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EASTBOURNE CONFERENCE DIARY



ALSO IN THIS ISSUE:

- **Improving the dispersion of pigments with hyperdispersants**
- **Recent advances in crosslinking and curing applications to surface coatings**
- **The reliability of durability testing**
- **AGM proceedings**



**OIL & COLOUR CHEMISTS'
ASSOCIATION**

SURFEX
88

A SELLOUT

Of the 124 stands available all but 10 have now been allocated and applications for these should be made as quickly as possible.

Surfex 88 will be the second in the series of new concept exhibitions mounted by The Oil & Colour Chemists' Association. Designed to combine the best features of theatre-style exhibitions with the simplicity and cost effectiveness of hotel bedroom shows, SURFEX 86 was held in Harrogate in May 86. By common consent of both exhibitors and visitors alike, it was acclaimed as a huge success.

Because of the co-operative attitude of local contractors, the luxurious atmosphere of the Harrogate International Conference Centre and the relatively modest costs for exhibitors, it has been decided that SURFEX 88 will again be held in the North Yorkshire spa town, 15-16th June 1988. In order to accommodate the additional exhibitors who will want to show, SURFEX 88 will be 30% larger than in '86 but still housed within the Conference Centre.

The simplicity and cost effectiveness will also be maintained by using a modular construction and setting a limit to the size of individual stands. Costs, which include carpeting, electrics and stand cleaning, range from £375 for 2 M x 1.5 M to £2,640 for 8 M x 3 M.

Further information on SURFEX 88 can be obtained by contacting:

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SURFEX 88
PO Box 161
Wigan WN2 5TB
England
Tel: (0942) 865438
Telex: 67233 Foscol G

SURFEX 15th - 16th June, 1988
Harrogate Conference Centre

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Blythe Colours Ltd
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| Contents | Vol. 70 No. 8 | August 1987 |
|--|--|-------------|
| Council 1987-88 and Committees of Council..... | | 203 |
| Section Officers and Committees 1987-88 | | 205 |
| <i>Transactions and Communications: Eastbourne Conference Papers</i> | | |
| Improving dispersion of pigments with hyperdispersants | | 207 |
| | <i>by A. C. D. Cowley</i> | |
| Recent advances in crosslinking and curing applications to surface coatings.... | | 214 |
| | <i>by H. Warson</i> | |
| The reliability of durability testing | | 219 |
| | <i>by L. Cutrone and D. V. Moulton</i> | |
| Letters | | 228 |
| Company Visits: Macpherson Industrial Coatings Ltd..... | | 228 |
| Conference Discussions | | 229 |
| Conference Diary: Eastbourne 1987..... | | 231 |
| Annual General Meeting 1987 | | 235 |
| News..... | | 239 |

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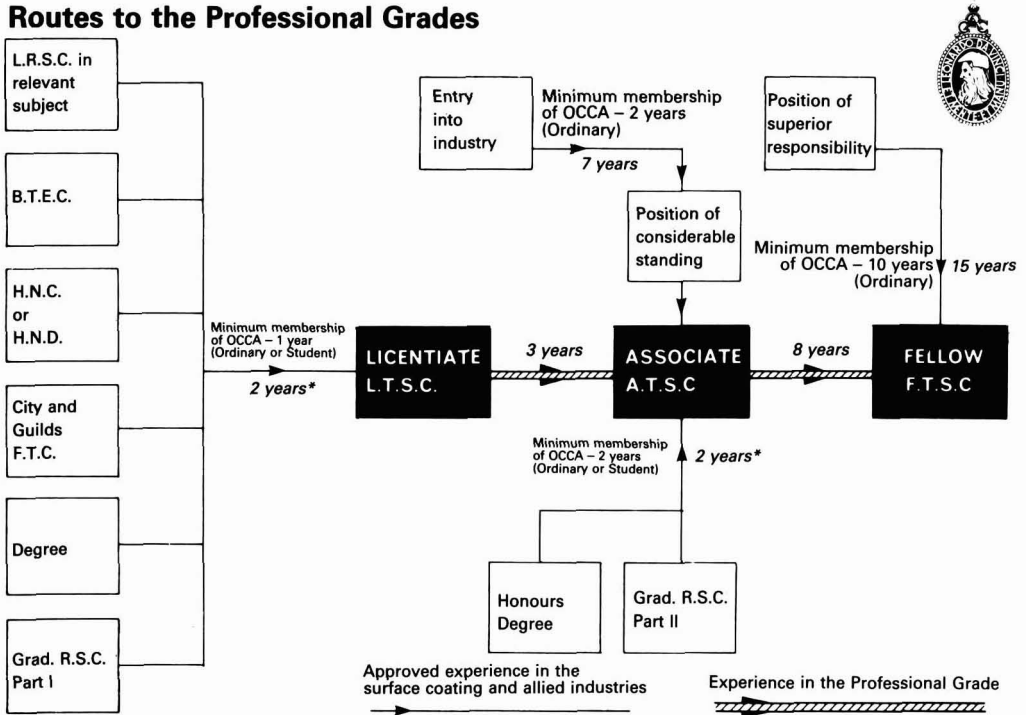
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Improving dispersion of pigments with hyperdispersants

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Abstract

The surface coatings industries operate in a very competitive market, where raw materials and production costs account for a high proportion of the total price of the finished goods. Any method of reducing these processing costs or of obtaining better value from the raw materials must produce an immediate economic advantage allowing the manufacturer to improve his profit margin.

Hyperdispersants have been developed and these are exceptionally powerful wetting agents which have been custom-designed for the dispersion of pigments into organic media.

The attraction of using these hyperdispersants is not only that of increasing productivity; significant advantages are also seen in the quality of the dispersion, e.g. the tinctorial strength of organic pigments may be 20% higher than from conventional dispersions. However it is essential to use specific hyperdispersants for particular types of pigment and media, in order to achieve optimum dispersion conditions.

Hyperdispersant technology represents a new scientific approach to the dispersion of pigments in non-aqueous systems resulting in significant economic and technical benefits to the surface coatings industries.

Introduction

Pigment dispersion is the art or science of incorporating a solid pigment phase within a liquid phase. The efficiency of pigment dispersion is a key factor influencing the ultimate profitability of surface coatings. With the rising costs of both pigments and energy, it makes economic sense to ensure both are used efficiently; it is desirable to achieve maximum tinctorial strength per kilo of pigment and to use minimum energy in achieving this effect.

Over the years the pigment manufacturers have recognised the problems of dispersing pigments and have attempted to mitigate them by using different types of surface treatments (Easily Dispersible pigments) or producing the pigment in a different physical form (pigment flushes or chips). More recently hyperdispersants¹ have been developed specifically for the purpose of improving the quality of pigment dispersions in non-aqueous media. This new technology offers the paint and ink industries a unique approach to the production of stable pigment dispersions.

The purpose of this paper is to consider traditional methods of producing stable dispersions, to describe the innovative design of hyperdispersants and finally to highlight some of the practical benefits which the paint or printing ink formulator is likely to derive from using hyperdispersants.

The dispersion process

The objective of milling pigments into a resin/solvent solution is to break down the pigment agglomerates and

aggregates to their fundamental particle size and distribute these pigment particles homogeneously throughout the medium.

As the size of the agglomerates is reduced, the surface area and the colour strength, which is proportional to the surface area, also increases². Usually a compromise is reached between the amount of energy expended on the dispersion process and the tinctorial strength achieved from a given weight of pigment.

The question arises as to why pigment manufacturers do not provide pigments already in a finely divided state, say of particle size less than one micron, which could be incorporated into a medium to achieve a highly dispersed product with very little energy expenditure. Actually, pigments are produced in a very fine particle size range, typical organics are 0.01-0.1 microns, while inorganics may be up to 0.5 microns in size.

Most pigments are isolated from water and dried as aqueous press-cakes. No matter how carefully it is carried out, drying by conventional methods causes some 'hydrophilic aggregation'³. As the water is removed, the fundamental pigment particles are subjected to compressive forces which cause aggregation. These aggregates vary in size but even after pulverisation they have diameters up to 50 microns.

Even if it were possible to produce pigments with particle size less than one micron in diameter it would be of little help. The particle size would be so fine, it would be like having to handle dust or smoke; it would be impossible to handle it.

Dispersion theory

It is essential to disperse pigment agglomerates and separate the fundamental pigment particles in order to develop the tinctorial properties, such as strength and opacity or transparency, of the pigmented dispersion. Other physical properties such as gloss, rheology and lightfastness are also affected by the resulting particle size distribution.

The dispersion process can be considered in three stages; wetting of the agglomerates by the medium, separation of the pigment particles, and stabilisation of the pigment particles in the dispersed state to prevent re-agglomeration or flocculation. These three stages may be considered separately although in practice they overlap.

During the wetting process the adsorbed air on the pigment surface is gradually replaced by the medium. The ease with which an agglomerate is wetted is favoured by a high surface tension and low contact angle at the solid-liquid interface whilst the viscosity of the medium should be as low as possible⁴.

The second stage of the process, separation of fundamental pigment particles, is usually achieved by mechanical action by either shear or impact, such as in cavitation (high speed) mixing, ball milling, sand or bead milling. Most agglomerates can be reduced in size into a distribution matrix, similar to a bell-shaped curve. As the average particle size is reduced, the desirable properties of the dispersion such as tinctorial strength and gloss are enhanced.

Following the mechanical breakdown of the agglomerates, the smaller particles must be stabilised. Unless the pigment particles are held apart, the high surface energy or van der Waals' forces create an attraction between the pigment particles and there is a danger of re-agglomeration or flocculation⁵.

The final stage of the dispersion process is the stabilisation of the pigment particles. To achieve a stabilised system it is essential that the particles are wet out and coated with an adsorbed layer of a stabilising compound, conventionally a resin, and that as each new surface is formed by cleavage of the agglomerates it is also wetted and stabilised by the resin to protect it from re-agglomeration.

If any of these stages is carried out ineffectively, the resulting dispersion will be of poor quality and may manifest such imperfections as lack of tinctorial strength, low gloss, poor transparency (of organic pigments), unsatisfactory rheology and poor dispersion stability.

Stabilisation mechanisms

Dispersion stabilisation may be achieved through two recognised mechanisms; charge stabilisation and steric stabilisation⁶. Charge stabilisation is due to electrical repulsion forces which result from a charged electrical double layer surrounding the particle and since all particles are surrounded by the same charge they repel each other when they come into close proximity.

In aqueous systems where the liquid medium has a high dielectric constant, this stabilisation mechanism works well. However in media of low dielectric constant (or polarity), such as hydrocarbons, the effectiveness of the charge stabilisation mechanism is very much less than that of steric stabilisation which relies on the spatial arrangement of the adsorbed polymers⁷.

Steric stabilisation arises when the particle adsorbs a layer of resin, the chains of which become solvated in the liquid medium, thus creating an effective steric barrier which prevents other particles from approaching too close. There have been many studies to determine the amount of resin adsorbed during the dispersion process; the consensus is that coverage of the surface amounts to 1-2 mg/m² which corresponds approximately to a monomolecular layer of resin.

Surfactants

Pigment dispersibility may be improved by incorporating surfactants⁸. Surfactants are simply substances that lower the interfacial tension between two immiscible liquids or liquids and solids.

Surfactants have been used in the paint and printing ink

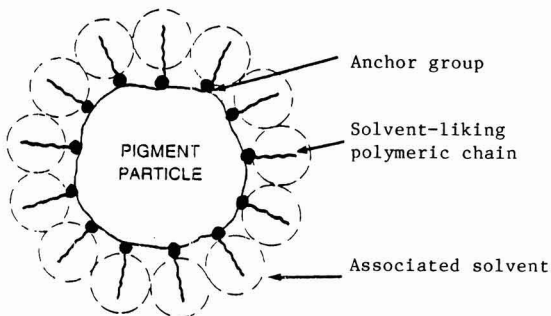


Figure 1. Hyperdispersant stabilisation mechanism.

industries for many years, e.g. soya lecithin—was once widely used as a surfactant or wetting agent for pigments in decorative gloss paints. Other wetting agents such as metal naphthenates and fatty acid amide derivatives have also been used in surface coatings.

Classical surfactant molecules contain two groups that are opposite in solubility or polarity; a lipophilic (oil loving, nonpolar) group and a hydrophilic (water loving, polar) group. The relative ratio of these groups determines their solubility in an aqueous or non-aqueous system. The chemical balance of these two groups is known as the HLB value⁹ (hydrophilic lipophilic balance); surfactants with high HLB values are water soluble, those with low HLB are solvent-soluble.

When these surfactants are adsorbed onto the pigment particles in an aqueous system, the lipophilic group is adsorbed onto the pigment surface and the hydrophilic group extends into the aqueous phase forming a protective barrier around it. Conversely in solvent based systems the hydrophilic group is adsorbed onto the pigment and the lipophilic group extends into and is solubilised by the solvent.

Although there are many surfactants suitable for use in water-based systems there have been few which were effective in solvent based systems. The reason for the latter is probably two-fold; first, the hydrophilic anchor group is inadequately adsorbed on the pigment, particularly organic pigments, resulting in desorption and pigment agglomeration, and second, the length of the lipophilic group was generally too short to achieve good steric hindrance in the solvent based medium.

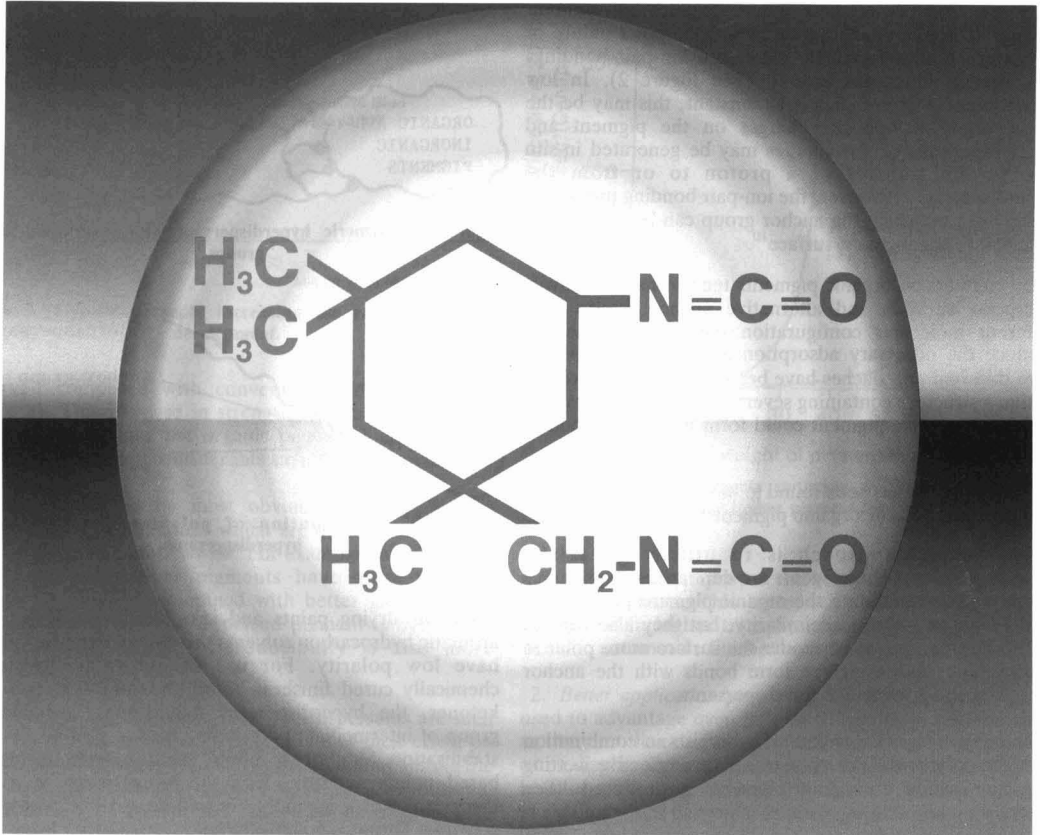
As a result of a need to achieve better dispersion and stabilisation of pigments in non-aqueous media a more effective range of surfactants had to be developed and these novel agents are known as hyperdispersants.

Design of hyperdispersants for non-aqueous systems

The effectiveness of hyperdispersants is based on their two-part structure which includes an anchoring functional group attached to a polymeric solvatable chain. (See Figure 1).

In designing the hyperdispersant, consideration must be given to the nature of the pigment surface which has to be wetted out, and also the nature or polarity of the medium in which the pigment is to be dispersed.

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Anchor group

The need for strong adsorption or 'anchoring' of the hyperdispersant to the surface of the pigment particle has been recognised. For simplicity we can classify most pigments as being organic or inorganic.

In the case of inorganic pigments such as titanium dioxide, iron oxides or lead chromate, the polar nature of their surface allows them to enter into ion-pair bondings with certain functional groups. (See Figure 2). In low polarity media of low dielectric constant, this may be the direct result of opposite charges on the pigment and hyperdispersant, or the charges may be generated in-situ due to the transfer of a proton to or from the hyperdispersant. However, the ion-pair bonding provides a mechanism by which the anchor group can become firmly attached to the pigment surface¹⁰.

By comparison organic pigments tend to have relatively non-polar surfaces and alternative anchor groups with different molecular configuration must be designed to produce the necessary adsorption and steric stabilisation. Two different approaches have been used. The first was to design a structure containing several anchoring groups with which the organic pigment could form many weak bonds. (See Figure 3).

