alkyd	45	5.39
6% cobalt naphthenate (Tenneco) ..	1	0.13
6% Zirco catalyst (Tenneco)	1	0.14
Water	240	28.81
	1074.75	99.22

PVC (%) 29.8 Weight/gallon, lbs: 10.83
Pigment (%) 30.7
Non-volatile vehicle (%) 32.9

White AC primer latex-alkyd modified T-21727

Materials	100 US gallon batch Pounds	US gallons
Nalzin (TM) SC-1 stain control pigment	100	2.96
Kronos RNCX titanium dioxide ..	100	2.93
Mica 325 mesh WG	35	1.49
Nytal 300 magnesium silicate ..	72.5	3.06
Bentone LT slurry—2% gellant ..	279	33.17
Borax	6	0.42
Dimethylethanolamine	5	0.68
Makon 10 (Stepan) dispersing agent ..	8	0.90
Victawet 35B (Stauffer) wetting agent ..	5	0.59
NDW defoamer (Nopco)	2	0.27
Polyco 2370 (Borden) latex	350	38.25
Aroplaz 1271 (Ashland) alkyd	45	5.39
6% cobalt naphthenate (Tenneco) ..	1	0.13
6% Zirco catalyst (Tenneco)	1	0.14
Water	100	12.00
	1109.50	102.38

PVC (%) 30.4 Weight/gallon, lbs: 10.84
Pigment (%) 28.2
Non-volatile vehicle (%) 29.8

White AC primer water soluble alkyd type T-21704

Materials	100 US gallon batch Pounds	US gallons
Nalzin (TM) SC-1 stain control pigment	100	2.96
Kronos RNCX titanium dioxide ..	100	2.93
Nytal 300 magnesium silicate ..	175.7	7.40
Ben-A-Gel EW suspending agent ..	5	0.23
Kelsol 2560 (75% NV) (Spencer Kellogg) WS alkyd	337.3	38.50
NDW defoamer (Nopco)	5	0.67
6% cobalt octoate (Tenneco)	5.6	0.76
6% Zirco catalyst (Tenneco)	3.8	0.53
Butyl cellosolve (Union Carbide) ..	83	11.05
Triethylamine	25	4.12
Ucar 360 (Union Carbide) latex ..	64	7.09
Water	251	30.13
	1155.4	106.37

PVC (%)	30.4	Weight/gallon, lbs: 10.86
Pigment (%)	32.9	
Non-volatile vehicle (%)	35.8	

White AC primer water soluble alkyd type T-21698

Materials	100 US gallon batch Pounds	US gallons
Nalzin (TM) SC-1 stain control pigment	100	2.96
Kronos RNCX titanium dioxide ..	100	2.93
Nytal 300 magnesium silicate ..	127	5.34
Ben-A-Gel EW suspending agent ..	5	0.23
Potassium tripolyphosphate	1	0.01
Arolon 376 (Ashland) WS alkyd ..	536	61.61
NDW defoamer (Nopco)	3.6	0.49
Triethylamine	5.4	0.89
24% lead naphthenate (Tenneco) ..	0.6	0.06
6% cobalt naphthenate (Tenneco) ..	2.4	0.30
Water	257.1	30.86
	1138.1	105.68

PVC (%)	29.8	Weight/gallon, lbs: 10.77
Pigment (%)	29.3	
Non-volatile vehicle (%)	33.7	

White electrodeposition primer Nalzin SC-1 T-21735

	Materials		117 US gallon batch Pounds	US gallons
	(Nalzin) (TM) SC-1	(2) Stain control pigment	8.3	0.24
	Kronos RNCX	(2) Titanium dioxide	14.0	0.41
A	(Ben-A-Gel) EW	(2) Suspending agent	1.0	0.05
	(Arolon 369-80)	(1) Alkyd	50.0	5.72
	(Butyl alcohol)		6.0	0.89
	(Arolon 369-80)	(1) WS alkyd	33.3	3.81
B	(6% manganese naphthenate)		0.2	0.02
	(De-ionised water)		333.3	40.01
C	(Triethylamine)		5.3	0.87
D	Water		538.6	64.66
			1 000.0	116.68

Grind *A* on 3-roll mill, add *B* to grind paste *A*. "Slowly" add (*A*+*B*) to *C* on high speed dissolver. Reduce to 10% non-volatile content with *D*

P/V 1/3 (by weight)		Fineness of grind 6
Bath solids	10%	Weight/gallon, lb: 8.55
pH	8	
Deposition voltage 100V for 2 min		(1) Ashland Chemical or equal
Baking cycle	20 min at 135°C	(2) NL Industries

White AC primer T-21557 D

Materials	100 US gallon batch Pounds	US gallons
Nalzin (TM) SC-1 stain control pigment	100	2.96
Kronos RNCX titanium dioxide ..	209.4	6.13
Mica 325 mesh WG	26	1.11
Kadox 15 zinc oxide (NJ Zinc) ..	6.1	0.13
Atomite-calcium carbonate (Thompson Weimman)	45.4	2.01
Bentone LT gellant	3	.20
Rhoplex MV-1 (Rohm & Haas) ..	600.9	67.52
Tamol 850 (Rohm & Haas) dispersing agent	15	1.56
Triton X100 (Rohm & Haas) wetting agent	2.2	0.24
NXZ defoamer (Nopco)	6.6	0.87
Tributyl phosphate	5	0.61
Super Ad-It (Tenneco) can preservative	3	0.37
Ethylene glycol	22	2.37
Water	109.8	13.18
Ammonium hydroxide, 28%	1	.13
	1255.4	99.39

PVC (%)	30.3	Weight/gallon, lbs: 12.63
Pigment (%)	31.1	
Non-volatile vehicle (%)	36.1	

White AC primer latex type T-21716

Materials	100 US gallon batch Pounds	US gallons
Nalzin (TM) SC-1 stain control pigment	100	2.96
Kronos RNCX titanium dioxide ..	100	2.93
Mica—325 mesh WG	35	1.49
Nytal 300 magnesium silicate	113.75	4.79
Kadox Grade 15 zinc oxide (NJ Zinc) ..	6.1	0.13
Bentone LT slurry—2% gellant ..	82	9.75
Tamol 850 (Rohm & Haas) dispersing agent	8	0.81
Triton CF10 (Rohm & Haas) wetting agent	2.2	0.25
NXZ defoamer (Nopco)	4.4	0.58
Ethylene glycol	30	3.23
Rhoplex MV-2 (Rohm & Haas) latex	600.9	67.52
Texanol (Eastman) coalescing agent ..	5	0.65
Skane M8 (Rohm & Haas) preservative	2	0.23
Ammonium hydroxide, 28%	3	0.40
Water	28	3.36
	1120.35	99.08

PVC (%)	30.0	Weight/gallon, lbs: 11.31
Pigment (%)	31.7	
Non-volatile vehicle (%)	36.0	

Discussion at Scarborough Conference

MR C. E. HOEY said that all the tests for prevention of corrosion described in the paper were carried out on steel substrates, and he wondered whether the author had done any work on non-ferrous metals.

MR DAVIDSON said he had started to make investigations in this direction and up to the present time had not encountered any differences about which he was concerned. One feature of non-ferrous substrates, however, was that it was almost "unnecessary" in very many cases to use an anticorrosive pigment at all, except perhaps to passivate the surface so promoting intercoat adhesion. For example, there was the problem of oxide formation; on aluminium, for example, the white aluminium oxide might go unnoticed but it was nevertheless present and reactions could take place. In summary, therefore, they were exposing non-ferrous panels and so far the results had been very encouraging.

MR L. J. A. WILLIAMSON asked the author whether he could indicate the chemical difference between "Nalzin" and conventional zinc phosphates. It was assumed that zinc phosphate acted by forming an anodic barrier. He wondered whether the author felt that Nalzin acted both as an anodic barrier and possibly by an electro-chemical side effect.

MR DAVIDSON replied that the compound Nalzin was an oxide of phosphorus and zinc, but he could say no more than that. On the second point, he personally was inclined to agree with Mr Williamson's suggestion.

DR M. L. ELLINGER asked whether it could be said that in the case of a white electrophoretic coating, the inclusion of this pigment would not only promote anticorrosive efficiency, but would also permit the use of a white electrocoat on steel without phosphate pretreatment, which hitherto was inevitable in order to prevent staining or discolouration due to iron ions.

MR DAVIDSON replied that when the pigments had been incorporated in a one-coat system no staining had been observed.

MR M. KALEWICZ asked whether the author had any experience in the application of this pigment in "welding primers".

MR DAVIDSON regretted that he did not have any information on this subject at the present time, although he did not expect to observe any differences from the results with other anticorrosive pigments.

MR F. G. DUNKLEY asked what were the conditions under which the blast-cleaned surface was exposed prior to painting and, if these were rural conditions, whether the author would expect a similar improvement in the performance of the paint on the rusted steel.

MR DAVIDSON answered that the panels were first sand blasted and then left out-of-doors in a rural atmosphere to "weather" them for approximately six weeks. He would certainly expect a similar improvement in performance in an industrial atmosphere where there was far more dirt.

MR A. N. MCKELVIE commented that the paper did not give the film thicknesses used in the tests. He was surprised to see on the slides illustrating the test panels that the blast-cleaned and rusted panels were giving superior protection when overcoated than the blast-cleaned panels unrusted and similarly overcoated. If the same film weights were applied, then it was highly likely that the rusted panels had a smoother profile because of the rusting of the peaks and were, therefore, more evenly covered, whilst the paint on the unrusted panels had flowed away from the high peaks to give a lower film thickness over the peaks and thus, of course, given rise to an earlier onset of rusting.

MR DAVIDSON answered that firstly, all their paints were applied on a weight basis. Coats were applied by brush and, in the case of the oil paints, the film thickness was at least 75μm. In the case of the latex paints, they had applied two coats to ensure that the total film thickness was again about 75μm. This had been standard practice for a number of years not only in these tests but for accelerated outdoor exposure and for angle iron. They were using cold-rolled steel and when this was sand blasted it became a very active substrate and this too made a great deal of difference. Generally, the procedures which had been followed should have been adequate to ensure that any possible effects of the type described by Mr McKelvie would be insignificant.

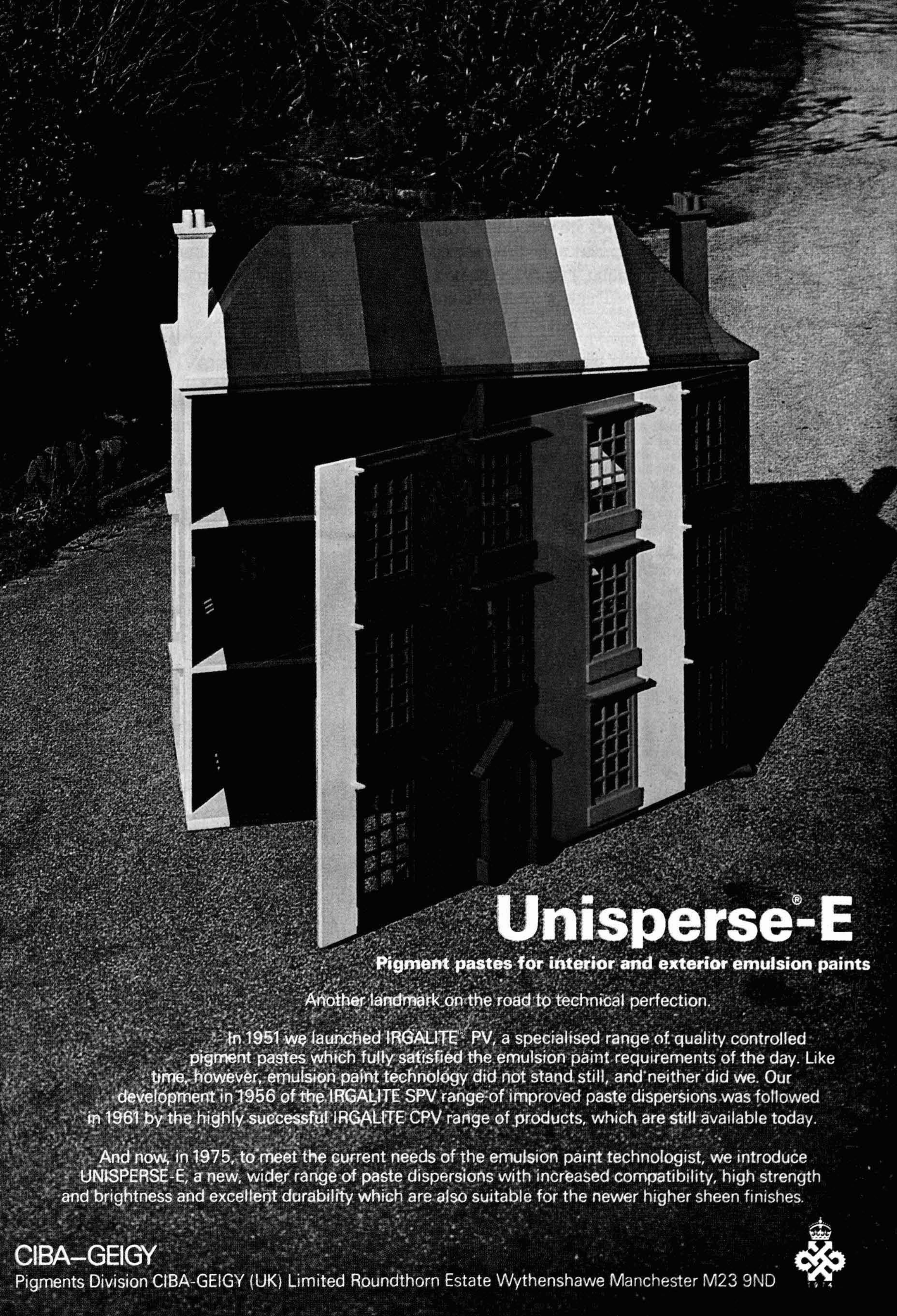
MR A. G. HOLT wondered whether the use of Nalzin SC1 affected the stability of an electrocoat paint when used as an anticorrosive pigment. Large volumes of paint of low solids content were involved and the turn-over of new paint might at times be very slow.

Secondly, box sections of cars were, in parts, inevitably washed free of some of the phosphate pretreatment and he asked whether Nalzin SC1 performed equally well over unpretreated steel as it did over pretreated steel.

MR DAVIDSON replied that they had taken Nalzin SC1 and made up an electrodeposition coating reduced it to 10 per cent solids, which would be the coating composition, and stored it—and in fact obtained the same type of coating three months later. This could not be done with some other pigments. In reply to the second part of the question Mr Davidson said that he could not give any information on this subject.

MR G. W. ROTHWELL commented that red cedar was not so generally painted in the UK but there was a knot staining problem on soft wood both when initially primed and when knot resin bleeding occurred after a length of time. It was not economically attractive either to eliminate knots or treat them individually, and a water-based stain-resistant system was highly desirable.

MR DAVIDSON said that this was not the stain to which he referred and a knot sealer should be used.



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Protection: from hypothesis to principle*

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Summary

Much that is called theory is only hypothesis or supposition and because of this there has been disappointment in the results of introducing new materials and, particularly, in applying specifications to the craft-based sections of the protective coatings industry. Codes of Practice usually state the concepts upon which they are based and the uncertainties are shown by the variety of alternative procedures offered.

Protective systems aim to preserve materials in their required condition and assumptions are made about the anticipated protective qualities of coating materials in unknown circumstances after changes due to drying etc have occurred. Performance in protection is an extrapolation of measurable properties. Testing in standardised conditions is the basis of specifications, but the relationship between tests and performance in "on site" operations is uncertain.

Examples are given of disappointing results following the use of specifications, which did not take into account all factors involved in the work. By contrast a successful instance of ship protection is quoted, which involved the application of theory, with a knowledge of all the important factors.

Keywords

Types and classes of coatings and allied products

corrosion resistant coating

marine finish

structural steel coating

Processes and methods primarily associated with service or utility

corrosion

weathering

Specifications, standards and regulations

specifications

standard procedure

La protection: de l'hypothèse au principe

Résumé

Une bonne partie de ce qu'on appelle la théorie n'est que d'hypothèse ou de supposition et par conséquent on a été déçu par les réponses à l'introduction de nouveaux matériaux, et surtout par les tentatives à introduire les normes aux secteurs artisanaux de l'industrie de revêtements protecteurs. En général les codes de la pratique donnent les concepts auxquels on les a basés et ils mettent en évidence les incertitudes en raison des diverses méthodes mentionnées.

Les systèmes protecteurs ont pour but de retenir des matériaux à la condition requise et l'on doit faire des suppositions à l'égard des caractéristiques protectrices attendues des revêtements dans ces circonstances inconnues et après les altérations dues au processus de séchage, et cetera, sont intervenues. Le rendement protecteur est une extrapolation des caractéristiques mesurables. Les essais effectués sous des conditions spécifiques constituent la base de la normalisation, mais le rapport entre les essais et le rendement obtenu "au pied d'oeuvre" reste incertain.

On donne les examples des résultats décévants obtenus lors de l'utilisation des normes qui ne tenaient pas compte de toutes les facteurs qui exercent une influence sur l'ouvrage. Au contraire on mentionne un exemple qui entrainait l'application de la théorie et également de la connaissance de toutes les facteurs importantes.

Schutz: Von Hypothese zum Prinzip

Zusammenfassung:

Viel von dem, was Theorie genannt wird, ist lediglich Hypothese oder Vermutung. Aus diesem Grunde gab es Enttäuschungen in den Resultaten mit neu eingeführten Materialien und insbesondere bei der Anwendung von Liefervorschriften in den, auf praktischen Erfahrungen basierenden, Teilen der Schutzlacke herstellenden Industrie. In "Codes of Practice" (Kode für die Praxis) werden gewöhnlich die Begriffe, auf denen sie aufgebaut sind, dargelegt, und die Schwächen sind an der Verschiedenheit der zur Wahl gestellten Verfahren erkenntlich.

Das Ziel von Schutzsystemen ist, Werkstoffe in dem geforderten, guten Zustande zu erhalten, wobei Annahmen gemacht werden hinsichtlich der voraussichtlichen Schutzqualitäten des Anstrichmaterials unter unbekannten Umständen, nachdem Veränderungen als Folge von Trocknung etc. stattgefunden haben. Schutzwirkung ist eine Extrapolation von messbaren Proportionen. Prüfen unter genormten Bedingungen ist die Grundlage für Liefervorschriften, aber die Beziehung zwischen Prüfungen und Leistung bei Anwendung "auf der Baustelle" ist ungewiss.

Es werden Beispiele enttäuschender Resultate als Folge von Liefervorschriften gegeben, wobei nicht alle mit der Ausführung der Arbeiten verbundenen Faktoren in Betracht gezogen wurden. Im Gegensatz dazu wird ein erfolgreiches Beispiel für den Schutz von Schiffen aufgeführt, bei dem die Anwendung von Theorie in Verbindung mit der Kenntnis aller wichtigen Faktoren verwickelt war.

Introduction

Refs. 1, 2

The Conference title suggests that there is a complete system of theory in paint performance and that if reality falls short, the theory has been flouted. The viewpoint adopted in this paper is that genuine theory is rarely applied in the protective aspects of the coatings' industry, and when it is, the match with reality is surprisingly good. Theory, in scientific or technical language, is a philosophical structure based on observed facts, which helps to produce new information for the advancement of knowledge and experience. There must always be an element of the unknown or untried in theory, but it must be soundly based on fact. Much of what passes for theory is supposition, or hypothesis, which the Concise Oxford Dictionary defines as "a supposition made as a basis for reasoning". It is because the industry often acts on such supposition that theory and practice are frequently regarded as antagonistic; the so-called practical man falls back within his own limited experience and the theorist loses confidence. Principle, on the other hand, is in one of its meanings defined as "fundamental truth as a basis for reasoning"—a much surer basis for reality.

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In sections of the protection industry, tradition based on craft experience not always critically examined and sifted but deeply entrenched, has been built up. Efforts to advance these craft-based processes by the introduction of new types of material and particularly by the adoption of specifications have not always been successful. In the opinion of the author this is because often in the design of a protective system many of the factors involved are ignored and some of those which are taken into account are suppositions or hypotheses rather than established facts. This is almost certainly the case where public specifications are involved.

This raises a doubt about the whole system of Specifications and Codes of Practice for the surface coatings industry. Specifications for materials, other than simple composition specifications, are based upon concepts which may or may not be sound, or proven. In that respect the specifications are theoretical. Even composition specifications, in so far as they imply a standard of performance, rely upon theories of performance. Most Codes of Practice in the field of protection state the concepts upon which they are based and they attempt to marry them with established practice[1, 2]. The uncertainties or inadequacies of the theories adopted are reflected in the precision or vagueness of the guidance given and the divergences between the alternatives offered.

