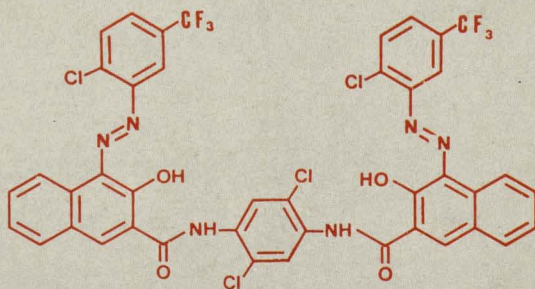


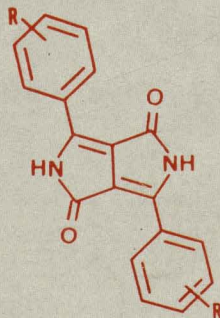


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ADVANCES IN ORGANIC PIGMENTS



PIGMENT RED 242



DPP – PIGMENTS

PIGMENT RED 254 & 255

ALSO IN THIS ISSUE:

- Induction paint thickness gauge calibration
- Ink jet printing ink advances
- Ecologically safe paint systems
- Index and Professional Grade Register

Annual
Index
Vol. 70
1987



CHLORINATED RUBBER TYPE

**CHLORINATED POLYETHYLENE
CHLORINATED POLYPROPYLENE
CHLORINATED RUBBERS
etc.**

APPLICATION

- Anticorrosive coatings
- Road marking paints
- Gravure printing inks
- Adhesives

ADHESIVE GRADES (Low Chlorine Type)

**CHLORINATED POLYPROPYLENE
CHLORINATED ETHYLENE VINYL
ACETATE COPOLYMERS
etc.**

APPLICATION

- Gravure printing inks, adhesives for untreated Polypropylenes
- Primer for plastics



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Editorial correspondence should be
addressed to the Hon. Editor, *JOCCA*,
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at the address below.

General correspondence should be
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General Secretary
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at the address below.

Assistant Editor:
P. J. Fyne, MA, DPhil

Tel: 01-908 1086
Telex: 922670 (OCCA G)

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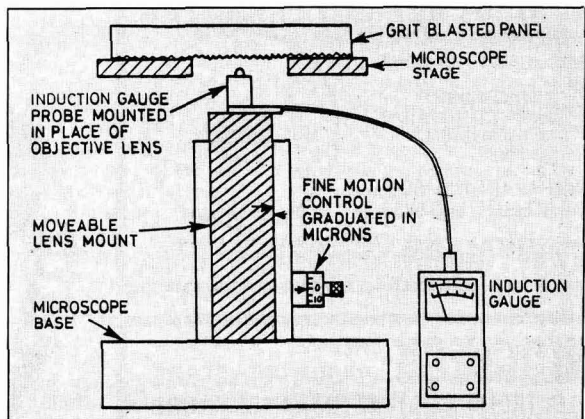
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OIL AND COLOUR CHEMISTS' ASSOCIATION

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

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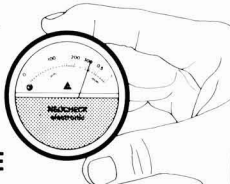
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Courtaulds buys leading US paint company

Courtaulds has acquired Porter Paint Co., a leading US paint company based in Louisville, Kentucky, for \$140 million. Porter is a premium supplier specialising in protective coatings and architectural paints for the professional market with a strong reputation for quality and service and a record of sustained growth. Turnover in 1987 is expected to be around \$120 million. Over the past four years sales have been increasing by about 11% a year and profit before tax at 24% a year. Porter's business is highly complementary to that of International Paint, Courtaulds coatings subsidiary, which is the leading marine and yacht paint supplier worldwide. The combined US operations will create one of the strongest heavy duty coatings companies in North America. Commenting today, Sipko Huismans, the Courtaulds director responsible for coatings, said: "Porter has been high on our list of US paint companies for some time. We recognise it as an excellent business with a cohesive, high quality management team. Combined with International Paint's existing business it will enable us to expand at a faster rate in North America."

ICI unveils new logo



ICI has modernised its logo which was designed twenty years ago. The new logo is the result of a major review led by Wolf Olins, international corporate identity experts. To increase the impact of the roundel, the letters have been increased in size and redrawn in a more modern style and the waves have been smoothed. The new identity will not be introduced overnight but will be phased in gradually to be completed by mid 1989.

Frank J. Borrelle receives 1987 George Baugh Heckel Award

Frank J. Borrelle, Executive Vice-President of the Federation of the Societies for Coatings Technology, was honoured with the 1987 FSCT George Baugh Heckel Award for his outstanding service to the Federation. The award was presented during the Federation's Annual Meeting on 7th October in Dallas. During Mr. Borrelle's tenure as Chief Executive Officer the Federation has grown in stature in the industry and has become an important component in the professional education of its membership. Mr. J. R. Bourne, President of OCCA presented a scroll on behalf of the Association.

Twenty years of titanium dioxide from Sachtleben: now into the nineties with high-tech solutions

Sachtleben Chemie GmbH (a subsidiary of Metallgesellschaft AG, with 1600 employees and annual sales of 480 million DM) has been producing the white pigment, titanium dioxide (TiO₂), in Duisburg-Homberg for twenty-five years. Since its introduction, titanium dioxide has largely displaced other white pigments and is today the mainstay of Sachtleben's trade, making up 55% of sales.

White pigments are used in the chemical processing industries for the manufacture of paints and coatings, plastics, paper, synthetic fibres and other products. Worldwide demand is continuously increasing in all sectors, and even newly constructed plants in the Far East are scarcely able to keep pace. Of the original ten titanium dioxide grades first manufactured at Homberg on the basis of Du Pont technology, only three remain in Sachtleben's present-day range — but forty new product types have been added in the meantime.

The business philosophy of this heavily export-oriented company (65% foreign sales) is founded on speciality products. While other TiO₂ suppliers have concentrated mainly on high production volumes, Sachtleben's strategic objective has for many years been based on the development of specialist products for smaller market segments. For instance, despite an initial share of the world titanium dioxide market of only 3%, it took Sachtleben only a few years to establish itself as the world's leading supplier to the fibres sector, with a market share of 50% worldwide, and over 90% in North America.

Since the sulphate process used at Sachtleben for production of titanium dioxide gives rise to waste acid as a by-product, and the amount of acid which may be discharged into the North Sea is restricted, expansion of TiO₂ production capacity at Homberg seemed for a long time to be impossible. However, the "Waste acid recycling plant" project (building commenced May 1987, investment costs DM 150 million, construction period two years, see JOCCA, p195, 1987) will provide the basis for expansion. And Sachtleben will be enlarging not only its quantitative titanium dioxide production capacity, but also the spectrum of high quality TiO₂ products available to its customers: a co-operation agreement with another German titanium dioxide manufacturer means that Sachtleben's range will in future include pigments made using the chloride process.

The versatility of this highly popular pigment long ago took it well beyond the boundaries of the classical "paints and coatings" field: titanium dioxide is

nowadays used in foodstuffs, in medicine, in environmental protection (flue gas denitrogenation in large power plants) and in the cosmetics industry.

HMG's new R. & D. Laboratory

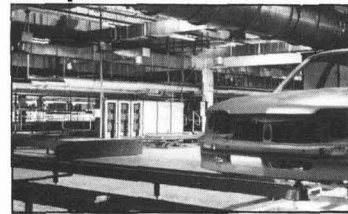


To keep pace with industry demand for customised finishes, paint manufacturer H Marcel Guest has built a new Development Laboratory at its Manchester headquarters. The additional facility provides the necessary physical space for its growing R & D team and rehouses the existing test room and specialised equipment. HMG undertakes a tremendous variety of specialist projects, designing customised coatings for every conceivable application, from golf balls to radio telescopes.

Integrated paint facility at General Motors

F. & H. Controls, the Luton-based Control, Automation and Systems Management Company has provided an integrated system for the installation of a £90m paint shop facility at its Luton plant, which can paint over 50 Vauxhall Cavaliers/Opel Asconas every hour. At any one time eight plcs are operating on-line, communicating to over 17,000 inputs and outputs, and interfacing with five Hewlett Packard HP 1000 family computers. Each car manufactured at Luton now undergoes an automatic 14 stage zinc phosphate treatment, an eight stage Elpo anti-corrosion treatment, and a fully automatic primer paint application before the colour coat is applied with automatic spinning bell machines. The car bodies travel through the process on conveyors and each is visually inspected by quality control personnel after top coat application. Results and scheduling channels are fully computerised.

F & H's programmable controllers at GM's Luton plant



Stop Press: Air Products have acquired the Anchor Chemical Group plc of Manchester for £25.5 m. . . . Williams Holdings (who own Crown Decorative Paints) have acquired Berger Jenson Nicholson for £133 m.

Major Investment Programme for BP Chemicals Barry

BP Chemicals International has announced a major investment programme for its Barry Division, South Wales, UK concerning its three businesses operating there i.e. nitrile rubber, phenolic resins and phenolic foam. A £2 million investment in the Breon nitrile rubber plant will upgrade and improve the removal of free monomer from the nitrile rubber. This project is due for completion early 1989. For Cellobond k technology for phenolic insulation foam BP plans to extend its range of applications in this technology. Plans for Barry Division to increase the capacity of cellobond phenolic resin unit are also being completed. These projects are seen as integral parts of the Quality Improvement Process in which BP Chemicals Barry Division is engaged. Barry Division achieved BS 5750 certifications in December 1986 as one of the steps in a process of continuous quality improvements stretching into the future.

Jean-Pierre DeVleeschouwer: 40 years' service

Recently Jean-Pierre DeVleeschouwer celebrated 40 years of service with NL Industries Inc., the worldwide chemicals and petroleum services company. Mr DeVleeschouwer, who is 61, began his career with National Lead Inc., in 1947 and has been President of NL Chemicals International since 1986.

Lloyd instruments buys Cray Electronics

Lloyd Instruments plc has been purchased by Cray Electronics Holdings plc. Cray Electronics is a publicly quoted company with profits in 1987 of £9.2M on a turnover of £53M. The Cray Group includes Malvern Instruments which is a leading UK manufacturer in particle size technology.

Spanish MIO

Litchem Limited, the Wigan based Chemical and Market Research Company, has signed agreements to market a new source of European Micaceous Iron Oxide. The product mixed in Spain is believed to be one of Europe's most strategic sources. The product, sold to major paint manufacturers, exhibits excellent laminar characteristics, a pre-requisite for this material. The formal agreement is between the German company, Helmut Detter & Co. and Spanish mine owner, Ramon Gimenez commented: "This agency agreement is part of a major expansion in Litchem's activities for 1988. Litchem have a growing number of European partners and we believe that this close collaboration will continue to the benefit of the market place."

