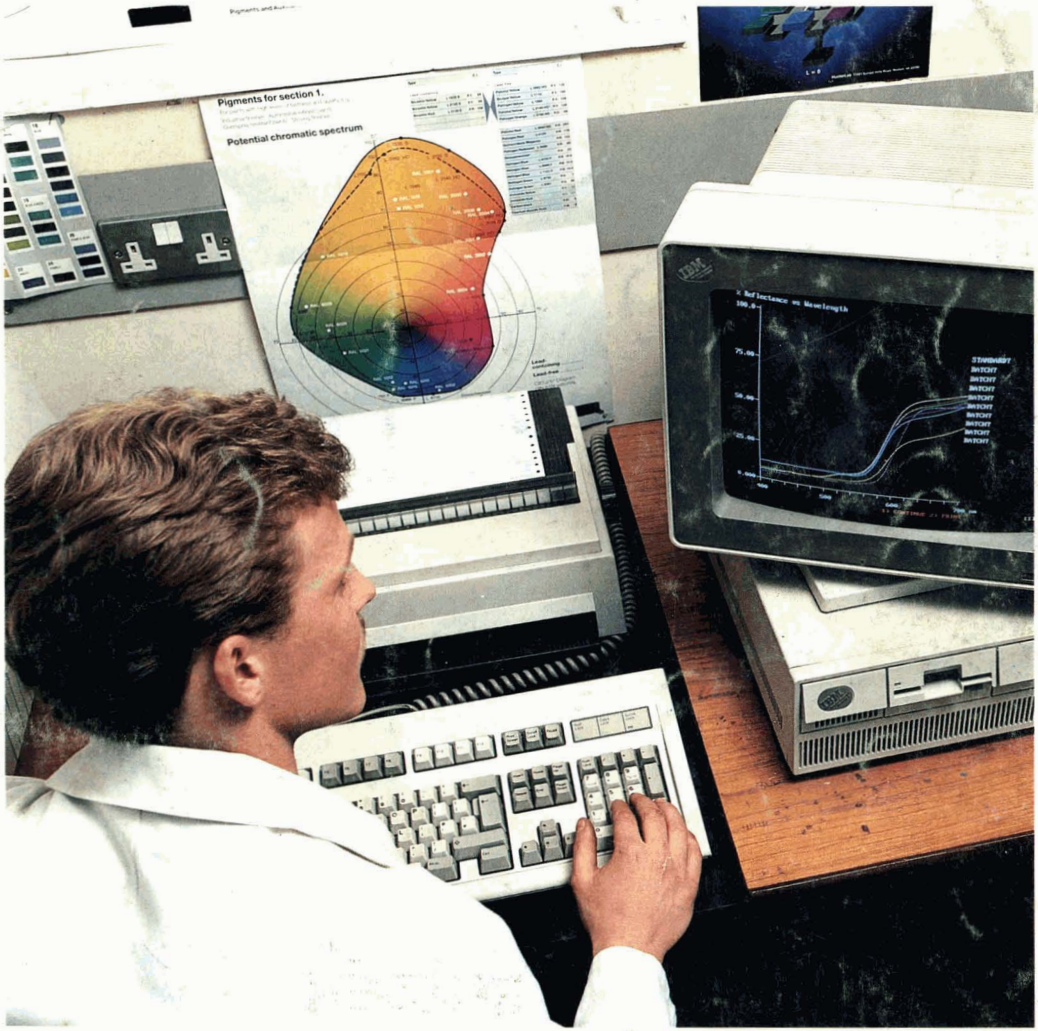
ISSN 0030-1337

October 1990
Vol. 73, No. 10

JOURNAL OF THE OIL AND COLOUR CHEMISTS' ASSOCIATION

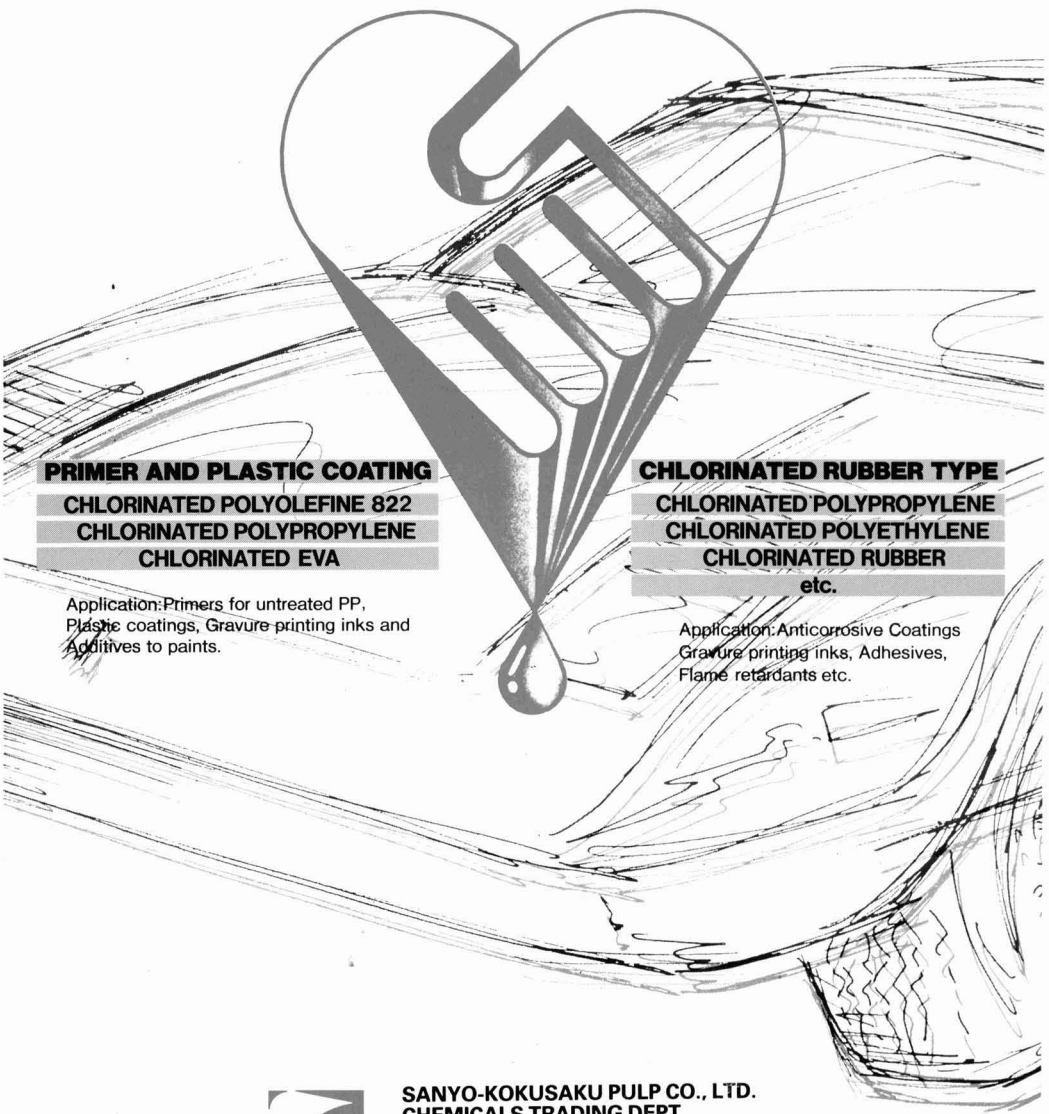
JOCCA



- Physical Testing
- Energy Conservation
- European Paint Show

SUPERCHLON
CPO

Super-efficient auto-industry adhesive primer also excels in modern home and industrial product uses.



PRIMER AND PLASTIC COATING

CHLORINATED POLYOLEFINE 822
CHLORINATED POLYPROPYLENE
CHLORINATED EVA

Application: Primers for untreated PP, Plastic coatings, Gravure printing inks and Additives to paints.

CHLORINATED RUBBER TYPE

CHLORINATED POLYPROPYLENE
CHLORINATED POLYETHYLENE
CHLORINATED RUBBER
etc.

Application: Anticorrosive Coatings Gravure printing inks, Adhesives, Flame retardants etc.

SANYO-KOKUSAKU PULP CO., LTD.
CHEMICALS TRADING DEPT.
1-4-5, Marunouchi, Chiyoda-ku, Tokyo, Japan
Telex: J 24279 SK PULP
Facsimile: 03(287)6488

Vol. 73 No. 10 OCTOBER 1990

JOCCA

JOURNAL OF THE OIL AND COLOUR CHEMISTS' ASSOCIATION

ISSN 0030 - 1337

SBPIM
The Society of British Printing Ink Manufacturers

An Official Journal of the Society of British Printing Ink Manufacturers and the Paintmakers Association of Great Britain Ltd.

Contents

Cover: The computerised matching process for wood stains using reflective values which has been developed by West Midland based Intercoat – see p.395. (Photo by courtesy of Intercoat)

Forthcoming Features: November—Application & Film Formation; Process Operation (PO), Valves; December—Weathering; PO, Feeding and Packaging; January—Greener Coatings, PO, Filling & Weighing.
Contributions are welcomed at least five weeks prior to publication date.

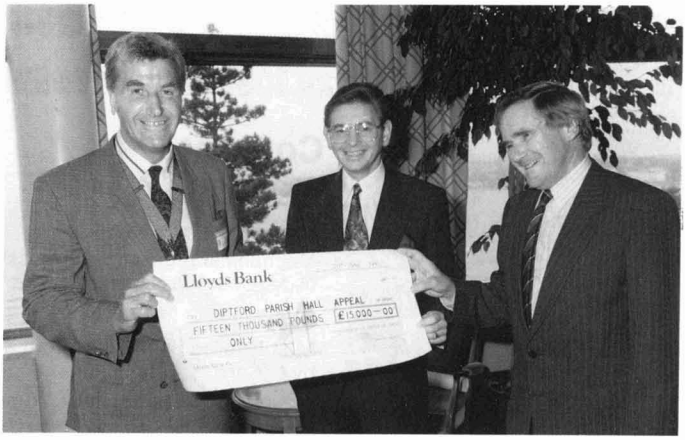
JOCCA (ISSN 0030-1337) is published monthly by the
Oil and Colour Chemists' Association,
Priory House, 967 Harrow Road, Wembley HA0 2SF, England
Tel: 081-908 1086 Fax: 081-908 1219 Telex: 922670 (OCCA G)
1990 annual subscription rate: UK £82.00, rest of the world (excluding USA) £90.00, USA $180.00. Single copies £8 ($16).
Air freight and mailing in the USA by Mercury Airfreight International Ltd Inc., 2323 Randolph Avenue, Avenel, NJ 07001. Second class postage paid at Rahway NJ. US Postmaster send address changes to JOCCA c/o Mercury Airfreight International Ltd Inc., 2323 Randolph Avenue, Avenel NJ 07001.

Editorial correspondence should be addressed to the Honorary Editor, and general correspondence addressed to the General Secretary at the Association Headquarters.

Printed by The Herald Press, 17 Rother Street, Stratford-upon-Avon, Warwickshire CV37 6NB Tel: 0789 66261

Tioxide celebrate anniversary of titanium dioxide discovery

Tioxide Group PLC, the world's second largest producer of white titanium dioxide pigments has good cause to celebrate the forthcoming 200th anniversary of the scientific discovery that made it all possible. As part of the celebration, Tioxide have returned to help the small Parish of Diptford in Devon where the existence of titanium dioxide was first proved in 1791 by the incumbent Rector, William Gregor. The Chairman and Managing Director of Tioxide UK Limited, Mr Peter Kerr presented a cheque for £15,000 to Mr Tony Redfern, Treasurer of Diptford Parish Hall Committee at the recent Paintmakers Conference. The money will enable the parishioners of Diptford to start the construction of their new Parish Hall building which should be completed in 1991; the 200th anniversary year.



Tioxide presentation: Geoffrey Watson, retiring President of the Paintmaker's Association, Peter Kerr, Chairman and Managing Director, Tioxide UK and Tony Redfern, Treasurer Diptford Parish.

Middle East Crisis affects paint prices

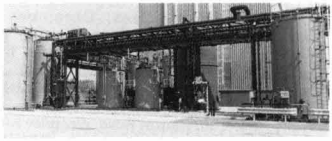
While the impact of the Gulf Crisis on petrol prices has received heavy coverage, there has been little comment on the knock-on effect that such costs will have on other products. One such product sector is the paint industry. The Paintmakers' Association of Great Britain, representing the majority of leading manufacturers, has warned that crude oil price is having a three-way effect on the cost of paint products to its customers.

Basic petrol prices will, of course, force up energy and distribution costs, as for all businesses. Equally, crude oil prices will affect the cost of derivatives such as high density polyethylene, which in its turn increases packaging costs, an important factor in paint marketing and storage. The most dramatic effect, however, will be on solvents and paints based on solvents, where raw material costs have already risen substantially.

Many manufacturers are already quoting prices that include a "Gulf Crisis surcharge" based on direct cost increases of raw materials. "With paint as a key factor in many industries," says Moira McMillan, Director of the Paintmakers' Association of Great Britain ". . . this will have an effect down the chain. We are doing what we can to hold prices increases to the minimum, but margins are already very tight and there is no leeway for these raw material costs to be absorbed."

Magnesium Elektron expands

Magnesium Elektron's new zirconium chemicals plant was recently opened and in attendance were the Board of British Alcan Aluminium, MEL's parent company, and the Mayor and Councillors from the Salford District Council, where the plant is located.



The new plant which was completed on schedule will increase the company's worldwide zirconium chemicals capacity by one third. It utilises MEL's proven alkali extraction technology for treatment of zircon sand enhanced by automatic process control from which MEL expects to gain benefits in both efficiency and product quality.

Levene Paint gain ISO 9002

Levene's Auckland-based paint manufacturing company Oregon Paint Co Ltd has gained registration to the International Standard for Quality Management systems NZS 5602 (ISO 9002) for the production of their Levene decorative and Levene industrial paints. Levene paint is the first consumer product in New Zealand with national distribution of its products to obtrain registration to NZS 5602 and obtain TELARC registered supplier status.

DeVilbiss acquired

Illinois Tool Works Inc (ITW) has announced that it has completed the acquisition of the worldwide DeVilbiss Industrial/ Commercial businesses of Eagle Industries Inc. The DeVilbiss Industrial/Commercial businesses, with annual sales in excess of $200 million, manufacture and sell products and engineered systems used for product finishing and coating applications, including conventional air spray equipment, powder coating devices and robotic finishing systems.

New coloration consultancy

A new company has been established in Nottingham to

provide consultancy and technical services to the coloration industries. The consultancy service is available worldwide and is supported by a modern, well-equipped laboratory which includes a colour matching computer, laboratory dyeing equipment and automated support equipment. For further information contact: Park Dyeing Services Limited, 7, Gregory Boulevard, Nottingham NG7 6LD.

Products

Dominion's stand highlights quality at SURFEX 90

The focal point of Dominion Colour Corporation's stand was their commitment to quality improvement. This is illustrated through DCC's slogan, "Working Together For Quality". DCC has for many years been a major supplier of high quality chrome yellow and molybdate orange pigments in the UK and their exhibit covered the extensive range of Stir-in, Low dusting, Low Soluble Lead and Sulphur Dioxide resistant grades of these pigments. Also being promoted was the ONCOR® range of lead silicochromate anticorrosive pigments which DCC is now marketing throughout the world. there was considerable interest in DCC's organic pigment line for printing inks. These products are well regarded in North America and will be available in the UK through a distributor who will be appointed shortly after the exhibition.

For further information Enter J101

Thinner solvent-free road markings

Developed by Degussa AG of Frankfurt am Main, this two-component cold-spray solvent-free plastic road marking is based on methacrylate resins and facilitates the laying of "thin" 0.4-1.2 mm road markings. In terms of durability, these markings are in no way inferior to the thick-layer markings used at present and do not impede snow ploughs.

For further information Enter J102

Equipment

Intercoat develop computerised wood stain match process

A computerised matching process for wood stains that has cut manufacturing time by 75 per cent has been developed by West Midlands based Intercoat. Intercoat are now using the system to supply furniture manufacturers with a variety of stains which have been colour matched exactly to colour samples supplied by the customer.

Immediate advantages have been a cut in manufacturing time from eight hours to two hours on an average matching project. The computer's memory will also reveal whether the same stain has been made before and if it is in stock or identify the nearest match if an exact shade is not critical.

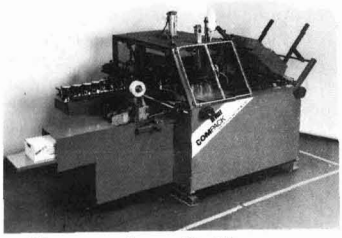
The process is effective on all types of stains applied to woods such as pine, mahogany, yew, oak, walnut, beech, and teak.

For further information Enter J103

New packaging machines from OBS

Two new high performance packaging machines for can-cartoning are now available from OBS Machines Ltd.

Manufactured by De Vree, is an automatic can-cartoning machine specifically designed to handle wraparound cartons. In its basic format the "Compack" will handle packs of up to six containers, ranging in size from 125ml up to 1 litre. Alternatively, it will cope with two containers of 3 litre capacity.



The second new De Vree machine launched by OBS is an automatic can cartoning machine known as the "Case Packer." This machine is purpose designed for packing paint containers and similar units into cardboard cartons, and is designed to be linked to any standard filling machine.

For further information Enter J104

Two probe thickness gauge

LIST's DUO-CHECK"SP" portable coating thickness gauge consists of a gauge with two probes (a magnetic induction probe for use on ferrous metals and an eddy current probe for use on non-ferrous metals) and a data printer, packed into a carrying case. The gauge itself incorporates the very latest technology in this field. It can store up to 8000 readings in four different application memories and can evaluate these statistically.

For further information Enter J105

Chemicals handling pneumatically

Pneumatic conveying systems provide a fast yet secure method of transferring large quantities of chemicals either granular or powder form. Bivac's pneumatic conveying systems enable the rapid transfer of product throughout all process stages including the unloading of tankers into holding silos and the transfer of products to weigh hoppers or cyclonic separators.

For further information Enter J106

TFL new equipment

TFL's Raywell Division has introduced two new products which will be of interest to those involved in powder handling or solvent reclamation.

The transfertox is a patented device incorporating inflatable seals to contain powders during discharge from hopper, blender, dryer etc. greatly reducing the level of airborne dust sometimes associated with this operation. The

addition of telescopics enables the unit to accommodate different drum/bin sizes.

The Raywell range of solvent recovery units incorporating wiped film evaporators are available for the recovery of clean solvent from dirty/contaminated solvent streams. The units are of particular use when the products are heat sensitive or highly viscous and come in a range of sizes, normally supplied as packaged plants, requiring only affixing to local site services before being fully operational.

For further information Enter J107

PRISYM — Chemical labelling for Europe

MAP 80's PRISYM computerised labelling systems are providing a simple and versatile solution for customers requiring hazchem labels. PRISYM software incorporates an impressive multi-lingual CPL phrase library enabling users to select risk and safety phrases in up to 10 European and Scandinavian languages.

For further information Enter J108

US Focus

By Abel Banov
Co-publisher
American Paint and Coatings Journal

VOC control

The Environmental Protection Agency of the United States has been underwriting two research projects which may offer ways to control volatile organic compound (VOC) emissions. One is aimed at controlling emissions both at paint plants and at paint spray booths. The other is for paint booths.

The first, uses a new adsorption-catalytic combustion system, especially where low concentrations of VOC's are present. Low equipment cost is a key feature of the undertaking, simple operation and low energy consumption are other key benefits. Both large and small industrial gaseous streams can use the prospective system.

The testing will be on solvent combinations that contain methyl isobutyl ketone, methyl ethyl ketone, acetate esters, and glycols and glycol ethers. The object is to convert these solvents into harmless gases. In addition, the system is expected to be able to be able to remove malodorous gases from such places as meat-rendering plants, and restaurants.

Mobile zone paint spray booth

The second EPA research project is a mobile zone device for waste reduction as well as pollution management and is applicable to the layup of fibreglass or composite products.

The system used in ventilated work chambers improves solvent management by confining a zone or path of fresh ventilating air to just a portion of the cross section of the chamber; it then provides means for shifting the location of the ventilating air zone from one place to another in the chamber to serve the worker as he changes from one place to another in his spraying activities, thus greatly reducing the quantity of VOC-contaminated air generated in the spray booth when he moves from areas where evacuation is adequate.

Alternative marine coatings

New biocidal agents are the focus of another EPA-sponsored program aimed at reducing damage to marine life caused by marine coatings.

The investigators propose to develop a long-lived anti-fouling system using a new generation of selective organic biocidal agents combined with high solids coatings for application either at dry docks or for emergency underwater repair.

Currently, copper compounds and tributyltin complexes are used in polymer vehicles to inhibit or limit the fouling organisms in sea water that reduce speed of vessels. The relatively high concentrations of these materials needed to accomplish their purpose and the relatively large amount of VOC's needed to disperse or dissolve the solids required have been coming into question by regulatory authorities and environmental advocates. In effect, the researchers are seeking to replace metallic antifoulants with biocides and to reduce solvent release by use of high solids formulations.

Replacement for chlorinated rubber

For various reasons, chlorinated rubber seems doomed in the United States, and the same may be true elsewhere, since only one major producer continues to make it, in Britain, with lesser producers in Italy and Japan. Fortunately, a replacement is available. It's Hypalon (C), a chlorinated ethylene/vinyl acetate offered by Du Pont Co.

Hypalon has already been a saviour for traffic paint manufacturers here who were suddenly confronted some time back with a dryup of sources of chlorinated rubber, a favoured traffic paint vehicle, and a prohibitively high price when they could obtain it.

Chlorinated rubber has had widespread use in anticorrosive paints, and on cementitious surfaces exposed to water pressure, notably for basements and swimming pools. Whether Hypalon will replace it for these purposes is still a question, but trials are underway.

Hybrid emulsion polymer

Combining three monomers to obtain desired coatings characteristics is not new anymore, but now Air Products and Chemicals Inc., is offering one that combines vinyls, acrylics, and polyurethane features. Coatings made with this hybrid emulsion are reported to exhibit resistance to solvents, corrosion, and boiling water, with abrasion resistance, hardness and flexibility. According to the manufacturer they are suitable for products to protect metals, and plastics, including high-impact polystyrene.

Literature

HSE guidance on storage of flammable liquids

PRecautions for firms to take against the potential hazards from storing flammable liquids on their premises are set out in two guidance documents published by the Health

and Safety Executive (HSE). 'The storage of flammable liquids in fixed tanks (up to 10,000m^3 total capacity)', HS(G)50, ISBN 0 11 885532 8, price £3.75 and: 'The storage of flammable liquids in containers' HS(G)51, ISBN 0 11 885533 6, price £3.50 are both available from HMSO and booksellers.

Polymer Science Dictionary, 6,000 entries. Elsevier. Price £98.00.

For further information Enter J109

Meetings

FSCT Show 90

A total of 14 **program** sessions, featuring more than 60 technical presentations, await registrants at the 1990 Federation Annual Meeting and Paint Industries' Show in the Washington, D.C., Convention Center, October 29-31.

The Keynote Address on Monday am, October 29, will be "A Generation of Eagles," by Lee Sherman Dreyfus, President, Lee Sherman Dreyfus, Inc., and former Governor of the State of Wisconsin. On Wednesday am, the Joseph J. Mattiello Memorial Lecture will be presented by Dr. Henry J. Leidheiser, formerly Director of the Center for Coatings Research at Lehigh University, who will speak on "Electrochemical Techniques for Studying Protective Polymeric Coatings".

