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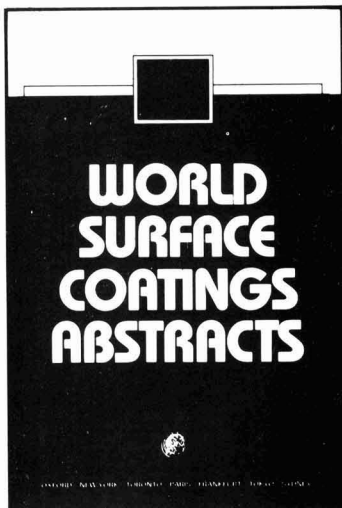
From a painting by Keith Griffin

SS GREAT BRITAIN PROJECT

See preliminary announcement on page 21

Also in this issue

- Formulation of solvent-based paints pigmented with titanium dioxide
- New materials for the furniture industry
- Polyurethane resins in moisture curable surface coatings



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Published by the Paint Research Association

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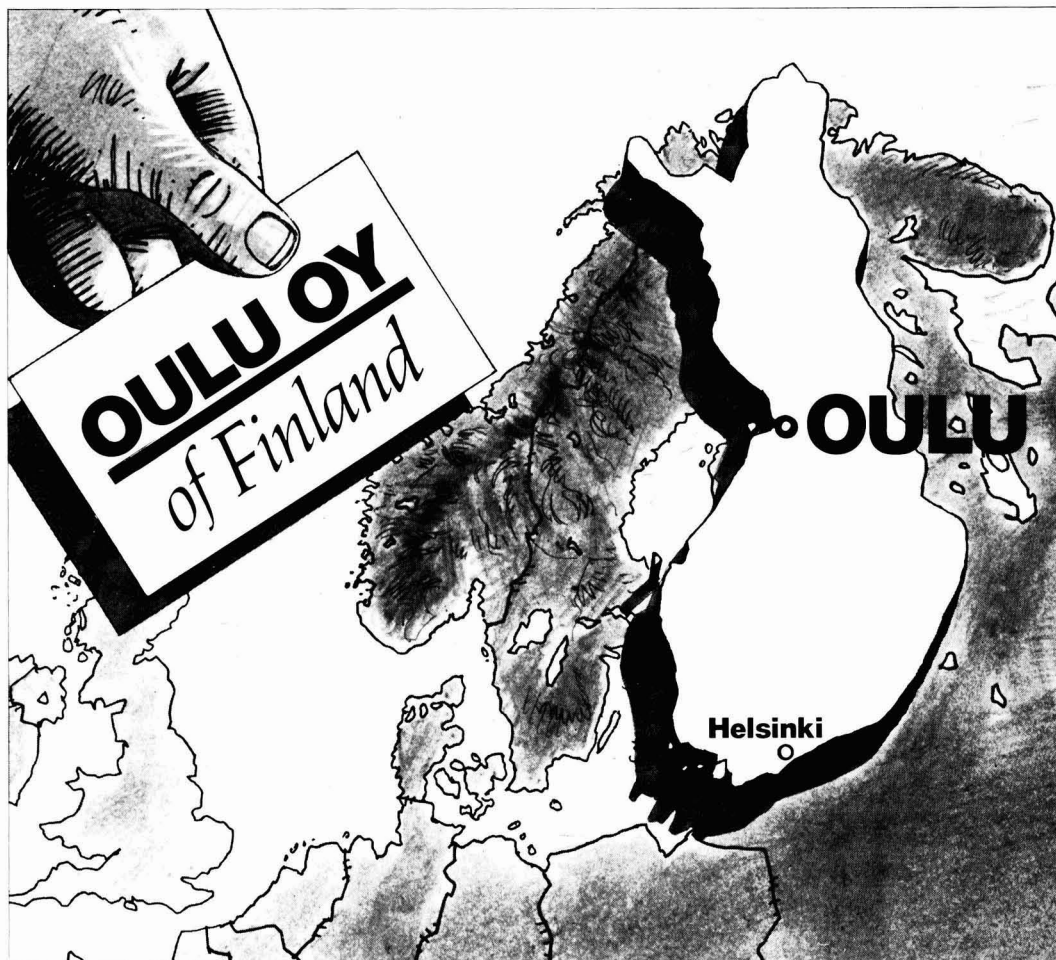
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- Road marking paints
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- Adhesives

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Editorial correspondence should be
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General correspondence should be
addressed to:
R. H. Hamblin, MA, FCIS,
Director & Secretary,
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Tel: 01-908 1086
Telex: 922670 (OCCA G)
Telegrams: OCCA Wembley

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Priory House, 967 Harrow Road, Wembley, Middlesex, HA0 2SF England

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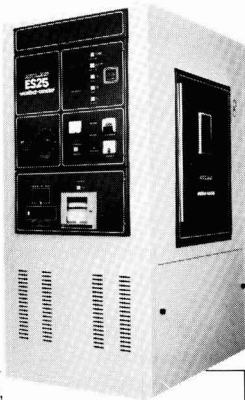
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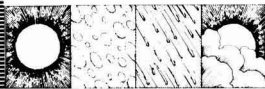
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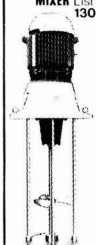




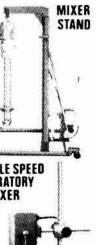

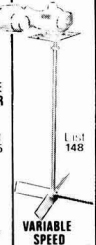





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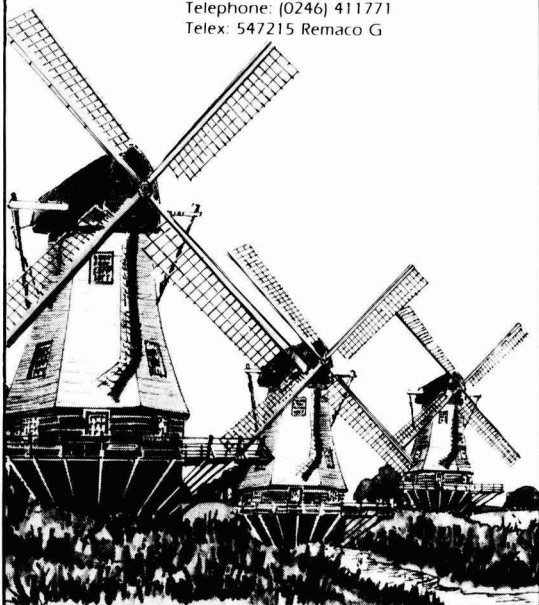
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President's Page

It is easy for our members who serve on Council to keep abreast of developments in the world of OCCA. Members of Section Committees receive reports from their representatives on Council; but the people for whom the Association exists, the members in any one of 60 countries around the world, may feel isolated and starved of information about their fellow members and what they get up to.

This Journal is a ready-made means of communication between our members, but our hard working Honorary Editor is not given to writing fairy stories—he needs your news to enliven the pages. You may be surprised to find that your news is often as interesting to others as their news is to you. So please, fill up the Editor's mail box; he will be happy in the work you give to him.

Now for my bit of news which covers my first half year in office as President. I was most fortunate to inherit a very sound financial situation, brought about by the hard work and diligence of my predecessor Cecil Finlay, and the continuing dedication of Robert Hamblin and his staff. This has meant that I could turn my attention to other matters.

As far back as the late seventies, our fellow members in New Zealand, of whom there are 292, were telling your Council that they had grown up, and wanted to run their own affairs in New Zealand—after all they are 12,500 miles away and can only very rarely take direct part in Council meetings. Their ideas of the form of independence they want have been fashioned into direct pleas to Council, and the pleas have become more and more demanding. I have set up a Working Party at the behest of Council, which I hope will work quickly towards a mutually agreeable formula for the independence of OCCA in New Zealand.

Our very long serving Director and Secretary, Bob Hamlin, will retire mid-1987. He has done so much for us over 30 years and more, that we have come to rely on him to do jobs that really we should do for ourselves. It is part of my job to see to it that my successor inherits a smoothly working organisation which will be much more self reliant and will survive the transition from many years of professional direction.

Your Executive Committee has been remodelled to take account of its increasing responsibility. Last year we appointed a Chairman of the Exhibition Committee who would take full responsibility for the organisation of the very first Provincial Exhibition of OCCA, "SURFEX 86". Fred Morpeth and his team have already guaranteed a "sell-out" of stands and thereby a financial success, and we must salute their achievements. However, before we can cheer and raise our glasses in celebration, we all have a part to play. An exhibition needs visitors. Those exhibitors who have supported us over the years, and those exhibitors who have returned after many years absence, together with first time exhibitors; all have committed their support, and none will be satisfied unless the visitors flock in. All members of OCCA can crown the success of "SURFEX 86" by attending themselves, and encouraging their colleagues and business associates to attend. Only when we have a four point success:

1. Sell-out of stands
2. Financial success
3. Satisfied exhibitors
4. Satisfied visitors

can we drink a toast to the next exhibition.

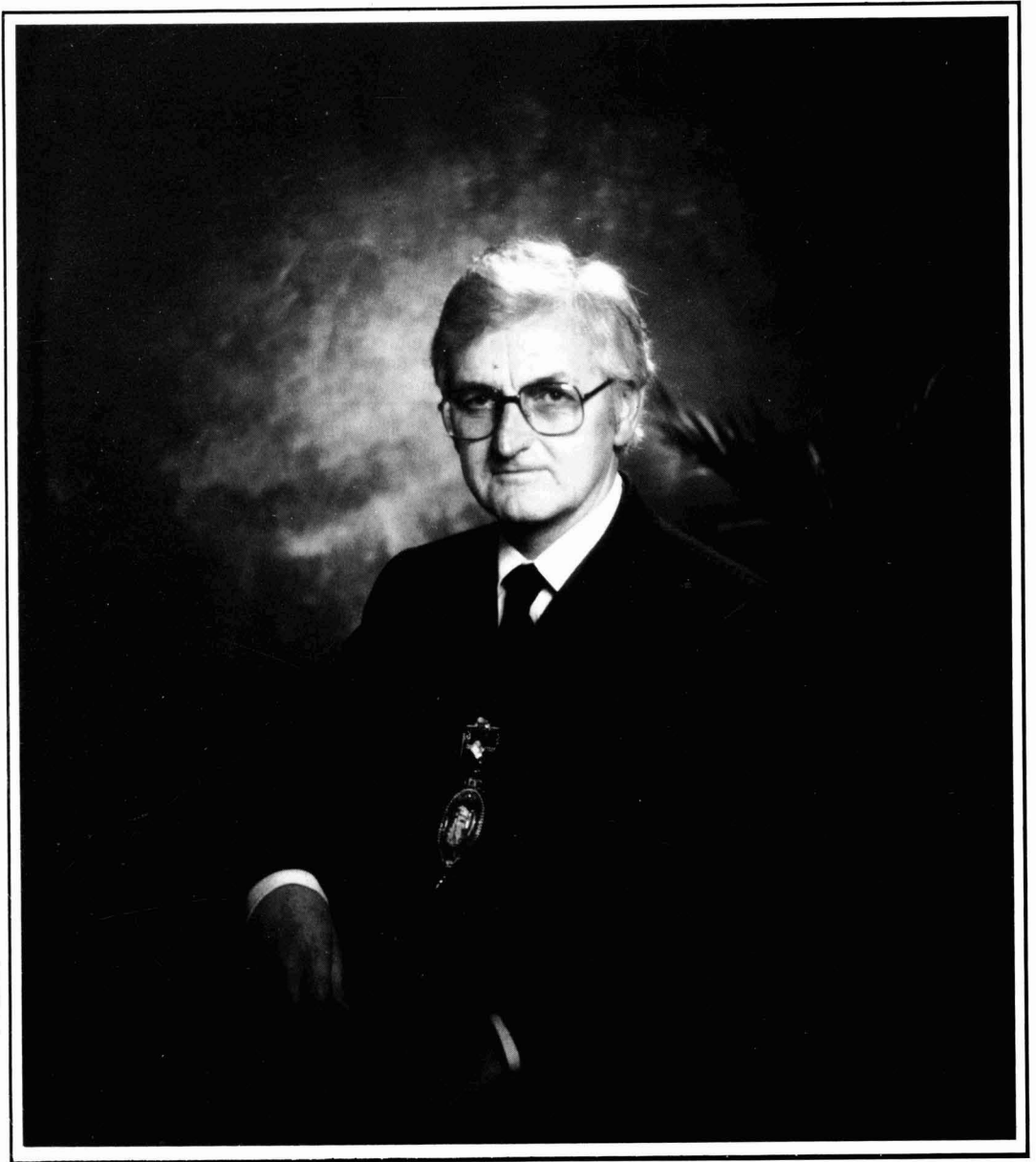
This year we have appointed an Honorary Conference Officer who will work closely with the Director and Secretary on preparations for the 1987 Conference. The Conference of June 1985 was held in Edinburgh in recognition of the Golden Jubilee of the Scottish Section, and the Scottish contributions to the success of the Conference will long be remembered by those fortunate enough to have taken part in the Conference. In similar vein, London Section will celebrate their Golden Jubilee in 1987, and the venue of Eastbourne will recognise this event. Tony Jolly and Bob Hamblin can expect the same enthusiastic support from London Section that we received this year from Scottish members.

The Surface Coating Industry in the UK has suffered pruning and consequent redundancies over the last decade. Our membership in Great Britain and Ireland has declined; but overseas our membership has increased. Our members in New Zealand, South Africa, Canada, Nigeria, Zimbabwe and many others around the world, form an increasingly important part of OCCA. In recognition of this we have appointed an Honorary Overseas Secretary, and Gordon Robson has already been very actively involved with members in South East Asia, as well as lending his support and making a significant contribution to the deliberations on New Zealand.

I was fortunate to have the support of my wife Peggy on visits to New Zealand, South East Asia, United States of America and Norway. Apart from this forming a very enjoyable travelogue, it brought very real benefits by way of communication and understanding between like-minded societies and associations. We also visited the OIL and COLOUR CHEMISTS ASSOCIATION AUSTRALIA (OCCAA) Convention, and outside OCCA there is a very special bond of understanding and common purpose with the Australians.

So much for the present, but I cannot sign off before wishing you all a Very Happy New Year, and may many fears subside, and many hopes be fulfilled, in 1986.