40 years of Wacker Silicones — a technique for the future

Silanes, silicones and silicic acids are strategical key products of Wacker-Chemie for the nineties. Investments in this field will amount to 350 to 400 million DM until 1992.

About one half of these investments will be applied for the enlargement of the division which manufactures traditional products such as monomers, fluids, resins and rubbers.

Around 10 to 15% will be invested in new ranges of products. This comparatively high share is the result of a comprehensive research work. This research concerns mainly the modification of traditional materials by specific incorporation of organic groups into the basic structures. These new products are distinguished by specific properties, enlarging the wide range of application of the silicones.

A further 45 to 50 million DM of the above total amount are destined to the enlargements which have become necessary in the field of logistics. This represents a rationalization measure but mainly a preparation for a delivery of materials following a strict schedule, i.e. exactly timed in hours. This is already known and practiced in Japan. In the future many clients will not accept suppliers which are capable of delivering their materials "just in time".

The investments for environmental protection and for security, amounting to 70 to 100 million DM represent 20 to 25% of the total sum and can be considered as

major investments. This is part of the traditional entrepreneurial policy of Wacker-Chemie. The different measures will help not only to minimize permanently the security risk but also to close product circuits or to further reduce the emissions. The current year of 1987 is characterized by our reorganization. The aim is to achieve not only structural improvements but in priority a better position for maintaining a closer contact with customers. This applies to the marketing as well as to sales and engineering services.

After a 40 years experience with silicones we are now in a position to meet individual requirements of our customers for "tailored" problem solutions with our materials. To take advantage of all these opportunities, a close contact with the customers is necessary. This is the objective of our reorganization.

To be in close connection with their customers abroad Wacker-Chemie has erected in the last years five plants (in the U.S., in Mexico, in Brazil, in Japan and in Australia). The main task of these plants is to develop and to manufacture materials which will meet the specific local requirements, the technological, feed-back for our manufacturing strategies in Europe is also of utmost importance.

Thanks to a closer co-operation with our clients Wacker have been able to develop a market strategy in line with real market conditions for the nineties. The technology, the investments and organisation structure have been made available by Wacker-Chemie.

products

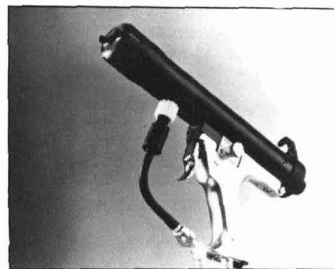
Kremlin expands electrostatic spray gun range

Kremlin Spray Painting Equipment Ltd of Slough has added another spray gun to its Kontour K2 electrostatic range. This is a *pneumatic air assisted Kontour*, i.e. it combines Kremlin's Airmix system with Kontour electrostatics, and can be used with either a low pressure pump or a pressure pot. The new Airmix Kontour creates an adjustable spinning circular pattern which gives the following advantages: the circular fan pattern with a spinning action slows up the forward speed of the paint particles from gun to workpiece to give an enhanced wrap round effect; improves the electrostatic spraying performance of materials with high resistivities; because of air assistance, better penetration is achieved.

Reader Enquiry Service No. 30

New conductive powders

Keeling & Walker Ltd of Stoke-on-Trent has available a new range of inorganic conductive powders, shading from off-



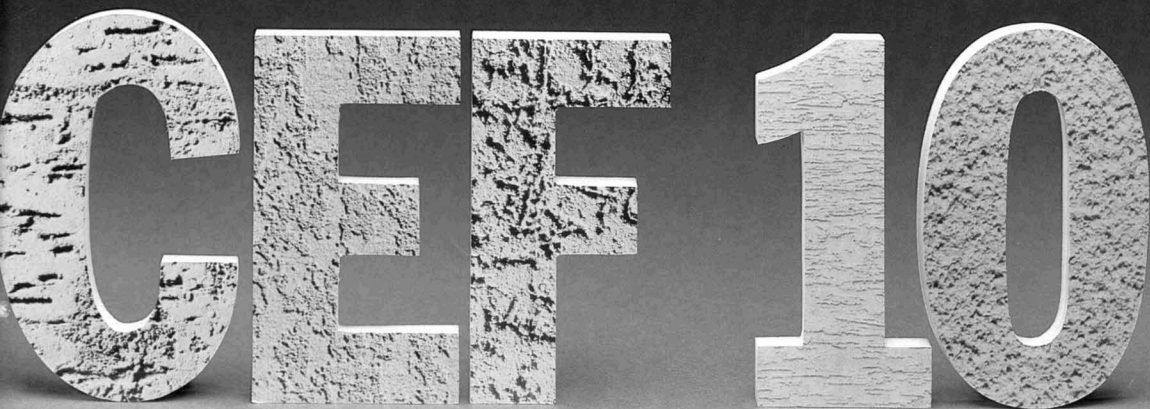
Kremlin Kontour airmix

white to pale grey. Based on doped tin oxide, the powders free the formulation chemist from the problem of masking the natural black or grey colours of carbon black or metallic fillers, enabling him more easily to produce bright or light coloured materials or coatings. The new powders, designated 'StanoStat CP', can be readily formulated as coatings or incorporated directly into paint or polymer systems. They have already shown significant promise in an anti-static coating for synthetic fibres for military, safety, industrial and domestic textiles, in conductive primers for electrostatic spraying of plastic components, and in paper coatings for computer and copier

High quality textured finishes? No problem!

Finishes based on our Vinnapas Dispersion CEF 10 are not only functional – they offer something that looks good too. With the help of this terpolymer Vinnapas Dispersion, a multitude of different textured finishes can be achieved. Our CEF 10 makes finishes easy to apply, able to breathe, permanently flexible and resistant to weather, driving rain and ageing.

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CEF 10

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our contribution to the subject of
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Synthetic resin dispersions are nowadays used in many different fields such as the building, textile, paper, non-woven and adhesives industries.

In the sixties, Wacker-Chemie first managed to produce ethylene/vinyl acetate copolymers on a large scale. This was the starting point for a new generation of copolymer and terpolymer synthetic resin dispersions which are today being marketed the world over under the name of Vinnapas E-Dispersions.

With an annual capacity of 100,000 tonnes, Wacker-Chemie is today Europe's biggest and most important producer of ethylene-containing dispersions.



Complete thermal insulation systems, structural and tile adhesives, textured finishes, interior and exterior paints, roofing compounds, concrete additives.

Carpet backing, finishes, flame resistant finishes, coatings, glass fibre binders.

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Filtration fabrics, hospital non-wovens, hygienic non-wovens, non-wovens for household and industry.

Laminating adhesives for furnitures, flooring adhesives, contact adhesives, adhesives for floors, walls and ceilings, packaging adhesives.

stationery. Easily dispersed and non-settling, the sub-micron particle size powder are inert, compatible chemically and heat stable, and do not degrade or oxidise within most resin systems. Four grades are available offering resistivity values from 5-100 ohm-cm.

Reader Enquiry Service No. 31

Sheen expands range of impact testers

Sheen Instruments of Teddington now manufacture impact testers for paint coatings in accordance with various international standards as well as their long-established BS 3900 models. The photograph below illustrates a model conforming to ASTM 2794. Sheen state that they are now able to make impact testers to any national or international standard.

Reader Enquiry Service No. 32



Sheen impact tester (ASTM-2794)

Goodyear launches new rheological resins

Goodyear France, European Chemical Division, has developed *Plioway EC-L* and *Plioway-EC-T*, two new acrylic film forming rheological resins soluble in virtually odourless, de-aromatised solvents. *Plioway-EC-L* will dissolve to form a thixotropic gel with an "elastic memory". It has been especially developed to bring enhanced flow and levelling and storage stability to flat interior and exterior paints. *Plioway EC-T* will dissolve to form a pseudoplastic gel especially designed to improve application characteristics and storage stability of thick interior and exterior coatings.

Reader Enquiry Service No. 33

Low friction coating

Mebon of Sutton-in-Ashfield, Notts, has available *Utimax BS* a low friction surface coating which was originally designed to solve material flow problems in coal-fired power stations, but is proving to be useful in many different types of industry which experience 'sticking' problems when attempting to make materials such as sand, cement, potash and cereal flow within

containers. For example, *Utimax* has been used by the Central Electricity Generating Board, who needed a continuous, joint-free lining for coal bunkers which would ease bulk flow. This compound has also been used as a means of preventing plaster, in fine dry powder form, from sticking to the sides of concrete bunkers. Finally this product has solved the problem of calcium carbonate in glass works from sticking to the insides of hoppers. The previous method involved a man hitting the hoppers' sides constantly with a hammer. *Utimax BS* is a high solids stick-resistant spray-applied polymer coating which provides good surface slip properties to assist bulk flow; good ice release properties for exterior application during Winter; and excellent resistance to abrasion.

Reader Enquiry Service No. 34

Cementitious coating with 'unbelievable' test results

Liquid Plastics Ltd of Preston has available a *Flexcrete Cementitious Coating*. This material is designed for use in the most testing environments on walls, roofs and floors and has exceptional resistance to attack from aggressive chemicals, etc. This makes it ideal for use on most industrial floors and especially suitable for resurfacing. The matrix density of the Cementitious Coating is so exceptional that even when applied as thinly as 2mm thick and subjected to a 100 metre pressure head of water, its water penetration coefficient equates to a resistance equivalent to 1,000mm of good quality concrete. Thus this enables the coating to be in damp cellars where the treatment of penetrating water would otherwise entail costly and inconvenient major external excavation and tanking.

Reader Enquiry Service No. 35

Corroless new anti-corrosion system

Corroless International of Basingstoke has announced a specially developed coal tar combination enables *Corroless Epoxy* T-low temperature grade to be used in areas subject to excessive moisture, abrasion and impact. It will fully cure down to temperatures of 0°C and lower, thus allowing application on to heavily corroded surfaces throughout the winter months. The combination incorporates the Corroless rust stabilising pigment which enables application on to damp firmly adherent rust, and Glassguard self-leaving glass-flake for increased impermeability, resistance and toughness.