The fundamentals of protection

The basic concepts upon which protective systems are built up are, in the opinion of the author, as follows:

1. Protection aims to prevent change in the substrate so that its initial, presumably required, condition is maintained; for example, steel remains as steel not as rust, concrete remains in its existing form with its initial strength etc.

2. In a secondary role, protection may enhance the properties of the substrate. For example, a protective coating may reduce the permeation of water or vapour through concrete and masonry.

3. Materials for protective coatings are not supplied in their final form. They are "unfinished" materials.

4. It is believed, or assumed, that a given starting material, some of whose properties can be measured, will have certain closely defined properties after going through a process of change, for example, drying.

5. Theoretical concepts are used to envisage the process of change to give a finished product with predetermined properties—the dry film.

6. It is believed that if the dried film, produced under certain standardised conditions, has the correct measurable properties, then it will give the required performance, although in practice it will not be produced under the test conditions.

7. The performance of protective coatings depends upon their interaction with their surroundings, atmosphere, substrate etc. In foretelling performance, theorists often concentrate their thinking on one or a few properties, to the exclusion of others and, thereby, do not get a complete or balanced forecast.

It may be justifiably argued that the uncertainties arise with items 4 to 7 in the above list, because it is here that the chemical changes during film formation and the interplay of the coating with the surroundings operate outside the full control of the designer or user. Thus protective performance is an extrapolation of measurable properties. It is often questionable whether the measurable properties bear much relationship to the deductions based thereon. Only in fully controlled industrial processes is it likely that a true relationship exists.

Test methods for coating materials

Ref. 3

Test methods for protective coatings fall within three groups:

(a) In-can tests aimed to define the condition of the material as supplied.

(b) Film-property tests intended to give information concerning certain physical and chemical properties of coatings under standard conditions, such as hardness, flexibility, etc. The author contends that these tests do no more than compare a range of materials under these standard conditions.

(c) Durability/protection tests intended to indicate in a short time what the dried coating, produced under the unpractical conditions described in (b), will give in the way of protection in different conditions over a long time. Specification tests in this, the key category, can only have meaning if there is a recognisable relationship between the test and practice. This relationship is the nub of the testing problem, and rests upon knowing whether acceleration of change or the subjection of the coated surface (not merely subjection of the coating) to excessive stress or influences of a different nature from those met in practice gives a true or distorted result. This particular aspect of the problem has been the subject of discussion over many years. The author was involved in the discussion a quarter of a century ago[3] and it has not yet been resolved. This fact alone sufficiently indicates the inadequacies of theory in specification procedures.

Relationship between test methods and use

In this relationship, the protection industry can be divided into four categories:

1. Where the coating material and substrate can be closely defined and controlled; its method of application accurately controlled and conditions of use are simple and controlled. In such circumstances if sufficient care is taken the result should be assured.

2. Where the coating material and substrate can be closely defined and controlled; its method of use accurately controlled but where the conditions of use may vary widely, as for example with weather variables. Here it is to be expected that with care an adequate result should be obtained within a range of conditions of use.

3. Where the coating material and substrate can be defined and controlled, but where conditions of application are uncontrolled and conditions of use vary widely. This situation calls for skill in understanding the properties of the materials being used and in assessing probabilities of performance.

4. Where the coating material can be controlled but the substrate cannot, or is not. In this situation usually neither the application nor conditions of use are controllable and, accordingly, it is in this region that most problems for the industry arise. It includes a large part of the coatings

industry's field, embracing virtually all building painting, maintenance of structural steelwork, public utilities, shipping etc. Here, in spite of excellent work by inspection and quality control engineers, it is not possible to ensure a good result.

Simply stated, tests can be devised and fully applied in category 1 with little or no area of uncertainty. In category 2 the area of uncertainty is limited, and in category 3 the opportunities for departure from the norm are great and poor performance may be expected from time to time regardless of the quality of material. In category 4 at best it is possible only to define the limits outside which disappointment is likely and within which there is a reasonable chance of success.

A particularly noteworthy fact about much of the research into problems arising in categories 3 and 4, and hence in the expectation of performance, is the preponderance of effort given to explaining failures, and as a result of the mass of published work on the subject it is difficult to see why coatings used in these circumstances ever succeed. This leads to a position where it is necessary to explain success rather than failure over a wide range of protective painting.

Limitations of specifications

There are three ways to decide on protective measures: to adopt specifications governing materials and procedures; to invoke Codes of Practice outlining minimum standards of procedure; and what some regard as no control at all, but which in practice is often the best control, reliance upon the skill and integrity of the team responsible for the protection. The basis of Specifications and Codes of Practice has been discussed earlier; it is a mixture of assumption and certain chemical and physical testing. The basis of skill and integrity is less easy to code, but the author submits that it is composed of known fact supported by theoretical deductions according to the strict discipline of science. Where facts are unobtainable and the discipline of theory cannot be applied the wise and honourable designer of protective schemes introduces a wide margin of safety; the venturesome or irresponsible accepts the risk of the unknown without any provision for safety and hopes to bluff his way through. It is the too frequent adoption of this latter practice in past years which has led to the plethora of specifications and so forth, to the embarrassment of the paint industry as a whole.

It is understandable that no development takes place without some risk, because development always involves at its driving point some yet untried theory and one is not sure that the reasoning has been sound, or that some important factor has not been overlooked. The problem then is to decide at what point it is acceptable to undertake a major job, and when the theoretically derived conclusion can be accepted as proven, and as fact. However, sound reasoning derives from sound training, and provided the necessary information is available, reasoning should not go far wrong. Unfortunately, in the field of protective coating, what is regarded as theory is frequently nothing more than a series of *ad hoc* tests, which has given certain results.

It is not possible to build up with confidence a protective system which will perform the task intended, working merely from a set of standard specifications, except in the most ordinary of circumstances. This, in itself, is justification for this Conference. The reality does not equal what the specifications lead the customer to expect, and the specifications are, to him, the theory. The deficiency is largely explained by the fact that desk-made specifications cannot by their nature take into account all the factors involved in a protective job of the type envisaged in categories 3 and 4 outlined above. These are what are usually known as "site jobs". A small number of examples will illustrate the point. Some years ago during erection of a major bridge, early corrosion appeared on the underside of the deck structure and appeared to be spreading to a serious extent. Indeed, the information available suggests that the problem has not yet been mastered. Official specifications for the paints were followed and there is no evidence to suggest that the work had been badly done, or that the paints were deficient, at least in terms of the specification. What the specified system did not allow for was that the hollow deck sections were launched into a river, floated to site and kept in the tidal water, moored to the bank by steel chains for periods up to nine months before hoisting into position. During this period the sections were effectively moored ships, but they had not been given the type of protection which would be expected on ship bottoms. The matter was further aggravated by the fact that the steel chains and metal mooring posts provided an electric circuit which allowed corrosion currents to flow. Moreover, ship bottoms, after some months in the water, are not hoisted high into the air and subjected to drying out, and the effect of sun and atmosphere. In this case the reality fully followed theory, but was not what the specifying authority expected.

In a quite different field, a piece of heavy duty machinery was designed to run at a closely defined temperature, so that the special oil was at the optimum condition, near the upper temperature limit, and worked well for a long period in this condition. In order to improve general conditions in the factory, painting specifications were issued involving amongst other things heat resisting aluminium paint to be used on all machinery. Improved working conditions were achieved, but the machinery in question failed and the critical oil carbonised because the heat radiation from the machine was reduced by about 15 per cent and temperature rose to 30-40°C above the critical level. Here again, reality followed theory but the result was not what the engineer expected.

The use of theory

Refs. 4-6

These "failures" serve to emphasise the importance of knowing all the facts and applying theory in a disciplined manner. Theoretical considerations show that when steel is cathodically protected in sea water at —0.85V potential[4], there will be a pH of 10.9 at the surface, and at lower potentials, which are achieved in practice to ensure protection, the pH will be higher. Measurement in practical situations confirms the theory. Clearly then, when coating a ship's bottom which is to be protected cathodically the paints used, particularly the primer, must be capable of resisting attack by alkali at a pH above 11. Further, theories of adhesion indicate that the metal/primer interface may have a greater concentration of highly polar, relatively small reactive molecules than the bulk of the film, and thereby constitute a layer sensitive to alkali attack, though the film in general is resistant. Anderton[5] has postulated a water-rich layer, which is conductive of ionic current and may give rise to blistering and stripping under cathodic protection. Furthermore, without cathodic protection, when rust forms at anodic areas on underwater plating, alkali forms at cathodic areas, sometimes at high concentration. Thus theory points clearly to the need for using highly alkali-resistant primers for all underwater plating. If this were done more widely a great many of the disappointments in ship painting would be avoided. Some major shipowners, particularly some oil companies, fully recognise this and when ships are to be cathodically protected require either that prefabrication primers and pretreatment primers be completely removed before painting or that only very special types should be used. Those who take this precaution, frequently have trouble-free protection for many years.

The "theoretical" approach to protection problems can be used satisfactorily only if theory can be applied to all the facts. This applies with particular emphasis in complicated situations, such as ship painting, where modern long-life coatings are involved. The development of underwater epoxy resin coatings depended upon overcoming blistering and adhesion problems, which in the early days were associated with epoxy resin based paints. Investigation showed that whereas certain polar groups in the film were necessary for good adhesion, some of these same groups in the solvent used had an adverse effect because of retention of the critical solvent for long periods, particularly at the interface. After immersion of the coatings in water, adhesion dropped alarmingly. This produced Anderton's "water-rich layer". By provision of the necessary polarity within the film structure and its elimination from the solvent, adhesion problems were overcome.

When T. S. S. Canberra was in building in 1960, painting problems arose because the steel had been blast cleaned, left unprimed and allowed to rust during construction. Yards at that time did not have modern cleaning equipment, but it was known that residual light rust was not harmful provided the content of sulfate was not above a certain critical level[6]. Evidence had been obtained from laboratory and raft tests that paints based on chemical resisting media and using some basic pigment (for example, basic lead pigment), would tolerate trapped sulfate to a greater extent than the 1 mgm per square inch reported, though clearly this was a desirable level to achieve. It was also known that the ship was likely to be fitted with impressed current cathodic protection, and to compound the problem, painting had to be carried out between Christmas and March, with temperatures likely to fall below that at which epoxy resins cure at an appreciable rate. With all this information available, critical reasoning and control were applied at all stages. It was found by analysis that rust on the flat bottom contained very little ferrous sulfate, which was more in evidence on the upper sides. Power tools, specially obtained for the purpose, were used for cleaning and the surface was treated as necessary so that any residual rust contained less than the critical amount of sulfate. Frequent analysis confirmed this. Welds were treated to remove roughness, and residual flux was removed. A primer capable of withstanding for long periods pH in excess of 12 was applied and overcoated before it could oxidise appreciably or be affected by contaminants, to produce alkali sensitivity. A record of daily temperatures of air and steel was kept to ensure that every coat in the system had sufficient time above the critical temperature to cure adequately before applying the next coat. In addition, the reactive components of the paint were always mixed at least one hour before the material was applied, so that the curing reaction had started before application and the time at risk was minimised. This may sound hazardous and wasteful but by careful planning very little paint was lost. By critical application of theories, a protective system was built up, of which it could be said that reality has matched the theory. The hull of this vessel has given 15 years of trouble-free service in all oceans and climates, and the protective coatings have not had to be removed nor has any remedial work had to be done, other than minor touching up.

From this and corresponding examples of land-based structures in both steel and concrete, it is felt that, provided a free hand is given to apply critical theoretical concepts to known facts free from the trammels of binding specifications, the design of protective systems has moved from a matter of hypothesis to one of established principle.

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Discussion at Scarborough Conference

MR A. N. MCKELVIE commented that in his paper, Mr Gay had touched on the aspects of responsibility in the success of protection by coatings. The point had been raised earlier in the Conference that where there were so often so many separate responsibilities—the paint manufacturer, the main contractor, the sub-contractor, the independent inspector and so forth—it was always "the other fellow" who was blamed for failure. It had been suggested that the only way out of this dilemma was for the paint manufacturer to take full responsibility and provide the complete package deal, particularly for large and important jobs in the steel construction industry. He would like to hear Mr Gay's views on this topic.

MR GAY agreed that there were so many people involved that it was all too easy for each one to blame one of the others. This was never constructive. In the successful operations with which he had been concerned, there had been complete openness with everyone getting together to sit round a table and accept a collective responsibility. This had been done in the case of the vessel mentioned in the paper. This was not to say that there had not been harsh words, but if everyone started off in the state of mind which he had just outlined, the situation could usually be handled successfully.

MR C. E. HOEY said that amongst other things, the author had commented on the inadequacy on codes of practice and made a plea for more dialogue between the paint manufacturer and the user (or designer).

Earlier speakers at the Conference had criticised the shortcomings of designers (architects, engineers and so forth). The problem to be overcome was how to provide the contact and information to designers who were not in a position to seek it or who had no inclination to do so. In any case, it was arguable whether all paint manufacturers were equally competent to provide such information. Secondly, he wondered how the information for good design could be imparted except through codes of practice. Whilst accepting that there would always be a few exceptions to any code of practice, there would be a vastly greater number of occasions when it would be of value.

MR GAY replied that he could not disagree with Mr Hoey. Codes of practice had been a great step forward. It was not possible, however, to take a code of practice which covered a wide range of circumstances and to expect perfection when applying it to every situation. In addition, anyone who was not an expert in the field covered by the code of practice would more often than not be bewildered by the wide range of options necessarily covered in the code. It would often pay the customer not to be too specific about his coating requirements, but to suggest a basis and ask everyone concerned to make suggestions for improvement according to the detailed facts which they had available. He was sure that if this were done, many people would be surprised by the number of "facts" which turn out not to be so. Cathodic protection of ships' hulls was one area of very great ignorance in this respect.

MR G. L. PALMER said that all branches of the materials supply industry had problems of educating the users to understand the choices and limitations in the selection of a material for a given use. The supplier needed to be prepared to do more than 50 per cent of the work in collaborating with the user, jointly to arrive at a performance requirement which took note of all the envisaged service performances required from the material. The onus was very much on the materials' supplier to set up effective liaison. These performance requirements would constitute a specification for the material, which should go a long way towards ensuring that materials of acceptable quality were supplied. Quite frequently, manufacturers announced the introduction of an "improved quality" material. The claim of improvement might be justified for many uses, but for others the "improvement" might well result in its unacceptability. The use of soundly based specifications helped to avoid troubles due to such changes.

MR GAY sympathised with Mr Palmer on this subject. He had not said that specifications, as such, were the real problem; he had used the phrase "desk-made specifications" and had meant to indicate that it was possible to draw up a specification to cover one aspect of the paint-user industry, and it would not apply to a particular situation within that sector. Disappointment would follow, despite the fact that a material of excellent quality for that application had been supplied and the application procedure was correct. As Mr Dunkley had pointed out in his paper, a great problem was "unforeseen circumstances" and if these were the cause of failure then the policy he had outlined earlier in the discussion was the most effective answer.

MR E. L. FRENCH said that the paint industry should follow the plastics industry where the use of its materials was in question. He had been involved with glass-reinforced plastic, and the problem there was not so much to do with the raw material supplier but with the fabricator.

There was sufficient technology in the paint industry, but he did not think that sufficient attention had been paid to the applicators. What was lacking was a quality assurance scheme where the guarantees or warranties did not originate from the paint supplier but from the applicator. If the paint industry was to have a training scheme for the applicators so that when they supplied paint they could say that it ought to be applied by certain trained applicators, then the customer might be more inclined to enter into a warranty concerning the performance of that material. This policy had also been adopted in the sealants industry, and the paint industry would do well to adopt it instead of their present introspective attitude.

MR GAY replied that there were, of course, a number of such schemes already operating in the paint industry. The problem still came back, however, to the customer, who invariably chose his paint applicator for price reasons and only later found that the applicator chosen had no experience of the type of paint system to be used. This situation could occur despite codes of practice and specifications. In addition, there was often the problem merely of people being too proud to ask advice concerning new developments, and certainly private organisations and independent testing organisations, such as the Paint Research Association, seemed to be under-used in this respect.

MR F. G. DUNKLEY thought that the industry ought to have some national school for training paint applicators. This had been tried in the past, but the problem was always lack of funds. In this regard, however, there were national organisations in the welding and also the testing and inspection fields. It would be more difficult quantitatively to assess the work of a paint applicator compared with a welder, but this was something which could be overcome.

Mr Gay was kind enough in his paper to draw attention to a point which the speaker had made in his own presentation. Although it would take too long to expand on this at the present time, Mr Dunkley said he would like to mention that during all his time with British Rail he had never once been able to point to "faulty paint" as the reason for paint failure. The reason for failure was invariably due to some aspect of the application or because the paint system had been used in an application for which it was not intended or due to some incorrect procedure in the surface preparation. Initially, there was often a tendency to suspect the paint manufacturer, but by and large paint manufacturers did live up to their products.

MR GAY said he would like to emphasise Mr Dunkley's points that one of the most common reasons for failure was the use of paint in an application for which it was not intended. He had once visited a mill in Yorkshire where the staff were firmly of the opinion that not even "the best paint on the market" could withstand the conditions in their dye house. In this room there was caustic soda pouring down the walls, and every paint which had been tried had failed. This was simply because they were using alkyd paints, and this was at a time when there were perfectly adequate alkali-resistant paints on the market.

DR G. DE W. ANDERSON commented with regard to painting theory, that he agreed with the author's contention that capable scientists and technologists should clearly distinguish soundly based theory from hypothesis. Existing theory, however, had never been entirely adequate for existing needs and ambitions. Skilled artisans in the old craft industries had achieved many products which had far better qualities than they had any "scientific" right to be. Indeed, the first impact of science on the craft industries in this century was to investigate and explain the performance of the better products of these industries.

In the absence of adequate theory, a capable scientist could, by intuition or careful observation, usefully suggest further worthwhile experiments. Mr Davidson's paper had provided an instance of the latter in the discovery of a new anticorrosive pigment not by theory, but by a sharp-eyed technologist who had noticed unrusty nail heads in painted wooden structures.

MR GAY said that it was often true that a good basis of theory led to the development of new ideas. Every worker in an advancing technology had to have one foot in the unknown. By this he was able to advance, but if he got too far into the unknown, he lost contact with his base and was in danger of being totally at sea. In this situation, he became merely an adventurer in technical matters.

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Paints for buildings—the potential and the performance*

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Summary

A general description is given of the performance, especially the durability, of paints and surface coatings for buildings, as observed by the Building Research Station under test conditions and in practice. The materials covered include coatings for wood, metal windows and sheet cladding, structural steel and masonry. The life achieved is often inadequate, leading to excessive maintenance. Improvements should be sought in the paints themselves, in better usage during site operations, and by the transfer of painting, whenever possible, from the site to the factory producing the components.

Keywords

Processes and methods primarily associated with service or utility

corrosion

weathering

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

dirt retention

durability

weather resistance

Peintures pour bâtiments—leurs possibilités et leur rendement

Résumé

On décrit d'une facon générale le rendement, et en particulier la résistance aux intempéries, de peintures et de revêtements de surface pour bâtiments, tel que l'on a déterminé à la Building Research Station tant sous les conditions spécifiques d'essai que sous les conditions qui règnent dans la pratique. Les matériaux constituant l'objet de cette étude comprennent des revêtements pour bois, pour la quasi-totalité des types de chassis de fenêtre, pour matériaux de construction en plaques, pour charpentes en acier, pour le stucage et le crépi. La vie utile de ces peintures est souvent insuffisante de sorte que l'entretien devient excessif. Les améliorations doivent être cherchées au sein des peintures elles-mêmes et des opérations au pied d'oeuvre, et dans la mesure que possible en transférant le peinturage à partir du pied d'oeuvre jusqu'à l'atelier où l'on fabrique les éléments de construction.

Bautenlacke—Möglichkeiten und Leistung

Zusammenfassung

Das Verhalten, besonders hinsichtlich Dauerhaftigkeit, von im Baugewerbe verarbeiteten Lacken und Beschichtungsmitteln wird beschrieben, so wie es von der Building Research Station unter Prüfbedingungen und in der Praxis beobachtet wurde. Zu den besprochenen Anstrichmitteln gehören solche für Holz, vor allem Fenster und Verkleidungen in Tafelform, Konstruktionsstahl und Mauerwerk. Die erreichte Lebensdauer ist häufig ungenügend und erfordert viel zu viel Instandhaltung. Nach Verbesserungen sollte gesucht werden und zwar hinsichtlich der Anstrichmittel, der Methoden beim Verarbeiten auf der Baustelle und der Möglichkeit die Malerarbeiten von letzterer in das die Komponenten erzeugende Werk zu verlegen.

