ISSN 0030-1337

Vol. 71, No. 7
July 1988
pp 185-217

JOURNAL OF THE OIL AND COLOUR CHEMISTS' ASSOCIATION

JOCCA

■ Resins

JOURNAL OF THE OIL AND COLOUR CHEMISTS' ASSOCIATION

JOCCA

Annual subscription to non-members: £75.00 ($150), post free by surface mail, payable in advance.

Single copies £7.50 ($15), post free by surface mail, payable in advance.

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The front cover photograph courtesy of and specially commissioned by Shell Chemicals International Co showing Liquid and Solid Epikote resin.

Oil and Colour Chemists' Association
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Printed by The Herald Press, Stratford-upon-Avon and Suite 108, Temple Chambers, Temple Avenue, London EC4. Tel: 01-583 3190.

From the General Secretary

These notes are being written in the lull before the doors open on the second day of SURFEX 88 with the debris from over 1200 visitors having been cleared away save from the Tioxide footprints leading up the spiral walkway to the distant promise of a hospitality suite. Even after only one day the success of SURFEX is self evident, fully justifying the decision to remain at Harrogate.

The joint OCCA/PRA/PA stand has been well received and augers well for future collaboration between the three institutions within the industry. Overall it has been a relaxed and happy Exhibition reflecting confidence in the future of the industry and the Association.

A full report on the Exhibition will feature in the August issue of *JOCCA* and will include details of the many new products and processes on display.

New Faces on Council

The AGM, the formal annual meeting of the Association, was held in the imposing surroundings of the auditorium at the Harrogate Conference Centre with a backdrop of exhibitors' stands and surely the ideal venue for a major European paint conference and exhibition, perhaps in 1992.

The meeting attracted 35 members, a small number, but proportionately better than many major learned societies who would be delighted to have such an attendance at their AGM.

President John Bourne conducted a characteristically business-like meeting before an audience which included several distinguished Past Presidents and Honorary Members. Honorary Secretary Les Brooke and Honorary Treasurer Brian Gilliam introduced the Annual Report of Council and Statement of Accounts for 1987, produced in the new format for the first time as part of the new presentation of the Association.

Les Brooke referred to the many changes that had taken place within the Association, including the modernisation of headquarters, the relaunch of *JOCCA* and the appointment of the General Secretary following the retirement of the former Director and Secretary. Brian Gilliam presented a satisfactory financial report following a better second half performance, particularly from the UK Sections.

Among a number of questions from the meeting, Barry Windsor raised the important question of the integrity of Sections following changes in employment patterns and Simon Lawrence called for support for members made redundant. John Bourne promised to refer both items to Council for consideration.

The meeting approved the appointment of Graham North from Cray Valley Products as President Designate to succeed John Bourne. Graham, although a newcomer to Council, will bring with him extensive experience of the industry and in particular the important resins sector. New Vice-Presidents, perhaps an underutilized resource, Mike Gamon, John Inshaw, Geoffrey Lewis and Gordon Munro, joined existing Vice-Presidents on Council.

Amongst the Honorary Officers, John Taylor was appointed Honorary Editor, a position he has de facto assumed since the death of Don Newton, to be succeeded as Research and Development Officer by Simon Lawrence of Ciba-Geigy. All other Honorary Officers remain unchanged.

Each of the Association's regional Sections is represented on Council by the Section Chairman plus one named representative. This year we have 6 changes in Section Chairmen:

Barry Mayes (Hull Section).
Noel McInerney (Irish Section).
Bernard Myatt (Midlands Section).
Robin Archer (Natal Section).
Richard Stephens (Thames Valley Section).
Douglas Lindsay (Transvaal Section).

The meeting concluded with votes of thanks to officers and member of Council and in particular to President John Bourne for his first year as President.

SOBPIM

The Association is pleased to have been invited to become an affiliate member of the Society of British Printing Ink Manufacturers. It is hoped that this affiliation will lead to more news and articles in *JOCCA* devoted to printing inks and their production. The Association has been invited to present a paper at the SOBPIM Conference in September. Any member interested in presenting a paper on the subject of "The major influences on future supply and demand patterns for important ink raw materials" should contact Priory House. ■

Editorial

Resins

A surface coating to give the desired physical properties requires suitable ingredients in its formulation and one of these which has a major influence is the selected polymer or resin. The research and development which goes into these organic polymers whether solvent or water borne, air drying or stoving or cured by UV or electron beam is essential and continuous if the Surface Coating Industry is to satisfy its customers. The amount of work now being undertaken can be ascertained by examining the large number of patents taken out to protect the expenditure which has been paid to obtain the desired resin. This is especially true for the Japanese coatings industry. This work in the past was often carried out by the paint manufacturers themselves, since it was usual for the resins used in their paint manufacture to be produced on site. Over the years as the resin technology has become more sophisticated it has now often become the policy of the paint manufacturers, apart from the very large manufacturers, to rely on Resin Manufacturers to produce resins for the more complicated industrial formulations, for example, epoxy, hexamethoxymethyl melamine and some melamine and acrylic resins have special properties. A similar situation is found on the decorative side of the industry and PVA copolymers especially terpolymers with ethylene and other types of emulsions are bought in from the resin suppliers.

The introduction of more severe regulations regarding toxicity and environmental pollution has required resin manufacturers to look closely into the constitution of their products and has again necessitated the expenditure of often large sums of money for R & D. The recent opening of the Shell Companies new Chemical Research Centre at Louvain-La-Neuve in Belgium (one of the papers in this issue describes this centre's work) clearly indicates the trend for customer orientated technical support in resins and resin intermediates. Other resin manufacturers have also made large expenditure on their R & D establishments and appear to be making a very substantial contribution to the progress of the Surface Coating Industry. Trends in application of coatings required in modern, often automated, production lines has again required much work to obtain polymers suitable for application on the newer forms of plant; electrodeposition is an example. Again resins for powder coating systems have progressed from the early formulations when often excessively thick films were applied and today when glossy finishes of suitable film thickness are possible.

The resin manufacturers have therefore become an important section of the Surface Coating Industry and in the future will play a further and continuing important part in the success of the industry. ■

From the Hon Editor

It will have become apparent to readers of the Journal that during the past few months that its format has changed as agreed by the Executive Committee and the Council and that papers of a general interest have been introduced, whilst retaining the technical and scientific papers of which the Journal has been associated in the past. The Hon. Editor would like to bring to the notice of Members of OCCA that papers of both types are welcomed as are papers from Section lectures.

Forthcoming Features

August: SURFEX 88 Report, September: Anti-Corrosion Coatings, October: Resins & Pigments Exhibition Preview/Additives, November: Total Quality Assurance and December: Painting of Concrete.

Contributions to these features are welcomed and should be received by the Hon. Editor five weeks prior to publication.

International Paint reinforces world leadership in powder coatings

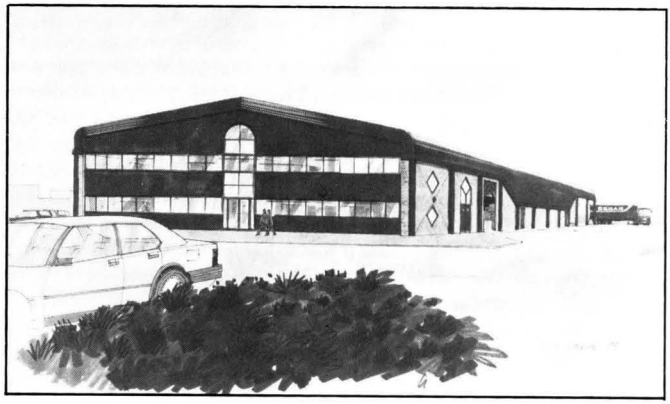
International Paint plc, the coatings subsidiary of Courtaulds plc, has acquired La Minerva srl, Italy, and the business of Drogas y Suministros sa (DYSSA), Spain. With the acquisition of these established powder coatings companies International Paint has consolidated its position as the world's leading producer of powder coatings. The powder market is presently estimated to be around 190,000 tons and with a growth rate of more than 15 per cent, it is by far the fastest developing sector of the paint industry.

Commenting today, Michael Pragnell, IP Group Managing Director, said, "These two significant acquisitions represent a further step in our programme for the development of a worldwide powder coatings business. International Paint has made substantial investment in powder coatings in recent years and has achieved the position of leading world supplier. These further acquisitions strengthen our position in the key European market." International Paint now manufactures its Interpon range of powder coatings in nine locations – Australia, Brazil, France, Germany, Italy, South Korea, Spain, UK and the USA.

Heubach UK on the move

Heubach UK have moved to new offices at 216A Bramhall Moor Lane, Hazel Grove, Stockport, Cheshire SK7 5JJ. Tel: 061 483 5084, Tlx: 669003, Fax: 061 483 6926. Heubach have been established with their own sales office in the UK for four and a half years during which time there has been a strong growth of sales brought about by the introduction of many technically innovative and advanced products. The foremost of these are the low-dusting low soluble lead, easily dispersible Heucotron lead chrome pigments. In the field of non-toxic anticorrosive pigments the Heucophos range are now the market leaders as alternatives to zinc chromates and they are

Ellis + Everard announce a new era in chemical distribution



Ellis + Everard's new Midlands Superbranch.

The Bradford based national chemical distributors, Ellis + Everard, are expanding in the Midlands with the construction of a £1.5m purpose-built distribution base at Nuneaton, near Coventry. The six-acre development includes a 20,000 sq ft warehouse for Ellis + Everard's range of over 400 chemical products supplied to a wide range of factories, public services and local authorities. The 'superbranch' replaces outdated facilities at Oldbury and Leicester. Yet it will still be a 'local depot' for industrial customers throughout the region.

Sited close to the M69, M1 and M6 motorways, the new centre will serve the industrial conurbations of Leicester, Coventry and Birmingham as far west as Hereford using its own fleet of trucks including some equipped with demountable cargo bodies which can be left at customers' premises for unloading to meet factories own production schedules. The centre will have a staff of 28 headed by Mr Paul Harris (41) who has been Ellis + Everard's Midlands Area Manager since 1983. Construction of the new centre is now well underway ready for opening in September. A similar superbranch for South Eastern customers will be completed in Greenwich early 1989.

A major improvement in customer service will be produced by the introduction at the new centre of a specially designed transport fleet which will include a number of trucks featuring a new, de-mountable body system. This new generation of cargo carrying workhorses for the chemical distribution industry achieve faster turnround for the delivery fleet and

E + E De-mountable body truck.

unrivalled flexibility for the customer.

Deliveries using the de-mountable system will enable units to be retained at the customer's own premises for unloading as required – virtually providing a mini-warehouse on wheels and becoming an extension of the customer's own storage facilities.

Similarly, future planning will enable 8,000 litre containers of liquid products to be left on site, which in many cases will eliminate the need for a customer to invest in his own bulk storage tanks.

The improvements under

Continued on p189

J O C C A

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the industry

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replacing conventional zinc phosphate due to their competitively priced superior performance.

Lawrence Industries distributorships

Lawrence Industries have been appointed distributors for the Harshaw Filtrol range of High Performance Metallic Pigments for coatings, plastics and ceramic colours and distributors for the Interfibe range of Cellulose Fibres for use in bituminous coatings and surface coatings.

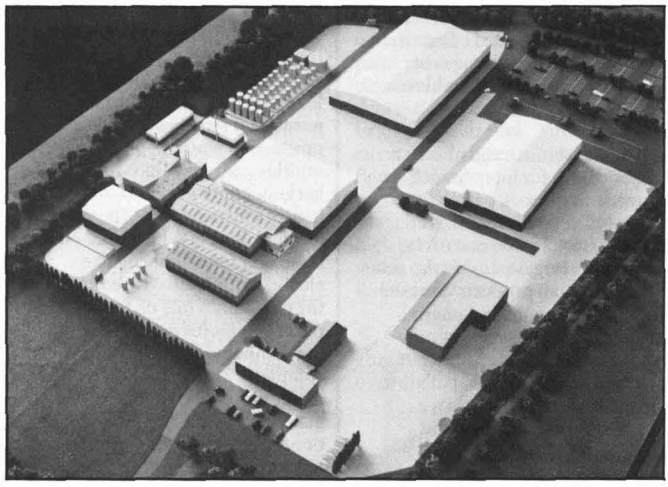
Cera Chemie wax investment

Cera Chemie BV, a leading European producer of Wax Emulsions and Wax Dispersions for the paint and lacquer industry, has recently completed a new investment of approximately 1.5 million DFl (£½m) at their premises in Deventer, Holland. This investment was necessary to adequately cope with the expanding global sales of their specialised products. The investment includes: the construction of a second warehouse with a surface of 600 M^2; extension of the offices; installation of six heated above-ground tanks with a total capacity of 250 tonnes; extension of the underground solvent tank park with six of 30 M^3 each; and the purchase of a new pressure vessel of 8,000 litres and various milling machines.

Prof Dr Werner Funke to present 1988 FSCT Mattiello Lecture

Prof Dr Werner Funke, Professor for Polymer Chemistry at the University of Stuttgart, West Germany, will present the Joseph J. Mattiello Lecture during the 66th Annual Meeting of the Federation, to be held at McCormick Place North, Chicago, Il, on October 19-21. Prof Dr Funke's presentation, "Microgels-Intramolecularly Crosslinked Macromolecules-Potent Components of Organic Coatings," will occur on Friday, October 21.

BASF invests £27.5m in UK inks market



Model of the expanded BASF Coatings + Inks' site at Slinfold, West Sussex, showing the new ink production buildings (white pitched roofs).

BASF Coatings + Inks plans to invest £27.5 million in the UK printing industry to position itself as the country's leading ink manufacturer in the 1990s. The investment is part of BASF's long-term strategy for the whole of Europe and represents a major commitment to its Fishburn and K+E brands.

The majority of the investment, over £20 million, will be devoted to a new oil ink plant at Slinfold, Horsham, where BASF has a freehold site of which it already manufactures ink varnishes. In addition to this new plant, a major capital programme will be carried out to expand the company's Huyton plant and to convert it to liquid ink production only. In both cases up-to-date streamlined productior methods and equipment will be adopted for maximum efficiency and quality assurance. "With the new investment and our quality programme, we can guarantee meeting customer requirements in all respects", added Dr Roger Lambert, newly appointed director and general manager of BASF's Printing Inks Division.

Approval of the investment package by the BASF executive board in Germany has removed the uncertainty over the relocation of the Watford ink plant when its lease expires at the end of 1990. The move also allows the company to concentrate oil and liquid ink production at Slinfold and Huyton respectively.

"In addition to our own facilities," said Dr Lambert, "we have access to unsurpassed technical back-up in Europe and the United States and can resolve customer technical problems very quickly. BASF also has excellent contacts with printing press manufacturers, so that as new machines are developed, we have ink ready to run on them from day one. Today's announcement means we can proceed without further delay to restructure a company that has a long tradition in ink making and return it to the level of profitability previously achieved."

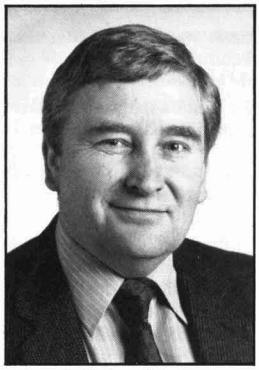
Work on the new factory at Slinfold and expansion at Huyton is planned to commence this autumn and be completed by the end of 1990.

AUGUST JOCCA: SURFEX 88 REVIEW

Continued on p187

development are in line with Ellis + Everard's progressive policy of operating as a 'one stop shop' for the chemical customer, supplying complete ranges of chemicals required by a wide variety of industries.

The new branch will also be a major centre for inter-branch movement of stock within the Ellis + Everard network. Its solvent store will be one of the company's largest. Inside the new warehouse, all products destined for the food, paint and pharmaceutical industries are not only stored in a segregated area but are also shrink wrapped on pallets to ensure that they arrive in a condition up to the standard demanded.



Dr Graham Ward.