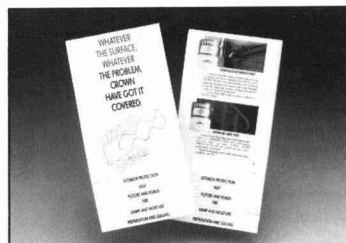
Reader Enquiry Service No. 36

OCCA ties at £4.25 each are available from the Association's offices, with a single Association Insignia on either a blue or maroon background.

literature

Whatever the problem Crown have got it covered

This handy new problem solving brochure now available from Crown Trade Paints is designed to help specifiers and applicators select the correct specialist product to meet every trade requirement, speedily and with confidence. Products developed to offer outstanding performance in the areas of exterior protection, heat resistance, fire retardance and resistance, floors and road markings, damp and moisture and surface preparation and sealing are all explained in detail. The new Crown problems solving booklet is available free from Crown Trade Centres or from Crown Trade Paints, PO Box 37, Hollins Road, Darwen, Lancashire BB3 0BG.



Crown's problem solving brochure

Asphalt thickener

Lawrence Industries has available a new information packet about Englehard's asphalt thickener which is designed as a rheological control agent in asbestos-free sealants and water-proofing coatings used in the construction industry. For copies of the info-pack on the Asphalt Thickener contact: Bryony Quiroga, Lawrence Industries plc, Streatham Road, Mitcham, Surrey CR4 2AP.

New 'Colours for concrete'

Deanshanger Oxides have produced a new brochure on their range of Deanox iron oxide pigments in a selection of concrete products. Copies are available from: Deanshanger Oxides Ltd, Deanshanger, Milton Keynes MK19 6HA.

meetings

Mixing/Rheology courses

The Centre for Professional Advancement will hold a 3-day course on Powder Mixing Technology from 22-24 February 1988 and Applied Industrial Rheology from 21-23 March 1988 in Amsterdam, Holland. The fee for each course is \$1,000. For further

information contact: The Centre for Professional Advancement, Palestrinastraat 1, 1071 LC Amsterdam, The Netherlands.

Missouri Short Courses

The University of Missouri-Rolla will hold the following Short Courses: Feb 22-24 1988, Maintenance Coatings for Contractors and Paint Inspectors, "Know Your Paints to Avoid Complaints", Feb 29-Mar 4, Introductory Short Course - The Basic Composition of Coatings, Mar 14-18, 16th Introductory - Paint Formulation, Apr 18-20, Conformal Coatings, May 16-20 Physical Testing of Paints and Coatings form Classic Methods to Modern Instrumental Techniques. For further information contact: Coatings and Polymer Science Program, Department of Chemistry, University of Missouri-Rolla, Rolla, Mo 65401-0249, USA.

people

RTZ Chemicals

John Matthews has been appointed managing director of a new management company, RTZ Chemicals UK Ltd, formed to assume overall responsibility for RTZ's chemicals operations in Britain. Mr Matthews was formerly marketing director of Crosfield Chemicals in Warrington.

BP Chemicals specialities appointment

Greg Wand has recently joined BP Chemicals Specialities Directorate. Mr Wand will be concerned with the international speciality sector. He has had international experience in the development of new businesses, having spent nine years in S E Asia developing an oilfield service business for Asia and Australasia.

New managing director at Spencer

Spencer plc, the Aberdeen-based manufacturer of industrial coatings and decorative paints, has announced the appointment of **Bill Findlay** as Managing Director. Mr Findlay is a graduate of Strathclyde University, member of the Licensing Executives Society and Fellow of the Institute of Petroleum.

New appointments: Sol Chemicals

Sol chemicals the Speciality Chemicals Division of the Solrec Group, Morecambe, have made two new appointments to their sales and marketing team. **Colin Matthews**, a graduate chemical engineer with sales experience in the chemical industry, is appointed Southern Area Sales Manager and **Jaimie Clarke**, a graduate chemist, is appointed Marketing Assistant based at the Morecambe Sales Office.

Reed Plastics Containers appoints new quality manager

Laurence Griffiths has been appointed Quality Manager of Reed Plastic Containers of Oakham, Rutland. In his new position Mr Griffiths will be directly involved in Reed's programme leading towards registration under ISO 900. Mr Griffiths is an Associate of the Institute of Works.

FSCT elections

Deryk R. Pawsey, British Columbia Area Manager of Rohm and Haas Canada Inc., Vancouver, BC, has become the 66th President of the FSCT. **James E. Geiger**, of Sun Coatings, Inc., Largo, Fl, was named President-Elect and **John C. Ballard**, of Kurfees Coatings Inc., Louisville, KY, was elected treasurer.

Executive Vice President of FSCT

Deryk R. Pawsey, President of the FSCT has announced the appointment of **Robert F. Ziegler** as Executive Vice-President. Mr Ziegler will also serve as General Manager of the Federation's Annual Meeting and Paint Industries' Show, and as Publisher of Federation publications. Mr Ziegler joined the Federation staff in 1976 as Assistant Editor of the Journal of Coatings Technology.

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Sandoz Huningue S. A., Avenue de Bâle, F-68330 Huningue, France

Summary

The organic pigment industry has been faced with new challenges and opportunities due to the startling expansion of the plastics, paints and coatings, printing and writing inks, and man-made fibres industries, coupled with the growth of the transportation industry, over the past three to four decades. New substrates and novel technologies, initially introduced because of technical and durability reasons and more recently as the result of economical and environmental pressures, have led to the development of new high-grade, non-toxic organic pigments of good to excellent fastness properties and to the improvement of existing classes of pigments. The objective of this paper is to review some of these developments. The subject matter presented is not a complete analysis of the recent advances in the field of the chemistry and technology of organic pigments. It only deals with some areas, particularly novel azo, heterocyclic and metal complex pigments, where our research interests lie. Whilst describing the characteristics of these novel pigments, some formulations based on these products rather than the properties of the individual products are discussed. Specific attention is given to unsolved problems in this field.

Introduction

The pigment industry is basically a segment of the chemical industry and like most chemical products, organic pigments are the offspring of modern industry that saw an explosive growth during the post World War II period. Colour pigments have wide applications. They can be found in most products that are coloured and recently in increasing amounts in textiles via mass coloration. In fact, the production of organic pigments already constitutes 40% of the total synthetic colouring matters produced throughout the world. Pigmentation does not only provide sales appeal and customer acceptance, it can and does in many cases impart functional characteristics (like light and heat protection) to the substrate.

The fact that classical pigments could not meet the demanding requirements of modern industry was recognised by major pigment producers early on. This recognition provoked extensive research for novel products culminating in the discovery of a new generation of organic pigments, called high-performance pigments, with entirely novel chemical structures. Moreover, the physical form of some already known pigments have also been modified to make their excellent inherent characteristics economically compatible with the type of application. The object of this paper is to examine this new generation of pigments for coatings application. The subject matter on the advances in the science and technology of pigments is large. This paper will concentrate on areas of particular interest to the author.

1. Chemistry

Arylamide Azo Yellows

The Hansa Yellows and Benzidine Yellows (Figure 1), derived from acetoacetarylamide coupling components, are the oldest and still one of the most important classes of

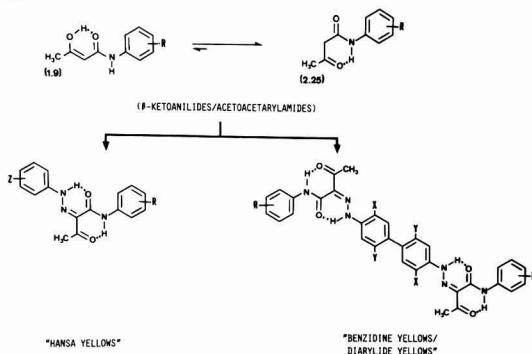


Figure 1.

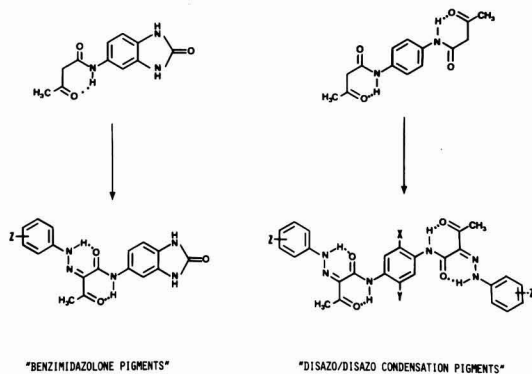
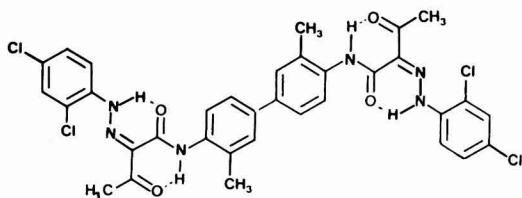


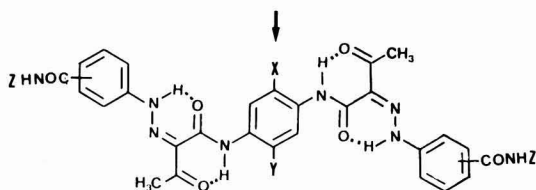
Figure 2.

organic pigments. Hansa Yellows exhibit good light fastness and find wide application in almost all aqueous paint systems because of their acceptable working properties. However, their use in solvent-borne systems, baking enamels and powder coatings is very limited due to their bleeding characteristics and blooming problems. Benzidine Yellows, on the other hand, possess better solvent resistance and heat stability. They are also well-known for their stronger and brighter colours. Unfortunately, these pigments are generally too deficient in light fastness for them to be used in paints and coatings. For these reasons research was carried out either to impart insolubility and improved colour strength to monoazo pigments or to improve the light fastness characteristics of diarylide pigments. This research led to the discovery of the benzimidazolone pigments¹ and the so-called disazo/disazo condensation pigments² (Figure 2). The benzimidazolone pigments are basically insolubilized Hansa Yellow pigments bearing a benzimidazolone moiety as the arylamide remainder.

The yellow disazo condensation pigments (Figure 3) formally represent a further development of the chemistry of Pigment Yellow 16 in which the bridging component, o-tolidine, of bis-acetoacetarylamide coupling components



PIGMENT YELLOW 16

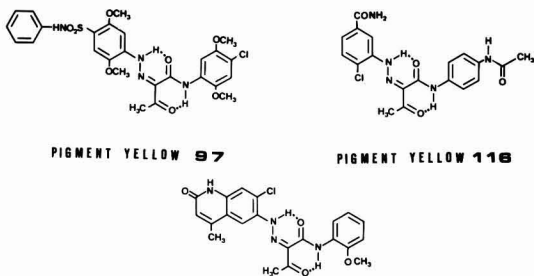


"DISAZO/DISAZO CONDENSATION PIGMENTS"

Figure 3.

has been replaced by a phenylene group and the diazo components bear additional arylamide groups. As the name implies, the condensation pigments are obtained by the coupling/condensation process rather than the coupling process alone.