F. B. REDMAN



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Formulation of solvent-based paints pigmented with titanium dioxide

J. E. McNutt

E. I. du Pont de Nemours & Co., Wilmington, DE, U.S.A.

Introduction

Presenting information about solvent paints on the kind of diagram shown in Figure 1 is helpful in conceptualizing the relationships among millbase, finished paints, and dry film compositions. This figure is a ternary diagram on which a point can be plotted for any combination of white pigment, binder and liquid. A composition with no pigment, such as a binder solution, would be plotted on the vertical axis at the composition corresponding to the solids content of the solution. Any system containing all three components (pigment, binder and solvent) will be plotted at a point in the interior of the diagram. Thus, such a diagram is related to the classical ternary phase diagram with the three components of binder, pigment and solvent. Pure solvent or thinner is represented at the origin, that is, 0 per cent binder and 0 per cent pigment. Pure binder and pure pigment are represented by the ends of the vertical and horizontal axis respectively.

All information is in terms of volume per cent. Vertical lines across the diagram represent compositions with constant volume concentration of pigment. Horizontal lines represent constant volume concentration of binder solids. The diagonal lines show constant volume concentration of the liquid phase, which includes solvent and thinner.

On such a figure, it is possible to plot the compositions of most interest in formulating paints. Both millbases and finished paints can be plotted. From the diagram, the composition of the letdown vehicle can be determined along with the quantity of the letdown vehicle needed to change the millbase into a finished paint. The composition of the vehicle, that is the liquid phase, in the millbase or paint can be found. Conditions that might contribute to shock or seeding during letdown can be examined and avoided or corrected. All in all, these diagrams are a useful, easy way to visualize and quantify several aspects of paint formulation.

A diagram of this kind has several interesting properties. Any line radiating from point A, Figure 2, shows compositions with constant pigment/binder ratio. As an example, any composition along the line AC has the same P/B; if a dry film with 30 per cent PVC (point C) is intended, the paint from which the film is cast must lie along line AC. A point at point B would be a possibility. This paint would have 63 volume per cent solids in the can (45 volume per cent binder, 18 volume per cent pigment). As the wet film dries, its average composition moves along line AC from point B to point C.

Any line radiating from point D, Figure 3, represents mixtures of pigment (point D) with vehicles. For example, point B in Figure 4 could be made up by adding pigment to a vehicle of composition E, which is 55 volume per cent binder, 45 volume per cent thinner. Using vehicle E, only compositions along line DE can be prepared by adding

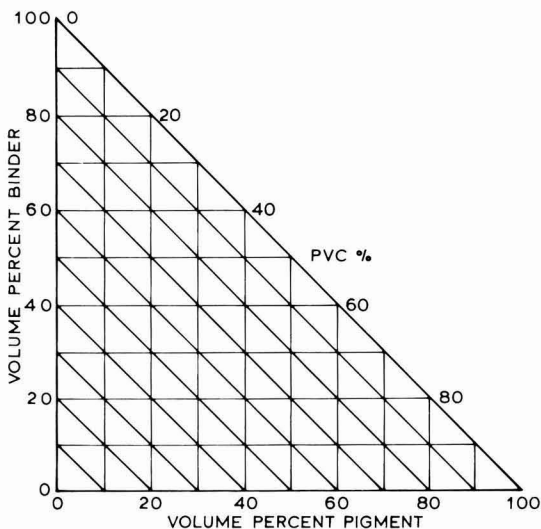


Figure 1. Vertical lines are constant pigment. Horizontal lines are constant binder. Diagonal lines are constant solvent.

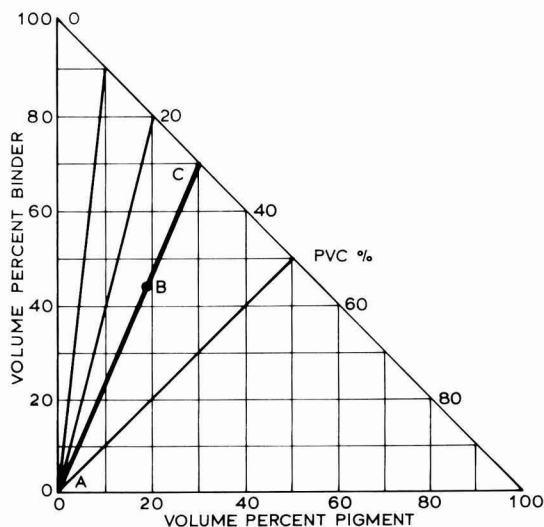


Figure 2. Each line radiating from point A represents compositions with constant pigment/binder.

pigment. Starting with vehicle E, if a composition other than one along DE is desired, it must be prepared by adding either solvent, which will move the blend composition below the line DE or more concentrated binder which will move the composition above the line.

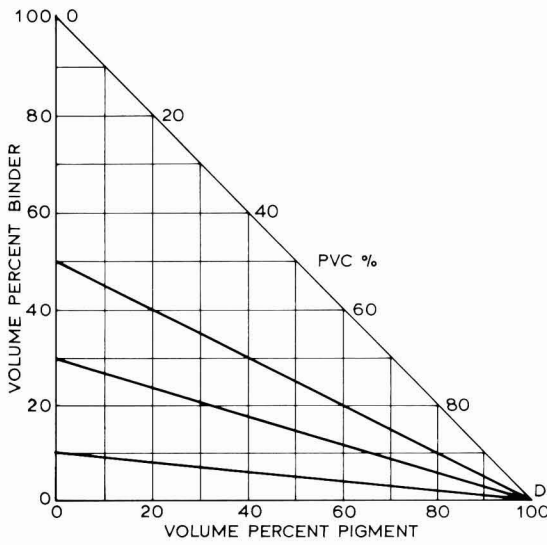


Figure 3. Each line radiating from point D represents mixtures of pigment with a vehicle of the composition shown on the vertical axis.

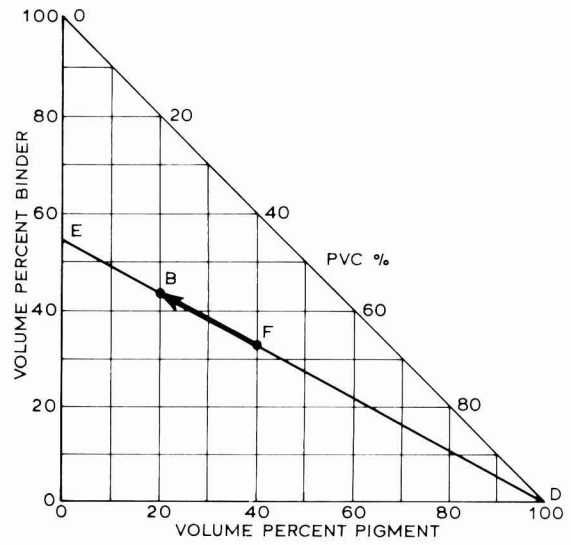


Figure 5. Millbase F is letdown to paint B by adding vehicle E.

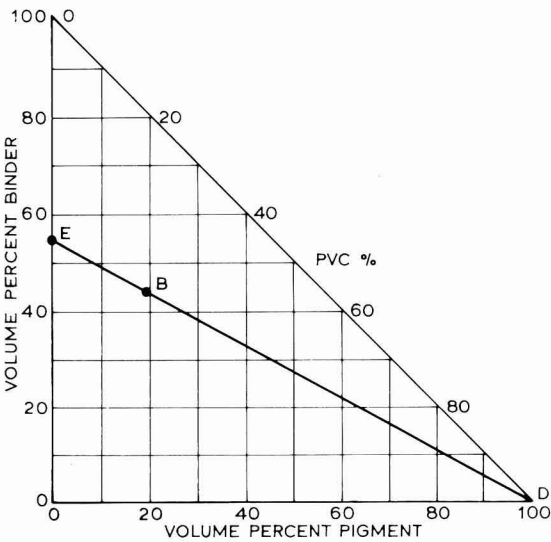


Figure 4. Paint B is composed of pigment in a vehicle of composition E.

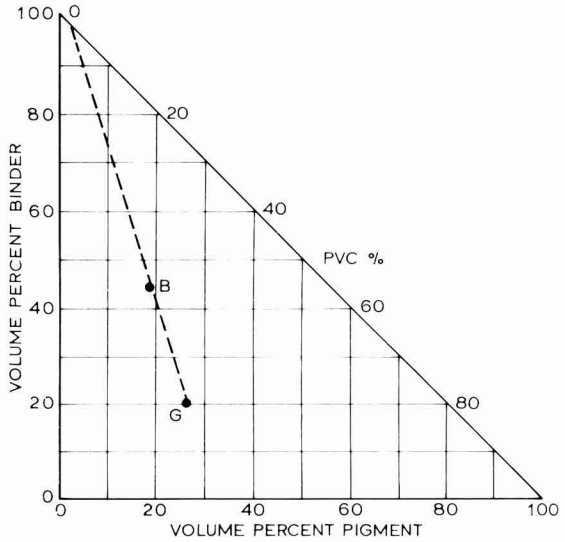


Figure 6. Paint B cannot be made by letting down millbase G.

Applications

A millbase suitable for high speed dispersing in a solvent system might be the composition at point F, Figure 5. After dispersion, this millbase can be let down to paint B by adding vehicle E. This would be an example of letting down with the same vehicle as used in the grind, a procedure which should minimize the likelihood of shock or seeding.

A different situation is presented in Figure 6, where point G represents a millbase such as might be suitable for sand milling: 20 volume per cent binder, 25 volume per cent

pigment, 55 volume per cent solvent. This grind base could not be let down to paint B; line GB extends to a letdown vehicle that would be more than 100 per cent binder, so making paint B from grind G is a physical impossibility without using some exotic procedure to distill off solvent.

Suppose a PVC of 30 per cent is desired from a paint made from grind G. Let down can be visualized in Figure 7. The finished paint composition must lie along line AC in order to produce a dry film of 30 per cent PVC. If binder is available as vehicle E, then this vehicle can conveniently be used to let down the grind to paint H.

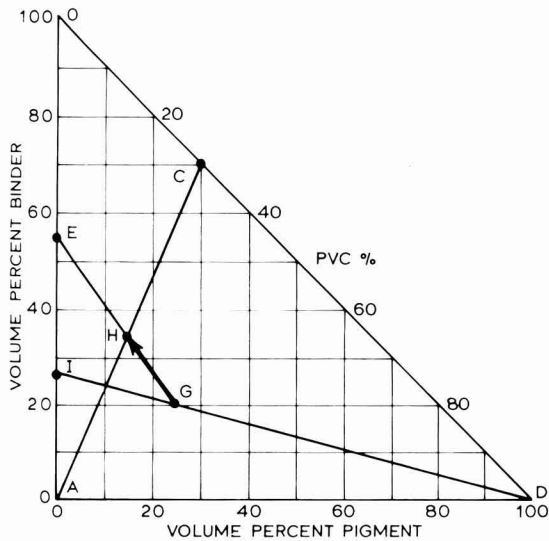


Figure 7. Millbase G is composed of pigment in vehicle I. It can be letdown to paint H by adding vehicle E. The dry film made from paint H will have 30% PVC.

The grind vehicle will have the composition I (obtained by extending line GD). This vehicle, 26 per cent binder, is significantly different from the letdown vehicle E and this factor should be considered if shock is encountered. Angle I G H is related to the difference in composition between grind and letdown vehicles and therefore the potential for shock.

Figure 8 illustrates the way in which this diagram can be used to anticipate and avoid a problem. Point J represents an alkyd grind base such as might be formulated for 3-roll mill dispersion. The finished paint is to have the composition K. Extrapolation of the line JK shows that the letdown must be made with pure solvent. This is quite different material from the grind vehicle L. This fact, graphically shown by the large angle L J K, indicates a potential danger. So care must be taken in the manner of adding solvent to grind J in order to avoid stripping binder from the dispersed pigment. Another possibility to avoid letdown problems is reformulation of the grind. For example, making the grind composition richer in pigment would make the grind closer to point D along line LD, assuming the same grind vehicle L is used. This would mean that the letdown composition would contain some binder and lessen the danger of shock.

If the same paint K were prepared by sand grinding, the grind base might be of composition L. Figure 9. Now the grind vehicle M is leaner in binder than the letdown vehicle N. If solvent migrates too rapidly from M into N, seeding of the pigment may occur. Again, the size of the angle M L K is a signal, warning of possible problems and the need to consider preventive action through reformulation or through careful letdown with good mixing.

Figure 10 shows millbase compositions which experience has shown to be appropriate for various methods of dispersing titanium dioxide. This may be useful as indications of where to begin testing millbase formulations for an unfamiliar system.

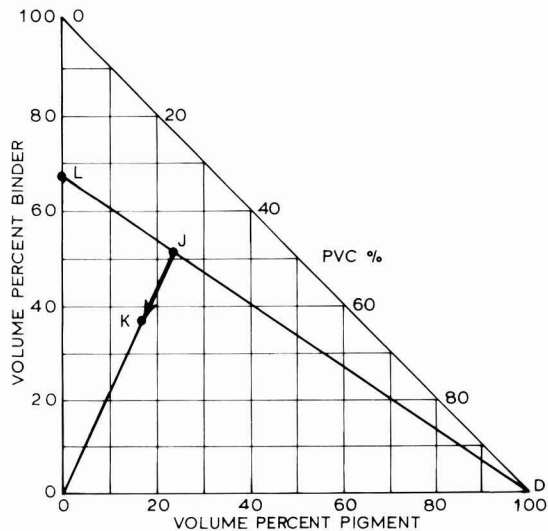


Figure 8. Paint K is made by adding solvent to 3-roll mill grind composition J.

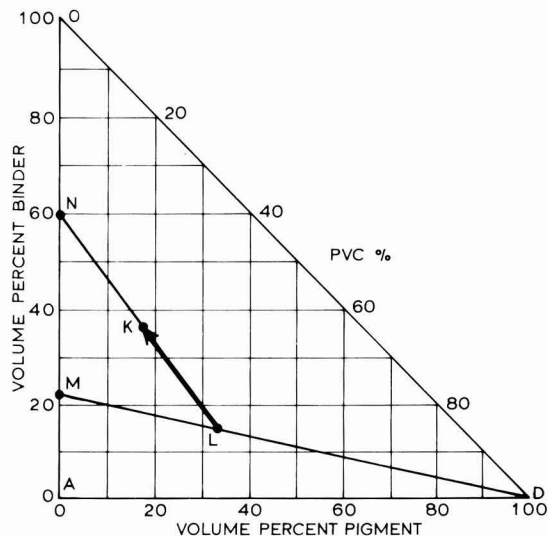


Figure 9. Paint K can be made from sand mill grind composition L.

Lever Principle

Figure 9 can be used to illustrate the useful "Lever Principle" which applies to diagrams of this kind. Grind L is composed of pigment D and grind vehicle M. Their proportions in grind L are ML/MD volume fraction pigment and LD/MD volume fraction vehicle. This is an example of applying the Lever Principle.