Also Dr Graham Ward has recently been appointed Managing Director of Ellis + Everard Specialities – a company formed by ICI Colours and Fine Chemicals and Ellis + Everard Group which will distribute pigments and dyes – commented on the new company, "This is a terrific opportunity for us to develop via our strength of commodity chemical distribution into speciality chemical distribution. No other UK distributor can provide the breadth of speciality and commodity chemical distribution that E + ES can."

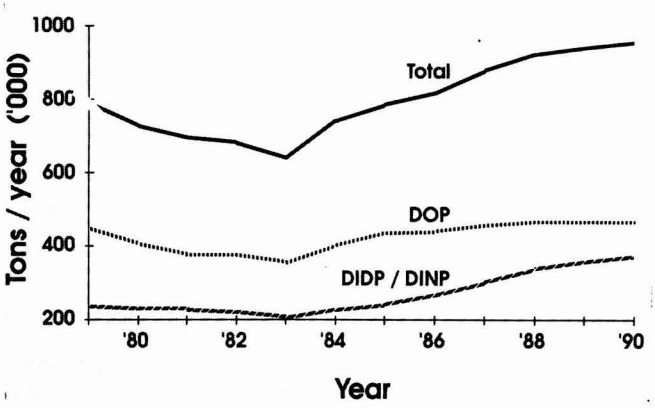
Exxon Chemical invests further into vinyls plasticisers capability

Exxon Chemical Holland has recently acquired a part of AKZO Zout Chemie's facilities at Europoort, near Rotterdam. The purchased facilities include production equipment, associated utilities, storage tanks, a barge,loading jetty and other logistics installations. These are located alongside Exxon Chemical's large unit for producing oxo-alcohols, themselves used to make the company's line of Jayflex phthalate plasticisers. According to the company, the acquisition neatly complements its other activities by increasing capacity and manufacturing flexibility, by permitting interesting growth and diversification opportunities, and by providing further support to its nearby plasticiser plant. This move will further strengthen the company's position in the phthalate plasticisers market.

In the past few years, Exxon Chemical has steadily increased its production capacity for both oxo-alcohols and phthalate plasticisers. This point was made by Winfried Doering, Vinyls Director at the company's Brussels headquarters. "Our plasticiser plants, in nearby Botlek, started up in 1979 with an annual capacity of 115,000 tonnes; it can now produce 200,000 tonnes/year," he said. "Similarly, our Europoort oxo-alcohols unit started up in 1982 with an annual capacity of 115,000 tonnes; it can now produce 180,000 tonnes/year." Mr Doering then pointed out that these capacity increments were achieved through process improvements, and that the potential for further capacity increase has not yet been exhausted. "Exxon Chemical now ranks as one of the largest and most efficient producers of oxo-alcohols and phthalate plasticisers in Europe, and with full feedstock integration."

According to an Exxon Chemical market analysis, West European demand for PVC plasticisers has now grown to around 900,000 tonnes/year (see chart). However, it is interesting to note that demand for DOP (di-octyl phthalate has stagnated for the past several years, and that much of the growth has been in higher molecular weight plasticisers such as the DIDP and DINP marketed by Exxon Chemical under its Jayflex trademark. "In my view," explained Mr Doering, "this is because the market is increasingly recognising the better performance, permanence and volatility properties of DINP and DIDP. And that's why we've been making sure we will be able to supply our customers' increasing needs," he concluded.

Plasticizer demand: W. Europe 1979-1990.



ICI Resins partnership produces water-borne dip coating for automotive industry

Dutch specialist paint manufacturer, Macostan Coatings based at Ede, has achieved a major breakthrough in the field of water-borne coatings for the automotive industry. The achivement follows several years' development work in close collaboration with ICI. Maquatherm is based on 'Haloflex' vinyl acrylic copolymer from ICI Resins and is the first dip coating for automotive components to contain no co-solvent whatsoever and is ammonia free. In addition to being 'user-friendly', it also sets new standards in anti-corrosion performance.

The Maquatherm concept was originated following a request from a major automotive component manufacturer who wanted a radically new dip coating for protecting its tow bars. Not only did the product have to be 100 per cent environmentally safe, but also had to perform twice as well as any coating previously developed for such an application. The coating, applied as a single coat, provides 400 hours protection in a salt spray test, whereas 200 hours on degreased material was the best that had been achieved previously.

A new formula for use on unblasted steel is currently under development and great potential exists to expand the application areas for Maquatherm within the automotive market to include protection for other underbody and under-the-bonnet parts. Spray coatings and coloured versions of the formulation are also on the horizon.

New pigment dispersing agents from Tego

Tego Chemie Service, the subsidiary of Th. Goldschmidt responsible for the surface coating industry, has recently introduced a new range of pigment wetting and dispersing agents. Known as Tego Dispers, this series was developed for dispersing inorganic pigments in non-polar, medium and highly polar system. They act as either coflocculating or deflocculating agents depending on which Tego Dispers additive is used, and prevent settling and flooding and shorten the time of dispersion and hence save energy. They are effective in air drying alkyds, acrylic and polyester/isocyanate systems as well as in nitrocellulose, epoxy and chlorinated rubber coatings.

Enter G101

Potable success . . .

Following recent successes with their range of unsaturated polyester resins for use in contact with drinking water, Cray Valley Products Ltd have just announced an extension to the range of potable resins approved by the Water Research Council: Synolac 6315-204 Unpigmented gel-coat for brushing, Synolac 6315-234 Grey pigmented gel-coat for brushing, Synolac 6330-224 Grey pigmented gel-coat for brushing with superior application characteristics and increased flexibility, Synloac 6349 SMC/DMC panel. A range of laminating polyesters has also be submitted to the Water Research Council, and approval is expected mid-June.

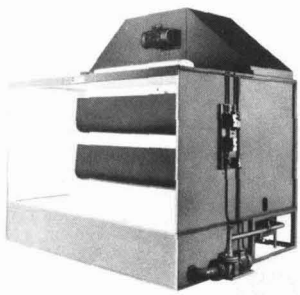
Enter G102

New spray booth range from Kremlin

Kremlin Spray Painting Equipment has introduced a new range of water wash spray booth, known as the PWS booth. The booths are constructed in bolt-on sections, thus giving considerable versatility in meeting a paint shop's requirement. All panels are fully painted for maximum protection. The PWS booths are fitted with removable water curtains which give efficient air washing at four different levels and reduce to a minimum the traces of atomised paint particles and solvent vapours exhausted to atmosphere. A depression meter is also fitted to balance the air flow. The water is circulated by a centrifugal recycling flame proof pump which is totally immersed in the base water tank. The air extraction fan is fitted with high performance light alloy blades and is operated by an external flame proof motor.

Enter G103

Kremlin PWS spray booth.



Taking the hard work out of drum handling

Ernest H. Hill a company with a vast experience in manual fluid transfer and pumping have turned their attention to drum handling with the introduction of a new range of equipment. For 100 and 205 litre steel drums, Hills offer the Model 869 drum stillage which is of sturdy welded steel construction, with heavy duty nylon wheels for mobility. It is said to be ideal for use where dispensing through a drum tap is required. Where the use of pump dispensing is preferred the model 834 adjustable drum dolly provides mobility. With three heavy duty nylon swivel castors (one of which is fitted with a safety brake) the 834 makes moving even full barrels an almost effortless operation. For pouring fluids from 25 and 30 litre containers, which itself can prove arduous, Hills have developed the Model 878 pouring frame. It accommodates most round and square/round 20-30 litre

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containers, both plastic and tin and makes the pouring process easier and in the case of hazardous chemicals much safer. Where mobility is required for the smaller drum, the Model 770 heavy duty Drum Trolley handles all drums up to 100 litre size with ease.

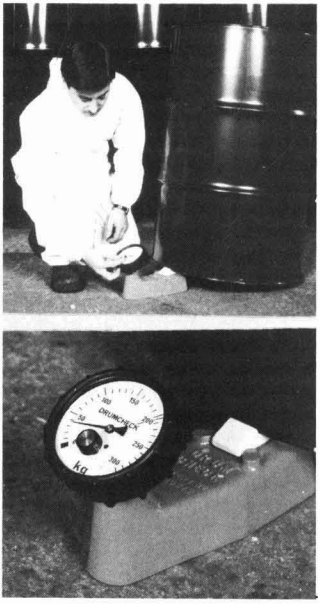
Enter G104

Instant check on storage drum contents

A portable weighing device that gives an instant check on the contents of industrial storage drums has been developed by Weighcheck Ltd. The device, known as Drum Check, offers a unique and accurate method of determining the remaining volume of liquid or powder in partly-used drums, based on a simple weighing principle. It is completely portable, weighing less than 5 lbs, so that all weighing operations can be carried out at the drum storage point, without the need for heavyweight drums to be moved to a static weighing device. The user first calibrates the Drum Check, by simply weighing an empty drum with it. The device incorporates a one-touch zeroing facility, so that the read-off scale is automatically set to allow for this empty drum weight. Subsequent weighings of the same type of drum will then provide an instant read-off of the exact weight of the drum's remaining contents. The Drum Check's scale can be graduated to suit user requirements, with read-off in units of weight, liquid capacity (litres/gallons) or dry volume.

Enter G105

Drum Check



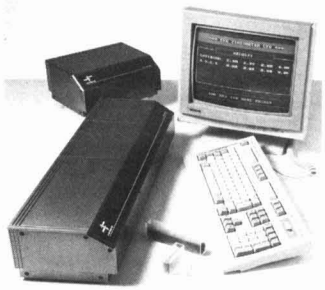
Flow through pressure gauge

Techmation has introduced a flow-through pressure gauge suitable for use in laboratory applications. Manufactured by Span Instruments, the Model CFP-224 gauge features a one piece, flow-through Bourdon tube and is designed with two connections located in the lower back part of the unit. The gauge can be installed directly in the process line and provides continuous flow of process media through the Bourdon tube. This procedure eliminates dead spaces in the tube, which can be completely flushed, and reduces or eliminates clogging problems. The unit has a 2.5 inch dial face, Zytel nylon bezel and liquid filled, anodised aluminium case. The CFP-224 is available in pressure ranges from 1,500 to 10,000 psi.

Enter G106

Lovibond launches Colourscan®

Lovibond has launched a new computerised colour measurement system for the analysis of liquid samples called the Colourscan®. Linked to an industry compatible personal computer the Colourscan® measures colours directly by transmission according to the CIE colour system, as well as the internationally recognised Lovibond® colour scales. Tristmulus co-ordinates X, Y, Z - Chromaticity co-ordinates x, y, Y - CIE colour space u–, v-, /L*, a*, b*, /L*, u*, v* - delta E values etc, are all directly displayed on the full colour enhanced graphics visual display. Colour differences, standard data and actual colour measurement are all displayed simultaneously on screen. All results, together with spectral transmission and absorbance data, may be stored in the computer memory for subsequent retrieval and analysis, or output to a printer. In addition, the Lovibond® "L" scale is included. This colour scale is used in the Lovibond Model E Tintometer AF900. Furthermore, the AOCS (American Oil Chemist Society) scales, together with various one-dimensional colour scales are all included in the system software.



Lovibond Colourscan®

The Colourscan® is available for the colour measurement of liquid samples, and flow-through as well as heated samples can be accommodated by the use of optional cells and sample holders. Reflectance measurement for Lovibond Colourscan® will be introduced shortly, using fibre optics and a remote illuminating head. This development is designed for accurate colour measurement of surface coatings, solids, powders and pastes.

Enter G107

CAPCIS coating inspector training

The Mace International Coating Inspector Training and Certification Programme is provided to meet worldwide industry needs for a certified standard for training for coating inspectors and for improved inspection of coating application work. Dates for the 1988 courses to be held at CAPCIS are as follows: Session 1 (Basic Coating Inspection) 9-14 October; Session 2 (Intermediate Coating Inspection) 17-21 October; Session 3 (Advanced Coating Inspection) 24-27 October; Peer Reviews 27-28 October. For further information and registration forms, please contact Patricia Pomfret, Course

Organiser and other enquiries to Dr. Jim Breakell, Manager Coatings and Non Metallics on 061-236 6573.

Resins & Pigments '88 and PRA conference

Resins & Pigments '88, organised by PPCJ, will be held at the Amsterdam Marriott Hotel, Holland, on 9-10 November 1988. Over 110 companies will be participating. For further information call 0737-768611.

Held in conjunction with the exhibition the Paint Research Association will be organising a special conference on 7-9 November 1988, entitled "Bio-Deterioration of Coatings and Substrates". Invited speakers from organisations worldwide will present papers on recent significant advances covering this important topic. It is expected that over 250 delegates from around the world will attend this conference. For conference information contact Dip Dasgupta on 01-977 4427.

A Preview of the Exhibition will be published in October *JOCCA* and exhibitors should send details of their stand to the Asst. Editor at Priory House. The Preview will be available at the Exhibition in Amsterdam.

Corrosion event prepares for 1992

UK Corrosion '88, organised by the ICorrST, becomes more cosmopolitan than ever this year, with extensive European input and interest in the annual conference and exhibition for the anti-corrosion industry. The venue is the Metropole Hotel, Brighton, and the wide-ranging conference programme and list of exhibitors makes the event, from 3-5 October, the largest, most comprehensive of its kind in Europe this year. As Britain and its continental neighbours prepare for 1992 and the removal of trade barriers to create a single European market, it is appropriate that this year UK Corrosion is being run in conjunction with Eurocorr, the annual conference of the European Federation of Corrosion. Details of the conference can be obtained from UK Corrosion '88, Exeter House, 48 Holloway Head, Birmingham B1 1NQ. Tel: 021-622 1912. Fax: 021-666 6316. Details of the exhibition can be obtained from Clayden Exhibitions Ltd, 6 Boscombe Cliff Road, Bournemouth BH5 1JL. Tel: 0202-35544. Fax: 0202-301575. Telex: 418447.

In-depth courses on Emulsions, Aerosols, UV & EB curing and Additives

An in-depth three-day course on: Emulsion Suspension Technology will be held on 29-31 August 1988, in Amsterdam; on Aerosol Technology 12-14 September 1988, The Hague; Radiation Curing 3-5 October 1988, Amsterdam; Additives for Coatings, Amsterdam. For further information contact the Center for Professional Advancement, Holland. Tel: 020/662.30.50. Fax: 020/79.75.01.

Fluid rheology course and suspension rheology course

A course on Suspension Rheology will be held on 27 October 1988, and on Fluid Rheology on 14-18 November 1988, at the Warren Spring Laboratory. For further information contact by telephone the Warren Spring Laboratory on 0438-741122.

Zinc alloy electrodeposits

A one-day symposium and exhibition on the use of 'Zinc alloy electrodeposits for better steel protection', is to be held at Aston University, Birmingham, on Wednesday, 19 October 1988. Arranged by the Midland Branch of the Institute of Metal Finishing, this will be the first conference to be held in the UK on this important new technique for improving the protection of steel against atmospheric corrosion. For further information contact: Dr J. Keith Dennis, Dept Mech & Prod Engineering, Aston University, Birmingham B4 7ET. Tel: 021-359 3611.

Newtown Industrial Paints Appointment

Peter Hassall has been appointed Product-Manager Agricultural Paints of Newtown Industrial Paints Ltd.

Volstatic International Newly Appointed MD

Newly appointed as managing director of Volstatic International Ltd, the UK's leading manufacturer of electrostatic powder coating equipment, is **Bob Russell** who was previously a director with a Burgess Group company. "Mr Russell's appointment is a key part of the management restructuring following the management buy-out of Volstatic in April this year," said Mr E. R. Cravens, chairman of Volstatic. Mr Cravens continued: "We have a number of high specification products under development and Bob Russell and his management group will be introducing these to the powder coating market during 1988."

Bob Russell

Two-pack spray paints – HSE guidance leaflet

The Health and Safety Executive has published today a free leaflet warning workers in the motor repair industry of the dangers of inhaling the mists and vapours produced when using two-pack spray paints containing isocyanates. The vapours and mists produced when using these paints are highly irritant to the eyes and respiratory tract and may cause asthma. A small number of fatal cases have been reported. These paints are

frequently used in small 'body shops' and the leaflet aims to set out very clearly the importance of taking safety precautions, in particular wearing adequate protective clothing and using self contained breathing apparatus. Copies of the leaflet, "Your health and 2-Pack Spray Paints", will be distributed by HSE field staff and through trade associations and manufacturers. It can also be obtained from HSE public enquiry points at Bootle (051-951 4381).