Along the way to the synthesis of the above classes of pigments, monoazo pigments which belong to the same class but bear peculiarities like the presence of amide or cyclic amide groups either in the diazo or in the coupling component or both have also been reported. Here examples include Pigment Yellow 105³, Pigment Yellow 116⁴ and of particular importance is the very widely used pigment Pigment Yellow 97⁴ (Figure 4).



PIGMENT YELLOW 105

Figure 4.

Except for Pigment Yellow 128, disazo condensation pigments have generally failed to meet the value-in-use requirements of pigments for surface coatings⁵, although they are widely used for plastics applications. However, in 1977 the disazo condensation yellow group of pigments has been extended to include a very greenish yellow pigment, Pigment Yellow 155⁶, with improved price-profile characteristics. This pigment bears ester groups rather than arylamide groups in the diazo component.

The newer types of monoazo pigments (including benzimidazolone pigments) do indeed possess much

improved solvent resistance and even improved weatherability. Nevertheless, these improvements have been invariably achieved at the expense of the already deficient colour strength of this particular class of pigments. However, recently a totally novel class of monoazo pigments has made its debut on the market. These pigments are characterized by the insolubility and colour strength of disazo/disazo condensation pigments, and the durability properties of the insolubilized type of monoazo pigments. The first representative of this class of pigments is Pigment Yellow 182⁷. Chemically, these pigments bear a heterocyclic moiety containing polyamide functions within their chromophoric system. They owe their high heat and light stability to the doubly intramolecular hydrogen bonded hydrazone structure, and their insolubility to intermolecular hydrogen bonds via the cyclic amide groups (Figure 5).

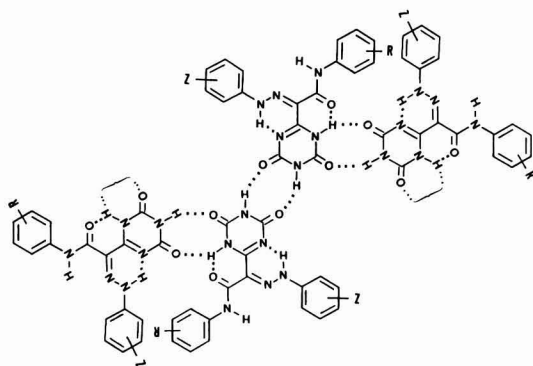


Figure 5.

Azo Red Pigments

Azo red pigments (Figure 6) constitute the largest volume of the organic pigments produced throughout the world. The oldest and the most prominent β -naphthol derivatives, like toluidine and para reds, are inadequate for modern requirements because of their poor heat stability and solvent resistance. Classical 2-hydroxy-3-naphtharylide azo pigments like Pigments Red 9, 11, 22, 23 and the slightly improved Pigment Red 112 possess somewhat better fastness properties. However, their insufficient bleed resistance and heat stability generally preclude their use in baking enamels and powder coatings.

Attempts to impart insolubility and better fastness characteristics to monoazo pigments in the orange to red shade area have culminated in the discovery of two new classes of pigments (Figure 7):

1. Naphtharylide pigments derived from 4-Sulfonamido-2-5-dichloroanilines as the diazo components⁸, and
2. the pyrazoloquinazolone pigments⁹.

These pigments, ranging in shade from reddish orange to bluish red, exhibit much improved exposure durability against state-of-the-art pigments for example pigment Red 170. Therefore, they are ideally suited for formulating very bright orange to red lead-free finishes of superior fastness properties. These two classes of pigments seem to have been particularly developed in the light of water-based, low solvent-based and powder coatings. They have made inroads into almost all areas of surface coatings because of environmental protection concerns.

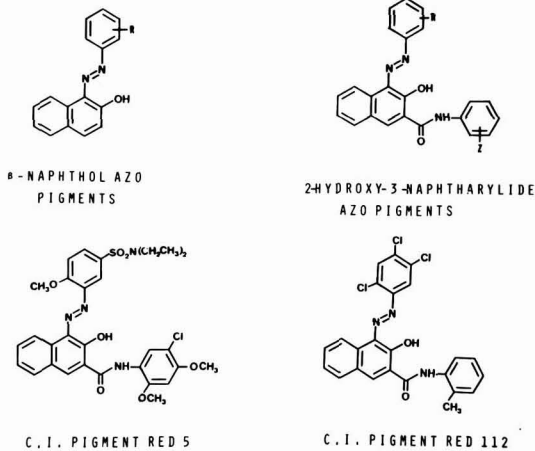


Figure 6.

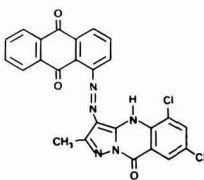
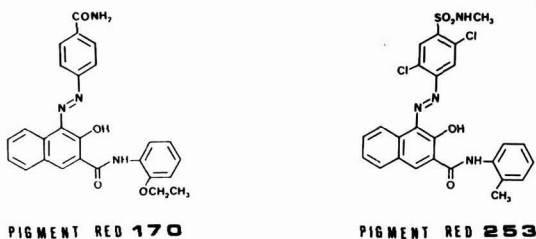


Figure 7.

It may be stated here that the search for novel azo red pigments has also extended to include the monoazo benzimidazolone pigments and the disazo condensation pigments. These pigments seem to be of more commercial importance for plastics application than in the paints and coatings industry. An exception to this statement is the disazo condensation pigment Pigment Red 242¹⁰ (Figure 8), put on the market in late 70s. This pigment possesses a brilliant scarlet shade, similar to that of molybdate orange, and could be of potential interest as a lead replacement.

Heterocyclic Pigments

The quinacridones and tetrachloroisindolinones are the most important classes of heterocyclic pigments belonging to the newer generation of pigments. Except for their structure determination and mechanism of formation¹¹, the chemistry of quinacridones has remained rather quiescent in the recent past. The isoindolinone group of pigments has been extended by the addition of a new greenish yellow pigment, Pigment Yellow 173¹², in which the chlorine atoms are contained in the bridging diamine rather than in the isoindolinone ring. Besides possessing a much higher

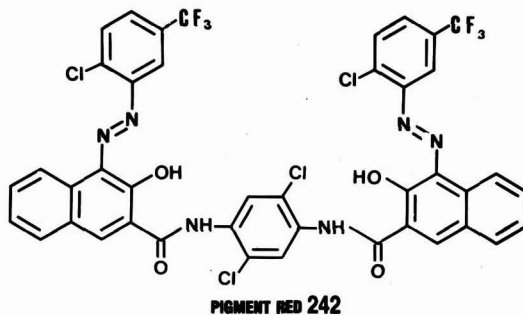


Figure 8.

colour strength, it is perhaps the most exposure durable greenish yellow pigment available on the market. A further addition to this class of pigments has been the inclusion of indoline type of pigments like Pigment Yellow 139 and Pigment Yellow 185¹³ (Figure 9). These pigments are of still higher colour intensity, partially offsetting the main drawback of isoindolinone type of pigments, i.e. their rather poor colour strength.

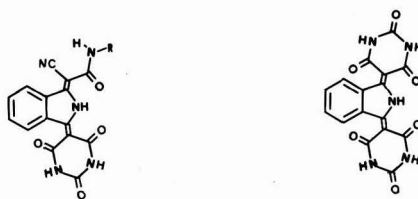
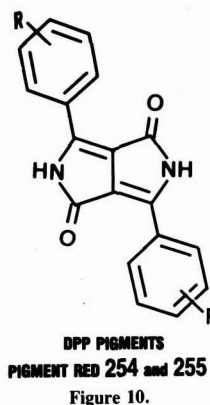


Figure 9.

The DPP (diketopyrrolopyrrole) pigments, viz. Pigment red 254 and 255 (Figure 10), are the latest class of heterocyclic pigments to reach the market¹⁴. They have been developed for lead-free automotive topcoats. However, because of their newness little information is available on their real technical merits.



Metal Complex Pigments

The epoch metal complex pigments chemistry and technology began in early 30s when the first phthalocyanine pigment was marketed. This range now includes a variety of

products, for example, nickel azo Pigment Green 10, nickel dioximes; Pigment Yellow 153 and Pigment Orange 59, copper azomethines; Pigment Yellow 117 and Pigment Yellow 129, and cobalt isoindolinones Pigment Yellow 177 and Pigment Yellow 179¹⁵. Within the last three years this commercial range of yellow to yellow-orange metal complex pigments has been further supplemented with a benzimidazolone bearing reddish orange nickel complex Pigment Orange 68¹⁶ and a red-violet isoindoline nickel complex Pigment Red 257¹⁷. The former Pigment is recommended for automotive metallic finishes in its transparent version and for coil coating application purposes in its opaque form. With its inherent properties similar to those of quinacridone pigments but with excellent application properties like rheology and dispersibility, Pigment Red 257 is mainly recommended for automotive solid red and deep-maroon colours.

With a few exceptions, metal complex pigments generally exhibit rather dirty shades in white reductions. However, in deeper colours and particularly in metallics, they outperform polycyclic pigments because of their non-seeding character and superior exposure durability in spite of their extreme transparency. Moreover, in this latter application they even provide much stronger and somewhat brighter shades.

2. Technology

Particle size, shape and distribution

Pigments are particulate organic and inorganic solids that are practically insoluble in the substrate in which they are incorporated. The pigmentation process basically involves dispersing pigments in the medium to be pigmented. Therefore, the size, shape, structure and surface properties of the individual particles of a pigment are of paramount importance both for ease of application and end use. The particle size and structure influence dispersibility, transparency or opacity, colour strength, hue and chromaticity, flocculation, gloss and rheological properties. It is also not unusual to observe that even such intrinsic properties as fastness to light, solvents and heat, that are generally attributed to the chemical constitution, are significantly influenced. This has been known for some time, but it is only recently that organic pigment manufacturers are paying more and more attention to these properties. The reason is that organic pigments, previously being used as shading components of predominantly inorganic pigmentations, are now being used as the main elements in colour paint formulations.

An example of the influence of crystal structure on the properties of a pigment can best be illustrated in the case of Pigment Red 253. This pigment can be produced in the existing semi-opaque commercial form or in a yet to be marketed highly opaque form (Figure 11). Whereas the existing commercial form consists of smaller crystals with somewhat broader particle size distribution, the opaque form contains much larger crystals of a very narrow size distribution (Figure 12). The latter is characterized by noticeably improved application and fastness properties.