Suppose binder is purchased as product N, 60 volume per cent binder in solvent. To prepare grind vehicle M, product N and thinner A are mixed in the ratio by volume of MA parts product N to NM parts thinner.

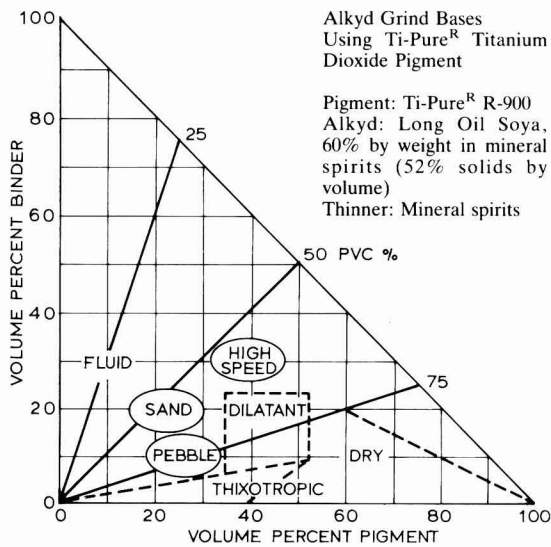


Figure 10. Diagram shows compositions that were found suitable for grinding in several types of mill.

After the grind is finished, letdown to paint K will be made by adding product N. This should be done by adding KL parts of binder solution to NK parts of millbase.

Thus Figure 9 can be used to determine the volumes of materials to be used in three different manufacturing steps: preparation of millbase vehicle; preparation of millbase; and letdown of millbase to finished paint. Using such a diagram can be a simple, quick, accurate way to decide upon the procedure for preparing a paint.

Weight vs Volume per cent

Although volume fractions and per cents may often be more useful than weights, sometimes weights are desired. Any system described in terms of volumes can be mapped onto a diagram of weight per cent if the density of each component is known. The calculations are simple, based on the relationship:

$$W_i = \frac{d_i V_i}{dV}$$

where W is weight fraction, d is density and V is volume fraction.

Useful approximations that can be used for quick

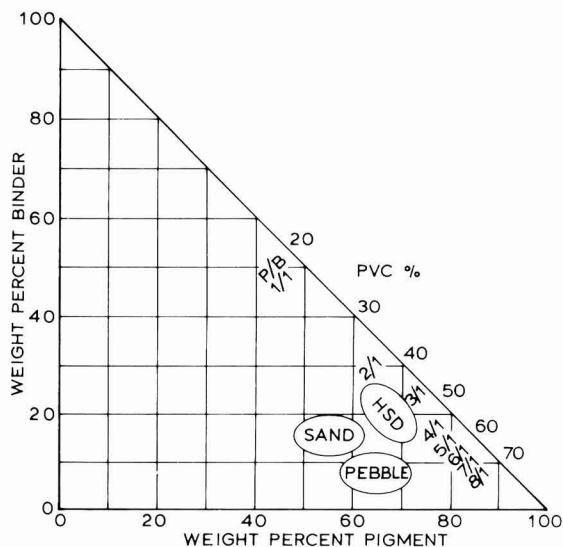


Figure 11. Guideline millbase compositions, in weight per cent, for high speed dispersion, sand milling and pebble milling of titanium dioxide pigment.

estimates in solvent-based systems pigment with titanium dioxide are

$$W_p = \frac{4 V_p}{1 + 3 V_p}$$

$$W_b = \frac{1.2 V_b}{1 + 3 V_b}$$

These equations are suitable for determining weight fractions within several per cent in many instances.

Figure 11 shows Figure 10 replotted in terms of weight per cent, as a starting point guideline in formulating alkyd millbases.

Conclusion

A useful way to describe and analyze preparation of paint formulations has been described. The diagrams used for such visualization can also be used to quantify paintmaking steps and so to develop instructions for operators.

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next month's issue

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

- The adhesive property of shellac modified with toluene di-isocyanate (TDI) by P. C. Gupta
- Effect of titanium dioxide pigments on the cure of thermosetting films by T. Entwistle and S. J. Gill

New materials for the furniture industry

A. J. Sparkes

Furniture Industry Research Association, Maxwell Road, Stevenage, Herts SG1 2EW.

Introduction

Whilst some people may still think that furniture is manufactured from solid wood pieces joined together with animal glue and finished with French polish, most have accepted the use of alternative materials as an inevitable consequence of increasing pressures on the world's forest resources resulting in reduced supplies and higher costs for the limited number of commercially acceptable species. Manufacturers of alternative materials have a difficult task as wood has many useful characteristics such as a high strength to weight ratio, surfaces which are readily receptive to adhesives and lacquers and a special attribute sometimes described as warmth or feel that cannot easily be achieved with other materials.

The strength, machining and jointing characteristics of solid wood are matched with varying degrees of success with wood based sheet materials such as plywood, particle board and medium density fibreboard (MDF). Additionally, these materials have overcome some of the limitations of solid wood particularly in respect of movement resulting from changes in moisture content. The decorative characteristics of solid wood have been matched completely by the use of wood veneers, and with increasing levels of realism, by plastics laminates and PVC, paper, and heat transfer foils. Whilst the aesthetic qualities of wood are readily appreciated, few can deny the value of the major developments in resin technology which have led to the introduction of binding resins for boards, laminating and jointing adhesives, printing inks and impregnating and surface coating resins. Some of these developments will be considered in this paper with particular emphasis on the problems which have been overcome and the problems which require further attention.

Wood based sheet materials

Boards used in the furniture industry can conveniently be divided into three groups characterised by the degree of conversion of the wood into veneers, particles or fibres.

Plywoods

Wood veneers, 1 to 3mm thickness, peeled from the circumference of a log are dried and then laminated with alternate veneers laid at 90° to each other to form boards generally in the thickness range 3 to 25mm. Birch plywood is probably most familiar to UK manufacturers but increasing quantities of plywoods manufactured from tropical hardwoods are used for cabinet backs, drawer bottoms and door skins. An interesting range of naturally occurring adhesives including casin, blood albumen, and bone and hide gelatine have been replaced by urea formaldehyde (UF) resins for interior grade plywood while phenol (PF) based resins are used for the manufacture of exterior plywood. Interest in third world countries is now centred on the development of alternative adhesives based on tannin and other derivatives of naturally occurring materials.

The relatively high cost of plywood and the problems of surface checking of plywood manufactured from large movement timbers such as birch or beech (JOCCA 1979, 62, 55-58) has reduced the amount of plywood used in the furniture industry. Core plywoods such as blockboard manufactured with a core of softwood blocks, each approximately 19mm width and laminboard manufactured with narrower core blocks, have also been largely replaced by lower cost and, in some respects, higher performance materials.

Particle Boards

Particle boards can be manufactured from most types of ligno-cellulosic materials including hardwoods and softwoods, flax, sugar cane residues and, more recently, straw. Most European particle board is manufactured from mixed softwoods, including pine, spruce and fir with a small addition of any locally available hardwoods. Flaxboard manufactured in Belgium and East Europe is also available in the UK, together with some bagasse (sugar cane) board from South Africa and the West Indies.

The development of particle board in the late 1930's was closely linked to the development of urea formaldehyde resin which is used as a binder for the individual wood particles. The first particle boards were manufactured largely from wood waste but the success of the boards in the furniture industry resulted in increased demand and a greater use of softwood plantation thinnings. Most cabinet furniture manufactured in Europe is now constructed from particle board surfaced with a wide range of decorative materials. The development of layered boards with small particles forming each surface and large particles in the core has enabled furniture manufacturers to use thinner decorative surfacing materials without adverse appearance effects resulting from the showthrough of the board surface. The separation of the particles used for the surface and core layers provides an opportunity for increasing the surface layer resin content to about 10 per cent compared with the 8 per cent addition to the core with a consequent improvement in surface strength and stability.

Although no wood based sheet material can be regarded as completely moisture resistant, particle boards with improved moisture resistance can be manufactured using phenolic resin or melamine/urea resins as the binding agents. Phenolic resin bonded boards have a propensity for swelling irreversibly in damp conditions although their strength retention is good. Better results are obtained with melamine/urea bonded boards and these are now widely used for building applications such as flooring, roofing and concrete form work where only limited exposure to weather is expected. The performance of particle boards with improved moisture resistance is assessed by checking thickness swelling and core strength after a V313 cyclic conditioning treatment which involves soaking in water at 20°C and freezing at -12°C and drying at 70°C as described in BS 5669 "Specification for wood chipboard and methods of test for particle board".

Since its introduction, wood chipboard has achieved considerable success as a furniture manufacturing material with few problems that cannot be resolved by the selection of boards from the many grades available with properties which are appropriate to the demands of the application. FIRA has identified those properties which are relevant to each application and guidance on the specification parameters for these applications is now available.

Recent concern with possible health risks resulting from long term exposure to formaldehyde has however necessitated a major reassessment of the resins used for the manufacture of particleboard. Several years ago, European particle boards were manufactured using resins with a formaldehyde to urea ratio in the range 1.6 to 1.4 The free formaldehyde content of these boards, measured using the EN 120 method, commonly known as the perforator method (BS 5669), was often as high as 60mg/100g of dry board.

Good ventilation in furniture factories associated with the operation of effective machining dust extraction systems normally prevented the accumulation of sufficient free formaldehyde in the atmosphere to cause significant eye irritation which, for most people, occurs at a concentration of 1 to 2ppm. Moreover the surfacing materials applied to most furniture panels and normal ventilation prevented a build up of formaldehyde to eye watering levels in places where furniture is used. This situation has however changed with the introduction of heat conservation measures which have often resulted in reduced ventilation. Greater public concern over the possible long term effects on health followed the publication of the results of formaldehyde exposure experiments on rats and mice carried out in the United States. Subsequent investigations carried out in the UK and elsewhere have not however identified any serious health effects of formaldehyde on human beings. Nevertheless, some standards authorities and specifying organisations outside the UK have reacted to this public concern by imposing specifications for the maximum acceptable level of extractable formaldehyde in particle board used for different applications.

In the UK, BS 5669 specifies a free formaldehyde content of 50mg/100g for particle board based on quality control testing. In Denmark, the free formaldehyde content of particle board used for furniture must not exceed 25mg/100g of board and, additionally, the boards must be surfaced with an approved coating. Boards with a free formaldehyde content not exceeding 10mg/100g of board can be used without surface coating. New regulations to be introduced in Germany will require all particle boards to have free formaldehyde contents not exceeding 10mg/100g of board with an additional requirement for maximum acceptable emission from finished panels or possibly complete items of furniture based on a chamber test.

In order to meet these requirements board manufacturers have been progressively using UF resins with lower formaldehyde/urea ratios and, nowadays, a formaldehyde/urea ratio in the range of 1:2 to 1:1 is not uncommon. Slight loss in performance resulting from the use of these resins has been offset by increased resin addition. An alternative approach has been based on the chemical reaction between ammonia and formaldehyde resulting in the formation of hexamethylenetetramine, a stable white powder. One treatment makes use of the

scavenging effects of ammonium salts added to the board with the binding resin while another treatment involves a vacuum impregnation treatment of manufactured boards with ammonia. Trials have also been carried out and some production boards are now being manufactured using isocyanate resins as binding agents to eliminate the formaldehyde problem. The recently introduced low cost Compak system for the manufacture of particle board from straw or other cellulosic waste material makes use of isocyanate resins.

Further development of low formaldehyde boards is thought to be required as the German regulations on formaldehyde emission from boards used by the building and furniture industries are adopted by other European countries. The relative economic advantage of systems based on low formaldehyde resins, neutralising treatments or alternative resin systems have not yet been fully assessed.

Fibre Building Boards

The third group of wood based sheet materials make use of wood fibres obtained using a high temperature steam refining process. For the manufacture of hardboard, the wet fibres are pressed at high temperature and high pressure to form sheets typically 3.2mm thickness. The strength of the board is derived mainly from the natural resins in the original timber but small quantities of resin and paraffin wax are sometimes added to increase strength and moisture resistance.

Two other types of fibre building board with lower densities than hardboard are manufactured by reducing the laminating pressure. These are medium board used for wall lining, partitioning and display boards and fibre insulation board used mainly for thermal insulation and sound absorption applications, for example ceiling lining.

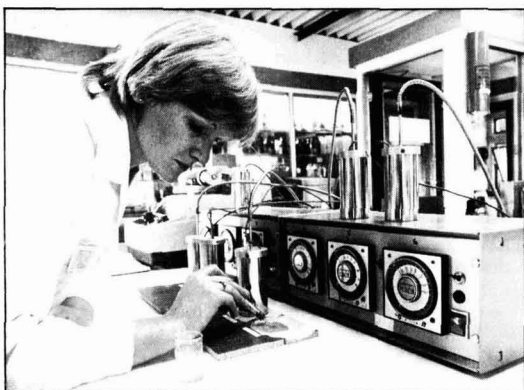
Recent interest in the furniture industry has however centred on a new type of fibre building board manufactured from dry fibres with a urea formaldehyde resin addition to provide strength. Medium density fibreboard (MDF) was first developed in the United States in the mid-sixties but about twenty plants are now operating in Europe. Caberboard operates the only UK plant but Medite have recently opened a large plant in the Republic of Ireland.

The uniform distribution of fibres throughout the thickness of MDF allows intricate machining operations to be carried out on board edges and faces without exposing the core voids which are found in most particle boards. The smoother surfaces of MDF derived from the close packed fibres provides a good substrate for direct painting or surfacing with thin decorative foils. Furniture manufacturers did however experience considerable difficulty finishing the edges of MDF as the high absorbency of the edges necessitated the application of additional coats of lacquer or paint. Moreover, stains applied to MDF panels were preferentially absorbed into the edges to produce a darker colour. The advantages of good machinability of MDF were largely being offset by these finishing difficulties.

Surprisingly, the lacquer industry were slow to recognise this problem and in the absence of satisfactory commercial sealers, FIRA developed a water based, cross linking system with the dual function of providing a non absorbent



Roller coater and UV oven being assessed in the FIRA pilot plant area

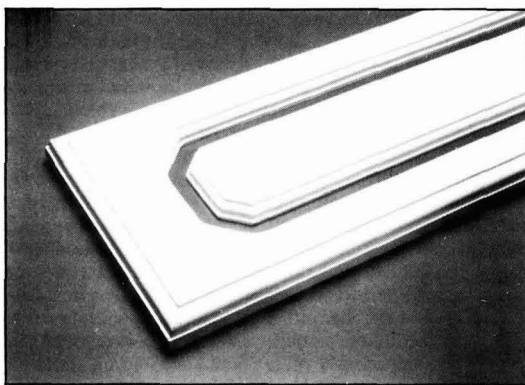


BS3962 Test used to assess the resistance of a surface to damage by wet heat

base for the application of stains and a solvent resistant surface for the subsequent applications of paints or lacquers. This system is now produced under licence by a manufacturer in the UK but several other companies have now introduced effective edge sealers for MDF.