Introduction

Paint has been such a ubiquitous feature in building that the present signs of a trend away from it must be considered as evidence of some dissatisfaction with its performance. It certainly has a continuing role in both the decoration and the protection of new buildings, and is still without rival in the maintenance and renovation of older ones; there is a remarkable element of satisfaction in the restored appearance of freshly painted, rather than merely washed, surfaces. But it is being replaced on wood by stains (perhaps somewhat tentatively), displaced by substrates such as plastics, which do not need painting, at least during the first part of their lives, and omitted on surfaces such as concrete and many external walls where it could be used decoratively or even protectively but is avoided for fear of incurring high maintenance costs.

There is a wide range of achievement in coatings, with plenty of unpublicised satisfactory results to balance the more prominent failures, and a large number of factors which can affect the realisation of expected results, every one of which must be considered before generalisations are made about paint as a single material or about specific types of paint for different purposes. This paper discusses the adequacy of various classes of paints for buildings in meeting the promised levels of performance, the reasons for any shortcomings, and the use of some alternative materials.

Paint in practice

Where paint continues to be used in the traditional way, there seems to be a somewhat complacent acceptance of a short life, for example, the belief that first maintenance painting is necessary after only one or two years, and that subsequent maintenance periods will not exceed five years and will often be only three or four. The average maintenance period for Local Authorities' housing is in fact five years, but the industry ought to be aiming to increase this as a means of saving the resources of both men and materials.

As an example, Table 1 shows the schedules for frequency of maintenance painting adopted by the Property Services Agency, Department of the Environment, as a result of practical experience. The figures are for maximum frequencies

*Paper presented at the Association's Biennial Conference held at the Grand Hotel, Scarborough, Yorks, England, from 17 to 21 June 1975.

Table 1

Frequency of external painting (wood and metalwork, all PSA buildings)

Climatic conditions	Atmospheric pollution	Interval to first redecoration	Interval to subsequent redecoration	Original paint system	Maintenance paint system
	None	2	5	1 primer	
Sheltered or moderate	Average	2	5	2 undercoats	1 undercoat
	Severe (Cities and towns in industrial areas)	2	4	1 gloss coat	1 gloss coat
Severe (High driving rain index, within 8 km of sea, high buildings, exposed hill sites)	None	2	4	1 primer	
	Average	2	4	1 undercoat	1 undercoat
	Severe	1	3	2 gloss coats	2 gloss coats

and in the worst situations, but for wooden windows, for example, a partial repaint or even shorter intervals between complete redecoration may be required. They may well reflect the difficulties of getting good workmanship, but it is reasonable to ask why these are so different from the claims for five or six years life made by manufacturers of typical paints of these kinds: primers, undercoats and gloss paints based on (modified) alkyd resins. The Department would obviously like to be able to reduce the frequency of maintenance but without incurring excessive costs for increased supervision of painting operations. A similar situation is found with both public and private housing.

The reasons for dissatisfaction naturally tend to be stated differently by the users and the producers of paint; it is difficult for individual users to get a correct perspective of the relative effects on ultimate performance of quality of product and extent of misuse. It is not easy for even an independent observer to be sure of the true situation. Nevertheless, the absence of product standards is a feature which tends to strengthen the users' belief that it is the quality of the paint products which is at fault, and that manufacturers are unlikely to improve durability as this would reduce their total market. The manufacturer, naturally, tends to believe that the great majority of failures arise from misuse either in the workmanship or in the conditions to which the coating is subjected.

Other reasons for the failure of a paint to match expectations can include incorrect choice for a given substrate and situation, though here the available guidance is greatest, and, of course, there is the inevitable emphasis on the cost of the paint, which is not always a good guide to performance.

In so far as product quality is at fault, apart from low priced materials, it is possible that many paints are not as good as they might be, even without increasing their cost, because of unrealistic testing. This seems to be shown by some of the test work at the Building Research Station (BRS), as well as by results in practice, and the main criticism lies in the excessive reliance on small test panels, well prepared on good quality substrates, which give a misleading and optimistic estimate of the durability compared with the actual results in the range of situations met in buildings. Thus, it is doubted that the kind of paint behaviour seen on test walls at BRS is ever shown on asbestos cement panels, severe though these may be on paint performance. There is also a tendency for test laboratories to examine films too early in their life, before they have achieved their full working hardness, and this can give a false impression of their extensibility and hardness.

Against these adverse trends is the increasing application of paint and coatings to sheet products and components in the factory, which provided that well-developed good quality materials are used, leads to improved results and longer life. In particular, it enables a wider range of polymers to be employed without the restraints imposed by site application. Even here, the results are not always all that would be expected, and the products need critical examination. But the elimination of uncertain site conditions and uncontrolled working is an important avenue towards better performance for coatings and deserves every encouragement.

Site applied paints and coatings claiming very much longer life (10 years and over), particularly with some form of guarantee, are also of great interest, but the user realises that such claims must be treated with caution, and questions how they can be verified. There are not sufficient evaluations being made by independent bodies in this field, no doubt largely because of questions of financing the work. The major sources of independent information of this kind are the Agrément Board and the Consumers Association; BRS evaluation is concerned with the range of performance of various types and cannot assist in the choice of proprietary products.

Selected examples of performance judged by test and practical results

Ref. 1, 2

Paints for wood

The oxidising hard gloss (alkyd) paint is probably the best known and evaluated of all paint types. It covers a variety of compositions, but most manufacturers would probably say that it had a life, if correctly used on a suitable undercoat and primer, of five to six years, although few, if any, would offer any form of warranty. But most users would put the life at well below five years, especially on wood and or on a new building. The question is whether these two judgements can be reconciled.

The manufacturers' belief will be based initially on artificial and natural weathering tests but, presumably, eventually on practical experience. The poor performance frequently seen in practice must raise doubts about the feed back.

Artificial tests do not give reliable results on wooden panels, but the results on metal panels will normally appear satisfactory even for long periods. In natural exposure tests the panels are usually small, the back and edges protected, edges rounded, and generous coats of paint applied. They will probably show at most slight chalking and no serious film deterioration after two years facing south at 45 degrees in different temperate climates. This result is then multiplied by a factor of three to predict six years on a vertical surface. This may well be true of vertical and partly protected areas on buildings, for example the upper parts of window frames, but major failure very often occurs in one-two years on the horizontal and fully exposed components, the lower rails and cills, beads and transom panels. The practical result is influenced by the high moisture concentration, from rain and often internal condensation, in these wooden members. The user may well conclude that the top coat or the whole paint system is at fault, but included in the failure may be the unsatisfactory timber, defective putty, failure of joints or glues.

Work at the BRS[1] has shown that much failure has been caused by unsatisfactory wood primers, to which too little attention has been paid either by the specifier or by the manufacturer. Examination of current commercial products showed that many were unable to provide adequate durability either exposed alone (as may occur on site) (Fig. 1) or when

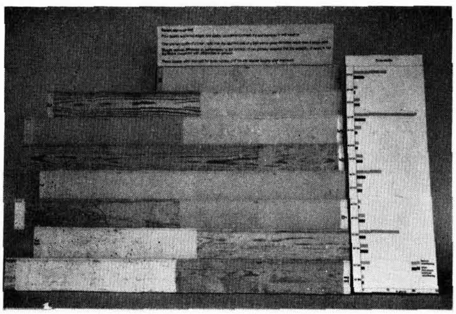


Fig. 1. Variation in performance of low-lead wood primers exposed six months at 45° facing south, Garston. (Chart at right shows corresponding extensibility)

protected by a top coat, but some were equal to or better than the traditional lead-based primer, of which expectations based on long experience are normally high. The worst offender has been the quick-drying joinery primer applied in the factory, where the over-riding requirements have been cheapness and rapid drying, but even many brushing primers were found to be not good enough.

As for the gloss paint itself, although in its better versions it represents a fair commercial product, it does suffer from degradation and embrittlement so that its life on exposed joinery is unlikely to reach the estimated five or six years, and an improvement (in conjunction with better primers) would be welcome. Although some properties, such as easy application and rapid drying, have been improved by development work, there seems to have been little or no increase in durability in recent years. An example of failure to meet expectations is provided by the early examples of polyurethane modified alkyds which were too brittle to have good outdoor durability. (Their undoubted value, derived from fast drying and hardness, lies in their resistance to wear and washing in internal use.) A similar result, but one which gave an even shorter life, was obtained when polyurethane clear varnishes were marketed as an improvement on the conventional alkyd and oil/resin types. Even the "advanced" two-pack polyurethane has been a disappointment when used on wood, although the chemistry of this type should allow adequately flexible films to be produced.

The frequently disappointing performance of paints on wooden window frames is reproduced in a building erected at the BRS for comparison of painted wood, metal and plastics components. With high internal humidity and temperature but normal natural weathering (north and south facing) deterioration of three-coat systems has occured in two and a half years, even on preserved wood (Figs. 2 and 3). Somewhat better results would be expected if the preservative and primer were selected from the best of the more recently tested products.

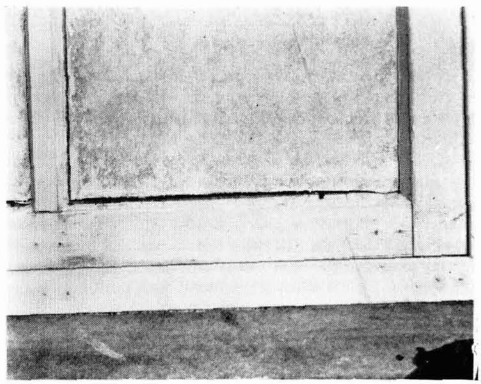


Fig. 2

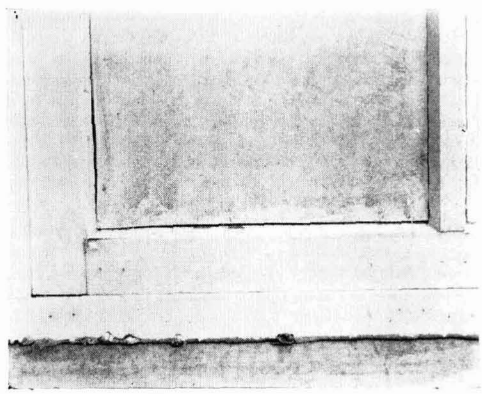
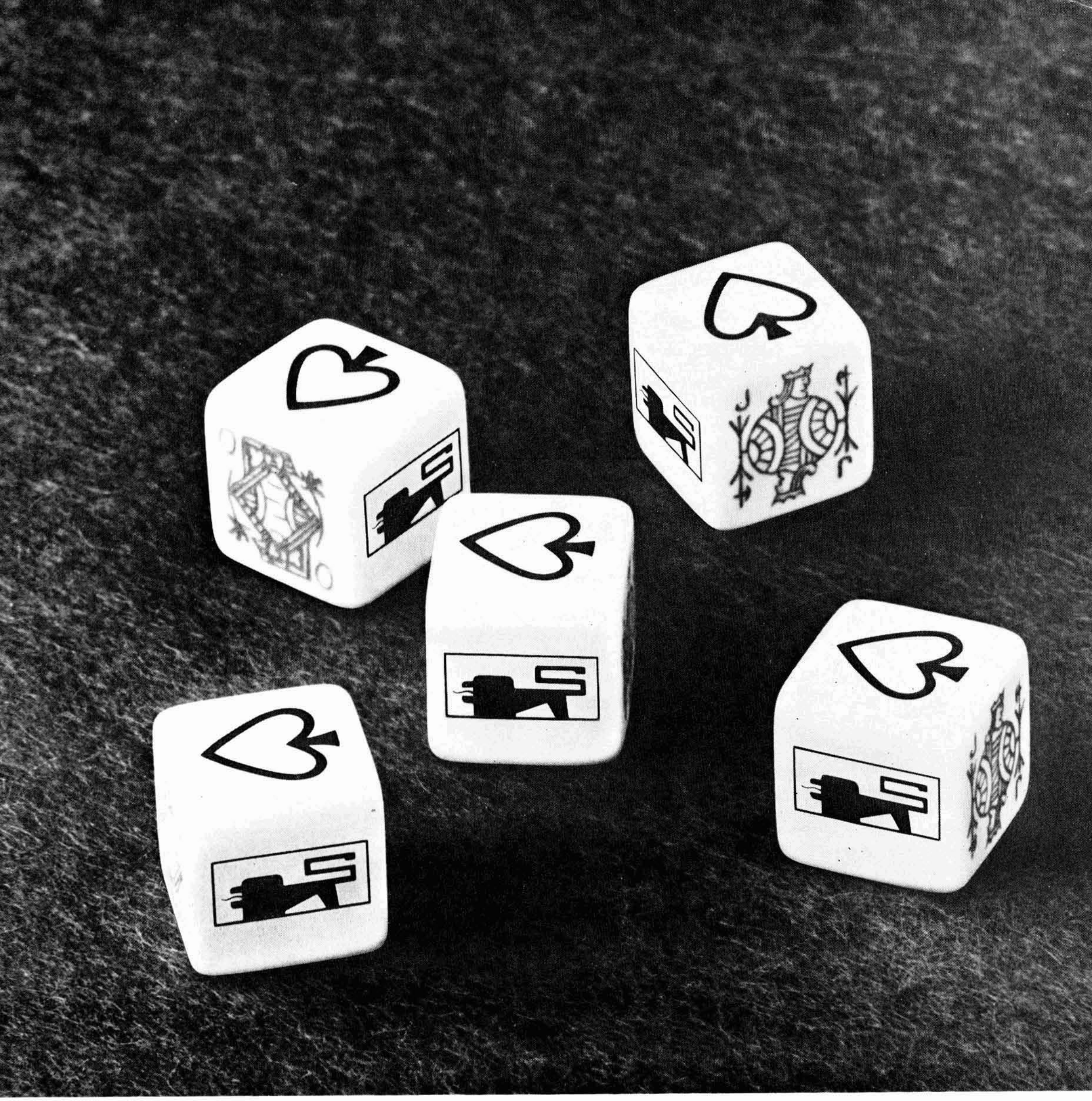


Fig. 3

Site applied 3-coat paint systems on preservative treated softwood sashes and frames in test building; 2.5 years facing south (Points of damage are made by moisture meter probes)

By contrast, two proprietary factory finishing systems for wood windows, both incorporating a preservative treatment, have shown overall good durability in the author's tests, although behaving in quite different ways. One (a polyurethane) has been found possibly rather too brittle to accommodate much wood movement, although tough and impervious and less affected by weather up to two and



half years than conventional paints; the other (based on an emulsion polymer) also shows good durability, but being softer it shows greater dirt retention than alkyd paints (Figs. 4 and 5). Also the site-painted softwood cladding has shown

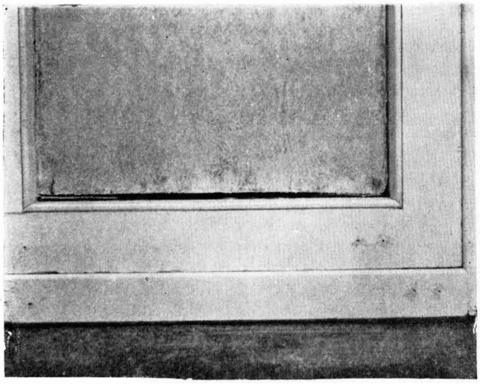


Fig. 4

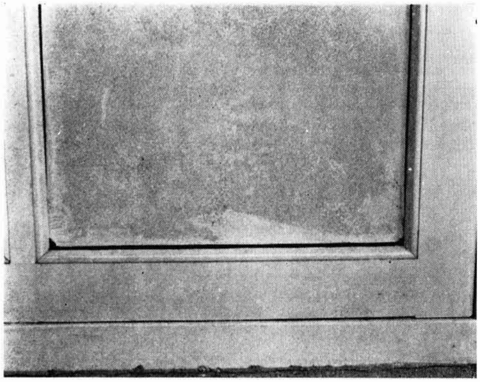


Fig 5

Factory applied coatings on preservative treated softwood sashes and frames, exposed as Fig. 2

a far greater need for maintenance than factory-coated metal or extruded plastics. The promise inherent in the benefits of factory controlled application, as well as in the materials which can be utilised by it, seems to be worth pursuing more extensively. It appears the best answer which the paint industry can produce to the alternative use of either thick plastics coatings on timber or the complete replacement of painted wood by plastics. Meanwhile, the main hope of improved site painting of timber lies in the general use of preservatives containing resins, together with better primers for site or factory application.

Another very different development arising from the reaction against conventional paint on woodwork is the water repellent preservative finish[2]. This is derived from the original Madison finish, which was based on preservative, oil, wax and transparent pigment; such treatments have diversified and developed into a semi-film forming (but still transparent) material with a wider range of colours. Although some penetration into the wood occurs, these are not rigorous preservative treatments and should preferably be applied over a vacuum or immersion treatment. Here no promise is offered of long and maintenance-free life, but of simple and cheap maintenance with a life almost as long as would be obtained from conventional paints. On timber cladding, both western red cedar and softwoods, these coatings would be acceptable, but on window joinery there arises the question of whether their ability to permit greater water transmission causes excessive movement and opening of joints, as well as a tendency for opening lights to become jammed. Such treatments, although enhancing the good features of wood's appearance, equally do not hide knots and other defects. Although considerable use of these products has already been made they have not satisfied all users. Moreover, they do not protect the putty in ordinary face glazing, and should only be employed in conjunction with bead glazing.

Alternatives to painted wood

In the test building mentioned above, traditionally painted wooden windows and cladding have deteriorated considerably, even when good products and practice have been used. Plastics materials (Fig. 6a) promise a life to first maintenance

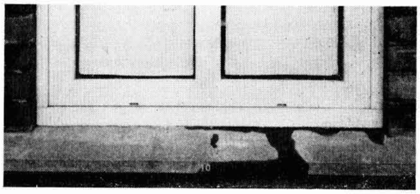


Fig. 6a. Plastics window sash (in painted wood frame) exposed as Fig. 2

(apart from washing) of well over 10 years. The comparison has to be made in terms of the costs in use over a long period, but the changing prices of both wood and various plastics tend to alter the relative overall costs at different times. At one stage, the initial cost of the plastics was less than that of painted wood, and their maintenance costs were very much lower, but later the overall costs moved back in favour of wood, even with the repeated maintenance needed. A wooden cored window with a thin pvc extruded coating, not included in these tests, shows at present a favourable economic comparison with painted wood.

Wood board materials

Plywood creates special difficulties for coatings because of the unbalanced strain on the outer veneers, and in some species (for example, Douglas fir and Finnish birch) this leads to a rapid checking of the veneer and of applied coatings. Plywood transom and infill panels are popular on certain types of crosswall construction and call for a decorative and protective treatment. Here paints, in general, have difficulty in providing a reasonable life with low maintenance costs; a four-coat system with a gloss top coat proved inadequate, and the best solution so far has been the use of plywood with a phenolic paper overlay to act as a sound substrate for liquid coatings. Certain forms of treatment, using a coarse textured emulsion-based composition, have shown many examples of early failure, being unable to prevent the penetration of rain water and subsequent deterioration. An adequate coat of a good water-resistant primer would be the minimum basis for such coatings, but a much more water resistant textured finish based on an oleoresinous or alkyd medium would be preferred. (Incidentally, the term "WBP grade" of plywood is, in itself, misleading to the extent that although it is made with water resistant glues the whole composite board is not necessarily durable. In particular, descriptions such as "Douglas fir" do not necessarily imply that all the veneers are of that species. Thus this is a material for which great care in painting and protection is required.)

Metal window frames

Steel is no longer used for this purpose without galvanising, paint alone having been inadequate for long term protection in this situation. Paint failures on galvanised steel still occur although suitable efficient primers are known, but the paint failure does not result in corrosion. Apart from this, a suitable paint system is capable of giving an adequate life, which should exceed five years on galvanised windows in most situations.

Mill-finished aluminium is often not aesthetically acceptable, and until the 1960s anodising has been the normal rather expensive alternative finish, generally lasting at least 15 years before maintenance (in the form of painting) would be needed, although frequent washing is normally recommended.