Thus, pigments are now being tailored more precisely to requirements. However, it should be borne in mind that the transparency is generally achieved at the expense of durability, whereas the opacification deprives a pigment of some of its colour strength.

ELECTRON PHOTOMICROGRAPHS 20000 X



Figure 11.

PARTICLE SIZE DISTRIBUTION

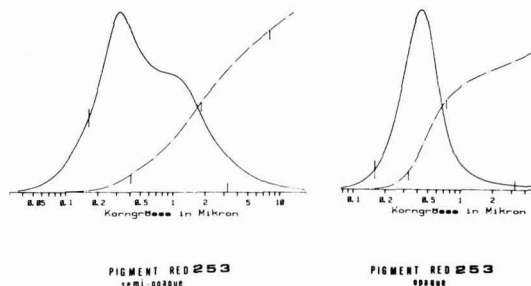


Figure 12.

Surfaces treatment

The use of a vast array of surface active agents during pigment finishing to achieve improvements in the properties of individual pigments is well-known. However, to avoid any undesirable side effects in the paint formulations, this process is becoming less popular and shall not be dealt with here.

A novel method of modifying the surfaces of the pigment particles has recently been developed in Japan. The method, called low temperature plasma oxidation, consists of superficial oxidation of the crystals under controlled conditions. This method is believed to impart polarity, and hence improved dispersibility in polar systems, to pigments without impairing their original properties¹⁸.

Physical forms

Hygienic conditions demand that the pigments be non-dusting without impairing their ease of incorporation. These conditions are being met by developing such physical forms as pigment granules¹⁹.

Pigment preparations

Again, from the hygienic point of view and economic considerations the so-called pigment preparations are finding growing application and acceptance from colour formulators.

Pigment preparations are basically predispersed pigments in a physical form easy to handle and use. They invariably offer numerous advantages over powder pigments. However, it is particularly important that an appropriate carrier be chosen for the predispersion. Ideally, the carrier

is freely compatible with the medium to be coloured without affecting its functional properties. To minimize the risk of compatibility, it is desirable to have a pigment preparation with the highest possible pigment content²⁰.

3. Application

The principal properties of pigments that determine their ultimate choice for paint application may be described as follows:

1. Application properties (i.e. dispersibility, rheology, opacity/transparency, solvent resistance, heat stability, flocculation, gloss etc.)
2. Chromaticity, colour strength and value-in-use.
3. Specific functional properties appropriate to the particular use of the surface coated product (i.e. durability etc.)

While evaluating pigments for surface coatings, it is important that their properties be compared on the basis of their colour strength and not on an absolute weight basis. Thus, a pigment of low colour strength but possessing excellent flow properties, hiding power and dispersibility may, initially, appear to be superior to a colour strong pigment in any or all of these properties. But, because of its inherent lower colour strength, the superiority of the former may not even be discernible in the actual paint formulation. A colour paint formulation based on a single pigment is more of an exception than a rule.

Most formulations are derived from a combination of inorganic and organic pigments. Whereas inorganic pigments are required to contribute to hiding and flow properties, organic pigments usually impart colour intensity and brightness. An ideal pigment formulation should, therefore, be based on a functionally selected combination in which each element does best what it is supposed to do, namely inorganic components providing opacity and organic components taking care of brightness and colour intensity. Any deviation from this solution to the equation of paint formulations, viz. pigmentations derived from predominantly organic pigments, is bound to lead to exorbitant costs that may not even be justified in every end use.

Our expectation regarding the adequacy of these criteria is, in fact, fully borne out by the experimental results. Thus to cite a few examples, the formulation of "Post Office Yellow" RAL 1021, which is very close to BS 355 "Lemon", based on Pigment Yellow 151 requires up to 300% of this colourant versus Pigment Yellow 182 (Table 1). Similarly, RAL 3000 based on semi-opaque Pigment Red 253 require half the amount of organic components against the one based on Pigment Red 170/Pigment Orange 34. Again, the formulation of RAL 3002, which is similar to BS 538 "Post Office Red", requires at least 30% less amount of Pigment Red 253 compared to Pigment Red 170.

4. Future

Stringent toxicological and ecological regulations and ethics

In the past the environment was freely exploited both as a resource and as a waste dump. In the future both legislative and ethical barriers will control all aspects of production

Table 1.

Pigmentation of "Post Office Yellow" RAL 1021 (Similar to BS 355 "Lemon")

<i>Example 1</i>		
Product		Amount (KG)
Pigment Yellow 182		0.2
Pigment Yellow 53		0.8
Pigment Weight Concentration	=	22.5%
Pigment Volume Concentration	=	9.7%
Film Thickness (Grey/Black contrast)	=	60µm

<i>Example 2</i>		
Product		Amount (KG)
Pigment Yellow 151		0.61
Pigment Brown 24		0.39
Pigment Weight Concentration	=	22.5%
Pigment Volume Concentration	=	15.0%
Film Thickness (Grey/Black contrast)	>	60µm

and waste management, not only in the pigment industry but also in the application industries. They may even filter down to consumer level.

Environmentally safe chemistry

The chemical industry will continue to play a vital role in sustaining and enriching our lives by influencing our health, food, agriculture, housing, clothings, transportation, packaging, communications and recreation. However, the growing public concern about chemicals, caused by the new spate of incidents, must be allayed. The industry will thus be forced to adopt adequate safety control facilities in production, storage and transportation of their products. Moreover, new products that are safe to handle, simple to apply and easy to dispose of without causing extensive environmental nuisance will have to be developed.

Durability factors

Excepting on-line finishing, coatings application is generally a very labour intensive operation. In the light of labour costs bearing no proportion to material costs, coupled with environmental pressures, it is believed that the durability factor will play a more important role in surface coatings in the future. Surface coatings are basically polymeric films susceptible to degradation while granting protection to the coated material. Coatings will have to be developed that last longer, maybe even in combination with stabilizers. Pigments will have to match these demands and requirements at reasonable value-in-use levels. If most of the pigments and stabilizers now in use are re-examined from this point of view and also what has been discussed under the sub-title "Application", there is still a large amount of research work to be undertaken.

Novelty and profitability pressures

After the industrial boom, lasting from the mid-50s until the first oil shock of the 70s, which launched the so-called developed countries on the path to modernity, there has been a period of consolidation and comparative stagnation. During this period, and maybe even today, people believed in manipulating rather than creating wealth²¹. Financial

wizards and software specialists have over-shadowed the functions of scientists and technologists. Wall Street and the Bond Markets have become more important than industrial conglomerations. As a result of this approach there has been a tremendous growth in unemployment and devaluation of currencies of the countries where this trend seems to be most conspicuous. In the future we anticipate a return of the cycle with industrial expansion. However, as the result of new environmental constraints plus economic pressures to ensure maximum profitability and our own moral responsibility towards the society, one will have to strive for a qualitative rather than a quantitative growth. Non-toxic, non-hazardous, non-polluting, ease of application, better resistance and durability, and last but not least better value-in-use are going to be some of the keys to this turnaround. However, the master-key is bound to be the open-mindedness and willingness to take calculated risks.

The coatings industry and its raw material supply industries have been characterized as one of the most mature of all global industries. Yet they are no more and no less mature than any other branch of the chemical industry. An industry becomes mature when the people involved in it cannot generate any new ideas. It is hoped that our own industries will stave off maturity for many years yet.

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The calibration of induction paint-thickness-gauges for measurements over blast cleaned steel

M. McKenzie

Transport and Road Research Laboratory, Old Wokingham Road, Crowthorne, Berkshire RG11 6AU, United Kingdom.

Summary

The measurement of the thickness of a paint coating applied over a blast cleaned surface usually concentrates on trying to estimate the thickness above the peaks of the underlying profile. This is generally approached by either calibrating the paint thickness gauge directly on the blast cleaned surface or by calibrating the gauge on smooth steel and subtracting a separate allowance for the effect of the profile. These two procedures can give quite different estimates of thickness above the peaks. Experiments were carried out in which the distance indicated by an induction paint thickness gauge from a specific point on a grit-blasted surface was compared to the absolute distance. These experiments showed that calibration on a grit blasted surface can introduce errors and that calibration over smooth steel with a separate estimate of profile effect is to be preferred. However, it is stressed that any estimate of paint thickness above the peaks of the profile is, to some extent, arbitrary, and it is suggested that paint thickness specification should be formulated in terms of a particular, well defined measurement procedure.

Introduction

On structural steelwork, paint is applied over a rough blast-cleaned surface and variations in the profile height of that surface can be of the same order as the thickness of paint to

be applied. Under such circumstances it is very difficult to define paint thickness, particularly a concept such as thickness above the peaks of the profile, in an unequivocal way. In reality estimates of paint thickness are defined only in terms of the particular measurement procedure used. The problems of definition and measurement were discussed in detail in an earlier publication¹.

In measurements with magnetic dry film thickness gauges the estimation of thickness above the peaks is usually approached by either calibrating the gauge directly on the grit-blasted steel surface using shims (surface calibration) or by calibrating the gauge on smooth steel using shims (smooth calibration) and subtracting a 'profile effect' from any thickness measurements taken. The profile effect is usually based on the average of a set of measurements taken directly on the grit blasted surface. This estimates the distance of the magnetic surface of the steel, from which the gauge actually measures, beneath the peaks of the profile. Notice that by this method the position of the peaks of the profile is determined by the average position taken up by the probe on the steel surface. The profile effect can be defined as the indicated induction gauge distance of the probe from the steel minus the absolute distance. Here this

absolute distance is zero because the probe is touching the steel surface.

When a shim is placed on a grit blasted surface and its thickness measured using a gauge previously calibrated on smooth steel, the indicated shim thickness shows an increase over the actual shim thickness. This increase is an indication of the profile effect at that particular point. In surface calibration the gauge is then adjusted to read the actual shim thickness, thereby removing the profile effect and allowing direct measurement of thickness above the peaks of the profile. Calibration is usually carried out at either end of the relevant thickness range and calibration positions on the surface are chosen to be representative of the general profile. Notice that, in surface calibration, the position of the peaks of the profile is determined by the average position taken up by the probe plus shim on the steel surface.