This approach has been found to be effective on the more complex polynuclear organic pigments and carbon blacks.

The second approach is to utilise synergistic hyperdispersants. These agents are derivatives of pigments which are adsorbed onto the organic pigment particle due to their physico-chemical similarity, but they also contain sufficient polar groups to render the surface more polar in nature. They can therefore form bonds with the anchor groups of the polymeric hyperdispersants.

Thus by using these coloured synergists in combination with the polymeric hyperdispersant, very effective wetting and stabilisation of organic pigments is produced. (See Figure 4).

Polymer solvatable group

Good steric stabilisation occurs when the dispersing agent is firmly anchored to the pigment surface and its polymeric tail extends into the liquid medium. The polymeric tail should have good solubility in the solvent and be of sufficient length to provide an effective steric barrier to counteract the attractive forces between the particles.

The molecular weight or chain length of the polymeric group must be optimised. If it is too short poor steric stability is obtained. This is precisely the case with classical surfactants based on natural oils which have polymeric chains containing a maximum of 18 carbon atoms; a size which produces only limited steric stability. If the chain length is too long it could either be too soluble in the medium, possibly resulting in desorption, or it could fold back on to the pigment particle thereby compressing the steric barrier, both leading to re-agglomeration.

The chemical nature of the polymeric chain can be varied to ensure compatibility and optimum effectiveness in various solvents covering a wide range of polarities. As the polarity of the solvent increases so the polarity of the polymeric chain must also be increased.

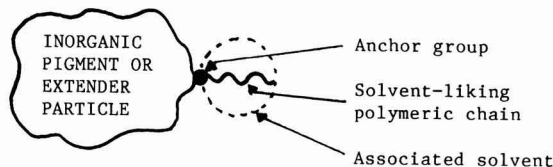


Figure 2. Polymeric hyperdispersant.

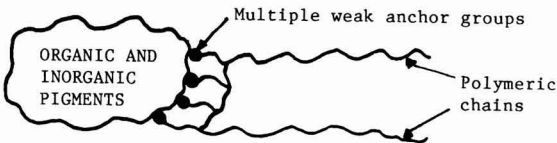


Figure 3. Polymeric hyperdispersant with several anchoring groups.

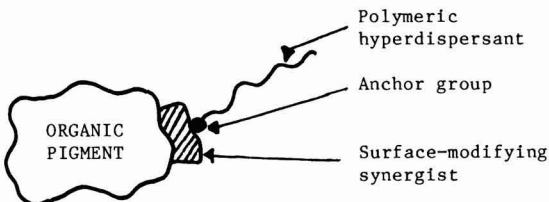


Figure 4. Combination of polymeric and synergist hyperdispersants.

For air drying paints and inks based on aliphatic or aromatic hydrocarbon solvents the polymeric group should have low polarity. For use in industrial stoving or chemically cured finishes, based on aromatics, esters or ketones, the hyperdispersant should have a polymeric group of intermediate polarity in order to give good steric stabilisation. Similarly it follows that for alcohol or water-based paints and inks it is advisable to use a hyperdispersant which is soluble in and compatible with polar solvents. Thus it is possible to tailor-make hyperdispersants to give optimum performance on pigments in the wide range of solvents used in the surface coatings industry.

Benefits from hyperdispersants

The benefits of using hyperdispersant technology can be considered under two headings, 'commercial'—those which result in direct savings in raw material or processing costs, and 'technical'—those where the use of hyperdispersants produce practical benefits which are not readily quantifiable.

Commercial benefits

1. *Reduced raw material costs.* One of the more significant benefits of using hyperdispersants is shown with the enhanced tinctorial strength of organic pigments. In conventional paint or ink manufacture, the millbases are often ground for either a fixed period of time (overnight in the case of ball mills) or until a fineness gauge reading shows the dispersions are bit free. In most cases the tinctorial strength is not fully developed. However by incorporating hyperdispersants in the millbase, a more rapid rate of strength development is produced and very often increases in tinctorial strength of up to 20% are

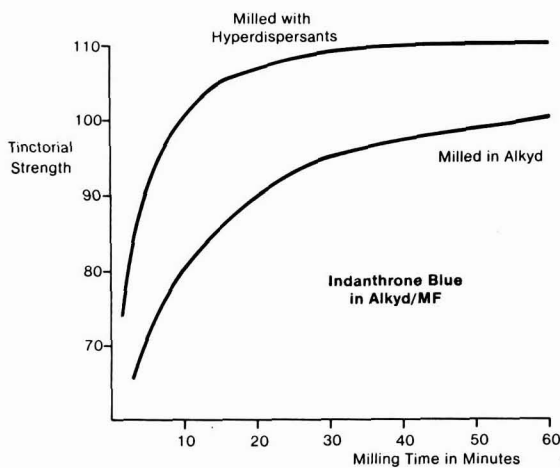


Figure 5. Hyperdispersants increasing the rate of strength development.

observed compared with conventional millbases. (See Figure 5). This increase in strength will enable the paint formulator to reduce the organic pigment loading in the final paint producing considerable savings in raw materials.

This benefit will be most obvious when applied to pigment/resin combinations which are difficult to disperse both quality and quantity-wise. For example quinacridones and other polynuclear pigments have given strength increases of 15-20% combined with better gloss. As the tinctorial strength of the dispersed pigment is more fully developed, the colour reproducibility is also more consistent.

2. Lower processing costs. The hyperdispersants are such powerful wetting and stabilising agents that their effect on the millbase can be quite dramatic. Predominant among the observed effects is that of viscosity reduction. Conventional millbases are so formulated that they have a suitable viscosity to enable efficient milling. If hyperdispersants are used with the same solids concentration their fluidising effects lower the viscosity to a level below the optimum and this decreases milling efficiency. However, the correct viscosity can be obtained by increasing the pigment concentration significantly, to more than double in some cases. (See Figure 6).

Typical pigment loadings for hyperdispersant based dispersions have been found to be up to 50% for organic pigments and up to 80% for inorganics¹¹. Examples of millbase formulations are given in Table 1. The effect of increasing pigment concentration in the millbase, permits a much greater quantity of paint and ink to be made which results in lower processing costs. Also as the rate of dispersion is very efficient, mills can be run under what would normally be regarded as inefficient conditions to give higher output. For example bead mills can be used with shorter dwell-times at a 20-30% higher throughput rate, and clearly this will utilise less energy and thereby reduce processing costs.

Technical benefits

1. Improved physical properties. Apart from higher tinctorial strength it is noticeable that the use of

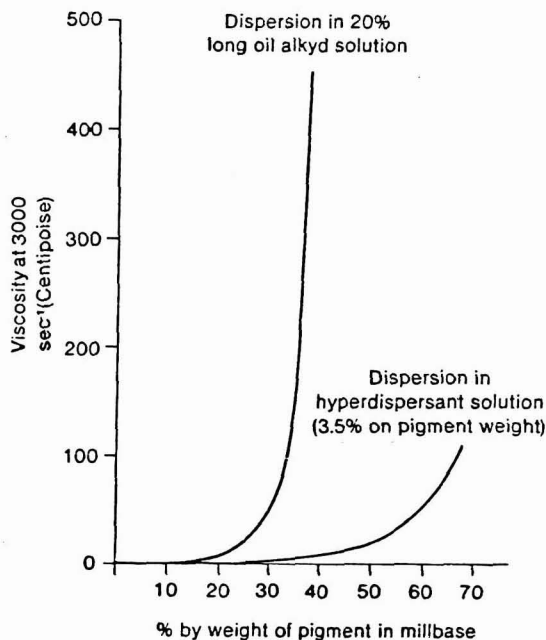


Figure 6. Hyperdispersants reducing millbase viscosity and permitting higher pigment loadings.

hyperdispersants improves the brightness or cleanness of organic pigments. This better state of dispersion is also manifested in higher transparency which is important for metallic automotive finishes and packaging gravure inks.

2. Better application properties. Hyperdispersants can be used to advantage even in 'easily dispersible systems' such as titanium dioxide in long oil alkyds. The resulting paints often display higher gloss resulting from better rheology or levelling properties and less flocculation. The improvement in rheology is of particular importance in liquid ink systems where good flow characteristics are highly desirable.

3. Reduced stockholding. As hyperdispersants are so effective in their stabilisation of pigments it is possible to carry out the dispersion stage in solvent alone or in a dilute resin solution¹². The advantage of preparing a millbase in a solvent common to many paint systems is that it allows one to produce a multi-media tinter system. The paintmaker needs only to make one standard dispersion, which could be let down with different types of resins according to the specific customer's requirements. This single dispersion may be used as the basis for a large number of paints in place of the individual tinters previously required. The value of this procedure arises from the savings in time and energy by not having to produce, segregate and store a multitude of bases and tinters each in their own specific resin. The multi-media compatibility also facilitates the production of 'nuicance' specials and small lot manufacture.

One danger of storing pigment dispersions in pure solvents, is that if the containers are inadequately sealed, they may lose solvent due to evaporation. This may leave dry pigment lumps on the walls of such containers which could create problems during further let down or if used as a tinter. This can be overcome by incorporating into the

Table 1

Hyperdispersant millbases for paints and inks

| Pigment | Conventional Millbase Pigment Loading (%) | Hyperdispersant Millbase | | |
|------------------|--|--------------------------|---------------------|-------------------|
| | | Pigment (%) | Hyperdispersant (%) | White Spirit (%) |
| Titanium Dioxide | 65 | 80 | 1.0 | 19 |
| Pig. Blue 15.2 | 20 | 40 | 6.0 | 54 |
| Yellow Oxide | 35 | 70 | 2.1 | 27.9 |
| | | | | Xylene (%) |
| Red Iron Oxide | 45 | 70 | 2.1 | 27.9 |
| Pig. Yellow 34 | 55 | 72.5 | 1.5 | 26 |
| Pig. Red 104 | 55 | 80 | 0.7 | 19.3 |
| Pig. Green 7 | 20 | 35 | 4.0 | 61 |
| Pig. Blue 15.2 | 20 | 35 | 5.0 | 60 |
| Barytes | | 90 | 1.0 | 9 |
| | | | | Offset Distillate |
| Pig. Yellow 12 | 30 | 50 | 5 | 45 |
| Pig. Red 57.1 | 30 | 60 | 6 | 34 |
| Pig. Blue 15.3 | 35 | 50 | 5 | 45 |
| Pig. Black 7 | 30 | 50 | 5 | 45 |
| | | | | Toluene (Gravure) |
| Pig. Yellow 12 | 30 | 40 | 4 | 56 |
| Pig. Yellow 13 | 30 | 40 | 4 | 56 |
| Pig. Red 57.1 | 20 | 45 | 2 | 53 |
| Pig. Blue 15.3 | 25 | 40 | 4 | 56 |
| Pig. Black 7 | 25 | 45 | 4.5 | 50.5 |

millbase five percent or 10 percent of a resin which is compatible with the binder system in which the dispersion will be used. It will be found that such a small resin addition to a concentrated pigment dispersion will have a negligible effect on the final formulation.

Resin media of wide compatibility are commercially available and it is worth considering using these with the hyperdispersant in the production of multi-media tinting systems. The presence of some resin binder in millbases of high pigment content will also help stabilise the dispersion and reduce the chance of shock seeding on resin let-down if carried out under inadequate agitation.

4. *Higher solids content.* As surface coatings technology changes from low solids content based on high molecular weight polymers to the 'high solids' systems using low molecular weight polymers, it creates a need for hyperdispersants. It has been recognised that these newer polymers are not very effective as pigment wetters, but when used in combination with hyperdispersants it is possible to produce paints with high solids content and low volatile organic content.

Practical aspects of hyperdispersant technology

To obtain the optimum effects from hyperdispersants it is usually best to incorporate them into the millbase prior to dispersion. The simplest method is to add them directly to the dilute (5-10% solids) resin solution and ensure they are dissolved prior to the addition of pigment.

It is important to use the correct amount of hyperdispersant in the millbase and this depends on the surface area of the pigment when fully dispersed. Ideally, the pigment particles should be coated with a monomolecular layer of hyperdispersant to ensure maximum stability on storage. The presence of any excess hyperdispersant represents a waste of raw material and

indeed if it is not firmly adsorbed to the pigment surface, but is free to migrate in the surface coating, it could possibly lead to adverse effects on the film.

The amount of hyperdispersant required to wet out a pigment, may be calculated by determining its effect on millbase viscosity. When the hyperdispersant is added in increasing quantities, the viscosity of the dispersed millbase falls to a minimum level and then increases slowly. (See Figure 7). In practice it is found that the millbase having the lowest viscosity has the optimum ratio of hyperdispersant to pigment. By keeping this ratio fixed and increasing or decreasing the proportion of dilute resin solution in the millbase it is possible to formulate a millbase of suitable millbase viscosity. In practice it is normally found that, if the correct hyperdispersant has been used, the pigment content in the millbase formulation is significantly higher than in conventional millbases when the viscosity of the millbase has been correctly adjusted. It is also of interest to note that the tinctorial strength of pigments is also maximised when this optimum ratio of hyperdispersant to pigment is used.

An alternative method of determining a starting-point formulation can be obtained from a knowledge of the surface area of the pigment. As a general rule the use of 2 mg of hyperdispersant per square metre of pigment surface should be sufficient to provide a monomolecular layer. Thus for pigments of, say, 50m²/g surface area, e.g. phthalocyanine blues, 0.1 g of hyperdispersant/g of pigment are required, i.e. 10% of the weight of phthalocyanine blue. In the case of channel blacks which have very high surface areas, e.g. 500 m²/g, we would expect a higher hyperdispersant level to be required. In practice it is necessary to use 100% of hyperdispersant with respect to the weight of pigment; a 1:1 ratio of hyperdispersant: pigment is required to provide a monomolecular layer. While this appears to be a high level of hyperdispersant, the finished paint would contain very

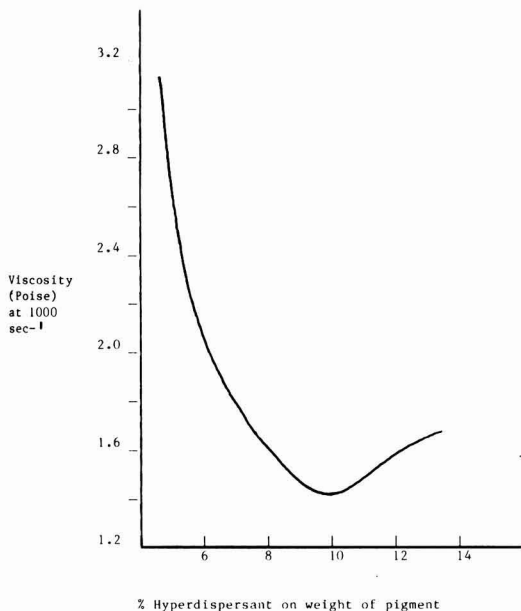


Figure 7. Effect of hyperdispersant concentration on viscosity (35.0% Dispersion Pigment Green 7 in Xylene/Butanol).

low pigment concentrations (2.5%) and in fact, the ratio of hyperdispersant to total binder will be correspondingly low. However, by using a 1:1 ratio on this high surface area carbon black, it is possible to produce greatly increased intensity or jetness with excellent flow and levelling, reflecting a superior state of dispersion.

One practical point to bear in mind is that for maximum effectiveness the hyperdispersant must wet out the pigment particles. It follows that if any other wetting agents or large concentrations of resin are present in the millbase with the hyperdispersant, there will be competition for the pigment surface. To obtain maximum effect from the hyperdispersant it is therefore essential to evaluate their potential in millbases free from competitive agents and to ensure that pigment contents are increased sufficiently to produce an adequate millbase viscosity.

Summary

Laboratory and bulk scale tests have confirmed that the hyperdispersants are highly effective in producing stable pigment dispersions. They offer the paint or printing ink formulator the possibility of obtaining better quality dispersions with improved rheological properties. The commercial attraction of using hyperdispersants arises from lower processing costs and from the higher strength obtained from the organic pigments which allows the formulator to reduce overall raw material costs. The potential applications of this technology are considerable and include high solids paints and inks and the production of multi-media tinting systems.

Hyperdispersant technology represents a major breakthrough, and it has changed pigment dispersion technology from an art into a science.

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Recent advances in crosslinking and curing applications to surface coatings

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Summary

The crosslinking or addition of "vinyl" polymers has been developed by a variety of methods, either internally or with external addition of a reactant. Crosslinking compositions may be prepared in water or solvents, and take place at ambient temperature, by stoving or radiation curing. Developments have been made with other reactive macromolecules, e.g. epoxides, polyurethanes, alkyd-melamines, and the more traditional alkyds. Drying by air oxidation is possible with poly(allyl ethers) and several other polymers with residual unsaturation.

Introduction

Vinyl and acrylic polymers have become well established as the basis for paint media, either in emulsion or solvent form. Application properties can be adjusted chemically by copolymerisation, and by the control of molecular weight. Application properties may be modified by variation of the rheology, especially in the case of polymer latices, and to some extent in the case of solvent-based polymers. The resultant films, however, have the general property of thermoplasticity. Thus they may be readily attacked by solvents, and possibly by acids or alkalis, most vinyl acetate polymers and copolymers being particularly susceptible. On the other hand, vinyl polymers are less susceptible to weathering than conventional drying oils, although white paints including copolymers with a high styrene content may yellow with time if exposed to sunlight. In the case of latices the included (co)polymers should with a few exceptions such as some core-shell or graft copolymers be above the minimum film forming temperature for satisfactory application. This may result in excessive film softness, and liability to easy scratching.