Fullbrook Systems Technical Literature

Fullbrook Systems have available a variety of technical literature on various types of instruments concerned with rheology. For example, the Viscocel continuous automatic viscosity control system, the TT100 in-line viscometer, the Dispermat dissolver and attritor. For literature on these products contact: Fullbrook Systems, 327 London Road, Two Waters, Hemel Hemstead, Herts HP3 9AL.

Europe's organic colorant suppliers see new opportunities

Europe colours the world. That is no exaggeration – for, in fact, Western Europe organic colorant suppliers dominate not only European but world markets.

The markets are looking better, particularly the West European market itself, concludes a comprehensive new 279-page Frost & Sullivan study: "The Market for Organic Colorants in the EEC" (#E1006). Even though the EEC market is mature as a whole, the study finds most sectors now expanding (after disastrous conditions in the early 1980s which forced some 20 companies to eventually shut down).

Total EEC consumption of organic colorants moved up from 155,500 tons in 1986, valued at $1.59 billion, to 157,100 tons in 1987, valued at $1.62 billion. The Frost & Sullivan report forecasts total consumption to jump to 167,300 tons by 1991, valued at over $1.74 billion (in 1986 US dollars).

In the dyestuffs sector – 73.2% of the total market by tonnage and 62.4% by value – fibre-reactive dyes currently play a starring role. EEC consumption is growing at a 3% annual rate – from 9,600 tons in 1986 to 10,000 tons in 1987, with a predicted rise to 11,100 tons in 1991.

Organic pigments – 26.8% of the EEC organic colorant market by tonnage and 37.6% by value – are showing relatively buoyant sales throughout the Community. Unlike dyestuffs, organic pigments are usually insoluble in, and physically and chemically unaffected by, the substrate in which they are incorporated. Printing inks comprise the largest end-use sector, 50.6% of the total, and include virtually the entire range of pigments produced. Printing ink usage is increasing 3.1% a year overall and more in some countries – 5.4% in the Benelux countries, for example. Frost & Sullivan sees interesting potential for pigments like the new fast yellowish-red pyrazoloquinazolone pigments, and also notes such factors as toxicological improvements and the development of deinkable compounds. Organic pigment sales in the EEC as a whole were $591.1 million in 1986 and $614.4 million in 1987, with $690 million forecast for 1991.

Six companies – Ciba-Geigy, BASF, Hoechst, Sandoz, ICI/Francolor, and Bayer – dominate the organic colorant industry in Europe (and the world), and the 1980s have not been kind to smaller companies. Nevertheless, as this study observes, some smaller companies are now thriving "through developing special technical abilities" – and even extending their international markets.

The price of report #E1006 is $2,850.

For sales information, contact Customer Service, Frost & Sullivan Ltd, Sullivan House, 4 Grosvenor Gardens, London SW1W 0DH. Phone 01-730 3438.

BSI Publications
BS 3406 : Part 7
Methods for determination of particle size distribution Part 7 Recommendations for single particle light interaction methods

Part 7 of BS 3406 gives recommendations on methods of determination of particle size distribution and concentration by single particle counting and sizing instruments using light interaction effects. It also provides information to assist in making comparisons between particle size measurements made in different laboratories and/or by different instruments.

BS 6770
Guide for exterior colours for park homes (mobile homes), holiday caravans and transportation accommodation units.

The purpose of this British Standard is to set down and provide identification for the colour range accompanying government guidance to local authorities on the question of colours for park homes, holiday caravans and transportable accommodation units. It is also for the information of the public.

For copies of BS 3406 : Pt 7 price £28.50, and BS 6770 price £17.00, contact BSI Sales, Linford Wood, Milton Keynes MK14 6LE.

Surface Coating Resin Developments at the Chemical Research Centre Shell Louvain-La-Neuve

by G. C. R. Russell, Shell International Chemical Co, Shell Centre, London SE1 7PG, UK and W. J. van Westrenen, Chemical Research Centre, Shell Louvain-La-Neuve, Belgium

The Chemical Research Centre Shell Louvain-La-Neuve (CRCSL), was officially opened on 10 March 1988 by the Prime Minister of Belgium, Mr Wilfried Martens. The modern laboratory complex is situated in a pleasant rural position, 27 kilometres from the centre of Brussels with easy access via the E411 motorway. The role of CRCSL is to provide customer orientated technical support to Shell Chemicals business activities in resins and resin intermediates, polyurethane chemicals and thermoplastics. The inital staffing level is 160, of which 50% are graduates, and combines a blend of youth and experience and with a total of fifteen nationalities represented including staff on assignment from Shell Operating Companies, it is well suited to its role of providing international technical support.

Surface coating developments

Shell Chemical Companies have an important presence in the surface coating industry with a variety of raw materials. However, surface coating developments at CRCSL are limited to Epikote* resins and the derivatives of Versatic* Acid (VeoVa 9*, VeoVa 10* and Cardura E10*).

Epoxy Resins were first used in the European surface coating industry in the early 1950's and have become increasingly important in the formulation of high performance industrial coatings. Some 55% of epoxy resin consumption in Western Europe is in surface coatings and the application sectors are shown in Figure 1.

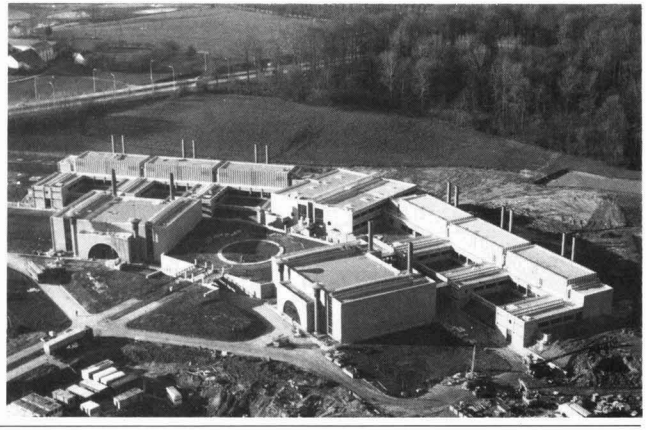
When epoxy resin coatings were first used, only the traditional methods of application were available and the binders consisted of solutions of resin and curing agent in organic solvents. For many years there has been pressure to reduce the solvent content of coatings for both environmental and economic reasons. This has been achieved with epoxy coatings via the use of powder coatings, water borne systems applied mainly by electrodeposition and by the use of liquid, solventless coatings applied by heated two-component spraying equipment. These more sophisticated application techniques have frequently required the development of more clearly defined epoxy resins than the traditional products. In the early days epoxy resins were characterised by the well-known Formula shown in Figure 2.

These resins were identified by a range of values for epoxide content and viscosity and a rather high maximum colour value. Today these simple specifications are often inadequate as a definition of quality. Sophisticated analytical techniques are now employed such as HPLC[1] to accurately identify end-group composition. This is particularly important in applications where the epoxy resins are used as "building blocks" in the manufacture of chemically complex binders which have stringent performance requirements. Furthermore, the advent of powder coatings has led to the need for very clean solid resins as it is impossible to filter-out gel particles etc, as in the case of solvent-based coatings.

It is certain that the demand for resins of high quality and consistency will increase in the future in response to the trend to quality assurance. The two major factors in ensuring the manufacture of consistently high quality epoxy resins is the purity of raw materials and the use of clearly defined and closely controlled processes. Shell companies plan to implement the introduction of high purity epoxy resin feedstock – diphenylol propane and epichlorohydrin – at the end of 1988 and the application of statistical process control is being studied.

CRCSL is making an important contribution to the quality programme in assessing the performance characteristics of the new quality epoxy resins derived from

The Chemical Research Centre Shell Louvain-La-Neuve, Belgium



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*Epikote, Versatic, VeoVa and Cardura are Shell Trade Marks.

Figure 1
Epoxy resin application sectors – Western Europe.

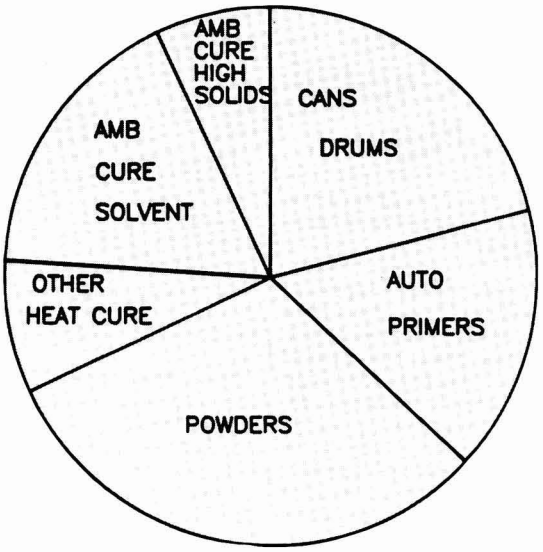


Figure 2

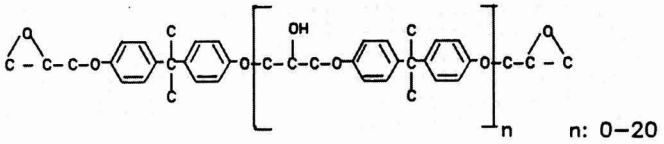
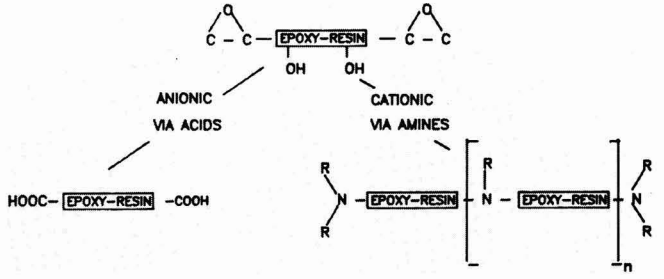


Figure 3



enhanced quality feedstock. An important future development for the surface coating industry is likely to involve the modification of basic epoxy resins to achieve specific characteristics, such as, water solubility, increased reactivity and higher film flexibility. A significant effort at CRCSL is aimed in this direction.

Water soluble epoxy resin binders for stoving applications

Epoxy resins have a prominent place in water-borne industrial coatings. The presence of hydroxyl and epoxide groups in the resin molecule make them ideally suited to conversion to polybasic acid anionic binders or to polyamine cationic binders as shown in Figure 3.

An interesting way of introducing carboxylic groups into an epoxy resin molecule is the use of amino acids. In 1980 during the FATIPEC Congress in Amsterdam[2] modifications of epoxy resins with p-amino benzoic acid were described. Their structure is shown in Figure 4.

Such binders are free from ester linkages and their synthesis is possible because p-amino benzoic acid reacts preferentially via its amine function with the epoxide groups. More recently[3] it has been found that instead of using the fairly expensive p-amino benzoic acid also natural occurring aliphatic amino acids can be used such as glycine, alanine and glutamic acid (shown in Figure 5).

The reaction of these amino acids with epoxy resins is slower than the p-amino benzoic acid reaction and is achieved via the salts of a strong base. This involves an ion-exchange procedure to remove the alkali metal ions which would harm the coating performance.

Figure 4

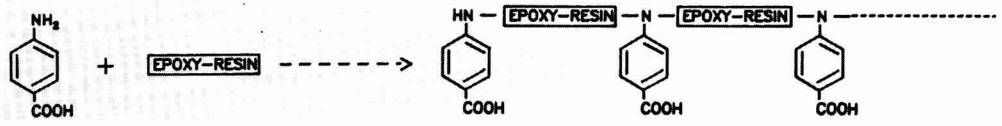
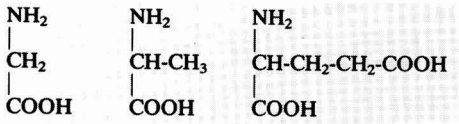


Figure 5



Electro-deposition and spray application of aqueous can coatings.

Traditional, solvent carried epoxy, phenolic and epoxy, urea formaldehyde resin systems are still widely used for interior can coatings. However, the advent of the two piece drawn and re-drawn can has led to the spray application of water-based epoxy can linings. These lacquers are generally based on a combination of epoxy resin and acidic acrylic polymers together with a melamine formaldehyde resin. It has been claimed[4] that the acrylic polymer is partly grafted onto the epoxy resin backbone and partly physically blended.

Figure 6 shows the suggested mixture of components in the epoxy/acrylic graft polymer.

The latest developments in the can sector involve the use of electrodeposition of can coatings[5]. This technique allows a 2-piece can to be coated internally by placing it over a stainless steel electrode of similar shape and marginally smaller dimension and injecting a suitable water-borne lacquer into the space via a central orifice. A potential difference is applied for about one second between the electrode and can, and a uniform coating over the internal can surface is obtained.

The industrial application of this technology is in its infancy and improvements are required in both equipment engineering and lacquer formulation. The binder must possess a combination of coating characteristics to obtain a pore-free coating with good flow and excellent resistance to processing and sterilisation; also it must conform with all food and beverage regulatory aspects.

Certain adducts of 2-amino-2 methyl-1-propanol with a blend of epoxy resins which have been partly defunctionalised with p-octyl phenol are showing promise in this application[6,7]. The difference is structure of the modified resin compared to a low molecular weight solid epoxy resin is shown in Figure 7.

Electro-deposition of epoxy car primers

The application of epoxy coatings by cathodic electro-deposition is used world-wide to afford excellent corrosion protection to the bodies of motor vehicles. Furthermore these primers have very good bath stability. The cationic binder is essentially an epoxy resin modified with a combination of amines which possesses suitable reaction sites to permit cross-linking on stoving, via one of the mechanisms shown below in Figures 8, 9, 10.

Clearly the complexity of the binder design in CED systems demands epoxy resins of exact and consistent quality, controlled by suitably precise analytical techniques as previously discussed.

Modifications to improve performance characteristics of traditional solvent based epoxy coatings

Although a large part of the epoxy coatings market has moved to solvent-free or water-based systems, there remains a need for solvent-based lacquers and improvements in the film performance of these lacquers are required.

Heat-cured epoxy coatings

Traditional solvent-borne

Figure 6
Proposed mixture of components in epoxy/acrylic graft polymer.

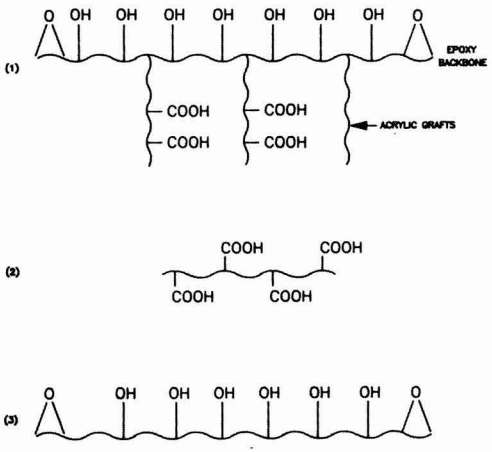


Figure 7
Structure difference of a standard epoxy resin and a specially defunctionalised epoxy resin.

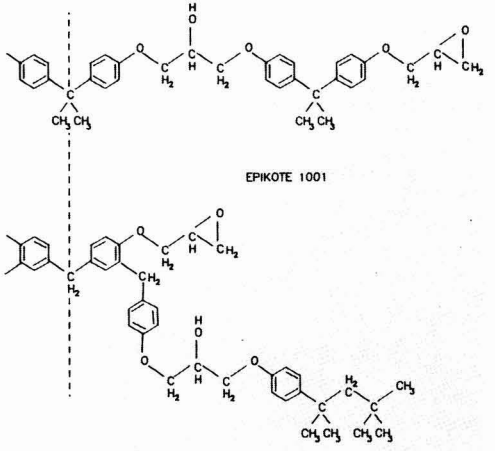


Figure 8
CED system based on epoxy resin cross-linked by transurethanisation.