Surfacing Materials

The wide range of wood based sheet materials for the furniture industry is matched by an even wider range of surfacing materials including different types of clear lacquers and paints, plastics laminates and a new generation of light and medium weight paper foils. In selecting any one of these surfacing materials, furniture manufacturers have to consider their ability to protect and enhance the appearance of the substrate in relation to production costs associated with each system.



Drawer front manufactured from medium density fibreboard with paint applied directly to the board



Assessment of the operation of an edge banding machine using PVAC adhesive

Lacquer and Paint

Solid wood and wood veneered panels are normally coated with clear lacquer. French polish is the traditional finishing material but the high costs of applying multiple layers by hand to achieve the required build has eliminated this material except for a few companies specialising in furniture of traditional manufacture.

Nitrocellulose based lacquers have largely replaced French Polish in the reproduction section of the industry. These lacquers are easy to apply by hand spray. They dry quickly at room temperature, subject to good air circulation, but they have the disadvantage that the dried film has relatively low resistance to heat and spilled liquids and a tendency to yellowing with age. Although these characteristics limit the performance that can be expected from a dining room table for instance, the poor solvent resistance of nitrocellulose lacquers is used to advantage in a pull over treatment which involves wiping the lacquered surface with solvent to create the smooth finish which is a characteristic of reproduction furniture.

The performance limitation of nitrocellulose lacquers

have been partially overcome by precatalysed lacquers which are normally based on nitrocellulose resins with the addition of modifiers to improve heat and solvent resistance. Most UK manufactured domestic furniture constructed from wood or wood veneered chipboard is finished with precatalysed lacquer.

Further improvements in performance can be achieved by extending the degree of cross linking using melamine or melamine/urea resins. These acid catalysed lacquers are widely used for contract furniture including The Crown Suppliers Whitley range of office furniture. Amongst the range of high performance lacquers, polyester systems are rarely used in the UK although some companies are now using acrylic based lacquers to take advantage of the production advantages of UV radiation curing. Possible health risks associated with droplet inhalation when spraying have largely eliminated polyurethane based finishes from the UK furniture industry. Increasing use of automatic spraying equipment and the possible greater use of robotic spraying systems may however provide opportunities for greater use of polyurethane lacquers which are known to have high resistance to the hazards of use combined with an inherent flexibility to accommodate inevitable moisture induced movement of wood substrates.

Plastics Laminates

Decorative plastics laminates have been used successfully for surfacing furniture panels for many years but developments in other materials such as paper foils, have resulted in their replacement for most applications with the notable exception of kitchen worktops and to a lesser extent, door and drawer fronts on kitchen units. Plastics laminates are manufactured by pressing several layers of resin impregnated paper at high pressure and temperature. As the phenolic resin in the individual sheets of backing paper and the melamine resins in the face papers are only partially cured, these resins flow to form an integral sheet during the first stage of pressing. Continued heating during the remainder of the pressing cycle results in the completion of the cure and the formation of a high performance sheet material which is ideal for use on kitchen worktops and other heavy duty surfaces. Recent developments in plastics laminates have been concerned with the use of plasticised or slightly undercured resins or flexible papers to allow the resulting laminate to be post formed round moulded edges of panels, thus obviating the need for the application of separate edging materials. Tighter curves have been achieved by reducing laminate thickness from 1.5mm which was normal about 10 years ago, to 0.8mm or thereabout. A major limitation of the application of plastics laminates to door and drawer fronts, for instance, is the impossibility of post forming a sheet material which is based on thermosetting resins round all four edges of a panel.

Until recently plastics laminates were manufactured by laminating individual cut size sheets of resin impregnated paper at high pressure in a heavy duty multi daylight press. The relatively high manufacturing costs involved in laying up individual sheets of foil and the long pressing time up to 40 minutes can however be avoided by supplying papers direct from the reel into the nip between two stainless steel bands stretched between two heavy duty roller presses. Plastics laminates produced in this continuous laminator can be reeled up as they leave the machine and supplied in this form direct to customers thus reducing trimming and

handling charges. Specification problems have occurred with plastic laminates manufactured by the continuous process as BS 3794 'Specification for high pressure decorative plastics laminates' refers to a minimum pressure of 5MPa by comparison with continuous laminating pressures currently in the range 2 to 3 MPa. Whilst most users will be concerned with the performance of plastics laminates irrespective of laminating pressure, the availability of laminates manufactured at the lower end of the pressure range, possibly with lower than desirable properties could have an adverse effect on the plastics laminates market generally.

Hitherto, the high pressures used for the manufacture of plastics laminates by conventional flat pressing were thought to be necessary to ensure complete flow of the phenolic and melamine resins between the individual papers. The pressure limitations of continuous presses have been partially overcome by improvements in press design but the development of new resins with improved flow characteristics and faster curing reactions has resulted in considerable improvements in performance and the acceptability of continuous plastics laminates for most furniture applications.

Paper Foils

Although grain printed and plain colour paper foils have been used for surfacing furniture panels for at least twenty years, recent interest has centred on light and medium weight foils which can be fed directly from the reel into high speed laminating presses. The paper foils originally supplied to the furniture industry were manufactured from paper in the weight range 80; to 150g/m². These papers were printed, impregnated with 20 to 30 per cent urea/melamine resin and then surface coated. They are normally bonded to panels following the handling and laminating procedures adopted for wood veneers.

Papers are also used for the manufacture of melamine surfaced chipboard. The papers in this instance are heavily impregnated with melamine or melamine/urea resin which is only partially cured. When the foil is laid directly onto chipboard without an intermediate adhesive layer, and then pressed at high temperature and pressure, the resin flows initially to form an integral bond to the chipboard surface. Further heating in the press completes the cure of the resin. The resulting sheet material is widely used for the manufacture of kitchen units and other items of furniture where a high level of durability is required. These boards have a relatively expensive surfacing treatment derived from the high concentration of resin, up to 60 per cent, in the paper and the 50 to 60 seconds required to complete the cure of the resin in the press.

A considerable reduction in production costs has however been achieved with the dual development of light and medium weight foils and high speed laminating presses using heated platens or rollers. The resin industry has contributed to this development by supplying foil impregnating resins which impart toughness without excessive brittleness and surface coating resins which provide adequate protection for the print.

Print quality has reached a high level of realism even to the extent of matching the texture of wood by modifying the ink, with a flow agent which causes the clear lacquer overcoat to flow away from the printed grain to create an

effect of wood pores as an alternative to the random fleck pattern achieved by an embossing treatment forming part of the foil pressing operation.

The performance of paper foils and their acceptability to the public is entirely dependent upon the level of protection of the print by the relatively thin coating. The requirements of flexibility and toughness imposed by the high speed laminating process direct from the reel are not entirely compatible with the requirements of high heat and solvent resistance and resistance to mechanical damage of the foil surfaced furniture. Unlike a lacquered wood panel which can be refinished if damaged, the long term performance of a paper foil surfaced panel depends entirely on the quality of the coating as the foil and print below the coating has low resistance to damage.

Finish Performance

With all the different surfacing materials to choose from, furniture manufacturers require guidance on the performance that can be expected from each general class of materials and from individual materials within each class. Over many years, FIRA has worked closely with the wood finishing section of the Paintmakers' Association developing test methods to assess various aspects of performance. As a result, tests for measuring the resistance of furniture surfacing materials to damage by wet and dry heat, spilled liquids and mechanical actions such as scraping and indentation are now included in BS 3962 'Methods of testing for finishes for wooden furniture'. The tests were originally developed for clear lacquers but they are now widely used to assess the performance of all surfacing material including the different types of paper foils.

A more recent development has been the publication of BS 6250 'Domestic and Contract Furniture' in three parts covering seating, tables and trolleys and cabinets. This standard includes finish performance specifications in each part covering items which are intended for careful, general and severe use. Furniture manufacturers can now obtain performance test data on different surfacing materials and then use the specifications contained in BS 6250 to make a realistic assessment of the suitability of the selected materials for different applications. Conversely, materials suppliers can promote their products using the different performance classification of BS 6250 to define possible areas of use.

Conclusions

The replacement of solid wood and clear lacquer by a wide range of wood based sheet materials and an even wider range of surfacing materials has had a major effect on the furniture industry and the many suppliers to the furniture industry. Instead of manufacturing furniture and applying the finishing treatment as the last stage in the process, companies operate panel lines finishing full size boards as the first stage of the manufacturing process or they purchase prefinished boards from specialist suppliers. The resin industries have made major contributions to these changes by developing high speed laminating adhesives and a wide range of impregnating and surface coating resins. Developments in the immediate future are likely to be concerned with further reductions in formaldehyde emission from wood based sheet materials and surface coatings, more efficient lacquer application and drying equipment and high performance coatings for paper foils.

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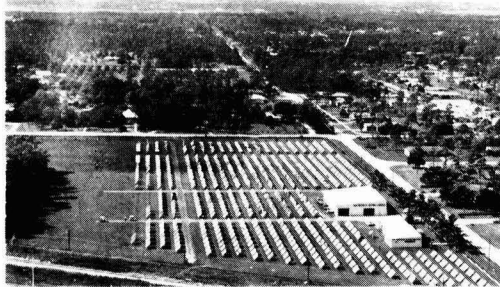
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Mr C. Hubbard Davis, Founder, Sub-Tropical Testing Service, Inc. (1904-1977)
PO Box 560876, 8290 S.W. 120th Street, Miami, Florida, U.S.A. 33156

Phones: (305) 233-5341
Cable: SUBTROP, Miami

Polyurethane resins in moisture curable surface coatings

A. H. Hughes

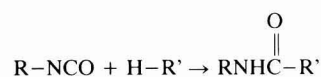
Baxenden Chemical Co. Ltd, Paragon Works, Baxenden, nr Accrington, Lancs. BB5 2SL.

Summary

The chemistry of moisture curing polyurethanes is covered in brief. The advantages and disadvantages of moisture curable coatings is outlined; followed by examples of the type of application in which these coatings are used. Anti-corrosion coatings are covered in more detail along with vehicle underbody seals; a completely new application. Typical formulations are given for a number of different coatings and the method of manufacture is covered in detail.

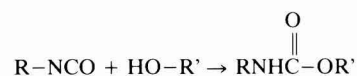
Chemistry

Of all the reactions we encounter as surface coatings chemists, it is interesting that one of the simplest is one of the most, versatile. This is the reaction between an isocyanate group and an active hydrogen.



Considering the multitude of end products containing isocyanates, it may be surprising to learn that in simple terms, isocyanate chemistry is really the study of this one reaction.

If the active hydrogen group is hydroxy then a urethane is formed.



With an amine, a substituted urea results.



Water is of course, hydroxy functional and one might expect a urethane group to be formed when an isocyanate reacts with water but due to a rearrangement and the evolution of CO_2 , a substituted urea results from the reaction of the liberated amine with further isocyanate.



The word Polyurethane has come to be used to describe coatings which contain isocyanates and the resin from which these coatings are formed. As can be seen from the simple chemistry above, these resins are in fact only true polyurethanes when an isocyanate is reacted with a hydroxy functional compound, but since this is normally the case, the term is usually correct.

The hydroxy resins concerned may be polyethers, polyesters, polycaprolactones, polybutadienes, polyacrylates or natural products, such as castor oil. The isocyanates may be any one of a number of commercially available mono-, di- or tri-functional materials.

Since the properties of the films formed from the co-reaction of these materials are very much dependent on the exact nature of the co-reactants and the ratio in which they are mixed, it becomes possible to formulate polyurethane coatings with a host of special properties not found in other types of coating and with a wide range of applications. The vast number of such combinations makes it difficult to generalize and coatings technologists make use of a number of different polyurethane systems but the main areas of interest can be categorised into four groups:

1. Two-part systems.

These can be one of two types; a hydroxy functional resin of intermediate molecular weight crosslinked or chain extended by a low molecular weight di- or tri-functional isocyanate or conversely an isocyanate functional resin of intermediate molecular weight (commonly known as a urethane prepolymer) crosslinked or chain extended by a low molecular weight polyol or polyamine.

2. Blocked systems.

These are one part systems where the isocyanate crosslinker is de-activated by reaction or "blocking" with a compound which will regenerate the isocyanate on heating. This blocked product can then be added to the hydroxy resin.

3. Isocyanate Modified Oils and Alkyds.

The hydroxy functionality of the oil or alkyd is partially reacted with isocyanate to give increased physical properties, the resulting resin drying by conventional means.

4. Moisture Curable Systems.

This again produces a one part system using an isocyanate functional prepolymer which cures by reaction with atmospheric water.

All these systems have been known for some time but recently there has been increased interest and activity in moisture curable systems and it is this sector which will be covered in more detail.

Advantages and disadvantages

There are significant advantages and some disadvantages in the use of moisture curable urethanes in coating systems.

Advantages:

1. There is no mixing of components involved and consequently no problems caused by bad mixing or mixing at the wrong ratio.
2. They can be applied by any of the normal means e.g. brush, roller or airless spray. No special machinery is required.
3. There are none of the pot-life limitations associated with two-part systems.
4. They can be applied to damp surfaces.
5. Curing takes place at temperatures below 5°C.
6. Recent advances in resin technology have produced coatings with equivalent performance to two part systems.

Disadvantages

1. Greater care and control of raw material selection is necessary in the manufacture of these systems because of the need to totally exclude water.
2. The paints etc. produced can have a limited shelf life.
3. The curing mechanism involves the liberation of carbon di-oxide which can cause foaming of thick films.
4. Overcoating time limits need to be more strictly observed if intercoat adhesion problems are to be avoided.
5. Partially used cans rapidly skin and become unusable unless extreme care is taken when resealing.

Technologists have now learned how to overcome these difficulties, hence the increase in the number of this type of product in the marketplace.