Conventional paints over a suitable primer are an alternative, and these are usually site applied, but the introduction of factory applied acrylic polymer paints (Fig. 6b) was hailed

Fig. 6b. Factory applied acrylic coating on aluminium sash (in painted wood frame)

as a considerable advance, being cheaper than anodising, but with a life of at least ten years (initially said to be guaranteed). As usual there appeared to be a marked variation in performance of paints from different sources, but gradually even the best of them seemed to fall short of their early promise. Arguments arose as to what constituted a 10-year life; one manufacturer considered that chalking occurring at three years or less was not unreasonable. But such chalking could seriously change the colour of greys and green finishes and it was not considered acceptable by the customers who were led to expect a 10-year life; it was no better than expected of a site applied alkyd paint. Another early failure was of under-film corrosion of a black finish, but this was overcome by modifying the pigmentation. In spite of the rather thin films used (20-30μm), the integrity of these acrylic finishes has just been sufficient to uphold the claim of a life of 10 years to repainting; the authors' figures for thickness loss on exposure would show erosion of up to half the original thickness in rather under 10 years. BS 4842, produced in 1972, should have done a great deal to secure improved organic finishes for aluminium windows, but no real evidence of its impact has yet been obtained.

Nevertheless, there are obviously doubts among customers about the acrylic finishes, and manufacturers are putting forward silicone polyester (alkyd) and fluoro-carbon polymer coatings. Whilst both of these should have very long lives, it is too early to give a performance rating for them. The weight loss of the fluoro-polymer over two to three years appears to be almost negligible, so that here the high promise could well be realised, and the light fastness within the limited colour range has also been uprated.

Although plastics, such as polyvinyl chloride (PVCl) and glass fibre reinforced plastic (GRP), will compete strongly with metal windows in the smaller sizes, the use of aluminium in curtain walling and large windows probably has no alternative among plastics and hence requires a very high standard in the finishes used.

Protection of structural steel in building

The requirements for protection of steel in buildings are often considered only in terms of the ultimate conditions of the occupied structure, but are frequently determined by the weather and conditions of exposure during erection. They may well be less stringent than for fully exposed steel structures, but more severe than expected. Little work has been done recently at the BRS in evaluating paints for steel, because so much is going on elsewhere, but the shortcomings of many coatings utilising new polymers and techniques were observed in earlier evaluations, and have been noted often enough in practice to indicate a deficiency in some of the products, not simply in their mode of use. Accelerated corrosion tests are certainly far from convincing and sometimes even conflicting, but many of the newer products seem to have been either poorly developed or inadequately tested by this form of test, so that claims for them are greatly exaggerated and many are unduly expensive.

High-build coatings are an important type, which should reduce the labour costs necessary to achieve the proper film thickness for a given degree of protection, but quite often painters seem unable to obtain the thickness claimed by the manufacturers and sometimes the authors have been unable to do so in the laboratory. Even correctly applied, there are many proprietary "high technology" coating systems which have failed under test to equal the performance of traditional primers and top coats, and which have also been the subject of enquiries from disappointed users. Certainly there are few of these which meet the needs of the building industry for site applied coatings where thorough preparation is impossible, and the tolerant oil based paints remain the best for this purpose (although lead based primers and paints may not be permissible in domestic areas). Used with reasonable preparation and adequate thickness, good quality paints based on drying oil are capable of achieving a satisfactory life in buildings for non-industrial uses in all but the worst situations.

For the more difficult requirements, in polluted situations, swimming pools, civil engineering structures and marine areas, the more advanced coatings have to be used, with appropriate control of metal cleaning. Increasing awareness of the need for good preparation is now being noted (BS 4232 has still not achieved complete cognizance), but difficulty remains in choosing between the many totally different protective paint systems available.

The revision of CP 2008, now in progress, ought to afford much improvement in the choice of coatings for structural steel, but until more precise definitions of performance are available, preferably in the form of product specifications, there will remain the situation in which the promise is derived from an inadequate generic description (eg micaceous iron oxide paint, chlorinated rubber paint, epoxy paint, zinc phosphate primer), but the performance is determined by a pared-down, under-tested formulation meriting the description but not the expectation. Anyone comparing a range of commercial products of the same general type will soon find that the classification in this way is not a good enough guide to actual performance.

Coatings on sheet metal

Refs. 3, 4

The application of pre-coated metal sheets for a wide variety of uses has become a large and important development in paint technology[3,4]. In the building industry much interest centres on the durability of coatings for external cladding—in general the performance of interior components does not give rise to many difficulties. Coatings may be applied in liquid form to coiled strip which is subsequently profiled or formed, or to preformed sheets, or from a preformed film applied with an adhesive.

The commonest coating on steel has been the PVCl plastisol at a considerable thickness (125-200μm). Experience has shown the acceptability of such coatings, although their corrosion resistance was quite inadequate without a prior galvanising treatment. The main difficulties which remain with these coatings are their dirt retention, since they are rather soft and resilient, and their light fastness. The light fastness has to be very good, and the colour change between different batches has to be kept to a minimum otherwise the use of different batches of sheet on very large buildings becomes only too obvious. An Agrément Certificate is available for one such product. Very good results have also been achieved with a polyvinyl fluoride sheet coating on galvanised steel; this is not in production in Britain.

Some thin vinyl coatings have proved inadequate for the protection of steel components, such as lighting fittings and ceiling suspension systems formed from coated strip, because the film has not remained intact over the tight bends and has allowed corrosion in humid air to occur before the building was heated and occupied (Fig. 7). Here the promised performance may be appropriate only to dry mild environments,

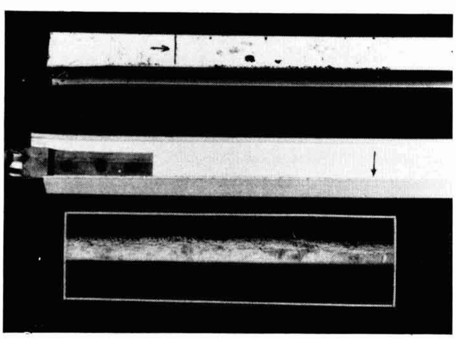


Fig. 7. Vinyl coating on steel component, showing corrosion at cracks in film over tight bends, occurring before building was heated and put into use

but an improvement is necessary to meet the conditions of installation which usually apply. It is possibly the very low price (a few pence per square metre) which militates against better performance in this field, but often the use of a primer would make all the difference.

Early results with PVCl on aluminium, both as applied sheet and as organosol coatings (ie 50-100μm), were disappointing. Colour stability was poor and even corrosion resistance was inadequate. Other coatings on aluminium have been the vinyl and acrylic solution resin types, the latter thermosetting, and these now have fairly acceptable performance; a life of 10 years before repainting can be expected although high chalking rates have been noted in some early examples with a weight loss amounting to about half the film in less than 10 years. In addition, very fine pitting corrosion and detachment of the film has been observed at around 10 years, and failure on the bends of profiled sheet can occur even earlier.

Here again, polyvinyl fluoride applied as a preformed film has proved a highly durable surface showing no chalking for eight years or more, and very little colour change. Its main disadvantage is its susceptibility to mechanical damage (for example by ladders) and its high cost. This polymer can certainly be said to fulfil its promise. Whether the polyvinylidene fluoride coatings, applied from the liquid state, will be equally good is not yet determined, but early indications are promising. One other type of coating is also of high durability —the alkyd amino stoved finish, applied to preformed sheets; some post-forming is also possible with coatings which have not been fully hardened.

All such products can be used with reasonable confidence that no early maintenance will be required, and that later attention will be simple and economic, but there should not be an expectation of a truly permanent material.

Masonry paints and coatings

Refs. 3, 5, 6, 6

The requirements of coatings for masonry (bricks, stone, rendering and concrete) invite a consideration of the necessary theoretical performance, on which formulations should be based. Although these inorganic substrates are regarded as stable and rigid, walls built of them are likely to develop cracks either in the material or in the joints. The simplest theoretical consideration would suggest that a coating cannot bridge a crack which forms underneath it, because two points, which might be superimposed originally at the paint/substrate interface would become separated by a finite amount if a crack were formed and would, therefore, create a theoretically "infinite" extension of the coating. This is certainly not true in practice, since the coating can lose adhesion at the edges of the crack, or the substrate can lose cohesion, either mechanism permitting the extension to be finite and possibly within the range of many coatings.

Thus, there is a requirement for relatively flexible or extensible films, and their ability to bridge cracks was demonstrated and described in a previous paper[6], but many coatings appear to have been formulated at too great a level of hardness, with excessive emphasis on the requirement to resist dirt pickup. If paints are tested on panels exposed at 45° to the horizontal, the dirt deposition is excessive and not comparable with that on a vertical surface. To resist dirt retention in this position the coating has to be very much harder than is necessary for a vertical surface, and is then very liable to crack. In addition, retention of solvent or low molecular weight components may be even greater than is expected, often lasting for months, so that the ultimate hardness of the film is greater than it was thought to be during early testing. This seems to be true not only of oil based and chlorinated rubber paints but even of emulsion polymer paints, and is, of course, accentuated in the thicker versions which are desirable for longer life. It is important, therefore, to bring such paints to a stable state before evaluating the properties of hardness and extensibility.

Another property of great practical importance is the balance between resistance to rainwater penetration and permeability to moisture vapour[5]. Investigations at the BRS are continuing in this field.

Following the traditional use of lime and colour washes and later distempers, with an expectation of only one or two years' life, there has been a gradual increase in decorative treatments for external walls derived from the improvement in water thinned paints based on emulsion polymers. Whereas in the early days of emulsion paints, separate exterior grades were made, these later became uncommon. They have now returned in strength, and many of them have a fine texture similar to that of the older oil based stone paints, which they have not yet entirely displaced.

There has also been development of exterior masonry coatings utilising a variety of solution polymers, and providing a range of textures and appearance. The usual wide spread of performance is found, even in examples using similar polymers, and of special interest is the range of permeability to moisture vapour, from very low up to the level of emulsion paints.

A new, much thicker and more strongly textured type of coating applied by spray by specialist contractors has been introduced from the USA, with promises of a life at first of over 10 years and now very often of 20 years, and usually with a guarantee or warranty of some kind. Claims of this type obviously make the products very attractive and they have been the subject of very many enquiries, partly the result of the intensive selling methods adopted and the proliferation of brand names. Some of the other claims made for these coatings, such as for thermal and acoustic insulation, seem to offer a performance not normally considered possible from paints. In this respect they are very unlikely to fulfil their promise. It was thought worthwhile to evaluate their durability in comparison with many other types of external wall finish, as described below.

Sealers

An interesting part of the study of masonry paints has been the behaviour and properties of the various sealers or primers recommended for use with some of them. With the availability of non-saponifiable polymers, the use of alkali-resisting primers has become rare, but the poor penetration of emulsion paint and of some thick coatings is often assisted by a penetrating solvent based primer. Of these, some have been surprisingly unlike their corresponding finishes in extensibility characteristics, and on the Fletton brick test wall there are some sections where failure is greater over the sealer than on areas without it. A particularly unfortunate combination is shown in Fig. 8, where an emulsion "sealer" was used under a thick texture coating and its water sensitivity caused the entire coating to strip off the treated rendering (top left), although it adhered well without a sealer (top right). However, on unrendered Flettons (bottom) adhesion remained adequate, possibly assisted by the greater water absorption of the brick.

Test results

The "life" of masonry coatings has to be assessed both in terms of film breakdown and also appearance, in which dirt retention, light fastness, erosion, and mould or algal growth all play a part. The results obtained from a test wall at Garston were described in a previous paper[6] and the state of the coating is shown as at 1974 (eight years) in Fig. 9. The updated estimates of the life of the coatings on the south, rendered side are shown together with the earlier estimates (at five years) in Fig. 10, related to the film weight.

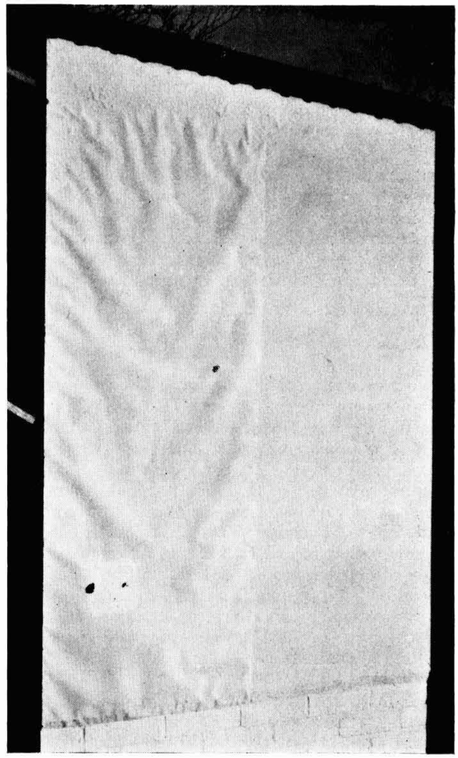


Fig. 8. Failure of thick textured coating over unsuitable sealer

Little change has been made to the earlier estimates, but it is seen that the thickest coating will now exceed the 10 years originally expected in this fairly straightforward situation. The results on the north, unrendered side are considerably worse, as the Fletton brick is a substrate with areas of poor adhesion for most paints.

A life of three to five years between repainting is shown for smooth thin emulsion films and this appears to be in agreement with general results; no very definite promises are normally made or implied for this type of paint. The fine textured emulsion paints specifically intended for exterior use are likely to have a life of seven years on average and the best varieties could reach 10 years except in severe conditions. In other tests, however, a wide range of performance of this type has been noted, and brittleness in some, shown by laboratory tests, has been manifest both in exposure tests and in practice. Oil-based "stone" paints are also in the seven-year life range.

The thin film, solution polymer paints have given rather better results than the thin emulsion paints in these tests, with a life around five years and better appearance (although they were worse on Fletton bricks). Fine textured paints of this type have appeared since early tests and for these a life of about seven years could be forecast, although they may show greater ultimate hardness than equivalent emulsion based paints.

OBERFLÄCHENSCHUTZ
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PROTECTION DE SURFACE

Dynamit Nobel
CHEMIKALIEN

DYNAPOL® P

DYNAPOL P co-polyesters on the basis of terephthalic acid are best suited for electrostatic powder coating and fluidized bed coating.

Electrostatic Powder Coating
We offer for this application saturated polyesters, containing hydroxyl groups, for the production of decorative, elastic and weather resistant coatings.

Typical Fields of Application:
- apparatuses
- metal window frames
- garden furniture
- household appliances
- automobile accessories

Technical Data:
Coating thickness 50–70 μm
Erichsen depth test (DIN 53156) 8–10 mm
Pendulum hardness (DIN 53157) 157–185 sec.
Impact test > 50 inch · lbs
Gloss according to Lange 45° depending on grade 80–130°
Salt spray test (ASTM B 117) 600 hours
Adhesion (DIN 53151) GT 0
Kesternich test 30 cycles

Fluidized Bed Coating
For this application we have a partly crystalline co-polyester available, which is best suited for the production of elastic, heat and weather resistant coatings.
Depending on the type of cooling process applied, bright or matt coatings may optionally be produced, having very good electrical insulating qualities in addition to a decorative surface.

The fields of application are those requiring a high quality protection against corrosion and a decorative surface.

Typical Fields of Application:
- sign posts
- garden chairs
- wire mesh
- valve handwheels
- household appliances

Technical Data:
Coating thickness about 250–500 μm
Erichsen depth test (DIN 53156) > 10 mm
Impact test > 80 inch · lbs
Hardness (DIN 53153) about 85–90
Gloss (Lange), depending on the kind of cooling 80–125
Kesternich test 40 cycles

DYFLOR® 2000

Polyvinylidene fluoride for powder coating.

<u>DYFLOR 2000 WS for fluidized bed coating.</u>

<u>DYFLOR 2000 ES for electrostatic powder coating.</u>

Powder coatings made with this fluorpolymere show some outstanding properties, e. g.:
- smooth surfaces
- very good resistance to chemicals
- wide range of service temperature
- high elasticity
- high impact strength
- high flame resistance

DYFLOR 2000 combines excellent resistance to chemicals with good physical properties. DYFLOR 2000 is giving an optimal protection, even at higher temperatures.

Because of its properties DYFLOR 2000 is recommended for the coating of such parts, which are exposed to strong chemical and corrosive influences, as for instance in the chemical industry construction and in chemical apparatuses.

DYFLOR 2000 can be processed safely and problem-free on the usual coating lines.

Coating properties:

Coating thickness	approx. 200 μm
Indentation test (DIN 53153)	85
Pendulum hardness (DIN 53157)	143 sec.
Erichsen depth test (DIN 53156)	10 mm
Impact test	8 mm
Adhesion	GT 0
Working temperature	−40° C to +150° C

DYNAPOL® L

DYNAPOL L-resins are high-molecular, linear, saturated polyesters containing terephthalic acid, which may be processed to physically drying binders and, combined with amino resins to extremely adhesive, highly elastic coatings.

DYNAPOL L are available in different degrees of elasticity.

DYNAPOL L-coatings are distinguished by an optimally balanced behaviour regarding flexibility and hardness. Due to their excellent weather resistance they are also suited for outdoor use.

In specific formulations DYNAPOL L-coatings can be composed to be sterilisation-proof. These coatings comply with the recommendations of the BGA (German Ministry of Health) and are, according to FDA-Regulations, generally recognized as safe in food.

Typical Fields of Application:
- packings
- sterilisation-proof packaging for foodstuffs
- prefabricated building and constructional elements for the architectural field (sidings, wallpanels, ceilings)
- apparatus construction

Technical Data:
(on pre-treated aluminium)

Gloss (Gardner)	approx. 95–100%
Pencil hardness	H
Impact test	approx. 80 inch · lbs
T-bend-test	T 0-2 depending on the type
Salt spray test	min. 400 hours, unaffected

These data comply with the ECCA Test Specifications (European Coilcoating Association, Brussels).

New modified polyesters with intensified reactivity, good forming properties and excellent weather resistance are specially recommendable for coilcoating lacquers.

DYNAPOL® H

DYNAPOL H-Types are thermosetting, branched polyester resins containing hydroxyl groups, having suitable stamping and deep-drawing properties, as required for the production of automobile stoving and repair lacquers as well as for the coating of aluminium, steel or galvanized steel for the packaging field.

Technical Data:
(on pre-treated aluminium)

Gloss (Gardner)	95%
Pencil hardness	2 H
Impact test	approx. 60 inch · lbs
T-bend-test	T 2–3
Salt spray test	min. 500 hours, unaffected

These data comply with the ECCA Test Specification.

DYFLOR® L 90

DYFLOR L 90 is a polyvinyl fluoride, which is to be processed in form of a dispersion. It is preferably used where an especially high life expectancy, resistance to chemicals, weather resistance, and a good forming property within a large temperature range (–50° C up to +130° C) is of importance.

Above all, dispersions based on DYFLOR L 90 may be processed on coil coating lines. But they are just as well suited for the spray coating. Metals, ceramics and other materials are suitable substrata, as long as they endure a heat treatment of about 250° C during the stoving process. The lacquer films may range from a semi gloss to matt as desired; they are dirt repellent and may be pigmented in many colour shades.

DYFLOR L 90 is being applied where the conventional coating will give an insufficient protection against corrosion.

Main Fields of Application:
- Building elements in an aggressive industrial atmosphere
- sidings, roofings and other structural parts on the architectural field
- high quality coatings for corrosion protection for machine parts which are applied to extremely aggressive media.

Technical Data:
(on pre-treated aluminium)

Gloss (Gardner)	about 70%
Pencil hardness	F – H
Impact test	80 inch · lbs
T-bend-test	T 0
Salt spray test	more than 1000 hours, unaffected

These data are in accordance with the ECCA Test Specifications.

For protection against corrosion even at high temperatures:

DYNASIL® 40

Ethylpolysilicate. Rawmaterial for zinc dust paints.

DYNASIL® H 400/H 400 LL* H 450/H 450 LL* H 500/H 500 LL*

* Binding agents on the basis of silicate ester with a shelf life of more than one year.

DYNASIL® EFP

Binding agent on the basis of silicate ester having an increased flash point (34° C/93° F)

DYNASIL® Li 20

DYNASIL Li 20 is a modified, specially stabilized lithium silicate. It serves as a binder for coatings, mainly for zinc-rich corrosion protective paintings. It doesn't contain any organic solvents, is dilutable with water and noncombustible.

Wherever is depends on a corrosion protection of iron and steel – even at temperatures up to 400° C – zinc dust paints with DYNASIL as a binder excellently satisfy expectations. Zinc dust paints on the basis of DYNASIL are particularly suited for industrial processing. They can be welded over, they can be applied either by air or airless spraying, brush or roller painting, and can be used as a one-coat layer or priming. They may be recoated with all conventional colour systems.