The **Federation's Annual Luncheon** will be held on Wednesday, October 31, in Hall C of the Convention Center. Highlighting this event will be **Douglas Kiker** — one of the nation's best-known and most respected television news correspondents.

Paint Industries' Show: Currently, 276 industry supplier companies have reserved 86,000 sq. ft. of exhibit space at the Washington Convention Center, making the 1990 event the largest ever sponsored by the Federation.

Exhibit hours will be 11.00 a.m. to 5.30 p.m. on Monday, October 29; 9.00 a.m. to 5.30 p.m on Tuesday, October 30; and 9.00 a.m. to 3.00 p.m. on Wednesday, October 31.

For further information contact: FSCT, 1315 Walnut Street, Philadelphia, PA 19107, USA Tel: 215/545-1506-1507.

People

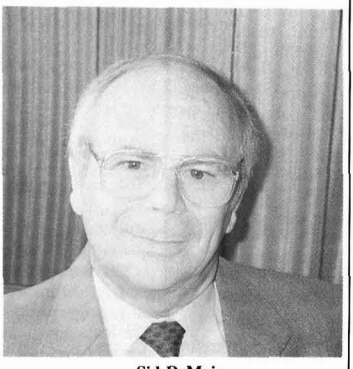
FSCT

William F. Holmes, Vice President — Technology, National Pigments & Chemicals, Inc., Garland, TX, has been nominated for the position of President-Elect of the Federation of Societies for Coatings Technology. Mr Holmes is a graduate of Texas Tech University and has served the coatings industry for 34 years.

The current President-Elect, **Kurt F. Weitz,** Manager — Technical Support, Indusmin Inc., Division of Falconbridge Limited, Toronto, Ont., Canada, will assume Presidency at the close of the 1990 Annual Meeting, October 31, in Washington, D.C. Employed by Indusmin for 22 years, Mr Weitz has been engaged with the development of nepheline syenite and feldspar as extenders in paints, plastics, rubber, and adhesives. He is a member of the American Chemical Society and the Society for Plastics Engineers.

New General Manager for Macpherson Industrial Coatings

Sid DeMain has been appointed General Manager of Macpherson Industrial Coatings — Leyton with complete responsibility for all operational functions. Mr DeMain has extensive knowledge of the paint industry with considerable experience in technical, production, sales and general management positions. This blend of skills will help Macpherson maintain and extend their position as leading suppliers of industrial finishes for metal and plastic substrates. He succeeds **Peter Leech**, who moves to Macpherson's Haverhill plant to take up the role of General Manager with complete responsibility for Macphersons' woodfinishing, mirror backing and specialist coating operations.

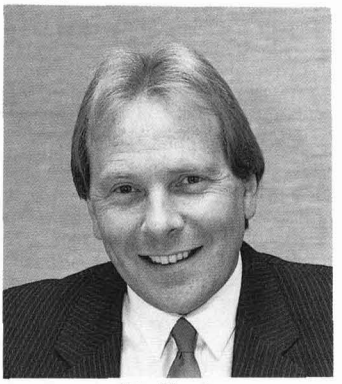


Sid DeMain

New board appointment at Tor Coatings

Tor Coatings, the Birtley, Co Durham-based manufacturer of specialist paints and coatings has appointed two new board members.

John Timmins becomes Marketing and Line Sales Director six months after joining the company from International Paints. John, who lives in Satley, Co Durham has over 15 years' experience in the coatings industry, the last five gained with International Paints in the UK and Korea.



John Timmins

He now takes overall responsibility for sales of the company's Line Division products, comprising anti-graffiti, masonry, hygiene and other high performance coatings. **Alan Turner** founding Sales Director, now runs full-time the very successful and fast-growing Toll operation, Tor's sub-contract paint manufacturing division. The other new director at Tor is **Brenda Forrest** who joined Tor three years ago as Financial Controller. ■

Chester Conference Paper

Mechanical properties of crosslinked coating systems

by Dr Ir M. Oosterbroek* and Ir O. T. de Vries**

* Akzo Research Laboratories Arnhem, Corporate Research, Physical Chemistry Department, PO Box 9300, 6800 SB Arnhem, The Netherlands.

** Akzo Coatings, Research Centre Sassenheim, PO Box 3, 2170 BA Sassenheim, The Netherlands.

Abstract

The utility of characterizing the mechanical properties of free films for the development of new coatings will be discussed. Examples of the relation between tensile measurements, dynamic mechanical measurements and impact resistance will be presented.

The characterization of the mechanical properties of free films should not replace traditional tests of coatings on a substrate, but is used in a supplementary way to provide insight into fundamental properties. Moreover, these tests open up opportunities for an interpretation based on fracture mechanics and stress distribution calculations.

Introduction

From time immemorial paints have been subjected to all kinds of practical tests aimed at determining the mechanical properties. Though these tests have long proved their value in the development of new paints, they often make a weird impression on outsiders. What to think of a nuts impact test or "pencil hardness"? Replacement of these tests by a scientifically better founded approach has not turned out to be simple, however[1].

Despite the fact that the paint industry has a respectable age and test methods have been optimised, it is still difficult to carry out well-defined mechanical measurements on substrates provided with coatings. Stress-strain measurements on free films of paint provide a good alternative[2]. Throughout the years this method has gained an important place, especially in scientific institutes. A major advantage is that the measurements guarantee connection with the extensive knowledge that has been built up in the field of polymer mechanics[3]. Moreover, the way is opened up for fracture mechanics and stress calculations. The results of various practical tests show a good correlation with characteristic parameters from a stress-strain curve[4,5]. For the every-day practice of an industrial paint lab, however, the stress-strain measurements are too time-consuming.

A relatively recent breakthrough in the field of polymer characterization is the dynamic mechanical analysis (DMA). This technique is also applicable to paint research[6,7]. Dynamic mechanical analysis is a versatile technique, which gives an impression of the flexibility of the binder (T_g) and shows the extent to which the mechanical properties of the product change with temperature. Moreover, it enables us to follow the curing reactions and to make an estimate of the effective degree of crosslinking of the product after curing. The decisive reason for the success of this technique, however, is the possibility of observing, often even semi-quantitatively[8], a phase separation between a soft and a hard component.

In this article both stress-strain measurements and the dynamic mechanical characterization of free films of paint will be dealt with. The usefulness of these characterization methods will be illustrated with the aid of two examples. One relates to an investigation into factors affecting damage to an automotive topcoat caused by stone chippings. The other example refers to the improvement of the impact resistance of painted plastics parts at low temperature.

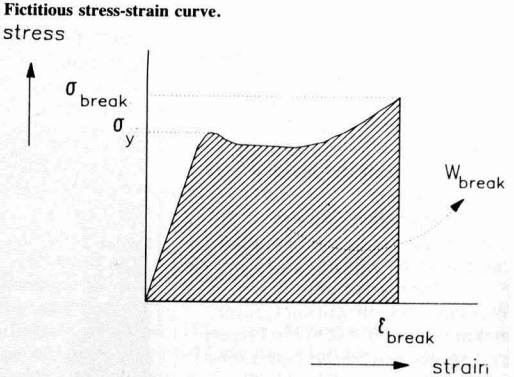
Stress-strain measurements on free films of paint

For conducting a stress-strain test, a cured paint film should first be separated from the substrate. The substrate selected for this purpose must be attuned to the relevant coating so that it is properly wetted when applying the coating but yet shows only a moderate adhesion after curing. The controversial "mercury method"[9] is distinctly losing popularity for environmental reasons.

A small strip is subsequently cut from the coating and inserted between the clamps of a tensile tester. In doing so, extreme caution is required to avoid premature break of the sample due to damage by clamping. The variation in elongation at break can be reduced by using a low tensile rate, which leads to a more flexible behaviour. A high relative humidity during testing will also contribute to a more flexible behaviour.

The course of a stress-strain curve can be characterized by a limited number of parameters. The most important parameters are: Young's modulus (E is the tangent at the start of the stress-strain curve), yield stress (σ_y), tensile strength (σ_{max}, which is the maximum stress occurring during the tensile test), breaking strength (σ_{break}), elongation at break (ϵ_{break}) and energy to break (W_{break}). Figure 1 shows a fictitious stress-strain curve including some parameters. Many coatings have been formulated in such a way that they show a strong viscoelastic behaviour at room temperature. This implies that in many cases no linear elastic, or Hooke's region can be observed. The way in which the elasticity modulus is determined from the results should therefore always be clearly indicated.

Figure 1
Fictitious stress-strain curve.



The stress-strain curves of the three coatings in Figure 2 are clearly different. The electrocoat, which behaves purely elastically, has a high strength and a low elongation to break. The other two coatings are more flexible. The shape of the curves depends on the physicochemical structure of the coating and on the test conditions. Relevant test conditions

are temperature, tensile rate and relative humidity. Important physicochemical parameters are chain flexibility, chain interactions, degree of crosslinking and pigmentation. The differences between the stress-strain curves of a series of samples are often visualized by a so-called failure envelope, which is a graph connecting the terminal points of a multitude of stress-strain curves. The failure envelope of cellulose acetate using the temperature as parameter (Figure 3) is a classical example[10].

Figure 2
Stress-strain curves of three different coatings for the automotive industry.

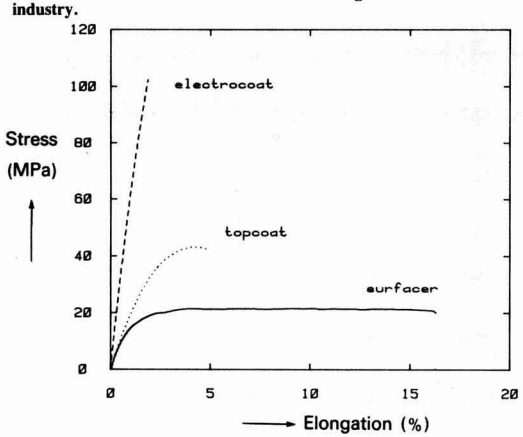
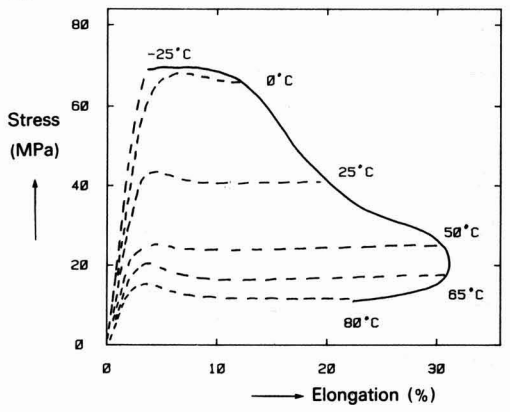
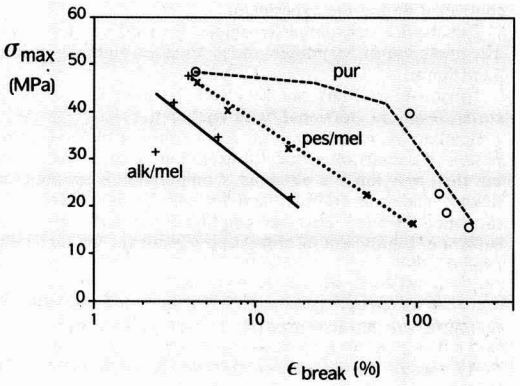


Figure 3
Failure envelope of cellulose acetate using the results of Reference 10.



The use of failure envelopes need not be restricted to the influence of the test conditions. Figure 4 shows the relation between the tensile strength and the elongation at break of three series of coatings. Each series of coatings has been prepared in five stoichiometric ratios. This results in three curves representing the balance between the hardness and flexibility of each product. Figure 4 immediately shows that the mechanical properties of polyurethane coatings, polyester/melamine coatings and alkyd/melamine coatings decrease in that sequence. The advantage of this approach is that new products can simply be compared with existing products even when the mechanical properties will strongly deviate from the envisaged ones.

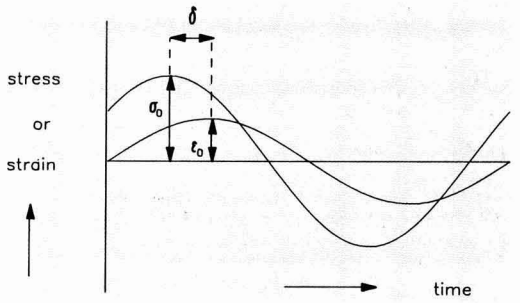
Figure 4
Relation between elongation at break and tensile strength– – –: polyurethane, . . . polyester/melamine, ——— alkyd/melamine.



Dynamic mechanical analysis

The principle of dynamic mechanical analysis (DMA) is based on imposing a harmonic deformation and analyzing the resulting stress (those having a mechanical engineering background will say it is just the other way round). The dynamic moduli of the sample are calculated from the strain amplitude ϵ_0, the stress amplitude σ_0 and the phase angle δ between the harmonic stress signal and the strain signal (see Figure 5).

Figure 5
Example of a dynamic experiment in which a harmonic deformation is imposed and the corresponding stress is measured.



$E' = (\sigma_0/\epsilon_0) \cos \delta$ (storage modulus)
$E'' = (\sigma_0/\epsilon_0) \sin \delta$ (loss modulus)
so that
$\tan \delta = E''/E'$

There are only two independent quantities. If E' and $\tan \delta$ are known, E'' can be calculated.

The DMA equipment, supplied by various manufacturers, can be classified according to the geometry in which the sample is loaded. Each geometry offers specific possibilities and has limitations. Leaving the liquid geometries unconsidered, we distinguish elongation, torsion, bending and compression.

Elongation is the natural geometry for thin samples (yarns and films). Corrections for clamping effects can hardly be calculated but are negligibly small in practice provided a minimum length/width ratio of 10 is chosen[11]. On the other hand, the value of the elongation modulus, especially near the glass transition temperature, strongly depends on the applied pretension. This can easily be seen from the stress-strain curve of the surfacer coating given in Figure 2.

Hardly a region can be found where the tangent to the curve is constant. Therefore reproducible DMA experiments in elongation require that the static pretension can be accurately controlled during the experiment.

Torsion is a convenient technique for isotropic test bars. The limited sensitivity makes the method less suitable for free paint films.

Torsion pendulums can very well be used for following curing reactions (torsional braid analysis).

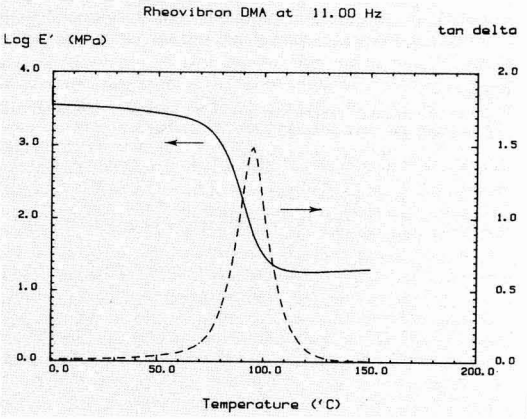
Bending is especially suited for fibre-reinforced composites. Coatings on a thin substrate may also be measured but then only tan δ is obtained. Compression is suitable for flexible materials (rubbers and foams). On miniature-scale this method may also be employed for coatings on a substrate. Equipment for this purpose is not yet commercially available.

Dynamic mechanical analysis of free paint films

As far as the influences on the dynamic mechanical behaviour are concerned, we will confine ourselves to crosslinked, amorphous coatings. The dynamic Young's modulus and the phase angle of an acrylic clearcoat as a function of temperature are shown in Figure 6.

Figure 6

Dynamic storage modulus and phase angle of an acrylic clearcoat as a function of temperature.

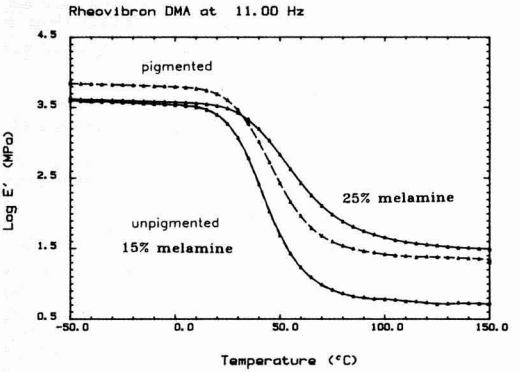


At low temperatures the sample behaves glassy and has a high modulus. Above room temperature the modulus strongly decreases. The rubbery plateau of the modulus is sometimes 3 decades below that in the glassy region. The glass transition temperature, T_g, is generally defined as the maximum of the tan δ curve. The value of T_g is determined by the chemical structure of the binder and by the imposed frequency. The shift of T_g with the frequency may be explained by the WLF theory[3]. The width of the T_g peak is connected with the distribution of the lengths of chains between junction points and the presence of dangling chains[12]. The area under the tan δ peak of the continuous phase is related to the chemical structure of the polymer[13]. In theory a complete description of DMA results as a function of temperature and frequency is possible. In practice the results are evaluated in a more qualitative manner.

The absolute value of the dynamic strain modulus in the glassy region is determined by physical interactions between molecules, e.g., Van der Waals forces, hydrogen bonds, and by the pigment volume concentration (PVC). The rubbery level is governed by the PVC and the degree of crosslinking (see Figure 7). Note that the PVC has no influence on the T_g but a change in the amount of crosslinker does have an effect.

Figure 7

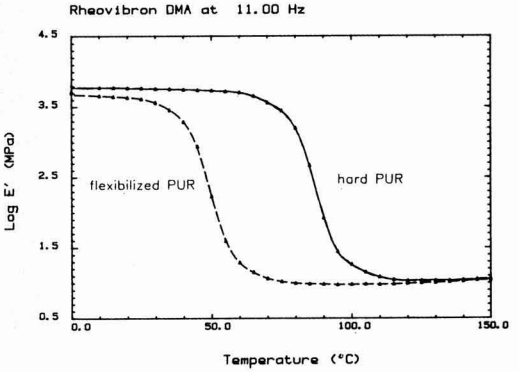
Influence of pigment volume concentration and melamine content on the dynamic mechanical properties of a polyester/melamine coating.



The position of T_g can also be influenced by the addition of a compatible plasticizer (Figure 8). However, the addition of an incompatible plasticizer or the use of block copolymers as binders may lead to the occurrence of two separate T_g's (Figure 9). Incomplete compatibility may finally be expressed in the DMA results in various ways. Well-known possibilities are: broadening the T_g transition, reduction of the temperature difference between two separate transitions and creation of a third transition between that of the two original components[8].

Figure 8

Influence of a plasticizer on the dynamic mechanical properties of a polyester/isocyanate coating.



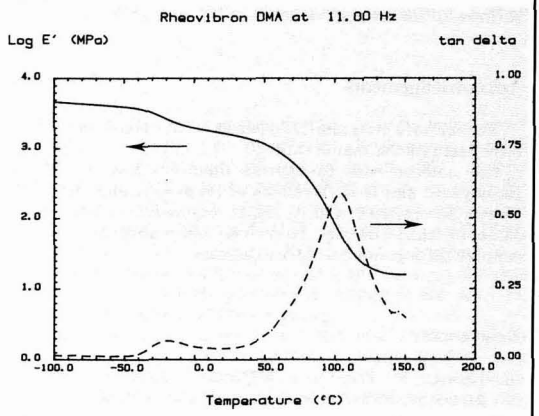
Impact resistance of coating systems for the automotive industry

The coating system of a car consists of a number of coats. Each coat is individually enamelled.

The first coat, viz., the electrocoat, is applied during immersion of the phosphated car body in an electrophoresis bath. The electrocoat is provided with a surfacer which serves to level the unevenness in the substrate. Finally, the topcoat is applied which gives the car an attractive appearance.

The impact resistance of the coating system is very important. During driving damage due to the impact of stone chippings may occur. This damage can lead to rust formation especially on the front side and on the undersides of the doors.

Figure 9
Dynamic mechanical behaviour of a coating based on a block copolymer.



By applying thicker coats or extra coats and by improving the intrinsic mechanical properties of the coats this damage can be prevented. Mutual adjustment of the mechanical properties of the coats also plays an important role.

The coat that has been most optimised with respect of stone chipping resistance is the surfacer. The intrinsic properties of surfacers can be compared with the aid of stress-strain measurements on free films. The stone chipping resistance of a complete coating system can be determined by means of multi-impact (gravel o meter) tests or mono-impact tests.

The gravel o meter tests have a statistical character and are further characterized by a certain degree of subjectivity in the assessment. Mono-impact tests have an objective character. The outcome of this sort of tests, however, depends on the shape of the impact body. As an example of the influence of the intrinsic mechanical properties of the surfacer on the stone chipping behaviour of a complete coating system, we consider three surfacers with an identical T_g of 60°C. The stress-strain curves of the coatings in Figure 10 clearly differ. The alkyd/melamine coating is weak and brittle. The polyester/melamine coating is stronger but brittle as well. Finally, the polyurethane coating is strong and tough. Table 1 shows that a complete system containing this surfacer has the best gravel o meter rating.

Figure 10
Stress-strain curves of three surfacers with the same T_g.

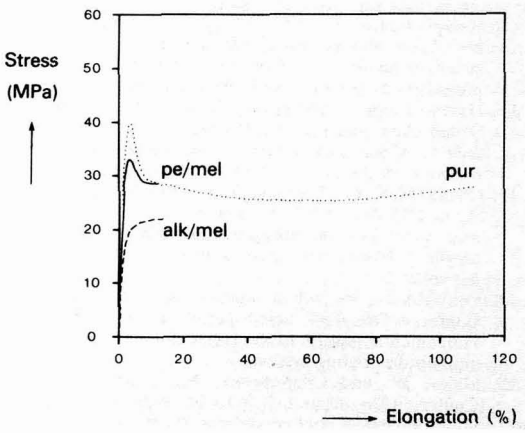
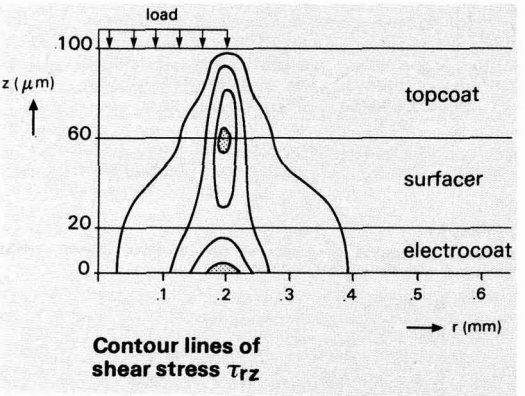


Table 1
Mechanical properties of the surfacer and gravel o meter rating of the complete automotive coating system (5=very poor, 1=excellent).

Surfacer	Alkyd/Mel	Pes/Mel	Polyurethane
T_g (°C)	60	60	61
ϵ_{break} (%)	16	16	90
σ_{max} (MPa)	22	33	40
VDA gravel o meter rating	2-3	2	1-2

The influence of the mutual adjustment of the mechanical properties of the individual layers can be elucidated with the aid of Figure 11. It shows the theoretical stress distribution in a coating system on a rigid substrate due to a uniform load. The surfacer is twice as stiff as the topcoat and the electrocoat. The rigidity of this surfacer leads to an increased stress level at the interface between topcoat and surfacer. Such an effect can be reached by using a surfacer with a high PVC or a high T_g. Both mono-impact and multi-impact tests have revealed that in the case of such surfacers often damage occurs at the interface between topcoat and surfacer. In the case of flexible surfacers the damage arises at the interface between surfacer and electrocoat[14].