Applications

Moisture curable urethane systems can be loosely split into two categories, "rigid" and "flexible", these terms being relative. Rigid types are highly branched, producing hard films. Flexible types are normally linear with high elongation (250 per cent plus) giving softer products. Both types utilise the same chemistry, the polymer backbone of the starting material governing the final physical properties. All isocyanate based resins and polymers when fully cured, derive their strength and high physical properties from their ability to form intermolecular hydrogen bonds. A moisture cured urethane can be considered as a two-component system which utilises atmospheric moisture as the second component. The substituted ureas that are formed by the reaction of moisture with a urethane prepolymer have a similar, if not slightly improved potential, for hydrogen bonding. Hence, it is realistic to say that one pack urethane coatings can be produced, which are similar to two pack systems in physical properties, for almost all applications.

Rigid applications

For "rigid" applications, polyurethane prepolymers with a

high degree of branching are necessary; but these "rigid" systems do in fact have a great deal of flexibility, to the extent that the cured unpigmented urethane resin will often pass a 3mm mandrel bend test. "Rigid" prepolymer resins are normally polyether or polyester based with a functionality of three or more and whilst these materials can be, and often are, supplied as 100 per cent solids, high viscosity liquids, they are more easily utilised in solution.

There are many uses for the high functionality resins but a growing market for these products is in anticorrosion coatings. Zinc-rich, micaceous iron oxide and red iron oxide primers can easily be formulated and similar systems can even be used as top coats. A multicoat, anticorrosive system can be formulated with all the coats moisture curable. This type of system can offer significant advantages in marine and offshore applications with its ability to cure under cold, wet conditions and even be applied to damp substrates if necessary. High water resistance is achievable even before full cure and when fully cured, the excellent weathering, chemical and abrasion resistance of urethane systems in general, is obtained. There have been, in the past, intercoat adhesion problems with this type of system but this should not be a problem if the primer coats are recoated within the day. Some systems will fully cure inside 24 hours and a fully cured coating will not provide a good key for the next coat (unless abraded).

Heavy duty, anticorrosive, one coat systems, can be made from rigid prepolymers in combination with tar or pitch, but these can only be used when aesthetics are not important. There is a colour choice of black only! Splash zones on offshore structures are an example of the type of substrate that can be coated in this way.

Anticorrosive applications for moisture curable systems are really in their infancy but similar types of resin have been used in floor paints, concrete priming and sealing applications, for some time.

Current moisture curable resins are usually based on aromatic isocyanates and as these products have a tendency to yellow, coatings based on them have to be pigmented dark green, red or brown, which due to the nature of the application, are generally acceptable. Again good chemical resistance, high abrasion resistance and rapid cure are features of these systems. Sealers and primers can be formulated from the same resins let down in solvent to give the required substrate penetration. Moisture curable screeds can also be made from rigid prepolymers by incorporation of sand and fillers.

Rigid prepolymers are also used in the production of shutter paints, for the relatively short term protection of wood. Abrasion resistance, alkali resistance and high gloss (for good release from the concrete) are the properties needed here.

Flexible applications

Whereas the rigid prepolymers are multi-functional, flexible types are usually linear, although some higher molecular weight tri-functional resins are used. By far the main use for these flexible prepolymers is in the formulation of moisture curable flexible roof membranes where a seamless coating covering the whole roof can easily

be applied. Up to the present time these products have again been aromatic isocyanate based and the desire to protect the base resin from UV degradation has limited the colours available to black or reflective aluminium.

Improved products can and will be developed in the future using aliphatic non-yellowing urethanes but when moisture cured urethanes were first launched they were far more expensive than the bitumen based products which they replaced and aliphatic systems would certainly not have been accepted commercially at that time. However, with the increased awareness of the potential of these materials it is likely that aliphatic systems will become of more significance.

Similar pitch systems can be used in damp proof membranes and decking compounds, and their use as high quality chip resistant underseals for vehicles is now being developed. These products are more expensive than conventional underseals, but physical properties are far superior.

This completely new application for moisture curable urethanes is interesting enough to be covered in more detail.

An automotive underbody coating must offer good corrosion protection and chip resistance. A tar extended membrane coating provides both; the combination of tar and polyurethane providing the corrosion protection and the elastomeric nature of the film imparting resilience to prevent chipping. A membrane coating is usually applied in one or two coats to a dry film thickness of 500-1000 microns and with this type of coating it is possible to achieve 20°C salt spray resistance in excess of 10,000 hours without rust inhibition additives.

A typical tar extended membrane coating would have physical properties of 350-450 per cent elongation, 1.5 MPa tensile strength and 10KN/m tear strength and when coated onto an electropainted panel this type of coating passes the German "Gravelometer" test with ease. Careful selection of prepolymers of varying molecular weight and functionality can alter the physical properties of the final film.

Methods of application present no real problems for membrane coatings; brush or airless spray techniques are usually used. Different markets might require slightly different application properties. A brushing grade would require good flow for ease of application but a spraying grade could easily be made thixotropic to impart anti-slump characteristics. Again considerable variation is possible.

The underseal market can be split into several sections having different requirements although there are obvious similarities. For the original equipment market underseals must meet the sometimes complicated specifications of the car manufacturers.

These are often similar and a membrane coating will satisfy most aspects. The only question mark is whether they could be applied under the existing conditions of a production line, for a moisture curing coating will withstand the temperature cycle of the baking oven but will not cure within the cycle. If, however, the coating can be applied in the latter stages of production full cure will be achieved while the vehicle is stored. The specialist car or vehicle

manufacturer can possibly accommodate this better than the volume producer.

The tar-extended membrane coatings already used in the chemical building industry could be made use of in the trade/refinishing markets. The coatings themselves are already in existence and application methods and techniques already established; small areas could be brush treated while larger areas could be sprayed, there would be no need to post cure and this is one sector of the market where traditional plastisol type coatings cannot be used because of the need to do just this.

Moisture curing membrane coatings are already being sold in the DIY market, proving that the man in the street is able to use moisture curing materials. Applying these to the underside of a car is no more difficult than applying the more traditional DIY underseals. Certainly the membrane coating will achieve a better result and will not suffer from embrittlement on ageing. It will also be more tolerant of poor surface preparation and more resistant to oil and petrol.

The physical nature of membrane coatings would appear to make them ideal for vehicle underbody protection, it requires the various sectors of the industry to be convinced and prove to their own satisfaction that membrane coatings are viable for this application.

Flexible prepolymers can also be used for the bonding of rubber and cork crumb, and a vast number of adhesive applications, but that subject will be presented in a separate paper.

Typical formulations

Formulations are shown in the following tables in order to provide examples of the type of materials used in these coatings and although the formulae incorporate the latest advances in moisture curable resin technology, no attempt has been made to show the details of the manufacturing procedure. The manufacturing process will be outlined in general later in the paper. See appendix for suppliers.

Tar Extended Roofing Membrane

Trixene SC772	11.0 pbw
Trixene SC773	33.0 pbw
Solvent (Caromax 15/18)	7.8 pbw
Tar (Carbomod AN)	40.0 pbw
Crude Polymeric MDI	1.6 pbw
Calcium Oxide	4.3 pbw
Moisture Scavenger (Additive TI, Trixene AS)	1.1 pbw
Air Release (Acronal 700L)	0.1 pbw
Anti-foam (Baysilon OL)	0.05 pbw
Flow Modifier (Multiflow)	0.3 pbw
Thixotrope (FPE940T or Sylothix 53)	0.5 pbw
Catalyst (DBTL)	0.25 pbw

The tar extended roofing membrane formulation, with minor modification, can be used as a vehicle underbody protective coating.

Zinc Rich Primer

Experimental Product 8775*	11.7 pbw
Trixene SC775	2.0 pbw
Moisture Scavenger (Additive TI, Trixene AS)	1.0 pbw
Air Release (10% Acronal 700L in Xylene)	0.1 pbw
Ultra Fine Zinc Dust	73.0 pbw
Thixotrope (10% Bentone 38 in Xylene)	6.5 pbw
Xylene	4.7 pbw
Triethylorthoformate	1.0 pbw

* Experimental Product 8775 is a polyurethane prepolymer of polyoxypropylene and toluenediisocyanate at 60 per cent solids in xylene/EGA where the free unreaction monomer is removed by vacuum distillation, from Baxenden Chemical Co. Ltd.

Micaceous Iron Oxide Primer

Experimental Product 8787*	17.7 pbw
Moisture Scavenger (Additive TI, Trixene AS)	1.0 pbw
Air Release (10% Acronal 700L in Xylene)	0.2 pbw
Micaceous Iron Oxide	55.0 pbw
Non Leafing Aluminium Paste	5.5 pbw
Thixotrope (10% Bentone 38 in Xylene)	11.6 pbw
Xylene	8.0 pbw
Triethylorthoformate	1.0 pbw

* Experimental Product 8787 is a polyurethane prepolymer of polyoxypropylene and undistilled polymeric diphenylmethanediisocyanate from Baxenden Chemical Co. Ltd.

Floor Coating

Experimental Product 8787*	63.3 pbw
Moisture Scavenger (Additive TI, Trixene AS)	0.5 pbw
Air Release (10% Acronal 700L in Xylene)	0.2 pbw
Red Iron Oxide	12.0 pbw
Thixotrope (10% Bentone 38 in Xylene)	16.5 pbw
Low Viscosity Plasticiser	6.5 pbw
Triethylorthoformate	1.0 pbw

* Experimental Product 8787 is a polyurethane prepolymer of polyoxypropylene and undistilled polymeric diphenylmethanediisocyanate from Baxenden Chemical Co. Ltd.

Manufacture

The main features of the manufacture of these moisture-curable paints and coatings are similar for both rigid and flexible systems and, of course, the exclusion of water from the system is of prime importance. It is this factor around which the process revolves. The more water that is excluded from the system the longer the shelf life of the end product, so all solvents used should be specified as urethane

Red Iron Oxide Primer

Experimental Product 8787*	32.5 pbw
Moisture Scavenger (Additive TI, Trixene AS)	3.0 pbw
Air Release (10% Acronal 700L in Xylene)	0.2 pbw
Talc (AT1)	32.0 pbw
Red Iron Oxide	8.0 pbw
Thixotrope (10% Bentone 38 in Xylene)	5.0 pbw
Xylene	18.0 pbw
Triethylorthoformate	1.3 pbw

* Experimental Product 8787 is a polyurethane prepolymer of polyoxypropylene and undistilled polymeric diphenylmethanediisocyanate from Baxenden Chemical Co. Ltd.

Reflective Aluminium Roofing Membrane

Trixene SC772	10.0 pbw
Trixene SC771	30.0 pbw
Moisture Scavenger (Additive TI, Trixene AS)	1.0 pbw
Leafing Aluminium Paste	30.0 pbw
Extender (Cereclor 70L)	15.0 pbw
Air Release (Acronal 700L)	0.1 pbw
Anti-foam (Baysilon OL)	0.15 pbw
Flow Modifier (Multiflow)	0.5 pbw
Catalyst (DBTL)	0.5 pbw
Solvent (EGA or similar)	12.75 pbw

Chemical Resistant Tar-based Topcoat

Experimental Product 8775*	40.0 pbw
Tar (Carbomod AN)	28.7 pbw
Crude Polymeric MDI	2.0 pbw
Moisture Scavenger (Additive TI, Trixene AS)	1.0 pbw
Air Release (10% Acronal 700L in Xylene)	0.3 pbw
Barytes	19.3 pbw
Talc (AT1)	4.7 pbw
Calcium Oxide	3.0 pbw
Triethylorthoformate	1.0 pbw

* Experimental Product 8775 is a polyurethane prepolymer of polyoxypropylene and toluenediisocyanate at 60% solids in xylene/EGA where the free unreacted monomer is removed by vacuum distillation, from Baxenden Chemical Co. Ltd.

grade, containing less than 0.05 per cent water with no contaminants or stabilizers which contain active hydrogen groups. The latter is sometimes overlooked in the quest for a low water content but many ester solvents contain free alcohols which are monofunctional and cause premature chain termination and correspondingly lower final molecular weight, giving poor physical properties. Pigments, fillers, extenders and solvents should be dry, or dried, before the addition of the prepolymers.

Careful choice of raw material sources and specification should ensure that water contents of less than 0.5 per cent on pigments, fillers and extenders are achieved but these need to be in the 0.1 to 0.2 per cent region before manufacture. Liquid extenders and solvents can be dried by storage over molecular sieve or calcium oxide, followed by filtration or separation. Fillers and pigments can be kept dry by storage under warm dry conditions and good housekeeping.

It is certainly possible to obtain a water content in the region of 0.1 per cent to 0.2 per cent in the initial stages of manufacture by the above methods but this needs to be reduced to less than 0.05 per cent before the addition of the urethane prepolymers, preferably less than 0.01 per cent. In the given formulation for tar extended roofing membranes, for example, a water content of 0.5 per cent prior to addition of prepolymers would result in total cure of the urethane resins with the corresponding disastrous consequences. There are many ways in which the water level can be reduced; calcium oxide, triethylorthoformate, molecular sieve and multifunctional isocyanates, are all used but monofunctional isocyanates are the 'safest' method because the reaction with water is irreversible and no species detrimental to the final product is produced. There is an added advantage as trace activity associated with other active hydrogen groups such as alcohols, phenols and amines is also removed by this method. Molecular sieves, which capture moisture by entrapment in regular sized 'pores' within their structure, are also satisfactory as this entrapment is permanent at ambient temperature and good stability is therefore achieved.

It is vitally important, no matter which scavenger is used, that the water content is measured accurately and that the correct proportion of scavenger is added because any excess will be detrimental to the final product. Monofunctional isocyanates in excess can cause chain termination on curing; molecular sieve can give sites for high moisture vapour permeability; multifunctional isocyanates can drastically affect the final physical properties of the coating, especially elongation and hardness; calcium oxide gives higher vapour permeability in pitch systems and should NOT be used at all in combination with aluminium and triethylorthoformate will produce ethanol on reaction with water causing chain termination. Triethylorthoformate, however, in small quantities, is a very effective in-can stabiliser and is efficient in removing any trace amounts of water which may enter the can during storage.

The whole process should be carried out under dry nitrogen for obvious reasons and if the ultimate in processibility is required then the product should be degassed immediately before canning off. Containers for moisture curable systems should be stored indoors in warm dry conditions to prevent condensation and a blanket of dry nitrogen should be added before closure. Drum inspection prior to filling should become second nature.

The actual process details differ slightly for each product but the principles are the same throughout. The pigments, fillers, extenders and solvents are mixed together then dried as described. It should be stressed again how important an actual water content determination is in the process, as excess scavenger will certainly lead to problems. When the water content is less than 0.05 per cent (the batch normally being left overnight to achieve this level), the urethane prepolymers are added under nitrogen and the

viscosity, etc. of the batch is then adjusted and the final product canned off.