The disadvantages may be overcome by crosslinking (curing), i.e. the formation of a giant molecule *after* application. For this to occur there must be a reactive group within the polymer molecules which may be self-reactive. Since the general nature of crosslinking has been described in many publications^{2,3} details will not be given here. Fundamentally crosslinking implies that a three-dimensional macromolecule is formed. This can either be effected from polymers which are multifunctional, e.g. the condensation of glycerol with phthalic acid, or a copolymer including divinylbenzene and monomers such as styrene with a single double-bond. Another method of crosslinking is to include a monomer with residual unsaturation which is not directly polymerisable, e.g. dicyclopentadienyl methacrylate. The multiple double-bonds in the side chains enable oxidative drying to take place in the same manner as drying oils.

In some cases for example with copolymers including derivatives of acrylamide there is self-reactivity¹. Alternatively a macromolecule which is substantially linear may have reactive groups, e.g. carboxyl, hydroxyl, amide, which are able to react with another multifunctional molecule to produce a crosslinked product.

The nature of the polymer and its medium may vary over wide limits, i.e. 100% reactive material, non-aqueous solutions, emulsions (latices), mixed water-solvent solutions or completely aqueous (usually alkaline) solutions. The media may be pigmented, often with titanium dioxide. The composition as a whole must fulfil all the necessary requirements for application whether by brush, roller, spray or electrophoretic deposition. The film on application must satisfy practical requirements, e.g. non-sagging, avoiding mud-cracking, maintaining gloss when required, and have all the required resistance with regard to salt spray and weathering, *inter alia*.

Some recent claims will be included here. Many are of Japanese origin, and are usually patents. It is not usually possible to include reaction mechanisms, but modified monomers should prove of interest.

Vinyl Polymers—Curing via Residual Double-Bonds

As an example of the inclusion of multi-reactive monomers a polymer solution with dispersed silica is prepared including the polymerisable surfactant Na-2-methacryloylethane sulfonate(1), more familiar in emulsion polymerisation. The formulation is:

| | |
|--|------|
| Monomer (I) | 5 kg |
| Methyl methacrylate | 25 |
| Isopropanol | 225 |
| Toluene | 225 |
| Water | 15 |
| Silica, av. part. diameter 3.5 μ m | 50 |

The above is polymerised with an unspecified initiator at 50° for five hours. The procedure is thence as follows:

| | |
|--|--------|
| Monomer (1) | 100 kg |
| Dipentaerythritol tetra-acrylate | 40 |
| Dipentaerythritol penta-acrylate | 40 |
| Tetrahydrofurfuryl acrylate | 30 |
| Isopropanol | 125 |
| Toluene | 125 |
| α , α -dimethoxy- α -phenylacetophenone | 8 |
| Silicone leveller | 1 |

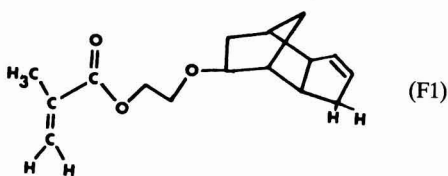
This composition is coated onto an acrylic polymer plate and cured with UV radiation for ten seconds to give a coating with 60° gloss 50 and strong scratch resistance. Note that a considerable number of reactions may occur in the above. There could be some grafting on to the initial base polymer, followed by crosslinking with the polyol acrylates, whilst the tetrahydrofuran ring might open, giving further scope of crosslinking, especially as there are surplus primary hydroxyl groups on the penta-erythritol tetra-acrylate⁴.

Tris(acryloylethyl) isocyanurate in conjunction with either 1,6-hexanediol diacrylate or pentaerythritol tetra-acrylate activated with benzoin isopropyl ether form cured

coatings with irradiation using a Hg lamp to give hard resistant coatings^{5, 6}.

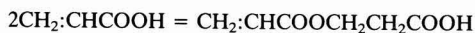
Solvent resistant coats include cyclopentadienyl methacrylate, methyl methacrylate, and isobutyl methacrylate (10:60:30). The composition, cured with the aid of a cobalt salt, also contains aluminium paste and chlorinated propylene⁷.

The inclusion of dicyclopentadienyl oxyethyl methacrylate is quoted as giving a residual double-bond in each unit of a polymer. It is prepared by the addition of ethylene glycol to dicyclopentadiene, then transesterification with methyl methacrylate by classical methods. It is considered superior to dicyclopentadiene methacrylate, made by direct addition, as this latter compound has a marked odour. The residual double-bonds are allylic. The addition of a cobalt salt enables crosslinking to take place. It is known that whilst the initiating reaction has not been exactly defined, it probably proceeds via a hydroperoxide formed by auto-oxidation. The radical then attacks an unoxidized allylic bond⁸.



Dicyclopentenoxylethyl Methacrylate

In the past it had not been realised that acrylic acid slowly polymerises on storage, not via the normal method of vinyl addition, but by a Michael auto-catalysed reaction. Thus:

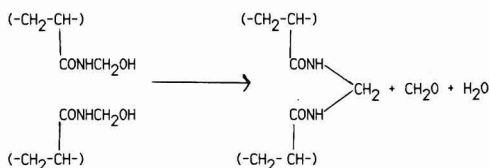


This step-wise addition continues and trimers, tetramers, etc. are formed, the technical product being a commercial mixture with about 45-65% of dimer acid. The pure dimer is much more viscous than the monomeric acrylic acid, and has little volatility, the boiling point being 98°C at 0.1 mm. These acids can form polyol esters in the same way as acrylic acid. Coatings formed from these polyols in solvents may be pigmented, and used *inter alia* for film forming. The trimethylolpropane triester converts faster and more completely when subject to an electron beam. Tests show that gloss is retained on cure, unlike the corresponding acrylic ester. This is hardly surprising since the dimers and other monomers are obviously not excessively reactive, the cure being more gradual, yet more complete than acrylate esters of polyols, where excessive hardness initially may prevent proper cure, yet cause considerable irregularity⁹.

An aliphatic epoxide acrylic diester is mixed with a silicon-containing compound including a silanol group, e.g. $(\text{C}_6\text{H}_5)_3\text{SiOOC}(\text{CH}_3)_3$ and aluminium tri(acetylacetonate) as catalyst (100:2:1). Whilst stable in the dark for at least 30 days, this blend may be radiation cured on tinplate to give an adherent coating with 2H hardness¹⁰.

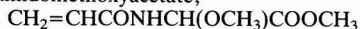
Cure by internal reactive group

One of the best known series of compounds by which cure is effected often without an external addition, and which may occur at ambient temperature are the reactive derivatives of acrylamide, $\text{CH}_2\text{:CHCONH}_2$ which is more frequently encountered as the derivative N-methylolacrylamide, $\text{CH}_2\text{:CHCONHCH}_2\text{OH}$, readily obtained by a condensation with formaldehyde under alkaline conditions. These may be further reacted with a primary alcohol, especially methanol under acid conditions to form ethers. The most usual ether is methoxymethyl acrylamide $\text{CH}_2\text{:CHCONHCH}_2\text{OCH}_3$, although the isobutyl ether $\text{CH}_2\text{:CHCONHCH}_2\text{O-iso C}_4\text{H}_9$ has been made available. The isobutyl ether has the advantage that it is monomer-soluble which makes for much easier operation. The other derivatives, because of their aqueous solubility are mainly of interest in aqueous or hydrophilic compositions. Acrylamide is a highly reactive monomer. Some of the reported rates for relative reactivities in the literature show wide discrepancies, and they are therefore not recorded here. This seems to be an effect of the lack of mutual solubility, particularly in aqueous media. There have been a number of theories as to the crosslinking reaction effected by the crosslinking of acrylamide derivatives, in particular of N-methylolacrylamide. The most well-known is the elimination of formaldehyde:



However some doubts have been expressed over whether this is actually the case as several papers report that formaldehyde emission has not been detected, unlike the case with aminoplasts. Elimination of water between two molecules resulting in ether formation would also give a crosslinked product.

Acrylamidomethoxyacetate,



is converted to a copolymer in methyl isobutyl ketone with the following formulation:

| | |
|--------------------------|-------|
| Acrylamidomethoxyacetate | 38.48 |
| Methyl methacrylate | 38.4 |
| Acrylic acid | 48 |
| Styrene | 52.8 |

To this is added a ketimine from an amine-terminated triazine resin. The mixture, which has good shelf stability, is coated on to pre-treated steel panels, and moisture cured, a feature of the ketimines. This is because they are not effective until they react with free moisture in the air, releasing amines. The ketimines are normally utilised as cures for epoxide resins. The coatings exhibited high MEK resistance and developed Knoop hardness 7.1 in 14 days¹³

Acrylamidomethoxyacetate is crosslinked by a di- or poly-amine. The ester group is activated by the adjacent amine and therefore ambient crosslinking occurs. Curing is also possible with diols, polyols and OH functional groups,

using acid catalysts. This is of especial interest since there are no formaldehyde or formaldehyde releasing groups in the preparation of the monomer. This monomer is also useful in latex copolymers. One recommendation is for wood finishes¹¹. The above acrylamidoglycollate may also be reacted with an amine-terminated triazine resin, and is suitable as a component of a copolymer solution intended for aluminium panels, which are cured for 20 minutes at 120° giving a solvent resistant coat¹².

Another type of crosslinking acrylic polymer is formed from 2-isobutyl-2-methyl-1,3-dioxalan-4-yl-methyl methacrylate(1) (30-50), 2-ethylhexyl acrylate (5-15), methyl methacrylate (10-15) and acrylic acid (2-5), these figures being expressed as percentages. A composition is deposited on aluminium at 20-25°, and cured either by UV radiation or heat at 100-140°¹⁴.

A rather ingenious method of ensuring UV cure without adding an activator is to react 2-hydroxyethyl methacrylate with 3,3',4,4'-benzophenone-tetracarboxylic acid in a 1:2 ratio. The ester formed is coated at 120 µm on copper sheet, and cured by UV radiation to a pencil hardness 5H¹⁵.

In a fundamental investigation copolymers including hydroxyl or epoxide groups, e.g. butyl methacrylate and glycidyl methacrylate, the latter up to 51% moles, were submitted to a secondary reaction with methacrylic acid, thus ensuring the presence of unsaturated side groups. Photopolymerisation took place with irradiation at 350 nm in the presence of benzoin isopropyl ether. The activation energy is a function of film thickness because of segmental motion and viscous flow effects. Infra-red spectrophotometry and microcalorimetry were used to determine the crosslinking effect¹⁶.

Crosslinking with secondary additives

A large number of modifications have been made with the now traditional combinations of reactive acrylic monomers containing hydroxyl, epoxide or acid groups with hydroxy-alkylmelamine and its modifications. Most processes require heat for cure and are useful for a range of metal coatings. Normally these require very exacting specifications, e.g. for car finishes. One specification quotes two combined copolymer solutions, with butyl methacrylate, methyl methacrylate and styrene as principal monomers. One copolymer contains glycidyl methacrylate and hydroxypropyl methacrylate the other hydroxyethylacrylate. Crosslinking is with hexamethoxy-methyl-melamine¹⁷.

Alkyl sulfamates, e.g. N,N-p-dimethylsulfamate as a 2% additive to an acrylic/melamine show no viscosity increase over two years, but have good curing profiles at 163°¹⁸. Polycyclic esters of sulfonic acids are also suitable catalysts for the acrylic/melamine aminoplast reaction, likewise the cyclohexyl ester of p-toluenesulfonic acid, and 2,2,4-trimethyl-1,3-pentanediolmethane sulfonate^{19, 20}.

Specifications are too numerous to quote in detail; in some cases coatings being in latex form. A regular series of bulletins describing improvements is available²¹.

Amongst less well-known crosslinking agents are polycarbodiimides. It is known that the monomeric type are highly toxic, but a polycarbodiimide formed from butyl isocyanate, isophorone diisocyanate in amyl acetate

(68.8:231.2:282) with 10% 3-methyl-1-1-phenyl-2-phospholene-1-oxide solution 18 part is heated for 144 hours at 145° to give the polycarbodiimide²².

Miscellaneous – Vinyl and Allyl unsaturation

Anticorrosive cathodic electrophoretic coatings from an ungelled epoxide-modified polybutadiene are reacted with a polyol, e.g. trimethylolpropane, and finally blended with a butylated melamine aminoplast. Coating is at 300V, then baking at 180°C for 30 minutes²³.

There have been a number of improvements in unsaturated polyesters, some in emulsion form, especially if modified by monomers such as maleic anhydride, styrene and acrylic esters. These are mainly improvements in existing technology rather than major developments. The inclusion of a dicyclopentadiene derivative similar to that shown in Formula F1 has been included in one case with linseed oil and a phthalic alkylid in a coating which at 45 µm thickness resists 1,200 hours of salt spray after air drying for ten days²⁴.

2,3,5-cyclopentylacetic acid and diaminodiphenyl ether are condensed in dimethylformamide to form a polyimide and 100 parts blended with three parts triallyl cyanurate and three parts dicumyl peroxide. Crosslinking takes place at 160° in 30 minutes. Note that the allyl compound is essential²⁵.

Epoxides and polyurethanes

It is much more difficult to pinpoint specific developments in the crosslinking of epoxide resins and polyurethanes than it is of the vinyl series. New formulations are very numerous, but are often improvements of known technology designed for specific ends. This is a general feature of the crosslinking of "step addition" macromolecules, to use the modern phrase. Only a limited number are directly concerned with the coatings industry. Some disclosures describe the inclusion of epoxide groups in compositions which are intended for electrocoatings or are cured by UV radiation. Thus the reaction product of Epon 1001 and triethylenetetramine ketimine with propylene carbonate as curing agent is electrodeposited on to steel and is cured at 182° for 30 minutes to a 76 µm coating²⁶.

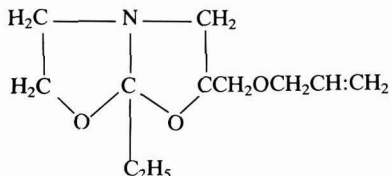
A self-crosslinking resin is obtained by reacting Epon 828 with a dienophilic amine, e.g. furfurylamine in mixed glycol ethers, followed by the reaction product of 7-oxabicyclo(2.2.1)hept-5-ene-2,3-dicarboxylic anhydride and isophoronediamine, each reaction being at 60°. This resin is self-crosslinking and after pigmentation and acidifying with acetic acid is electrodeposited on metal and baked at 150-180° for 30 minutes to cure²⁷.

Epoxide resin precursors, when used as coatings which are cured by radiation, contain a suitable catalyst. Diphenyl iodonium tetrafluoroborate has been used in conjunction with a coating formed from a 1:1 allyl alcohol-styrene-copolymer, (3,4-epoxycyclohexyl)3,4-epoxycyclohexane-carboxylate and 3 phr of catalyst which after coating on tinfoil gives a tack-free coating at two seconds with an 80-W/cm Hg lamp. A novolak-epoxide with an epoxidized polybutadiene (1:1) with 5 phr of catalyst cures a 5 mil coating on steel to pencil hardness 6H in six seconds giving a coating which withstands solder, flexing at 180°, and has good impact and weather resistance^{28, 29}.

This type of catalyst has been generally developed so as to include salts including pyridium or pyridine rings, and anions from BF_4 , PF_6 , SbF_6 and AsF_6 .³⁰

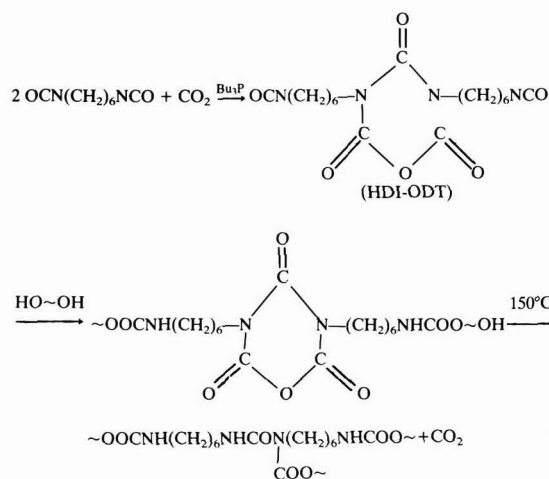
Tris(ethylacetoacetato) aluminium is included at 1 phr with a photocurable aliphatic epoxide also including *tert*-butylperoxytriphenylsilane (4 phr) and methylvinylsiloxane (1 phr), the UV cure lasting 30 seconds, with dielectric loss tangent 2%³¹.

Similar considerations to those applying to epoxides may apply to the curing of polyisocyanates. Thus an amide acetal as shown which is also an allylic derivative is mixed with hexamethylene diisocyanate (4.3:8.4).



Cure is effected in two days at ambient temperature, to give a film which is resistant to 5% caustic soda, and with methylethyl ketone and xylol resistance. The curing mechanism is probably quite complex, although it is not clear whether the allyl group takes any part in it. Possibly there might have a reaction by atmospheric oxidation as already described^{32, 33}.