Figure 11
Coating system containing a stiff surfacer. Contour plot of the shear stress acting on planes parallel to the substrate.



Impact resistance of painted plastics parts

Plastics parts are finding increasing use in modern cars. Also external steel parts are more and more replaced by plastics. Painting these plastics parts presents a surprising problem. It turns out that a thin coat of 50-100μm thickness may affect the originally good impact resistance of the plastics. This is caused by cracks that develop in the coating upon impact. At the tip of these cracks a stress concentration is developed. The result of the stress concentration is that cracks easily advance into the substrate. Brittle fracture of tough plastics car bumpers may occur after e.g., a smooth collision with a pole. In the laboratory such collisions are simulated by means of puncture tests using a fast hydraulic tester. From curves shown in Figure 12 it is evident how a brittle coating system attacks the impact resistance of the substrate already at the freezing point.

An obvious solution is the use of very flexible coats. The impact resistance of the substrate up to −20°C can thus be retained. The use of a soft primer, however, makes sanding impossible and a special topcoat for plastics parts irrevocably leads to a difference in appearance relative to metal parts.

Akzo's coating division has found an original solution to this problem by apply a special two-layer primer[15], the so called floating surfacer. Thus sufficient impact resistance can be reached up to a least −10°C, despite the use of a brittle topcoat.

Sandability of the surfacer and a uniform appearance of the end product can thus be maintained.

Dynamic mechanical measurements have played an important role in this development. The mechanical properties of the individual layers of the floating surfacer system (Figure 13) are such that a gradual transition in stiffness has been achieved from the flexible substrate to the hard topcoat.

Figure 12

Energy to fracture of a plastics test panel as a function of temperature: bare substrate; with brittle coating system for metal; with flexible coating system; with new primer provided with a brittle topcoat.

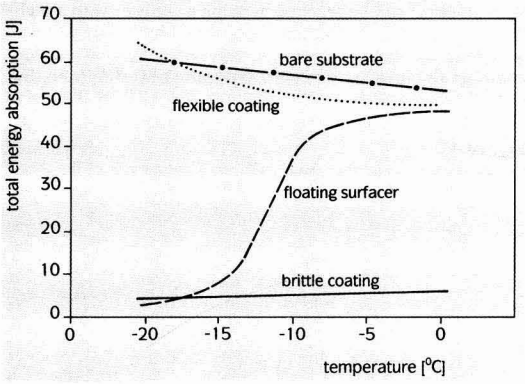
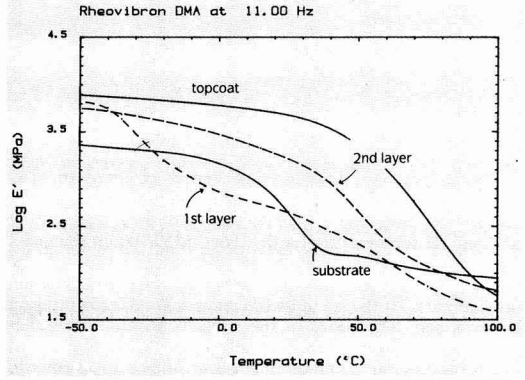


Figure 13

Dynamic mechanical properties of the two-layer primer system compared with the topcoat and the substrate.



Conclusions

Characterization of the mechanical properties of free films of paint should not replace traditional paint tests but may make an important contribution to the development of new products.

The dynamic mechanical properties of coatings can best be determined in elongation.

The interaction between the layers of a coating system is essential to the mechanical behaviour of the system as a whole. This interaction is influenced by differences in stiffness of the successive layers.

Acknowledgements

The authors are grateful to Mr H. J. M. Tomassen for the translation of the manuscript.

The authors wish to express their gratitude to Mr R. Boomgaard and Ir K. Wolthuis of Akzo Coatings, Research Centre Sassenheim, and to Ing H. Schmidbauer and Dr W. Maier of Akzo Coatings, Research Centre Stuttgart, for their support throughout this investigation.

References

1. Hill, L. W., Progress in Organic Coatings, 1977, **5,** 277. Stress analysis – A tool for understanding coatings performance.
2. Evans, R. M., in "Treatise on Coatings. Vol. 2. Characterization of coatings: physical techniques." Part 1. p.131. Ed. R. R. Myers, J. S. Long, *Dekker* 1969. The ultimate tensile properties of paint films.
3. Nielsen, L. E., "Mechanical properties of polymers and composites." *Marcel Dekker,* New York, 1974.
4. Rehacek, K., *Plaste und Kautschuk,* 1975, **22** (5), 442. Zugfestigkeitsparameter freier Anstrichfilme und die Möeglichkeit ihrer Korrelation mit Ergebnissen der technologischen Anstrichprüefungen.
5. Sato, K., Progress in Organic Coatings, 1980, **8;** 1. The hardness of coating films.
6. Roller, M. B. and Gillham, J. K., *JCT,* 1978, **50,** 636; 57. Application of dynamic mechanical testing to thermoset and coatings research and development.
7. Varadarajan, K., *JCT,* 1983, **55,** 704; 95. Review of dielectric and dynamic mechanical relaxation techniques for the characterization of organic coatings.
8. Hourston, D. J. and Satgurunathan, R., *J. Appl. Pol. Sci., 1984,* **29,** 2969. Latex interpenetrating polymer networks. I. Predicted and observed compatibilities.
9. Yaseen, M. and Ashton, H. E., *JCT,* 1977, **49,** 629; 50. Effect of free film preparation method on the physical properties of organic coatings.
10. Carswell, T. S. and Nason, H. K., *Modern Plast.* 1944 June, **21;** 121. Effect of environmental conditions on the mechanical properties of organic plastics.
11. Wedgewood, A. R. and Seferis, J. C., *Polymer,* 1981, **22;** 966. Error analysis and modelling of non-linear stress-strain behaviour in measuring dynamic mechanical properties of polymers with the Rheovibron.
12. Havranek, A., Ilavsky, M., Nedbal, J., Boehm, M., Soden, W. v. and Stoll, B., Colloid & Polymer Sci., 1987, **265;** 8. Viscoelastic behaviour of model polyurethane networks in the main transition zone.
13. Chang, M. C. O., Thomas, D. A. and Sperling, L. H., *J. Appl. Pol. Sci.,* 1987, **34;** 409. Characterization of the area under loss modulus and tanδ-temperature curves: acrylic polymers and their sequential interpenetrating networks.
14. Oosterbroek, M. and Boomgaard, R., Proc. XIIIth Int. Confer. in Org. Coat. Sci. & Techn. Athens, 1987, p.287. Fundamental aspects of the stone chipping resistance of automotive coating systems.
15. Maier, W. and Oosterbroek, M., Proc. XIVth Int. Confer. in Org. Coat. Sci. & Techn. Athens, 1988, p.193. Development of coating systems for plastic parts. ■

Multilayered paint films from single coat systems

by C. Carr, The Paint Research Association, 8 Waldegrave Road, Teddington, Middlesex TW11 8LD, UK

Introduction

The Paint Research Association has recently begun work on a four year project to investigate self-stratifying coating systems. The project is 50% funded by the EEC and by industrial sponsorship under the BRITE scheme up to a total of 2.2 million ECU. The collaborating research centres are CoRI (Belgium), NIF and DTI (Denmark), CERIPEC (France), EOLAS (Ireland), FPL (West Germany) and PRA. The project is pre-competitive and aims to develop guidelines for selecting suitable components for the formulation of self-stratifying coatings.

A self-stratifying coating would comprise two (or more) incompatible resins and a suitable solvent applied to a substrate in one operation. The solution could be two phase before application or phase separation could occur in the film as the solvent evaporates. The resulting phases would spontaneously separate into layers during solvent evaporation or subsequent curing. It is not necessary to form distinct layers of resin 1 and resin 2; a gradient across the film from pure resin 1 at one interface to pure resin 2 at the other would be satisfactory and possibly desirable. Such systems potentially have all the benefits of two coat systems – good adhesion and corrosion resistance with good weathering, abrasion and chemical resistance – without the problem of interlayer failure.

Funke[1] described a system in which a mixture of two polymeric powders form distinct layers when heated above their melting points. Self-stratifying powder coating systems based on this phenomenon have been produced using combinations such as epoxy/polyolefin, epoxy/acrylic or polyester/acrylic[2-4]. When the coating is baked the epoxy or polyester is claimed to bond to the metal and the other component is present at the surface remote from the substrate.

The theory was extended to solvent borne systems by Verkholantsev[5]. In this case the incompatibility of two resins causes phase separation to occur as a common solvent evaporates. The two phases then form into layers. These studies have shown that the resulting films can perform better than would be expected if the different components were applied separately. This is thought to be due to the formation of a 'transition' layer which contains significant concentrations of both resin components as phase inclusions which lock the two layers together. This removes the problem of delamination caused by lack of adhesion between separately applied coats.

The present study is concentrating on solvent borne systems and will include aqueous emulsions. The main properties to be considered are: polymer compatibility, phase separation in polymer solutions and wetting by concentrated polymer solutions.

Predicting phase behaviour

The phase behaviour of a solution of two polymers dissolved in a common solvent is governed by the Gibbs Free Energy, G. Any spontaneous change must result in a decrease in the free energy of the system.

The free energy change is dependent upon the change in enthalpy and entropy during the process as well as the temperature. Expressions for calculating the free energy of mixing or demixing in polymer solutions require a knowledge of the polymer/polymer and polymer/solvent interaction parameters. For two polymers in a single solvent three interaction parameters are required. For a four component system six interaction parameters are required. These parameters are not normally available for the polymers used in the paint industry and they cannot be calculated as accurate structural information is not usually available.

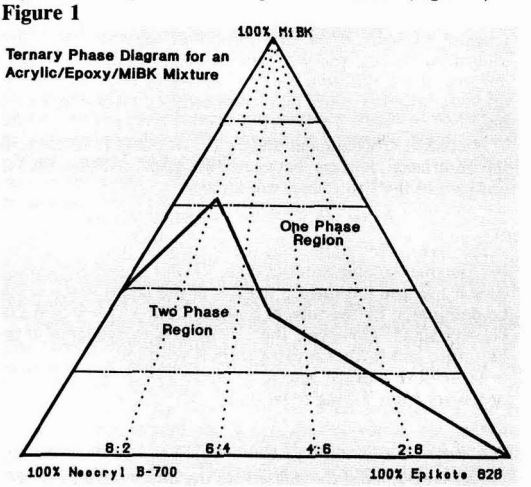
The compatibility, β, of two polymers can be estimated from a knowledge of solubility parameters of the polymers, δ_1 and δ_2.

$$\beta=(\delta_1-\delta_2)^2$$

Two polymers are regarded as incompatible if $\beta > 0.07$ Jcm^{-3} [6]. However, Funke[1] has shown that this is not a reliable guide for oligomers typical of those used in paint resins and the formula cannot allow for the presence of solvents. In fact changing the solvent can influence whether two polymers produce a one phase or two phase film[7]. There is no simple theoretical model available at present which will allow us to predict phase behaviour in mixtures of two polymers or oligomers with one or more solvent components.

Experimentally determined composition/phase diagrams may be of some use in three component systems (resin 1, resin 2, solvent). For example, light scattering can be used to rapidly identify the point of phase separation in such a system. A triangular grid can then be used to indicated regions of one-phase and two phase behaviour (Figure 1).

Figure 1



It is usual to use blends of two or more solvents in real paint formulations which complicates the construction of the phase diagram. Each solvent component has a different evaporation rate which means that the solvent composition will change during evaporation. Programs are available to calculate differential evaporation rates in solvent blends but the determination of the phase diagram would be time consuming. It would be necessary to calculate the solvent composition at several stages of evaporation then to examine the phase behaviour of the whole formulation at each solvent composition. This would then be repeated for several different ratios of the two resins.

Work is under way as part of the BRITE research program

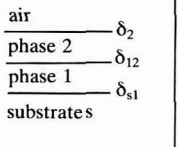
to develop a better theoretical model which would allow us to calculate the phase behaviour of any mixture of resins and solvents from activity coefficients of resins and solvents.

In practice phase separation from concentrated polymer solutions is easily achieved for most resin combinations. Compatibility is reduced as molecular weight increases so curing of paint films will further favour phase separation.

Factors influencing stratification

Once phase separation is achieved it is necessary that the two phases form into layers and that the direction of stratification is independent of gravity or substrate geometry. This requires that one component must wet the substrate and that the total surface and interfacial energies of the required layer sequence is the lowest possible.

If the two phases have interfacial surface tensions of δ_1 and δ_{s2} with the substrate and an interfacial surface tension of δ_{12}, then the condition for wetting of the substrate by phase 1 is [8]:



$$\delta_{s2}-\delta_{s1} \geq \delta_{12}$$

This is equivalent to saying that if δ_{s2} is the highest energy interface it could realise a state of lowest free energy (δ_{s1} + δ_{12}) by interposing a layer of phase 1 between it and the substrate. The larger the inequality the higher the 'spreadability' of the liquid phase 1 on the substrate.

Wetting is favoured by a low value of δ_{12}, which may be achieved close to a phase boundary, provided that the expression on the left of the equation approaches zero more slowly than δ_{12}. To discover which side of the equation diminishes most quickly we need to measure the surface tensions of two phases in equilibrium together with their interfacial surface tension. The same measurement can be performed at different points on the phase diagram to discover whether particular compositions favour stratification.

According to Neumann and Sell[9] it is possible to estimate the interfacial tension between two phases if the surface tensions of the two phases are known:

$$\delta_{12}=(\sqrt{\delta_1}-\sqrt{\delta_2}^2/(1-0.015\sqrt{(\delta_1\delta_2)})$$

However, Wu[1] states that the interfacial tension between two polymer solutions in the same solvent is negligibly small. This is because the surface tension of the liquid phase would be dominated by the solvent and the term $\sqrt{\delta_1}-\sqrt{\delta_2}$ would be very small. However, there is little data available in the literature and further investigation is required.

To achieve perfect wetting of phase 2 on phase 1 it is also necessary from Young's law that:

$$\delta_1-\delta_2 \geq \delta_{12}$$

This is satisfied if the phase with the lowest surface tension (to air) is present at the air interface and the highest surface tension phase is adjacent to the substrate. This has been utilised in the powder coating systems[2-4] where high and low surface energy resins are mixed which stratify when heat cured. For example, a mixture of epoxy powder (high surface tension) and a polyolefin powder (low surface tension) should produce a stratified coating with the polyolefin at the air interface and the epoxy at the interface with the substrate.

For solvent borne systems the problem is altered because of the presence of solvent. It is likely that the phase with the highest surface energy will be the most concentrated and not necessarily the one containing the highest energy polymer.

This factor can be utilised to cause the correct resin to move to the substrate. The high energy resin should be the predominant component in the most concentrated phase after phase separation. Solubility parameters and evaporation rates can be used to choose a solvent mix which will produce a high concentration in the phase required to go to the substrate (phase 1). The solvent mix should contain a highly volatile component which is a good solvent for phase 1 and a lower volatility component which is a bad solvent for phase 1 but a reasonable solvent for the other phase. As the volatile solvent component evaporates phase 1 becomes more concentrated than the other and its surface energy increases driving phase 1 to the substrate.

The effect of gravity on a solvent borne system was investigated by Verkholantsev[5]. Film thicknesses up to 500μm could be employed before any layer inversion due to gravity was noted. This is a sufficient thickness for any real coating system so it would appear that effects due to gravity will be negligible.

At very low film thicknesses (< 25μm) the kinetics of the stratification process may be of importance. It is possible that the solvent will evaporate too quickly for the stratification process to be completed before the viscosity becomes too high. Verkholantsev[5] showed that a combination of highly volatile solvents such as acetone and thin films (< 90μm) could prevent stratification from a system which was successful at greater film thicknesses.

The forces responsible for stratification have been shown to be strong enough to carry pigments such as iron oxide in the top layer[1-5]. Addition of curing agent promotes stratification, probably due to the decrease in compatibility of the two resins as the molecular weight increases. However, care must be taken not to select a curing agent which reacts equally well with both resins as this will lead to cross-linking of the two resins preventing separation.

Conclusion

The feasibility of producing self-stratifying coatings has been demonstrated by studies on powder coatings and on solvent borne systems. The process is driven by surface tension effects but opposed by viscosity and, in thick films, gravity.

For powder systems the surface tension of the different components and their viscosity at the curing temperature are the important factors. For solvent borne systems the choice of solvent will be crucial. The surface tension of the separating phases will be dominated by the solvent and the solvent evaporation rates will determine the rate at which viscosity builds up.

References

1. Murase, H. and Funke, W., XVth Fatipec Cong., Congress Book, 1980, **2,** 387.
2. UK Patent 1 570 540 to Kansai Paint Co Ltd, 1980.
3. UK Patent 2 046 765 A to Kansai Paint Co Ltd, 1980.
4. UK Patent 2 076 693 A to Kansai Paint Co Ltd, 1981.
5. Verkholantsev,V. V., Prog. Org. Coat., 1985, **13,** 71.
6. Hildebrand, J. H. and Scott, R. L., 'Solubility of non-Electrolytes'. New York, 1950.
7. Bank, M., Leffingwell, J. and Thies, C., Macromecules, 1971, **4,** 43.
8. Williams, J. K. and Dawe, R. A., *J. Colloid Interface Sci.*, 1988, **125,** 347.
9. Sell, P. J. and Neumann, A. W., *Angew. Chem., Internat. Edit.*, 1966, **5,** 29.
10. Wu, S., *J. Macromolec. Sci. Revs. Macromolec. Chem.*, 1974, **C10,** 1. ■

Preservative treatments — Where are we now and future trends

by E. A. Hilditch, Cuprinol Ltd, Adderwell, Frome, Somerset BA11 1NL, UK

Where have we come from?

Wood decays if it becomes wet, and for use in ma situations it must be preserved.

Some sort of wood preservation was practised in ancient times. Modern materials and practices are however generally considered to have started 150 years ago with Bethell's patent of 1838[1]. This patent laid the foundation for the pressure treatment of timber with creosote. Creosote was, at that time, a by-product of the production of coal gas, then coming into general use for lighting, heating etc.

This development was just in time for the period of railway growth. Railways depended on wooden sleepers. It has been supposed that without an effective wood preservative their rapid decay would have made railways uneconomic. Without railways the world would look very different.

Preservatives using petroleum fractions as solvents for wood preserving active ingredients were developed in the early years of this century. Probably the first of these organic solvent preservatives was Cuprinol sold in Denmark in 1912, consisting of copper naphthenate in petroleum distillate. Solvents are commonly white spirit or a similar petroleum distillate. The most common active ingredients in current use are pentachlorophenol, tributyltin oxide (fungicides) and lindane (insecticide)[2]. Materials such as Acypetacs-Zinc and permethrin are now coming into use.

Some simple water-borne preservatives were used quite early on but were easily washed out. The 1920's and 1930's saw the development of fixed water-borne salts, in particular CCA a mixture of copper, chromium and arsenic salts.[3]. This now dominates the pressure applied water-borne preservative markets of the world.

Present practice

Currently these three types of preservative are used, creosote, water-borne, organic solvent. There are three main areas of use:

1. Pretreatment, that is the industrial treatment of timber before it is installed in a building or wherever, to prevent decay or insect attack.
2. Remedial treatment, the treatment of timber in use, and mostly in buildings, to cure or prevent decay or insect attack.
3. DIY, craftsman or tradesman treatment for either prevention or eradication.

Pretreatment

Current practice for industrial pretreatment falls into several groups[4].

1. The application of creosote under high pressure, used mainly for the treatment of poles and posts.

There are two basic types of process, full cell and empty cell. In both the preservative is forced into the wood by pressure (around 14 bar). In the empty cell process some of the preservative is drawn out by vacuum. The two processes achieve similar penetration but the empty cell process uses less preservative and leaves a cleaner surface. There are several varieties of both processes.

Both processes are very effective, giving service lives in the 50-100 year range but the dirty nature of creosote makes it unacceptable for many uses especially in buildings.

2. Application of CCA salts under pressure follows the same process.

CCA is a much cleaner treatment than creosote. It competes with creosote in the treatment of poles and posts but it also used to treat building timbers. Because of the amount of water absorbed (150-300 litres per cubic metre) timber should be redried for building use. The cost and/or time of drying can be a restriction on its use. Impregnation with water causes dimensional change which may result in permanent distortion. The process is not, therefore much used on dimensioned timbers such as window frames and other joinery.

Water-borne preservatives do not, naturally penetrate readily into timber, they are not therefore used with other processes.

3. Double vacuum or double vacuum pressure treatment with organic solvent preservatives is mainly used for window frames and other dimensioned components including prefabricated roof trusses.

In this process air is first drawn out of the wood by vacuum. The vacuum is released so that preservative is drawn into the timber. In the double vacuum/pressure process further absorption is forced by applying a positive pressure of between 1 and 2 bars. A second vacuum draws some of the preservative out of the timber. This reduces the amount of preservative used and leaves a cleaner quicker drying treatment.

4. Some industrial pretreatment is by simple immersion of timber in an organic solvent preservative. The efficiency of this process is totally dependent on the immersion time. As generally practiced this is 3-10 minutes, at this level the process is somewhat less effective than double vacuum but is still adequate for many purposes. Extended to several hours, as used on some estates and by amateurs, then provided the right products are used, the process gives long term protection even to timbers in ground contact.

Organic solvents penetrate more readily than any other type. Treatment has the advantages of being clean, quick drying and is free from any effects on the dimensions of the timber. But organic solvent products are the most expensive of the preservatives. Use therefore is mainly where these features are of most benefit.

Remedial

For remedial treatment the dominant use is of organic solvent type preservatives applied by spray. The technique is effective for eradication of insects in "ordinary" size timbers but can be less than fully effective with large timbers.

There is some but increasing use of insecticidal emulsions for woodworm eradication, these are less effective than solvent-based products but have the major advantages of being free from solvent odour and fire risk.

Several other methods may be used selectively, these include injection and the use of pastes which are applied thickly to the surface and which then penetrate slowly over several days or weeks. This technique is particularly valuable in treating deep seated insect attack in large timbers.

DIY and Trade

DIY, trade maintenance or craft construction uses organic solvent preservatives or for fences and similar uses, creosote. Application is mostly by brush, sometimes by spray or immersion. These are the least effective of the methods of treatment but, using organic solvent preservatives which have superior penetrating powers adequate protection for all but the most demanding situations can be obtained.

Whenever timber is worked treatment cannot be effectively carried out until after working is complete. Other methods of treatment are not practically available to this group of users.

There is also DIY use for eradication of woodworm. Often insect attack is, in initial stages, very localised. Local treatment by the householder is fully adequate and considerably cheaper.

Where next?

Today preservation of wood is established, use of preservatives has steadily increased and their value is recognised. Conservation of wood is economic sense, conservation of trees is environmental sense. The future should look bright, but there are clouds. These have been generated by media sensationalism playing on public ignorance and fear on matters related to the safety of many of the chemicals used.

It should be emphasised that these are "alleged problems" for a few, except where there has been gross misuse are based on scientific or medical evidence. Yet our present justification for the safety of our products depends too much on historic and practical lack of evidence of problems.

Any industry must retain the confidence of its customers. They must be satisfied that treatment of wood with the materials the industry supplies is effective, economic and safe.