These precautions, which are absolutely vital for the production of stable moisture curable systems should not deter potential manufacturers as they soon become an accepted part of the process.

There are many more potential applications for moisture curable intermediates and without doubt their full potential in surface coatings has not yet been realised but with increased industry awareness and product development, moisture curable urethanes are likely to achieve very significant growth in the future.

[Received 22 January 1985]

Appendix — Suppliers

Acronal 700L (*BASF UK Ltd*)
Additive TI (*Bayer UK Ltd*)
Barytes (*Zach Cartwright Ltd*)
Baysilon OL (*Bayer UK Ltd*)
Benton 38 (*Steetley Minerals Ltd*)
Calcium Oxide (*John & E. Sturge Ltd*)
Carbomod AN (*Collinda Ltd*)
Caromax 15/18 (*Carless Solvents Ltd*)
Cereclor 70L (*ICI Ltd*)
Crude Polymeric MDI (*Bayer UK Ltd, ICI Ltd, Dow Chemical Co. Ltd*)
Dibutyltindilaurate (*Albright & Wilson Ltd*)
FPE 940T (*Sparkford Chemicals Ltd*)
Leafing Aluminium Paste 65L (*Johnson & Bloy Ltd*)
Micaceous Iron Oxide (*Miox Ltd*)
Multiflow (*Monsanto via, Durham Chemicals Ltd*)
Non Leafing Aluminium Paste (*Johnson & Bloy Ltd*)
Red Iron Oxide (*Calder Colours (Ashby) Ltd*)
Sylothix 53 (*W. R. Grace Ltd*)
Talc AT1 (*Norwegian Talc Ltd*)
Triethylorthoformate (*Steetley Chemicals Ltd*)
Trixene AS (*Baxenden Chemical Co. Ltd*)
Trixene SC772 (*Baxenden Chemical Co. Ltd*)
Trixene SC773 (*Baxenden Chemical Co. Ltd*)
Trixene SC775 (*Baxenden Chemical Co. Ltd*)
Ultra Fine Zinc Dust (*Durham Chemicals Ltd, ISC Alloys*)

Newcastle Section

Seminar – “So you want to make paint”

A seminar entitled “So you want to make paint” was held in the James Duff Lecture Theatre, University of Durham, on Thursday, 26 September, 1985. The subject matter was aimed at junior technologists or qualified personnel new to the paint and allied industries. Some 49 delegates attended, from as far afield as Glasgow and Cambridge and the day proved to be one of the most successful held by the Section. The following are summaries of the various lectures presented:

Fields to Factory

The lecturer was Mr J. G. N. Smith a Consultant. Many factors are involved in the planning and construction of a new paint factory, from the initial concept through to eventual commissioning. Early feasibility studies require a suitable brief, giving details of products, volumes, demand forecast, pack sizes and expected return on capital, so that investigations of suitable green-field sites, sources of finance and operational factors (labour, machinery, services, supplies) can be made.

With approval to build on a specific site, a whole range of expert skills come into operation, e.g. Marketing – product ranges, specifications, hazard/safe handling information; Engineering – structural detail, machinery, energy needs, tankage, piping, ancillary services; Personnel – labour acquisition, union negotiations, communications, pay structure, training; Finance – expenditure planning/control, contract examination/surveillance; Works Management – appointment of contractors, machinery suppliers etc., and monitoring progress – critical path analysis/simulation techniques, contact with factory inspectorate, local authorities, nationalised industries.

There are pitfalls at each stage for the unwary, e.g. tenders on a “firm basis”, supplier responsibilities (small print in contract), erection/installation times, variation clauses.

Operation Planning

This lecture was given by Mr D. Neal of Crown Paints. Materials planning and control systems aim to optimise three objectives – customer service, control of working capital and operational efficiency. High service levels can be met with unlimited stocks but profitability demands strict control on levels of materials, containers and products.

Systems need to be simple, flexible and reactive. In a product offer of several thousand items they must answer the questions: what product? how much? when? and how? Early systems suffered from lack of equipment to provide rapid stock up-dates. Modern equipment has reduced lead times by 75 per cent of earlier systems.

Current systems use basic input from free stock, sales

forecast, stocking policy and outstanding production to develop production programmes for individual factories in a large company four weeks in advance. These programmes are used for container/packaging orders but raw material deductions/re-orders are left nearer the production date when later sales input may have modified the programmes. The systems stand or fall on good sales forecasting, which is something of a black art, despite various attempts to introduce science. Some modern concepts are claimed to improve efficiency – Economic Batch Quantity (EBQ), Materials Resource Planning (MRPI) and Manpower Resource Planning (MRP2): Just-in-time (JIT) Theory is the latest to be tried. Whatever the system, the benefits of efficient planning can only be achieved consistently by continual monitoring and maintenance of the system, input data and equipment.

Manufacturing and Filling

This lecture was given by Mr F. Hellens of International Paint.

A brief outline was given of the duties and responsibilities of any supervisory or management post within a manufacturing organisation. This was followed by an indication of the various forms of legislation which apply to industry, with particular reference to paint manufacture.

The importance of development laboratory personnel gaining works experience to give understanding of large scale manufacturing variables and parameters was stressed. This was illustrated with a few choice examples.

Discussion of suitable manufacturing equipment was directed at the need to know one's own company business and probable future developments: this would guide a user towards the correct type of equipment to meet specific needs. The importance of secondary equipment was also highlighted. With filling operations a review of weight/volume possibilities was made, with the emphasis on close circuit systems for safety reasons.

The need for training at all levels of a company was stressed as the way to “improved quality and efficiency”.

Dispersion

A lecture on “Dispersion” was given by Mr J. J. Marron of Tioxide U.K.

The degree of pigment dispersion influences all coating characteristics and successful dispersion is as important as correct choice and blending of raw materials.

The dispersion of titanium dioxide pigments was discussed, using a white alkyd gloss paint as a model. Aggregates, agglomerates and flocculates were described and the forces of attraction (London – Van der Waals) and repulsion (electrical) were discussed. Pigment particles can be broken down by impact or shear using various milling machines. As a starting point to formulation, the Daniel Flow Point technique was discussed and its application to mill bases for various mills described in good, average or poor dispersing media.



Shown standing in the back (from left to right): Mr D. Neal, Mr F. Hellens, Mr. S. Catterall, Mr J. G. N. Smith, and shown in the front (from left to right): Mr J. J. Marron, Mr G. D. Carr (Chairman), Mr J. Bravey, and Mr L. Morpeth.

A film was shown on the use of Flow Point technique for air-drying gloss paints manufactured on ball, sand and high speed impeller mills. Time lapse sequences of millbase being added to difference concentrations of resin illustrated flocculation and the importance of stabilization before let-down. Flocculation in paint films during the drying process was demonstrated via transmission microscopy: its measurement by settlement, X-ray sedimentation filament tests and scanning electron microscopy.

Finally, the use of "flocculation gradient" was shown and the effect of dispersion/flocculation on colour uniformity (flooding/flotation) and durability.

Laboratory Involvement

This lecture was given by Mr J. Bravey of International Paint.

The importance of approved raw material specifications was discussed, together with need for laboratory personnel to be aware of normal property variations possible in future bulk deliveries. Paint formulations and Q.C. test specifications should take account of these variations in meeting the coating performance claims in company literature.

Simulation of Works' processing conditions in the laboratory is necessary to avoid problems in large-scale manufacture. Instructions for manufacture should be simple, clear and unambiguous: product rheologies and volumes should be optimum for the processing equipment at each stage. The value of test batches was emphasised and the relevance of Q.C. tests to end use of coatings: testing should not hinder or delay production unnecessarily.

The importance of correct safe handling procedures was emphasised, together with safety labelling of packaging and advice to users.

Health & Safety

This lecture was given by Mr S. Catterall of the H.S.E.

The lecture began with an introduction to the Factory Inspectorate, now known as the Health & Safety Executive, highlighting not only its "industrial police role", but also how it advises industry on ways of improving health and safety.

Attention was drawn to the risks in paint manufacture. Particular stress was placed on fires caused by static discharge and careless handling of flammable solvents. Next, the health risks from solvent fumes and contact dermatitis were highlighted and the necessity of individuals to work sensibly.

The lecture was completed with some general references to machine guarding, the use of fork lift trucks and the extension of H.S.E. authority (CPL Regs) to paint labelling. A detailed list of H.S.E. Advisory Publications for the paint industry was handed out to members of the audience.

J. Bravey

London Section

Purchasing and technical co-operation in optimising supply and price of raw materials

The second meeting of the current session of the London Section was held at the Pearly King, Bromley High Street, on Thursday 17 October 1985.

Some 40 members and guests were treated to a most interesting on "the other side of the fence" talk on the theme "Purchasing and technical co-operation in optimising supply and price of raw materials". This was given by Mr Vic Moran of Sericol Ltd (Burmah Castrol Group) who is well known in both supplier and user industries.

Mr Moran called on his long experience in the buying field in outlining the various parameters for making buying decisions. This included comparison of offers, multiple sourcing, factors affecting "make or buy" decisions and not least, internal relationships between technical, sales and purchasing in optimising the benefits for the company.

As expected, Mr Moran was challenged on a few points and after some lively repartee, a vote of thanks was proposed by Dr Thukral.

D. Bannington

Ontario Section

Ever changing needs

The Ontario Section of the Oil and Colour Chemists' Association met on Wednesday 16 October 1985 at the Cambridge Motor Hotel, with approximately 24 members and guests in attendance.

Mr James Wegemer, General Manager of Canadian Fine Colour, Liquid Inks Limited spoke on "Ever Changing Needs" with particular reference to the ink industry. Some examples quoted included the change away from letterpress, the change from gravure to flexographic printing, and that from conventional printing on corrugated paper to pre-printing.

The list of change was endless, including the constant introduction of new technology such as faster presses, computers, high speed scanners, and so on, resulting in increased quality demands by ink users. More efficient ink dispersion equipment such as bead and shot mills help cope with these demands.

Recent changes in the external environment were highlighted, particularly such legislative developments as the "Transportation of Dangerous Goods" Act, and "Waste Disposal Regulations 309".

Jim concluded his talk by stressing that we could cope with all of these changes provided that we act with professionalism, pride and commitment. A lively and lengthy question period ensued following which the vote of thanks was proposed by Alan Gray.

P. Marr

Midlands Section – Trent Valley Branch

Members and guests were invited to a lecture on the premises of Courtaulds Acetate, Spondon, Derby, given by Mr Gordon Smith, who was, until his recent retirement, the Divisional Technical Safety Officer of Courtaulds Acetate.

Mr Smith, originally a research chemist, had spent the last eleven years of his working life involved in Health & Safety legislation with respect to packaging and labelling of dangerous substances.

He was able to sketch the various attempts at labelling legislation with reference to the transport of goods by road, rail, air and sea, so as to identify substances and make them easily recognisable by all nations, from as early as 1893 to the present day, schedules and amendments of the complex structures involving EEC substances directives, which evolved in 1967 and the attempts of the United Nations to introduce uniformity of labelling hazards.

Mr Smith was able to draw on his considerable personal experiences to illustrate his talk. A lively discussion period was followed by a buffet supper kindly provided by Courtaulds Acetate. Mike Hannah of Joseph Masons proposed a vote of thanks on behalf of those present.

J. R. Kitchen

news

"Further restructuring needed" urges European plastics president

Despite the good economic progress during 1985, the European plastics industry should not relax its policy of restructuring, warns the president of APME (Association of Plastics Manufacturers in Europe), Manfred Roh. Writing in the latest issue of the APME newsletter, the president calls for "bold restructuring and reduction of production capacity" in the standard plastics materials, coupled with "intelligent and technological" development of new, high added-value materials.

News of the latest three-way discussions between the plastics industries of Europe, the United States and Japan is also given in the APME newsletter, which reports on experiences in the three regions on combustibility of plastics, industrial hygiene and toxicology, environmental and resource management, public relations and food contact recommendations.

The newsletter also gives a summary of a paper on the energy content of plastics, presented recently by the chairman of its environment committee, together with the latest news on its own activities and those of national plastics associations in Europe.

Reader Enquiry Service No. 31

New Resins and Coatings Consultancy

Four former BP Chemicals technical management colleagues have formed RACCON LTD (Resins and Coatings Consultancy) to offer technical assistance to both manufacturers and users of synthetic resins and polymers. The managing director, John Taylor, and co-directors, Tom Hunt, David Ilsley and Jim

Wood, are professional chemists who have wide experience in the formulation, production and evaluation of synthetic resins for use in surface coatings, adhesives and structural applications. Collaboration with clients is supported by an investigative laboratory and workshops. Jim Wood, the company secretary, is located at 15, Oakfield Road, Barry, South Glamorgan.

Reader Enquiry Service No. 32

KEK and Gardner integrate

Kemutec have announced the full operational integration of KEK and Gardner into a single consolidated unit. The new company, known as KEK-Gardner, will be marketing and manufacturing the full range of Kemutec processing equipment related to size reduction, size classification, mixing and blending of powders and granular materials.

This move is the natural culmination of integration plans subsequent to Gardner joining the Kemutec Division of the BSS Group in June 1984. It will provide the co-ordinated effort to further enhance Kemutec's position as a major supplier of dry and semi-dry solids processing equipment to the food, pharmaceutical, chemicals, plastics and other industries.

All Gardner sales, project, applications and technical functions are being transferred from St Blazey to Macclesfield. The St Blazey factory will become the focus of Kemutec's manufacturing operations, to optimise use of the excellent facilities and skilled personnel available.

Product testing, evaluation and demonstration facilities for mixing

equipment and systems have been integrated into the newly expanded Macclesfield Test and Demonstration centre. This has become one of the best equipped, most versatile powder processing and handling facilities available anywhere in the world.

KEK-Gardner products will continue to be promoted by the existing established sales team under the direction of Mr Russel Alt and Mr Roger Ellis, who will maintain continuity of service. As previously, the "Process Equipment and Systems" field sales engineers will represent the interests of KEK-Gardner and Kemutec Process Systems.

Tourell-Gardner will continue to service the specialised needs of the confectionery industry from St Blazey, under the auspices of Mr Nigel Bailey.

Reader Enquiry Service No. 33

Sun Chemical opens new organic pigments facility in France

Sun Chemical Corporation has opened a new organic pigments plant in Huningue, France, the company's first pigments installation outside the United States. The new facility serves France and Export markets, primarily in Western Europe, but also in other areas of the world.