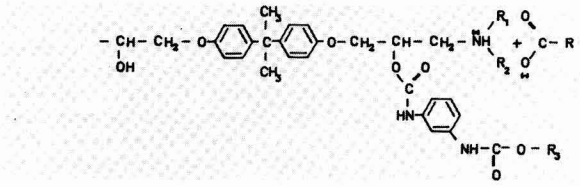


Figure 9
CED system based on epoxy resin cross-linked via double bonds.

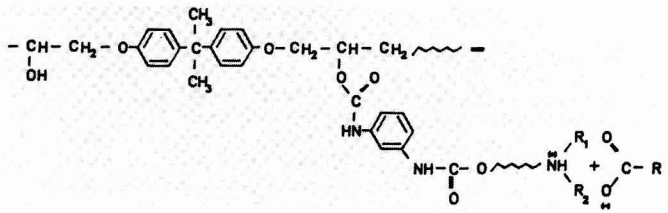


Figure 10
CED system based on epoxy resin cross-linked by transesterification.

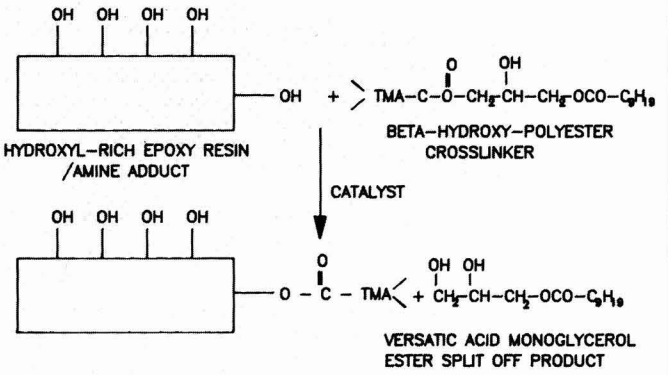
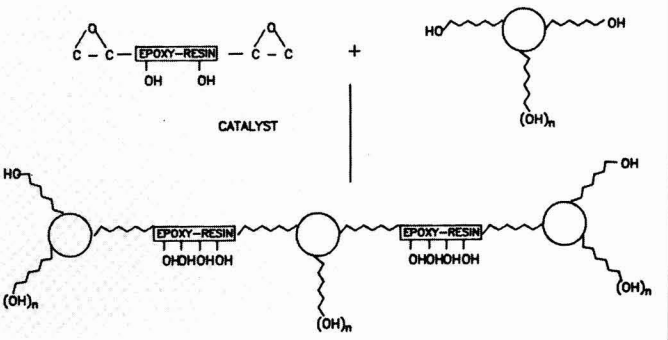


Figure 11
Modified heat-cured epoxy resins.



coatings based on high molecular weight solid epoxy resins and phenolic resin curing agents are still used in significant quantities in the can coating and coil coating sectors. Under the influence of heat these coatings cure by the chemical reaction of the components, predominantly via the secondary hydroxyl groups of the epoxy resin. A transetherification reaction is involved and it is activated by the presence of an acid catalyst, usually phosphoric acid. In such resin systems the presence of epoxy groups may be disadvantageous as they can react with acid leading to instability and an increase in viscosity on storage.

Furthermore, the secondary hydroxyl groups of epoxy resins are slow to transetherify with butoxy or methoxy groups of the curing resins. Model studies[8] have shown advantages of replacing the epoxy groups by primary hydroxyl groups preferably avoiding ester linkages, broadly according to Figure 11.

The lacquers based on these modified resins have shown excellent storage stability and enhanced coating flexibility.

Ambient cure solventless/high solids coatings

The original epoxy ambient cured coatings consisted of a solid resin with a molecular weight of approximately 1000, organic solvents and an amine curing agent such as ethylene diamine.

The first improvements were the use amine/epoxy resin adducts and amino-amide type curing agents. This was followed by a move to high solid content or solventless coatings based on liquid resins and curing agents which required heated two-component spray equipment for application

As an alternative to heat to reduce the resin viscosity, it is possible to add low viscosity reactive diluents.

However, this approach suffers from the disadvantages that film performance is lowered and the diluted resins and derived formula-

tions crystallize readily at temperatures below 10°C.

Another approach to obtain low viscosity resins free from crystallization is to use a combination of resins based on diphenylol propane (bisphenol of acetone) and diphenylol methane (bisphenol of formaldehyde) see Figure 12.

Various combinations of these two resins are now freely available.

VeoVa Monomers

VeoVa 10 is widely used as a plasticising monomer in vinyl acetate copolymers used in the manufacture of emulsion paints. A new monomer, VeoVa 9, has been developed in Shell laboratories which produces polymers of much higher Tg than VeoVa 10. Terpolymers of vinyl acetate, VeoVa 9 and VeoVa 10 can be prepared which have greatly improved paint performance compared to vinyl acetate, VeoVa 10 copolymers. The large difference in the physical properties between VeoVa 9 and VeoVa 10 cannot only be explained by the difference of one carbon atom in chain length and is largely due to increased branching of the Versatic acid feedstock. This is shown in Table 1.

Work is in progress at CRCSL aimed at the development of new applications for VeoVa 9[9].

Cardura E10

Cardura E10 is mainly used as a raw material in the manufacture of CED primers, thermosetting automotive top coats and ambient cured and low bake automotive refinishing paints. The direction of future developments at CRCSL are towards high solids, durable stoving enamels.

The future

The establishment of CRCSL as a customer orientated research laboratory will add impetus to Shell Chemicals product developments for the surface coatings industry.

Figure 12

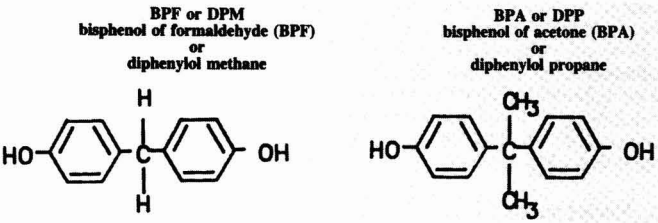
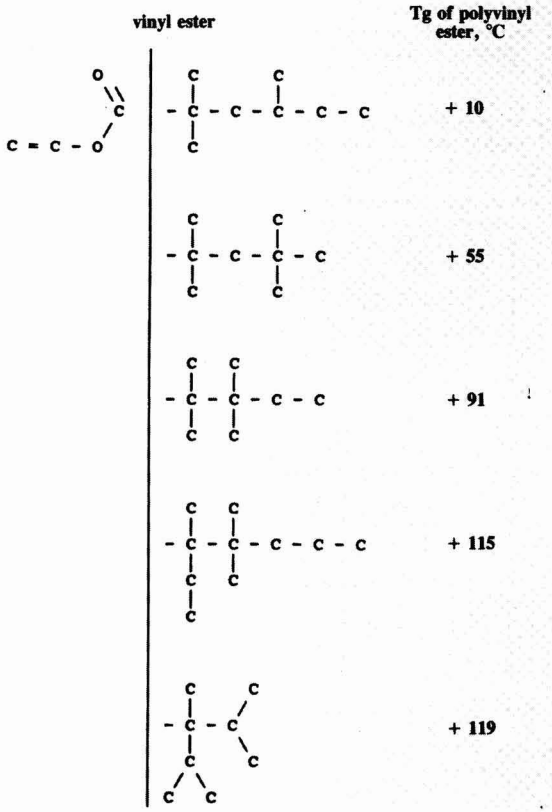


Table 1
VeoVa 9 isomer distribution/effect of branching on glass transition temperature.



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2. van Acker, E. M. A. A. J., "Modern developments in formulation and testing of can coatings". FATIPEC Congress, Amsterdam, 1980.
3. Raudenbusch, W. T., Noordam, A., and van Westrenen, W. J., "Entwicklung von Wasserloslichen Bindemitten fur Dosenlacke durch Modifizierung von Epoxidharze mit Aminosauren". To be presented at the XIX-FATIPEC Congress, Aachen 18-24 September 1988.
4. Robinson, P. V. *J.Coat.Tech.* 1981, **53,** 23. (1981).
5. European patent application 0 050045.
6. Kooymans P. G., and Stachowiak, S. A., "The design of epoxy resin binders for use in electrodepositable can coatings". Lecture to be

Continued on p213

Recent advances in decorative emulsion paint binders

B. L. Widdop, Kirklees Chemicals, George Street, Batley, West Yorkshire WF17 5AU, UK

Over the years water based paints have sharply reflected the continually changing face of emulsion polymer technology but the advances secured during the last five years must surely rank amongst the most note-worthy. Whilst general reference is made to their precursors the greater emphasis is placed on prevailing market trends, prime binder engineering and subsequent performance plus consideration of the latest developments.

1. Introduction

Since their conception in the 1930s emulsion polymers, or synthetic resin dispersions as they are more correctly termed, have entered into all aspects of everyday life from wood adhesives to wall-paper coatings and from textiles to footwear and polishes. Undoubtedly the largest market for these materials has continued to be the paint industry at large and aqueous interior wall-paints in particular.

Externally plasticised polyvinyl acetate homopolymers represented the first binders to find wide acceptance and even to this day certain European countries retain their use in specific applications where their unique contribution to product rheology cannot be reproduced by their more sophisticated contemporaries.

The late 'fifties saw the advent of internally plasticised vinyl acetate copolymers whilst further improvements to alkali and water resistance were achieved with the replacement of acrylate and maleate esters by the "VeoVA®" range of monomers in the mid 'sixties.

At the same time expertise gained from the United States saw the use of gaseous monomers offered as an alternative approach to polymer production and ten years of progressive refining culminated in the mid 'seventies with copolymers and terpolymers exhibiting a level performance considered acceptable by the UK paint industry.

2. Market trends

Obviously whilst the technology associated with the polymerisation of vinyl acetate improved, similar developments were being made with other chemical types so as to satisfy the varied requirements of the European paint manufacturers (Figure 1).

Despite the popularity of styrene-acrylic binders on the Continent vinyl acetate based polymers continue to reign supreme in the UK though some partitioning has tended to occur in recent years between conventional and pressure derived types (Table 1).

The most recent trend has been "binder segregation" with speciality grades being employed specificially in matt or silk vinyls to maximise the positive attributes of the individual polymers in each particular paint sector.

The properties which govern the effectiveness of the emulsion binder in the finished paint are essentially generated from one of three sources,

(a) monomer composition
(b) water phase composition
(c) production technique

and a generalised indication of influence is given in Table 2.

3. Speciality polymers for silk vinyls

Because of the nature of this category of paints the potential for cost savings through prime binder innovation is very limited since there is little or no scope for increasing pvc and thereby achieving a more economic

Figure 1
Estimated distribution of Western Europe paint output.

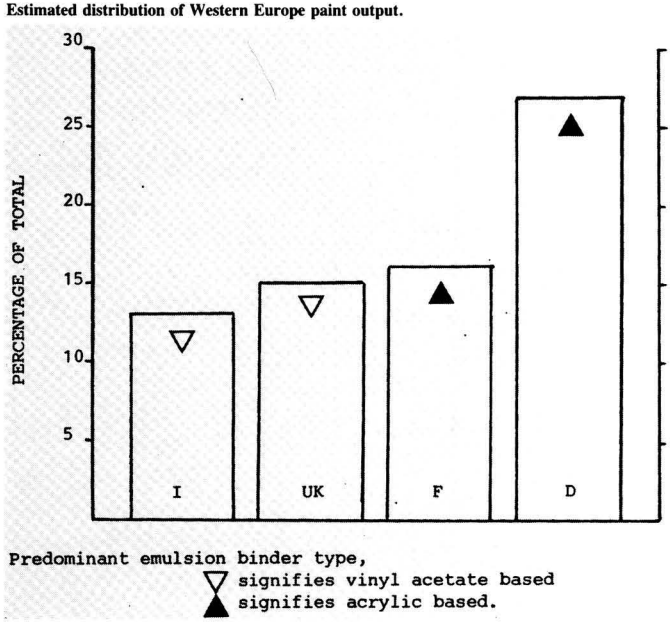


Table 1
UK Paint Industry; Estimated chemical type distribution

51%	vinyl acetate/VeoVa 10
19%	acrylics
14%	vinyl acetate based pressure polymers
9%	vinyl acetate based "others"
7%	styrene acrylics

formulation.

Indeed an entirely different collection of performance facets are required relative to matt vinyls and in principle the polymer should possess a moderate particle size with controlled distribution to facilitate good gloss development and retention characteristics as well as being capable of making a positive contribution to paint viscosity and gel strength.

Whilst monomer composition does not register as a major influence on a polymer's ability to generate gloss it would be impractical to consider materials with a minimum film forming temperature below 10°C since blocking and dirt pick up potential would be noticeably increased.

Consequently slightly harder polymers, typically containing 20% VeoVa 10 as flexibilising monomer, have been adopted as the industry standard for semi gloss paints.

The combination of idealised water phase composition and optimised manufacturing technique can result in a dual benefit of high gloss capability and positive contribution to paint viscosity and rheology.

The thixotropy, or "false body", which may be induced is of great importance since a high requirement for conventional thickener can seriously impair flow and levelling characteristics – a defect exaggerated and most apparent in paint coatings exhibiting sheen.

4. High binding emulsions for matt vinyls

Traditionally when reference has been made to high binding polymers, styrene acrylics and all-acrylic systems have been identified as the most complete options. However, by combining various techniques it has been possible to produce vinyl acetate based polymers (both by conventional and pressure routes) that are capable of exhibiting good film integrity even at high pigment loadings. The degree of improvement relative to their general purpose precursors can be assessed and quantified by a wide variety of tests ranging from Binding Index values on single pigment systems through to mechanical property determination on detached paint films. Although actual values vary depending on the test method employed, the relative positions of binders invariably remain consistent. Most demonstrable differences are obtained by appraisal of scrub resistance and performance levels for alternative polymer types are expressed as critical pigment volume concentrations (cpvc) in Figure 2. General formulation and testing data are summarised in Table 3.

As the block diagram shows

Figure 2
Binder performance; scrub resistance vs cpvc.

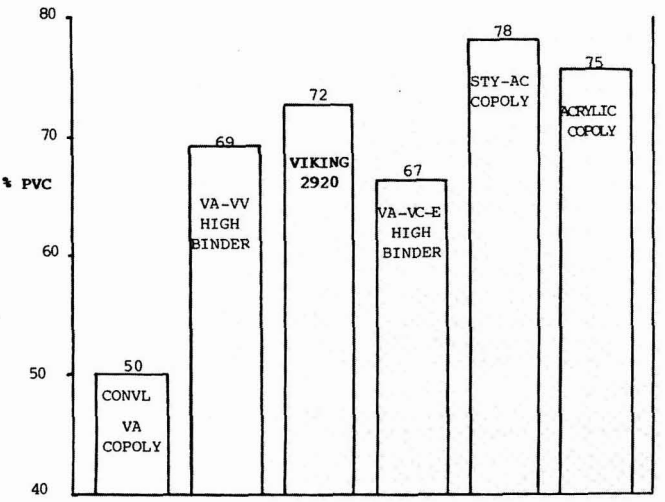


Table 2
Major influential factors on performance

Property	Monomer Composition	Water phase Composition	Production Technique
Molecular Weight		*	*
Film Forming Temperature	*		
Alkali Resistance	*		
Water Absorbance	*	*	*
Particle size		*	*
Viscosity	*	*	*
Electrolyte Stability		*	
Mechanical Stability		*	
High Binding Capability	*	*	*
Gloss Potential		*	*

Figure 3
Scrub resistance comparison (75% PVC Matt Vinyl).