Main Fields of Application:
- shipbuilding
- industrial plant construction
- power plant construction
- bridge building
- large steel constructions
- building elements on a large scale production basis

Test results of zinc dust coatings on the basis of DYNASIL:
Salt spray test (DIN 50021) unaffected after 1000 hours.
Adhesive strength, grating (DIN 53151) Grating value 0
Temperature resistance:
Permanent load max. 400° C.
Short term load max. 600° C.

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CHEMICALS

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We would like to have detailed information on the following subjects:

☐ DYNAPOL® P
☐ DYFLOR® 2000 WS
☐ DYFLOR® 2000 ES
☐ DYNAPOL® L
☐ DYNAPOL® H
☐ DYFLOR® L 90
☐ DYNASIL® 40
☐ DYNASIL® H
☐ DYNASIL® EFP
☐ DYNASIL® Li 20

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Please send us

☐ the leaflet "Basic and Auxiliary Materials for the Surface Treatment Technology".

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☐ DYNAPOL® L
☐ DYNAPOL® H
☐ DYFLOR® L 90
☐ DYNASIL® 40
☐ DYNASIL® H
☐ DYNASIL® EFP
☐ DYNASIL® Li 20

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☐ the leaflet "Basic and Auxiliary Materials for the Surface Treatment Technology".

Other tried and tested products for the surface protection:

Electrically insulating lacquer resins
ICDAL® TE/TI
Ester and esterimide resins. Wire lacquer resins for the production of insulated conductors, resistant to permanent temperature loads. Resins for insulating impregnating lacquers.

Titanic acid esters
Reactive cross-linking agents for paint and lacquer resins, binders for high temperature lacquers.

Vandyl alcoholates
Catalysts for the polyurethane coatings with variable adjustment of the setting times.

Nitrocellulose
COLLODION COTTON
PLASTICIZED NITROCELLULOSE

Plasticizers
WITAMOL®
for different lacquer applications.
Special plasticizer heat-sealing and physiologically unobjectionable aluminium coatings.

Chlorinated paraffins
WITACLOR®
To get flame resistant lacquers, for the production of facade paints.

Chlorophenoles
WITOPHEN®
Additive to oil and dispersion paints in order to prevent the formation of fungi and the decomposition during storage. For the production of fungus-resistant wall paints.

Chlorinated hydrocarbons
DYNATRI® LQ, trichloroethylene
Solvent for paint and lacquer resins for hot and cold dip coating processes.
For the de-greasing of metals:
DYNAPER® perchloroethylene (tetrachloro ethylene)
DYNATRI® trichloroethylene
MECLORAN® 1,1,1-trichloroethane
MECLORAN® D 1,1,1-trichloroethane (vapor type)
For the de-greasing of light metals:
DYNATRI® LM trichloroethylene

Special hard aggregates
TROCOR®
Electro-corundum as an aggregate for high-stress concrete pavings and for abrasion coatings on the basis of synthetic resin.

Blast material, not giving cause to silicosis
REWAGIT®
Standard corundum, economical is use, low dust content, rust proof. To clean and roughen material surfaces.

Please, get yourself informed about our extensive delivery program. Ask for our leaflet "Basic and Auxiliary Materials for the Surface Treatment Technology".
Please contact us if you want detailed information for the above mentioned products or if you have problems. We shall be pleased to help you with our knowledge and experience.

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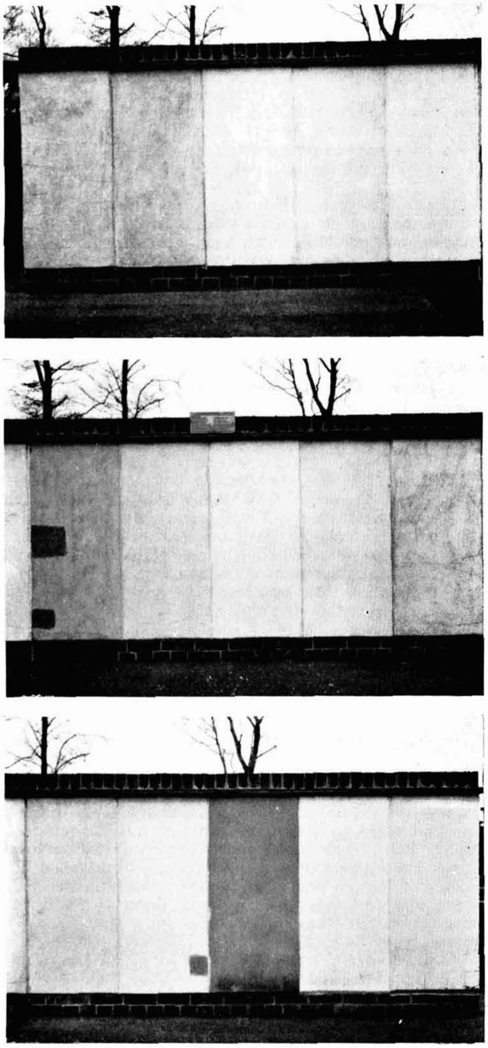

Fig. 9. Test wall for masonry paints on rendering. Garston, eight years

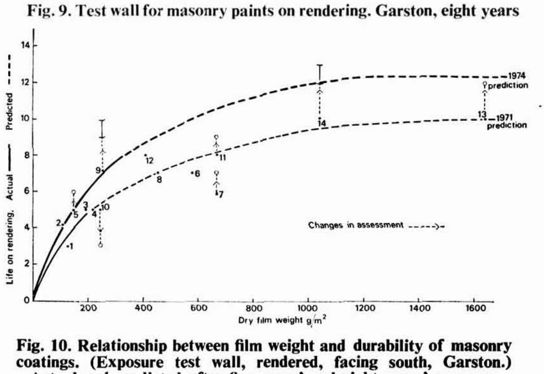

Fig. 10. Relationship between film weight and durability of masonry coatings. (Exposure test wall, rendered, facing south, Garston.) Actual and predicted after five years' and eight years' exposure

In the previous paper[6], an attempt was made to compare these coatings on the basis of their cost in use over a 50-year period. Since then, the rate of interest required to discount the future maintenance costs has increased and thereby made even less favourable the cost/performance of the thickest coatings, which have the longest life; however, there are other reasons for utilising this type of coating, including the excellent appearance it maintains, the possible value of less disruption caused by maintenance work, and the existence of a written guarantee. Equally, where maximum life is essential it may be necessary to accept higher cost, for instance on high rise and prestige buildings and for concrete bridges and abutments, where disruption of traffic must be minimised. In the latter application, dirt resistance is a particularly important factor, making the balance of properties even more critical.

Nevertheless, a wider acceptance of coatings on concrete structures and many other buildings seems to await the certainty of a life of more than 10 years in fulfilment of an implied promise, or better still an acceptable form of guarantee. The earlier work described here has, therefore, been followed by further comparative trials in other practical situations.

Conclusion

The authors have attempted to give a balanced picture of the role of surface coatings in building, whilst illustrating the challenge to their continued use and improvement, which is continually observed.

Areas of possible improvements in contemporary types of coatings have been suggested, and standard specifications are seen as a requirement to define expected levels of performance. Improvement in the usage of paint is equally necessary and here the biggest single step is the transfer of the painting operation from site to factory wherever possible. On site, higher productivity methods need to be coupled with higher standards of acceptance for the finished work. Improved forms of warranty, or continuing responsibility for maintenance, could also lead to greater satisfaction with paint performance.

Acknowledgment

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Discussion at Scarborough Conference

Mr C. E. Hoey said that reference was made in the paper to the use of thin acrylic coatings—presumably thermosetting—on aluminium. In his experience, the use of thin uninhibited coatings on aluminium was a recipe for filiform corrosion which, whilst structurally unimportant, was disfiguring.

Mr Whiteley replied that they had not observed this on their building and they had not received any recent complaints of under-film corrosion, whether filiform or not. Certain of the suppliers of windows using these acrylic coatings employed a primer coating, whereas the systems he had indicated did not incorporate a primer. Nevertheless, it did not appear to be a common complaint.

Mr F. G. Dunkley asked the author to indicate what he had in mind when speaking of "suitable primers" for galvanised windows or galvanised steel and whether he had any experience in this regard or mordants and in particular "T wash".

In addition, he wondered whether the author could indicate the maximum humidity and minimum temperature for the satisfactory performance of etch primers on galvanised surfaces.

Mr Whiteley answered that they expected to get satisfactory performance from either calcium plumbate or etch primers. They did not do so always, but these were what would be regarded as "suitable". The difficulty nowadays was that many people wished completely to avoid lead-containing pigments and they were, therefore, looking for any primers which had adequate adhesion to galvanised steel and which were suitable for on-site application—such coatings could be termed "suitable".

Mr Rothwell commented that originally mordants were thought to be undesirable and it was considered better to use either etch priming or some primer capable of coping with the original corrosion on the zinc. The BRS had recently begun to look again at improving the adhesion of paint systems on zinc, not necessarily using solvent-based coatings, and including the investigation of a variety of mordants.

He could not yet give any results from this work except to reiterate Mr Whiteley's earlier point that satisfactory adhesion was not always obtained with either calcium plumbate or etch primers, and this particularly applied to etch primers on the building site. This investigation included a study of maximum humidity and minimum temperature conditions. One of the things which had emerged from this, rather surprisingly, was that underfilm corrosion of the zinc could still occur even when using supposedly effective primers.

Mr Whiteley added that Mr Dunkley would know that weathering of zinc was an accepted method of obtaining good adhesion and the difficulty of this was the presence of corrosion products on the zinc surface, which might not be washed off—particularly at the building site. One of the main factors against the use of etch primers was on weathered zinc with corrosion products present.

Mr D. A. Bayliss remarked that the authors expressed the opinion that precoated metal sheets could be used for external wall cladding with reasonable confidence. Unfortunately, this has not been the case with the CEGB. The main problem had been with PVCl organosols, plastisols and laminates used at sunny locations in the south of England; particularly where the atmosphere was clean from industrial dirt, but close to the sea (in other words, a typical power station site). At the CEGB cladding exposure site at Dungeness and at new power stations in the south, PVCl based coatings had, without exception, failed to some degree by one or all of the following: change of colour to black or brown, loss of adhesion, corrosion, or blistering of the substrate.

Mr Whiteley said that he was aware of the CEGB's unfortunate experience with these products. Mr Bayliss was using a test site which was particularly severe and his buildings were highly exposed and had special requirements with regard to colour matching and so forth. He hoped there had been some improvement, although it had to be stated that in spite of their failures, these materials very often performed better than the materials which preceded them.

Mr E. L. French was very interested in the slides which had been shown of a brick wall which had been rendered and coated and the reverse side which had not been rendered. A possible mode of failure might be due to the migration of moisture through the semi-permeable coating, causing stress within the coating and subsequent premature failure.

Mr Whiteley replied that certainly this was happening. The failures were common to almost every type of coating, however, regardless of type or permeability. It was probably true that slight movement of moisture was the reason for failure, but it was particularly severe on that substrate. It was interesting that, whilst emulsion paints failed more quickly on the rendered side than did solvent thinned paints of low film thickness, they performed better on the brick in general. One of the reasons was simply that the solvent thinned paint tended to flow away from fissures in the brick, whereas the emulsion paints, being of a "stodgy" consistency, tended to fill the fissures rather better.

Mr Rothwell added that the worst failures had been on the more brittle and, in this case, the more permeable coatings.

Next month's issue

The Honorary Editor has accepted the following papers for publication, and they are expected to appear in the January 1976 issue of the *Journal:*

Ecological coatings: the theory and the reality *by A. G. North, J. L. Orpwood and R. Little*

Preconstruction primers *by C. A. Grey, L. A. Hill and F. Marson*

Some factors affecting the water absorption of films from synthetic latices. Part II Particle size and latex stability *by J. Snuparek*

Information Received

Akzo additive for non-gassing cure of vinyl ester resins

The Akzo Group has recently filed a patent for the curing of vinyl ester resins by a ketone peroxide formulation and cobalt accelerator without the evolution of gas which can otherwise take a considerable time to subside.

There are other possible curing systems, but each has its disadvantages, and Akzo claims that the addition of between 0.5 and 1 per cent of maleic anhydride to the normal methyl-ethyl-ketone peroxide/cobalt accelerator curing system will eliminate this undesirable side effect.

Analytical services

Applied Research Laboratories Ltd, Contract Analytical Services, has opened a laboratory at its Luton plant equipped with the latest instrumentation for the analysis of organic and inorganic solutions, metals, powders and minerals. The new analytical service is intended to apply to smaller companies who cannot raise the necessary capital funds or justify the purchase of expensive large scientific instruments. A.R.L. has issued a leaflet "Contract analytical services" dealing with the various analytical techniques available.

New plant for Silberline

The Silberline Manufacturing Co., USA, has opened a new manufacturing plant on the Banbeath Industrial Estate, Leven, Fife, Scotland.

The "Sparkle Silver" range of aluminium pastes will be manufactured for automotive and industrial paint finishes in Leven, and will continue to be marketed through the company's established chain of selling agents throughout Europe. In addition, it is intended that local manufacture will guarantee customers an even faster supply of pastes and all the advantages of a full back-up service from technical specialists based in Scotland.

"Sparkle Silver 3500" aluminium paste is the first in full production. This product, whilst perhaps best known for its use in the metal automotive finishes in Europe, is also widely used in the United States for a diverse range of products with metallic finishes applied by spray coil coating or aerosol.

Change of name

Cowan Colours Ltd is the new name of Cowan Brothers (Stratford) Ltd. This change of title has resulted from a continuing programme of closer integration of Cowan's pigment manufacturing activities with those of Blythe Colours Ltd, the major colour-producing company of the Johnson Matthey Group.

Cole Chemicals' agent for Dercolyte

Cole Chemicals Ltd has announced that it is now marketing in the UK and Eire the "Dercolyte" range of α- and β-pinene resins manufactured by Societe Polyterpene Resins Terpeniques, a subsidiary of Dérivés Résiniques et Terpéniques, Dax, France.

Results of laboratory programme at Bradite

Bradite Ltd of Bethesda, Gwynedd, North Wales, has recently completed an extensive laboratory programme, covering numerous interrelated formulations, which the company feels will be of interest to hollow-ware manufacturers as non-stick finishes and to a very much wider range of engineering concerns by virtue of the products' high heat stability and chemical resistance properties.

New products

Surface roughness measurement

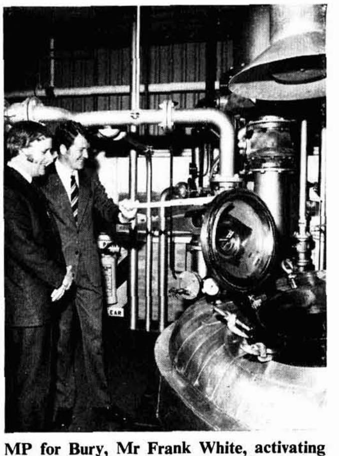
An instrument to determine whether surfaces to be painted meet the requirements of the painting specification has been patented by the British Steel Corporation. The instrument, named the "Roughtector," was designed and developed by the Corporation with the assistance of Elcometer Instruments Ltd, and this latter organisation has been licensed to manufacture and market the instrument on a world-wide basis.

A "Roughtector" model 181 instrument being used to measure the surface roughness of the outside walls of a steel cabin after it has been cleaned by sand blasting

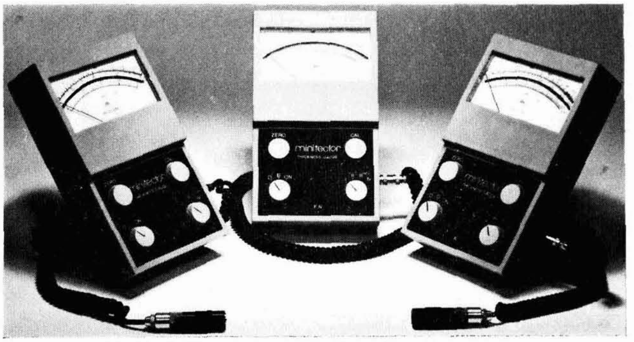
The Roughtector displays a profile of the surface under inspection on a ground glass screen incorporated in the viewing aperture at the rear of the instrument, to give either a visual indication or permanent record (photograph) of the surface roughness in

Donald Macpherson opens a new resin production unit at the Group's main site in Bury, Lancashire

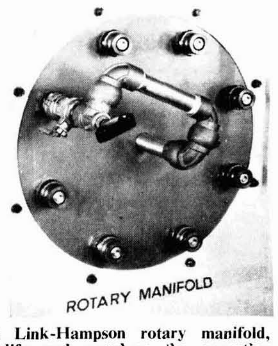
The new resin production unit of the Donald Macpherson Group at the company's main site in Bury, Lancashire. This new facility, which cost in excess of £500 000, is claimed to be one of the most modern resin production units in Europe, and is capable of meeting all the Group's resin requirements for many years to come. Unlike the previous resin plant, which was destroyed by fire, this unit is to a large extent automated and is capable of considerable expansion of production capacity when the need arises



MP for Bury, Mr Frank White, activating the switch which controls the main reactor, watched by executive chairman Mr Rex Chester, Donald Macpherson Group



The "Minitector Model 150" modular range of coating thickness measuring instruments available from Elcometer Instruments Ltd. The three instruments in the range are for measuring the thicknesses of non-magnetic coatings on magnetic substrates ('F' type instrument), electrically non-conductive coatings on non-ferrous bases ('N' type), and coatings on both ferrous and non-ferrous substrates ('FN' type).



The Link-Hampson rotary manifold, to simplify and speed-up the operation of mixing chemicals and paints, or filling bulk containers. Apparatus is based on the OPW Kamvalok self-sealing coupling and swivel joints

terms of peak-to-valley distances between the limits of 12.5 and 200 µm. The image light source is activated by a micro-switch built into the front face of the instrument, and is powered by two 6-volt rechargeable batteries mounted in a leather carrying case.

New pigments from BASF

Paliogen Red Violet 5010 is a new perylene pigment with high fastness properties, which has been placed on the market by BASF. Exceptionally high colour strength and the outstanding fastness to light and weather characterise the product, and principal applications include finishes to give a metallic effect and combinations with inorganic colour pigments.

Paliotol Yellow 1770 is a pigment which has established itself for medium and reduced yellow and heavy metal-free yellow formulations. The product has now been supplemented by another yellow pigment with the same chemical composition. This new BASF product is *Paliotol Yellow 1771*.

The new product is 20 per cent stronger and less transparent than Paliotol Yellow 1770. The gloss retention, in particular, has been improved considerably. Like Paliotol Yellow 1770, *Paliotol Yellow 1771* can be applied in all common binders for paints without trouble.

Literature

New brochure on Hygrotherm synthetic resin plant

A new full-colour brochure from Hygrotherm Engineering deals with the company's design and supply of all sizes of plant for the manufacture of synthetic resins. Hygrotherm has had 25 years' experience in this field and there are now more than 200 Hygrotherm installations operating in 20 countries.

Hygrotherm has designed plant employing all types of heating methods, including steam and direct firing, but the brochure details the advantages of mains frequency electric induction heating and indirect thermal fluid heating, pointing out that the choice is likely to be based largely on actual and forecast costs of fuel.

Test methods for paints

Mr D. A. Bayliss has kindly sent us a copy of his summary of a recent ISO meeting in Zurich which discussed international standards on test methods for paints and varnishes. Further information may be obtained from Mr Bayliss at the Central Electricity Generating Board, Suffolk Road, Gravesend, Kent.

Conferences and symposia

SLF Congress

The eighth SLF Congress will be held at Congress Hotel Kalastajatorppa, Hensinki, Finland from 29 September to 1 October 1976. The technical programme will consist of technical sessions on the first two days, with 12 papers being presented, and visits to paint and raw material manufacturers on the third day. There will also be a social programme, and shopping and sight-seeing activities will be arranged for the ladies.

Color '77 Congress

The third Congress of the International Colour Association, "Color '77," will be held on the campus of Rensselaer Polytechnic Institute in Troy, New York, USA, from 10 to 15 July 1977 under the sponsorship of the Inter-Society Color Council and the Canadian Society for Color. The programme will consist of invited survey lectures on various aspects of colour and short papers contributed by specialists in the field.

Ernest and Dora Bader were joined by family, friends and Scott Bader staff on 9 October to celebrate their 60th wedding anniversary. On behalf of the staff, purchasing manager Mr Geoffrey Green (extreme right) presented the couple with a radio cassette recorder. Ernest Bader is Founder President of Scott Bader Commonwealth Ltd and Founder and Past-Chairman of Scott Bader Co. Ltd.


M100

London

North Sea oil and gas

The first meeting of the session was held on 25 September 1975 at the Imperial College of Science and Technology. Mr J. T. Tooke-Kirby presented the Chairman's evening lecture entitled "North Sea oil and gas—its effect on industry".