In essence, both methods of calibration should lead to the same estimate of thickness above the peaks provided that the two estimates of profile effect, using the probe direct on the grit blasted surface in the case of smooth calibration and using the probe plus shim in surface calibration, are equivalent. In fact they are not. The apparent increase in shim thickness due to the profile is not constant but varies with the thickness of shim used, the thicker the shim the greater the apparent increase in shim thickness¹. This implies a variable profile effect as the distance of the thickness gauge probe from the steel increases. Since smooth calibration followed by subtraction of a profile effect assumes a constant profile effect with distance, the two calibration methods will lead to different estimates of thickness above the peaks.

To decide which is the more accurate of these methods of calibration is made difficult through lack of an absolute method of measurement of thickness above the peaks against which they can be compared. Use of cross sections of painted specimens on which induction gauge measurements have previously been taken is a common method but has serious limitations. The basis on which the thickness above the peaks is estimated from cross sections is itself arbitrary – and the tedious nature of cross-section preparation means that only a very small sample of the surface can be examined. It is, of course, impossible to relate a particular induction gauge reading to a particular position on a cross section.

To overcome some of the difficulties inherent in the use of painted specimens an alternative approach was taken. This paper describes experiments in which the effect of profile on induction gauge readings was studied by comparing the absolute distance of the probe from specific points on an unpainted steel surface with the indicated distance on an induction gauge.

Experimental

Method of absolute/indicated distance comparison

The probe of an induction gauge was mounted in the position normally occupied by the objective lens of a metallurgical microscope equipped with a fine motion control. A steel test specimen was placed on the microscope stage and the induction gauge probe moved up to touch the steel surface. This served as a zero point. Then, by using the graduated fine motion control on the microscope, the

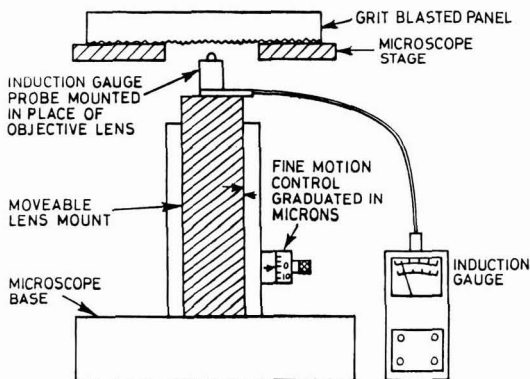


Figure 1. Comparison of induction gauge readings with distance from a steel surface using a metallurgical microscope.

induction gauge probe could be positioned at any chosen distance from the steel surface and the indicated distance on the gauge compared with the absolute distance; see Figure 1. Two types of induction gauge were used, an analogue instrument and a more modern, microprocessor controlled digital instrument. Since the operating procedure differed for the two gauges, two separate sets of experiments were carried out.

Experiments with the analogue gauge

Smooth steel calibration of the analogue gauge

A smooth steel block was placed on the microscope stage and the induction gauge probe moved up to touch the steel. The gauge reading was adjusted to zero. The probe was then moved exactly 500 μm away from the steel, using the microscope fine motion control, and the gauge reading adjusted to 500. The gauge had now been calibrated at both ends of the scale in use. A calibration curve was then built up by moving the probe back to touch the steel (the zero point) and then moving the probe away from the steel surface in 25 μm steps and noting the induction gauge reading at each position.

Effect of the grit blasted profile on analogue gauge readings

After the gauge had been calibrated on smooth steel in the manner described above, the smooth steel block was replaced with a grit blasted panel on the microscope stage. The probe was moved up to touch the steel surface of the grit-blasted panel and the reading on the induction gauge noted. Because the magnetic surface plane of the steel, which the probe 'sees' as the zero point, lies beneath the peaks of the profile, this reading represented the profile effect at that particular point on the steel surface. The induction gauge probe was then moved away from the steel surface in 50 μm steps and the induction gauge reading noted at each position. By this method the profile effect at varying distances from a particular point on the steel surface could be found.

All the above procedures were carried out at four positions on each of two panels that had been blast cleaned with G5 grade grit² and two panels that had been blast cleaned with G24 grade grit².

To compare these absolute estimates of profile effect

with the effects given by shims, the induction gauge was calibrated on the microscope then used to measure shims of known thickness over smooth steel and each of the grit blasted panels used previously. On the grit blasted panels, 20 readings were taken over each shim placed at various positions on the surface and the average effect calculated. In addition 20 readings were taken directly on the grit blasted surface.

Results from analogue gauge tests

Figure 2 shows the calibration curve for the analogue gauge as the gauge error plotted against the gauge reading. Gauge error is defined as the difference between the indicated induction gauge distance from the smooth steel surface and the actual distance. The actual distance in this case was the distance set on the microscope.

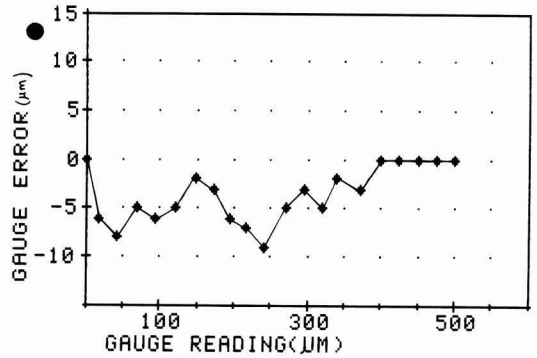


Figure 2. Calibration curve: analogue gauge.

Figure 3 shows the profile effect (i.e. the difference between the indicated induction gauge distance from the steel surface and the actual distance), when the actual distance is given by the shim thickness. For the G5 panels there was little change in profile effect with increasing shim thickness, but for the rougher, G24 panels the profile effect increased with increasing shim thickness. The curve for smooth steel shows that the shim thicknesses were being measured quite accurately over smooth steel. (Note: Profile effect and gauge error, as defined earlier, are numerically equivalent).

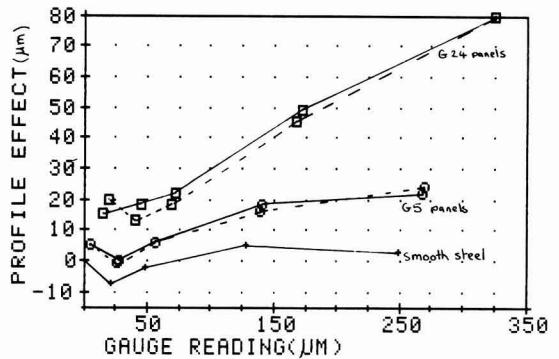


Figure 3. Apparent profile effect using shims to estimate absolute distance from steel: analogue gauge.

Figures 4, 5, 6 and 7 show the profile effect for the G5 and G24 grit blasted panels when the absolute distance from the steel surface was measured on the microscope. For comparison the smooth steel calibration curve is also shown on each figure. For both sets of grit blasted panels the profile effect is fairly constant as the distance of the probe from the panel increases contrary to the impression given by the measurements over shims.

Experiments with the digital gauge

The mode of operation of the microprocessor controlled digital gauge differed from that of the analogue gauge in that the digital gauge took a reading as soon as the gauge probe was relatively stationary at a distance from a steel surface within the measurements range of the instrument (0 to 1,000µm). This reading remained on display until the probe was taken out of the measurement range then returned into the range once more. Hence the exact positioning used with the analogue gauge was not possible and amended procedures were used.

Smooth steel calibration of the digital gauge

A smooth steel panel was placed on the microscope stage and the digital induction gauge probe moved up to just touch the panel. The probe was then moved exactly 900µm away from the panel using the fine motion control of the microscope. The steel panel was then tilted up and back down on the microscope stage. This tilting effectively took the gauge probe out of the measurement range of the instrument then returned it into the range thereby giving a reading on the induction gauge. The gauge calibration control was adjusted and the tilting procedure repeated to give a reading of 900µm on the induction gauge. Since the steel panel was smooth, any slight horizontal changes in position should not have affected the distance from the probe. This was confirmed by taking a number of readings.

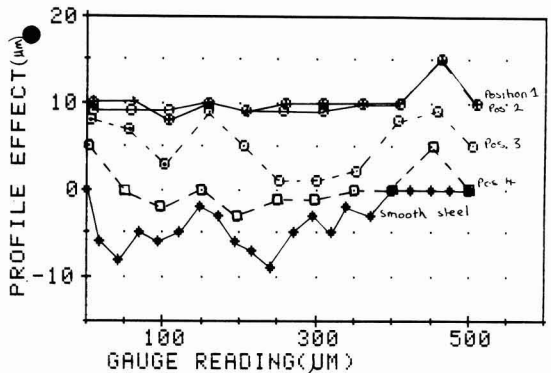


Figure 4. Variation in profile effect with distance from steel G5 panel 1: analogue gauge.

The probe was now moved back 900µm to just touch the panel and the zero position set in a similar way. A calibration curve was then built up by moving the probe away from the steel in 50 or 100µm steps and noting the average induction gauge reading at each position by the tilting procedure. Again variation between readings at a particular position was very low. A second calibration curve was built up in the same way for calibration points of 0 and 500µm.

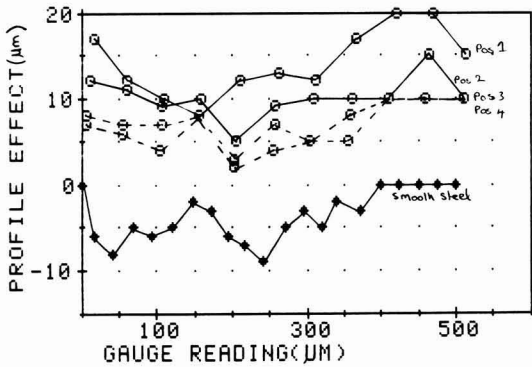


Figure 5. Variation in profile effect with distance from steel G5 panel 2: analogue gauge.

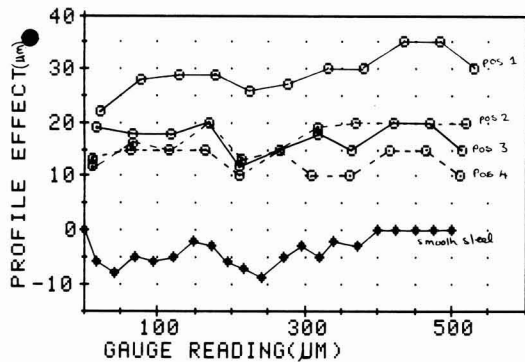


Figure 6. Variation in profile effect with distance from steel G24 panel 1: analogue gauge.