The 2H-1,3,5-oxadiazine-2,4,6(3H,5H)-trione ring is synthesised from two moles of alkyl diisocyanate and one mole of carbon dioxide in the presence of a catalyst, e.g. tributyl phosphine. A polyurethane prepolymer is obtained by the reaction of diisocyanate with this ring, and a polyhydroxyl compound. The prepolymer can be crosslinked by heating with liberation of carbon dioxide:



For the second reaction a strongly basic *tert*-amine without steric hindrance is the preferred catalyst. The prepolymer may also react with acrylic polyols. Coating compositions including triols show comparable drying and

hardening abilities to the conventional polyisocyanate hardeners.

Less hardness is needed than with conventional types³⁴.

Curing with UV light has been especially noteworthy with urethane acrylates. One example quotes a prepolymer derived from TDI including sorbic acid which is cured with sorbic acid/trimethylpropane triacrylate with benzoin propyl ether as activator in a manner similar to the polyol acrylates quoted already, after coating on steel or copper³⁵.

Other examples include isobornyl acrylate with hexanediol diacrylate with a polyester diurethane diacrylate and acrylic acid which are cured by UV light to give a crack resisting coating³⁶. A solution of an allyl alcohol-styrene copolymer with a polydiisocyanate and octa-*tert*-butylcyclo-tetastannane is coated on to steel baked at 175° for 15 minutes and cured by UV for two minutes to give a film pencil hardness 3H³⁷.

Alkyds

There have been a number of modifications of the type known as styrenated alkyds, but which in practice include other monomers. The use of glycidyl esters of drying oils enables acid monomer units to enter the same molecule as in the following formula operated as a blend of two 80% solutions, A and B:

| | | |
|---|--|------|
| A | Acrylic acid | 13.5 |
| | Butyl methacrylate | 20 |
| | Styrene | 7.1 |
| | Linseed oil fatty acids glycidyl ester | 12.5 |
| B | Methacrylic acid | 7.8 |
| | Butyl methacrylate | 22.1 |
| | 2-hydroxyethyl methacrylate | 8 |
| | Linseed oil fatty acid glycidyl ester | 31 |

The blend is as follows:

| | |
|---------------------|------|
| A, reaction product | 12.5 |
| B, reaction product | 18.7 |

A film of 42 μ without sagging has a tack-free time of one hour, an improvement on the first resin alone³⁸.

Conclusion

This paper indicates some of the directions in which improvements in crosslinking have been made with special regard to coatings. There are many gaps, e.g. siloxane derivatives, and further possibilities for water-based ambient crosslinking compositions. This survey does indicate a few of the routes by which development is proceeding in obtaining desirable properties without sacrificing others, and with the minimum of subsequent treatment, the ultimate object being the perfect ambient curing paint.

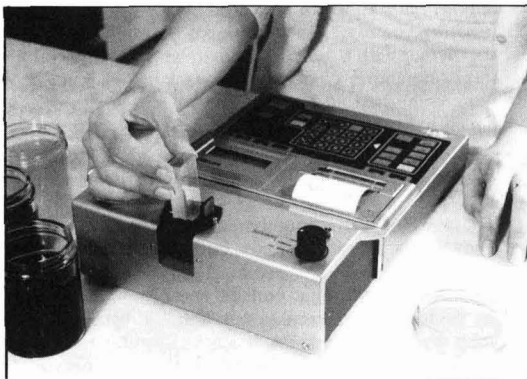
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- N.B. JK refers to Japan Kokai, unexamined Japanese patent application.

The reliability of durability testing

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Abstract

Durability is a property of interest to most of us in the surface coating field. It holds the distinction of being one of the most studied but least understood aspects of surface coating technology. This paper seeks to review the factors which can produce misleading results. Exposure conditions are important, and the selection of natural exposure sites and accelerated conditions are discussed, together with instrumentation which aids this selection. A more fundamental discussion of the factors which can influence durability is then presented, with the effects of film thickness and pigment flocculation being amongst the topics discussed. Finally, concentrating on accelerated testing, information is presented on the importance of correct operation. This includes the maintenance of constant light intensity, and the provision of pure water when it is sprayed over panels. The effect of water contaminants is illustrated.

Introduction

A common factor linking many different products and fields of endeavour is how well a surface coating will stand up to exposure to the elements. In the early days of the surface coating industry, when a nitrocellulose automotive paint required weekly polishing to retain an acceptable gloss, it was relatively easy to demonstrate acceptable durability performance. This was done with a makeshift fence outside the factory in a matter of a few months.

Modern paints present different problems altogether. Modern day business practices will often not allow us the luxury of extended testing, and where companies are offering 10 or even 20 year guarantees on paint film integrity, how often will this be backed up by actual exposure testing? More and more, manufacturers are being forced into accelerated testing as a means of comparing the durabilities of their products.

The question then arises as to how close is the correlation of accelerated weathering to natural weathering, a subject which has been under study for many years, and which has generated many publications^{1, 2}. Tioxide has undertaken numerous studies of various aspects of weathering with a view to improving the reliability of accelerated data. Taken together, these indicate that the degree of realism achieved is directly related to the thought and effort that is put into the tests themselves. Good correlation is obtained in isolated cases, but generally the absolute agreement is poor.

This paper examines the degree of correlation that has been achieved between natural and accelerated exposures, or the reliability of the results as a means of predicting natural exposure behaviour, and goes on to examine the factors which can influence the performance of a pigment, and change its performance relative to another.

Accelerated testing

Titanium dioxide is the main white opacifier in use today. It is also an efficient ultra-violet absorber, and can prolong the life of coatings by protecting the binder from photochemical attack. Titanium dioxide also has a

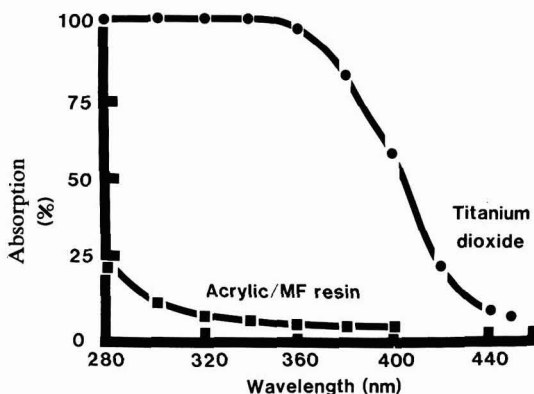


Figure 1. The absorption spectra of rutile titanium dioxide and an acrylic resin.

photocatalytic effect by which it forms reactive species³ on irradiation with light of less than 410 nm. These species are formed when excited states formed by irradiation interact with oxygen and water, and subsequently degrade the binder surrounding the pigment particles. In highly durable resins, this can outweigh the protective aspect, causing the degradation of polymeric materials into which it is incorporated. This process acts in addition to the photochemical degradation of the polymer itself, and causes complications in the weathering behaviour of the system, in particular in the response to changes in wavelength of degrading radiation.

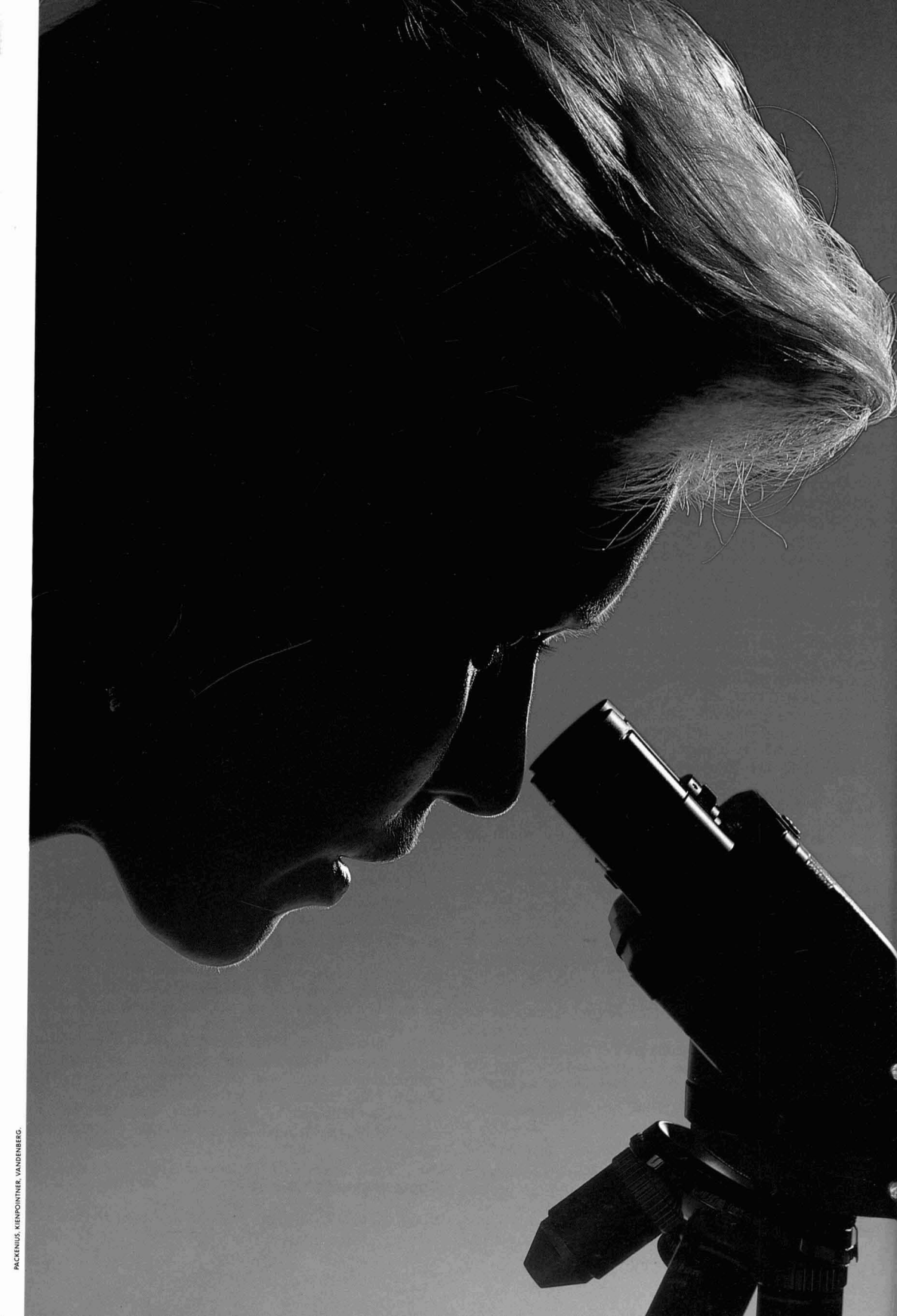
This problem arises since titanium dioxide absorbs ultra-violet strongly at all wavelengths of less than 410 nm, and thus all ultra-violet can cause photocatalytic degradation. Binders, on the other hand, absorb to a lesser extent, and sometimes over smaller wavelength ranges. Durable binders in particular absorb significantly over only a very small part of the spectrum of sunlight, and absorption is a necessary precursor to photochemical degradation of the binder itself.

The absorption characteristics of titanium dioxide and a durable acrylic resin are compared in Figure 1. Figure 2 shows the ultra-violet spectrum of sunlight, and comparing this with Figure 1 it can be seen that both photochemical and photocatalytic modes of degradation will be active in sunlight, causing both photochemical decay of the resin and photocatalytic release of the pigment as chalking.

The photocatalytic effect already mentioned operates at all wavelengths in the ultra-violet region. By contrast, the photochemical effect can only occur where the resin absorbs, and Searle⁴ has shown that absorption is not necessarily followed by degradation, since the fate of absorbed energy depends on the chemical nature of the binder.

Comparison of pigments

When seeking to emulate sunlight with light sources not



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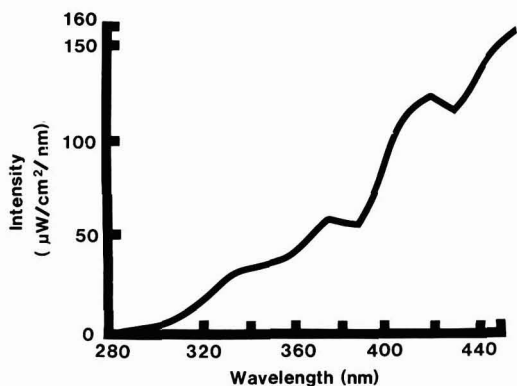


Figure 2. The intensity of UK summer sunlight in the ultra-violet region.

identical to sunlight, the realism achieved is a function of the binder, and the selection of the wrong source can lead to misleading conclusions, especially for gloss results. A study has been undertaken of this point⁵, using a fluorescent tube/condensation device, which lends itself to this work by having a variable wavelength capability. Wavelength was varied by choosing different fluorescent tubes, and combinations of them. The study involved four paints pigmented with four different rutile titanium dioxide pigments, spanning the range from superdurable to non-durable, with two pigments of intermediate durability.

Figure 3 shows the correlation with Florida observed for the gloss response of four acrylic/MF paints containing these different pigments under a variety of wavelengths. Exposure times were 31 months for Florida exposure, 1,000 hours for the two single tube conditions, and 2,800 hours for the two combinations, since degradation was slower with the longer wavelength combinations. The results are expressed in terms of a positional correlation, where the pigment with the best gloss retention at Florida is given position 1, and plotted against the position of that pigment under each source, and so on for the other three pigments. The results demonstrate that for a realistic gloss performance, the final combination of 370 + 410 nm tubes was the best.

The light sources used in this study have been examined using a spectroradiometer. This instrument provides a measure of the intensity of light from a radiant source as a function of wavelength. This has proved useful in rationalising some of the results obtained in investigations of accelerated weathering. Briefly, it comprises a monochromator with a light sensor attached to the exit port. The monochromator scans over the desired range, and the signal produced by the light sensor is converted to an intensity reading by a computer.

Figure 4 shows the wavelength distribution of the sources used in the above work, and it is obvious that the 370 + 410 nm tube combination which gave the best correlation in Figure 3 has a distribution which closely resembles sunlight. For reliable reproduction of gloss performance at Florida, then, it is best to choose a light source resembling that of daylight, in which all regions of the ultra-violet spectrum are represented in realistic proportions.

This may be further illustrated by the results obtained in

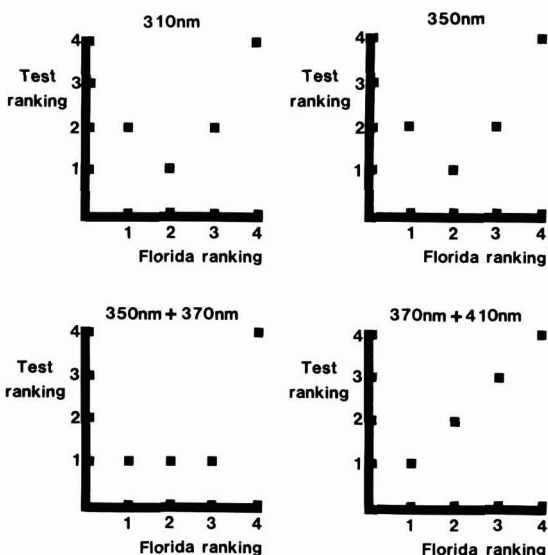


Figure 3. Positional correlation for the gloss retention of four grades of rutile titanium dioxide pigment exposed under four different light sources with the results obtained at Florida in an acrylic resin. Exposure times for the 310nm and 350nm illuminants were 1000 hours and, for the remaining conditions 2800 hours. Exposure time at Florida was 31 months.

an extension of the above work. Other machines were used to weather the same set of four pigments, and the correlation between them and Florida was examined. The machines used were an ultra-violet carbon arc device, and a xenon arc machine using both filtered and unfiltered conditions. Exposure times were 1,500 hours under the carbon and xenon arcs, and 31 months at Florida. The gloss results obtained are shown in Figure 5, in terms of a positional correlation as discussed above. These results indicate that better agreement with Florida is obtained by using the filtered conditions than by using the unfiltered xenon arc. The carbon arc is also seen to be giving relatively good correlation with Florida. Their emission spectra, as measured with the spectroradiometer, may again be used to throw light on their performance. Figure 6 demonstrates that the filtered xenon arc is more akin to sunlight than is the unfiltered, which has excessive intensity in the short wavelength ultra-violet region. The carbon arc is seen to be unrealistic, which makes the good results obtained surprising.

The basic requirement of heat, ultra-violet light and moisture are fulfilled by a number of weathering machines, and a novel method of producing degradation by excited oxygen has been proposed as a rapid alternative to their use⁶. This involves bombarding small paint samples with excited atomic and molecular oxygen produced in a microwave discharge, and can yield results in a matter of minutes. The technique was evaluated in a wider study than that which produced the results shown in Figure 3. Eight pigments (A to H) were involved in this work, and compared to the previous exercise, a smaller range of photoactivities was involved.