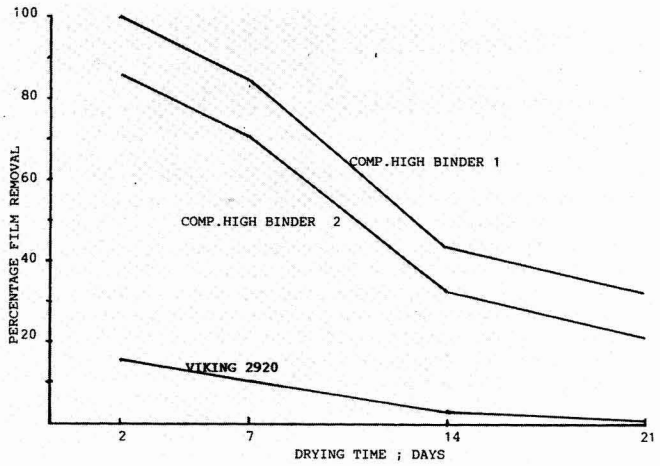
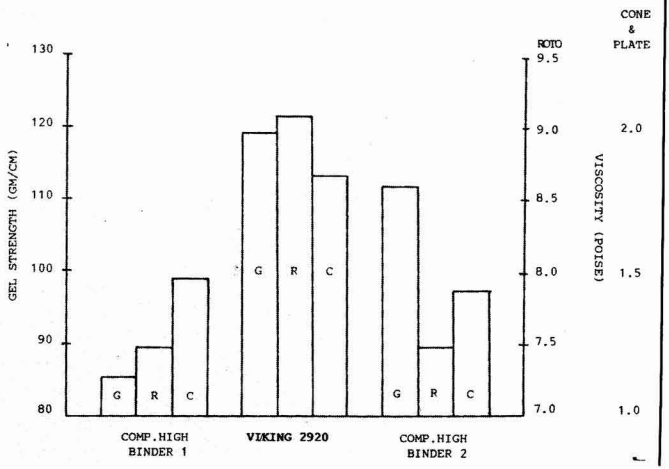


Table 3
General formulation and testing data

Formulation data:	
pvc ladder	55 - 85%
Non volatiles content	approx 51% by weight approx 30% by volume
Titanium Dioxide content	6% by volume
China Clay content	7.5% by volume
Whiting content	3.5 - 10.5% by volume
Test conditions:	
60 micron wet film thickness	
Dried 7 days; 23°C, 65% RH	
500 gm brush loading	

Figure 4
Viscosity/Rheology Contribution (30% PVC Silk Vinyl) where R=Rotothinner Viscosity, C=Cone & Plate Viscosity and G=Gel Strength.



styrene-acrylic copolymers as a generic class retain their premier position as the best high binders but two aspects restrict their overall acceptability,
(a) highter costs
(b) lower rheology contribution
the consequence being that a high performance vinyl acetate system will be more cost effective in the final analysis.

5. Recent advances

Whilst the emulsion polymer chemist can be justifiably proud of his achievements in elevating the binding potential of vinyl acetate systems into a higher sphere the initial commercial acceptance of these newer polymers was hampered by their inability to match conventional general purpose grades in silk paints.

Since approximately half of the estimated 200 million litres of emulsion paint produced in the UK is in fact silk vinyl then overall binder split is of the order of 2:1 in favour of the semi-gloss systems.

Additionally, other factors prevalent during the last eighteen months have also had a bearing on the direction of development projects being instigated by the prime binder manufacturer,

1. Escalating cost of Titanium Dioxide and its subsequent influence on public awareness and appreciation of non-pigmentary extenders.

2. Continual refinements by Rohm & Haas leading to the first truly acceptable opaque polymer – Ropaque OP62.

3. Novel improvements in thickener technology resulting in partial replacement of conventional cellulosic products by either acrylic emulsion or urethane solution grades.

Consequently targets had to be re-established in order to develop "State of the art" paint binders (Table 4).

Binders are now available which will satisfy even the most demand-

Continued on p213

The development of resins which give a high sagging limit for industrial application

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Introduction

In recent years governments in many countries have taken measures to protect the environment and it is expected that further measures will follow. The paint industry has been set a difficult task in reducing the emission of organic solvents during the application of paint systems. Due to these measures the paint industry has had to develop new paint systems which show large reductions in organic solvent content.

The development of solvent based paint systems with high solid content necessitates the use of newly developed resins. A common characteristic of these resins is their relatively low molecular weight. However, during application of paints based on these resins, it appears that sagging of the paint is a major problem. This problem manifests itself during both the application and the stoving of the paint. To obtain the desired effect on rheology, unusually large amounts of conventional products, such as silicates and colloidal clays, would have to be used which would result in a detrimental effect on the gloss of the paint film.

A unique product called SCA (Sag Control Agent) was developed in our laboratories in order to solve the above-mentioned problems. Resins modified with SCA meet the high quality demands of the automotive industry. Paint systems based on SCA modified resins can be characterised as follows:

— The rheology of the paint is adjusted in such a way, that sagging is prevented whilst the levelling of the system remains unaffected.
— During the stoving schedule SCA is "built in" to the paint film and as a result, the original form is not present in the cured system.
— Paint films retain optimum gloss.
— No significant decrease in the solid content of the paint.
— No change in the properties of the paint film, i.e. solvent and chemical resistance and mechanical properties.
— No influence on the durability of the paint system.
— No negative influence on potlife.
— Consistently reproducible quality in production.

In practice, SCA modified resins have already proven their worth, especially in automotive paints. However, the use of SCA is not restricted to automotive applications – their use in other and newer systems is currently under investigation.

The following sections will now describe the SCA in more detail.

Description of the sagging phenomenon

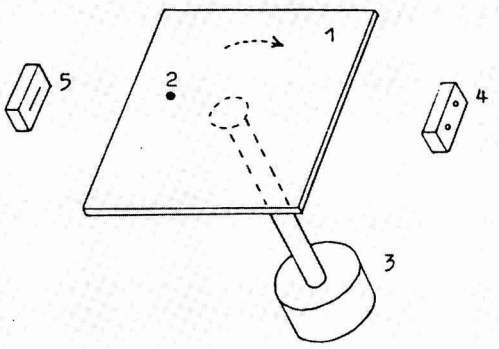
The development of solvent based paint systems with a high solid content necessitates the use of newly developed resins. A common characteristic of these resins is their relatively low molecular weight. During application of paints based on these resins, it appears that sagging of the paint is an important problem. This problem manifests itself during both the application and the stoving of the paint. If the paint is a Newtonian fluid placed on a vertical plane, the total mass transport (Q) per unit of breadth and per unit of time is given by

$$Q = \frac{\rho g \triangle^3}{6\eta} \qquad (1)$$

in which ρ is the density of the paint, g is the gravitational acceleration, $\triangle$ is the total thickness of the paint layer and η is the dynamic viscosity. In this type of system, it appears that the extent of sagging is proportional to the third power of the layer thickness and inversely proportional to the viscosity. A means of measuring the viscosity change during the baking schedule is given by the TNO film viscometer. The principle of the apparatus is shown in Figure 1. The TNO film viscometer is based on the rolling ball method. According to the principle employed in this method, the viscosity of the paint is inversely proportional to the actual speed of a ball moving through the paint layer. A steel ball of restricted diameter, e.g. 2 mm, is put on a rotatable paint panel, which is mounted at an angle adjustable with the horizontal plane.

The panel can be rotated by a step motor in an opposite direction to the movement of the rolling ball. The step motor is steered by a combination of a light source and a detector, in such a way that the rolling ball holds its position precisely. Consequently the sphere moves along a spiral orbit in relation to the axis of rotation of the test panel. The viscosity of the drying paint film is derived from the speed of rotation of the panel and from the distance between the ball and the mid-point of the panel, and is recorded directly. The rotating test panel is built in a housing in which the rate of ventilation can be adjusted and controlled. The paint film can also be submitted to an adjustable temperature/time schedule by steering a heating element which is positioned under the test panel. Consequently the viscosity of the drying paint film can be measured during a chosen temperature/time schedule.

Figure 1
Principle of the TNO film Viscometer where 1 = Panel with paint film, 2 = Steel ball, 3 = Step motor, 4 = Light source and 5 = Detector.



In Figure 2 the viscosity changes of a conventional and a medium solids thermosetting acrylic system during the baking schedule, as measured with the film viscometer, are given.

From Figure 2 it can be observed that
— the viscosity increase of the medium solids system during the flash-off period is significantly lower.
— the viscosity of the medium solids system drops to a much lower absolute value during the baking schedule.
— the viscosity rise, as a result of the crosslinking reaction of the medium solids system, proceeds at higher baking temperatures and takes a longer time.

These observations explain the increased susceptibility to sagging of medium and high solids paint systems (see also Eq. 1).

Sag control agents

To solve the problem of sagging it was necessary to develop an adequate additive. This additive should work on the rheological properties of the paint and should not show any side-effects.

The demands that are made on such an additive are:
○ It should control the rheology of the paint i.e. it should give a good anti-sagging effect and a good levelling of the paint.
○ It should not cause a significant decrease of the solids content at spraying viscosity. This is only possible if the additive does not have a significant effect on viscosity at high shear rates.
○ It should not influence the appearance (gloss) of the paint film in a negative way. It should disappear totally as a physical entity during the stoving process.
○ It should not have a negative effect on the pot-life of the paint. The anti-sagging property should remain constant during storage.
○ It should not impair the durability, the chemical or mechanical properties of the final paint film in any way.

The sag control agent (SCA) developed by AKZO meet these demands. From a physical viewpoint the SCA consists of long, thin flakes, that are composed of very fine, crystalline needles. Figure 3 shows a Scanning Electron Micrograph of SCA as it was isolated from an acrylic resin for automotive paints. It is obvious from the micrograph that the flakes are very small (each flake being composed of even smaller crystalline needles).

Figure 2
Viscosity profiles of a conventional and a medium solids termosetting acrylic system during the baking schedule. Flash-off period: seven minutes.

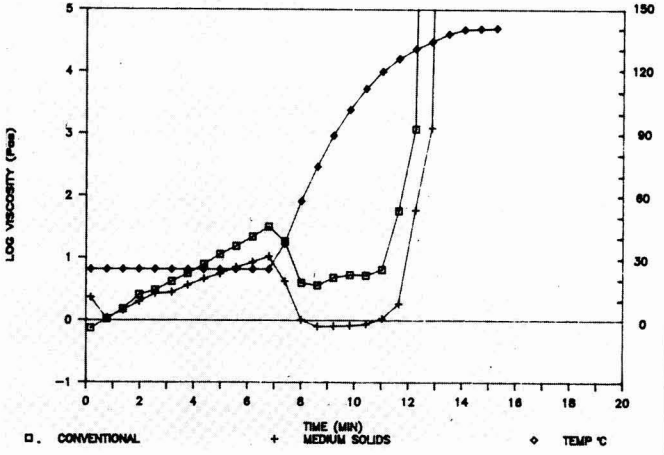
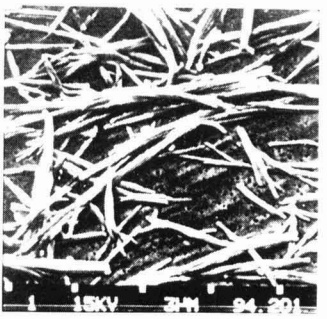


Figure 3
Scanning Electron Micrograph of a SCA.



Chemically the needles consist of symmetrical diurea's. They can be prepared by reaction of a diisocyanate with an amine "in situ" (in the resin). For example 1,6-hexyldiisocyanate and benzylamine will react as shown in Figure 4.

These diurea-compounds are insoluble in the resin and the paint. They crystallize in needle-shaped particles, that can agglomerate to

Figure 4

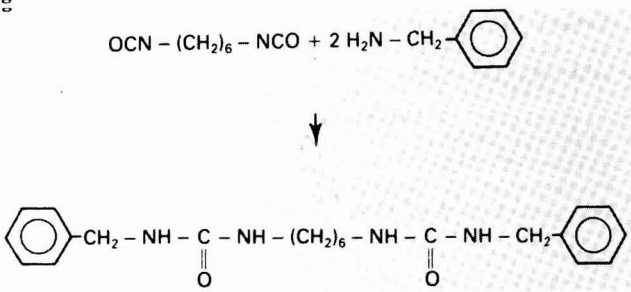
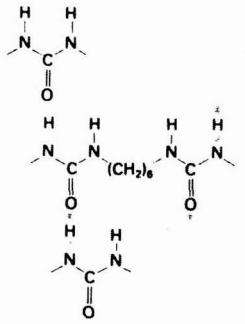


Figure 5
Hydrogen-bridges between diurea-molecules.



structures as shown on the photo. The Hegman-fineness of a SCA modified resin should always be below 15 µm. The form and size of the particles depend strongly on the following factors:

— type of amine and diisocynate
— reaction temperature
— reaction medium (resin and solvent)
— applied shear stress during reaction.

This means that, in principle, the SCA preparation has to be optimized for each resin. In a paint at rest the SCA flocculates to build a loose network by the formation of hydrogen bridges beween the diurea molecules (Figure 5).

Under relatively mild shear conditions, and certainly in the spraying nozzle, this network is destroyed. After application, the paint restructures itself into a smooth film thereby preventing sagging. In the time required for building this structure, the paint levels to yield a smooth film. Because of this reversible formation and breakdown of a framework in the resin (paint) the SCA shows its typical rheological behaviour. In Figure 6 the shear stress is illustrated as a function of the shear rate. The figure shows that from a situation of rest a certain yield stress has to be overcome in order to break down the SCA-framework.

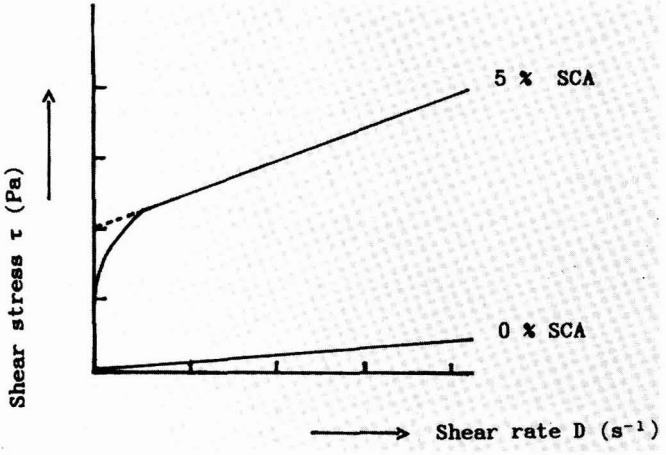
At the temperature used in the stoving process, the SCA reacts with the alkyd/melamine or acrylic/melamine binders. As a result it loses its physical identity, and thus does not affect the brightness and the gloss of the coating. The durability, chemical and mechanical properties of coatings remain unaffected by the inclusion of SCA and the storage stability of the paints is regarded as satisfactory.

The application of SCA in paints

Apart from the SCA developed by the Akzo laboratories there are several rheology controllers commercially available to the paintmaker. However, these additives have in common the fact that they do not disappear during the stoving process. In the quantities that they are needed they cause loss of brightness and gloss in the hardened film. The SCA presented in this paper shows it full advantages in paint systems with strong emphasis on properties like gloss, brightness, image clarity, etc. Until now this SCA has been used mainly to formulate medium solids and conventional automotive paints, both clearcoats and solid colours topcoats.

With regard to automotive coatings, another aspect should be mentioned (apart from the solid content of the paint) and this is the appearance of metallic paints (due to the presence of aluminium flakes in the coating) which can change, as can the colour, depending on the angle of view. The orientation of the aluminium flakes is a result of the spreading and subsequent shrinking of the paint film during the drying process. In newer metallic basecoats which exhibit longer drying times, such as high solids types or those formulated on waterborne resins, a high mobility in the uncrosslinked film will lead to increased disorientation of the metallic flakes. SCA increases the low shear viscosity and will fix the aluminium particles during the

Figure 6
Rheogram of a resin with and without SCA.



'flash off' time and also during the induction period of the stoving cycle, resulting in a much lower degree of clouding and a higher degree of brightness.

The following types of SCA resins are currently commercially available:
— Thermosetting saturated polyester resins, for metallic basecoats
— Thermosetting acrylic resins, both medium solids and conventional for automotive topcoats and clearcoats
— Thermosetting saturated alkyd resins for automotive topcoats.