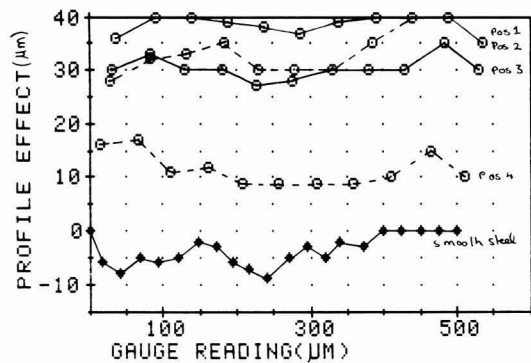


Figure 7. Variation in profile effect with distance from steel G24 panel 2: analogue gauge.

Effect of profile on digital gauge readings

The digital induction gauge was calibrated using a smooth steel panel as described above. A grit blasted panel then replaced the smooth steel panel on the microscope stage. To assess the effect of profile at specific positions on the panel surface the probe was positioned at a distance from a grit blasted panel outside of the measurement range of the gauge. Using the fine motion control, the probe was then moved to an arbitrary distance from the steel panel within

the measurement range. As probe movement was halted an induction gauge reading was obtained. The probe had to be moved quite rapidly with the fine motion control as the gauge equated slow movement with stationary and gave a reading whilst the probe was still moving. Hence the final distance of the probe from the panel surface could only be controlled approximately. This procedure was repeated so as to give a range of different positions from the panel and associated induction gauge readings. Although the exact distance from the panel was not known, the relative distance amongst the readings was known from the fine motion scale. Hence, relative change in induction gauge reading could be compared with relative change in the distance of the probe from specific points on the panel surface. Measurements were carried out at three positions on each of the two G24 grit blasted panels.

In addition to these direct estimates of profile effect the effect of shims was estimated in the same way as described for the analogue gauge.

Results from digital gauge tests

Figure 8 shows the calibration curves for the digital gauge as the gauge error plotted against the gauge reading. The performance over the 500µm scale was particularly good with a maximum error of 5µm. This performance was superior to that of the analogue gauge.

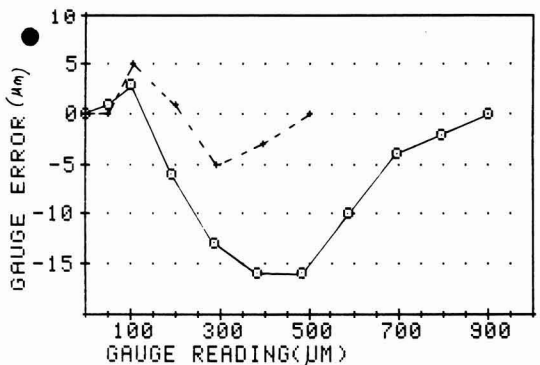


Figure 8. Calibration curves over 500µm and 900µm ranges: digital gauge.

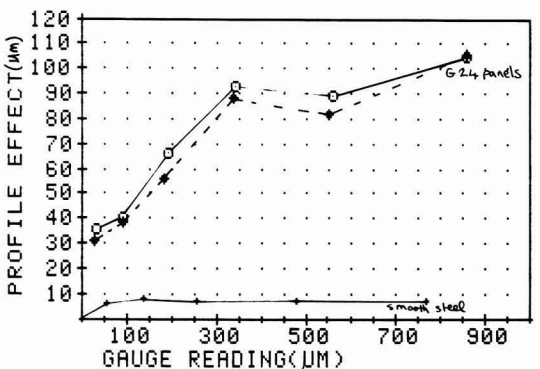


Figure 9. Apparent profile effect using shims to estimate absolute distance from steel: digital gauge.

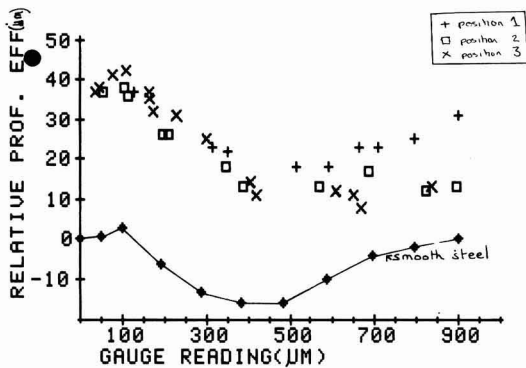


Figure 10. Variation in relative profile effect with distance from steel. G24 panel 1: digital gauge.

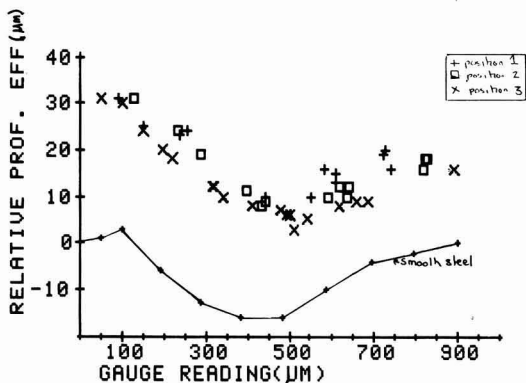


Figure 11. Variation in relative profile effect with distance from steel. G24 panel 2: digital gauge.

Figure 9 shows the profile effect when the absolute distance was given by the shim thickness. As with the analogue gauge, shims were measured quite accurately over smooth steel but over grit blasted steel the profile effect increased with increasing distance from the steel surface.

Figures 10 and 11 show the relative profile effect of the grit blasted panels when the distance from the steel surface was measured on the microscope. As has been explained, the exact distance from the steel surface was not known, only the exact distance from an arbitrary lowest position of the probe. Therefore to make the profile effect of about the correct magnitude the average profile effect measured by taking readings direct on the grit blasted surface of the relevant panel (i.e. at an average absolute zero distance from the steel) was also assumed to be the profile effect for the lowest induction gauge reading obtained. This arbitrarily fixed the absolute distance of the lowest induction gauge probe position but for greater distances the absolute distance relative to this lowest point was known exactly and hence the profile effect relative to the effect assumed at the lowest position. Because we are interested in changes in profile effect as distance from the steel surface increased it is not necessary to know the distance from the steel exactly. Correcting the errors in the estimate of the profile effect at the lowest position would only result in moving each set of results up or down the vertical axis. In fact, as in the case of the analogue gauge there was no

indication of the profile effect increasing with increasing distance from the steel. The shape of each set of results tended to follow the smooth steel calibration curve with some suggestion of a slight reduction in profile effect with increasing distance.

Discussion

The results with both types of gauge have shown that the profile effect of a grit blasted surface, i.e. the difference between the distance indicated by an induction gauge and absolute distance from the steel surface, is for practical purposes relatively constant as the distance of the induction gauge probe from the steel increases. Because surface calibration using shims implies an increasing profile effect with increasing distance from the steel, this procedure is introducing significant errors into film thickness measurement and should not be used.

The variable profile effect produced by the use of shims in surface calibration probably results from shims resting on the higher peaks of the profile and thicker shims distorting less than thinner shims between such high peaks when the induction gauge probe is placed on them. Hence for thicker shims the distance of the gauge probe from the steel surface is rather greater than the actual shim thickness would suggest. In effect surface calibration with a shim changes the position within the profile from which thickness above the peaks is being estimated. For thick films the zero position is towards the top of the profile but for thin films it is lower down in the profile. Because this changing zero position depends on the particular shim thickness used, surface calibration seems to be a recipe for confusion. In addition, this zero position within the profile is an average level with some peaks rising above it. To minimise the chance of very high "rogue" peaks penetrating the paint film it would seem to be more important for the zero position within the profile to be near the top of the profile for thin paint films than for thick films where there is a greater margin of error. Ironically, surface calibration achieves just the opposite.

Smooth calibration necessitates a two stage procedure for the estimation of film thickness above the peaks. First the gauge is calibrated on smooth steel using shims. As has been shown, this can be done accurately and reproducibly particularly with the modern microprocessor controlled gauges. The calibrated gauge is then used to take measurements on the painted surface in question. This gives a set of accurate measurements of paint thickness above the magnetic plane of the steel surface. Only now are the uncertainties of estimating thickness above the peaks introduced. Whatever adjustment is made is seen in relation to the initial accurate set of measurements.

The standard procedure used to allow for the effect of the profile after smooth calibration is to subtract an estimate of profile effect based on the average of a set of measurements taken direct on the steel surface. The zero position within the profile for film thickness measurement is, by this procedure, the average position taken by the probe on the steel surface. This seems a reasonable if rather arbitrary solution to the problem. However, it must be borne in mind that this is an average position and some peaks of the profile will be much nearer the surface of the paint film than the average thickness implies. An alternative approach would be to base the estimate of profile effect on measurements taken over a shim on the steel surface. As

has been already discussed this would lead to a greater margin of error dependent on the thickness of shim chosen. Again this fixes the zero position at a higher, controlled, but still arbitrary position within the profile. General adoption of either technique would at least lead to consistency in film thickness measurement. All that is then required is paint thickness specification with regard to a specified method of measurement. However, an ISO/BSI committee attempting to specify blast cleaning profile measurement decided that no specification based on quantitative measurement, including the use of paint thickness gauges measuring direct on the steel surface, was realistic and opted for profile classification in terms of standard test comparators instead³. This results in a qualitative description of the profile as fine, medium or coarse. In view of this, it seems inconsistent to use a method of estimating profile effect on film thickness which was considered unsuitable for classifying the profile itself, especially as the main reason for needing to classify the profile is that paint is to be applied over it. To be consistent, perhaps consideration should be given to paint thickness specification directly in relation to the underlying profile classification. Such a specification would require increasing thicknesses for the fine, medium and coarse profiles with no requirement to actually measure the profile effect. Paint thickness could then be measured directly after smooth calibration and the misleading reference to thickness above the peaks abandoned. Such an approach would simplify paint inspection but place more emphasis on the initial specification. It would also necessitate some investigation of the profile effects represented by the qualitative comparator classifications.

So far the main concern has been the average film thickness. In fact many specifications call for a minimum film thickness. This is a completely unrealistic requirement in relation to present methods of paint application and inspection.

There may certainly be considerable variability in applied thickness and specifications should indicate what is acceptable. However, this should be done in a way that is realistic and amenable to testing. One possibility would be to require that the mean and standard deviation of a sample of thickness measurements were such that a chosen proportion of the distribution of all measurements would be expected to lie above a particular lower limit. This would necessitate a higher average thickness as variability increased. This again would require more thought at the specification stage.