Mr Tooke-Kirby opened by explaining that it was a tradition of the Section for the Chairman to present a paper during his term of office and that this was his contribution. The talk was drawn from the speaker's own knowledge of North Sea exploration.

The exploration of the North Sea was being carried out against a background of rising energy costs and dwindling energy reserves. Supply shortages were now accepted as "facts of life" by the Chemical and Surface Coating Industries, which relied heavily on oil products.

The history of North Sea oil exploration dated back to 1965, when oil was discovered not in the North Sea, but off the Dorset coast. In 1969 the first sizable North Sea well was discovered and rapid development had taken place since that time.

Large deposits of natural gas had also been located off the coast of East Anglia, and these were already being piped into the national network.

Mr Tooke-Kirby went on to discuss the multi-national aspect of exploration. There were 240 companies involved in the North Sea: 75 were British, 100 American and the remainder either Dutch, French or German. Costs were high and already some companies had stopped exploration.

Much off-shore technology was American, but a major part of the construction and allied services were carried out by UK companies. This was illustrated by a film entitled "Location North Sea," which dealt with the floating out and location of a drilling platform in the Forties field.

North Sea oil was not suitable for producing certain end-products, such as lubricating oils, it but was suitable for mixing with high sulfur content oils, which would otherwise be prohibitively expensive to refine.

In closing, Mr Tooke-Kirby stated that the UK industry needed fuel supplies from the North Sea, and it was already using these. The supplies would last about thirty years, and it was vital to continue the search for new energy sources. Shortly, Great Britain would be one of the ten largest oil producers in the world, with all the advantages and responsibilities which this entailed.

A vote of thanks to the speaker was proposed by Mr R. H. E. Munn.

B.A.C.

Notes and News

Manchester Section

FIFTIETH ANNIVERSARY CELEBRATIONS

In November, the Manchester Section celebrated its Golden Jubilee. Manchester was the first local Section of OCCA to be formed and to celebrate its 50th anniversary the Section held a Foundation Dinner at the Midland Hotel, Manchester on Thursday 6 November 1975. The Section's annual Dinner Dance was held at the Piccadilly Hotel, Manchester on 24 October and a Ladies' Lecture and Supper Evening took place on 13 November. Reports on these events will be appearing in the *Journal* in due course, but in the meantime details are given below of the special symposium to be organised by the Section.

Films—formation and behaviour

The Section, as part of its fiftieth anniversary celebrations, will hold an international symposium on the subject "Films—formation and behaviour" at the University of Manchester Institute of Science and Technology on 6 and 7 April 1976.

The authors of the papers to be presented are international experts in their fields. A very wide range of subjects will be covered, including discussions on various aspects of film structure, types of film formation, methods of deposition, the effect of film components, the nature of substrates, the effect of pigment dispersion and the influence of drier catalysts. The role played by the introduction of new technologies will also be considered.

Details of the papers to be given are:

1. Keynote Address—*Professor R. K. Penny (Liverpool University)*
2. Molecular structure and film properties of alkyd resins—*Dr G. Walz (Hoechst AG)*
3. Why determine internal stresses in coating films?—*A. Saarnak (Scandinavian Paint and Printing Ink Research Institute)*
4. The use of gas discharge etching for accurately and easily measuring the clear layer on paint films—*J. L. Prosser (Paint Research Association)*
5. Electro-induced polymer coatings—*J. D. Scantlebury, V. Ashworth and B. Yap (UMIST)*
6. Preparation and properties of paint films with special morphological structures—*Dr W. Funke, (F.P.L.)*
7. Thermal cure of acrylic finishes in a laboratory gradient stove —*Dr J. F. A. Hazenberg, (Verf. TNO)*
8. Study of film formation by photographic means—*F. Williamson (British Titan Products)*
9. The influence of electrostatic deposition methods on the properties of surface films—*Professor A. W. Bright (University of Southampton)*
10. Comparison of the effects of resin composition and pigments on the anti-corrosive properties of powder coatings—*A. V. D. Werff (Scado)*
11. Effects of wet time on accelerated outdoor exposures—*J. L. Scott (Desert Sunshine Exposure Tests)*
12. The influence of aluminium surface structure upon the performance of an applied resin layer—*E. W. Garnish (CIBA-GEIGY)*
13. The role of new technologies in coating for the packaging industry—*A. J. Newbould (International Pinchin Johnson)*
14. Theoretical aspects of and practical experience in the use of reducible coatings—*E. C. Wehner (Byk-Mallinckrodt)*
15. The effect of oxidative and co-ordination drier systems on film properties—*W. K. H. Lakin and D. J. Love (Manchem)*
16. Effect of pigment dispersion and application methods on film properties—*Dr W. Carr (CIBA-GEIGY)*
17. The influence of plasticiser content on the mechanical water-vapour permeability and adhesion properties of chlorinated rubber films—*Dr W. D. Ferguson (ICI)*

Further information and application forms are available from Mr A. C. Jolly, Synthetic Resins Ltd, Edwards Lane, Speke, Liverpool L24 9HR (Tel. 051-486 3922). Application forms are also included in this issue of the *Journal*.

OCCA-28 Exhibition

Alexandra Palace, London. 23-26 March 1976

The continuous dialogue between suppliers and manufacturers in the surface coating industries

The economic situation of the chemical industry in western Europe

In a recent speech by Mr John Townsend, President of Counseil Europeen des Federations de l'Industrie Chimique (CEFIC), the European Confederation of Chemical Industry Associations, attention was drawn to the fact that the present recession was deeper and more prolonged than any since the 'thirties, but that recovery in the United States and Japan was now under way and that a number of European countries had recently introduced reinflationary policies, notably France and to a lesser degree Germany.

It was pointed out that the European chemical industry made a major contribution to the balance of European trade. It competed heavily among its own members, but also had to be able to compete with other powerful chemical industries, particularly of the United States and Japan. Conditions had to be created in Europe where all chemical manufacturers would compete with these overseas industries, as well as among themselves.

The annual Technical Exhibition of the Oil & Colour Chemists' Association is the established forum for display and discussion in the surface coatings industries and, by regularly attracting exhibitors and visitors from countries all over the world, has provided an unparalleled opportunity for communication within the industry and the opening of new markets throughout the world.

The next Exhibition, "OCCA-28," will be held in London from 23 to 26 March 1976. The trend of economic recovery in the United States during the last few months is reflected in the number of applications to exhibit which have already been received from that country.

The Exhibition, which is known as the international forum for technical display and discussion in the surface coatings industries, is the most important annual event of its kind in the industries and it offers an unparalleled opportunity for a continuous dialogue on technical advances and problems between suppliers and manufacturers in an informal atmosphere.

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

In recent years the Exhibitions have been visited annually by representatives from 50 countries and bringing all these interested parties together at a regular meeting is in itself invaluable when exhibitors consider the cost in time and travel which would be entailed in making personal contact with these visitors each year.

Information in foreign languages

As in previous years, the Association will be circulating information leaflets in six languages, which will contain application forms for those wishing to purchase copies of the *Official Guide* and season admission tickets before the Exhibition.

"Official Guide"

This unique publication will contain descriptions of all exhibits and advertising space is available both to exhibitors and those organisations not able to show at the 1976 Exhibition. As in previous years, the *Official Guide* will be published several weeks in advance of the Exhibition so that intending visitors can obtain copies and plan their itineraries.

For the 1975 Exhibition, it was decided that a small charge should be made both for the *Official Guide* and for season admission tickets to the Exhibition. This policy undoubtedly prevented casual visitors who might otherwise be attracted to exhibitions for which no admission charge was made and who gathered quantities of technical literature from the stands. The innovation was welcomed by many exhibitors and in no way acted as a deterrent to visitors to this Exhibition. It is envisaged that a similar charge will be made for the *Official Guide* to OCCA-28.

Each Member of the Association, at home and abroad, will be sent a copy of the "Official Guide" and free season admission ticket.

As for the 1976 Exhibition, copies of the *Official Guide* and season admission tickets will be available several weeks in advance of the Exhibition (*pre-payment only*) from the Association's office and they will also be available for purchase at the entrance to the Exhibition Hall.

Full details of advertising in this publication, the basic rates for which are the same as for the *Journal*, can be obtained from the Association's offices.

Report of Council Reunion Dinner

A Reunion Dinner of past and present members of Council was held on Wednesday 15 October. On this occasion the venue was the Rugby Club, Hallam Street, London W1. There were 41 members present, including four Past-Presidents and three Past-Honorary Officers. The Dinner followed a Council meeting held earlier in the afternoon.

The President, Mr A. T. S. Rudram, gave the Address of Welcome. He explained he had taken over the presidency from Mr Silver only a few months ago at the Association's Conference in Scarborough, but it was traditional on the occasion of a Council Reunion Dinner to review the year since the last Reunion Dinner and this he would endeavour to do.

The Twenty-Seventh Technical Exhibition, OCCA-XXVII, had been held at Olympia from 22 to 25 April and this had proved a great success. It was of particular credit to the Association that despite four days being lost from the "build up" period due to an industrial dispute in the exhibition industry, the Exhibition had opened only three hours late and was, in fact, one of the very few Exhibitions during that month to open on the day announced.

The Association's Biennial Conference had been held in Scarborough in June and despite a small decrease in total attendance, had proved to be one of the most successful Conferences organised by the Association, with a total of 17 papers being presented in five technical sessions: this was the highest number of papers ever presented at an Association Conference and there had been a very high attendance at all the lectures.

One very notable event was the fiftieth anniversary of the Manchester Section, the first Section of the Association to be founded. It was Mr Rudram's privilege and pleasure to present to Mr H. G. Clayton on behalf of the Manchester Section a commemorative scroll with the following wording:

The Council of the Association sends greetings to the Manchester Section, the first Section of the Association to be founded, in this year which marks the fiftieth Anniversary of its foundation and expresses its sincere gratitude to all Chairmen, Hon. Officers, Committee Members and all other members who have served the Section for the way in which it has at all times so fostered the growth of Association activities that the Council rightly takes pride in the many past achievements of the Section and looks forward in confidence to its continued contribution to the Association's future.

It also recalls with pleasure the service rendered at the Council by many members whilst attached to the Section, four of them having served as Presidents of the Association.

A.T.S. Rudram *President* — *R. H. Hamblin* *Director and Secretary*

Mr Clayton thanked Mr Rudram and said that the Manchester Section would look forward to welcoming the President to its fiftieth anniversary foundation dinner in November.

The Jordan Award for 1974 had been presented at the Scarborough Conference and on this occasion the Award had been made jointly to Mr J. G. Balfour and Dr M. J. Hird for their paper on the flocculation on titanium dioxide pigments.

Mr Rudram then stressed the international character of the Association. In particular, a new Branch of the London Section had been formed in Ontario, Canada. This Branch had already made great progress since its inauguration in May, and the London Section and all involved in this venture were to be congratulated. There were, of course, Sections already established in New Zealand and South Africa and it was especially pleasing to welcome to the Dinner Mr L. F. Saunders, a Past-Chairman of the South African Section and currently a Vice-President of the Association. Mr Saunders thanked Mr Rudram and those present for the welcome extended to him and he passed on best wishes to the Association from the members in South Africa.

A very pleasant duty on this occasion was to present Mr A. R. H. Tawn with a gift as a token of Council's appreciation for his services as an Hon. Officer of the Association. Mr Tawn had, in fact, held two posts as Hon. Officer, first as Hon. Editor of the Association's *Journal* and (for the last six years) as Hon. Research and Development Officer. These were both posts which involved much time and effort and Mr Tawn deserved an especially warm vote of thanks.

The Professional Grade had continued to make progress. Over 400 members had now successfully applied for admission to one of the three grades, and the qualification was becoming increasingly recognised and respected both in industry and by technical training colleges.

The evening concluded with short speeches from the four Past-Presidents present and from other members of the assembled company, after which there was the opportunity to meet old friends and renew acquaintances.

Report of Council Meeting

A meeting of Council was held at the Great Northern Hotel, London N1, on 15 October when 28 members of Council were present. The President, Mr A. T. S. Rudram, took the Chair. He extended a welcome to Mr L. F. Saunders, Vice-President from South Africa, and asked him to convey the best wishes of Council to the South African Section on his return. Mr Saunders conveyed the best wishes of the South African Section to the Council.

It was reported that Mr F. Sowerbutts, President 1967-1969, was in hospital and Council asked that very best wishes be sent to him.

The following appointments were noted and/or approved:

1. Mr T. Entwistle as the South African Section's Representative on Council in place of Mr Schollick who had returned to South Africa.
2. Mr J. Bravey to serve on the Technical Education Committee in place of Mr N. J. P. Buchanan.
3. Mr M. Pettit to serve on BSI Committee PVC/20—Calcium Plumbate Priming Paints, in succession to Mr A. G. Walker.
4. Mr D. E. Hopper to serve on the BSI Committee PVC/25—Organic Finishes for Aluminium Windows, in succession to Dr J. B. Ley.
5. Mr N. Locke to serve on the Technical Training Board for the Printing Ink Industry in succession to Mr A. R. H. Tawn, who would be serving on that Committee as a representative of Society of British Printing Ink Manufacturers.

Council was pleased to learn that arrangements had been made for papers to be presented on behalf of the Association, both at the Los Angeles Convention of the Federation of Societies for Coatings Technology in October 1975, by Mr J. H. Sinclair on "Recent developments in epoxy resin-based coatings", and at the FATIPEC Congress in Cannes in May 1976, by Mr J. C. Bax on "Formulation of gloss emulsion paints."

It was reported that new arrangements had been made for the 1977 biennial Conference which would assemble on the afternoon of Thursday 16 June and disperse on the morning of Sunday 19 June.

The arrangements were agreed for the holding of the Association's Dinner Dance at the Savoy Hotel, London WC2 on 14 May 1976.

Council received the report of the Finance Committee Meeting and considered the Accounts for the half-year which had been presented by the Committee, together with estimates for the second half of the year.

It was reported that the names of members in arrears with their 1975 subscriptions had been removed from the Register.

The Honorary Editor reported on the progress made for the revision of the "Introduction to Paint Technology" and Part IV of the Paint Technology Manuals.

Council was pleased to learn that the total of those admitted to the Professional Grade now exceeded 400.

The Council considered the charge to be made to members of OCCA Australia for the *Journal* in 1976, since the Australian Federal Committee had not accepted the capitation fee of £6 each to cover all members of OCCA Australia. As the Australian Federal Committee was unable to provide figures to show the number of its members who would wish to receive the *Journal* on an optional basis, the Council decided that it would be able to offer the preferential rate applicable to members of the Federation of Societies for Coating Technology, who took the *Journal* on the exchange basis, ie £12 each.

Details concerning Section activities were received from Section Chairmen and it was noted with pleasure that the Sections in South Africa and New Zealand wished to implement the suggestion of Divisions in their countries.

It was also reported that the Ontario Branch was making good progress.

The Council learnt with interest the arrangements made to celebrate the 50th Anniversary of the first Section, Manchester, and arrangements had been made to present a commemorative address on behalf of the Council to the Chairman of the Manchester Section at the Reunion Dinner.

Mr Saunders reported on the activities of the South African Section.

It was further reported that OCCA Australia would be organising a Pacific Convention in September 1977 and it had requested that information should be sent to Chairmen of the UK Sections and leaflets to members of the General Overseas Section. It was agreed to help in this way and to include advertisements in the *Journal* from time to time without charge.

There being no other business, the President thanked members for their attendance and declared the meeting closed at 3.28 p.m.

West Riding Section

Golf tournament

The annual golf tournament, which includes competition for the OCCA Golf Trophy and the West Riding Chairman's Trophy, took on a new lease of life on this occasion.

The national competition attracted a field of 33 entries which, together with 19 visitors competing for a special prize, brought a swinging occasion to the usually sedate Yorkshire countryside.

OCCA Golf Trophy—winners

Mr Brian Falder with the OCCA Cup

Mr B. Falder (Manchester Section) won with 37 points, gaining the principle trophy on the second-half total from Mr P. Kerr (Thames Valley Section) who returned the same overall score. Mr J. Dunderdale gained 3rd prize with 35 points on a narrow second-half advantage over Mr S. Sharp, also with 35 points.

West Riding Chairman's Trophy

After a lapse of only two years, Mr R. Hardy again claimed his undisputed right to this trophy by returning a winning card (33 points). This was the fifth occasion upon which he has won the competition.

Second was Mr N. Cochrane, and there was a tie for third place between Mr L. H. Silver and Mr C. Butler.

The members' guests provided very keen competition for the Visitors Tankard and Prize, and it transpired that the youngest competitor in the field, Malcolm Tennant (17 years, and son of a Midlands Section member) won this event with a score of 34 points from eight handicap. Second was Mr K. Knellors with 33 points, and third Mr R. W. Kershaw, also with 33 points but losing on the last nine holes.

Birdie 2s were recorded by Mr J. A. Burns, Mr J. L. Everett, Mr K. Knellors Mr J. M. Parker, Mr H. L. Richardson and Mr J. Seddon, and these were suitably rewarded with two-ball prizes.

The Section's appreciation is extended to the following companies, who created that added incentive by providing an

Mr Ron Hardy holding the West Riding Trophy

excellent variety of prizes: BP Chemicals Int., BASF (UK) Ltd, English China Clays Ltd, R. W. Greeff & Co. Ltd, Silver Paint & Lacquer Co. Ltd, Synthetic Resins Ltd, Tioxide International Ltd. Fifty members and visitors eventually sat down to a well-deserved beef dinner. Mr P. Bartrum, Chairman of the Section, thanked those associated with the success of this meeting, including a vote of thanks to Mr R. S. N. Brown, Captain of Pannal GC, for allowing his Club's very fine course to be used for the tournament. Presentation of the prizes concluded the proceedings.

Optional Professional Grade for Ordinary Members

Admission

As the result of a viva-voce examination, the following Ordinary Members were admitted as Licentiates in the Professional Grade on 15 October 1975:

Michael Ambrose Rogers*—*General Overseas Section: Trinidad*

Olatunji Pekun Sawyerr—*General Overseas Section: Nigeria*

(**To date from July 1976 to satisfy regulation A.1*)

Both candidates attended courses at the East Ham College of Technology, where they each obtained a Diploma in Coatings Technology, following which they submitted dissertations to the Professional Grade Committee. They have taken up appointments overseas.

The subject chosen by Mr Rogers was "Corrosion and the use of zinc rich primers for marine/industrial environment", and Mr Sawyerr's dissertation was entitled "Some factors affecting the throwing power and corrosion resistance of electrodeposited paints".

The attention of senior members of the Association is particularly drawn to the Licentiate Grade and they are asked to encourage younger technical personnel to take advantage of this important Association activity. Several Colleges are now willing to help suitable candidates with the preparation of dissertations, and a list of Colleges was given on page 324 of the August issue of the *Journal.*

Anyone who had allowed his membership of the Association to lapse and now desires to rejoin the Association is reminded that previous service as an Ordinary member (or Registered Student) can be counted towards the qualifying period of membership set out in the regulations.

Reprints of the regulations covering the Professional Grade are obtainable from the Association's offices, together with application forms.

List of successful candidates

As laid down in the report of the Working Party on Education, Training and Qualifications which was adopted in the institution of the Professional Grade, a list of all those Members who have entered the Grade will be published in the December issue of the *Journal* each year. The fourth such list appears below.

The Section to which the Member is attached is given in italics.