An automotive clearcoat based on a SCA containing thermosetting acrylic resin can be formulated as shown in Table 1.

The test results of this clearcoat are compared with those of the same clearcoat without SCA (Table 2). The small difference in solid content at spraying viscosity is due to the fact that the spraying viscosity has been adjusted at a relatively low shear stress by using an Afnor, Ford or DIN cup. Under these conditions SCA has significant influence on the viscosity of the system. It follows, therefore, that an SCA containing paint should have a higher viscosity when measured by this type of cup in order for it to display the desired viscosity during spraying.

During the baking schedule SCA will disappear by reaction with a thermosetting resin, provided that a minimum temperature is reached. In Table 3 the appearance of a number of SCA modified systems (baked at two different schedules) is described.

Conclusion

From the results presented, it can be concluded that the SCA technology contributes significantly to the solution of sagging problems not only for high solids systems, but also for medium and low solid stoving applications without exhibiting undesirable side effects. Akzo has already licensed this patented technology to companies in America and Japan.

Table 1
Automotive clearcoat formulation

Automotive clearcoat	Weight parts
Setalux C-91757 VX-60 (cont. 3.6% SCA on solids)	342.0
Setalux C-1757 VV-70	264.0
Setamine US-138 BB-70	233.0
Baysilonoil OL-17 (2% in xylene)	27.0
Butylglycol acetate	27.0
Butanol	16.0
Tinuvin 1130	8.5
Tinuvin 292	5.5
Xylene	77.0
	1000.0

Diluent: xylene
Spraying viscosity: 28-30 s Afnor cup nr. 4, 20°C
Bake: 24 min 140°C
Amount of SCA in clearcoat, calculated on solid resin = 1.56%
Ratio acrylic: melamine = 70:30 (solids: solids).

Table 2
Test results clearcoat, based on Setalux C-91757 VX-60

Property	with SCA	without SCA
Substrate: Bonder 130		
Layer thickness [μm]	45	45
Persoz hardness [s]	248	249
Gloss Gardner 20° [gloss units]	89	89
60° [gloss units]	96	96
Erichsen indentation [mm]	8.8	8.8
Conical bending [mm]	0	0
Impact – face [kg.cm.]	42	60
– reverse [kg.cm.]	14	21
Adhesion DIN 53151 [GT]	0	0
Xylene resistance 1 min	1	1
3 min	1	1
5 min	1-2	1-2
Petrol resistance 3 min	1	1
5 min	1-2	1-2
Substrate: Cold rolled steel		
Sagging limit [μm]	40	25
Gloss Gardner 60°	96	96
NV% at spraying viscosity	52.1	54.1

Table 3
Appearance of SCA modified systems (not pigmented) at two baking schedules

SCA modified resin	30 min. 80°C	30 min. 100°C
Setal 90176 (polyester)	clear	clear
Setalux C-91152 (acrylic)	very slight haze	clear
Setalux C-91389 (acrylic)	very slight haze	clear
Setalux C-91756 (acrylic)	very slight haze	clear

Amount of SCA: 1.5% on resin (solids)
Ratio polyester: melamine or acrylic: melamine = 3:1 (solids on solids)
Layer thickness: 90 micron (wet) on glass.

Moisture-curing one-pack polyurethane coatings – development, application*

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Summary

Polyurethane paint films are normally produced by the polyaddition reaction of isocynate and hydroxyl groups. At an early state of ploy urethane paint chemistry it became evident that applicators wanted to become independent from two components. The research for a one component material was, therefore, inevitable. Today, moisture curing polyurethane coating materials are used in many sectors of modern paint application. They can be based on different isocyanate monomers and show in many respcts an outstanding sum of valuable properties.

It was with the granting of Patent No. 728 981 Figure 1 entitled "Process for the production of polyurethanes and polyureas" to the former IG Farbenindustrie in 1937 that polyurethane chemistry actually began. The invention was based on the results of research undertaken by Otto Bayer et al.

Now, about 50 years later, the isocynate polyaddition process forming the basis of the patent is of inestimable importance in many sectors of our modern technology.

We are certainly familiar with polyurethane foams, while polyurethane adhesives and polyurethane textile impregnating agents also play a very significant rôle today. Polyurethane coatings, too, have gained a world-wide reputation.

Polyurethane paint films are produced by a two-component process in which isocyanate and hydroxyl groups are added to urethane groups in line with the following equation:

$$-N=C=O + HO- \rightarrow -NH-\overset{\overset{O}{\|}}{C}-$$

If we start with polyfunctional isocyanate and hydroxyl compounds, we arrive at sterically crosslinked macro-molecules with marked duromeric properties, in other words, films produced by this process are virtually unmeltable and insoluble. The very wide range of applications for such two-pack polyurethane coatings in virtually every area of the paint industry is a clear argument for the high quality of the resultant films and coatings.

At an early stage of this

Figure 1

DEUTSCHES REICH

AUSGEGEBEN AM 7. DEZEMBER 1942

REICHSPATENTAMT

PATENTSCHRIFT

№ 728981

KLASSE 39c GRUPPE 6

I 59592 IV c/39c

Die Erfindernennung unterbleibt auf Antrag.

I. G. Farbenindustrie AG. in Frankfurt, Main

Verfahren zur Herstellung von Polyurethanen bzw. Polyharnstoffen

Patentiert im Deutschen Reich vom 13. November 1937 an

Patenterteilung bekanntgemacht am 12. November 1942

Gemäß § 2 Abs. 2 der Verordnung vom 28. April 1938 ist die Erklärung abgegeben worden, daß sich der Schutz auf das Land Österreich erstrecken soll.

Es wurde gefunden, daß neuartige und wertvolle hochmolekulare Produkte erhalten werden, wenn man organische Diisocyanate mit solchen organischen Verbindungen reagieren läßt, die mindestens 2 Hydroxyl- oder Aminogruppen mit austauschbaren Wasserstoffatomen oder mindestens eine Hydroxyl- und mindestens eine Aminogruppe der genannten Art enthalten. Als hierfür in Betracht kommende Diisocyanate seien erwähnt solche aromatischer Natur, wie m- und p-Phenylendiisocyanate, p, p'-Diphenyldiisocyanat und Naphthylendiisocyanate sowie deren Methyl- oder Methoxysubstitutionsprodukte, ferner solche Produkte, bei denen die die Isocyanatgruppen tragenden Reste durch andere Atome oder Atomgruppierungen getrennt sein können, z. B. das 4 · 4'-Diisocyanat des Diphenylmethans und des Diphenyl-1 · 1'-cyclohexans. Ferner seien aliphatische Diisocyanate, wie Tetra- und Hexamethylendiisocyanat, erwähnt. Geeignete Hydroxylverbindungen sind Glykole, wie Äthylen-, Propylen- und Butylenglykol; als geeignete Diamine seien Äthylendiamin, symmetrische Dialkyläthylendiamine, Tetramethylendiamine sowie aromatische Diamine genannt. In allen Fällen können die reaktionsfähigen Gruppen durch Heteroatome oder Heterogruppen getrennt sein. Die Reaktion wird durch Erhitzen der Komponenten, gegebenenfalls in inerten Lösungsmitteln, d. h. solchen, die mit den Isocyanaten selbst keine Reaktion eingehen können, durchgeführt.

Die erhaltenen neuartigen Verbindungen sollen u. a. zur Herstellung von Kunststoffen Verwendung finden.

Es ist bereits vorgeschlagen worden, Monoisocyanate mit Polyoxyverbindungen bzw. Diisocyanate mit Monoaminen bzw. Monooxyverbindungen umzusetzen. Die so erhaltenen Umsetzungsprodukte sind niedrigmolekular. Vorliegende Erfindung liefert dagegen hochmolekulare Produkte und stellt somit ein neues Aufbauprinzip zur Herstellung von Kunststoffen dar, welche für die verschiedenartigsten Anwendungsgebiete benutzt werden können.

Beispiel 1

44 Gewichtsteile m-Phenylendiisocyanat werden in 100 Gewichtsteilen Xylol gelöst und bei etwa 30° mit einer Lösung von

* Presented at the 11th National Symposium OCCA South African Division, Durban

development, however, it became evident that application by the two-component method was not acceptable in all areas of coating application. In further development work, the aim was therefore to come up with products having comparable properties but at the same time to dispense with the mixing processes before application and with the limited potlife. One important stage along this route was the development of urethane-modified alkyd resins, in which the phtalic resin content was partially or completely replaced by urethane (see Figure 2).

Compared with the air drying alkyd resins a urethane modification of this kind resulted as expected in an improvement in the resistance properties, but, also as expected, these efforts did not succeed in matching the outstanding overall properties of the two-pack polyurethane systems.

Urethane alkyds, sometimes wrongly called one-pack polyurethanes, nowadays play an interesting rôle in surface coating and printing ink technology. They are much appreciated for their good pigment wetting, abrasion resistance and ease of application.

The development of blocked isocyanates also proved to be an important step in coating technology. With these products, the NCO groups are paralyzed with monofunctional alcohols, phenol, 1'3-diketones etc., which means that they can be packed together with the polyol component to give a one-pack coating of good storage stability. Only at elevated temperatures, generally above 100°C, is the blocking agent split off and the NCO groups become available for the crosslinkage. The major fields of application for such polyurethane stoving systems are the coatings of electric wires and particularly flexible stone chip-resistant paints in the automotive industry.

The two-pack polyurethane coatings dealt with so far cure under normal climatic conditions. Contact between the freshly applied coating on the surface and the moisture in the air results not only in the formation of polyurethane but also in a so-called competitive reaction in which isocyanate groups react with atmospheric moisture via two intermediate stages to form N-substituted polyurea compounds (see Reacation Scheme R1).

$$\underset{\text{substituted carbamic acid derivative}}{R{-}N{=}C{=}O + HOH \rightarrow R{-}NH{-}CO{-}OH} \rightarrow \underset{\text{primary amine}}{R{-}NH_2} + CO_2 \qquad \textbf{(R1)}$$

$$R{-}NH_2 + O{=}C{=}N{-}R \rightarrow R{-}NH{-}CO{-}NH{-}R$$

Use is made of this reaction mechanism in the cross-linking of moisture-curing one-pack urethane prepolymers. They can be described as reaction products which contain NCO groups, can be thinned with conventional organic paint solvents and consist of difunctional to multi-functional isocyanate compounds and monofunctional to multifunctional hydroxyl compounds. The molecule segments are thus connected via urethane groups. After application from the solvent phase, the free NCO groups react according to the described reaction principle, forming sterically crosslinked N-substituted polyurea molecules. The film properties largely conform to those of the two-pack systems.

Common isocyanate monomers for the productions of one-pack polyurethane systems are shown in Figure 3.

The type of diisocyanate used largely influences the basic properties of the film. Linear or weakly branched polyethers or polyesters are generally used as the hydroxyl compounds, with the molecule size, functionality etc. influencing the overall properties of the films.

Polyether urethanes form films with good resistance to alkalis but limited weather stability. Films of polyester urethane have the better weather resistance but poorer resistance to chemicals. Linear and long-chain links bring greater flexibility, while shorter ones produce greater hardness and chemical resistance.

Polyisocyanates that are suitable as the hardener for two-pack coatings are also frequently used as the binder for one-pack coatings. They generally have an average functionality of 3 and can be linked via urethane, biuret, isocyanurate groups etc.

Moisture-curing one-pack polyurethane prepolymers are used in very large quantities and in many fields of application. Although they are still gaining increasing interest in practice, there is already news of a new generation of one-pack reaction systems based on mixtures of polyisocyanates and blocked amine compounds. The blocked amine compounds hydrolyze in the presence of atmospheric moisture (Figure 4).

The amines or amino alcohols that are released react promptly with isocyanate groups to form

Figure 2

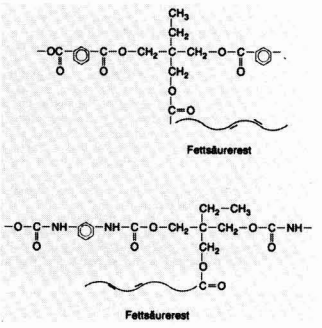
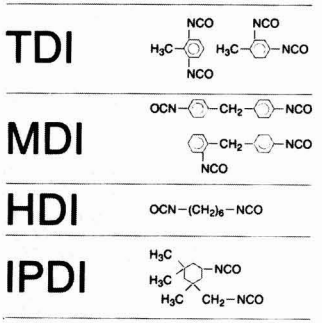


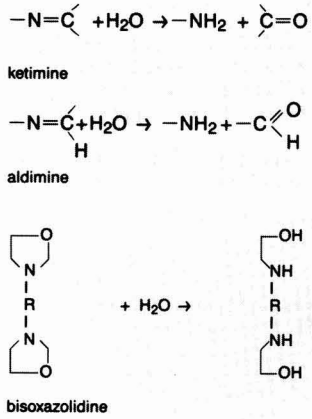
Figure 3



substituted polyureas.

Such products are already arousing considerable interest in the industry. They also dry quickly in thick coats without any blistering. Important applications are in the field of elastomer coatings and one-component sealants.

Figure 4



Production and application
Transparent coatings

Transparent one-pack polyurethane coatings are produced by diluting the prepolymers to the desired application viscosity and adding the usual additives such as levelling agents, deaeration agents, stabilizers etc. If non-reactive and anhydrous additives are used, they have good viscosity stability and storage life.

The following fields of application are typical for moisturecuring one-pack polyurethane clear coatings:

TDI-based Sealing of parquet floors, varnishing of wall panelling and doors. Concrete impregnation indoors. DIY applications with medium requirements concerning resistance to yellowing.

MDI-based Sealing of concrete, synthetic resin mortar, sealing of parquet floors (only with dark woods), varnishing of formwork. DIY applications with low requirements concerning yellowing resistance.

HDI-based Impregnation of concrete both indoors and out (only (R) Desmodur E 3150) with good Co_2/So_2 barrier and good H_2O diffusibility. DIY applications where maximum demands are made on yellowing resistance.

In addition to their good chemical resistance, their resistance to spots and stains and their ease of cleaning, special mention should also be made of the high abrasion resistance of one-pack polyurethane coatings (Tables 1 and 2).

Table 1

	drying			Σ
	dust-dry	tack-free	pendulum hardness	solvent resistance
TDI-based				
Desmodur E 1160	3 h	6 h	190″	3
Desmodur E 1361	1.5 h	3 h	170″	2
MDI-based				
Desmodur E 21	3 h	5 h	180″	0
Desmodur E 23	2 h	3 h	100″	5
HDI-based				
Desmodur E 3150	3 h	5 h	200″	2
Desmodur E 3265	4 h	5.5 h	210″	1

Pigmented coatings

When pigmenting the polyurethane prepolymers, particular attention should be paid to removing the water from the pigments and extenders in order to obtain good viscosity stability and storage life.

The following methods of removing water are commonly used in practice:

Direct method

This is used above all with MDI prepolymers with NCO contents of more than 15%, as, for example, (R) Desmodur E 21 and E 23. With this method, the isocyanate prepolymer, either completely free of solvent or diluted as little as possible, is mixed in portions with the pigment and extender with the dissolver disc rotating at a speed of 10-13 m/s. The speed is then raised to 15-20 m/s, whereupon the temperature of the batch rises to approx. 60°C. The dispersion process should continue for about 20 minutes at this temperature before the speed is reduced considerably and the mill base can cool down. The additives listed in the formulation are then added before it is diluted to the supply viscosity and finally packed.

Reaching the temperature of approx. 60°C is important for good storage stability. It contributes to the mobility of the NCO groups and water molecules, thus ensuring optimum water removal.