The greater number of pigments allows the use of correlation coefficients, together with the simple ranking system used in Figure 3. In this case, 1 is the best and 8 the worst. The method used is that of Spearman⁷, and if n

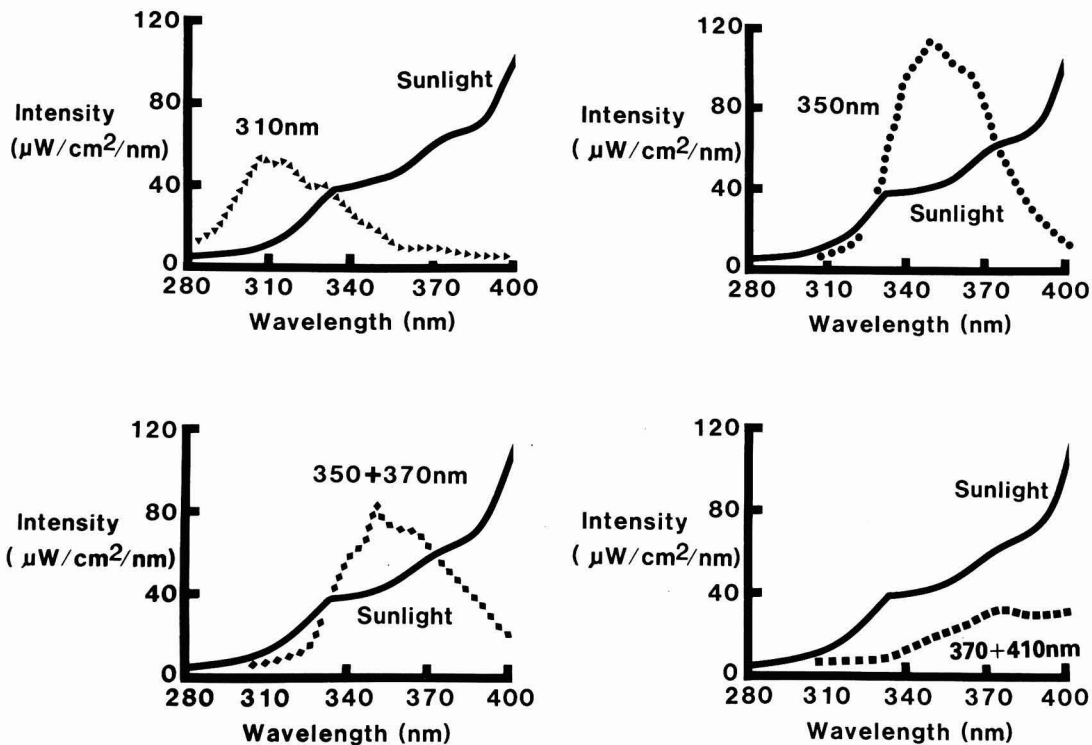


Figure 4. The spectra of the four illuminants used in Figure 3. Solid lines indicate UK summer sunlight, and broken lines the different illuminants.

pigments have positions $x(1), x(2) \dots x(n)$ in a given environment, and positions $y(1) \dots y(n)$ in another, then the positional correlation is given by:

$$PC = 1 - \frac{6d}{(n^3 - n)}$$

$$\text{where } d = \sum_0^i (x_i - y_i)^2$$

A good correlation is indicated by a positional correlation of 1, and a perfect inverse correlation by -1 .

Sample results are given in Table 1, comparing the interim results after two years' Florida and Carlton, Cleveland, U.K. exposure with 4000 hours' exposure in a carbon arc machine, 2000 hours' in a fluorescent tube/condensation machine, and with the excited oxygen results. These demonstrate that the best correlation with Florida was achieved by the Tiioxide Weathering Station at Carlton, Cleveland. A twin carbon arc weathering machine produced the next best correlation, closely followed by the 350 + 370 nm combination in the fluorescent tube/condensation device used in the previously reported exercise. The figure for the excited oxygen weathering machine of -0.41 indicates that in this case, the desire to obtain results as quickly as possible has prejudiced accuracy. Although the technique involves excited species similar to those involved in photocatalytic degradation, they are applied externally, rather than being generated internally around the pigment particles. The effect is to simulate photochemical

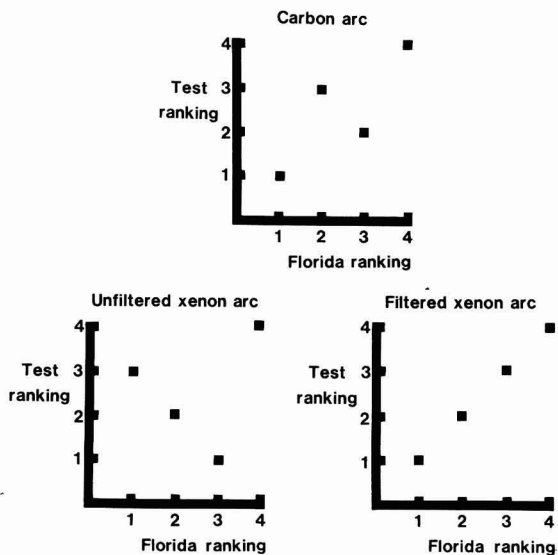


Figure 5. The correlation between accelerated testing and Florida results for the gloss retention of four grades of rutile titanium dioxide pigment in an acrylic resin under various exposure conditions. The Florida exposure was for 31 months, and all other exposures were for 1500 hours.

degradation alone, and to ignore photocatalytic degradation. The consequential effect on the correlation with Florida is disastrous.

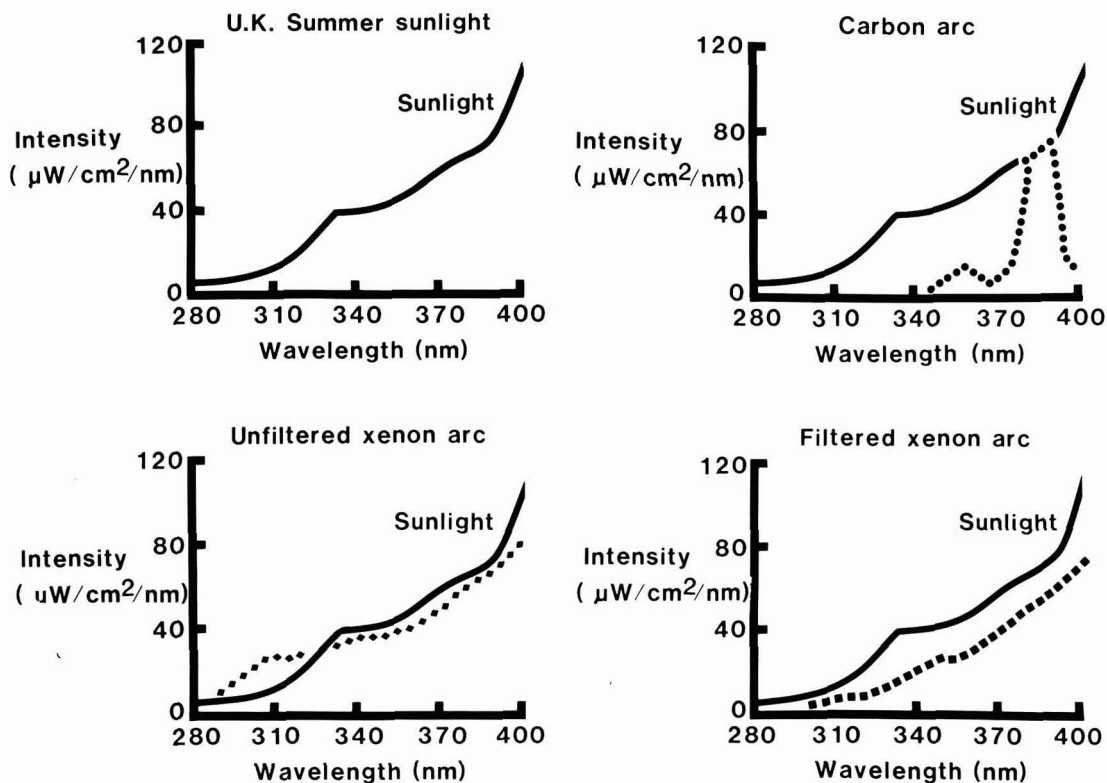


Figure 6. The spectra of the three illuminants used in Figure 5. Solid lines indicate UK summer sunlight, and broken lines the different illuminants.

Table 1

Positional correlation for the gloss retention of eight pigments exposed in an alkyd/MF resin under various natural and accelerated conditions. Exposure times were two years for the natural exposures, 4000 hours for the carbon arc and 2000 hours for the fluorescent tube/condensation machine.

| Pigment | Florida | Carlton | Carbon arc | Fluorescent tube/condensation machine 350+370nm | Excited oxygen technique |
|-------------|---------|---------|------------|---|--------------------------|
| A | 1 | 2 | 1 | 2 | 5 |
| B | 2 | 2 | 5 | 1 | 8 |
| C | 3 | 2 | 2 | 2 | 2 |
| D | 3 | 2 | 4 | 7 | 3 |
| E | 3 | 1 | 6 | 2 | 7 |
| F | 3 | 2 | 3 | 2 | 3 |
| G | 7 | 8 | 8 | 8 | 6 |
| H | 8 | 7 | 7 | 6 | 1 |
| Correlation | — | 0.88 | 0.73 | 0.69 | -0.41 |

Comparison of resins

The variation in order of performance observed in a series of pigments in a given resin system in different weathering environments becomes small when compared with that seen for a series of resins containing one pigment under different conditions. This is because although pigments are designed to exhibit quite wide variations in durability, they are all

basically the same material with the same absorption spectrum. A series of resins is quite different, in that each has its own absorption spectrum, quite different from another resin of different chemical composition. Bearing in mind that in order for light to have any effect, it must first be absorbed, the comparison of a range of resins in an accelerated weathering environment becomes a problem.

If the response to sunlight is the desired criterion, then the broad envelope of the solar ultra-violet spectrum, with its wide range of constituent wavelengths becomes difficult to mimic with any of the radiation sources in use in accelerated weathering machines. This can be demonstrated by reference to Table 2, where results are reported from a study involving a single pigment in a range of five different resins, ranging from a polyurethane to an air-drying alkyd. Exposure times were 30 months at Florida and Carlton, 2000 hours in the carbon arc, 1000 hours under 310nm illumination, and 2800 hours under the less aggressive mixed 350 + 370nm illumination. Carlton and the carbon arc both show excellent agreement with Florida, but the two fluorescent tube/condensation machine conditions produced only moderate correlations. Reference to Figure 6 shows that it is the sources with large amounts of short wavelength ultra-violet radiation that are producing the poor results. This is probably due to excessive amounts of photochemical degradation with these sources.

As an aside, it is equally true that natural weathering sites can produce results that are at odds with each other. In none of the exercises reported so far has Carlton agreed

Table 2

Positional correlation for the gloss retention of five resin systems containing a single pigment under various natural and accelerated conditions. Exposure times were 30 months for each of the natural sites, 2000 hours for the carbon arc, 1000 hours for the 310nm illuminant and 2800 hours for the 350 + 370nm illuminant.

| Resin system | Florida | Carlton | Carbon arc | Fluorescent tube/ condensation machine | |
|--------------|---------|---------|------------|---|-------------|
| | | | | 310nm | 350nm+370nm |
| | | | | | |
| Polyurethane | 1 | 1 | 1 | 5 | 3 |
| Alkyd/MF | 2 | 2 | 2 | 3 | 2 |
| TS acrylic | 3 | 3 | 3 | 1 | 1 |
| A/D alkyd | 3 | 4 | 4 | 4 | 4 |
| Latex | 5 | 5 | 5 | 2 | 5 |
| Correlation | — | 0.95 | 0.95 | 0.55 | 0.55 |

totally with Florida. A wider series of exposures illustrating this point further formed part of a weathering site inter-comparison involving 11 pigments (A to K) in six resins at 11 natural sites. Table 3 is a positional correlation between Huelva (Spain), Arizona and Florida, for one of the systems under test, a thermosetting acrylic/MF. Results are for 12 months exposure.

The results indicate another less-than-perfect correlation. The reasons for this variation include differences in latitude, humidity and prevailing weather, all causing differences in the nature of the irradiation, and hence in the response of the pigments to weathering. This supports Scott's observation that Florida is not always the right place to test paints, and it would be perhaps better to test them in the intended place of application⁸.

Reasons for variations in exposure within a test

Having examined the variations which can arise between different exposure environments, some of the factors which can lead to misleading results within one series of paints in one given test will be examined. These are film thickness, flocculation and contamination within a weathering machine.

Film thicknesses

Dealing first with film thickness, it must be acknowledged from the start that this does not affect such parameters as gloss retention and chalking, which are of everyday concern to the paint manufacturer. When developing new grades of pigment, however, it is often found useful to have a quantitative way of comparing the absolute rates of erosion of paints, and for this reason, mass loss is sometimes found to be of use. This involves the periodic weighing of panels throughout exposure, and of course, the need to prevent scratching and chipping of panels is obvious.

What may not be so apparent, however, is the extent to which the variation in film thickness can alter the rate of loss of paint from a panel. Figure 7 shows the increase in extent of mass loss after 3000 hours weathering for four alkyd/MF paints with increasing film thicknesses. Due to the efficiency with which titanium dioxide absorbs ultra-violet light, it might be expected that ultra-violet light would be attenuated so rapidly that after quite a small increase in thickness, no further increase in extent of mass loss would be observed. As can be observed in Figure 7, the extent of loss continues to increase as the thickness is

Table 3

Positional correlation for the gloss retention of eleven pigments in an acrylic/MF resin exposed at several natural sites for 12 months.

| Pigment | Florida | Carlton | Huelva | Arizona |
|-------------|---------|---------|--------|---------|
| A | 1 | 1 | 1 | 5 |
| B | 2 | 1 | 9 | 1 |
| C | 3 | 1 | 6 | 2 |
| D | 3 | 1 | 1 | 3 |
| E | 5 | 1 | 4 | 4 |
| F | 5 | 1 | 6 | 6 |
| G | 5 | 9 | 1 | 9 |
| H | 5 | 9 | 4 | 6 |
| I | 9 | 1 | 9 | 6 |
| J | 10 | 1 | 6 | 9 |
| K | 11 | 9 | 9 | 11 |
| Correlation | — | 0 | 0.54 | 0.78 |

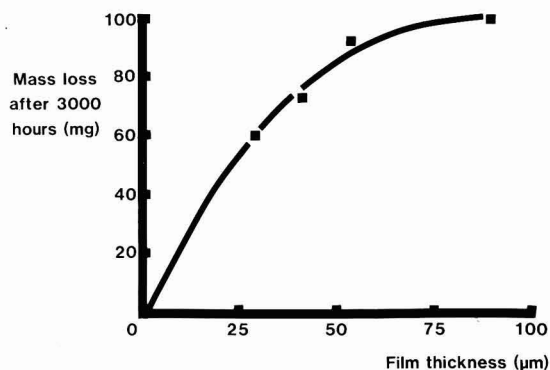


Figure 7. The increase in extent of mass loss with the film thickness of four pigmented alkyd/MF paints exposed in a twin carbon arc weathering machine.

increased to quite high levels. If mass loss is being used as an indicator of paint performance, then some allowance must be made for any variation in applied thickness. The effect is resin dependent, being more marked in some resins than others. The results indicated that the severity of the effect decreased in the order polyurethane > alkyd/MF > acrylic/MF > thermoplastic acrylic.

Flocculation

Flocculation is more universal in its effects. A study was undertaken in which a single pigment was made up in a single millbase for six different resins. A third of the dispersed millbase was taken and a flocculating agent was added to induce flocculation. This flocculated millbase was then made into a paint. The remainder of the millbase was stabilised, divided in half, and one half was treated with the flocculating agent. Both portions were then made up into finished paints. This procedure resulted in three paints of varying flocculation levels, as confirmed by the flocculation gradient technique⁹.

The addition of the flocculating agent to the millbase resulted in the greatest amount of flocculation, followed by the paint which was post-treated. The untreated paint had the lowest level of flocculation, as expected.

These paints were then exposed both in a twin carbon arc machine and at Florida, and both mass loss and gloss retention were studied. The gloss results for a typical case,

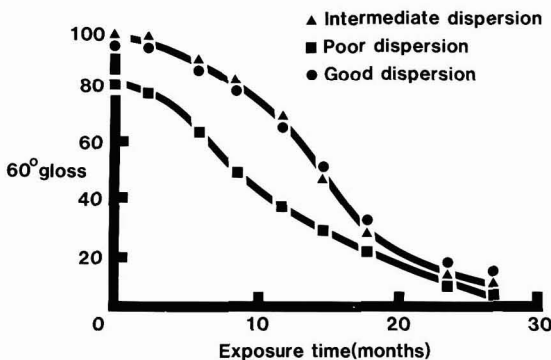


Figure 8. The influence of flocculation on gloss retention of a polyurethane paint exposed at Florida for 32 months.

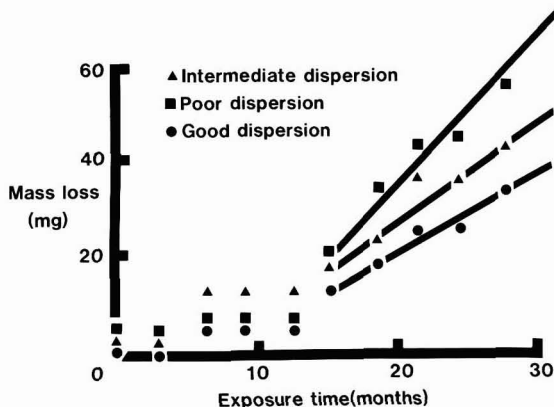


Figure 9. The influence of flocculation on mass loss of a polyurethane paint exposed at Florida for 32 months.

(a polyurethane paint at Florida), are shown in Figure 8. They show not surprisingly that increased flocculation leads to poorer gloss retention.

The results for mass loss in the same resin system are shown in Figure 9. It seems as if the flocculation encourages the loss of titanium dioxide, probably because the penetration of ultra-violet light into the film is increased as flocculation increases. Thus mass loss increases in rate with the extent of flocculation.