The main worry is centred on some of the specific chemicals used, for these and others detailed evidence must be available on any potential effects on the health of:

☐ Those who use wood preservatives
☐ Those who live or work near treatments
☐ Those who use treated wood
☐ Those who live in treated buildings
☐ Wild life, both flora and fauna and any general Environmental effects.

Both immediate and long term effects, including from accumulation must be considered.

The "risk" is the "product" of several factors:

1. Toxicity of the product. (Which depends on toxicity and content of components).
2. Level of exposure.
3. Length of exposure.
4. Personal susceptibility.

A great deal of information is available on most present products but, for many it is not extensive enough for today's needs. Especially, the data available on exposure is very limited and most especially on low levels of exposure for long periods.

The cost of getting such information is enormous. The wood preservative part of the pesticide industry must now move towards the extent of testing and cost that has been a requirement for agricultural, horticultural, home garden and allied pesticides for many years.

In looking forward, industry and the scientific community must recognise that the standards of yesterday are not those of today and the standards of today will not be those of tomorrow. Adequate data, to a high standard must support all products, new or old. Only then will we be in a position to convincingly counter the crusading zeal of our detractors, especially when supported by sensationalising investigative journalism now in favour in some papers and television channels. As demonstrated with timber frame housing, these can be disastrous for an industry unless effectively countered.

Products that cannot be shown to meet new standards must be exchanged for new. Active incredients, like pentachlorophenol, tributyltin oxide and lindane, are being questioned and have partly been superseded by Acypetacs-zinc, boron esters and permethrin. More active ingredients are desperately needed, possessing properties now known to be desirable for long term efficacy and safety.

☐ lower toxicity
☐ low volatility (a) for permanence
(b) related to toxicity so that there is no risk to dwellers in treated buildings.
☐ free from effect on non-target organisms
☐ degradable to inert materials by fire or in the environment but not so as to reduce effectiveness.

Carrier systems that:

☐ are convenient and easy to apply, effectively and safely
☐ solvents that dry without creating a concentration in the air that might present a hazard.

Beyond these needs any go-ahead industry must seek improvements to its materials and methods.

The future?

What changes can be expected?, other than in the specific chemicals used.

Pretreatment

For the main pretreatment processes, water-borne applied by pressure and organic solvent by DVP or immersion, there is certain to be process modifications as new timbers come into use and to improve performance as gains in knowledge enable us to define needs more exactly. Plant is likely to have more automation and more environmental safeguards.

Beyond these "evolutionary" developments no great changes in basic technology are likely. A lot of research and practical development has gone on in the 150 years since Bethell's first pressure patent yet the basic process, with "full cell" and "empty cell" variants, remains the same, after all, the fundamental nature of wood remains as it was.

The disadvantages of diffusion processes are unlikely to be overcome. Use of ultrasonics, magnetic fields and the like have all been tried and seem to hold no promise.

With the current concern for pesticides, chemical modification of wood may seem attractive but, in application at least most of the chemicals used have far more potential for harming the environment or the health of users than any of the pesticides now in use. The costs of these processes are unlikely to fall to a level that will allow general use.

Remedial

In some ways the remedial area is ripe for change. Changes are needed for improvement and to counter the many problems, real, anecdotal or fancied that follow the use of large amounts of pesticide or solvent in dwellings, especially if occupied.

Essentially the remedial industry depends on skilled tradesmen but it is here that misuse by those who are inadequately trained, or not conscientious or inadequately controlled will have greatest consequences. The responsible part of the industry faces up to these problems, the Control of Pesticides Regulations[5] gives power to control or eliminate the rest. Industry through the BWPDA has made considerable progress in this direction, now that there is support in law further progress can be expected.

Other changes must be looked for. What will they be?

For woodworm treatment, emulsions with low solvent content are being used. These are less effective than solvent materials, better emulsions are likely to be developed but because of fundamental limitations on penetration of water-based systems it remains to be seen how close they will get. Almost certainly they will replace solvent products for "ordinary" use but solvent products will be kept for most demanding or severe cases.

For fungicidal treatments simple emulsions or aqueous solutions seem a poor bet. More emphasis on elimination of damp with, as a general rule any fungicidal treatment being for immediate sterilisation rather that longer term

preservation is the probably solution. Use of penetrating solvent products may become limited to situations where there are special problems or where drying out is going to take a long time.

None of these overcome the basic objections to spraying, the limited effectiveness or the health risk from large amounts of pesticide containing a spray mist and these only partly overcome any solvent problem. Bodied mayonnaise pastes are already used, current products have some shortcomings, there is potential for the introduction of better pastes and the development of better methods of applying them.

DIY (Amateur)

Any consideration of DIY development must consider what is practical by way of methods of application. No changes in techniques, acceptable on a wide scale, to the customer can be forseen.

Segmentation of products for indoor use from those for outdoor use is likely. Much DIY use is outdoors, with some re-selection of active ingredients, current products may well continue to meet all the needs of this sector.

For indoor use changes to materials, in part following the same lines as for remedial use, emulsions, pastes and the like may come about. This market has some special requirements. Products must be "ready for use", the high pesticide content of concentrates is OK for trained professionals but not for amatuers. Products for spraying need formulating to avoid atomisation, paste application systems must be part of the pack. Selection of active ingredients and other components must be such that products have a high margin of safety. Clear instructions that are easily understood and followed must be given and the whole (product and pack) must generally be "user friendly".

An added problem that affects the future for DIY products is the extent to which true preservation is getting mixed up with decoration, surface protection and short term protection against moulds.

For much of this market an ideal product is a wood preservative stain offering both preservation and decoration. The technical requirements are in a large part conflicting, and while compromise products have a useful place in the market, it is doubtful if the regulatory authorities will see them as sufficiently effective, and I doubt if adequate "all purpose products" will be developed.

Going forward?

Britain has some claim to be the world leader in wood preservation, both commercially and technically. Not all the inventions were made here but we were properly selective in what we took up.

Today the situation is very different. Seeking improvement and getting fresh information depends on research. Present national attitudes on this topic come together in a way that has an exaggerated effect on the wood preserving world. We are in danger of throwing all away, through lack of investment in development.

Overall this country is reducing its R&D expenditure, others are increasing theirs, in this respect the wood preservation is well to the fore. With it's world wide connections Britain's wood preserving industry leads the world commercially, yet of 123 applications for European patents since 1978 only 9 (7%) were to British companies. On a world basis the proportion can only be lower.

Who should/will do the research?

Suppose that the light is seen and we again become willing to spend on R&D. Who will then do it?

Will the universities?

University research is naturally academic and as such is intended to increase knowledge. Most is fundamental, it has increased enormously our understanding of how wood rots, but has not yet led us to a better way of preserving wood or to a solution for the specific problems we now face.

Solving industrial problems will be aided by increased knowledge but we cannot expect the universities to solve our problems for us. Help, yes, but only incidentally. Remember, also, that once you start dealing with preservative systems the long time scale is way beyond the three year PhD course that is the basic module of university research.

What about the government?

Many consider that long term research, for the benefit of British industry and therefore of the British people and economy should be supported by government funded research laboratories.

The present government does not. Perhaps they are right in some cases, especially if "near market" but is their definition of "near market" right and does the rationale apply to all industries? It is not just industry that depends on industry, it is the whole population.

To make matters worse almost all the research in government laboratories (and much in industry) is directed to test methodology aimed at standards to support a bureaucratic regime in post 1992 Europe. Some standards are necessary to eliminate ineffective or dangerous practices or materials, but they enshrine the present and so stand in the way of developing anything new which does not fit closely into the present mould.

Should Industry solve it's own problems?

Yes! Invention of new and improved products and processes should be an aim of industry. Indeed it is, but current wood preservatives are highly effective, economic and have a high degree of safety. The present world wants better and with the types of problem we face, there are major scientific and technical problems. They cannot, by their very nature, be solved quickly or cheaply. Present input is too small and too fragmented.

It might be said that the problems are as much financial as technical. Compared to most, wood preservation is a small industry, there are, by wider standards, no large companies and only a few of even medium size. The smallness of the industry does not reduce the size of the scientific problems, large total spend is needed with units large enough to have "critical mass", with the expertise and size to enable fast progress. Some combining of efforts and avoidance of wasteful competition is essential. Can this happen with the present commercial and financial structure of the industry?

The level of investment required is high, can this be supported? My guess is that the wood preserving industry average R&D costs (excluding customer service, quality control etc.) are below 1%, possibly below ½% of sales. In the agricultural pesticide or pharmaceutical industries they are around 10%. We have many of the problems of these industries.

Such an increase in investment in the future can only be made if it can be recovered through increased selling prices. No company would survive if it raised prices to this extent and its competitors did not. Again are there implications for the structure of the industry?

The time scale for wood preservative development is necessarily long. Industry is in the hands of investors. They have short or shortish financial goals. Today's research reduces today's profit. Substantial investment in anything that is only going to yield returns in the distant future is out of line with current financial thinking.

Continued on p.420

Resins & Pigments 90

The thirteenth Resin & Pigments Exhibition, organised by PPCJ, will be held at the Sheraton Copenhagen Hotel on the 14-15 November 1990.

In conjunction with the exhibition the Paint Research Association will hold its tenth International Conference on Paint and the Environment at the same venue on 12-14 November 1990. Companies exhibiting include:

The newly formed Coatings and Specialities Division of **ALLIED COLLOIDS** will be exhibiting at Resins and Pigments Exhibition for the first time. As well as its well-known range of Dispex dispersing agents and Viscalex and Rheovis rheology modifiers Allied Colloids will feature its first binder for waterborne wood finishes, Development Product 6-3715 is also suitable for concrete sealers, appliance finishes and floor tile sealers. For the Printing Ink Industry the latest addition to the Glascol range of acrylic and styrene-acrylic emulsions will be featured allowing the ink manufacturer to achieve gloss, hardness and heat resistance on a wide range of substrates including paper, plastic film and metal foils. Stand personnel: Eric Alston - Sales Manager, David Marshall - Marketing Manager, Robert Hildred - Product Group Manager - Paints, Chris Batchelor - Product Group Manager - Inks, Diane Thompson - Technical Representative and Janet Mackintosh - Sales Secretary.

For further information Enter J401

ARCO CHEMICAL is one of the major producers of propylene oxide and its derivatives. The ARCOSOLV® range of propylene glycol ethers and propylene glycol ether acetate and ARCONATE® grades of propylene carbonate are part of this derivative range. Ever growing numbers of formulators are turning to ARCOSOLV® products to replace ethylene glycol ethers and ethylene glycol ether acetate. The lower toxicity of ARCOSOLV® products make them a natural alternative. ARCONATE® propylene carbonate is used in a diverse range of applications as a reactive diluent in urethane systems, in wood chip and foundry sand binders, as a reactive intermediate, as a dispersing agent and in replacing more hazardous or expensive products in other applications.Formulators can also take advantage of our ARCOCOMP computer programme designed to assist in preparing solvent blends.

For further information Enter J402

BRAIVE-INSTRUMENTS, well-known manufacturer of high quality instrumentation, presents a wide range of equipments designed for testing corrosion, ageing, adhesion, elongation, impact and cupping, washability, scrubbing and brushability, mainly for coatings. Braive also specializes in measurement and control instruments for density, wet and dry film thickness, hardness, application of films, porosity, grinding and fineness of grinding, viscosity, roughness, softening point, surface cleanliness, opacity power, permeability and drying time of paints, internal coatings stresses.

For further information Enter J403

CARDOLITE will show their range of epoxy products which consists of the Phenalkamine curing agents, reactive diluents and flexibilisers and extenders. New are: Water reducible epoxy curing agents; Low viscosity phenalkamine curing agent. Cardolite is also offering intermediates based on cashew nut shell liquid. These products can be used to modify resins or as a starting material for surfactants, demulsifiers and lubricants.

For further information Enter J404

CERA CHEMIE BV offers a wide range of waxbased additives for the paint and printing ink industry. These waxdispersions act as a surface protective device, distracting mechanical attack by increased surface slip. Cera waxdispersions are available in any kind of solvent or mixture of solvents: from water to xylene. In many cases waxdispersions are developed in close dialogue with the customer: made to measure. Emphasis is laid upon waterborne systems. A special range of waxdispersions offers the possibility to combine surface protection with gloss control. Interesting new developments will be revealed during the exhibition.

For further information Enter J405

The range offered by **TISZAMENTI CHEMICALS WORKS (TVM) of CHEMOLIMPEX** to the paint, plastic, printing ink and ceramic industries will be exhibited as follows: Chrome Yellows: Colour shades varying from golden yellow through lemon colour to very pale greenish-yellow primrose hue. Improved light, weather and heat fastness (up to 180°C). Fastness to industrial atmosphere (SO_2). Low dust and easy dispersibility chromes. Anticorrosive pigments: Zinc Chromate (micronized) — a powerful corrosion inhibitor in primers of light metal or steel structures. Zinc Tetraoxychromate — for application in wash primers. Zinc Phosphate (micronized) — among the basic anticorrosive pigments zinc phosphate has found an extensive application in recent years. Available in bihydrate and tetrahydrate form. Barium chromate — with low watersoluble chromate content mainly used in combination with other anticorrosive pigments. Chrome Oxide Green — with outstanding light and weathering fastness and resistance to industrial atmosphere.

For further information Enter J406

CRAYNOR SNC, together with its Sister Company Sartomer (USA) offer the most comprehensive range of acrylic and methacrylic monomers and oligomers for UV, EB curing, and other applications. The latest developments in this field will be on show.

For further information Enter J407

The latest technologies in the field of surface coating will be shown by **CRAY VALLEY PRODUCTS LIMITED,** including conventional and high solids SYNOCURE two-pack acrylics; SYNOCURE non-isocyanate two-pack systems; GELKYDS and SUPER GELKYD thixotropic resins for decorative and industrial use; long-life durable finishes and wood stains; and new developments in ADDITIVES for pigment suspension and sag control.

For further information Enter J408

What's the link between **DOW CORNING,** silicones, surface coatings and Scandinavia? Dow Corning, the world's leading supplier of silicones, invites you to discover the superb performance characteristics of its range of silicone paint additives. We will be focussing on environmentally friendly silicone additives such as the waterborne and high solid types. Dedicated technical and commercial specialists from Dow Corning, plus our Scandinavian distributors — Algol, Diatom, Lindberg & Lund and Sikema,

Stirring new ideas for a changing world from Eastman.

Eastman has a wide range of high quality products and innovative new ideas to help improve your coatings and to meet the changing requirements for today's technologies.

If you have used our well known products—such as Texanol® ester alcohol, Ektapro® EEP solvent, MAK and Ektasolve® EP solvent, let us introduce you to our film formers, flow additives, retarder solvents, coalescing aids, adhesion promoters and resin intermediates. These products are designed for both conventional and compliance coatings.

And products aren't all you get when you buy from Eastman—outstanding, innovative technical service is offered from the United Kingdom to Japan in addition to personalized, global marketing support.

For more information contact Eli Klokke, Eastman Chemical International A.G., Kodak Nederland B.V. Zeisterweg 1, 3894 NH Odijk, Netherlands. Telephone: (31) 03405-999 62; Fax: (31) 03405-999 55 or Anna Hausheer, Eastman Chemical International A.G., P.O. Box 3263, CH-6300, Zug 3, Switzerland. Telephone: (41) 42-232525; Fax: (41) 42-211252 or Beat Zeuger, Eastman Chemical (UK) Limited, P.O. Box 66, Kodak House, Station Road, Hemel Hempstead, Herts, HP1 1JU, England. Telephone: (44)442-41171; Fax: (44) 442-41177.

will be available to answer your enquiries.

For further information Enter J409

DSM RESINS will present: □ Alkyd emulsions, polymer dispersions and high solids alkyd resins for gloss paints, stains and parquet varnishes. □ Urethane alkyd emulsions for metal substrates. □ Hydroxy acrylic resins for high solid, two component systems. □ Acid curing Acrylic resins (AA system), low formaldehyde amino resins and acrylic dispersions for industrial wood applications. □ Powder coating resins. □ Printing ink resins.

For further information Enter J410

DYNO CYANAMID, the joint-venture of American Cyanamid Company in the USA and Dyno Industrier AS in Norway, will exhibit their range of Cymel® and Dynomin® amino crosslinking resins. Emphasis will be placed upon the use of amino resins in low organic solvent emission formulations such as waterborne, high and medium solids coating systems. New at the exhibition will be the introduction of Powderlink® 1174 amino powder coating resin which will be commercially available by the fourth quarter of this year and Cymel 254, a mixed ether highly reactive amino for higher solid paint systems.

For further information Enter J411

During the 1990 Resin & Pigment Show in Copenhagen, **EASTMAN** will exhibit solvents, Resin-Intermediates and Coating Additives. Coating Additives: Eastman will feature a new Chlorinated Polyolefin primer, a new commercial CAB for medium solid automotive basecoats, a developmental cellulosic for waterborne automotive basecoats and a radiation curable cellulosic. Resin Intermediates: Included in the exhibit is new information on NPG Glycol, 1,4 CHDA, t-BAA and AAEM. Eastman will introduce 3 new intermediates: BEPD, HPHP and 1,3 CHDA. Other information includes the use of 5-SSIPA in WB Polyesters. Solvents: For high solids and WB coatings, Eastman will exhibit speciality Ketones (MAK, MIAK) Ether Esters (Ektapro EEP) and Glycol Ether Solvents (EKTASOLVE EP, DP).

For further information Enter J412

EFKA CHEMICALS BV Holland will present: EFKA-LP 8848 A new high molecular weight dispersant which gives better steric hindrance, better deflocculation. Resin minimal pigment concentrates, based on high molecular weight dispersants. EFKA-POLYMER LP 7980 A high molecular weight dispersant for aqueous coatings, based on a modified polyacrylate with self-emulsifying properties. EFKA-772 A levelling and anti-cratering agent for aqueous coatings. EFKA-701 A solvent-free wetting and dispersing agent. The following personnel will be present on the Efka-stand: F. Duivenvoorden, W. Habel, M.Pessina, P. Quednau, S. Wisser.

For further information Enter J413

Alongside a representative selection of their extensive programme of lacquer and paint testing instruments, **ERICHSEN GMBH & CO KG** will mainly present newly developed products: Ohmmeter acc. to VDA; Spinning Coater (completely revised version); Pendulum Hardness Tester with automatic test sequence; Adhesion Tester (acc. to ISO, portable, off the line); Accelerated Weathering Apparatus (bench model) and a new generation of portable Glossmeters.

For further information Enter J414

EXPANCEL will show its range of EXPANCEL thermoplastic microspheres with unique properties: ultra low density, resiliency and small size. A brand new quality will be presented where the surface of the microsphere are totally different.In emulsion paints the new EXPANCEL quality can save binder because of lower oil absorption. The solid content by volume can also be increased resulting in a higher filling capacity of the paint. In spackling compounds the new EXPANCEL grade reduces the formation of cracks.In caulks and sealants the new microspheres can be expected to give a better adhesion to the matrix resulting in better mechanical properties.

For further information Enter J415

PLIOLITE® and PLIOWAY® Resins are high performance binders destined for the paint industry produced by **GOODYEAR CHEMICALS EUROPE** in Le Havre (France). PLIOLITE® resins are used in exterior masonry paints, thick coatings, anticorrosion paints, inks, traffic paints, intumescent paints and waterproofing sealers. They provide excellent adhesion, water & alkali resistance, self cleaning and long lasting protection. PLIOWAY® resins soluble in virtually odourless, aromatic free solvents are used to formulate high performance, low odour interior and exterior paints. These resins have been developed at GOODYEAR's European Chemical Technical Centre near Paris which provides technical service and application development ideas.

For further information Enter J416

HENKEL's COK-DEHYDAG KLF-T Division and Henkel-Nopco, Drammen will present its full range of additives for the paint and printing ink industries. The extensive range includes additives for aqueous and non-aqueous systems, dispersing, wetting antisettling, flow, slip, rheology, defoaming, air-release, corrosion inhibitors, conductivity improvers, plasticizer, solvents etc. A special subject will be the presentation of a waterborne alkyd resin for industrial coatings without need for solvents or volatile amines. The TEXAPHOR series has been extended by new multifunctional polymeric dispersants: TEXAPHOR 3112 and TEXAPHOR 3114

For further information Enter J417

The **HITOX CORPORATION** of America will showcase its line of unique formulating pigments and extenders for the coatings industry. HITOX Buff-Colored Titanium Dioxide, a 95% rutile alternative to white TiO_2, offers the chemist flexibility and economics in formulating. BARTEX Barium Sulfates, OSO Iron Oxides and HALTEX Alumina Trihydrates are other products offered in the Hitox tradition of quality. Information on all Hitox products will be available at our stand. Experienced technical and marketing personnel will be on hand to assist you in incorporating Hitox Corporation products into your coatings. We hope you will visit us and meet Miss Sara M. Robinson, Vice President for Sales and Marketing. The Hitox Corporation manufactures pigments and extenders at our plants located in the United States, Spain and Malaysia. Our products are represented internationally by a network of agents and distributors. Please contact us for the name of the international distributor or agent nearest you.

For further information Enter J418

ICI RESINS will exhibit a wide range of products including several water-borne formulations. A number of new products will be on display including □ NeoCrest — carboxylated polyester resins specifically designed for powder coatings, □ An aliphatic urethane-acrylic copolymer for parquet flooring, □ Resins for low odour, super high gloss decorative paints, □ Emulsion for industrial wood coatings, providing high resistance properties without external crosslinkers, □ An acrylic emulsion for

39

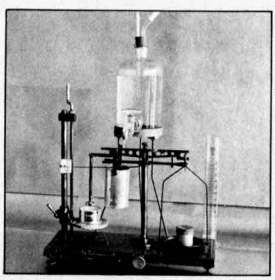
CVPost

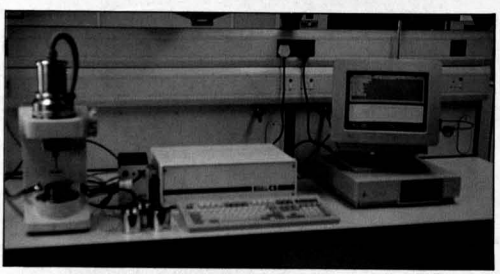
A BRIEF AND TOPICAL REPORT ON SOME OF OUR ACTIVITIES AND DEVELOPMENTS IN THE FIELD OF SYNTHETIC RESINS

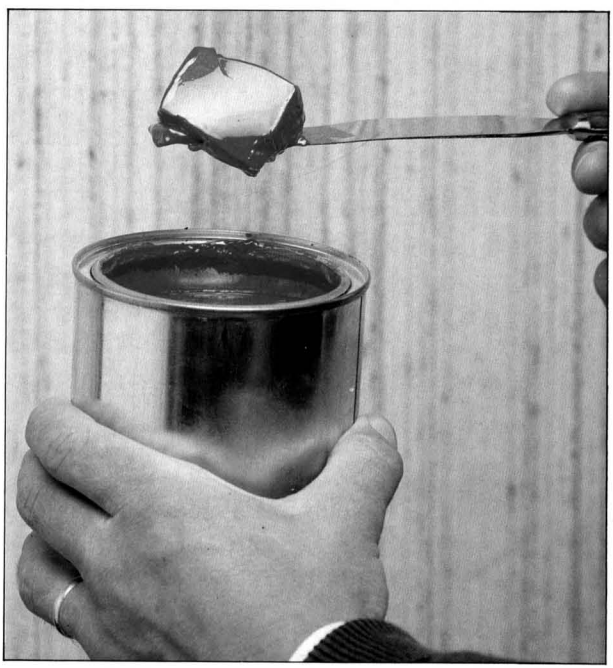
35 YEARS OF PROGRESS IN THIXOTROPY

In 1955, the European market was introduced to the concept of controlled thixotropy in paints. Thirty-five years later, **GELKYD** thixotropic alkyds form the basis of most structured decorative paints on sale worldwide. From initial scepticism – especially from the professional decorator – to global acceptance in half a lifetime is an unrivalled achievement for this special class of thixotropic alkyd.