Table 2

	Abrasion values (Taber) 1,000 rev, CS10, 1 kg
Desmodur E 1160 and 1361	20-25 mg
Desmodur E 21 and 23	appr.15 mg
Desmodur E 3150 and 3265	15-20 mg
Acid-curing system	40-60 mg
Urethane alkyd	70-100 mg
Long-oil alkyd	100-150 mg

Alkali alumosilicate process

Here, the drying and dispersion of pigments and extenders are carried out in the solution of a wetting resin which is free of hydroxyl groups and compatible with the isocyanate component (eg (R) Soft Resin P 65, Bayer AG). The resin solution and the pigment/extender mixture is put into a ball mill without the balls in it. In line with the calculated water content of the pigments and extenders, alkali alumosilicate beads with a diameter of 2-3 mm (eg Baylith SE-G 233, Bayer (AG) are added and the ball mill is set into operation at such a low speed that the entire mixture just about

keeps moving. After 12-16 hours, moisture absorption is complete, with the alkali alumosilicate absorbing 3-5% of its own weight in water. The mill base is sifted off, mixed with the isocyanate prepolymer and the alumosilicate beads are discarded.

Instead of the hydroxyl group-free polyester, it is also possible to use linear polyesters or polyethers with OH contents of less than 2%, although an increase in the viscosity of the final formulation has to be taken into account.

The alkali alumosilicate process can be employed for all the previously mentioned prepolymers.

TI process

This process is based on tolylsulphonyl isocyanate, which is used in the paint industry under the name (R) Additive TI. It has exceptionally high reactivity and extracts the moisture from the pigments to form toluene sulphonamide.

With this method, the previously described wetting resin, possibly also a plasticizer of low saponifiability such as trioctylphosphate, with a sufficient amount of Additive TI is mixed to dry the pigments and extenders. We can work on the assumption that 25 g Additive TI will react with 1 g water. The pigment/extender mixture has to be added in portions, stirring at the same time. Foaming indicates that the monoisocyanate is reacting with the moisture. After dispersing for 20 minutes at a speed of 15-20 m/s, the auxiliaries are added. Now leave to cool and mix the pigment dispersion with the isocyanate prepolymer.

The direct and TI processes are mainly used in the paint industry, since they permit fast production with good storage stability of the one-pack polyurethane coatings.

Application of pigmented one-pack polyurethane systems for the maintenance of buildings

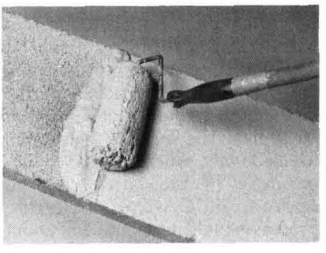
Because of their good resistance to abrasion and chemicals, pigmented one-pack polyurethane

Figure 5

systems are used in large quantities for the sealing and coating of concrete floors (Figure 5). For indoor applications, eg production halls and warehouses in trade and industry, large garages, changing rooms and showers in sports-grounds, gymnasia, etc, the economical MDI prepolymers are of major importance. They can be formulated and applied with only a small amount of solvent. A particularly attractive possibility is to make Desmodur E 23-based coatings thixotropic so that they provide a perfect coating even to very rough substrates. Small amounts of (R) Additive DT are used as the thixotropic agent.

Through the movement of the application roller the material is able to flow and can be easily applied (Figure 6). One-pack mortars or levelling compositions also play a rôle in the repair of cement floors. They are produced directly on the building site by mixing together one part by weight of the isocyanate prepolymer with – depending on the particle size – 15 to 20 parts per weight of sand. Because of the moisure entrained

Figure 6



by the large amount of sand, the potlife of such compositions is limited to about one hour.

After the entire floor has been carefully cleaned, the surface to be coated with the synthetic resin mortar is saturated with a 60-70% solution of the one-pack binder. The mortar is then applied direct to the areas to be repaired or to the whole surface (Figure 7).

After adequate curing, a thixotropic one-pack material or a solvent-free two-pack system (Figure 8) can be applied.

The polyurethane mortar cures as a result of the moisture in the air

Figure 7

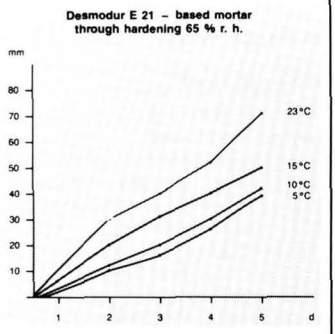
Figure 8

diffusing into it. Because of its microporous structure, moisture permeation is rapid and the Co_2 which is formed can escape without problem. The actual curing rate is dependent on temperature and moisture, but can generally be assumed to be in the range of 1 mm per hour (Figure 9).

The following mechanical data are obtained:

Desmodur E 21-based mortar, mechanical data
Compressive strength DIN 1164=45 n/mm^2

Figure 9

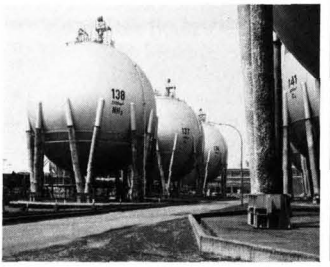


Flexural strength
DIN 1164=20 N/mm^2
Flexural modulus=8200 N/mm^2

The use of pigmented one-pack polyurethane coatings in the field of corrosion protection.

The system in Table 3 is recommended for the protection of steel using one-pack coatings.

Figure 10
Petrochemical Plant.



is not possible, the steel must be carefully derusted by hand and the aluminium primer used instead of the zinc dust primer.

Each of the subsequent coats should be applied at the earliest after six hours and at the latest after 24 hours in order to avoid any problems regarding intercoat adhesion. The coating materials are applied either by brushing or by rolling and the average dry film thickness is 50-70 µm per coat.

Figures 10-11 show examples of applications for one-pack polyurethane systems.

Figure 11
Steel bridge in the USA with one-pack polyurethane for the undercoats and lightfast two-pack polyurethane for the top coat.

and for protecting steel and concrete structures under water or in the ground. A dry film thickness of up to 300 µm can be achieved on vertical surfaces. The coatings dry quickly and can be subjected to normal stresses only a few hours after application.

Figure 12

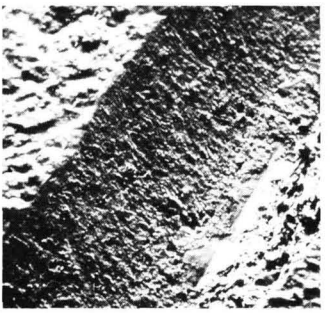


Figure 12 shows a one-pack polyurethane/coaltar coating applied to a vertical surface. Even in thick coats there are no bubbles or pores. The wedge-shaped cut clearly illustrates this fact.

Typical examples of applications for one-pack polyurethane/coaltar coatings are shown in Figures 13, 14 and 15.

Figure 13
Solvent tanks being buried in the ground.

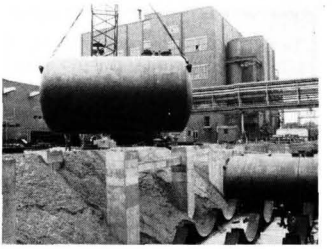


Table 3

1-2 x	1. Prime coat Desmodur E 21/zinc dust	on sandblasted steel
	alternatively	
1-2 x	1. Prime coat Desodur E 21/aluminium	on manually derusted steel
2 x	2. Prime coat Desmodur E 21/aluminium/talc/quartz powder	
1 x	Top coat Desmodur E 21/aluminium	
	alternatively	
1 x	Top coat Desmodur E 1361/colour pigment or aluminium	
	alternatively	
	Top coat Desmodur E 3265/colour pigment	

The zinc dust primer is suitable for universal application, in other words even if subsequent coats are based on a different binder. On vertical surfaces, dry film thicknesses of between 25 and 75 µm are obtained. Adhesion of the primer to steel is good, the surface is smooth, pore-free and without any bubbles or cracks.

In all cases in which sandblasting

Polyurethane/coaltar combinations

Isocyanate prepolymers are usually compatible with coaltar. Such combinations are frequently used for steel constructions in water

One-pack polyurethane prepolymers are nowadays being used in virtually every field of the present-day paint industry. One of the major arguments in their favour is certainly their high economy due to their optimum protection properties.

Figure 14

Protective coating for a blast furnace in Belgium. The coating was applied in wet weather in the winter.

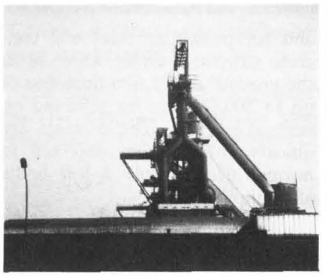


Figure 15

Container quay in the port of Bremerhaven.

■

Continued from p203

Figure 5

Gloss potential and retention characteristics (30% PVC Silk Vinyl).

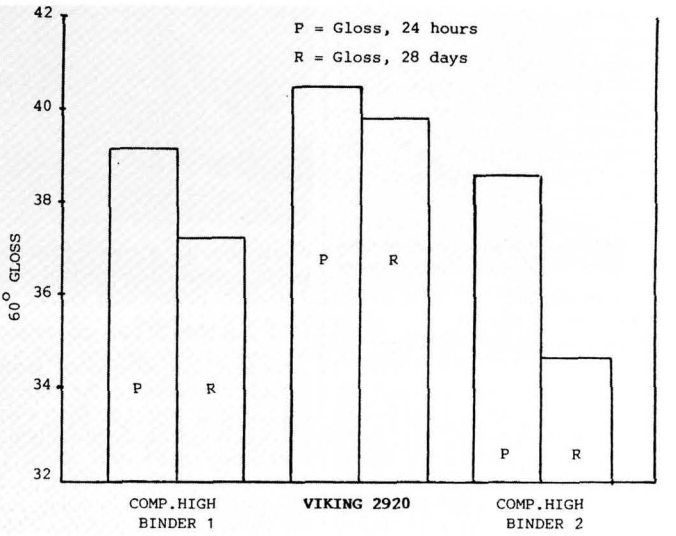


Table 4

Performance targets against traditional binders

Paint Property		Performance Target
High Shear Viscosity	*	Increased Contribution
Low Shear Viscosity		Increased Contribution
Gel Strength	*	Increased Contribution
Opacity		Equal
Colour		Equal
Gloss		Equal
Gloss Retention	*	Improved Retention
Scrub Resistance	*	Increased Washability
Stain Resistance		Improved Hold-Out
Spatter Resistance		Excellent
Compatability with Ropaque OP62		Excellent
Response to associative thickeners	*	Excellent

* signifies priority target

ing requirements of the modern day paint industry and VIKING 2920 typifies the highest level of performance currently possible and Figures 3, 4, 5 illustrate its influence on viscosity, rheology, gloss development, gloss retention and washability.

It can be concluded that through continual research and development the polymeriser has been able to positively respond to the challenge of his market place by offering decorative paint binders which have allowed a quantum improvement in paint performance relative to the previously acceptable standard ■

Continued from p200

presented at the 14th Int. Conference on Organic Coatings Science and Technology, Athens, 11-13 July 1988.

7. European patent application 0 127915.
8. Scholten, H. P. H., and Stachowiak, S. A., "Modified expoxy resins in heat-cured coatings". AFTPV Symposium, Nice, 15-18 September 1987.
9. Scholten, H. P. H., and Jan Vermeulen, "A new versatile monomer for high-performance polymeric binders". To be presented at the XIX FATIPEC Congress, Aachen 18-24 September 1988 ■

Quality Control & Assurance

On 17 and 18 May the Paint Research Association, in association with the Paintmakers' Association, the British Resin Manufacturers' Association and the British Adhesives and Sealants Association, held a Symposium on Quality Control and Quality Assurance in Paint and Allied Industries. This was at the Excelsior Hotel, London (Heathrow), and was attended by approximately 100 participants. It followed a previous PRA Symposium four years ago on Quality Control in the Paint Industry, held in anticipation of BS5750. This Specification is now in operation (also the equivalent ISO 9000) with many companies registered, and the present Symposium focussed on some of the technical and administrative challenges met by firms wishing to become BSI Registered Firms. John Bernie, Managing Director of the Paint RA, introduced the proceedings; David Clayton, Quality Assurance Manager, Crown-Berger International Ltd, was Chairman on the first day and Brian Elgood, Manager of General Products Division, Scott Bader & Co Ltd, on the second day.

Seven papers were presented on each day, as follows:

1. Fundamentals in Quality Assurance, by Derek Wallace of the De La Rue Company plc.
2. BS5750 – Where are we now? by Mike Lukey of BSI Quality Assurance.
3. Route to BS5750/ISO 9000 Registration, by Reg Easy of Yarsley Quality Assured Firms Ltd.
4. Control of Dispersion and Rheology, by Martin Camina of Paint Research Association.
5. Quality Control in Decorative Paint Making, by Stuart Morgan of ICI Paints.
6. Quality Assurance in the TiO_2 Industry, by Barry Hulme of Tioxide Group plc.
7. BS5775 – The Reality, by Ken Smith of Cray Valley Products.
8. An Adhesive Manufacturer's Viewpoint, by Richard Sandland of Borden UK.
9. Getting the Message Across, by David Clayton of Crown-Berger International Ltd.
10. Principles and Practice of Statistical Process Control, by David Wright of PERA, Quality Assurance.
11. Expert Systems and Quality Control, by Andrew Basden of the University of Salford.
12. Does Automation Assure Consistent Quality? by Richard Oldroyd of Kalon Group.
13. The Role of an Instrument Maker in Meeting Quality Control Demand, by Alan Routs of Sheen Instruments Ltd.
14. Training Requirements for BS5750 by Don Clement of Paintmakers' Association.

The list of papers indicates the scope of the Symposium. There was inevitably some overlapping but this was no bad thing because it revealed the differing emphasis accorded by different companies to various aspects of quality control and quality assurance. A recurring theme was the necessity for a total commitment to quality throughout the company from top management (in particular) to the humblest employees – everyone must be involved and quality improvement should be recognised and rewarded, perhaps by a bonus scheme. In some companies major changes in management philosophy are needed before the full benefits of a total approach to quality can be attained. It is generally found that quality improvement leads to improved long-term productivity, and this in turn to greater profitability. Comparisons were made between countries; in Japanese firms the contribution per employee to productivity and profits is higher than in US, European and British firms, in that order, and it was suggested that this is due in large part to their greater commitment to, or even obsession with, quality.

Quality is defined as fitness for purpose and conformity with specification – Quality Assurance covers all activities and functions concerned with attaining quality. BS5750 is a management tool for all industries, essentially a structured approach to a quality management system. To become a Registered Firm under the Specification a structured, fully documented quality system is demanded; some firms find it well to employ consultants to guide them in setting this up, although care must be taken to select consultants experienced in the industry. A Quality Assurance survey of a company may show a system in operation that is (a) effective, meeting BS5750 requirements but needing better documentation, (b) ineffective and needing improvement, (c) satisfactory, properly documented and meeting BS5750, or even (d) no real system in operation. A QA system is best implemented in stages, building on satisfactory procedures already in operation; the system should be reviewed regularly to ensure that proper controls are maintained and to check whether any improvements are needed.

Examples were described of good quality control and management systems operated by leading firms, and of the stages leading to Registration. Advantages of automation for some processes were outlined and the uses of Statistical Process Control in minimising variations described. Application of Expert Systems in detecting, correcting and preventing mistakes was introduced. Calibration and care of measurement instruments was covered, with horror stories of misuse, e.g. using a screwdriver to clean the orifice of a viscosity flow cup! The Paintmakers' Association is preparing training methods and, no less important, training records.

This was a well organised Symposium, running efficiently to the timetable. All participants must have improved their knowledge of how a Quality Assurance system should be introduced and maintained, how to become a Registered Firm under BS5750, and the advantages of so doing – equally, the disadvantages of not becoming registered!

T. A. Banfield ■

Natal Section

Corrosion additives for solvent-bourne coatings

At a meeting held at the Natal Training Centre, Pinetown, on 16 April 1988 Dr G. Rogez of Ciba-Geigy discussed research conducted for substitutes of toxic heavy metals such as lead and chromium for safe use as corrosion inhibitors. Giba-Geigy have developed Irgacor 252 as an alternative to toxic heavy metals and this product can be used as the sole pigment or in combination with zinc phosphate. The slight solubility of the material gives passivation of the surface. Dr Rogez discussed the method of addition, preferably by post-addition, and the level required to give the required properties. Then followed a presentation of test results using different resins and demonstrated test results with numerous slides. Although the material is higher in cost than the conventional materials, its synergistic effect with zinc phosphate reduces the levels required.