The two effects just outlined can have serious effects on the reliability of an exposure test. If one or two paints in a series have a greater or lesser film thickness than the norm, or if one of the paints has been shocked during let-down, causing flocculation, then results will at best be more scattered than the ideal. If the offending paint is a standard, the entire test may become of dubious worth.

Light intensity

The spectroradiometer equipment mentioned earlier has been used to monitor the ultra-violet output of carbon arc machines, and paints have been exposed to see how the variation in intensity observed affects the weathering behaviour of paints. The results are shown in Table 4. As would be expected, higher average intensity leads to more rapid loss of mass and gloss, and to more rapid evolution of chalk. This should not affect the reliability of results

Table 4

The changes in extent of mass loss, gloss retention and chalking for three alkyd paints exposed for 3250 hours in carbon arc weathering machines exhibiting different power outputs.

| Machine number | Relative peak intensity | Relative degree of mass loss | Relative degree of gloss loss | Relative extent of chalking |
|----------------|-------------------------|------------------------------|-------------------------------|-----------------------------|
| 4 | 1.8 | 1.31 | 1.20 | 2.25 |
| 6 | 1.4 | 1.23 | 1.16 | 2.84 |
| 9 | 1 | 1 | 1 | 1 |

providing that a standard of known durability is included in each programme, and results are quoted relative to that standard.

Water contamination

The final reliability factor to be discussed affects test programmes as a whole, but its severity may vary from pigment to pigment. The factor is contamination of panels during testing, and as such the remarks apply to accelerated weathering machines, in particular those in which water is sprayed over the panels.

The majority of problems which have been experienced in the course of these exposures have been caused by dissolved matter in the water supplied to sprays. BS 3900 Part F3 lays down the following standards for impurities in water supplied to carbon arc machines:

| | |
|--------|--------------|
| Iron | >0.25ppm |
| Copper | >0.20ppm |
| Silica | undetectable |

The first two impurities are readily apparent on panels, imparting a brownish colour to white paints. Their effect is to decrease the rate of degradation by acting as ultra-violet absorbers. No problems with these two impurities have been encountered recently by Tioxide, but some years ago, a persistent problem with brown staining was attributed to the presence of a short section of copper pipe in the water supply lines.

A recent problem with impurities has involved slight brown staining, but also a speckly gloss. This has arisen since the installation of a deionisation system as a replacement for a water distillation unit. Symptoms were very low mass loss rates, no chalking and low rate of loss of gloss. The substance responsible proved very difficult to detect, but could be seen using scanning electron microscopy. Observations of pigment are generally preceded by etching using atomic oxygen to remove the obscuring binder¹⁰. A weathered paint was etched in this way for thirty minutes with the intention of revealing lower levels of the paint. Normally, six minutes etching serves to remove all binder, and so it was with some surprise that sheets of material were seen after thirty minutes, as depicted in Figure 10.

It was quickly realised that this was not binder, but a deposit of some substance resistant to oxygen etching. Comparison with the titanium dioxide in the same picture showed that the thickness was about 0.2µm, and the present theory is that this material is silica from the deionised water supply, baked onto the paint surface by the warm conditions in the carbon arc machines. Attempts to

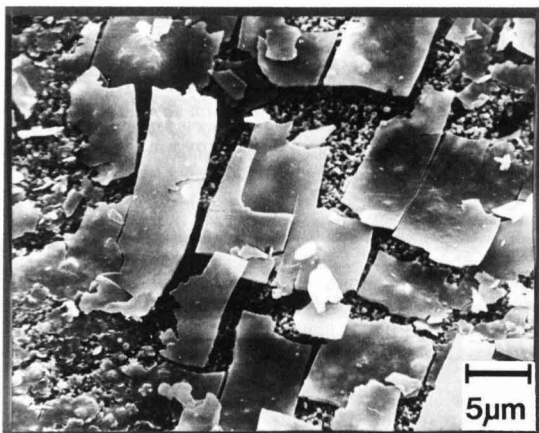


Figure 10. Scanning electron micrograph of deposit on the surface of a weathered paint film.

confirm this analytically have been thwarted by the thinness of the deposit and the fact that most pigments contain some silica as a coating. Circumstantial evidence is available in the form of water analysis data, and one exposure test in particular.

Figure 11 shows the mass loss behaviour of a paint, on which is superimposed the silica reading for the water supply nearest in time to the test dates. There is a marked change in gradient corresponding to a high level of silica in the water. The interpretation of this data is that deposit has occurred on the panel, retarding mass loss, and from the analysis data, it appears that this substance was silica. The silica matrix serves to trap any metallic ions present in the water, and often adopts a brownish hue as a result.

An indication that silica had been deposited on panels came from comparative X-ray fluorescence measurements on similar paints exposed in one case in an accelerated weathering machine, and in the other at Florida. This technique subjected the painted panels to X-rays, and examined the X-ray radiation given off, which is characteristic of the elements present. The results are shown in Table 5, where the relative levels show an increase in silica as the most profound difference. The fact that one film was thicker than the other explains the difference in iron contents, since the underlying steel panel gave a stronger contribution for the thinner film.

The effect of a silica coating on a microscopic scale must

Figure 11. The change in rate of mass loss resulting from high levels of silica. Inset figures refer to measured silica levels.

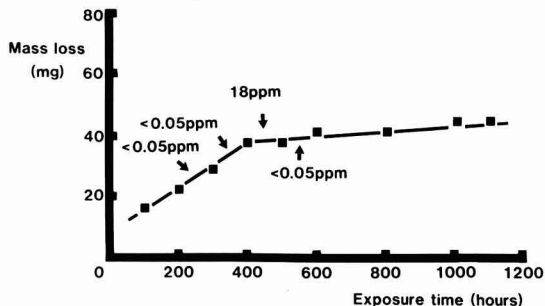


Table 5

The elements present in paint films exposed in a carbon arc machine, and at Florida.

| | Natural conditions | Accelerated conditions |
|-----------|--------------------|------------------------|
| Aluminium | 1 | 1 |
| Silicon | 1 | 6 |
| Zinc | 1 | 1.5 |
| Iron | 8 | 1 |
| Lead | 1 | 1 |

be to retard the loss of titanium dioxide, leading to the absence of chalking and slow rate of loss of mass. This in turn will slow the degradation of the film still further via the absorption of ultra-violet light by the trapped titanium dioxide. Gloss continues to change slowly, since photochemical degradation of the binder will continue, with the oxidation products given off as gases.

The recommendation of the installer of the deionisation equipment was to increase the frequency with which the deionisation resins were regenerated. This is because the silicate anion is removed only inefficiently, and the anionic resin will thus be exhausted before regeneration is indicated by the instrumentation. Another problem is that silica may also exist in colloidal form, which is not removed by ion exchange. The only remedy in this case is to use ultrafiltration. At the time of writing, the measures taken seem to have had a beneficial effect.

Conclusion

The first part of this paper showed how to obtain useful gloss data under accelerated conditions, provided the conditions of test are chosen with care, with particular reference to the wavelength characteristics of the irradiation. This applies to natural weathering as well to a certain extent, in that data obtained at one site will not necessarily be of value for an application in another geographical location.

Having selected one's conditions with care, the second half of the paper warns of some of the factors which can lead to misleading results being obtained. These include flocculation, film thickness and contamination of paint surfaces.

Acknowledgement

The authors wish to acknowledge the help of colleagues in Central Laboratories, and to thank the directors of Tioxide UK Ltd. for permission to publish this paper.

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letters

Correspondence

Dear Sir,

May I be afforded the opportunity of using the Journal first to express my sincere thanks to all those who contributed to the retirement fund and also to those who made personal gifts and wrote with their best wishes for my retirement.

I shall treasure these memories of a long and happy association with OCCA and wish it continued prosperity in the years ahead. I shall keep in contact with the Association and will be happy to hear from any of my old friends of their activities.

*Yours faithfully,
R. H. Hamblin*

Director & Secretary

Oil & Colour Chemists' Association

1 July 1987

Viscosity BS188:1977

Sir,

As your OCCA representative on BSI Technical Committee PTC/14 - Viscosity. I am particularly interested to learn if any member has any comment to pass on to me regarding the existing BSI Standard BS188:1977 "Methods for Determination of the Viscosity of Liquids". This document concerns the use of glass capillary viscometers of the direct flow, reverse flow and suspended level type in addition to the falling sphere technique of viscosity determination. It is my opinion that the procedures in BS188:1977 are adequate and require no further amendment, but if any member has additional information that should be considered please write to me at the address given below.

*Crown Decorative Products Ltd,
Paint Division,
P.O. Box No. 37 Crown House,
Hollins Road,
Darwen, Lancashire BB3 0BG*

Yours faithfully,

*R. A. Ellis
16 June 1987*

company visits

Macpherson Industrial Coatings Ltd

Macpherson Industrial Coatings of Leyton, London, the UK's largest industrial paint company, announced at a press conference on 18 June that they, like Macpherson Paints of Bury, are now members of the British Standards Institution's Registered Firms Scheme. This entitles them to use the BSI Registered Firm logo, showing that their management and quality systems have been assessed by BSI as consistently meeting the requirements BS5750 to Quality Assessment Schedule 2551/202. The award of this registration has involved a major up-grading of their management, manufacturing and quality control systems; customers are now guaranteed that all products meet the appropriate detailed specifications.

Mr Ian Arnison of BSI congratulated Macphersons on their award, outlined the BSI audit procedures and pointed out that BS5750 is fully compatible with International Standard ISO 9000 - a useful feature when exporting products.

A note on the introduction of the BSI Registered Firms Scheme appeared in our April issue, Vol.70, pp.117-8.

T. A. Banfield

Introduction to Paint Technology





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Following the presentation of each paper at the OCCA Conference a period of time was allotted for discussion. Those who put the questions were asked to fill in discussion slips with the details of their questions. Edited versions of the discussions that followed three of the papers (authors in bold type) published in the July and August 1987 issues appear below: questions in ordinary roman type, answers in italic. Only those questions for which discussion slips were received are published.

H. Warson

P. J. MOLES: In the paper there are comments on formaldehyde not being a reaction product in N-methylolacrylamide crosslinks. In view of the environmental instance of knowing about formaldehyde emissions can this point be explained?

H. WARSON: I believe that the release of formaldehyde is more likely to occur in the aminoplasts than N-methylolacrylamide crosslinks. There has been some divergence of opinion and the release may depend on actual conditions of service which may vary considerably.

R. H. E. MUNN: Does not Dr Warson feel that the majority of the crosslinking mechanisms he has put forward are of limited applicability in coatings, since they are too expensive, too specific in performance and of questionable effects in terms of health and safety. Are they not merely of academic interest and do more to boost the egos of those taking out the relevant patents rather than progressing the development of commercially and technically viable coating polymers?

H. WARSON: Many items thought to be of academic interest are now in commercial production. It is certainly true that there is a wide variation in the types of surface coatings and the specific conditions demanded in application. Many of these mechanisms require the additives to be present in comparatively small quantity, even if they are relatively expensive. The variation in costs of standard materials themselves may completely swamp the specific rather expensive additives required for crosslinking, e.g. in the last year, as far as I understand, the price of styrene has virtually doubled. In any case some of these apparently complex items are very much simpler, if the structural formula is produced in full rather than as a line formulation. An example of this would be cyclopentadiene derivatives.

A. C. D. Cowley

H. MEYER: If you disperse pigments in a 10% resin solution there is a great risk of "shock" during the let-down. Do you not have to take any precautions to avoid shock when using hyperdispersant in a 10% resin solution?

A. COWLEY: I agree that conventional dispersion in a 10% resin solids solution are prone to shock-seeding on let-down, particularly if viscous resins are added without agitation. One of the main features of the hyperdispersants is the length of the polymer chains, which confer excellent steric stabilisation to the pigment particles. Dispersions which contain hyperdispersants and 10% resin solids solution are therefore much more stable than conventional millbases on let-down. However, it is always advisable to let-down millbases slowly under agitation if possible. If hyperdispersants are used for producing multi-media tinters, we recommend using our new acrylic copolymers at 20% non-volatile content. These tinters are then very stable and

can be added directly to white or coloured bases without risk of shock-seeding.

A. Wilson and J. Nicholson

M. J. ZISSEL: Dr Nicholson has described a novel method of cross-linking – but has he measured the amount of diol lost on stoving, which at 250°C might be quite considerable?

J. NICHOLSON: The loss of diol has not been measured directly, but the evidence from infrared spectroscopy is that there is significant ester formation. In addition, films cured at 200°C, which is still well above the boiling point of the diols used, not only show infrared spectroscopic evidence for ester formation, but also show better resistance to aqueous media than films without diol in them.

T. SAY: Does the generation of CO₂ during the curing reaction destroy the film integrity, allowing formation of pinholes and subsequent attack of the substrate?

J. NICHOLSON: We have seen no evidence of that, possibly because the films are very thin (2-5µm). A more serious problem appears to be bubbling by water evaporation in thicker films.

R. J. WOODBRIDGE: In view of low film thickness, what possible applications do you see for these films?

J. NICHOLSON: Firstly, there is possibly scope to develop these coatings for their originally envisaged use, as interior lacquers for metal cans. Secondly, they could be used as wash coats for the exterior of metal cans (and we have some evidence that they would give adequate resistance to aqueous media under the much shorter and lower temperature cure conditions employed in this technology). Finally, they can be pigmented, so that pigment and filler contribute to film bulk, and under such circumstances, we have found it possible to produce films of at least 25µm without problems of bubbling.

J. BERNIE: A major limitation on future use of your coating may be the high temperature of 250°C required for cure. You alluded to possible low temperatures being tried, what do you think will be the lowest temperature system available?

J. NICHOLSON: It is hard to say what the lowest cure temperature might be. We know that the reactions go at lower temperatures, but the resistance of the resulting films have not been good enough for the use we originally had in mind, i.e. interior lacquers for metal cans. If, on the other hand, a less demanding application is considered, e.g. one in which, say, bluish resistance to hot water is all that is required, then it is possible to cure these coatings to a much lesser degree, and, for example, 200°C for one minute, is sufficient.

L. Cutrone and D. V. Moulton

S. VOUT: Can you relate in general terms the effect of 45° versus 90° on exposure results i.e. is one of these 1-3 times more severe i.e. Florida 45° exposure versus Twin Carbon Arc? and Florida 45° exposure versus Xenon Arc? How many hours of accelerated weathering relate to one year of exterior exposure?

D. V. MOULTON: *The answer to the first part depends on where the panels are exposed. Ultra-violet radiation can reach the panels directly, or via a scattered route, and the relative intensities of these two components depends on latitude. Within about 30° of the equator, horizontal surfaces receive more irradiation, while at higher latitudes, exposure at the angle of latitude leads to a higher irradiance. The difference in irradiation received between 45° and 90° exposures will thus increase as latitude decreases. At Florida, (26°N) horizontal exposure was 10% faster than 45° south-facing exposure, but I have no figures for the reduction in rate at 90°. Perhaps of equal significance is the fact that scattered radiation can have a different spectral distribution than direct sunlight, and so changing the orientation of panels could change the conditions as well as the rate of an exposure test (see e.g. J. Vinyl Tech. 1986, 8, 176). The following table indicates the problems of quoting equivalent exposure times, and relates time to an equal degree of weathering for a specific set of tests.*

| Time to change equal to Florida (12 months) | | | |
|---|-----------|----------|-----------|
| | Gloss | Chalking | Mass Loss |
| Alkyd Paints | | | |
| Carbon Arc | 3250 hrs | 2520 hrs | 425 hrs |
| Xenon Arc | 1200 hrs | 900 hrs | 500 hrs |
| UK Natural | 72 months | — | 36 months |
| Acrylic Paints | | | |
| Carbon Arc | 1750 hrs | — | 800 hrs |
| Xenon Arc | 1600 hrs | — | 1000 hrs |
| UK Natural | 49 months | — | 36 months |

R. H. MILLER: As the Chairman said your paper has been a most interesting one and it prompts numerous questions and comments. One comment I would make is that it appears to me very doubtful that we shall ever get one accelerated weathering technique which can simulate conditions in for example Carlton and Florida. The question I would ask relates to Figure 2 showing the UV spectrum of sunlight and your comment that UV is the region of sunlight which does most damage to paint films. Do you have any experimental evidence for this? Basic photochemistry tells us that UV should be most damaging but have we any data showing the split between UV and visible? For example, alkyd systems for which hydrolytic attack may also have an influence.

D. V. MOULTON: *In our work to date it has been impossible to establish unequivocally which part of the spectrum does most damage. The wavelengths ascribed to light sources have been peak wavelengths, and even the single wavelength sources have quite broad emission peaks. Work is now being started which will isolate spectral regions and examine their effect on degradation.*

R. H. MILLER (2nd Comment): Observed adhesion failure of alkyd gloss paint which has been caused by chalking of the undercoat can only be explained by the effect of visible light. Your own graph of mass loss versus film thickness which shows losses at film thicknesses approaching 100µm also points to an effect of longer wavelengths.