The certification fees at present are: Fellows £10.00 + VAT, Associates £6.00 + VAT, and Licentiates £3.00 + VAT. The amended regulations for admission to every grade last appeared in full in the March 1975 issue of the *Journal.*

Fellows

Anderson, George (*Scottish*)
Apperley, Thomas William James (*West Riding*)
Archer, Harold (*Manchester*)
Arnold, Michael Henry Miller (*London*)
Ashworth, Norman (*Manchester*)
Atherton, Donald (*Scottish*)
Austin, Denis Leonard (*Bristol*)
Balbi, Giorgio (*General Overseas—Italy*)
Banfield, Thomas Arthur (*London*)
Beere, Andre Jaimie (*Thames Valley*)
Bell, Sydney Hector (*London*)
Bennett, Norman Arthur (*General Overseas—Malta*)
Bester, Lawrence Percy (*South African*)
Bews, Ian Charles Randall (*London*)
Bishop, Eric Harold Abbott (*Thames Valley*)
Bohringer, Eberhard (*London*)
Boroky, Joseph Stephen (*General Overseas—Australia*)
Bourne, John Robert (*Midlands-Trent Valley Branch*)
Brooks, Leo James (*London*)

Optional Professional Grade Successful candidates—*cont'd*

Brown, Arthur Ernest Girdlestone (*London*)
Butcher, George Alfred (*Midlands*)
Butcher, Kenneth William George (*Manchester*)
Butler, Cecil (*West Riding*)
Caldwell, David George (*Wellington*)
Campbell, George Alexander (*Manchester*)
Carr, William (*Manchester*)
Carter, Eric Victor (*Midlands*)
Ceresa, Raymond John (*London*)
Chatfield, Herbert Walter (*London*)
Chessman, Clifford Reginald (*South African*)
Clarke, Harry James (*Midlands*)
Colborn, Douglas Charles (*Thames Valley*)
Cole, Derek (*General Overseas—Australia*)
Cole, Reginald Joseph (*London*)
Collier, Claude William (*Midlands-Trent Valley Branch*)
Collings, Arthur Geoffrey (*London*)
Cook, Harold Gilbert (*Manchester*)
Coupe, Raymond Richard (*London*)
Coverdale, Peter Frederic Muir (*Midlands*)
Cutter, John Outram (*London*)
Day, Keith Julyan (*London*)
Duckworth, Samuel (*Manchester*)
Duell, Arthur Albert (*Newcastle*)
Dunkley, Frederick George (*Midlands-Trent Valley Branch*)
Durrant, George Geoffrey (*Hull*)
Ellinger, Marianne Livia (*London*)
Entwistle, Thurston (*Newcastle*)
Fillingham, Thomas Alan (*Hull*)
Finn, Stanley Russell (*Hull*)
Fullard, John Edward (*South African*)
Gate, Peter Atholl Jackson (*South African*)
Gay, Philip James (*Hull*)
Gellay, Victor Peter (*London*)
Gellman, Alexander (*London*)
Gillan, James Graham (*Manchester*)
Gollop, Percy Lionel (*London*)
Gosling, Harry (*Manchester*)
Graham, Thomas (*Manchester*)
Grainger, William Alan (*Irish*)
Gray, Denis Roy (*West Riding*)
Grover, Donald Henry (*London*)
Hampton, Horace Arthur (*Manchester*)
Hawkey, John Albert Lawrence (*London*)
Hess, Manfred (*London*)
Hill, Lawrence Albert (*General Overseas—Australia*)
Hill, Roger Frederick (*Midlands*)
Hipwood, Hubert Allan (*London*)
Hodgson, Kenneth Vickerson (*Newcastle*)
Holbrow, Gordon Leonard (*London*)
Holt, Alfred Gordon (*Thames Valley*)
Hutchinson, Geoffrey Herbert (*Scottish-Eastern Branch*)
Inshaw, John Leslie (*Thames Valley*)
Jacob, Basil (*Thames Valley*)
Jolly, Anthony Charles (*Manchester*)
Keenan, Henry Wilfred (*London*)
Kinsman, Roy Granville (*South African*)
Kut, Siegmund (*London*)
Landmann, Axel Wolfgang (*London*)
Lasser, Howard Gilbert (*General Overseas—USA*)
Lewin, John Buckingham Grey (*London*)
Lewis, Fred (*Manchester*)
Ley, John Barry (*London*)
Lomas, Harold (*Ontaria Branch*)
Long, Denis Terence (*Irish*)
Lunt, Walter Richard (*West Riding*)
McKelvie, Archibald Neil (*London*)
McLean, Angus (*Scottish*)
McWilliam, Anthony (*Manchester*)
Mell, Cedric Charles (*Hull*)
Mitchell, John Edmund (*Manchester*)
Mole, Seymour Lloyd (*General Overseas—Canada*)
Moll, Ivor Stuart D'anvers (*Manchester*)
Monk, Cyril James Henry (*Thames Valley*)
Moon, William Robert (*Manchester*)
Morgans, Wilfred Morley (*London*)
Munn, Raymond Henry Edward (*London*)
Newnham, Herbert Alan (*London*)
Newton, Dennis Sydney (*London*)
Newton, Donald Stringer (*Bristol*)
Nutt, William Owen (*London*)
Oostens, Emile Elie Eugene (*General Overseas—Belgium*)
Parfitt, Geoffrey Derek (*Newcastle*)
Penfold, Arthur de Ramon (*General Overseas—Australia*)
Piggott, Kenneth Elliot (*South African*)
Polaine, Sydney Alan (*London*)
Ray, Stanley Arthur (*Midlands*)
Rechmann, Heinz (*General Overseas—Germany*)
Robinson, Ralph Sidney (*South African*)
Roe, David Edwin (*London*)
Rose, Charles (*Manchester*)
Rouse, Robert Earnshaw (*South African*)
Rubin, Wallace (*London*)
Rudram, Arthur Thomas Stephen (*London*)
Saunders, Laurence Frederick (*South African*)
Seymour, Norman Henry (*Manchester*)
Slade, Harold Aitken (*West Riding*)
Slinn, Thomas Walter (*Wellington*)
Smethurst, Jack (*Manchester*)
Smith, Francis Mark (*Manchester*)
Smith, Harry (*General Overseas—Tanzania*)
Sowerbutts, Frank (*London*)
Stoyle, Francis Wilbert (*Irish*)
Talbot, Ernest Alexander (*Thames Valley*)
Tatton, William Henry (*Thames Valley*)
Tawn, Alec Richard Hornsey (*London*)
Taylor, Cyril James Allan (*Midlands*)
Taylor, John Roberts (*Bristol*)
Taylor, Maurice David (*Wellington*)
Thorpe, William Frederick Albert (*Midlands*)
Tickle, Trevor Cyril Kenneth (*Manchester*)
Tooth, John Henry Collins (*London*)
Touchin, Herbert Roy (*Manchester*)
Tozer, Edwin John (*General Overseas—Argentina*)
Unsworth, Alfred Kenneth (*London*)
Valentine, Leslie (*London*)
Walker, Alan Gordon (*Thames Valley*)
Wall, Dennis Charles (*Manchester*)
Warner, Eric Albert André (*Wellington*)
Watkinson, Leonard James (*West Riding*)
Westwood, George Ernest (*London*)
Whiteley, Peter (*London*)
Whitfield, Thomas (*Auckland*)
Wilkinson, Thomas William (*Hull*)
Willis, Gervase Hewitson (*Manchester*)
Woodbridge, Richard John (*Bristol*)
Worsdall, Herbert Charles (*London*)
Yorath, Robert Stanley (*Wellington*)

Associates

Acey, John Arthur (*London*)
Adams, John Charles (*Midlands*)
Adams, Terry Ernest (*London*)
Addenbrooke, Brian John (*Midlands*)
Aitken-Smith, Frank Joseph (*Auckland*)
Allavena, Antonio (*General Overseas—Switzerland*)
Anthony, Alan Sydney (*London*)
Armstrong, Edward (*Hull*)
Arnold, Frank (*Manchester*)
Assink, Jo (*Auckland*)
Baker, John (*General Overseas—USA*)
Baldwin, George William (*Manchester*)
Bannington, Donald Bertram (*London*)
Bargrove, Kenneth Laurence (*London*)
Barnes, Peter James (*London*)
Barton, James Francis (*London*)
Batch, Alan James Edward (*London*)
Beachen, John Frederick (*Auckland*)
Bell, Brian Robert (*Midlands*)
Bentley, Major Gordon (*West Riding*)
Bird, George Donald Chaplyn (*Midlands*)
Blackledge, Amos (*Manchester*)
Bloomfield, Kenneth Vincent (*London*)
Bluck, Ross Steele (*Wellington*)
Bolam, Ion Barrow (*Newcastle*)
Bowerman, David Francis (*Manchester*)
Bowler, Kenneth Ernest (*Midlands*)
Boxall, John (*Thames Valley*)
Brockman, Andrew Leonard Sloane (*General Overseas—Australia*)
Brooke, Leslie John (*Bristol*)
Brown, Peter Thomas (*London*)
Caffery, George Francis (*London*)
Calder, Robert Malcolm (*Auckland*)
Campey, Leslie John Randall (*General Overseas—Canada*)
Cartwright, Jeffrey (*London*)
Catherall, Kenneth David (*Midlands*)
Chebsey, Maurice (*Manchester*)
Chellingsworth, Horace Thomas (*Midlands*)
Chippington, Kenneth Alan (*Bristol*)

Optional Professional Grade Successful candidates—*cont'd*

Clark, Laurence Norman (*London*)
Clement, Donovan Harry (*Midlands*)
Coates, John Allen (*Manchester*)
Cole, Francis William (*Midlands*)
Constantinides, Erricos (*London*)
Cordwell, Terrence Allan (*Midlands-Trent Valley Branch*)
Cunnington, Robin Roy Carol (*London*)
Daggett, Wilfred Francis (*London*)
Dalton, Frank (*Manchester*)
Dando, Vivian Charles Owen (*London*)
Davies, Frank Watkin (*Manchester*)
Davis, Reginald Albert (*Bristol*)
de Waal, Tielmann Johannes (*South African*)
Delorette, Gustav Otto Hans Jurgen (*South African*)
Donkersley, Brian (*Newcastle*)
Dowsing, George Frederick (*London*)
Drew, Harold Henry Lennox (*Midlands*)
Dunn, Paul Alan (*London*)
Durdey, Alan James (*Newcastle*)
Dury, Ian Clifford James (*Thames Valley*)
Eaton, Michael George (*Thames Valley*)
Ebdon, James William (*General Overseas—Rhodesia*)
Eltringham, James Norman (*Auckland*)
Ernst, Joel (*London*)
Evans, Carey Pearce (*Auckland*)
Fairless, Joseph (*London*)
Fell, Alan William (*Manchester*)
Field, Lawrence Edward (*South African*)
Finlay, Cecil Newton (*Newcastle*)
Fisher, Leslie Alexander (*South African*)
Flood, Geoffrey Terence (*Manchester*)
Ford, Keith Sydney (*Manchester*)
Formanek, Leopold (*General Overseas—Czechoslovakia*)
Frazee, Jerry Daniel (*General Overseas—USA*)
Garratt, Peter Garth (*General Overseas—Switzerland*)
Gay, Alan Stanley (*Midlands*)
Geddes, Kenneth Raymond (*Manchester*)
Ghosh, Sunil Kumar (*General Overseas—India*)
Gibson, John Carrington (*Hull*)
Goodman, Robert John (*General Overseas—Spain*)
Green, Brian James (*London*)
Greenall, Brian John (*Wellington*)
Greenfield, Eric (*Midlands*)
Griffiths, Henry James (*Midlands*)
Grime, David (*London*)
Groom, John Robert (*London*)
Gunn, Reginald (*Thames Valley*)
Hamilton, Alexander (*Scottish*)
Harrison, Cyril Geoffrey (*Hull*)
Harty, David Basil (*General Overseas—Australia*)
Hasnip, John Anthony (*Hull*)
Hayes, Gerard Francis (*London*)
Heald, Desmond (*Manchester*)
Heffer, Victor George (*Manchester*)
Herriott, Charles Edward (*London*)
Hickman, Edwin Peter (*Midlands*)
Hill, Gilbert Victor Geoffrey (*Thames Valley*)
Hill, Raymond Forsyth (*Scottish*)
Hirst, John William Arthur (*Auckland*)
Hodge, Robert Alexander Paul (*Auckland*)
Holden, William Desmond (*Manchester*)
Holmes, David James (*Midlands-Trent Valley Branch*)
Holt, Clifford (*West Riding*)
Homden, Kenneth James Arthur (*London*)
Honiball, Alan Edward (*Manchester*)
Hopper, Derek Edgar (*Midlands*)
Hossack, James (*Scottish*)
Howard, Eric (*Manchester*)
Howells, Barry John (*Hull*)
Howes, Edward John (*London*)
Hughes, Gilbert William (*Manchester*)
Humphrey, Thomas Lawson Myles (*Scottish*)
Jangbahadur, Shyam Sharan (*General Overseas—Iran*)
Johnstone, James William (*Manchester*)
Jones, Derek Frederick Arthur (*Thames Valley*)
Jones, Geoffrey Peter (*Wellington*)
Judah, Jack Everard (*Hull*)
Kelly, Peter Graeme (*General Overseas—Australia*)
Kenna, Frank William (*Manchester*)
Kerr, Michael Anthony (*Manchester*)
Khan, John Mohammed (*London*)
Khidher, Abdul Monum (*General Overseas—Iraq*)
King, Charles William Henry (*Midlands*)
King, Raymond John (*Midlands*)
Kirakoz, Yousif Diran (*Manchester*)
Kirlew, Charles Wesley (*General Overseas—Jamaica*)
Kitchen, John Robert (*Midlands-Trent Valley Branch*)
Knight, Richard Charles (*London*)
Laker, Bernard George (*London*)
Lakshmanan, P. R. (*General Overseas—USA*)
Lang, Robert (*Scottish*)
Langford, Henry (*London*)
Langley, Robert (*Scottish*)
Lawton, Cyril Victor (*Midlands*)
Lewis, John David (*Thames Valley*)
Lipscombe, Charles George (*Auckland*)
Low, Charles (*South African*)
Macdonald, Alan (*Auckland*)
Macdonald, Arthur Gillings (*Newcastle*)
Mandelson, Jack (*Scottish*)
Maple, Donald Peter (*London*)
Marsden, Chris Eyre (*Manchester*)
Martin, Christian Pierre (*General Overseas—France*)
Maynard, Albert William David (*Overseas*)
McCapra, Ronald (*Auckland*)
McDonald, Kenneth Roy (*South African*)
McKay, Alan Gordon (*London*)
McKay, Robert Bruce (*Scottish*)
McKean, James Newlands (*General Overseas—Hong Kong*)
McMillan, James (*Manchester*)
McQuirk, Peter John (*London*)
Mepham, Brian Edwin (*London*)
Mikucki, Wiktor (*London*)
Mitchell, Seward John (*Midlands*)
Moore, Frank Roden (*West Riding*)
Moore, James (*Manchester*)
Moore, Ronald Henry (*West Riding*)
Moore, William Alexander (*Auckland*)
Moreham, Frank Joseph (*Newcastle*)
Morpeth, Frederick Johnson (*Manchester*)
Morris, David (*West Riding*)
Munro, Hugh Anderson (*Scottish*)
Murray, David John (*Manchester*)
Murray, Robert Frederick (*London*)
Myers, Gordon (*South African*)
Mynett, Raymond John (*Midlands*)
Naess, Erik (*General Overseas—Norway*)
Ness, Robert Alexander (*Auckland*)
Nisbet, Peter Samuel (*Scottish—Eastern Branch*)
Norton, Douglas Kent (*Midlands*)
Oakley, Ernest (*Newcastle*)
O'Connor, Eugene Daniel (*Manchester*)
Orpwood, John Leonard (*London*)
Oswitch, Stanley (*General Overseas—USA*)
Pace, Graham (*Midlands*)
Parry, Martin Gerald (*London*)
Patrick, Alan Clive (*Irish*)
Pemberton, Joseph James (*London*)
Perry, Leonard C. (*Bristol*)
Pessall, Robert George (*Midlands*)
Piper, Norman William (*Manchester*)
Poborca, Stefan (*Midlands*)
Proudley, Philip Miles (*London*)
Quorn, Peter James (*South African*)
Rackham, John Michael (*Newcastle*)
Rampley, Dennis Neil (*London*)
Redman, Frank Benson (*Manchester*)
Reeve, Frank Nicholson (*South African*)
Robinson, Arthur Graham (*Manchester*)
Robinson, Francis Derrik (*Hull*)
Rothwell, Gerald William (*London*)
Rout, Peter George (*West Riding*)
Routley, Alan Francis (*London*)
Scott, Neville (*Manchester*)
Sharp, Peter Frank (*Auckland*)
Sharpe, David (*Hull*)
Sheikh, Saeed (*General Overseas—Pakistan*)
Shirt, John Michael (*West Riding*)
Shoham, Joseph (*General Overseas—Israel*)
Silsby, Denys John (*Midlands*)
Silverwood, David (*Manchester*)
Smith, David Dorman (*Scottish*)
Smith, Harry Bertram (*London*)
Soman, Chettiparambil (*General Overseas—USA*)
Sowerby, Alan Hope (*Auckland*)
Spargo, Robert (*Auckland*)
Speding, George (*London*)
Springett, Robert Arthur Edward (*London*)
Sreeves, John Ernest (*Midlands*)
Staples, Peter Graham (*London*)
Stephenson, Robert Perry (*Auckland*)
Stewart, Donald (*Manchester*)
Stone, Francis Edward (*Midlands*)
Stone, James Bryan (*London*)
Stott, Raymond (*Manchester*)

Optional Professional Grade Successful candidates—*cont'd*

Stretton, Elizabeth (*Manchester*)
Stubbings, Alec Walter George (*London*)
Surinphong, Julian Suriya (*General Overseas—Thailand*)
Suthers, Peter (*Manchester*)
Sutton, Peter Michael (*London*)
Talwalkar, Vinayak Sakharam (*London*)
Tasker, Leonard (*General Overseas—Iran*)
Taylor, Terence (*Manchester*)
Thomas, Anthony (*General Overseas—Brazil*)
Thoms, Hugh Sydney (*Manchester*)
Tillyer, Richard Brian (*London*)
Topping, George David (*London*)
Trevitt, Edwin William (*London*)
Triggs, Francis Cyril (*London*)
Troparevsky, Alejandro (*General Overseas—Argentina*)
Tye, Terence Thomas (*Thames Valley*)
Unni, Madhavan T. N. (*General Overseas—Malaysia*)
Venus, Norman (*South African*)
Walker, Peter (*Thames Valley*)
Weineck, Terrence Graham (*South African*)
Westbrook, Ernest Louis Edward (*London*)
Whalley, James (*General Overseas—Kenya*)
Wheatley, Kenneth Valentine (*Irish*)
Whetstone, Peter John (*London*)
White, Robert Arthur (*Wellington*)
Williams, Adrian Arthur Owen (*London*)
Williams, Cyril (*Manchester*)
Wood, George (*London*)
Wooll, Frederick James (*London*)
Zissell, Martin John (*London*)

Licentiates

Canterford, Barry Albert (*London*)
Chambers, Anthony (*London*)
Churchman, Anthony Edward (*London*)
Cox, Garth Anthony (*West Riding*)
Downham, Stephen Airey (*Manchester*)
Elliott, Peter (*London*)
Fernandes, Larry Raphael Francis Joseph (*London*)
Hemmens, Anthony John (*Bristol*)
Moss, Noel Sydney (*London*)
Ohene-Kwadade, Kofi (*General Overseas—Ghana*)
Sawyerr, Olatunji Pekun (*General Overseas—Nigeria*)
Schierbaum, James Helmut (*Midlands*)

Obituary

James Miller

Mr James Miller died in Ninewells Hospital, Dundee, on Monday 22 September, at the age of 66.

Jimmy Miller was born in the Springburn district of Glasgow in the autumn of 1909. In 1923, at the age of fourteen, he started his career in the chemical industry when he joined Kirkpatrick & Lauder, a well-known firm of chemical merchants in Glasgow, as an office boy at a salary of £2 per month. He had just completed a two-year course of evening classes which, as he put it, were aimed at "making him commercial" when his company built a new laboratory and Jimmy was appointed their first chemist. He attended classes in chemistry and mathematics at what was then the Technical College—the precursor to Strathclyde University—and his salary shot to £6 per month.

In 1931, at the age of nineteen, he started his active career as a technical sales representative. The company technique was to give the new man a list of contacts with whom nobody had ever done any business and set him loose, the theory being that if he stuck it out, without becoming utterly disillusioned, he must "have the makings". Cruel as this process now seems, it was Jimmy's own opinion that it was no worse than some of the pressure techniques used today. His own ability and personality told and he was eventually given a list of live accounts, along with another increase in salary. The going was particularly tough for him, for these were the Depression years of the 1930s, when it was not uncommon for queues of twelve to fourteen representatives to be found waiting to see one buyer. By 1938, at the age of 28, he had been appointed a director of his company.

With the beginning of the war in 1939, he volunteered for active service, and in spite of an old ankle injury was accepted. It was at this time also, that he married his first wife, Jean. He was called up to the Royal Artillery in 1940 and, having served for two years in the Anti-Aircraft Regiment, he was invalided out in 1942. And so, it was back to industry, this time with a firm of chemical manufacturers in Manchester, where he was general manager throughout the remainder of the war. Although destined to be managing director, he parted from the company on a matter of principle in 1945 and then followed a period of serious illness, which prevented his setting up in business with a colleague who had resigned at the same time. When his health recovered, he returned to Scotland and, for a few years, acted as agent for the company which this colleague had established.