The new installation is located on the site of a manufacturing complex operated by Sandoz of Basle, Switzerland. A year ago, Sandoz and Sun Chemical entered into an agreement under which Sun Chemical would establish a direct manufacturing presence for pigments in Europe and Sandoz would have access to the Sun Chemical pigments distribution network in the United States.

The facility dedicated today houses the production of organic pigments in dry and "flushed colour" form. Flushed colours are pigments pre-dispersed in an oil vehicle and well suited for use in the manufacture of printing ink.

The start of dry colour production has progressed to the point where Sun has the capability to service all international markets from the Huningue facility. For flushed colours, Sun has installed heavy-duty mixers, which are in full operation to replace US production for the growing worldwide market for pigments in this form. The plant incorporates advanced process technology, including an automated materials handling system to ensure optimal product quality.

The facility also includes a discreet unit for the manufacture of a type of blue

pigment used extensively in the production of printing inks for the gravure printing process.

Reader Enquiry Service No. 34

BASF takes over Seal Sands

The BASF Group have taken over Monsanto's Seal Sands plant on Teeside, Cleveland. To operate the plant, a new company named "BASF Chemicals Ltd" has been set up as an affiliate of BASF Aktiengesellschaft, Ludwigshafen.

The Seal Sands plant has very modern production facilities for 200,000 (metric) tons of acrylonitrile, 90,000 tons of adiponitrile and 90,000 tons per year of hexamethylenediamine. These chemical intermediates are used mainly for the manufacture of man-made fibres and speciality plastics.

The acquisition is claimed to fit perfectly with BASF's operations and objectives in fibre intermediates and speciality plastics. The highly sophisticated and modern process used by Monsanto at Seal Sands is based on propylene. BASF will increase its feedstock flexibility in an important section of its fibre intermediates business. The acquisition will significantly strengthen BASF's engineering plastics activities, which are developing at an above-average rate.

Reader Enquiry Service No. 35

Sheen appoints northern distributor

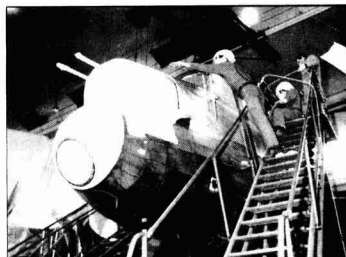
Sheen Instruments has appointed Tri-Spray UK Ltd as North of England distributors for the Sheen range of coating thickness measurement instruments. Tri-Spray UK Ltd, who are the North of England's leading distributor of paint application equipment, are based at Moor View, Leeds, and also have an office and warehouse in Manchester.

Reader Enquiry Service No. 36

Airmix finish for the Battle of Britain Lancaster

The only World War II vintage Lancaster bomber still flying recently received a major maintenance at RAF Abingdon. It is a regular visitor at Air Shows throughout the U.K., where it appears in company with a Spitfire and a Hurricane as the Battle of Britain Memorial Flight.

In addition to an extensive mechanical overhaul, the Lancaster also had a complete repaint. Kremlin Spray Painting Equipment's patented Airmix system was



Using a Kremlin Airmix spray gun for refinishing the Lancaster bomber at RAF Abingdon.

used, which drastically reduces the amount of paint fog resulting from bounce-back and overspray that is associated with conventional air spray guns. This was, of course, particularly advantageous in spray painting the Lancaster as it gave much cleaner working conditions, as shown in the photographs, than would normally be possible when spraying without the use of a booth.

Two Kremlin Airmix 16:35 pump units were used, each feeding to two Airmix Spray guns. The Airmix units were positioned below the bomb bay during spraying and were able to supply the paint, without any pressure drop, through its hoses simultaneously to spray operators even when at opposite tips of the Lancaster's 102 ft. wing span.

ICI Paints zinc chromate epoxy resin based primer was first applied to the top surface, followed by a polyurethane finish in "night camouflage", supplied by International Paint.

SURFEX
86

Extra space has been made available

So great has been the interest aroused in Surfex 86 (the next OCCA Exhibition to take place 14 and 15 May 1986, at the Harrogate Exhibition Centre) that an additional area has been allocated to the following companies:

- Bromhead & Denison
- B. P. Chemicals
- Vuorikemia Oy
- Miox Ltd

The full list of exhibitors is given on an advertisement page elsewhere in this issue. Admission to the exhibition is free and the "Official Guide" will be contained in the April issue of JOCCA.

products

New aqueous colourants for fencing panels

Foscolor Ltd has developed a new range of water based colourants specially designed for dipping and spray systems for fencing panels and other wood treatment.

Marketed under the trade name Fostain, the range includes single pigment concentrates for in-house blending, as well as pre-matched wood shade blends. They are highly concentrated, cost effective colourants for low solids systems exhibiting great stability and compatibility with a variety of biocide systems.

They have been specially formulated to prevent the occurrence of colour patching, even on wet wood, and will set at temperatures down to freezing point without the addition of binder. The colourants are based on high lightfastness pigments which will not wash out and retain their colour many times longer than creosote. After treatment with Fostain based systems, the wood can be overpainted at any time with either emulsion or gloss systems without any risk of staining.

Aqueous systems have many advantages over creosote including lack of odour, ease of handling, overpainting etc and Foscolor are in a position to offer advice on formulation to suppliers wishing to move to this modern advanced process.

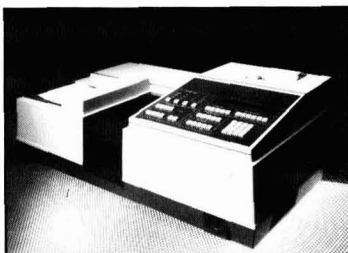
Reader Enquiry Service No. 37

Philips Analytical new IR spectrophotometer

Philips Analytical has announced a new version of its successful PU 9500 series of ratio-recording infrared spectrophotometers.

The instrument incorporates a new special subtraction accessory which simplifies the analysis of a wide range of difficult samples.

For example materials that need to be handled by use of reflectance accessories such as ATR, MIR or specular reflectance can produce far better results if the new spectral subtraction unit is employed. The spectrum of the particular reflectance accessory is stored in memory and then subtracted from the spectrum of the sample plus accessory. Any baseline effects



The new version P49500

due to the reflectance accessory are removed.

The spectrum of a reference sample, such as a solvent, can be stored in digital memory and subsequently automatically subtracted from the spectrum of a sample dissolved in the solvent.

The first work carried out in Philips Analytical's Cambridge laboratories using the new PU 9500 was the quantitative analysis of additives in oils. Subtraction on the base oil gave much greater accuracy to the final answers which were produced in concentration using the Quant accessory with built-in printer.

These spectral subtraction techniques are normally carried out using a separate data station, so major cost savings can, it is said, be achieved using this accessory.

Reader Enquiry Service No. 38

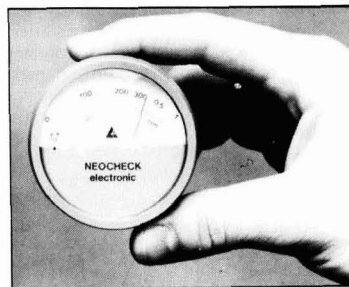
New electronic coating thickness gauge

Wymark have introduced a new electronic thickness gauge, the Neocheck, which is said to be not only genuinely pocket size, but it also has an easily read dial in place of the conventional digital display of other currently available electronic thickness gauges. This makes it much easier to use when many repetitive measurements have to be assessed and evaluated for variation within a specified thickness range.

The Neocheck is said to be ideal for quick and accurate non-destructive measurement of all non-magnetic coatings (such as chromium, zinc, copper, paints, plastics, rubber, enamel, etc) on steel or iron.

It is available with two alternative Scales - 0 to 300 microns and 0 to 1000 microns. It operates by magnetic induction and is powered by a small 1.5V battery with a life of about 300 working hours. It is only 63 mm in diameter, 33 mm thick and 55g in weight.

Reader Enquiry Service No. 39



The Neocheck

meetings

Symposium on Health and Safety

The London Section of the Oil and Colour Coatings Association are holding a one-day symposium entitled "Health and Safety in the Coatings and User Industries". This will be held at the Royal Institution, London W1, on Thursday, 10 April, 1986, commencing at 10 am with coffee being available from 9.30 am.

The meeting will be of interest to Production and Laboratory managers because of their responsibility for ensuring safe working conditions for their workers as well as to Health and Safety Advisers and Safety Officers who are directly involved.

The programme will include information on the toxicity of raw materials, labelling for supply and conveyance and risks of fire and explosion. Prominently featured will be the implications of the Control of Substances Hazardous to Health Regulations with speakers from Paintmakers' Association and the London School of Hygiene and Tropical Medicine.

For further information contact Mr K. H. Arbuckle, Berger Group, Freshwater Road, Dagenham, Essex RM8 1RU. 01-590 6030.

literature

Brochure on colour control from ACS

A new full-colour, six page brochure describing the technology, product line and capabilities of Applied Color Systems, Inc., is now available.

The new brochure discusses the state of

computer colour control technology and ACS systems and software capabilities. Also detailed is the company's customer support, training and service programmes. Specific cost savings and user benefits are described in text and graphically. Case history summaries are cited to support financial and benefit claims. Colour photographs throughout depict systems and their areas of application.

According to the brochure, ACS systems and software are widely used to provide speed and accuracy in formulating, reproducing and controlling colour in industrial processes. The textile, plastics, paint, coatings, ink and printing industries are cited as users of the systems.

Reader Enquiry Service No. 40

Microcalorimeter Booklet

A 12-page booklet "Isothermal temperature scanning investigations by Setaram" is available from Clandon Scientific Ltd. Contents include the Heatflux Principle with explanatory diagrams, details of several applications and a brief specification of the Model 1286 Microcalorimeter.

Reader Enquiry Service No. 41

CBNB now available on-line

Chemical Business News Base (CBNB), the new database developed by the Royal Society of Chemistry (RSC), is now available on-line from Dialog, bringing to three the number of vendors. The others are Data-Star and Pergamom Infoline.

Information is abstracted from international trade and business journals and company literature and new entries are being added at the rate of about 600 per week, with the ultimate goal of listing 50,000 entries each year. Emphasis is on the needs of the European chemical industry and the database is the only one of its kind available in Europe.

Reader Enquiry Service No. 42

New Bayer shade card covers colour pigments

A new eight-page fold out shade card for inorganic colour pigments used in the coatings industry is now available from Inorganics Division of Bayer UK Ltd. The card is easy to read and gives colour examples of the complete Bayer colour range—comprising Bayferrox iron oxides; Lightfast pigments; Chrome oxide green, Cadmopur cadmium pigments; and Anticor anticorrosion pigments.

The card also contains detailed and updated tables of technical data on all products. The shade cards are available to technical, specifying and purchasing executives by request.

Reader Enquiry Service No. 43

people

Obituary

Dr Pierre Castan – the Discoverer of Epoxy Resins

Mr. E. V. Schmid (Past President of FATIPEC) writes:

On 12 September 1985, Dr Pierre Castan died of heart failure in Geneva, aged 86. His death brought to an end a lifetime of inventive effort full of ups and downs, and it is certainly fitting that we pay tribute to its significance for the paint and plastics industries.

Pierre Castan was born on 17 August 1899 in Berne, Switzerland and gained his doctorate at the University of Geneva in 1922. Following his graduation he lectured for several years at Geneva and Lausanne Universities and worked as a chemist at the Federal Testing Laboratories for Wine-growing in Lausanne.

In 1928, he joined the scientific staff of Gebr. de Trey AG in Zurich, a dental specialties manufacturer, and was given the job of developing new synthetic resins for dentures. This was the era of earth-shaking discoveries in the field of synthetic resins, the era in which Carothers, Kienle and others demonstrated the significance of multifunctional structural units for these syntheses.

One of Castan's approaches was to use polyaddition¹: he combined diphenols with epichlorohydrin and proceeded to cure the resin-like product of the reaction which contained epoxy groups, with acid anhydrides. Without releasing volatiles, he thus obtained an insoluble, rigidly elastic synthetic resin with outstanding properties. A patent application was filed on the discovery in 1938, and Swiss Patent No. 211 116 was issued in 1940. A follow-up patent was issued in 1943 covering the use of basic components for curing.

Gebr. de Trey was unable to exploit these discoveries in the dental field and sold them during the war to CIBA AG in Basle, now Ciba-Geigy AG. It proceeded to market these epoxy resins under the "Araldite" trademark starting in 1946, and they rapidly gained worldwide importance.

One occasionally hears the charge that Castan based his discovery on the somewhat earlier patent of P. S. Schlack of I. G. Farben (Bayer), which was applied for in 1934 but published only in 1938. Castan refuted the allegation in an article entitled "Trois Chimistes – et la groupe Epoxy" in *Double-Liaison* in 1972, claiming that he could not possibly have known of this patent application while doing his work in the 1935-38 period. Furthermore, Schlack's patent dealt exclusively with resin-containing finishing agents for textile fibres. The third chemist referred to in Castan's article was the American S. Greenlee, who worked in the paint industry. Greenlee was obviously familiar with Castan's patents, which had been released for general use by the U.S. Government during the war. Shell (U.S.A.) then purchased the patent rights and proceeded to market its epoxy resins successfully under the tradenames "Epon" and "Epikote".

Therefore, there is no doubt whatsoever that Castan was the first to describe the outstanding properties of the epoxy resins for the plastics and paint sector and, therefore, is quite justly regarded as the true discoverer of these resins.

With time, these synthetic resins have developed into materials of astounding technical importance. Annual consumption has now reached about 400,000 tons worldwide for all sorts of applications: coatings in the paint industry (over 50 per cent of consumption), adhesives – mainly in the light metal sector – casting resins for electrical insulation, in the form of moulding resins and laminating resins, and many other uses.

Like a great many genial inventors before him, Castan was destined to earn only a pittance from his discoveries while others with economic "clout" went on to reap untold profits from them.

Despite many setbacks in the course of his life, Pierre Castan always remained a quiet, modest and kind human being who placed his great knowledge primarily at the disposal of the paint industry. From 1950 to his retirement in 1967, he was technical director of the Geneva paint producer Stella S.A. Many honours were conferred on him. In 1969/70, as Swiss president of FATIPEC, he organized the unforgettable conference at Montreux. And, as honorary member of the Swiss Association of Paint Chemists, he was active in a number of technical committees even when he was well on in years.

His friends and colleagues will never forget his sound advice nor his warm, kind-hearted nature.

Eric V. Schmid

Annual General Meeting 1986

The 1986 Annual General Meeting of the Association will take place at the Unicorn Hotel, Prince Street, Bristol, and will be preceded by a Reunion Luncheon to which Past Presidents, Past Honorary Officers and Honorary Members of the Association are invited as the Association's guests.