D. V. MOULTON: *Work done on the UV transmission of a 0.7:1 P:B air-drying alkyd paint film indicates that a 20µm film would screen out all ultra-violet light from an undercoat. It is thus surprising that much thicker films than this show differences in degradation rate in line with their thicknesses. Dr Miller's own work on the degradation of wood pointed towards longer, visible, wavelengths having surprisingly large effects. A project has been initiated to look at the delamination of paint systems, but I wonder whether water disbondment has been active in some cases previously ascribed to interfacial chalking? (JOCCA, 1987, 70, 121).*

D. Dargan and J. Hemmings

M. PALMER: What method was used to measure critical P.V.C.? Our studies using optical and mechanical means do not demonstrate any fundamental difference between the vinyl acetate "high binders" as a group and the established products which they replace. Any minor difference in Gilsonite stain resistance with a specific commercial material is believed to be solely due to changes in type and location of stabilising surfactant?

D. DARGAN: *A P.V.C. "ladder" technique was used to determine the CPVC of the binders under test. In our experience, stain hold out tests, while giving lower values of CPVC relative to the scrub method (of the order of 4-5% lower), still show significant advantages for the high binders compared with traditional polymers.*

R. J. WOOLDRIDGE: Surely CPVC is influenced as much by the pigmentation/extender system used and cannot be quoted by reference only to the binder. Changes in extender will influence CPVC?

D. DARGAN: *We would agree entirely with your comments. Changes in extenders do affect the CPVC but in our experience the relative positions of the binders under comparison are maintained throughout a wide variety of pigment and extender combinations.*

R. J. ARCHER: What is significant in choosing 500 cycles as a standard – in S Africa the usual pass/fail level is 10,000?

D. DARGAN: *The significance of the chosen 500 cycles was to obtain a test level capable of differentiating between a variety of binders, in a test formulation deliberately designed to induce failure. The formulation and test system chosen enabled rapid evaluation in the development programme.*



EASTBOURNE

"Advances and application of science and technology in surface coatings"

To coincide with the 50th Anniversary Celebrations of the London Section of the Association, the Biennial Conference was held in Eastbourne at the Grand Hotel from 17-20 June 1987. Eastbourne has been a popular venue for several OCCA conferences, the first being held in 1953. As usual the conference attracted many overseas visitors with the following countries being represented: Belgium, Denmark, Egypt, Finland, France, Holland, Germany, Israel, Italy, New Zealand, Norway, South Africa, Sweden, Switzerland and USA.

Also staying at the Grand Hotel were many famous tennis stars for the pre Wimbledon Pilkington Glass Ladies' Tournament and a number of delegates

recognised Chris Evert, Ann Jones and Virginia Wade in the hotel lobby.

Nineteen papers were presented in four sessions which took place in the mornings and afternoons on Thursday and Friday. All technical sessions were well attended and the discussions were often extremely animated. The Association also arranged a full social programme to run concurrently with the conference for the benefit of both delegates and their families.

Wednesday 17 June

The first main function of the conference was the customary reception of overseas delegates by the President, Honorary Officers and the Director & Secretary

which was held in the Duke's Room. The Association welcomed representatives of other societies within the International Alliance: Mrs A. Saloranta (President of SLF) and Mr Saloranta, Mr C. E. Dorris (President of FSCT) and Mrs Dorris, Mr F. Borrelle (Executive Vice President, FSCT) and Mrs Borrelle and Mr J. Roire (Past President FATIPEC).

After dinner, the London Section arranged an excellent entertainment of Music Hall songs presented by the Players' Theatre Company. Mr K. Arbuckle (Immediate Past President of the London Section) first welcomed the delegates and expressed the pleasure of the Section at being given the opportunity to arrange the evening. In the traditional Music Hall



The meeting of lecturers and chairmen of sessions: (Back row, left to right) Dr B. L. Kaul, Mr G. W. Fowkes, Mr T. Fjeldberg, Mr A. C. D. Cowley, Mr P. C. Stievater, Mr D. V. Moulton, Mr D. S. W. Dargan, Mr J. Spauwen and Mr I. Tonini; (Front row, left to right) Dr J. W. Nicholson, Mr R. H. E. Munn, Mrs A. Saloranta, Dr H. Warson, Mr J. R. Taylor (Hon. Research & Development Officer), Mr F. B. Redman (President), Mr D. S. Newton (Hon. Editor), Mrs N. Usman, Mr I. Sarvimaki, Mr M. Leclercq, Dr P. J. Fyne (Asst Editor) and Dr W. G. Erskine.

conference diary

style, Mr Alan Curtis admirably chaired the evening bestowing upon the audience his phenomenal wit and eloquence in introducing each act. Amongst the artistes were the actress Miss Sheila Burnette of television renown (Candid Camera). Miss Jenny Wren distinguished herself to OCCA members by singing songs of the British Isles using a copy of JOCCA as her song book. The audience warmly responded to the singing by joining in using the song sheets specially provided. The evening's entertainment finished with a rousing finale by the Company and the delegates responded with well-deserved acclamation.

Following the entertainment a meeting of the lecturers and the session chairmen took place under the chairmanship of the Hon. Research & Development Officer (Mr J. R. Taylor) to discuss procedure for the Technical Sessions and allowed the session chairmen the opportunity to meet the lecturers.

Thursday 18 June

At 9.00 a.m. the President welcomed delegates to the Conference and declared the Conference open before handing over to Mr J. R. Taylor who had arranged the papers for the sessions and who acted as chairman "with stopwatch primed" for the first session. The Association records its thanks to Mr J. R. Taylor for the work involved in providing such an interesting and wide range of papers. The first of which appeared in July JOCCA; further papers will be published in the following months along with discussions.

During the morning, a coach tour party went to Beachy Head and Alfriston.

After the first technical session, the President and Mrs Redman welcomed all those attending the Conference at an informal reception.

The second Technical Session in the afternoon was chaired by Mr G. W. Fowkes (Vice-President, OCCA).

After the session a meeting was held of the International Liaison Committee which was attended by delegates for FATIPEC (J. Roire, Past President), for FSCT (Mr C. E. Dorris, President, Mr F. Borrelle, Executive Vice President) and Mr G. Gough, (President Birmingham PVLC), and for OCCA by the President, President Designate, the Hon. Secretary, the Chairman of Midlands Section and the Director and Secretary. Mr J. Haim kindly acted as interpreter.

During the afternoon, a coach party visited Bramber in West Sussex.

In the evening 60 delegates travelled by



Representatives of the International Alliance at the overseas reception: (Back row, left to right) Mr J. Roire (Past President, FATIPEC), Mr C. E. Dorris (President FSCT), Mr F. B. Redman (President, OCCA) and Mr Saloranta; (Front row, left to right) Mrs Dorris, Mrs Redman and Mrs A. Saloranta (President, SLF).

coach to Drusillas for an English Wine Tour and Cuckmere Carvery. The evening's programme included a guided tour of the wine cellars followed by a Carvery Dinner in the Thatched Barn Restaurant at Drusillas. According to those attending this function was a great success.

Friday 19 June

The Third Technical Session was under the chairmanship of J. Bernie (Director, Paint Research Association). For families a morning coach tour to Battle was arranged which included a visit to the historic Battle Abbey.

At 12.30 p.m. the President and Mrs Redman held a reception in the Duke's Room for Council Members, overseas Presidents, session chairmen and lecturers.

In the afternoon, the final Technical Session was chaired by Mr G. J. Gough (President, Birmingham Paint, Varnish and Lacquer Club). A coach tour to the Cinque Port town of Rye and Winchelsea was arranged for delegates and families.

The President closed the Technical Sessions at 4.15 p.m. and thanked all those who had contributed to the highly successful technical part of the Conference and invited delegates to the Chester 89 Conference.

The Association records its thanks to Mr D. S. Newton (Hon. Editor) and to Mr J. R. Taylor (Hon. Research & Development Office) who helped at all the technical

sessions.

Following the final session the Association held its Annual General Meeting at 4.15 p.m., a report of the proceedings of which appear elsewhere in this issue of JOCCA.

In the afternoon the Golf Tournament took place at the Royal Eastbourne Golf Club. The Sam Sharpe OCCA Conference Golf Trophy was won by Mr S. T. Harris. The Pearson Panke Trophy was won by Dr W. G. Erskine. The Association thanks Mr L. Jennings for organising the Tournament.

In the evening the final event of the Conference – the Association's Dinner and Dance – was held in the Grand Hotel. Prior to the dinner guests were cordially received in the foyer by the President (Mr F. Redman) and Mrs Redman, and the Mayor of Eastbourne (Councillor Mrs Janet Grist accompanied by her escort).

At the end of the reception guests took their places at the tables and applauded the President and Mrs Redman together with Mayor and escort to the top table.

The menu had been chosen to have a distinctly Sussex flavour, the main course being Roast Saddle of Sussex Lamb.

After the dinner, following the loyal toast by the President, a toast to the Association was proposed by Prof. Dr K. Meguro (President, Japan Society of Colour Material) who complimented the Association on its Conference. Prof.

LONDON SECTION'S EVENING



The Artistes of the Players' Theatre Company.



Delegates joining in with the Music Hall songs.



Mr K. H. Arbuckle (Chairman, London Section) organiser of the evening, introducing the Players' Theatre Company.

conference diary



Prior to the Dinner on Friday evening the guests were received by the President and Mrs Redman and the Mayor of Eastbourne Mrs J. Grist and Mr Grist.

Meguro commented that he was proud to be associated with OCCA and was honoured that he was able to have borne greetings from the East to an Eastbourne Conference!

The President replied on behalf of the Association and thanked Prof. Meguro for his kind remarks. He welcomed delegates, lecturers, chairmen of technical sessions and thanked them for their contribution to the success of the Conference. In welcoming the Mayor of Eastbourne and her escort, he also welcomed other guests of the Association - Mr C. Dorris (President, FSCT) and Mrs Dorris, Mr F. Borrelle (Executive Vice President, FSCT) and Mrs Borrelle. He extended a warm welcome to his personal guests Mr & Mrs T. Graham, and thanked Mr Graham for the way in which his company (Crown Paints) had supported him throughout his term of Presidency. He also thanked in particular Mr J. R. Taylor for the organisation of the technical sessions and Mr R. H. Hamblin, Director & Secretary, who was retiring after 36 years as chief executive officer. Mr Pacey-Day, the General Secretary Designate, and his partner Silvia Lorden were introduced to the dinner guests and the President thanked everyone at council and section level for their assistance during his presidency. Also present at the dinner dance were Priory House staff who had travelled down to honour Mr Hamblin on his impending retirement.

Mr C. Dorris (President, FSCT) expressed the thanks of all guests for the hospitality shown by the Association during the Conference, extended a welcome to those delegates planning to visit the FSCT's 52nd Paint Show and

Convention, October 5-7 in Dallas. Mr J. R. Bourne (new President, OCCA) will be presenting a paper on behalf of the Association. He commented that noticing that two of the office holders on the top table were ladies it might not be inconceivable that at a future conference a lady would reply to this toast which might then be to the "Guests and Gentlemen!"

Following Mr Dorris' speech the investiture as President of Mr J. R. Bourne, who had been elected President of the Association at its Annual General Meeting in the afternoon, took place.

Mr F. B. Redman invested Mr Bourne with the Presidential Insignia, using the traditional form of words:

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

In return, Mr Bourne presented Mr Redman with his Past President's medallion, inscribed with his name and years of service, which would act as a memento of his Presidency and his work on behalf of the Association. In this he had been most ably supported by Mrs Redman, both in their visits to Sections in the United Kingdom and overseas and also to the Conventions of sister societies abroad. It was a tradition for the Association to present the wife of the retiring President with a gift of her choice and Mrs Redman had chosen a silver tea service.



The main speakers at the Dinner were (top to bottom): Prof. Dr K. Meguro (President, Japan Society of Colour Material), Mr F. B. Redman (President, OCCA) and Mr C. E. Dorris (President, FSCT).

The photographs were taken by Mr R. Holland of the Photo Centre, Eastbourne.

conference diary

Mrs Redman thanked the Association in a charming speech, saying how much she had enjoyed the last two years and the kindness which had always been extended to her. She concluded her speech by presenting Mrs Bourne with the medallion worn by the President's Lady. Mrs Bourne thanked Mrs Redman and looked forward to serving the Association in the coming years.

This concluded the formal part of the proceedings and the President (Mr J. R. Bourne) and Mrs Bourne retired with the Mayor and her escort and the guests moved to the Devonshire Suite where the dancing was held. The dancing went on till 1 a.m. in the morning with a mixture of ballroom and contemporary popular music. After the dancing the President wished all who had attended the Conference a safe journey to their homes.

Following breakfast, delegates dispersed and it was expected that many who had attended would return for the next Conference which is scheduled to take place in Chester, 21-24 June 1989.

P. J. F.



The new President, OCCA, Mr J. R. Bourne (right) receiving the Presidential Insignia from Mr F. B. Redman.



Mr F. B. Redman (left) receiving his Past President's medallion from Mr J. R. Bourne (President).



Mrs Redman was presented with a gift of her choice – a tea service – by the President for her support to the outgoing President during his term of office.



The incoming President's lady, Mrs Bourne (right) receiving the President's lady's medallion from the outgoing President's lady, Mrs Redman.

annual general meeting 1987

The twenty-fifth Annual General Meeting of the Incorporated Association was held at 4.16 p.m. on 19 June 1987 at the Grand Hotel, Eastbourne, with the President (Mr F. B. Redman) in the chair.

There were 29 members and 10 visitors present. The notice convening the meeting was read.

Apologies

Apologies for absence were received from Mr S. A. Ray, Mr D. J. Silsby, Mr H. J.

Clarke, Mr J. P. Richards and Mr B. J. Gregory.

Minutes

The President asked the meeting to take as read the minutes of the twenty-fourth Annual General Meeting held on 18 June 1986 as printed and circulated in *JOCCA* pp 226-228 inclusive, August 1986.

There being no comments, the adoption of the minutes was put to the meeting and carried unanimously.

Report of the auditors to the members

The report of the auditors to the members was read.

Annual Report of the Council for 1986

Mr L. J. Brooke (Honorary Secretary) moved the adoption of the Annual Report and Statement of Accounts and drew attention to the many encouraging signs that the Association was entering a new phase of its existence but required as wide support as possible from its membership.

annual general meeting 1987

Mr B. F. Gilliam (Honorary Treasurer) seconding the adoption recalled that at the York Conference in 1983, amid a certain amount of gloom, he had stated that the Finance Committee were well aware of the financial problems facing the Association, and had taken steps to rectify this. The last three Annual Reports each showing surpluses had vindicated the Finance Committee's view that the Association was well managed and able to accept the challenge of the future.

The President asked for comments and, there being none, the Annual Report of the Council and Statement of accounts for 1986 were formally adopted by the meeting.

Election of President (1987-89)

The President stated that, as indicated on the agenda, Mr J. R. Bourne had been nominated by the Council and he now asked the Annual General Meeting to accept the nomination.

This was carried unanimously with acclamation.

Mr J. R. Bourne thanked the members for the honour and for the trust placed upon him. He would endeavour to uphold the high traditions of his predecessor in office. He then asked Mr F. B. Redman to preside for the remainder of the Annual General Meeting and at the Conference Dinner later in the day.

Election of Vice Presidents of the Association

Mr F. B. Redman read the nominations of the Council as printed on the agenda and asked the meeting to accept them en bloc. This was agreed. He pointed out that the representation among the Vice Presidents reflected the world wide interest of the Association since the seven names included the Chairmen from the South African Division, the Nigerian Branch of the General Overseas Section and immediate past Chairman of the Ontario Section. The following were then elected as Vice Presidents:

- (i) Prof D. E. A. Williams-Wynn
- (ii) Mr G. W. Fowkes
- (iii) Mr K. H. Ar Buckley
- (iv) Mr H. J. Clarke
- (v) Mr F. Adefarati
- (vi) Mr M Prigmore
- (vii) Mr R. Purnell

Election of Honorary Officers of the Association

Mr F. B. Redman asked the meeting to accept the nominations of Council as printed in the agenda en bloc. On being put to the meeting it was unanimously

agreed to elect the honorary officers as follows:

Honorary Secretary: Mr L. J. Brooke
Honorary Treasurer: Mr B. F. Gilliam
Honorary Editor: Mr D. S. Newton
Honorary Research & Development Officer: Mr J. R. Taylor
Honorary Conference Officer: Mr A. C. Jolly
Honorary Overseas Secretary: Mr W. Borrell
Honorary Exhibition Officer: Mr F. Morpeth

Mr Redman pointed out that as Mr Newbould was forced by increased business commitments to resign as Honorary Technical Education Officer shortly before the circulation of the agenda, the appointment of an Honorary Technical Education Officer would be undertaken by the Council at the first meeting of the new session.

Announcement of election of Elective Members of Council (1987-89)

The Chairman reported that, under Article 43(ii) of the Association where the number of persons nominated for the three elective places did not exceed the number, then the persons so nominated would be declared so elected. At the closing date for nominations only two nominations had been received, those of Mr J. Coates and Mr G. Fielding and accordingly they were elected to serve on Council for the period 1987-89. The remaining place would be filled by Council as its first act at its meeting on 15 July in accordance with Article 50.

The Chairman expressed concern that in recent years so few members seemed willing to be nominated to serve on Council and asked the Section Committees to consider this matter early in 1988 so that sufficient candidates were nominated to ensure that an election took place from amongst the membership for the three places on the Council.