In the beginning, no suitable test equipment was available... so ***CVP*** invented some... from simple Gel Strength Testing to the modern computerised sophistication of the Bohlin Rheometer.







Reproduced by courtesy of 'Daily Telegraph and Morning Post.'

1958

Reproduced by permission of the 'Sunday Express.'

1961

Thixotropy was instrumental in starting the 'D·I·Y' craze, as these cartoons during the early days of thixotropy illustrate!

35 YEARS OF PROGRESS IN THIXOTROPY...

...technology has not stood still over this period. Alternative structure mechanisms to those provided by polyamide bonding have been developed and in 1979 the **SUPER GELKYDS** were introduced, offering:

- Total resistance to syneresis
- Stable structure at tropical temperatures
- Excellent compatibility with a wide range of blending alkyds
- Tolerance to polar solvents and difficult pigments

These key features have promoted the **SUPER GELKYDS** as alternatives to traditional thixotropic alkyds for decorative paints and varnishes.

The development of stable low viscosity wood stains incorporating translucent oxide pigments and offering excellent exterior durability has been a particular **SUPER GELKYD** success story.

The maintenance of thixotropic structure in the presence of strong solvents has led to the latest developments from ***CVP*** !

- Spray applied industrial paints, both air drying and stoving, with rapid structure regain – enabling high solids, one coat primers and finishes to be applied without sagging.
- Thixotropic thermosetting acrylics for high solids clear and pigmented finishes

INDU
for c
high
SUPE
SUPE

LONG LIFE
SUPER GEL
with **SYNO**
exterior fin

SUPER GELKYDS for heat stable thixotropy a
low solids **SUPER GELKYDS 390W, 391W, 395W**

GELKYDS for clean, quick, one-coat decorative paints
GELKYDS 310W, 320W, 361W, 9135W plus **UNITHANE 654W**

1955

THIXOTROPIC THERMOSETTING ACRYLICS
for high solids clear & pigmented finishes
SYNOCRYL 850ST

OPARAFFINIC OLVENTS
sensitive
vironments
PER GELKYD 391WP

RIAL SUPER GELKYDS
rolled flow at
ids
ELKYD 290X
ELKYD 291X

INTS
D 6006W in combination
C 6005W for long life
es

efficiency at

→ **1990**

During the last thirty five years Cray Valley Products has become the world's foremost authority on the production and use of thixotropic resins in decorative paints.

THE GELKYD RANGE FOR:

- Prevention of pigment settlement
- Good breakdown on brushing for easy application
- High film thicknesses with no sagging – even on vertical surfaces
- Controlled penetration into porous substrates
- Dripless paints to lightly structured systems

THE SUPER GELKYD RANGE FOR:

- Heat resistant thixotropy for tropical climates
- Compatibility and stability with most medium and long oil alkyds
- Tolerance to highly polar solvents and to all commonly used pigments and extenders
- A full range of syneresis free structures from light and creamy to dripless
- Transparent wood stain varnishes with stability at low viscosity and excellent durability

INDUSTRIAL SUPER GELKYDS FOR:

- Thixotropy in strong solvents
- Sag control in spray applied coatings
- High solids one coat finishes
- Compatibility with a wide range of industrial coating systems
- Commercial stoving or air drying applications

SUPER GELKYD 6006W/SYNOLAC 6005W FOR:

- Long life paints with superior colour retention
- Flexible woodstains for maximum durability
- Simplified redecoration cycles without the need for film removal

ISOPARAFFINIC SOLVENT BASED SYSTEM FOR:

- Low odour decorative systems
- Reduced downtime in sensitive environments

For the future, our development programme includes the continued introduction of non-aromatic solvent grades and the development of controlled rheology in high solids coatings. These objectives are designed to meet the needs of the surface coatings industry as we respond to the challenges and opportunities provided by new environmental protection obligations.

As we enter the final decade of the 20th century, *CVP* polymer technology experience is already being harnessed to produce the new thixotropic coatings of the 21st century.

Comprehensive technical data covering all the GELKYD and SUPER GELKYD applications is available from *CVP*. We welcome your enquiries.

CVP THIXOTROPIC RESINS

Ref	% Oil Length	Oil Type	Polyol	Average Non-Volatile %	Volatile	Max Acid Value mgKOH/g	Viscosity Centipoise at 25°C at 2500 sec.$^{-1}$	Specific Gravity at 20°C	Suggested Uses
GELKYD	Cray Valley Products pioneered the manufacture of thixotropic alkyds in Europe with the introduction of the GELKYD range in 1955...								
310W	56	Linoleic	Penta	40	White Spirit	12	250-350	0.87	High gel type for use in undercoats, flat wall and semi-gloss finishes.
320W	60	Linoleic	Penta	51	White Spirit	10	1200-1800	0.90	General purpose high gel type for all thixotropic paints.
361W	65	Linoleic	Penta	55	White Spirit	10	800-1300	0.91	General purpose use in decorative paints.
9135W	61	Linoleic	Penta	51	White Spirit	25	350-550	0.89	For use in most types of structured finishes in combination with non-thixotropic media.
UNITHANE	...Thixotropic polyurethane alkyds were subsequently introduced under the trade name UNITHANE.								
654W	–	Linoleic	–	55	White Spirit	10	600-800	0.91	Thixotropic high quality general purpose urethane alkyd. Particularly recommended in colour retentive decorative enamels and varnishes.
SUPER GELKYD	The SUPER GELKYDS are a family of thixotropic alkyd resins, manufactured using a completely new process. The resins have a non-melting characteristic and high resistance to syneresis. The SUPER GELKYDS have been designed to complement the existing GELKYD range.								
290X	33	Linoleic	–	42	Xylene	10	250-450	1.00	For use in combination with other binders to provide sag control in spray applied coatings.
291X	23	Saturated fatty acid	–	60	Xylene	10	600-1000	1.06	For use in colour retentive stoving systems.
390W	70	Linoleic	–	60	White Spirit	9	900-1300	0.94	For use in the manufacture of thixotropic decorative paints as the major or minor proportion of the binder. Excellent application characteristics over a wide temperature range due to stability of gel structure.
391W①	73	Linoleic	–	55	White Spirit	8	600-1000	0.93	Primarily recommended as the major component in the manufacture of anti-corrosive primers. Excellent application characteristics over a wide temperature range due to stability of gel structure.
395W	52	Linoleic	–	40	White Spirit	7	500-900	0.88	Particularly suitable for low sheen finishes. Accepts silica flatting agents without any loss of structure.
6006W	65	Linoleic	–	55	White Spirit	10	500-700	0.90	Flexible thixotropic alkyd for use in blends with Synolac 6005W.
SYNOCRYL	Thixotropic acrylic resin introduced in 1990.								
850ST	–	Hydroxy Acrylic	–	42	Xylene	–	100-200	0.95	Sag control in thermosetting acrylic systems.

NOTE: ① Also is available in Shellsol TD

CVP

Comprehensive information is available on all the resins described in this issue of ***CVPost***
We welcome your enquiries. Please contact: **LEN NEWTON, CRAY VALLEY PRODUCTS LTD,**
FARNBOROUGH, KENT BR6 7EA, ENGLAND. TELEPHONE: 0689 53311 TELEX: 25898 TELEFAX: 0689 62843

high heat resistance, low temperature film forming overprint varnish and aluminium primer coats and □ A new topcoat based on Haloflex EP 252. Specialists will be available to discuss the full range of ICI Resins products.

For further information Enter J419

The **INTERORGANA** Chemiehandel GmbH is an independent marketing and distribution organisation for speciality chemicals. Interorgana's exhibition will feature the following items: 1. *Monomers* to the resin and related industries (acrylates, methacrylates and specialities).
2. *Flame retardants and plasticizers.*
3. *Rubber* and rubber additives.
4. *Waterborne epoxies* and *high solids acrylic polyols* to produce industrial coatings, architectural and flooring, adhesives, glass fibre coating a.m.o.
5. *Elastomer raw materials:* polyols, prepolymers, specialities based on polybutadiene resins etc. Stand personnel: Dr. H. P. Ansteeg and B. Rienau.

For further information Enter J420

KEMIRA has been producing FINNTITAN TiO_2 pigments in Pori for 30 years. From the very beginning we have had a strict commitment to high and consistent quality. To achieve this, we have continuously developed our production and quality control systems.Kemira also supplies a complete line of FLONAC pearlescent pigments for paints, printing inks, cosmetics and plastics. These heat-stable, chemical-resistant and highly refractive pigments with no heavy metals provide a sophisticated silver and gold effect for your applications.KEMIRA MICA is extracted from Kemira's mine in Finland and has found applications in building products and automotive materials. Due to hitech production methods the quality of Kemira Mica is at a consistently high level.A current issue today is environmental responsibility. Kemira has invested abt. FIM 400m on reduction of effluents and further recycling of process wastes at its Pori plant. Vuorikemia's technical and commercial staff welcomes you to their stand to hear more about their products and plans for environmental protection and to discuss your specific needs.

For further information Enter J421

KIRKLEES CHEMICALS LIMITED are exhibiting their latest VIKING emulsion binders for the Scandinavian paint and adhesives industries. A new Vinyl Acetate/VeoVa 10 copolymer for the paint industry, VIKING 2900, demonstrates excellent performance in matt and semi-gloss wall paints, exterior textures and masonry systems. VIKING 3000 offers high performance for the environmentally conscious — simply substitute your existing binder and remove the coalescing solvent. Adhesive customers will welcome VIKING 1645 a cost effective woodworking base confirmed by the German "INSTITUT FÜR FENSTERTECHNIK e.V" to perform to DIN 68602, B3. Customers should also ask about our developments in acrylic binders.

For further information Enter J422

New applications of micronised and classified LANCO-WAX products for slip and matting will be shown by **LANGER & CO.** A new structuring additive for powder coatings with homogeneous effect will be demonstrated. LANCO-ANTISKIN P is a very effective antiskinning agent for low odour printing inks. A brand new slip and release agent for can- and coil-coatings will be featured. This product LANCO-GLIDD RM shows no matting properties at normal addition level. Within the range of LANCO-BEIT-PIGMENT CONENTRATES new flushed deep black pastes and products for solvent and water based coatings will be shown. A full series of gloss and levelling agents for solvent based and powder coatings will be offered.

For further information Enter J423

"Naturally Yours" is the new slogan under which Necarbo now serves the market. **NECARBO,** belonging to the Petrofina Group, offers from own production: Nebosol/Neboplast-aqueous emulsions, Nebocure-epoxy curing agents, Nebores-resins, Nebochips-colourchips, Nebotint-concentrated pigment dispersions and several Neboadditives. Necarbo also represents many leading chemical industries either on an exclusive or on a distribution base, such as: Akzo Chemicals B.V., Bayer A.G., Larvik Pigmentfabrikk Norzink A/S, Oleofina S.A., Petrofina S.A., Possehl GmbH, PPG Industries S.A., Shamrock Aluminium Ltd., Stockhausen GmbH, Supercolori Spa., United States Bronze Powders Ltd., Wolff Walsrode AG.

For further information Enter J424

NEVCIN POLYMERS BV have specialised for 3 years now in the production of hydrocarbon resins. With our reliable sources of raw materials and large plant capacity plus a high standard in technology, we have the flexibility to manufacture a wide range of products. These include petroleum, coumarone-indene and modified resins together with epoxy-modifiers and resin solutions. This flexibility enables us to offer large quantities of standard resins plus "tailor made" products. Our technical staff will be available to advise you how to obtain the optimum benefits from our resins in adhesives, concrete curing membranes, paints, coatings, printing inks, resins, roadmarkings and many other fields.

For further information Enter J425

PERSTORP POLYOLS is the world leading producer of PENTAERYTHRITOL and TRIMETHYLOLPROPANE with production sites in Perstorp/Sweden, Castellanza/Italy and Toledo/Ohio, USA. Production of Neopentyl/glycol will start during 1991.
An extended range of ethoxylated and propoxylated products based on Pentaerythritol and Trimethylolpropane is now available, These products are of particular interest in making UV curing monomers and oligomers, plus e.g. high solids, polyesters, polyurethanes, etc. Allylethers are creating a growing interest in unsaturated polyesters, high solids or waterborne alkyds, etc. The product range consists of several Trimethylolpropane- and Pentaerythritol-allylethers. Stand personnel: GORAN BERGVALL, NIGEL COOPER, MATS OLOFSSON, KENT SORENSEN, LARS-ERIK RAVEMARK.

For further information Enter J426

RHONE-POULENC Group will present: RHODOPAS dispersions (vinyl acetate copolymers, acrylate-styrene copolymers, pure acrylic copolymers). TITAFRANCE (titanium dioxide) from THANN ET MULHOUSE (white pigments for all applications). RHODOPOL 50 MD, (xanthan gum), an effective thickener useful for all water based formulations. TOLONATE (aliphatic polyisocyanates), non-yellowing polyurethane intermediates for the coating industry. RHODORSIL silicones, binders for water-repellent building paints, binders for high temperature paints, intermediates for silico-organic binders, solvent and waterborne water-repellent masonry. FLATOSIL, TIXOLEX 24, precipited silicas and sodium silicoaluminates. Untreated and treated matting agent for paints and varnishes. Extender for emulsion paints.

For further information Enter J427

RÜTGERSWERKE AG produce a wide range of aromatic and heterocyclic chemicals together with a comprehensive line of C9 hydrocarbon resins, aliphatic-modified C9 resins, indene-coumarone resins and modifiers for epoxy, polyurethane and polysulphide systems. The forementioned resin range is marketed worldwide by VfT GmbH, Duisburg, a subsidiary of Rütgerswerke AG. The resins offered range from liquids to high softening point solids. The versatility of the VfT-resins permits great latitude in formulating. Current capacity of light coloured resins is 26,000 tpa. Some of the VfT-resins are: aromatic/aliphatic copolymers; a light-coloured low cost general purpose KW-resin; PH3-Sa/15-V6, a low viscosity, light coloured modifier for epoxy and polyurethane systems. Rütgerswerke AG have also developed the Rüta-mod range of dark modifiers. This supplement to the Carbo-mod series (special tar types) does not have to comply with the labelling requirements laid down by the German Hazardous Goods Regulations. Stand personnel: Dr. Mildenberg, Dr. Knips, DI.Zick (VfT); N. Volkmann (Rütgerswerke AG)

For further information Enter J428

SCANDIBUTOR: display their programme in waxes and wax-compounds for printing inks. They also represent the following principals: Columbian: producer of special carbon black pigments. Exhibits will highlight untreated and post-treated (oxidized) carbon blacks. Daicolor: exhibits a total programme of organic pigments and pigment preparations for printing inks and plastic. Hercules BV: supplier of a wide range of resins for printing ink, paint and adhesive industry with a large variety of physical and chemical properties. Huttenes-Albertus: exhibits unique binders for paint. Interesting applications are amongst others: anticorrosion primers with very good salt spray property; structure paint and UV-curing systems.

For further information Enter J429

BERND SCHWEGMANN will this year again be exhibiting their full range of paint additives. In the foreground will be the product "Antigel", which stabilizes the viscosity of alkyd resins for a long time. Furthermore, Antigel is as well an effective dispersing, anti-skinning, antifloating agent as a levelling agent.

For further information Enter J430

SILBERLINE LTD, manufacturers of high performance aluminium pigments will be exhibiting their latest extension to the highly successful range of sparkle silver premier grades. These pigments are available in various forms for medium and high solids as well as waterbased coatings. For the manufacturers of printing inks, new extra bright leafing pigments will be on display as well as new waterdispersible pigments (Aquapaste, Aquavex). A further range of solvent-free, granular alu-pigments has been designed specifically for powdercoatings and metallic masterbatches for plastics (Silvet). Visitors will be welcomed by Dr. D. King and Alwin Baumann.

For further information Enter J431

SOCIETE NOUVELLE DES COULEURS ZINCQUES-SNCZ will present: 1) Phosphinox PZ 06 and Phosphinal PZ 04: two activated zinc phosphates which bring quality solutions to the replacement for zinc chromate. The appropriate choice between these two products depends on the used system.2) Novinox PZ 02 as a replacement for zinc tetraoxychromate in wash and shop primers. Gives a salt spray resistance of 150 hours for a film thickness of 15 microns.3) Polynox TP 5: this brand new pigment, will be exhibited for the first time: thanks to its structure, it is the closest pigment to zinc chromate; quite non toxic. It has been tested successfully in numerous alkyds and epoxy resins etc.

For further information Enter J432

SPECHEM a well known water borne polymers company, will be exhibiting their complete range of products for today's Graphic Arts markets. An example is the JONCRYL Alkali Soluble Resins, displaying superior wetting characteristics. SPECHEM will also be exhibiting their full line of Rheology Controlled (R.C.) Emulsions. 1990 sees the launch of SCX 8210 in the plastics and woodcoatings industry. SCX 8210 as a (R.C.) Emulsion features: near Newtonian Flow, shear stability, low foaming SCX 8210 has superior solvent resistance. Speciality Chemicals Mijdrecht b.v. are dedicated to their customer,the environment and their goal of fulfilling tomorrow's needs today!

For further information Enter J433

SUD-CHEMIE AG, will present their extensive range of gelling agents, comprising three groups: organophilic bentonites for solvent based systems under the brand name TIXOGEL; hydrophilic bentonites OPTIGEL and the organic gellants RHEOTIX and RHEOCIN. Special attention will be drawn to our OPTIGEL products. They could be used as functional fillers or highly effective thixotropic agents in water based as well as in water reducible systems. Also to be discussed will be the latest developments for water based metalics or coatings.

For further information Enter J434

VINAMUL will present the latest in its new generation vinyl acetate – ethylene copolymers for low odour, solvent-free matt and silk paints. Using the inherent efficiency of ethylene in its water-borne binder systems, Vinamul technology is raising standards of user and environmental care. Technologists are focussed on the design of binder systems which can be manufactured and used with the least possible impact on the environment or people. Emphasis is also placed on the safety of paints made with Vinamul binders. Our products are developed to minimise and eliminate the need to incorporate harmful agents – so allowing the formulation of very safe paints.

For further information Enter J435

WINTER-BOUTS BV is one of the leading producers of coloursystems in Europe offering a range of coloursystems e.g. D.I.Y. Market: Machine tinting and injectorsystem. Professional Market: Coltec coloursystem (universal colourants); Duodek coloursystem (water-based colourants). Industrial Market: M.P.S. coloursystem (multi purpose colourants). All these systems are (also) integrated to inplant-tinting and exclusively offered to the paint manufacturer.

For further information Enter J436

A new range of dusting bronzes compatible with new and old Dreissig machines will be featured by **WOLSTENHOLME BRONZE POWDERS** at this year's exhibition along with the SUPEROTO 'family' of inks for the liquid ink industry. SUPEROTO represents five different qualities of ink and is expected to be as successful as their UNIPAK, ready-mixed offset metallic inks for quality, stability and performance. METANA has been synonymous with high quality aluminium paste for over 40 years with their copper and bronze powders and pastes, used in paint and plastic applications. Includes: METANA TR tarnish resistant bronze powders as well as conventional and low dust powders and pastes, designed for incorporation in thermoplastic masterbatch, compound and certain paint applications.

For further information Enter J437

Continued on p.425

VfT Resin applications
for example:
Paint and Lacquer
Manufacturing

VfT Resins for reducing system costs!

Paint and lacquer manufacturers use VfT Resins to reduce raw material costs for existing formulations, without impairing the technical performance.
In close collaboration with paint and lacquer manufacturers, new resin types have been developed, such as special liquid resins of the PH3-series with OH-numbers of up to 6% for polyurethane and epoxy systems, IBP-Resin and the special reactive resin 5,6 for cataphoretic spray paints.
For many years, VfT Resins have already been used successfully, for example KW-TN-Resins for aluminium paints, KW-Resins in combination with alkyds and for temporary rust prevention, Carbo-Mod-types (special tars) as extenders for epoxy and polyurethane systems in marine paints and for heavy-duty anti-corrosive coatings.

VfT GmbH · A Subsidiary of Rütgerswerke AG
Varziner Straße 49, Postfach 12 02 44, 4100 Duisburg 12
Tel.: (02 03) 4 56-03, Teletex: (17) 203318, Telefax: (02 03) 42 25 51

VfT Resins are thermoplastic, unsaponifiable, hydrophobic, alkali and acid resistant, neutral and non-toxic. Resins with special solubility and compatibility characteristics, light and thermal stability, etc, can be supplied.

VfT GmbH in Duisburg is the sales company for the products of the business area Aromatics of Rütgerswerke AG.

The prediction of performance

by J. E. O. Mayne, Department of Materials Science & Metallurgy, Pembroke Street, Cambridge, CB2 3QZ, UK

Abstract

In 1948 Bacon, Smith and Rugg concluded that valid predictions could be made from the d.c. resistance of coatings. The use of d.c. has been criticised on the grounds that polarization would occur. In a recent paper it was shown that either d.c. or a.c. may be used with protective coatings of high impedence; however, d.c. measurements are simpler to make and this note is concerned with the number of ways in which this can be done.

Introduction

Accelerated tests for the prediticion of performance have been devised by numerous workers. Over 40 years ago Bacon, Smith & Rugg[1] measured the d.c. resistance of over 300 paint coatings and concluded that for good performance a coating should have a resistance of over 10^8 ohms/cm^2. Coatings having resistances in the range 10^6 - 10^8 ohms/cm^2 were unreliable and those whose resistances were below 10^6 ohms/cm^2 behaved poorly.

The use of a d.c. current has been criticised on the grounds that polarisation would occur during the measurement, a shortcoming that would be eliminated by the use of a.c.

This dilemma has now been resolved[2]. In a recent paper the resistances of a number of paints and varnishes, both in the form of free films and as coatings on mild steel, have been measured using a.c. and d.c. techniques. It was found that the resistances as measured by both techniques were the same for protective high impedance coatings, provided that the frequency of the a.c. was sufficiently low. No polarization resistance was detected.

When the resistance was sufficiently low for corrosion to occur the progress of corrosion could be followed by a.c. measurements and the resistance of the paint film separated from the polarization resistance of the corrosion process.

It follows that if one is concerned with the development of protective coatings then either a.c. or d.c. may be used, but d.c. measurements have the advantage of being quicker and the apparatus is less complicated and consequently less expensive. It is proposed, therefore, to review the d.c. methods available for the measurement of the resistance of supported and unsupported paint films.

The preparation of the films

The preparation of supported and unsupported films has been described in an earlier paper[2]. In brief, slightly abraded degreased mild steel panels, 10cm × 10cm × 0.2cm, were coated by means of spreader bars, allowed to dry, and 3 half cells attached by means of dow corning Silastic 738, which was allowed to cure for 2 days. The cells were then filled with 0.1 M KCl. The free films were prepared by casting the paint, or varnish, onto the adhesive side of gummed paper. After a suitable period the coated label was soaked in water, the film removed, dried and portions mounted between two half cells by means of Silastic 738; later the cells were filled with 0.1 M KCl.