Following the Luncheon an illustrated talk will be given by a speaker from the *SS Great Britain Project* which will deal with the work of restoration and the problems of corrosion involved in the restoration project.

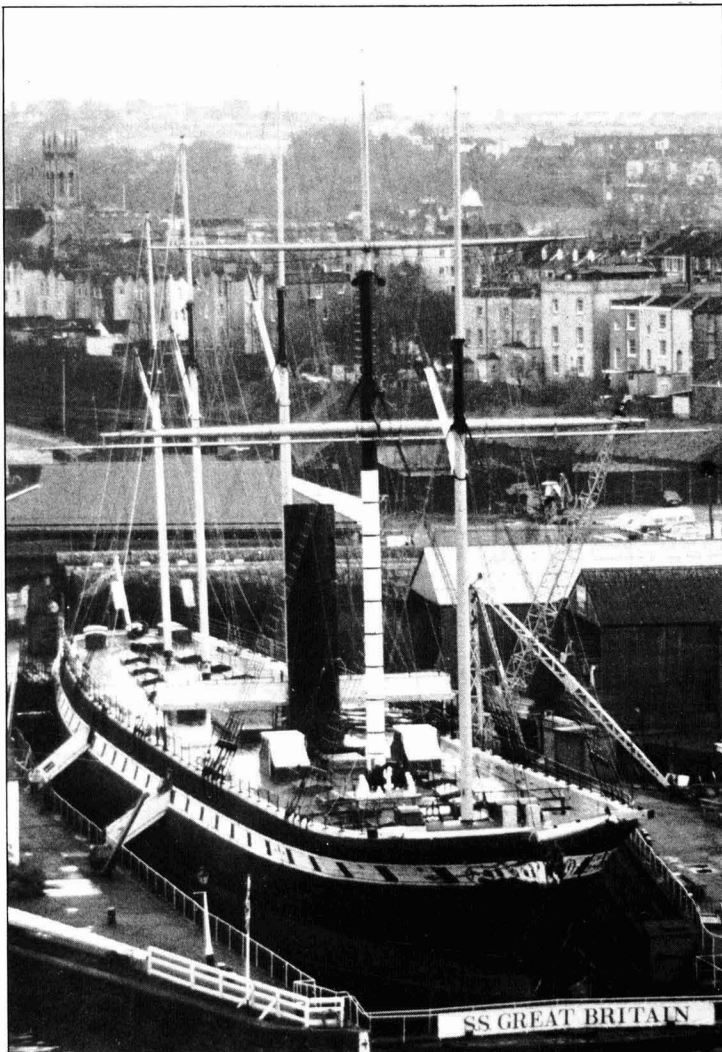
This talk has been arranged by the Bristol Section of the Association and it is felt that members of the Association will be most interested in the talk on this project and those visiting Bristol for the AGM may like to take the opportunity to go and see the *SS Great Britain* on the same day.

Full details of the luncheon and the talk will be circulated to members with the Annual Report with the May issue of the Journal and those wishing to attend the lecture and travelling from overseas should apply to the Association Headquarters for an application form as soon as possible so that this can be sent by airmail to them. Further details regarding the lecture will also be appearing in the Journal and in the monthly Bulletin of meetings sent to members in the UK and Irish Sections.

Report of Council Meeting

A meeting of the Council took place at 1.30 p.m. on Wednesday 23 October 1985 at the Great Northern Hotel, Kings Cross, London, N1 9AN. The President (Mr F. B. Redman) was in the Chair; there were 26 members present.

It was reported with sadness that a past member of Council (and past Chairman of Manchester Section) Mr S. Duckworth had died on 19 September. Council stood in silence in tribute to the work on behalf of the Association by their former colleague. Mr Stuart Heyes (Representative Manchester Section) who was attending his first Council meeting was welcomed by the President and introduced to the other members. Details were given of the final arrangements for the Council Reunion Dinner to take place later in the day and a report appears elsewhere in this issue of the *Journal*. The half year accounts and estimates for the second half of the year were adopted by the Council.



The *SS Great Britain*

The number of members in arrears with 1985 subscriptions was reported to Council and it was reported that a final reminder had been sent to those who had been admitted to the professional grade reminding them that removal from the main register automatically meant removal from the professional grade register; this had resulted in almost all such members paying their 1985 subscriptions. It was reported that as well as the conference papers there were other papers available for the *Journal* and that a further reprint of the Introduction to Paint Technology had been necessary. The Honorary Research & Development Officer asked all Sections, as well as the Technical Committee, to con-

sider the subject and format for the next Conference which will take place in Eastbourne from 17-20 June 1987. Any member wishing to put forward suggestions for a possible lecture should send the title of the paper and possible lecturer to the Director & Secretary without delay.

It was reported that the Association wished to find lecturers for the South African Division's next Convention which will now take place on 21-25 October in Natal and for the 25th Convention of the New Zealand Division which will take place on 22-26 June 1987, on "Timber, its protection and decoration". Any member

who is able to offer a paper for either of these Association functions is asked to notify the Director & Secretary. A report was received on the progress of the Open Tech. project.

It was reported that at the meeting of the Professional Grade Committee, two Associates had been regarded to Fellow and two new Associates had been admitted. Regarding SURFEX 86, the next Association Exhibition to take place on 14/15 May 1986 at the Harrogate Conference Centre, it was reported that almost all space had now been sold, not only in the Hall but in two reception areas as well as the hospitality suites in the adjoining hotel. Details appeared in the November issue of the *Journal*.

The Council considered in considerable detail the request by the New Zealand Division regarding future organisation and referred this to a small working group for further consideration.

It was reported that a new order for Association ties had been placed. There being no further business, the President thanked members for their attendance and declared the meeting closed at 3.45 p.m.

Reunion Dinner

The Reunion Dinner for Past Presidents, Past Honorary Officers and Past Council members with present members of Council took place at the Great Northern Hotel, King's Cross, London N1, following the Council meeting on 23 October 1985.

The President (Mr F. B. Redman) welcomed the guests: Mr H. Gosling (*President 1953-55*); Dr F. M. Smith (*President 1979-81*); Mr S. R. Finn (*Honorary Member*); Mr H. C. Worsdall (*Honorary Member*); Mr M. H. M. Arnold (*Past Honorary Editor*); Dr H. R. Hamburg (*Past Honorary Treasurer*) and Mr D. S. Newton (*Past Honorary Editor, Past Honorary Secretary and currently Honorary Editor*).

The President then gave a resumé of Association events since the last Reunion, which had been held at Manchester in June 1984 on the occasion of the Association's Annual General Meeting. He mentioned particularly the Edinburgh Conference which was the culmination of the celebrations of that Section's 50th Anniversary. He had visited the New Zealand Division's

Convention and the conferences organised by OCCAA, FSCT and SLF and conveyed the greetings of the Association on all occasions. He was pleased to report that everywhere he and Mrs Redman had been made extremely welcome as the Association's representatives and it was clear that the Association was held in very high regard by other organisations. The Association was involved in the marketing of books on behalf of bodies through the *Journal* in which leaflets were also placed by sister societies concerning their functions. He was sure that the members present all congratulated the Manchester Section on their Diamond Jubilee and the splendid commemorative brochure which had been circulated with the September issue.

On behalf of the guests, the senior Past President present (Mr H. Gosling) thanked the President and Council for their hospitality and for the opportunity given for previous members of Council to meet some of those currently serving on the Council and he wished the Association continued prosperity in the years to come.

Manchester Section

Diamond Jubilee Foundation Dinner

The Diamond Jubilee Foundation Dinner of the Manchester Section took place at the Manchester Club on Friday, 8 November 1985, celebrating 60 years of Section activity.

An impressive array of Past Section Chairmen were present on the top table, Mr H. Gosling, Mr H. G. Clayton, Mr J. E. Mitchell, Mr W. F. McDonnell, Mr T. E. Johnson, Mr A. C. Jolly, Dr F. M. Smith, Mr F. B. Redman and Mr G. R. Robson. Also on the top table was the Director & Secretary, Mr R. Hamblin.

The current Chairman, Mr Barry Windsor gave the speech of welcome to the guests and Mr H. Gosling proposed the toast to the Section in his usual witty style.

After an excellent meal the company was entertained by the magical skill and humour of Mr Jock Steel who gave the audience an introduction to the art of the pickpocket.

All present agreed that the 60th anniversary of the Manchester Section was celebrated in fine style.

R. G. Handley



The guests at the Manchester Section's 60th Anniversary Dinner were: seated (left to right): Dr F. M. Smith (Chairman 1970-72 and President 1979-81), Mr T. E. Johnson (Chairman 1954-56), Mr F. B. Windsor (Chairman), Mr F. B. Redman (Chairman 1981-83 and President), Mr H. Gosling (Chairman 1950-52 and President 1953-55) and Mr R. H. Hamblin (Director & Secretary); standing (left to right): Mr A. C. Jolly (Chairman 1978-81), Mr G. Clayton (Chairman 1978-81), Mr J. E. Mitchell (Chairman 1976-78), Mr W. F. McDonnell, (Chairman 1968-70), and Mr G. R. Robson (Chairman 1983-85).

Annual Dinner Dance

On Friday, 18 October, 357 members and guests were present at the Annual Dinner Dance of the Manchester Section in the Peacock Suite of the Hotel Piccadilly, Manchester.

The Manchester Section Chairman, Mr Barry Windsor and his wife, Marie, were joined on the top table by the guest speaker, Mr Terry Dalton of England Hughes Bell & Co., with his wife, Daphne, and the Association President, Mr Frank Redman, with his wife Peggy. Other guests at the Chairman's table were Mr and Mrs M. Prigmore, Mr and Mrs E. Wallace, Mr and Mrs K. Arbuckle, Mr R. Hamblin, Mr and Mrs G. R. Robson, Mr and Mrs A. C. Jolly, Mr and Mrs F. Morpeth, and Mr and Mrs N. H. Seymour.

To commemorate this special evening in the Diamond Jubilee season of the Manchester Section, souvenir menus were provided and the meal was rounded off by a special Jubilee dessert.

Following the meal Mr Terry Dalton gave the Toast to the Section in the form of a witty reminiscence of some of his more humorous experiences, gained during his former career in the Pharmaceuticals industry.



Shown at the Annual Dinner were, sitting in the front row (left to right): Mr T. A. Dalton (Guest of Honour), Mrs Dalton, Mr F. B. Redman (President), Mrs Redman. Standing (left to right): Mr F. Morpeth Vice Chairman, Mrs Morpeth, Mr N. H. Seymour (Hon. Treasurer), Mrs Seymour, Mr E. C. Wallace (Chairman, Midlands Section), Mrs Wallace, Mr G. R. Robson (Immediate Past Chairman and Vice President), Mrs Robson, Mr K. Arbuckle (Chairman, London Section), Mrs Arbuckle, Mr M. Prigmore (Chairman, Bristol Section), Mrs Prigmore, Mr A. C. Jolly (Vice President), Mrs Jolly, Mr R. H. Hamblin (Director & Secretary).

Dancing continued until 1 am to music provided by Satin Brass. A successful evening and most appropriate for the Jubilee year.

All those present felt that this was a very

R. G. Handley

Midlands Section

Ladies' Night

The Midland Section Ladies' Night was held once again at the Penns Hall Hotel, Walmley, on 27 September 1985.

The Chairman of the Midland Section, Mr E. C. Wallace, in his speech welcomed the ladies and guests. He said that the success of the evening was mainly due to the efforts of the Committee, especially the Social Secretary, Mr K. Chater, who unfortunately was unable to attend. Mr Wallace also thanked his Company and those of the members for their continuing support of the section. The guests of the section were the President, Mr F. B. Redman and Mrs Redman, the immediate Past President, Mr C. N. Finlay and Mrs Finlay, the Director and Secretary, Mr R. H. Hamblin, the Chairman of the Thames Valley Section, Mr A. W. Fell and Mrs Fell, the Chairman of the Manchester Section Mr F. B. Windsor and Mrs Windsor and the immediate Past President of the Birmingham Paint Varnish and Lacquer Club, Mr R. L. Staples and Mrs Staples.



Standing (left to right): F. B. Windsor, D. Hopper (a past Chairman of Midlands Section), Mr C. N. Finlay, Mr F. B. Redman, Mr E. C. Wallace, Mr R. L. Staples, Mr A. W. Fell, Mr A. G. Eades (Hon. Treasurer, Midlands Section), Mr. R. H. Hamblin. Seated: Mrs Windsor, Mrs Hopper, Mrs Finlay, Mrs Redman, Mrs Wallace, Mrs Staples, Mrs Fell, Mrs Eades.

the ladies and guests and wished the Section every success for the future.

"Take Five" and continued to 1 am, when the Chairman wished everyone a safe journey home.

The President responded on behalf of

After the speeches and meal had ended the dancing commenced to the music of

B. E. Myatt



LACQUER CHEMIST

We are a well established coatings manufacturer who have been servicing the industry for the past 40 years. Guertin's is a growth oriented organisation and to ensure future growth we are seeking an individual with a minimum of five years' experience in formulating nitro-cellulose lacquers for wood, paper and metal substrates.

Qualifications needed:

- Must be familiar with modern wood surface coatings techniques.
- Ability to work closely with customers in problem solving environments.
- Formulating capabilities for conventional lacquer clears, high solids urethane lacquers, sealers and stains.

Guertin's offers competitive salary and an excellent benefits package.

To apply, send resume with salary, history and expectations, in confidence to: **Steve Schultz, Chief Chemist, Guertin Bros. Coatings and Sealants Ltd., 270 Assiniboine Avenue, Winnipeg, Manitoba, Canada R3C 0X6.**



POLYMER CHEMIST/ MATERIALS SCIENTIST

Opening for a graduate, preferably with post-qualification industrial experience in the application of emulsion polymers, who is not a narrow specialist, to work on a variety of topics relating to leather.

These include development of surface coating systems for use on highly flexible substrates and the investigation of cross-linking in natural and synthetic polymers.

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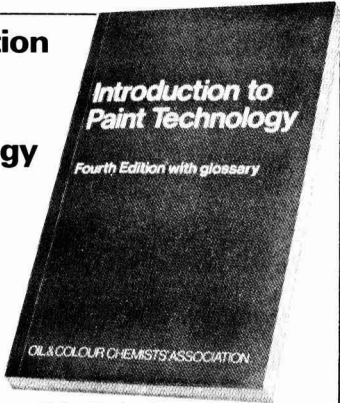
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