In 1951 he joined Vinyl Products Ltd and so began one of the happiest and most satisfying periods of his industrial life. Scotland and Northern Ireland were virtually virgin territory and, amongst other things, he experienced the thrill and challenge of building up an entirely new connection and of seeing business grow steadily. He was by now in his middle fifties and had been appointed area manager. In 1965, his wife died after a prolonged and distressing illness. During this period, Jimmy had coped with a home, hospital visits and business, and though the establishment of an area office, with an assistant and a typist, greatly eased matters, the strain of constant travelling turned his thoughts to retirement.

He remarried in 1967 and found great joy and quiet contentment with his second wife, Margaret. Retirement, however, still attracted him and in 1970 he took the final step. In the peculiarly Scottish sense, Jimmy Miller was "daft" about St. Andrews. He spent much of his spare time in this ancient university town, the centre of the world of golf, and that was where his retirement finally took him. He was happy there. He had had a full and active business life and he embarked on his more leisure years "with the knowledge and satisfaction that since he had built up the territory from scratch, whatever happened in Scotland and Northern Ireland in the future, it would in some ways be a memorial to him".

Jimmy's interests outside business were many; he had a deep love of music and not everyone knew that in his younger days his proficiency with the trumpet and cornet was such that he could well have played professionally had he wished. His main sports were swimming, golf and football, and when his active participation in the last of these had finished, he spent many happy hours supporting his beloved Third Lanark FC at Cathkin. He continued his active participation in golf, with a little restriction, to the end.

He was a devoted churchman throughout his life; brought up a congregationalist, he was an elder for twenty-five years and was president of his local church. His other abiding interest was OCCA. He served for many years on the committee of the Scottish Section and became the second Student Liaison Officer, where his friendly personality did a great deal to encourage the younger members. He was chairman of the Section from 1968 to 70 and was deeply involved in the organisation of the very successful symposium which was held in East Kilbride just afterwards. He served on Council for several years and his point of view, quietly put, as always, was invariably received with respect.

Jimmy Miller was the kind of person who gave real meaning to all the time-worn platitudes. He was a family man and the best of all possible friends, with a simple and disconcerting humility; courteous to a degree, even to those who little merited it. He had a wonderfully pawky sense of humour and a remarkable fund of reminiscences to go with it. He was a man of unquestionable principle and of utter integrity—his word was, indeed, his bond—no one could possibly imagine Jimmy requiring, far less inventing, such a thing as a written contract. It was inevitable that, naturally and spontaneously, he should attract respect and friendship throughout his business and private life.

He was surely the kind of person who had a personality and standards to which we would all aspire, but which we so seldom achieve. He said of himself that, in most aspects of life, he was somewhere around the middle of the performance league. In this, at least, he was wrong. To all who knew him, Jimmy Miller came out at the top.

To his widow, Margaret, and to his family, the twins Margaret and Cameron, we extend our deepest sympathy.

A. McL.

News of Members

Mr K. S. Rajan, an Ordinary Member attached to the General Overseas Section, has been promoted to Senior Technologist in the Resin Department of Dow Chemical Europe SA.

Dr S. H. Bell, OBE, attached to the London Section, a Fellow in the Professional Grade and a Past-President of the Association, has retired after 42 years' service with the Paint Research Association. Dr Bell was appointed research chemist at the PRA in November 1933, he became Secretary in 1945 and has been Deputy Director since 1953. He was President of the Association from 1965 to 1967 and was awarded the OBE in the 1974 New Year's Honours List.

Dr Sydney Bell

Mr M. K. Jones, an Ordinary Member attached to the London Section, has been appointed Secretary to the Paint Research Association, with effect from 1 October 1975. Mr Jones joined the PRA in 1955 after graduating in chemistry at Durham University, and he has been Assistant Secretary since 1974.

Member's attention is drawn to the Association's notices published on page 474 of this issue, regarding the standard of competence for election to Ordinary Membership, 1976 Members' subscriptions and changes of address, and also the facility for Members to obtain bound copies of the 1975 volume of the *Journal*.

Forthcoming Events

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

December

Monday 1 December

Hull Section: "Paint exports" by Mr L. H. Silver, Silver Paint & Lacquer Group, to be held at the George Hotel, Land of Green Ginger, Hull, at 6.30 p.m.

Manchester Section: "The highly flammable liquids regulations" by Mr D. V. Offord, HM Factory Inspectorate, to be held at Woodcourt Hotel, Brooklands Road, Sale, at 6.30 p.m.

Thursday 4 December

Newcastle Section: "High solids, water reducible aminoplast cross-linkers for modern coating systems" by Dr M. Donnez, Monsanto Europe, to be held at the Royal Turks Head Hotel, Newcastle upon Tyne, at 6.30 p.m.

Thames Valley Section: "A new approach to large batch milling" by Mr J. Jarvis and Mr R. Ward of Torrance Machinery Ltd, to be held at the Beaconsfield Crest Hotel (White Hart), Aylesbury End, Beaconsfield, Bucks, at 6.30 p.m. for 7.00 p.m.

Friday 5 December

Irish Section: "Car coatings" by Mr A. C. Patrick, Fords of Cork, to be held at the Clarence Hotel, Dublin, at 8.00 p.m.

Tuesday 9 December

Scottish Section—Student Group: "Manufacture of explosives" by lecturer from the Royal Ordnance Factory, Bishopton, to be held at the CIBA-GEIGY site, Hawkhead Road, Paisley.

West Riding Section: "Aluminium coordination complexes" by Mr J. H. W. Turner, Manchem Ltd, to be held at The Griffin Hotel, Boar Lane, Leeds, commencing at 5.30 p.m.

Thursday 11 December

Scottish Section: "Dispersion and flocculation of titanium dioxide" by Mr J. Rackham and Mr J. G. Balfour, Tioxide International Ltd, to be held at the Beacons Hotel, 7 Park Terrace, Glasgow, at 6.00 p.m.

Thursday 18 December

Scottish Section—Eastern Branch: "Antiquities" by Mr R. Snowdon. *Time and venue to be announced.*

January

Monday 5 January

Hull Section: "High solids, water reducible aminoplast cross-linkers for modern coating systems" by M. M. Donnez, Monsanto Europe, to be held at the George Hotel, Land of Green Ginger, Hull at 6.30 p.m.

Thursday 8 January

Newcastle Section: "Biodeterioration of paints" by Mr C. N. Finlay, Nuodex Ltd, to be held at the Royal Turks Head Hotel, Newcastle upon Tyne at 6.30 p.m.

Friday 9 January

Manchester Section: "Masonry coatings" by Mr P. Whiteley, Building Research Establishment, to be held at Manchester Literary and Philosophical Society, George Street, Manchester at 6.30 p.m.

Scottish Section: Annual Dinner Dance.

Tuesday 13 January

West Riding Section: "Water based adhesives" by Dr K. Sellars of Harlow Chemical Company Limited, to be held at the Griffin Hotel, Boar Lane, Leeds at 7.30 p.m.

Thursday 15 January

Scottish Section: "Gloss emulsions and high performance decorative acrylic emulsions" by Mr G. Keith and Mr D. H. Kerrison, Rohm & Haas Ltd, to be held at Beacons Hotel, 7 Park Terrace, Glasgow at 6.00 p.m.

Friday 16 January

Irish Section: Ladies' Night, Fashion film—cheese and wine tasting, to be held at the Clarence Hotel, Dublin at 8.00 p.m.

Midlands Section and Trent Valley Branch: "Corrosion: the supplier's problems" by Mr A. E. Claxton of Inmont, and "The user's problems" by Mr F. Timmins of British Rail, to be held at Birmingham Chamber of Commerce and Industry, Harborne Road, Edgbaston B15 at 6.30 for 7.00 p.m. Dinner lecture.

Monday 19 January

London Section: "Applications for cellulose ethers in paint manufacture" by Dr V. Knittell of Kalle Wiesbaden, W. Germany, at East Ham College of Technology, High Street, London E6, at 7.00 p.m.

Wednesday 28 January

Manchester Section—Student Group: "The formulation and manufacture of emulsions for the paint industry" by Mr K. R. Geddes, Crown Decorative Products Ltd, to be held at Manchester Literary and Philosophical Society at 4.30 p.m.

Thursday 29 January

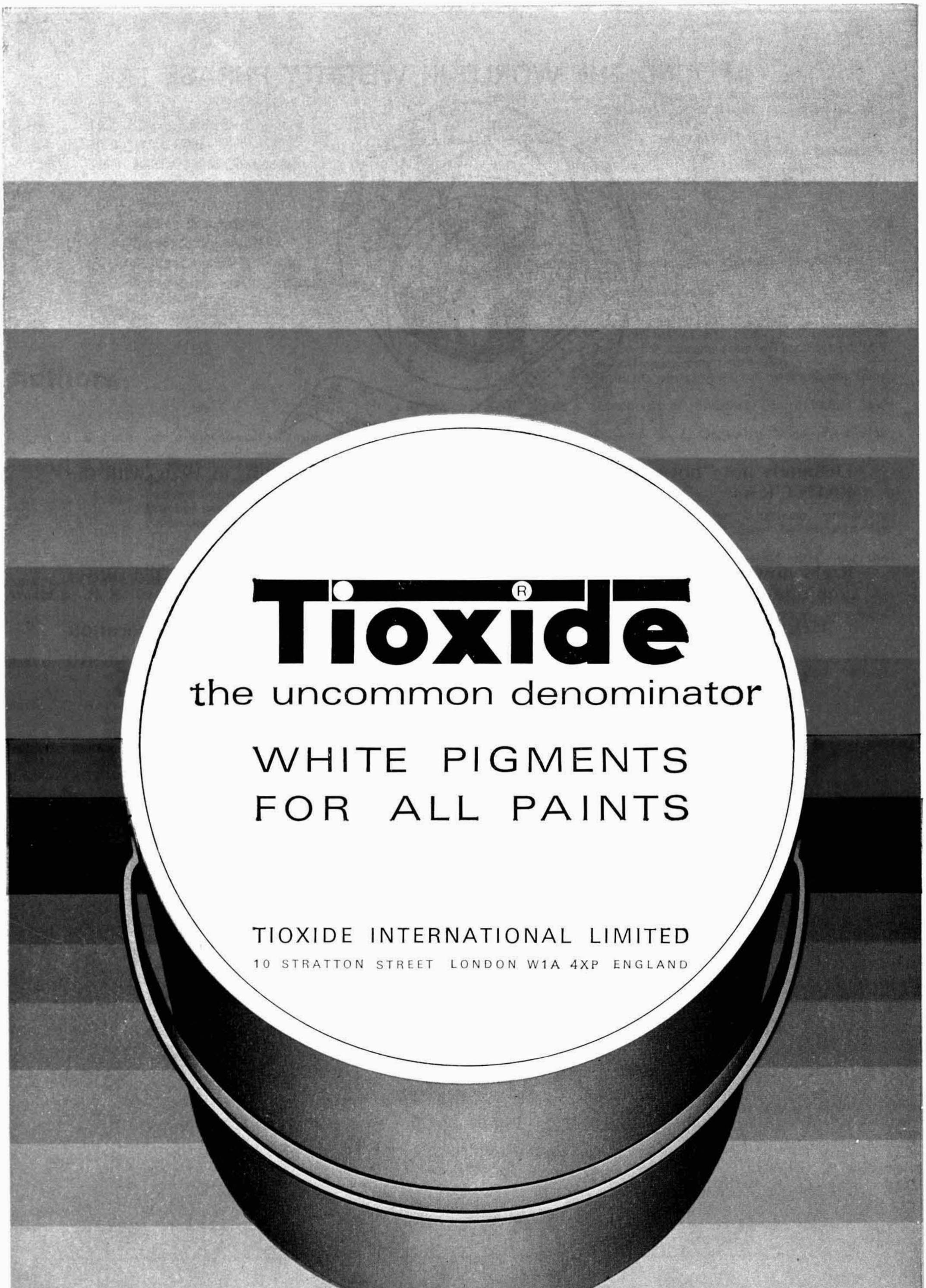
Thames Valley Section: "Packaging testing for hazardous goods" by Mr C. Swinbank, Packaging Co-ordinator ICI Ltd, to be held at Beaconsfield Crest Hotel (White Hart), Aylesbury End, Beaconsfield, Bucks, at 6.30 p.m. for 7.00 p.m.

Friday 30 January

Bristol Section: "Modern techniques of wood preservation and protection" by Mr R. E. Hambling of Cuprinol Ltd, to be held at Royal Hotel, Bristol at 7.15 p.m.

Bristol Section

Details of the meeting for 27 February 1976 have now been arranged. A lecture entitled "Photopolymer printing plates" will be given by Mr D. J. Hodgkins, manager of the Graphic Arts Division of BASF (UK) Ltd. The meeting will be held at the Royal Hotel, Bristol, commencing at 7.15 p.m.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Authors

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Subjects

Association Notices

Applications for membership

It is felt that the members would like to be reminded of the standard of competence for the election of candidates to Ordinary Membership of the Association, as laid down by the Council, when they are sponsoring candidates for election. The qualifications for the granting of Ordinary Membership at the present time are:

1. A degree in a scientific subject or any generally accepted equivalent qualification; or an approved technological qualification in a subject covered by the Association.

2. Or where there is adequate evidence of the technical competence of the candidate other than the obtaining of the qualifications mentioned above, the qualifying period of practice in the industries covered by the Association shall be normally not less than seven years.

Associate Membership is open to those employed in the industries who do not qualify for Ordinary Membership.

The Council has further resolved that Student Membership should be open without restriction to the age of 21 years and may be extended to 25 years of age, where candidates are following courses of technical study to the satisfaction of their employers or technical college lectures.

Retired members

Council also wishes it to be known widely that in 1962 it introduced a reduced membership subscription rate for members who have retired from business. This applies to a member who has completed 20 years as an Ordinary or Associate Member and has retired from business, and normally has reached the age of 60; he may apply for his name to be retained on the Register of Members at an annual subscription rate of £1.50 and he will retain the same rights of membership as the class of membership to which he was attached upon retirement.

Members wishing to avail themselves of this concession should write, in confidence, to the Director & Secretary at the address shown on the front cover of this *Journal*, giving the relevant information under the four headings: (*a*) name, address and Section, (*b*) date of election, (*c*) date of retirement, (*d*) age.

Change of address

Members changing their address are urged to inform the Association's office immediately so as to avoid any misdirection of mail. This is particularly important as far as the *Journal* is concerned.

Will members please note that since membership of the Association is entirely on an individual basis, if notification of the change of an address for a company is sent to the Association's office this will not necessarily guarantee the change of address in the Association's records of the member concerned unless the name of the member is stated on the communication.

Binding of Journal

Members will be pleased to know that J. S. Wilson & Son, 14a Union Road, Cambridge CB2 IHE, will undertake the binding of back volumes of the Association's *Journal* sent in by individual Members at a cost of £4.05 (including postage and packing) per volume.

Members wishing to avail themselves of this facility should send the parts, securely wrapped, direct to J. S. Wilson & Son Ltd, enclosing a remittance of £4.05 (including postage and packing) per volume, and ensuring that notes bearing their names and addresses are enclosed with the parcels. It is particularly important that packets are sufficiently wrapped to negate the possibility of damage in the post.

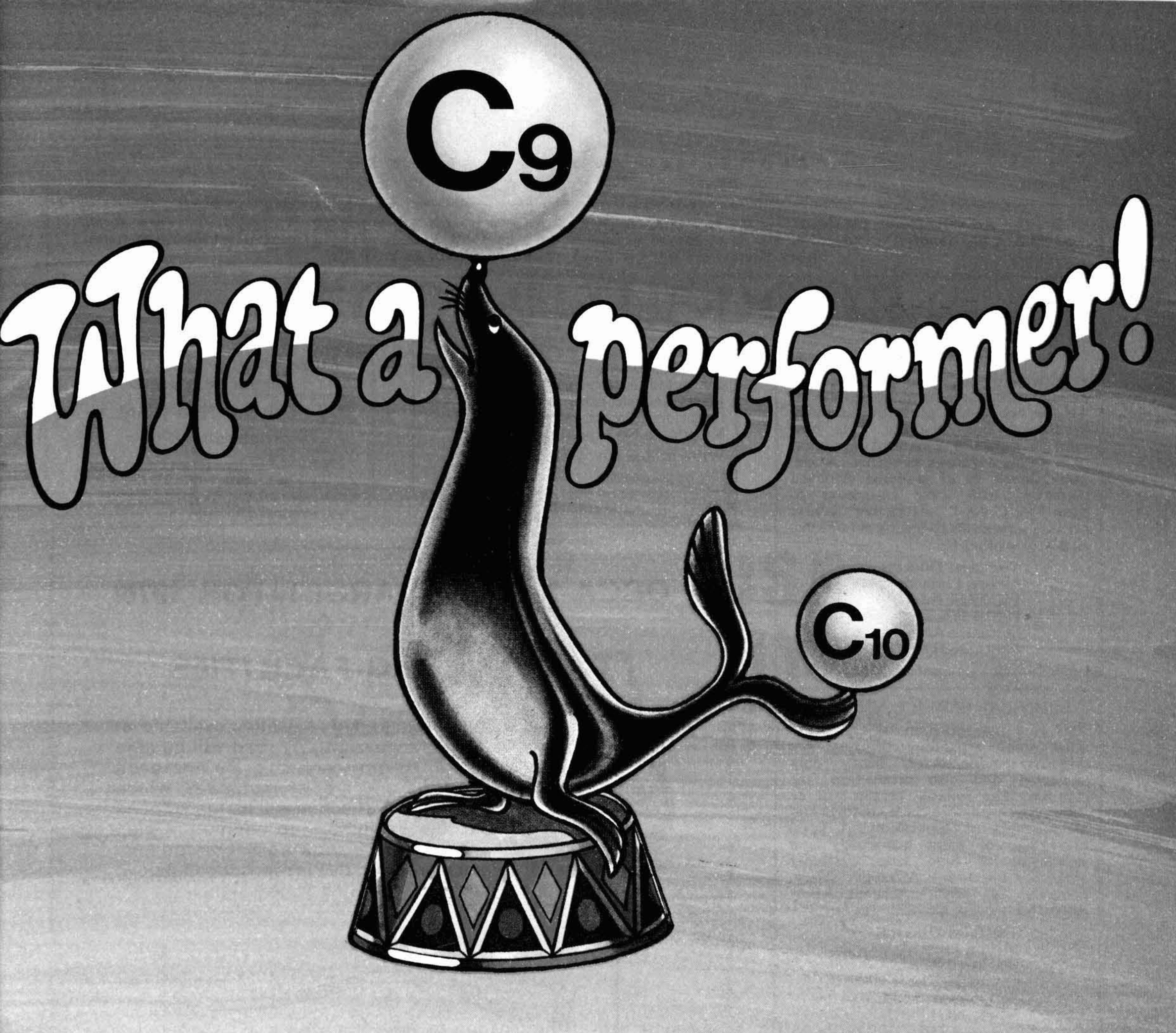
1976 Members' subscriptions

Members are reminded that 1976 Membership subscriptions to the Association are payable on 1 January 1976. Forms were despatched to all members in October or November, depending upon address.

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

1976 library subscriptions

The *Journal* subscription rate to non-Members, including libraries, for 1976 will be £20.00 ($50) post free by surface mail, home and abroad. Individual copies can be purchased for £2.00. Remittance should be sent with order to the Association's offices.



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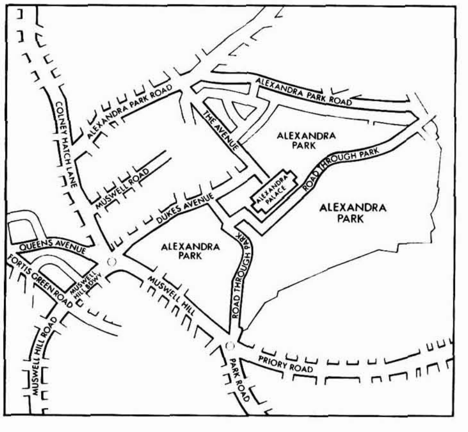
CAR PARKING FACILITIES

There are adequate free car parking facilities available at Alexandra Palace. Visitors travelling by road will be able to consult the simplified diagram showing the approach roads from Central London and the M1 motorway, which has appeared in the *Journal* and which will be reproduced in the *Official Guide* to the Exhibition. In addition, a map will be printed in the *Official Guide* showing an enlargement of the Alexandra Palace area and this is reproduced below.



Further details on the Exhibition will be published in the Journal during the early months of 1976 and copies of the Official Guide and free season admission tickets will be sent to all members of the Association in February 1976.

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