In the case of supported films a simpler form of cell can be used. The half cells can be replaced by a short length of glass or plastic tubing, approximately 1cm. in diameter, fixed vertically by means of Silastic 738, or some other suitable compound, to the coated metal, which rests flat on the bench. The tube can then be filled with the solution and a Ag/AgCl electrode inserted, care being taken that the electrode does not touch the coating.

Methods of measurement

Three methods of measurement have been used.

The first was that used by Bacon, Smith & Rugg, which is based on the standard method for determining the internal resistance of a battery. The coated specimens, which were in the form of rods, were immersed and connected via a pH meter/potentiometer to a standard electrode, calomel or silver chloride, and the potential E_o measured. A known resistance R was then connected across the cell and the potential E_c determined. The resistance of the coating is then given by:

$$R\ ([E_o\text{-}E_c]/E_c)$$

This method cannot be used for the measurement of the resistance of detached films.

In the second method a potential E_1, preferably of the order of 1 volt, is applied to a known resistance R, which is connected in series with the painted specimen and the standard electrode and the potential drop E_2 across the known resistance measured by means of a pH meter/potentiometer. The resistance of the film is then given by:

$$R\ ([E_1\text{-}E_2]/E_2)$$

This method, which has been extensively used in Cambridge, can be used with both supported and unsupported films and maximum accuracy is obtained when the resistance R has a similar value to that of the film being measured.

The third method, which is the easiest to carry out, is the use of an electrometer. A suitable instrument, which is now used in Cambridge, is the Keithley, Model 610C, which can be used to measure resistances directly so that no calculation is necessary.

At the moment this is probably one of the best instruments to use in an intensive research programme, but quite satisfactory results can be obtained by the other methods in exploratory work.

A comparison of the results obtained by the three methods is given below.

Method	Substrate			
	Stainless Steel		Mild Steel	Free Film
B.S. & R.	9×10^{11}, 0.4×10^{9}		3.4×10^{4}, 6.5×10^{7}	—
Potential Drop	—	10^{9}	— 4.5×10^{7}	4.5×10^{7}
Direct	10^{12}	10^{9}	4.5×10^{4}, 6.0×10^{7}	6.5×10^{7}

Acknowledgement

The author wishes to thank Professor D. Hull for the provision of facilities, without which this work could not have been carried out.

References

1. Bacon, R. C., Smith, J. J. and Rugg, F. M., *Ind.Eng.Chem.*, 1948, **40,** 161.
2. Burstein, G. T., Gao, G. and Mayne, J. E. O., *JOCCA*, 1989, **72,** 407. ■

Amine synergy in UV curable coatings

by M. A. Johnson and K.T. Oldring*

Radcure Specialities, Inc. 9800 Bluegrass Parkway, Louisville, KY 40299 USA
* Thomas Swan & Co Ltd, Crookhall, Consett, Durham DH8 7ND, UK.

Abstract

The effects of amine synergy on cure rate were studied for an epoxy acrylate and an amine modified epoxy acrylate with various levels of alpha-cleavage and hydrogen abstraction photo-initiators using the new N101 UV Cure Tester for assessing rates of cure. It was shown that the amine modified epoxy acrylate gave faster cure rates than the unmodified one for both types of photo-initiator. Using a nitrogen atmosphere the effects of oxygen inhibition were studied for both systems and it was found that amines can contribute more than just oxygen scavenging for non-hydrogen abstracting photo-initiators.

Introduction

There are oligomers which are recognized as having enhanced cure speed through the presence of amine functionality compared to the oligomer from which they are derived. One such system is Ebecryl 3600 which is an amine containing Ebecryl 3700. Until now it has been tedious and difficult to measure the magnitude of this effect. The N101 UV Cure Tester is a new and novel technique for comparing cure rates easily and cost effectively. Typically commercial coatings use mixtures of photo-initiators and synergists. Thus it was decided to investigate the effects on cure rate of representatives of different classes of initiators with two similar oligomers believed to differ in reactivity, using the N101 UV Cure Tester. The effects of oxygen inhibition on these systems were also studied.

For a radiation curable coating to be converted to a commercially viable coating, it has to form a solid, tack-free, integral film upon exposure to radiation. For a UV curable coating this requires that the incident light causes one or more components of the coating to react and directly or indirectly cause polymerization of the bulk of the constituents present in the coating. In the case of conventional UV curable coatings (c.f. UV cationic systems) this is through the generation of free radicals from a photo-initiator system which then initiates polymerization through the carbon carbon double bonds present in the oligomers and monomers of the coating composition.

Traditionally photo-initiators are divided into two classes, viz;

(i) Photo abstractors (hydrogen acceptors)
(ii) Radical cleavers (photo fragmentors)

The two classes of photo-initiator are commonly believed to function by different mechanisms. Photo-abstractors depend upon the presence of a hydrogen donor molecule (co-initiator, synergist etc.) while photo-cleavers depend upon molecular structure to generate free radicals. It is commonly believed that for some photo-initiators both mechanisms can occur, but generally they are at different rates and one predominates. The two types of mechanism are outlined in Figures 1 and 2.

It is a common belief that different types of photo-initiator are required to obtain different types of optimum cure. An example is the use of a benzophenone system for surface cure and a radical cleaver for through cure. The situation is further complicated by the effect of oxygen upon the attainment of surface cure. The majority of UV curable systems are expected to give tack free films in the presence of air. It is well-known that oxygen inhibits free radical polymerisation and conventional UV curable systems are no exception. It is common practice for an amine to be included in a formulation along with increased photo-initiator levels to overcome the effects of oxygen inhibition. The mechanism of oxygen inhibition, oxygen scavenging, and mitigation of oxygen scavenging by amine are believed[1] to operate as shown in Figures 3 and 4.

Figure 1
Photocleavage initiators

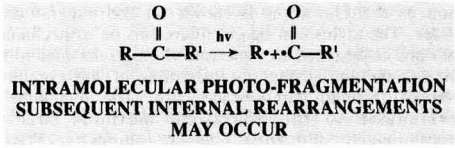


Figure 2
Photo-abstraction initiators

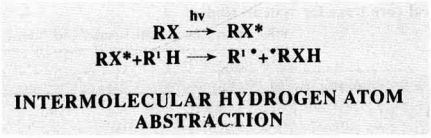


Figure 3
Oxygen inhibition reactions

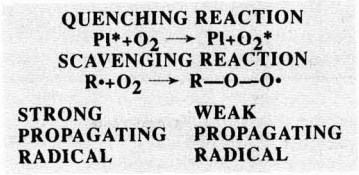
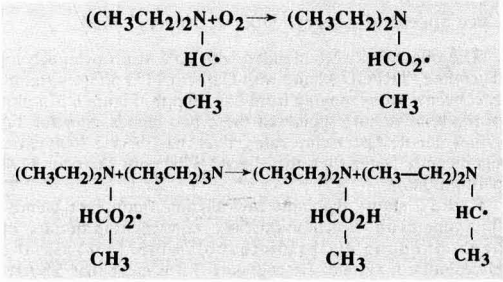


Figure 4
Amine synergy mechanism



Experimental

The oligomers used for these experiments were Ebecryl 3700 and Ebecryl 3600. Ebecryl 3700 is a diacrylated epoxy

resins based on bisphenol A, which provides fast cure, good gloss, and chemical resistance. Ebecryl 3600 is an amine modified 3700. Oligomers were blended with 30% TRPGDA. All products were from Radcure Specialities, Inc, Louisville, KY.

Photoinitiators representative of both photocleavage and photoabstraction mechanisms were used. Darocur 1173 (from E. M. Industries, Inc., Hawthrone, NY) was used as the photocleavage type. Benzophenone with a 1/1 molar ratio of methyldiethanolamine was used for the photoabstraction type. The substrate was Thames Carton Coat (a high quality filled carton board).

Drawdowns (nominal 6μ) were made manually using a #4 wire wound applicator.

Cure measurements were made using a N101 UV Cure Tester, from Thomas Swan & Co Ltd., Consett, Co Durham, England.

N101 UV cure tester

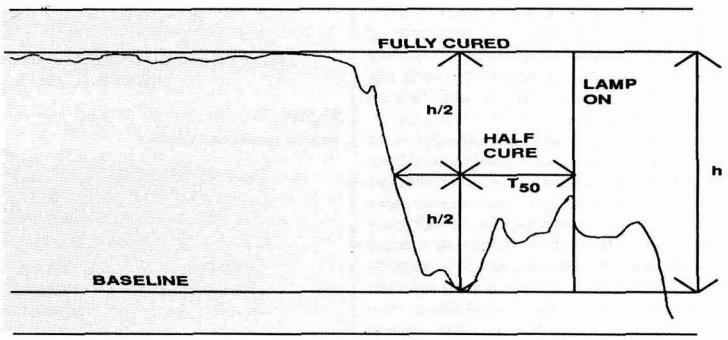
The cure tester operates by continuously measuring the resistance to motion of a stylus being propelled through the film while it is being irradiated. The variation in resistance to motion as the film cures is shown on the integral chart recorder. The stylus can be considered to be a mechanical thumb and is designed to penetrate through the film to the substrate, thereby giving an indication of the combined effects of through and surface cure. The technique is intermediate to the analytical methods such as photocalorimetry, differential scanning calorimetry, Fourier transform infrared, and dielectric constant measurements and the more practical thumb twist and MEK double rub tests. The N101 cure tester enables comparison of cure to be made under standardized conditions, and on substrates used in practice, thereby eliminating many of the unknowns frequently present when trying to compare cure rates

A temporary nitrogen purge was fitted to enable the effects of oxygen inhibition to be studied. It was found at a later date that the level of oxygen in this work was much higher than that expected or obtainable in the new N121 model with integral purge.

The cure tester has been described in more detail[2], as have the effects of substrate upon cure rate[3].

The chart recorder shows a measurement of the resistance to motion before and during irradiation and the variation in the trace represents a physical change in the film as it undergoes polymerization. The point at which the lamps are illuminated (in instant start mode) is taken as zero time. The assessment of cure rate is by determining significant events in the cure profile and measuring the time for these to occur. Depending upon the conditions of test, two types of traces are generally obtained. One type refers to a point at which the stylus rides up onto the surface of the cured film. The distance of this point from zero time is used as a measurement of cure time. For the other type, a plateau is reached on attainment of cure. The distance from zero time to half the total deflection (denoted T_{50}) may be used to compare cure between different systems. For the work reported here the latter measurement for comparison of cure was used. A typical trace for the systems studied is shown in Figure 5.

Figure 5
Typical cure trace for systems studied



Results and discussion
Cure Speeds of Ebecryl 3700 vs. Ebecryl 3600

The oligomers were blended with 30% tripropyleneglycol diacrylate (TRPGDA) and with Darocur 1173 photoinitiator, at concentrations ranging from 2 to 10 pph. Figure 6 is a plot of the relative cure speeds of these two blends. Smaller T_{50} values denote faster cure rates, thus the Ebecryl 3600 cures significantly faster than the ebecryl 3700 with Darocur 1173 photoinitiator.

Figure 7 shows the same two oligomer/monomer blends, this time with stoichiometrically equivalent amounts of benzophenone/methyldiethanolamine (1:1) as the photoinitiator system. From Figure 7 it is clear that Ebecryl 3600 cures significantly faster than Ebecryl 3700 under these conditions as well. Differences are most dramatic at the lowest photoinitiator concentrations, and are at least at the highest levels.

Figure 6
Eb 3600 vs. Eb 3700 — Darocur 1173

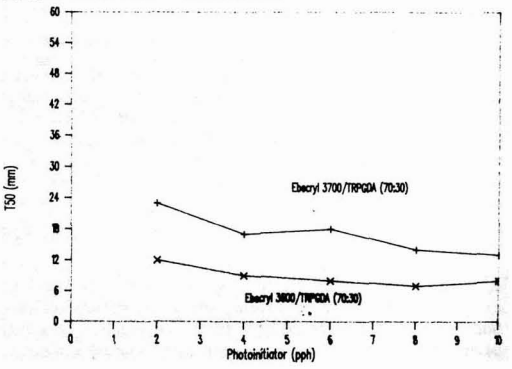


Figure 7
Eb 3600 vs. Eb 3700 — BP/MDEA

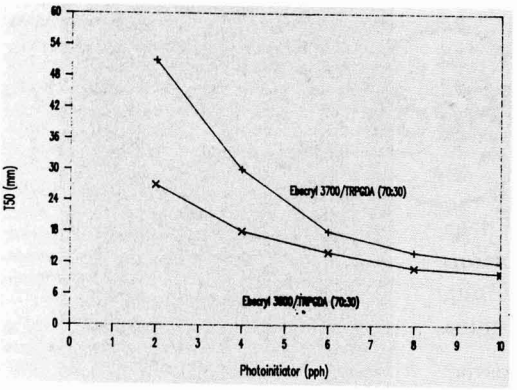


Table 1 contains all of the data for the relative cure speeds (T_{50} values) of Ebecryl 3600 vs. Ebecryl 3700 with each of the two photoinitiator systems. From Table 1 and Figures 6 and 7 it can be seen that Ebecryl 3600 is faster curing (smaller T_{50} values) with both the Darocur 1173 and benzophenone/amine photoinitiator systems. Additionally, Darocur 1173 is faster curing than the stoichiometrically equivalent amount of benzophenone/amine for both resin systems. this is clearly evident in Figures 8 and 9.

Table 1
Cure Rates* of Ebecryl 3600 vs. Ebecryl 3700

	pph photoinitiator (as Darocur 1173)				
	2	4	6	8	10
Darocur 1173	T_{50}(mm)				
Eb 3600	12	9	8	7	8
Eb 3700	23	17	18	14	13
Benzophenone/amine					
Eb 3600	27	18	14	11	10
Eb 3700	51	30	18	14	12

* Cure rates can be converted to time (sec) by multiplying the values by a factor of 2 (Standard chart speed of 3 cm/min. was used throughout).

Figure 8
Darocur 1173 vs. BP/MDEA — Eb 3700

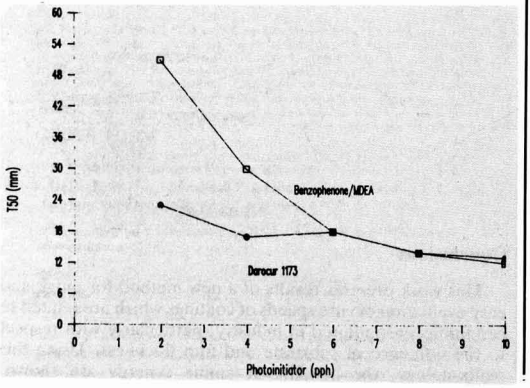


Figure 9
Darocur 1173 vs. BP/MDEA — Eb 3600

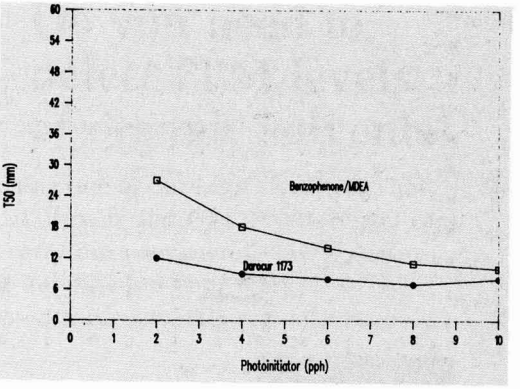


Table 2 contains data for the same comparisons of oligomers, this time under conditions of nitrogen inerting, intended to reduce the effects of oxygen inhibition.

With Ebecryl 3700/Darocur 1173 and nitrogen inerting, photoinitiator concentration effects are negligible. Cure speed is virtually independent of photoinitiator concentration in this system. This is in contrast to the air system, as shown in Figure 10. With Ebecryl 3600 and Darocur 1173 the differences with and without inerting are minimal, as shown in Figure 11.

Table 2
Cure Rates* of Ebecryl 3600 vs. Ebecryl 3700 under a Nitrogen Blanket

	pph photoinitiator (as Darocur 1173)				
	2	4	6	8	10
Darocur 1173	T_{50}(mm)				
Eb 3600	9	8	7	7	7
Eb 3700	9	10	10	9	9
Benzophenone/amine					
Eb 3600	26	15	13	12	10
Eb 3700	45	20	15	13	12

* Refer to Table 1.

Figure 10
Air vs. Nitrogen — D 1173 — Eb 3700

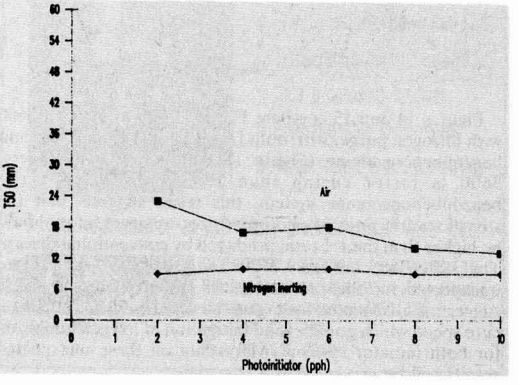
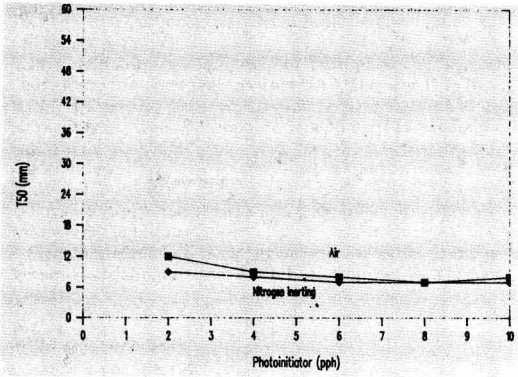


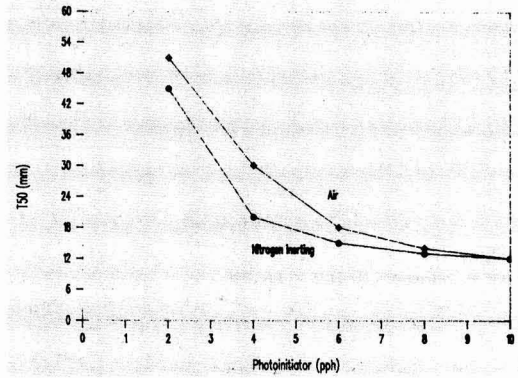
Figure 11
Air vs. Nitrogen — D 1173 — Eb 3600



For the benzophenone/amine systems, the differences between air and inerted atmosphere are similar or smaller than those found with the Darocur systems, as shown in Figures 12 and 13. Even so, for the amine-functional oligomer systems, cure speeds are again higher. However, in contrast to Darocur 1173, it can be seen that the cure rates are photoinitiator concentration dependent for benzophenone/amine systems under all test conditions.

Figures 10 through 13 illustrate that irrespective of the photoinitiator system the effects of air (oxygen) are minimized by using the amine functional Ebecryl 3600 rather than Ebecryl 3700.

Figure 12
Air vs. Nitrogen — BP/MDEA — Eb 3700



Figures 14 and 15 compare Ebecryl 3700 to Ebecryl 3600 with nitrogen purge, with both Darocur 1173 (Figure 14) and benzophenone/amine (Figure 15). In both cases, Ebecryl 3600 is faster curing than Ebecryl 3700. For the benzophenone/amine system, this result suggests that the stoichiometric ratio of photosensitizer to co-initiator should be higher than the 1:1 ratio predicted by conventional theory. The difference between 3600 and 3700 was even more unexpected for the radical cleaver system (Darocur 1173) suggesting that amine synergists have a beneficial effect on cure speed which goes beyond mitigation of oxygen inhibition for both initiator systems. More data on these unexpected results will be presented at a later date.

Figure 13
Air vs. Nitrogen — BP/MDEA — Eb 3600

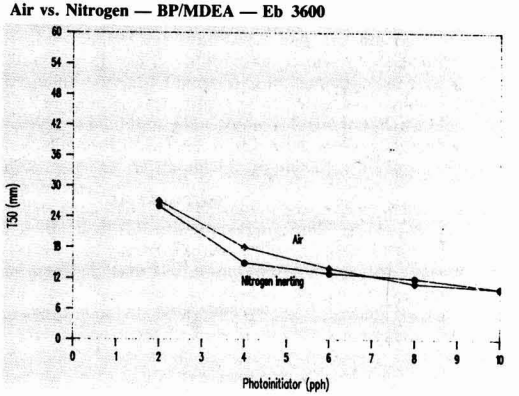


Figure 14
Eb 3600 vs. Eb 3700 — D 1173/Nitrogen

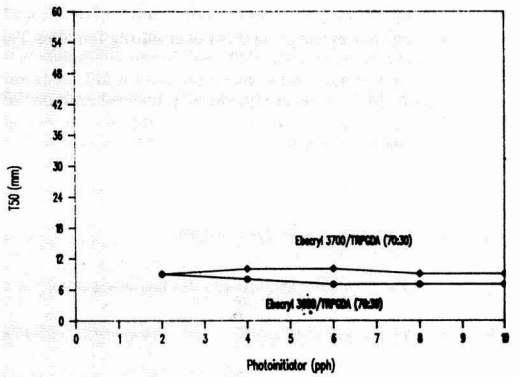
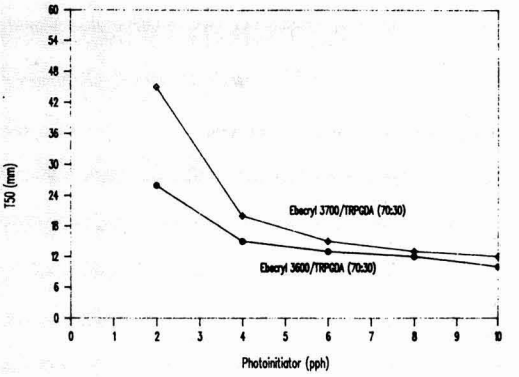
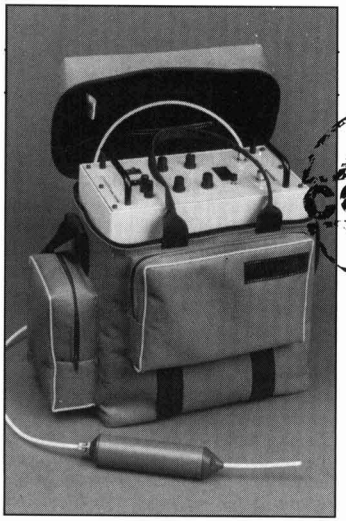


Figure 15
Eb 3600 vs. Eb 3700 — BP/MDEA/Nitrogen



Conclusions

This work presents results of a new method for quick and easy evaluation of cure speeds of coatings which are related to conditions encountered in industry, particularly with respect to the influence of substrate and film thickness. Using this methodology, the benefits of amine synergy are shown.



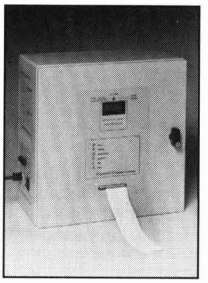
Do you need to detect PPM levels of organic solvents?

By using one of our high sensitivity, low cost, Toxic Vapour and Gas Detectors you can quickly carry out your own COSHH survey and find out whether your workplace complies with the COSHH regulations.

Solvector
A fully portable instrument for detecting hazardous gases and for COSHH assessments.

Droela
Fixed installation monitor with printout for COSHH records.

GC System
Gives unique response to one solvent or gas in the presence of others. Available for Solvector and Droela.