At the end of the lecture Dr Rogez answered questions. Mr Neil Johnson thanked Dr Rogez and Ciba-Geigy for hosting the meeting.

Chromate pigments for plastics and paints

Mr J. Maenen of Ten Horn Pigments delivered an interesting lecture on the use of chromate pigments in the plastics and paint industries. The meeting was held at the Natal Training Centre, Pinetown, on 24 May 1988.

The topic covered the range of Chrome Yellows, Molybdate Oranges, Chrome Green, Phthalochrome Greens and flushed colours. Some of the products were for captive use and others for sale to industry. With the help of an overhead projector, the lecture was well illustrated with slides and covered the history, improvements effected since the commercial introduction, chemistry and production of chrome pigments.

Pure Chrome Yellows have poor properties in relation to the requirements of industry. However, by encapsulating the pigments with metal oxides such as Silicon, Titanium and Antimony vastly improved properties are developed in terms of brilliance, strength, opacity, weather and sulphur dioxide resistance, heat and dispersibility. Generally the Chrome Yellows showed improved characteristics over Organic Yellows.

A new class of Chrome and Molybdate pigments have been developed by Ten Horn, called Hornachrome pigments, and these are characterised by very high colour strength and high covering power. Other properties are similar to the conventional types. A new technology of intimate mixing by the use of turbulent mixers has lead to the pigments having a smaller particle size of up to two-thirds the size of the conventional types. This range now has an increased colour strength 15 to 41% greater than the current range. Reduction with titanium dioxide does not lead to a reduction in light, weather and sulphur dioxide resistance. Also the soluble lead content of the new range has been reduced.

Mr Maenen concluded his lecture by answering questions from the audience. The meeting closed with Mr Dick Philbrick thanking the lecturer for his in-depth presentation and Ciba-Geigy for sponsoring the meeting.

E. Puterman ■

OCCA News

Midland Section

Forty years on

This year the Midland Section is celebrating the fortieth anniversary of its foundation. The Section was inaugurated by the President, Dr L. A. Jordan, in Birmingham on 30 April 1948 and Mr Frank Sowerbutts, who had played a big part in its formation, was honoured for his work by being made its first Chairman. Frank had helped to found the Manchester Section in 1925 and served as Treasurer from 1927-40. He was then transferred by his Company to Birmingham and organised a meeting there in January 1944, which, as history shows, was to lead to the formation of the Midland Section. The first Honorary Secretary was Dr C. S. Woolvin and the Treasurer was Mr F. Ewart Morley.

The first technical meeting of the Section was held on Friday, 15 October 1948 at the Central Technical College, Suffolk Street, Birmingham. The lecture was given by Dr N. W. Hanson and entitled "The Analytical Characterisation of Alkyd Resins". At the end of this meeting three committee members were elected. They were Mr H. Drew, Mr M. H. M. Arnold and Mr R. L. Yeates. Mr Arnold later served as the Hon Editor of *JOCCA* 1955-58.

To commemorate Dr Hanson's talk, the Midland Section has planned a Fortieth Anniversary lecture on 20 October 1988 at the Clarendon Suite, Stirling Road, Edgbaston, Birmingham. A talk entitled "Forty Years of Alkyds and Polyesters" will be given by Mr J. Cornish of Croda Resins. Further details will be published in the OCCA Bulletin.

B. E. Myatt ■

News of Members

Mr **Dudley House,** FTSC, has been recently appointed Group Production Manager of Plascon Evans, Transvaal. He was previously the Technical Director, Plascon Evans, Natal. Mr House joined the Natal Section, OCCA, in 1957, and the Natal Committee in

Continued on p217

Obituary

George A. Campbell MSc, FRIC, President 1934-36

Dr F. M. Smith writes:

A lovable Christian gentleman, George Campbell finished his career in the chemical industry in 1963 just as computers and technological forecasting were beginning to take us over and before the depression and the oil crisis. Perhaps this was how he could maintain a relaxed and almost benevolent attitude to running a business.

After the first world war he graduated in Colour Chemistry from Leeds University fulfilling a planned ambition. Having joined the Geigy Colour Company in 1932 from the Cornbrook Chemical Company in Manchester he took charge of the Colour Laboratory at the Parsonage behind Kendal Milne, whilst Harold Clayton was in charge of marketing. They became joint managing director and chairman respectively of the Geigy Company and directors of James Anderson & Co (Colours) Ltd which was in the Gorbals of Glasgow and is now the Pigments Division of Ciba-Geigy (UK) plc in Paisley.

During the second world war George Campbell became responsible for Geigy's DDT and he became an expert on the subject publishing a book with West. After the war Geigy gave up manufacture and George Campbell presented the case for special financial recognition for the contribution DDT had made to the war effort.

After the war he was responsible for setting up Geigy in South Africa.

He was always ready to assist his colleagues and many junior staff remember and appreciate his help. It was this approach which made him sceptical about the arrival of the Personnel Department – what would they do that good managers did not do already?

He was a keen supporter of OCCA and became President at the age of 33 and served in the formative years of 1934-36. He has outlived practically all his contemporaries of those years, partly because he must have been the youngest President ever. At the end of his Presidency he was praised for the close co-operation which he had established with the Research Association and which has continued ever since. He continued to play a significant role over the years and was a keen supporter of the introduction of the Blue Wool Scale, used in the dyeing industry, for the assessment of the lightfastness of pigments (later restricted to pigmentations). He was made an Honorary Member in 1964 and has attended Past-Presidents' functions in later years whenever health and distance permitted.

But he will assuredly be remembered for his outstanding humour and wit in after-dinner speeches or in fact any speech he ever made. The apparent ease with which he kept his audience enthralled must have been a combination of talent and careful preparation. He could laugh at his own old age recounting how a grandchild had asked him whether he was in the Ark with Noah. When replying in the negative his grandson wanted to know why not seeing he was so old! He also said that he would have looked after himself better if he had known he was going to live so long.

But perhaps his unstressed attitudes were the real answer; in relation to driving when trying to enter a major road he believed in 'the inevitability of gradualness'. His desk always had a pending tray which relied on a second request being made if the subject was important enough to the enquirer (was he serious?).

He will be sadly missed but with wonderful memories by those of us who have been fortunate enough to keep in touch with him over such a long period. We join in this with his son and daughter and their families. ■

Chester Conference Column

You will no doubt recall that John Taylor sent out a "Call for Papers" some time ago. The response has been comparatively successful in that we have TEN firm offers of papers. This result has been achieved only with an additional communication to various parties amounting to some 25 contacts.

We do need 16 papers and would be glad to receive some more offers.

John Taylor has asked me to remind all those who are already committed that he requires their cv/photograph/precis of paper to be given, as soon as possible. I hope those reading the colum and identifying themselves will respond to John's request as quickly as possible.

The assistance offered by the Manchester Section will be called upon nearer the date when detailed tasks have been formulated.

In the meantime I have to report that I am still involved with setting up the 1991 Conference at Cambridge.

A. C. Jolly ■

Continued from p215

1974. He was Chairman of the Natal Section in 1976/77 and vice-President of OCCA in 1982/84.

Mr **Lester Bowman** has been appointed Business Manager, Resins and Adhesives of Borden (UK) Ltd.

E. Puterman ■

President of Ghana's PMA visits Priory House

Samuel Kofi Asubonteng, President of Ghana's Paintmakers' Association and Managing Director of Two Worlds Manufacturing Co Ltd (Manufacturer of Paints, Allied Surface Coatings and Metal Containers) recently visited Priory House and met the General Secretary. They discussed the General Overseas Section especially within Ghana and West Africa. Mr Asubonteng outlined to the General Secretary the current expansion of Surface Coatings Production in Ghana which is a relatively young industry founded in the 1960s. Mr Asubonteng was also visiting the UK to attend SURFEX 88 to meet raw materials suppliers interested in exporting to Ghana and also to meet colleagues in the UK PMA and the PRA.

Northern Sections

1988 Golf Tournament

The McWilliam's Trophy was once again competed for in glorious weather at Hawley Hall Golf Club, Morley, on the 7 June, 1988. There were eighteen competitors and the course was in excellent condition, but was quite difficult.

The Trophy was won decisively by West Riding with 8 clear points over Manchester sections.

The top scorer was Gordon Adam with 35 points as a guest player and the top team were all members of the West Riding section and were Malcolm Baker 31 points, Philip Jones 26 points and Roger Wells 25 points.

The day was rounded off with a well received meal followed by a presentation of the prizes.

G. C. Alderson ■

Scottish Section

Golf Outing

The phrase "It never rains on the Golf Course" could have been coined with the Scottish Golf Outing held on 6 May 1988. Yet again the Gods were kind to the participants at our Annual Golf Outing. The sun shone brilliantly throughout the day. There can be few finer sights than Aberdour on such a fine day.

The golf, for the most part matched the weather, some splendid scores being returned. Nineteen players participated, the principal prize winners being:

Whittaker Cup:

Joint winners: H. Munro, nett 65; N. Wilkinson, nett 65.

Morris Ashby Quaich:

Best Scratch Score: H. Munro, gross 80.

Tioxide Tankard:

Most Improved Golfer: N. Wilkinson.
Booby Prize: R. F. Hill.

Visitors' Shield:

Joint Winners: I. McRaild, nett 67; C. Marshall, nett 67.
Best Scratch Score: A. McMaster, gross 81.
Booby Prize: D. Dickie.

The Scottish Section are indebted to Aberdour Golf Club for the use of the playing facilities and the excellent catering provided.

Thanks are also due to various companies for the donation of prizes, viz: Hays Chemicals, B.P., Samuel Banner, Tioxide, J & B, Craig & Rose.

R. F. Hill ■

New members

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

Ordinary members

Bowring, M. R. *(Transvaal)*
Dhotar, D. S., BSc *(Ontario)*
Drake, J. A. G., PhD *(West Riding)*
Dyer, P. R., BSc *(Natal)*
Giddey, S. M. *(Cape)*
Ilkanic, A. J. *(Ontario)*
Kenan, S., BSc *(Transvaal)*
Morris, J. *(West Riding)*
Mudaly, G. D. *(Natal)*
Patel, M., MSc *(Ontario)*
Simpson, R. K., BSc *(West Riding)*
Turner, G. J. *(Hull)*
Zielinski, G. P. *(Midlands-Trent Valley)*

Associate members

Chapman, G. A. *(Cape)*
Chessman, D. C. *(Transvaal)*
Monn, G. R. *(Transvaal)*
Naicker, G. *(Natal)*
Nemeti, C. F. *(Transvaal)*
Opperman, W. J. *(Cape)*
Pace-Balzan, A. *(Natal)*
Perrins, S. M. *(Transvaal)*
Piette, L. N. M. *(Transvaal)*

Registered student

Robertson, C. *(Midlands-Trent Valley)* ■

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Yorkshire Chemicals plc

Kirkstall Road, Leeds LS3 1LL.
Telephone (0532) 443111 YORKSHIRE

Liquid ink technologists

Q.C. COLOURS is an independent company with locations throughout the U.K. We are firmly established in the field of flexible packaging ink and due to continued expansion we require technical staff for the following positions at our Northampton Branch:

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Please send full C.V. and letter with relevant academic and career details to:

Mr. E. McMillan
Group Technical Manager Q.C. Colours Limited,
Stirling Road Industrial Estate,
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Airdrie ML6 7UD.

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SITUATIONS VACANT

PROJECT OFFICER

CAPCIS/UMIST

COATINGS AND NON-METALLICS GROUP

The Corrosion and Protection Centre Industrial Services (CAPCIS) is a self-supporting consultancy unit based at UMIST. Commercially managed with over fifty full-time professional staff, CAPCIS combines highly-qualified corrosion and materials technologists with experienced high calibre industrial consultants.

As part of the long-term development plan, we are seeking a suitably qualified and experienced Project Officer to support activities within the Coatings and Non-Metallics Group. Work is varied and will be divided between short-term commissions, consultancy and contract R & D. Initial salary will be commensurate with qualifications and experience and will be in the range of £8,675 to £15,720.

In the first instance, please supply detailed C.V. to:

DR. JIM BREAKELL,
COATINGS GROUP MANAGER,
BAINBRIDGE HOUSE, GRANBY ROW, MANCHESTER, M1 2PW.

JOCAD1

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SITUATIONS WANTED

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Please reply to Box 8861, c/o JOCCA, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF.

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"ON COLOUR, CHEMISTRY, AUXILIARIES — SOME ADVANCES"

at Sun City on 14 - 16 September, 1988

The following papers will be presented:

The importance of Productivity Improvement in South Africa *by Dr J. Visser National Productivity Institute.*

Current Trends and Developments in MF Resins and their Uses in Industrial Coatings *by Mr J. R. Green, BIP Chemicals, UK.*

Opacity is value for Money *by Mr J. M. Rackham, Tioxide Group PLC, UK.*

Replacement Costing in an Inflationary Environment *by Mr E. G. Webster, AECI Paints, Transvaal.*

New Heterocyclic Pigments for the Pigmentation of Automotive and Industrial Coatings *by Mr E. J. Gangl, Ciba Geigy, Basle.*

You can have any Colour . . . . . *by Mr K. A. Conway, Plascon Evans Paints, Natal.*

Development of Amino-acid Modified Epoxy Resins for Aqueous Can Lacquers *by Messrs W. Raudenbusch, A. Noordam and W. J. van Westrenen Shell Research BV Amsterdam. To be presented by Dr S. A. Stachowiak.*

Artificial Intelligence an Expert System for the Coating Industry *by Mr H. Peters, Compuchem CC, Cape Town.*

High Performance Exterior Alkyd Woodcoatings *by Mr A. S. Masefield, Cray Valley Products, Durban.*

High performance, High Solids Coatings using Solvent Resins *by Mr W. Mayer, Coatings Resins Division of U C C Roundbrook, New Jersey.*

Lacquer Thinners for the Nineties *by Dr D. P. Harpur, Mobil Oil, Cape Town.*

Distance Learning Progress and Developments *by Mr G. M. Russell, SAPMA.*

Solvent Free Polyurethanes for Coatings and Sealants *by Dr H. Gruber, Bayer Leverkusen.*

Protection against Corrosion in hot Climate Zones *by Dr H. B. Hartl, BASF, Ludwigshafen.*

For further details please contact: The Symposium Chairman, Oil and Colour Chemists Association, c/o Chemrite Coatings (Pty) Ltd, P.O. Box 41014, Alrode, 1451 Transvaal, South Africa.

or Contact: Peter Quorn in S. Africa Tel: 27-11-868-1193, Telex: 4-26929 SA, Fax: 27-11-868-2504.

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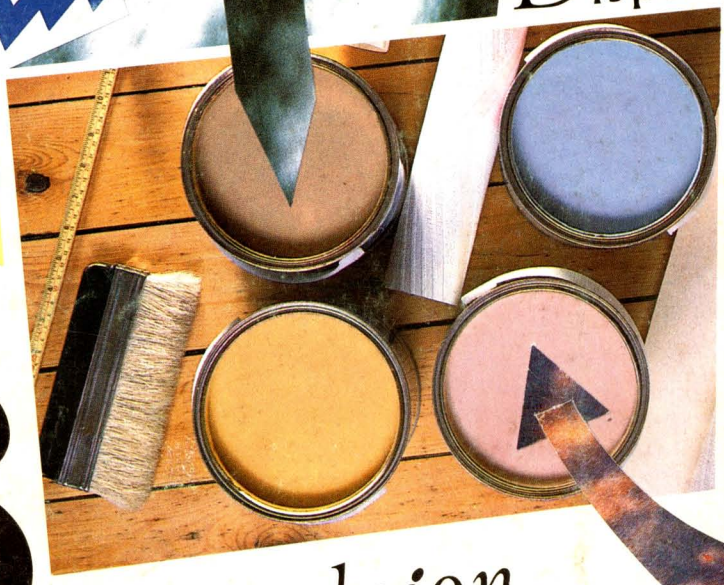

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