Chairmen of Sections for the coming session

The names of the Section Chairmen to serve on Council for the coming year were given as follows:

Bristol Mr D. S. Newton
Hull Mr M. Gamon
Irish Mr A. Taylor
London Mr B. Canterford
Manchester Mr F. Morpeth
Midlands Dr G. J. Lewis
Newcastle Mr S. Lynn
Scottish Dr S. Lawrence
Thames Valley Mr J. L. Inshaw
West Riding Mr J. Hemmings
Ontario Mr J. Ambury

Cape Mr D. F. Smith
Natal Mr R. H. Philbrick
Transvaal Mr P. J. Quorn

Membership Subscription Rates

The Chairman asked the meeting to accept the items on membership subscriptions covered by the agenda items 11(a) and (b) en bloc and this was agreed. Mr B. F. Gilliam (Honorary Treasurer) pointed out that it was intended to review subscriptions annually to ensure that they did not fall behind any general inflationary movement and also so that undue dependence was not placed, as had happened previously on revenue from Exhibitions, advertising and Journal sales.

In accordance with Article 11, resolutions concerning subscriptions had been passed at two successive Council meetings on 18 February 1987 and 15 April 1987 and were now placed before the Annual General Meeting for confirmation. He proposed, Mr D. S. Newton seconded and it was agreed without dissent that:

(a) The 1987 Ordinary and Associate membership subscription rates for those members attached to the three Sections of the South African Division and the Ontario Section were SA Rands 60 and Canadian \$40 respectively.

(b) With effect from 1 January 1988 the Annual membership subscription rates in the various categories of membership shall be as follows:

| | |
|--------------------------------|------------------|
| Ordinary of Associate Members | £35 per annum |
| Retired Members | £12.50 per annum |
| Registered Students (under 21) | £12.50 per annum |
| Registered Students (21-25) | £17.50 per annum |

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

Jordan Award 1985-86

The Chairman stated that the Jordan award was instituted in 1967 by Mrs Marjorie Jordan in memory of her late husband, Dr L. A. Jordan, who was President of the Association 1947-49 and became an Honorary Member in 1955. The late Mrs Jordan wished the award of £100 to be made for the best contribution to the science or technology of surface coatings by a Member or Members under the age of 35 of any nationality, working in either the academic or industrial field. It had not always proved possible to make the Award so that on this occasion the Jordan Award Committee had decided that two Awards should be conferred for two outstanding

annual general meeting 1987



Ms I. Davies (left) receiving from the President (Mr F. B. Redman) the Jordan Award Certificate for 1985-86.



Dr J. Nicholson (left) receiving from the President (Mr F. B. Redman) the Jordan Award Certificate for 1985-86.

contributions – one to Ms Ilona Davies on “Instrumental analysis in the coatings industry” and the other to Dr J. W. Nicholson on “Heat cured ionomers prepared from poly(acrylic) acid a new class of water-borne coating material”.

He then presented framed certificates and cheques to Ms Ilona Davies and Dr J. W. Nicholson.

Reappointment of auditors and fixing the remuneration thereof

It was proposed by Dr G. Lewis that Coopers & Lybrand (Chartered Accountants) be reappointed auditors of the Association and their fee for 1987 be £1,700. This was seconded by Mr R. Munn and carried unanimously.

Vote of thanks to retiring Council members

Mr J. R. Taylor proposed a vote of thanks to those members retiring from Council and pointed out that a great deal of work was carried out by these members and the meeting would also bear in mind the support given by companies to enable members to serve in this way. He felt that the meeting would like to show its appreciation for the service given to the Association by those who had served as Vice President's, Elective Members,

Section Chairmen and Section Representatives and he proposed a vote of thanks to those members, which was carried with acclamation.

Vote of thanks to the Honorary Officers of the Association

Mr G. Fowkes proposed a vote of thanks to the Honorary Officers of the Association. He felt that members well understood the work undertaken by these members to ensure that the activities of the Association were carried out so well – Mr L. J. Brooke (Honorary Secretary), Mr B. F. Gilliam (Honorary Treasurer), Mr D. S. Newton (Honorary Editor) for his work on the Journal, Mr J. R. Taylor (Honorary Research & Development Officer) who had proposed such a splendid array of technical papers for the Conference, Mr W. Borrell (Honorary Overseas Secretary) who was doing much to promote the Association in the Far East, Mr F. Morpeth (Honorary Exhibition Officer) who had made such an enormous success of the SURFEX 86 Exhibition and Mr A. C. Jolly (Honorary Conference Officer) who was already busy planning the 1989 Conference at Chester. He asked the meeting to recall also the work as Honorary Technical Education Officer of Mr A. J. Newbould, who was not able to continue in that office because of increased business commitments. He then asked the Annual General Meeting to show their appreciation to the Honorary Officers of the Association and this vote of thanks was carried with acclamation.

Vote of thanks to retiring President

The Director & Secretary called upon Mr C. N. Finlay (Immediate Past President) to propose a vote of thanks to the retiring President. Mr Finlay stated that a great deal of progress had been made during Mr Redman's presidency, not least of which were the setting up of the New Zealand Association from the former New Zealand Division and the many problems involved in changing the pattern of administration of the Association which would involve greater participation by the Executive Committee. His work on behalf of the Association had been particularly arduous and he asked the meeting to show their appreciation in a vote of thanks which was carried by acclamation.

Mr Redman thanked Mr Finlay and the members for their support during his two years of office and for their vote of thanks.

Any other competent business

The Chairman stated that with the retirement of Mr Robert Hamblin as Director & Secretary, the Association would be at the end of an era. There would be a change in the running of the

Presentations to the retiring Director & Secretary



Mr F. B. Redman (President) presenting Mr R. H. Hamblin with the Association's gift.



Mr F. B. Redman (President) presenting Mr R. H. Hamblin with OCCA Australia's gift.



Mr F. B. Redman (President) presenting Mr R. H. Hamblin with a personal gift from himself and his wife.



Mr R. Archer on behalf of the South African Division presenting Mr R. H. Hamblin with one of the three gifts from the South African Sections.

annual general meeting 1987

Presentations to the retiring Director & Secretary



Mr F. Borrelle (Executive Vice President FSCT) presenting Mr R. H. Hamblin with a scroll on behalf of the FSCT.



Mr C. Dorris (President, FSCT) presenting Mr R. H. Hamblin with a John Piper print also on behalf of the FSCT.



Mrs Yvonne Waterman (Senior Secretary, OCCA) presenting Mr R. H. Hamblin with a teasmade on behalf of the staff at Priory House.

Association from Head Office, with greater participation by the Executive Committee. The General Secretary Designate would benefit from the way Mr Hamblin had worked to further the Association and against this background the Association wished to honour Mr Hamblin, who had served the Association selflessly for the past 36 years. He felt sure that by the end of the meeting it would be apparent that Mr Hamblin had been held in very high esteem not only by members in the UK, but across the world where OCCA members have served the Association. He



OCCA Staff with Mr R. H. Hamblin after the AGM: (Front row, left to right) Mrs P. Stringer, Mrs I. Jenkins, Mrs H. Pooley, Mrs J. Reynaud; (Back row, left to right) Mrs Y Waterman, Mr R. H. Hamblin, Dr P. Fyne.

would be making a few presentations and others would also be made.

The Association had made a gift, based on £20 per year of service, amounting to £720 together with the transfer of ownership of the car in which Mr Hamblin had travelled to so many Sections and other functions on behalf of the Association. He then asked the Director & Secretary to accept the car keys and the remittance from the Association.

He informed the members that the special retirement gift fund had achieved £772 and on being made aware of this Mr Hamblin had chosen a Bang & Olufsen music centre which would be delivered to his home.

The Chairman presented the Australian Association's gifts on their behalf which was a collage of eucalyptus bark inscribed "Presented to R. H. Hamblin on retirement as Director & Secretary of OCCA from OCCAA" together with a pictorial book on Australia.

The Chairman made a personal presentation from himself and his wife to Mr Hamblin.

Mr Robin Archer, on behalf of the Sections in South Africa, presented Mr Hamblin with a hand crafted and painted copper clock, items of ostrich skins, a picture made from butterflies wings and a pictorial book on South Africa mentioning his long association with many members there, such as Kurt Engelbert.

The Chairman then called upon Mr Frank Borrelle (Executive Vice President of FSCT who would himself be retiring at the end of October) to make a

presentation.

In presenting a scroll, Mr Borrelle paid tribute to the 41 years in which the Federation had worked with OCCA, 36 years of which had been with Mr Hamblin as the Chief Executive Officer of OCCA and 15 years with Mr Borrelle as the Chief Executive Officer of the FSCT. The scroll had been inscribed: "Federation of Societies for Coatings Technology in grateful acknowledgement and appreciation to Robert Hamblin for 36 years of dedicated service to the Oil & Colour Chemists' Association and to the international coatings manufacturing industry. Eastbourne, England, June 1987."

Mr Carlos Dorris, President of the FSCT presented the Director & Secretary with a print by John Piper, whose work was much admired by the Director & Secretary.

The Chairman stated that Mr Frank Borrelle was nearing his own retirement and it would be the pleasure of the Association's President to attend the Dallas Paint Show and OCCA would recognise his retirement suitably.

The Chairman called upon the Senior Secretary of the Association (Mrs Y. C. Waterman) who presented a teasmade and china cup and saucer on behalf of the staff at Priory House.

The Director & Secretary thanked everyone concerned for their kindness and looked forward to enjoying these gifts during his retirement.

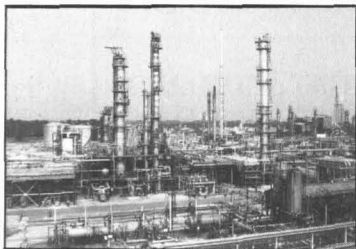
The Chairman declared the meeting closed at 5.05 p.m.

Kalon acquisition

Kalon Group PLC has acquired Beard Polymers Ltd, based at Rossendale, Lancashire. Beard Polymers, formerly part of the Industrial Latex Compounds group, are manufacturers of high-technology thermosetting resins for the electrical, electronics and adhesives industries. These activities complement those of another part of the Kalon Group, Hadfields Industrial Coatings, who have a strong position in similar markets.

Exxon starts up Fawley MEK plant

Exxon Chemical has started-up the latest expansion of its methyl ethyl ketone (MEK) plant at Fawley, England (May JOCCA p.146). The unit, which was already the largest in Europe at 75 kt/yr, is now capable of producing 90 kt/yr. The expansion was completed two months ahead of schedule and comes at a very convenient time for the MEK market as product supply has been increasingly tight. This project has cost \$6M and incorporates some pre-investment for the next expansion step to around 110 kt/yr.



Exxon's Fawley MEK plant.

New controls for cadmium sulphide pigments

The Health and Safety Commission has agreed to adopt a Control Limit for the exposure of people at work to cadmium sulphide pigments. The new limit is 0.04 mg.m⁻³, respirable dust, 8-hour time-weighted average (TWA). The new Control Limit takes effect on 1 May 1988. Cadmium sulphide pigments are manufactured at three factories in the UK and are widely used in the paint and ink industry.

products

Kimberly-Clark Ltd launches "designer" workwear range

Kimberly-Clark Ltd of Maidstone, the UK's leading manufacturer of disposable and limited life products for industry has introduced a new range of Kleanguard^(R) 'designer' workwear to bring protective clothing styles up-to-date. Kleanguard coveralls were developed by a professional



Kimberly's designer workwear.

fashion clothing designer and incorporate the new 'T' Design. This advanced pattern removes stress points from the garment by re-positioning its seams and provides comfortable dimensions in all sizes giving freedom of movement during active work tasks.

The Kleanguard range offers a choice of three fabrics for different levels of protection. The new GP (general protection range) gives low cost but high specification for protection against general and low toxicity contaminants. SP (standard protection) is for particle protection - proven protection from hazardous dusts and fibres, and EP (extra protection) for liquid splash protection and anti-static properties. Both SP and EP workwear is designed for extended use applications.

Reader Enquiry Service No. 40

New lead-free paint drier

Servo Delden BV of the Netherlands has introduced a combination drier APB which replaces Lead - or Barium - based driers in alkyd paints. Combination drier APB shows excellent drying performance also at lower temperatures and high humidity. Properties such as gloss, colour and stability are not negatively influenced when using combination drier APB instead of Lead - or Barium - based driers. In the UK their local agent Hüls of Orpington can be contacted for further information.

Reader Enquiry Service No. 41

New flexible alkyd

Resinous Chemicals Ltd, the Tyneside based resin manufacturer has extended their product range with the addition of a new "Flexible" alkyd. Alfatat VAS 9238 is a long oil length, air drying alkyd resin supplied as a 65% solution in white spirit. The nature of the resin affords immediate elasticity and also imparts sustained flexibility, over and above levels associated with conventional systems. This property is particularly important when considering the manufacture of wood coatings, where natural movement of the material often

leads to flaking or cracking. Test results confirm that systems incorporating Alfatat VAS 9238 maintain extended flexibility even after 2,000 hours in a QUV machine. The resin is particularly suited for the manufacture of top coats, varnishes, stains and undercoats for application on wood.

Reader Enquiry Service No. 42

New car rust protection system

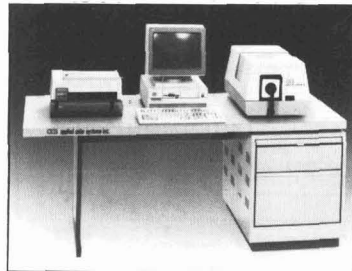
Corroless International Ltd of Basingstoke has introduced a new rust protection range. Corroless is brushed into the rusted area and converts the rust into an inert black iron oxide (magnetite) bonding it firmly to the metal. As the product dries, millions of tiny new hardened glass flakes self-leaf in the coating. These form a tough impermeable barrier that seals out moisture and corrosive elements.

Reader Enquiry Service No. 43

ACS introduces new IBM system in colour control

Applied Color Systems of New Jersey, USA (ACS) has incorporated the new IBM Personal System/2 models in its computer colour control system line. The IBM-based systems provide users with combinatorial colour matching, batch correction and colour quality control capabilities. The new personal computers provide a palette of over 256,000 colours plus 64 shades of grey are built into the systems. Video Graphics Array capabilities provide videolike clarity for graphics and text.

Reader Enquiry Service No. 44



The new ACS System incorporating the IBM personal system/2.

literature

A glimpse of coatings + inks from BASF

A corporate brochure explaining the structure and product capability of the newly formed BASF Coating + Inks Ltd has been published by the company. The applications reflect the composition of the company which is organised into five

operating divisions: Automotive Refinish, Automotive OEM Finishes, Industrial and Building Products, Printing Inks, and Coatiner Coatings. The brochure is available from: David Neal, MPR Communications, West End House, Hills Place, London W1R 1AG.

meetings

Resin systems

The Newcastle Section of the Association will be holding a Seminar on "Resin Systems" at Durham University on Wednesday, 30 September 1987. For further details see this month's Bulletin.

FATIPEC Congress 1988

The XIXth FATIPEC Congress will be held from 18-24 September, 1988 in Aachen, Germany, at the Eurogress Center on the "Presence and future in science and technology of coatings and their compounds". Papers are currently being called for. For further details contact: XIX. FATIPEC-Kongress, Kongress-Sekretariat, c/o Forschungsinstitut für Pigmente und Lacke e.V., Allmandring 37, D-7000 Stuttgart 80. Tel (0711) 687800.

people



Peter Harland

New Paintmakers President

Peter Harland (49), Managing Director of Croda Paints Ltd, has recently been appointed President of the Paintmakers Association of Great Britain at the annual conference of the Association in Gleneagles, Scotland. Mr Harland joined Croda Paints 25 years ago as a technical service representative after initial training and experience as a paint chemist. By 1967, after changing to sales and marketing, he was appointed Sales Director. In 1983, he was promoted to his present position. Highlights of his term of office as Paintmakers' President will include attendance at the centenary of the American Paintmakers' Federation in Washington and the Conference of European Paintmakers in Copenhagen, Denmark. At both events he will make presentations on behalf of British paint manufacturers.

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INDEX TO ADVERTISERS

| | | |
|---|-------------------|-----|
| | H | |
| Hüls | | 209 |
| | M | |
| Minolta (UK) Ltd | | 218 |
| | S | |
| Sanyo Kokusaku Pulp Co Ltd | Inside Back Cover | |
| Sachtleben Chemie | Centre Spread | |
| Servo Delden BV | Back Cover | |
| Sub-Tropical Testing Services Inc | ii | |

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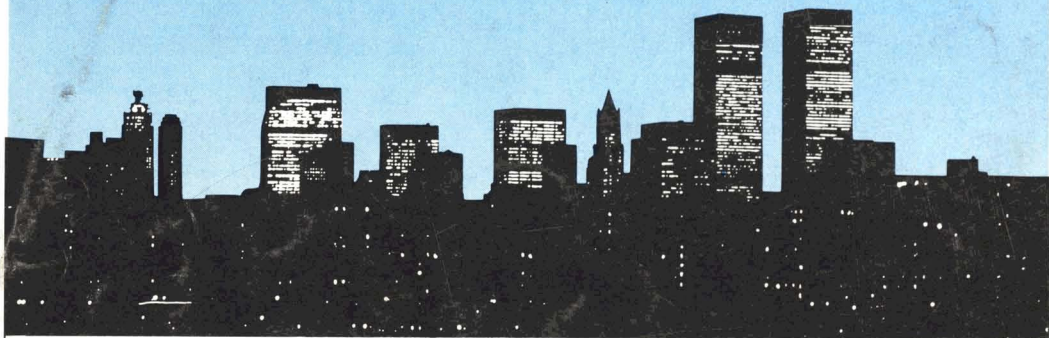
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