Cavendish
APPLIED TECHNOLOGY

Unit 24, Clifton Road,
Cambridge CB1 4ZD
Tel: 0223 - 210105. Fax: 0223 - 210712

Enter J706 on Reader Reply Card

Paint and Surface Coatings

Theory and Practice

OCCA BOOK SERVICES

Edited by R. LAMBOURNE, Technical Manager, INDCOLLAG (Industrial Colloid Advisory Group), Department of Physical Chemistry, University of Bristol.

696 pages; Published 1987; £84.30 (plus p&p UK £2; overseas £4 ASP, £7 airmail).

CONTRIBUTORS

D A Ansdell, Technical Manager, Automotive Products*
J Bentley, Senior Scientist, Research Department*
T R Bullett, Retired. Formerly Research Director, Paint Research Association, Teddington, Middx.
A Dorosiewski, Research Department*
F K Farkas, Consultant, FKF & Associates
J A Graystone, Technical Manager, Research Department*
R A Jeffs, Retired. Formerly with Research Department*.
W Jones, Research Department*
R Lambourne, University of Bristol.
A H Mawby, Director, Refinish Marketing, PPG Industries (UK) Ltd, Ladywood, Birmingham.
Miss J F Rolinson, European Technical Manager for Products and Materials*
T A Strivens, Senior Scientist, Research Department*
G P A Turner, Technical Manager, Industrial Coatings Research*

* ICI Paints Division, Slough

CONTENTS: Paint Composition and Applications—A General Introduction; Organic Film Formers; Pigments for Paints; Solvents, Thinners and Diluents; Additives for Paint; The Physical Chemistry of Dispersions; Particle Size and Size Measurement; The Industrial Paint Making Process; Coatings for Buildings; Automotive Paints; Automotive Refinish Paints; General Industrial Paints; An Introduction to Rheology; The Rheology of Paints; Mechanical Properties of Paints and Coatings; Appearance Qualities of Paint—Basic Concepts; Specification and Control of Appearance; Durability Testing.

Orders can be sent to the association by completing the form below and by **Prepayment** only

ORDER FORM

To: Oil and Colour Chemists Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF, UK

Please supply . . . . copy(ies) of **Paint and Surface Coatings** at £. . . .
£84.30 per copy (plus p&p UK £2; overseas £4 ASP, £7 airmail).

Cheques must be made payable to OCCA — Post with remittance to the above address

Name.....
Address.....
.....
.....
Telephone.....

BROOKFIELD VISCOMETERS

FOR YOUR SOLUTION TO A STICKY PROBLEM

BROOKFIELD LABORATORY VISCOMETERS AND ACCESSORIES CAN SOLVE ALL OF YOUR VISCOSITY MEASUREMENT PROBLEMS

- ☆ A variety of spindle geometries
- ☆ Sample volumes down to 0.5ml
- ☆ Temperature control to 300°C
- ☆ Data processing facilities
- ☆ Programmable viscometers
- ☆ Range from 0.5 to 1.6 x 10^9cps

To find your solution to your sticky problem contact Nigel Dixon

S&M

SCIENTIFIC & MEDICAL PRODUCTS LTD.
Shirley Institute, 856 Wilmslow Road, Didsbury, Manchester M20 8RX
Tel: 061-434 3466
Fax: 061-445 2943

Enter J705 on Reader Reply Card

Amine-modified acrylated expoxy resin cures faster than the corresponding acrylated epoxy oligomer without amine functionality. Reducing the oxygen content of the curing atmosphere by nitrogen purging improves cure rate of all systems, as would be predicted, but this expedient is less necessary with the amine functional products, attesting to the benefits of this material in mitigating oxygen inhibition. Finally, the nitrogen atmosphere data suggest that amine synergists of the type studied here enhance cure in addition to mitigation of oxygen inhibition, as evidenced by the sustained cure speed advantage of Ebecryl 3600 over Ebecryl 3700.

Acknowledgements

The authors wish to thank Mr Terry E. Moorehead for the conscientious manner in which he undertook the experimental studies, and also both companies for supporting this work.

References

1. Van Landuyt, D. C., "Practical Aspects of Thick Film UV Curing", *Journal of radiation curing,* July 1984, pp 4-8.
2. Nobbs, J. H., Duerden, D., and Oldring, P. K. T., "A Novel Method of Testing the Curing Properties of UV Coatings", presented at Radcure Europe '87, Munich, May 1987.
3. Nobbs, J. H., Guthrie, J. T., Oldring, P. K. T., and Duerden, D., 'Optimizing the Photoinitiator System in a UV Curable Coating Formulations", presented at Conference on radiation Curing Asia, 1988, in Japan. ■

Hilditch, E. A., continued from p.407

For the prosperity of the industry there must be both a change in the structure of the industry and a change in attitudes to long term investment of technology. Acceptance of this message may be slow in coming, meanwhile individual companies must decide their own level of development. The winners of the commercial battle will be those who invest most and most wisely.

None of these aspects of future R&D are peculiar to the wood preservation industry, much of the developed world is retreating from "technological wonders", mostly through lack of understanding.

Research Associations

Industry could "club" together through independent research associations. This could be a sensible way forward but it would have to start from basics for no British research association has any real expertise in wood preservation (several fringe on the subject).

Better understanding

If wood preservation is to prosper, if wood is to prosper, then, having established a scientific base that is sound and able to withstand challenge, the world must be told. the customer must be convinced.

Today is the age of "PR", the scientific message must be packaged by the professionals, for it to be understood there must be adeqeuate basis of knowledge and understanding. In matters of science, all too often this does not exist. It will only come with more education on environmental and chemical matters in the country as a whole, starting in the schools but extending to adults. The level of chemical education in schools is a national problem[6]. There is a shortage of scientists both to teach and for research. More than just wood preservation is affected by this problem.

Putting it all together we have a vicious circle. The future of the wood preservation industry lies in the hands of the present industry. Nothing will happen by magic, or by faith alone nor by hoping that the problems will go away.

Attitudes

Through these routes we must encourage a more rational public attitude, but industry must also change its attitudes on environmental matters.

There are "three ages" of reaction to environmental concern:

1. Low profile, ("not real", "will go away").
2. React and cure.
3. Evaluate, anticipate and prevent.

Few industries have yet grown up.

Market impact

How will all these factors affect the future market?

The best scenario is that the present problems will be overcome, confidence retained, technical and other advances made. Then the moderate but steady growth of the last decade will continue.

The worst scenario is that failure to combat environmental and health concern will lead to a decline, with stabilisation at some lower level.

In any decline, pretreatment is likely to be affected least, retaining heavy duty and window joinery markets but with a reduction in general use on building timbers. Remedial may well be most effected. Building Societies no longer requiring treatment "as a matter of course" and most decay eradication using only building methods to eliminate dampness and replacement with pretreated timber, neither of these needing a specialist industry. DIY is the most difficult to predict, most susceptible to media pressure but with any real hazard minimised by small, infrequent use. I predict short term fall with slow recovery as better understanding and improved products come about.

Conclusions

If the wood preservation industry is to progress into the next century on a sound, prosperous base there need to be changes in public understanding, a change in the commercial profile of the industry and a fundamental change in attitudes to and investment in the technical basis of the industry.

Remember, the seed is scientific knowledge, the sower is publicity, the ground is only as fertile as it is knowledgable and the crop is prosperity.

"Just in Time" is a good philosophy in it's place, but only when well planned, with all time scales defined. Industry is already suffering, going forward takes a lot of preparation and time, let us not be "just too late".

References

1. British Patent 7731-1838.
2. BS 5707.
3. BS 4072.
4. For further details of present practice see: Timber Preservation published jointly by TRADA & BWPA or BRE publications.
5. The Control of Pesticides Regulations 1986 SI 1986 No 1510.
6. Environment Education from 5 to 16: HMSO 1989. ■

Paper presented at PRA Symposium — "The Protection and Maintenance of Building Materials", London, 1989.

Infra red means go for energy efficiency

by P. G. Heslop, Pilkington Energy Advisors Ltd, Prescot Road, St Helens WA10 3TT, UK

"A haemorrhage of cash which industry cannot afford" – that is how John Banham, Director of the CBI, described the amount of energy being wasted in the UK today. He made the comment prior to an infra red aerial survey of the Swansea business area which the CBI were co-funding and which was designed to make visible the otherwise unseen heat losses which were taking place.

Everyone, whether in industry, commerce or the home, uses energy for space heating. It also powers many industrial processes. The opportunities for waste are everywhere. In fact, some 20% of the country's energy demand is lost by inefficient use and, as this wastage often occurs unseen, it is frequently ignored.

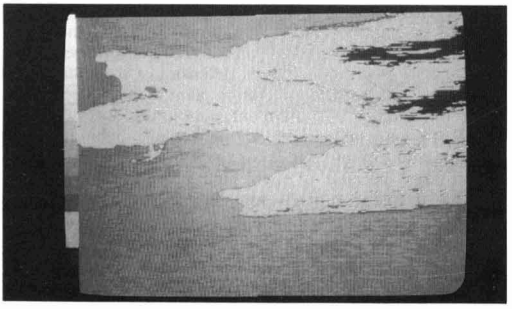
The use of infra red thermography is set to change all that. An infra red thermogram of heat loss can have a most salutary effect. To see waste actually occurring because insulation is missing or a concealed pipe leaking a hot liquid into the surrounding earth is a great motivator towards a better management regime.

The power of infra red thermography to reveal this on the scale that it does has taken even its proponents by surprise. As industrialists and others have read about the uses of remote surveying by infra red cameras, they have asked for help on a range and scale of problems which the developers of the technique had neither conceived nor imagined.

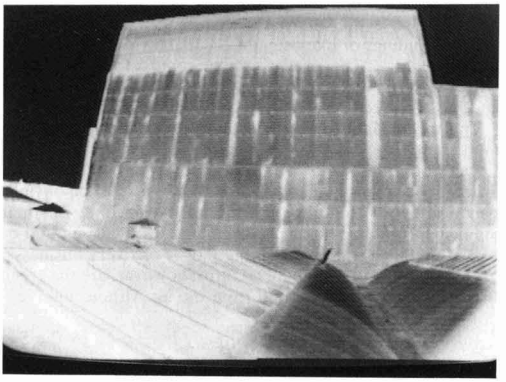
Even as the notorious oil spill in Prince William Sound was spreading, it was tracked with infra red cameras and the images assessed to show the thickest areas. This information played an essential role in containing the disastrous effects. It also meant that the clean up operation could continue around the clock since the cameras operate independently of visible light.

This article aims to demonstrate a few of the more important applications to date of infra red remote sensing technology; to indicate its versatility and its extreme sensitivity in measuring heat loss. What is certain is that there are many more problems which can benefit from infra red surveying techniques – they have yet to come to the notice of those offering the service.

Traditionally, to demonstrate heat loss within the confines of a single business, or even a single process plant, an accurate energy audit is required. The conventional audit takes time and money. Time because measurements have to be made. Money because measuring equipment may have to be bought or hired, a consultant may have to be employed or a member of staff's time paid for. At the end of it all, the audit will look like a financial accounting report with none of the dramatic impact of actually being able to see the wastage taking place.



Colourised (printed B & W) aerial thermal image of oil spill on water. The light grey and black areas are the oil on the water.



Thermal image of large building. White areas are hot (i.e. emitting heat), dark areas are cold. White areas therefore show inadequate or missing insulation.

Infra red cameras are made by Barr and Stroud, a Pilkington Glass subsidiary, but it is Pilkington Energy Advisors Ltd (PEAL) who have developed their use as a means of studying hot and cold areas in business premises.

As an energy management tool, infra red imagery can detect heat leakage from plant processes, pipelines or buildings. A building can be inspected after a contractor has insulated it to prove that the insulation has been carried out correctly and to the required specifications. The results are available in any video format or as still photographs. Sophisticated image processing colouring analysis is used in interpreting and quantifying the data.

In practice an engineer operates the camera on a daily basis. He studies all or part of the premises as required. For more extensive surveys the camera can be operated from an aeroplane or even call on satellite images and these last two extensions of use, together with the interpretation of results, are proving of enormous value in a wide diversity of application.

An excellent example, of the sensitivity of the technique and the speed with which results can be made available, occurred when it became known that central government was to withdraw its roof insulation grant. The City of Cambridge Council felt all uninsulated lofts should be dealt with urgently in order to take advantage of the available finance. But, with only a small staff to determine which premises needed attention and with time running out, the council had a large problem.

PEAL agreed to undertake an aerial survey of the whole city. Even from the air they could clearly identify which individual houses required insulating.

Although the older houses were the most likely candidates, supposition alone is not sufficient grounds for grant applications – some kind of inspection was required which could be accepted by the central authorities to support the claim. The evidence of the survey was used successfully to claim grants towards loft insulation for those houses which needed it.

Not only can data from aircraft be handled, measurements can even be taken from satellite photographs. Of course these are not able to show the condition of individual buildings but are good enough to show the relationship between individual cities and the industrial areas within them. A league table is now possible of UK towns, in terms of energy waste, at the same time of the day. Whilst this may be fascinating, of more practical use is the information which can be compiled of similar buildings of like use and occupancy in different parts of the country. The results can be compared and studied. Differences in building performance will need explanation and, possibly, remedial action.

This mixing and matching of results – known in the trade as multi sampling strategy – is clearly a pretty powerful tool. Local authorities, with their widely separate buildings, with different occupancy times and disparate uses must be obvious beneficiaries of this type of technical advance. Even their municipal rubbish tips can be examined for heat build up or loss of methane if they are in the biogas recovery business.

One of the most intriguing features, however, are the green issues which can be explored from the air without intervention and actual disturbance.

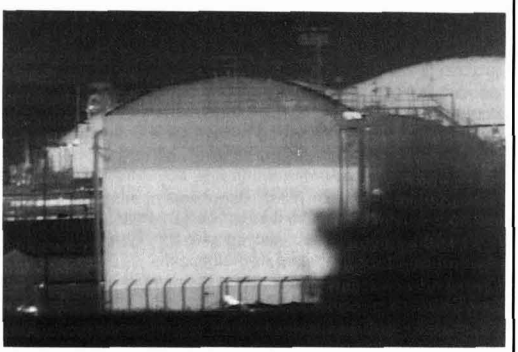
Infra red thermography has already been used by the Sea Mammal Research Unit on the east coast to carry out a population census of seals and to provide data on their state of health. The London borough of Elm Bridge has commissioned a land use classification study utilising ground, airborne and satellite data in certain urban areas in order to decide whether the micro climate is appropriate to building, recreation or other uses and to establish stress on or vigour of local vegetation.

Despite all this, aerial energy surveys cannot provide the detailed information which an energy manager needs. For this a competent engineer must survey the site at ground level using a hand held camera. In this way, surveys of even vast industrial complexes can be made with precision and accuracy within a matter of hours when more traditional methods might take weeks.

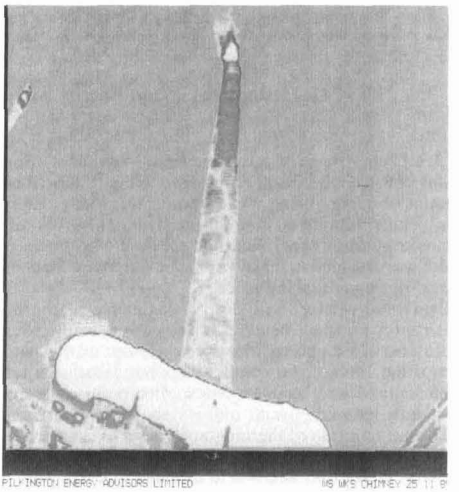
Sites difficult to access – such as those which meant erecting scaffolding, etc – can now be surveyed from ground level. The resulting thermographic pictures show in the most graphic way where waste is occurring. Such visual presentations can galvanise management into urgent action.

A follow up picture after remedial steps have been taken is early evidence that energy is being saved. It also avoids the need to wait for confirmation by carrying out an audit in a more conventional way.

It is the computer programmes which PEAL have developed to interpret the images recorded by the cameras which make all this possible. Not only can heat be seen to be escaping, but just how much is being lost can be measured.



Thermal image of storage tank. The level of liquid in the storage tank can clearly be seen.



Computer colourised (printed B & W) thermal image of a chimney stack. A large crack can be seen running vertically with the lower part of the chimney.

A most valuable refinement to the technique is the use of telescopic lenses. These enable the cameras to be focussed on isolated and specific areas, thus allowing a detailed examination of the subject to be built up bit by bit.

Fluctuations in heat emissions during different stages of a process can be followed accurately by continuous recording. Heat loss variation, as different process events occur, can be accurately determined. This is particularly easily seen when the survey is recorded on video.

Checking the integrity of insulation on large industrial vessels can be done extremely quickly by using infra red techniques. Oil storage vessels are a good example as they are kept warm to prevent the contents from becoming too viscous. Achieving a constant temperature throughout the tank can be a problem, especially if very large volumes are involved.

The correct thickness of insulation plus uniform heating is clearly vital. Should the insulation deteriorate, cold spots may develop which will upset the energy balance, resulting in inefficiency and waste – interference with the factory processes is even possible. Regular surveys with a hand held camera will identify potential problems and action may be taken before they develop.

Similar situations are encountered in low temperature vessels such as fermentation tanks found in breweries. When the insulation of these vessels deteriorates it creates a hot spot. The load on the refrigeration plant then goes up – along with the energy bill. Fermentation tanks are subject to condensation problems. This takes place behind the insulation and cannot be seen – except by the infra red lens.

Furnaces, because of their high operating temperature, provide dramatic subjects for study by infra red thermography. Leaking doors stand out, as do cracks in the furnace structure. The furnace does not lend itself to easy physical or visual inspection because of its high temperature. Remote infra red surveying is probably the only satisfactory answer. The correct thermal balance of a furnace depends on an efficient chimney – a leaking chimney means that a furnace is not operating as efficiently as it might. It may not be easy to see a chimney crack, or indeed the effect it is having, but an

infra red survey will show that cold air is being drawn into the chimney and affecting the draught.

Stenters, which have large energy needs, are widely used in textile finishing. It is very important to the manufacturer that they should be operated to give the best possible product finish. It is also important to his profitability that a weather eye is kept on just how much energy is being used – and, indeed, how much might be saved.

One large manufacturer of textiles, based in the north east of England, found the annual cost of gas for drying and finishing exceeded £260 k. Various energy saving measures reduced this to £180 k. These measures came about as a result of targetting and monitoring procedures and an energy efficiency programme.

It is interesting to speculate as to the colourful thermal images the stenters were producing before an enlightened management took control, compared with how they look today. How many stenters in other parts of the country are currently producing exactly the same picture of unnecessary heat loss, one wonders.

Equally impressive results have been obtained using infra red cameras in commercial buildings – sometimes in a most creative way. The new building housing the Burrell Collection in Glasgow has a complex roof shape which, unfortunately, leaked. The major problem was not dealing with the leakage but discovering where water was actually penetrating the roof. An infra red survey was able to do this as the cameras clearly showed the damp patches and the route taken by the rain water.

Most of us, however, work in the less glamorous environment of the factory floor. Here infra red surveys are extremely suitable for routine site surveys – for instance, quick inspections can be made of steam service pipes. Many problems which slowly get worse, but which may be overlooked because the steady deterioration is not recognised, tend to show up in such surveys. A series of visual records will, over a period of time, show progressive deterioration of parts of plant which might otherwise go undetected until some serious failure occurs. Being able to anticipate trouble of this type is a major strength of management using infra red.

Remote surveying is a fast emerging technology which will surely play a very significant role in the 1990s and beyond. At present the only limit to its use appears to be man's own imagination.

The applications discussed in this article probably only scratch the surface of what infra red imagery can do for energy efficiency. We may not as yet have felt the full impact of the crisis in the Gulf but, whatever the outcome, the episode will serve as a reminder of how volatile the fuel supply situation can be and how vulnerable we all are.

Not so long ago we were looking forward to the "peace benefit" as a consequence of taking down the Berlin Wall. Now the threat of rising oil prices is compounded by high interest rates. Only one thing is certain – every reduction of one pound from the energy bill is another pound in the profit account. Never has there been a more appropriate moment for individual firms to take a closer look at their energy bills. ■

The sixteenth International conference in Organic Coatings Science and Technology

Almost a hundred delegates attended the sixteenth 'Athens' Conference which was held from 9 to 13 July to hear 32 invited papers, 4 contributed papers and one short communication. As usual the papers presented were of high quality and they prompted much discussion. Notable reviews were given by Dr. S. Ishikura of Nippon Paint on the uses of microgels in coatings, by Dr. P. J. Palackdharry of the Dexter Corporation on non-PVC based coatings for the rigid packaging industry and by Dr. A. B. J. Rodrigues of Du Pont on instrumental colour matching. This latter review was particularly interesting since it clearly illustrated how an understanding of the operation of a human eye can lead to improved instrument design. Nevertheless, it seems that instrumentation will never replace human observation and that successful colour matching will always require a combination of the two methods. The key is to recognise the strengths of instrumentation and to capitalise on them. This is true, of course, for all instrumentation and this point was illustrated by several speakers who between them described a wide array of techniques which can be used to study cure reactions, to characterise materials and to predict performance characteristics of coatings.

The paper by Dr. E Maze of Akzo Coatings SA, for example, described how preprime steel sheet has been developed for use in the automotive industry by making use of dynamic mechanical analysis, electrochemical impedance spectroscopy, cathodic delamination, coulometry and surface profile measurements. Other 'technique' orientated papers were given by: Dr. C. Carr of the PRA who described the use of FT-IR, extended x-ray absorption fine structure analysis (EXAFS) and small angle x-ray scattering (SAXS) in studies of the curing of alkyd films; Dr. D. Y. Perera of CORI who discussed stress development in coatings and showed how it can be measured using the CORI stressmeter; by Dr. A. F. M. J. Van de Ploeg of DSM Resins BV who vividly illustrated the use of ^{13}C-NMR in studying reaction paths; Dr. R. B. Prime of IBM who reported an application of time-temperature superposition techniques for the characterisation and control of cure processes; Dr. A. Roche of Claude Bernard University, Lyon who described how the adhesion of organic coatings to metal substrates can be studied using XRFS, LEEIXS, XPS, AES, ISS, XRD, EMPA, SEM, GDOS in addition to more conventional techniques; Dr. N. Thomas of ICI Resins who discussed the failure mechanisms of coatings on rusted mild steel which are consistent with data obtained by XRD, SEM, TEM and electron probe x-ray microanalysis; and by Professor M. W. Urban of North Dakota State University. Professor Urban gave a superb lecture on the use of various surface sensitive methods which can be used in conjunction with FT-IR spectroscopy. In particular, the use of photoacoustic detection for monitoring cure in surface coatings offers many advantages over more conventional methods.

Advances in instrumentation have also had a marked effect on the depth to which rheological behaviour can be studied. This was illustrated by two papers. First Dr. M. Breucker of Herberts GmbH described his investigations on the rheological behaviour of aqueous polymer dispersions using a controlled strain rheometer and, second, Dr. R. Buerstinghaus of BASF discussed the relevant rheological characterisation of waterborne metallic basecoats using a controlled stress rheometer. Methods for the reduction of costs will always be important and three papers were given which described how savings can be made. First, Dr. D. C. Adams of Crown Berger Europe described how a second generation of 'tubular reactor' will give substantially increased productivity for vinyl acetate homopolymer and copolymer production. Second, Mr C. Apostolakis of Chromolac SA reported how the TiO_2 content of emulsion paints can be reduced by up to 20% using proper reformulation and, third, Dr. J. H. Braun of Du Pont proposed a new method which can be used to measure the catalytic effect of TiO_2 pigment on the degradation of coatings. The new method should allow faster durability testing.

There is always interest in new materials and the papers by Dr. J. A. Antonelli of Du Pont and Dr. W. Rutsch of Ciba-Geigy generated a great deal of interest. Dr. Antonelli described how methacrylate macromonomers, prepared by group transfer polymerisation, can be used in the production of non-aqueous dispersions which give improved rheological control and appearance in acrylic/melamine clearcoat formulations. Dr Rutsch presented data which showed how new photoinitiators can be used for optimal performance in printing ink applications, in electronic resists and in the curing of thick sections. The proper design of polymer molecules for optimal performance is vital. Therefore, the paper presented by Professor F. Ciardelli prompted much discussion. Professor Ciardelli described how functional acrylic copolymers possessing high degrees of functionality and narrow molecular weight distributions, can be prepared using functionalised initiators and chain transfer agents. Also, how polyolefins can be modified to improve their suitability for painting. Dr. R. J. Clemens of Eastman Chemical Company described acetoacetylated resins which can be used to advantage in the formulation of ambient curing coatings and Dr. G. C. Fettis of the University of York reported the synthesis of a novel oxazoline modified acrylate monomer which can be used in the formulation of high solids coatings.

The crosslinking theme continued in presentations by: Dr. A. Mercurio of Rohm and Haas who discussed the use of hydroxyamide crosslinkers in both polyester powder coatings and waterborne acrylic formulations; Dr H. Oshikubo of Hitachi Chemical Co who reported a new water soluble amino resin for coatings, a spiroguanamine; Dr. R. G. Lees of American Cyanamid who described two new crosslinkers for powder coatings, a new aliphatic, blocked isocyanate and a tetramethoxymethyl glycoluril: and, Dr. R. K. Pinschmidt of Air Products who reported new vinyl substituted cyclic hemiacetals which can be used as efficient crosslinkers for emulsion copolymers.

Several papers dealt with powder coatings in one way or another. Those which described crosslinking reactions have already been mentioned. However, an interesting paper by Dr. A. F. M. J. Van der Ploeg of DSM Resins described how the flow properties of powder coatings can be improved via control of the curing chemistry using suitable catalysts. Dr. Van der Ploeg also described how triboapplication characteristics can be improved using suitable additives without adversely affecting the curing profile or flow behaviour. The final paper on powder coatings was given by Dr. W. Sietses of Sigmas Coatings BV. Dr. Sietses reported on a new generation of powder coatings based on

PVDF. The new powders possess good application characteristics and give excellent weatherability and corrosion resistance.

From the brief comments given above on the many papers presented at the conference it can be seen that the meeting was a very interesting one indeed. Of all the papers, however, the most significant paper was probably that given by Dr. Kenneth Hoy of Union Carbide. Dr Hoy's paper was entitled: "Super critical fluid spray application technology, a pollution prevention technology for the future". The use of supercritical carbon dioxide allows the reduction of up to 70% of the solvent normally required for the application of spray applied coatings. Thus, it is now possible to formulate conventional coatings for spray application whilst meeting current VOC requirements and retaining their inherent performance advantages. The new technology can also be applied to two-pack systems and to waterborne coatings, an interesting development you will agree.

T. Corner
Group Research Manager
Coates Brothers ■

R & P Show, continued from p.412

WORLEE-CHEMIE will exhibit mainly: Worleesol and Worleepol – latest lab work with water thinnable, air drying and stoving paints based on alkyd resins and oil free saturated polyesters. Worleekyd C 622 hs and 743 hs – for high solids stoving paints. Worleekyd B 865 UL, 55% ws – new aliphatic urethane modified long oil alkyd with good yellowing, gloss and outdoor resistance. Worleekyd and Worleethix – liquid and thixotropic alkyd resins in aromatic frec solvents for decorative and industrial paints. Worleedur H 80 – low viscous, solvent free, aliphatic polyamine hardener for epoxy coatings. Worleecryl-and Zinpol – the newest development from Zinchem USA and Worlee for water thinnable printing inks and overlays will be introduced. Worlee-Add, Worleecat and Resiflow – the whole range of powder coating additives will be demonstrated.

For further information Enter J438

For further information on the Exhibition contact: Joan Ridge, Resins & Pigments 90, Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS, UK. Tel: 0737 768611. Tlx: 948669. Fax: 0737 761685.

For further information on the PRA Conference contact: Dip Dasgupta, The Paint Research Association, Waldegrave Road, Teddington, Middlesex TW11 8LD, UK. Tel: 081-977 4427. Tlx: 928720. Fax: 081-943 4705.

Natal Section Debate (L to R): Pat Draper (Chairman), Charles Simpson, Peter McCullum, Bill Mexson, Dick Philbrick, Colin Maytom and Ken Piggott.

Natal Section

Paint manufacturers and raw materials suppliers – profitable partners

Profitable partners need each other! This was stated at a well attended OCCA Natal meeting under the chairmanship of Mr Pat Draper held at the MBA Centre Westville on 19 June 1990.

While the debate might have ended in a draw, the frankness of the discussion gave a deeper meaning to the need of partnership between paint manufacturers and raw material suppliers.

Mr Charles Simpson of Revertex spoke of the relationship that does exist with bonds of trust and loyalty between the two partners. The suppliers do invest heavily to help and give freely to help their customers.

Mr Colin Maytom of Plascon Paints stated that the manufacturers hold stocks of a wide variety of raw materials. These raw materials form a large proportion of the total stock holding. Mr Maytom discussed local and imported costs and criticised the suppliers for basing the price of locally sourced raw materials on the London Metal Exchange to the detriment of the manufacturer. Also the advertising costs are borne by the manufacturer and this benefits both partners.

Mr Peter McCullum of Witney Chemicals said that partnership results in profit for both parties. The suppliers can effect economy in scale to the benefit of the small and large manufacturer. Information is expensive and the supplier gives this freely. The supplier frequently works on slender margins. He ended by stating that life without an agent can be very expensive.

Mr Dick Philbrick of Dekro Paints discussed his perception of the suppliers to small manufacturers like his own. The suppliers sometimes show a take it or leave it attitude and adopt a low profile to the small manufacturer. However where there is competition there is good representation.

Mr Bill Mexson of Lewis and Everitt said that his first reaction is that the relationship is profitable for both parties. However he criticised the secrecy and lack of two-way communication between the partners. Changes in new products and new sources of raw materials can leave the supplier holding expensive dead stocks. Manufacturers are moving away from direct indenting to expecting the suppliers to carry stock for "just in time" delivery but are tardy in helping to bridge the extra costs involved. Sanctions had also resulted in higher prices for alternative raw materials. Better communications would lead to better understanding with benefits to all concerned.

Have the parties lost respect for each other asked Mr Ken Piggott of AECI Paints? He said that the most important part of the relationship is for the parties to build a stable and mutually profitable partnership with each other. There is friction between the supplier and the manufacturer and this must be overcome to have a profitable partnership.

Some interesting points from the floor covered phrases like "sole suppliers", "cartels do exist", "need for better communication", "fickle end user" and "paint-free developments". The vote of thanks for an enthusiastic debate was proposed by Mr Robin Archer. He also thanked the sponsors for helping to make an enjoyable evening.

E Puterman ■

▷▷▷

High solids (saturated polyester and alkyds)

The need to develop higher solids coatings to reduce the volatile organic content (VOC) was the theme of an interesting lecture presented by Mr Richard Adams of Amoco Chemical Company to an OCCA Natal meeting. This meeting was held on 4 July 1990 at the MBA Centre, Westville.

The first part of the lecture dealt with the development of high solids two component polyester urethane coatings for plastics. These urethane coatings will air-dry or cure at low temperatures and are therefore ideally suited for heat-sensitive thermoplastics. The resin system, based upon isophthalic acid, offers the required balance of flexibility and hardness required for the coating of plastics. This type of coating is suitable for automotive, business machine and general industrial plastics.

Three polyester urethane coatings were prepared together with an acrylic coating as the control. The coatings were applied over four thermoplastic substrates and the application and test results were discussed by Mr Adams. These tests covered VOC, crosshatch adhesion, gloss, water immersion, blister rating, acid spot resistance, flexibility, gasoline and stain resistance, elongation, abrasion, impact resistance at ambient and low temperature and QUV exposure. The polyester urethane coatings offered the balance of flexibility and hardness that coatings for plastics require and also meet or exceed the relevant automotive specifications. The polyester urethane coatings also have a lower VOC when compared to the acrylic coatings.

Mr Adams then discussed an experimental low VOC airdrying alkyd which when compounded into a coating will meet the VOC restrictions covering solvent emissions in many states of the USA.

The resin is a styrene/acrylic grafted alkyd (isophthalic acid and maleic anhydride) and a chain transfer agent to control excessive molecular weight build and prevent the formation of a high viscosity resin.

One effective tool which is often used to achieve significantly lower VOC coatings is a reactive diluent based on trimellitic anhydride.

Intended for an industrial type application, a coating formulated from this resin affords the applicator such properties as lower VOC, fast dry time, good adhesion, flexibility, impact resistance and high gloss.

Mr M Eveleigh proposed the vote of thanks to Mr Adams for a stimulating lecture and also thanked the hosts, Lewis and Everitt, for sponsoring the meeting.

E Puterman ■

Ontario Section

Canadian chemical industry regulations

CEPA and TSCA; DSL, NDSL and PDSL; CAS, MSDS and LC_{50}; NOx, VOC, and finally LRTAP: to his great credit, Mr Robert Kennedy of BASF Coatings & Inks Canada Ltd made all of these terms intelligible when he addressed the technical meeting of the Ontario Section on 24 April 1990. (This review of the meeting has no such ambitions!)

Firstly, CEPA: according to Mr Kennedy, the Canadian Environmental Protection Act states that, subject to certain conditions, no "new" substance will be allowed to be manufactured, imported or used without prior notification and assessment. The early stages of implementation, which began in 1988 and are still in progress, involve identifying substances that are not new. These will appear on one of the following lists:

- ☐ Domestic Substances List (DSL): substances in manufacture or commerce during the years 1984, 1985 and 1986;
- ☐ Non-Domestic Substances List (NDSL): substances on the US Toxic Substances Control Act (TSCA) list of 1985, except for biotechnology products and substances already on the DSL.

Any substance that is not on one of these two lists is, by definition, a "New Substance". The speaker explained in detail the requirements for notifying the government of the intention to manufacture or import a New Substance or a product containing a New Substance, as of 1 February 1991. There are various levels of notification (Schedules I, II and III), each having its own "package" of required data and timing. The appropriate Schedule is to be selected on the basis of several criteria including annual and cumulative volumes, whether the substance is to be used domestically or only exported, and whether it is to be used in commerce or only in research.

Mr Kennedy noted that the period from 1 January, 1987 to 30 January, 1991 is not covered by the above timetable for listing substances which are not new and reporting those which are. This gap and any omissions from the Provisional DSL are to be filled by the Transitional Substances List, which has its own reporting requirements and timetable.

Secondly, Mr Kennedy informed the meeting of the Federal/Provincial steering committee which is addressing the subject of LTRAP — the Long Range Transport of Air Pollutants. He tabled a draft first edition (March 1990) of this group's "Management Plan for Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOCs)". The plan targets certain industries and other alleged pollution sources for evaluation and action under various timed Initiatives, many of which are aimed at specific sectors of the manufacture and application of paints, printing inks and resins as well as solvents.

In conclusion, Mr Kennedy urged his listeners to be as fully informed as possible about both current and proposed regulations and restrictions, and to make every effort to ensure that these are designed with industry input and with at least some measure of rationality.

After answering a number of concerned questions, the speaker was thanked on behalf of the Section by Chairman Doug Pratt. Mr Pratt closed the meeting by reminding members to be sure to attend the final technical meeting of the session on 16 May 1990.

J. F. Ambury ■

OCCA News

News of Members

Painter-Stainers' Exhibition

On 16 and 17 July, the Worshipful Company of Painter-Stainers held an exhibition of painting and sculpture by 32 Liverymen and Freemen of the company at their Hall in the City of London.

This was the first time in its long history that the company had mounted an exhibition where the exhibits could be purchased. The last major exhibitions of work, at which sales were not permitted, took place over a century ago and were abandoned after a few years. However, since the company introduced a prize-giving ceremony in 1967 at which 40 awards are presented annually, there hasbeen a presented annually, there has been a substantial increase in the number desire for the more comprehensive exhibition mounted this year.

Robert Hamblin (Honorary Member and former OCCA Director & Secretary) was invited to be present at the Opening Ceremony by the Master of the Painter-Stainers Company.

Professional Grade

At the meeting of the Professional Grade Committee held on 14 June 1990 the following admissions were made:

Admitted to Associateship through approved affiliated body

Ellen, Christopher Maurice *(Wellington)*
Stratmore, John Benson *(Wellington)*

Transferred to Fellowship through approved affiliated body:

Dalzell, Kerry Wayne *(Wellington)*
Greenall, Brian John *(Wellington)*

New Members

Ordinary members

Alvey, C. E., BSc, PhD *(Transvaal)*
Anderson, D. C. *(Natal)*
Boucher, S. M. *(Natal)*
Briand, R., BSc *(General Overseas – Canada)*
Brooklyn, G. *(Cape)*
Bauman, P. J. *(Transvaal)*
Holtby, N. W. *(London)*
Kerbel, A. S. *(Cape)*
Loukidis, D. *(Transvaal)*
Macdonald, M. C. *(Transvaal)*
Mullineux, C. R. *(Cape)*
Pugh, R. L., BSc *(London)*
Rowbotham, N. *(Manchester)*
Scamell, B. A. *(London)*
Steinke, A. P., BSc *(Natal)*
Swanepoel, F. S., BSc *(Cape)*
Wray, J. R. *(Transvaal)*

Associate members

Galbraith, W. R., MA *(Scotland)*
Kelly, S., BSc, PhD *(London)*
Webel, P. *(Natal)*

Registered student

Zomorrodian, M. R. *(General Overseas – Iran)*

■

BSI Committees

Representatives are sought on the following Committees:

British Standards Institution:
PVC/1/5 Red Lead Pigments.
PVC/1/10 Miscellaneous Pigments.
PVC/27/1 Organic Finishes for Aluminium.
PVC/27/-/3 Zinc Phosphate and MIO Paints.
PVC/28/-/6 Masonry Paints.
GME/29/1 Test Sieves.
GME/29/2 Test Sieving and other Sizing Methods.
RDB/25 Road Marking Compounds.

DECEMBER JOCCA: WEATHERING

BSI News

BS 2000 Methods of test of Petroleum and its products

The British Standards Institution have announced the publication of Method of Test BS 2000 Part 71 : 1990 — Kinematic viscosity of transparent and opaque liquids and calculation of dynamic viscosity.

This Standard is identical with standard IP 71/87 published by the Institute of Petroleum.

The method is generally suitable for liquids possessing Newtonian flow, and is also suitable for some non-Newtonian liquids (fuel oils). It depends upon the rate of flow of the liquid through a calibrated capillary viscometer under gravity. Many standard instruments are covered, and the standard is applicable to most liquids whose viscosity can be determined by a capillary method.

The price of the 16-page standard from BSI is £21.00 to non-members of the Institution.

P. Munn ■

Classified Advertisements

SITUATIONS VACANT

JOCCA

CLASSIFIED ADVERTISEMENTS

can be placed by contacting Victoria Craik by
Telephone: 081-908 1086
Telex: 922670 (OCCA G)
Fax: 081-908 1219

PLANT & MACHINERY

WINKWORTH FOR GOOD USED PLANT

Stainless Steel Storage Tanks from 10 to 12,000 gallons.
Vertical and horizontal some jacketed many with Mixers.
Over 600 in stock.

Enquire for details, you could save ££s
Mastermix 100HP Disperser. Hydraulic. Saw Tooth Blade.
225 Litre Beken Planetex Mixer, Flameproof Drive.
Dyno Mill KD 50 Stainless Jacketed 37Kw. Flameproof.
Molteni Mill MS 020 Stainless Jacket 22Kw. Mastermix Mill CH15
Stainless Steel Jacketed 18.5Kw. Flameproof.

New illustrated list available.
Winkworth Machinery Limited, Willow Tree Works, Swallowfield, near Reading, Berks RG7 1QX.
Telephone (0734) 883551. Fax (0734) 884031. Telex 847967

Enter J501 on Reader Reply Card

SERVICES

BOYDEN ASSOCIATES

Paint and Printing Ink Manufacturing Consultancy.

— Process Improvement
— Plant Design
— Project Management
— Bulk Handling, Packaging, Mixing, Dispersion, Pumping, Metering

20 years' experience of Major Capital Installations.

34 Northcliffe, Great Harwood, Blackburn BB6 7PJ
Telephone (0254) 884648

Enter J502 on Reader Reply Card

ANALYSIS · TROUBLE SHOOTING · RESIN FORMULATION

Paints · Resins · Printing Inks

Electropaints a Speciality

LEDGER SCIENTIFIC

Unit 5, Dyffryn Industrial Estate, Hengoed, Mid Glamorgan CF8 7RJ. Tel. 0443 816614

Enter J503 on Reader Reply Card

SHELLACS NATURAL RESINS GUMS & WAXES

SWANLAC
ESTABLISHED 1906

A. F. SUTER & CO. LTD.

Swan Wharf 60 Dace Road
London E3 2NQ
Tel 081-986 8218. Tlx 919056 SUTERS G
Contact B. A. Slater

Enter J504 on Reader Reply Card

SITUATIONS VACANT

Broaden your career horizons . . .

CHEMISTS/ TECHNOLOGISTS

Significant career opportunities exist ***now*** for technical people in the polymer industries.

You may wish to continue in R&D or perhaps transfer into technical service or even sales.

There are vacancies in all areas of the U.K. covering:

- ★ industrial coatings
- ★ coatings for plastics
- ★ wood finishes
- ★ highway products
- ★ masonry coatings
- ★ printing inks
- ★ paint raw materials

Salaries range from £12k to £30k + benefits

If you would like further details in TOTAL CONFIDENCE telephone or write:

David W. Mendez,
Whitehall Polymer Recruitment,
36, London Road,
East Grinstead,
West Sussex RH19 1AB.
Tel: (0342) 410111

BUREAUTECH SCIENTIFIC STAFF AGENCY

Top jobs for chemists experienced in the polymers, paints, inks, adhesives and surface coating industries. We cover the entire spectrum from technician to M.D.
Our service is friendly, fast and free.
Please send your full c.v., including salary required, desired job and location, to:-
B.S.S.A., 46 Selvage Lane, Mill Hill, London NW7 3SP.
Telephone: 081 959 3517
Enquiries also welcomed from employers.

Enter J505 on Reader Reply Card

SERVICES

PROBLEMS WITH SURFACE COATINGS?

for full chemical analysis of a vast range of materials...

Contact Dr Andrew Swift on
061 200 4441 (Fax 061 200 4443)

C•S•M•A

THE CENTRE FOR SURFACE AND MATERIALS ANALYSIS
UMIST PO BOX 88
MANCHESTER M60 1QD

A Partnership between UMIST and AEA TECHNOLOGY

Enter J506 on Reader Reply Card

SITUATIONS VACANT

OPPORTUNITIES IN THE USA

TECHNICAL MANAGERS *and* PIGMENT CHEMIST

As part of the world's largest graphic arts group and a leading international supplier of organic pigments, Sun Chemical is expanding fast, creating a range of technical/manufacturing posts for Chemists and Technical Managers.

Opportunities exist at our units in New York; Cincinnati, Ohio and Muskegon, Michigan for which previous experience in the organic pigment industry would be preferred, although post graduate research students in Colour Chemistry will also be considered.

As well as attractive salary and benefits packages, successful applicants will enjoy a favourable tax situation and ample relocation expenses. In the first instance, please write with details of academic training and industrial background to the Group Personnel Manager, Sun Chemical Corporation, 4605 Este Avenue, Cincinnati, Ohio 45232. Initial interviews will be held in the United Kingdom.

SunChemical

SERVICES

R&D SUPPORT

With our modern laboratory facilities we are at your service

Industrial chemical research
Process research & development
New product ranges
Yield optimisation
Novel synthetic routes
By-product stream utilisation
Quality control procedures

- **SURFACTANTS**
- **OILS, FATS & WAXES**
- **ORGANIC INTERMEDIATES**
- **HETEROCYCLICS**

St Andrews ChemTech International Ltd

Technology Centre, St. Andrews, Fife KY16 9SR Scotland
Telephone 0334 76890. Fax 0334 76493

Enter J507 on Reader Reply Card

PLANT & MACHINERY

Fairfield Dalton Ltd.

Home Office Stores,
The Common, Parbold,
Near Wigan. Lancs, WN8 7DB
Tel: (02576) 3198/2025
Fax: 4246. Telex: 67603.

NEW EQUIPMENT FOR SALE:

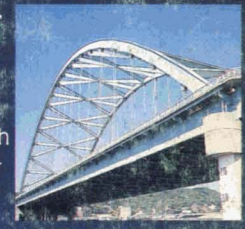
S/STEEL SCRAPED WALL PANS, Jacketed, Vac, Pressure.
VICKERS WORSAAM 'Z' BLADE S/S Mixers — New!
LARGE INVENTORY OF EQUIPMENT:
SILVERSON 10, 15 & 20hp; 10hp Flash Mixer.
LODIGE MORTON Ploughshare Mixers, M/S & S/S.
GUEDO Jktd Underarm Mixer; KELLIE Pulper Mod. 2JA.
DRIVER SOUTHALL 53" x 36" VIB Sieve.
MASTERMIX, 10hp, 24" diam. Trifoil Impeller, 0-300 rpm.
VEEDERROOT Batching, Wayne, Rhodes & Taylor Flowmeters.
BAKER PERKINS 'Z' Blade Jktd SS Mixers.
TORRANCE MIXER, 50hp, 38" diam. Trifoil Impeller, 0-180 rpm

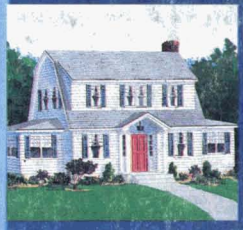
SEND FOR FREE CATALOGUE & BROCHURE — NOW!

Enter J508 on Reader Reply Card

Fortify every drop of your paint with HALOX SQP

HALOX® Pigments' unmatched commitment to SQP—Service, Quality, Performance—adds unique value to every one of our non-toxic inhibitive pigments. These pigments will fortify your coatings with proven resistance to corrosion or tannin stains, augmented by the special strengths of HALOX SQP. HALOX Service—from customized formulation recommendations through on-time delivery from distribution centers worldwide. HALOX Quality—with lot-to-lot, shipment-to-shipment consistency assured by employee-run SPC and SQC programs. HALOX Performance—proven in the lab, the field, and ultimately, in every mil of your applied coatings. To fortify them with HALOX SQP, call or write for detailed product data.





Advanced technology applied against corrosion

HALOX®

HALOX PIGMENTS

Lawrence Industries PLC., P.O. Box 3
Mitcham, Surrey, England CR4 3ZD
Telephone: (44) 81-648-2272 Fax: (44) 81-640-9932
A DIVISION OF HAMMOND LEAD PRODUCTS, INC.

Enter J702 on Reader Reply Card