Finally, it must be emphasised that the suggestions made in this paper would not solve all the problems associated with the measurement of paint thickness over blast cleaned steel. They acknowledge the problems and are intended to lead to realistic, relevant and above all consistent procedures for specification and inspection. Ill-defined concepts such as thickness above the peaks can lead to much confusion depending on an individual's definition of what "the peaks" refers to. Words meaning whatever you like may be acceptable to Humpty Dumpty - "When I use a word . . . it means just what I choose it to mean - neither more nor less"⁴; it should not be a feature of technical specifications.

Conclusions

Induction gauges used in the measurement of the thickness

of paint applied over blast cleaned surfaces should be calibrated on smooth steel. Allowance for the effect of the underlying profile on the measured thicknesses should be carried out separately. Specification of paint thickness should be formulated in terms of a particular, well defined measurement procedure.

Acknowledgements

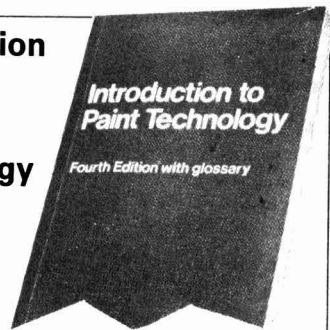
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Advances in ink jet printing inks

W. G. Erskine

Domino Amjet Ltd, Saxon Way, Bar Hill, Cambridge CB3 8SL, UK

Abstract

Inks for continuous ink jet printers are discussed with particular reference to the automatic control of their viscosities in the printer. There are three main categories of ink jet inks—fast drying ketone, alcohol and water-based inks for printing on a wide variety of substrates. New UV curing ink jet inks for security applications and electronic parts marking are briefly described.

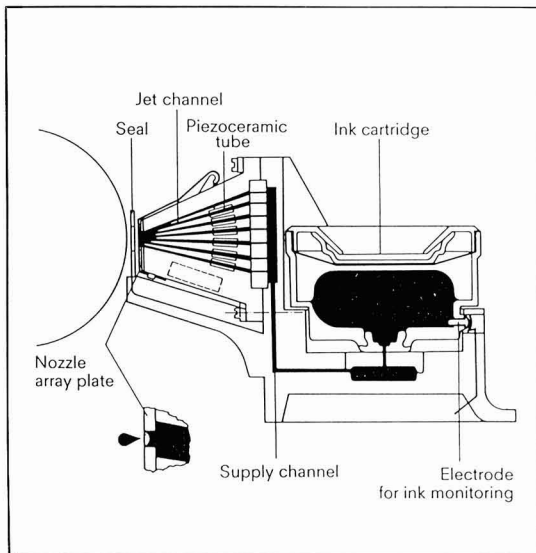
Introduction

Ink jet printing is a versatile electronic imaging technology which has evolved considerably over the past 20 years or so. In this paper, the inks which are used in continuous ink jet printing and drop-on-demand ink jet printing shall be discussed. The inks for each of these methods of printing are markedly different because of the inherent differences between the two techniques. A brief recent review of ink jet and other non-impact printers is given by Heys and Jewitt¹.

Continuous ink jet is the generic name given to the method in which a continuous stream of drops is generated at high frequency by forcing a liquid ink under pressure through a small circular nozzle. The break-up of the ink jet into drops can be controlled by vibrating the nozzle or the ink in such a manner that the size and spacing of the drops are effectively constant. At the point where the drops form, an electric field is applied to charge selected drops. After the charging process there are essentially two different methods of directing the drops image wise towards the substrate to be printed. In one method Sweet² caused the stream of droplets to pass through a traversing high voltage field; those drops which are not charged pass straight through and are caught by a gutter. Those drops which are charged are deflected in accordance with the charge they bear and miss the gutter and impinge upon the substrate to form the image. In another method Hertz et al³ describe a technique of forming and charging drops similar to that employed by Sweet. However, a much higher charging voltage is applied to the drops so that they repel one another. This spray of drops is deflected by a traversing deflection field and is caught in one of the electrodes, which being comprised of a porous material, serves also as a gutter or collector of ink. The uncharged droplets continue undeflected and print the substrate. The jet is very fine and issues from a 10 or 15 micron nozzle which is vibrated at 1 MHz.

The first method in which the electrostatically deflected drops are printed is extensively used in the industrial sector for coding, marking and over printing on a wide variety of impervious and absorbing substrates. The second method is mainly applied to producing high quality computer generated multi-colour images on paper.

Impulse and Valve Jet Printers both operate by producing drops only when required to do so. In this type of printing there are principally two different methods. The Impulse Jet uses piezoelectric transducers to apply a pressure pulse to an ink which is held at or near



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Figure 1. Layout of the Siemens ink jet print head.

atmospheric pressure. This method is capable of operating at frequencies up to 40 KHz from one nozzle, but frequencies in the range two to ten KHz are more common. Siemens⁴ have developed and commercialised 12 and 32 nozzle print heads for applications in the office and have fully documented their system. Figure 1 shows the construction of a Siemens 12 nozzle print head.

Valve Jet Printers operate with ink held under pressure and valves control the formation of drops which are large enough to form approximately 2 mm diameter dots on cardboard. The operating frequency per nozzle is up to 600 Hz and seven or 16 nozzles are arranged vertically to print large characters. The character height is set by the nozzle arrangement and can only be altered by changing the print head. The valves can be positioned at the nozzles themselves as shown in Figure 2, to virtually eliminate nozzle blockage and allow fast drying solvent based inks to be used.

Ink jet inks

Continuous jet inks

Continuous jet inks must have low viscosity, excellent flow characteristics and electrical conductivity for jet formation, consistent break-up and drop charging, whilst being capable of producing sharp dense images. They are composed of a colorant and binder system, additives to achieve functional objectives and a volatile solvent. The inks' constituents must be selected with care to ensure compatibility not only with each other, but also with the components of the printer.

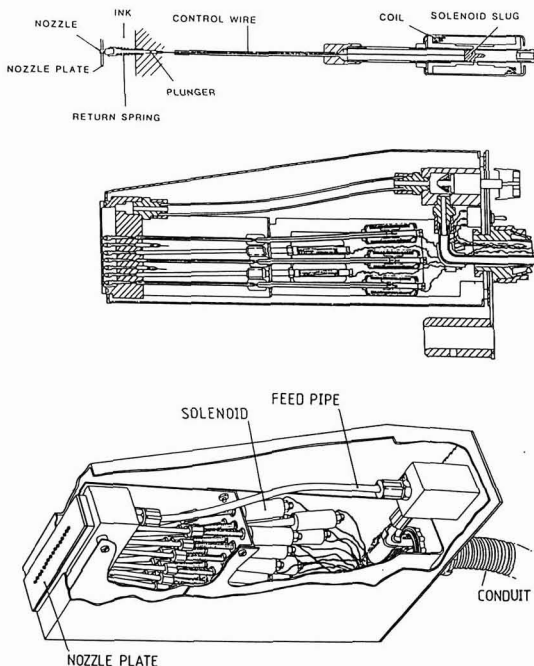


Figure 2. The Macrojet print head.

The colorant is selected from dyes which show high solubilities in the solvent system. The level of impurities in the dye must be kept as low as possible to avoid the deleterious effects of trace metals, halogen ions and insoluble particulate matter. The dye should also have a high absorption coefficient and, if printing on paper, an inherent affinity for cellulose.

A large number of dyes is mentioned in the literature relating to ink formulations. Examples of these are given in references 5, 6 and 7.

The binder serves to impart the designed rheology to the ink in terms of viscosity, flow characteristics and to a lesser extent drop formation. When printed on the substrate the binder provides the physical properties required of the print as in conventional printing inks.

The binder must be entirely soluble in the solvent and provide consistent viscosities in the range 2 to 10 cP, at concentrations up to 20% by weight. The operating viscosities of inks from major manufacturers of ink jet printers vary. Domino printers generally operate at between 3 and 4 cP while those of an American based manufacturer (Videojet) are between 1.5 and 2.5 cP.

Filtration of inks

The inks for continuous ink jet printers are generally solutions of dyes and resins dissolved in suitable solvents, there being little or no particulate matter in the ink. The main reason for this is that the ink issues through a very fine nozzle of diameter between 10 and 100 μ m and blockages must be avoided at all costs. Consequently inks in the production cycle are carefully filtered to ensure that all

particulate matter larger than 1 μ m is removed and the ink is supplied ready for use.

The ink system in a typical industrial jet coder is designed to supply filtered ink to the print head at the correct pressure and recycle the ink which is collected in the gutter (see Figure 3). The ink emerges from the reservoir via a 3 μ m absolute filter and is filtered again when feeding the print head. In the recycling return line there is a 20 μ m filter to remove particulate matter which may have been picked up from the air between the drop formation and collection in the gutter.

In addition to dye-based inks, there are a few pigmented inks which have been developed to run in ink jet printers. These are mainly white TiO₂ or carbon black inks and they must be formulated, manufactured and filtered to run in the ink system described above.

Viscosity control of inks

In continuous ink jet printing most of the ink drops are collected in the gutter and returned to the reservoir for re-use. Only those ink drops which are printed are not recycled. Each time the ink is exposed to air, some evaporation of solvent occurs. This is an on-going process and causes the concentration of non-volatile materials in the ink to rise to unacceptable levels. This occurs at a faster rate at higher temperatures and low humidity. The upper limit of concentration is observed by a large increase in viscosity and manifests itself in poor quality print.

Two methods are employed to maintain the ink viscosity within limits; the ink can be replaced or the ink can be replenished with solvent.

When water is the solvent, the first method can be adopted as in IBM 6640 printers but when highly volatile solvents are employed the replenishment method is preferred.

In 1984 automatic monitoring of the viscosity was first introduced in a commercial printer⁹ by Domino. In this method, an upright tube has a movable stainless steel ball within it. There is a continuous upward flow of ink which keeps the ball at the upper end of the tube. On terminating the flow of ink, the ball falls past sensors through a predetermined distance. The time taken for the ball to fall a known distance is representative of the viscosity of the ink. Because the temperature of the ink is monitored, the actual viscosity can be compared with the ideal at that temperature. This information is stored in an EPROM in the electronics circuitry of the printer. If there is a significant difference, the viscosity of the ink is brought within range by the addition of one or several aliquots of solvent or "make-up" which is held in a cartridge positioned on top of the ink reservoir.

Continual monitoring, and correcting when necessary, of the viscosity by this technique ensures that the rheology of the ink is consistent with regard to drop formation and electrical charging of the drops to be printed. The reliability of the printer is thereby enhanced even further by automatic viscosity control.

Large character printer inks

Large character printers (LCPs) produce drops on demand,



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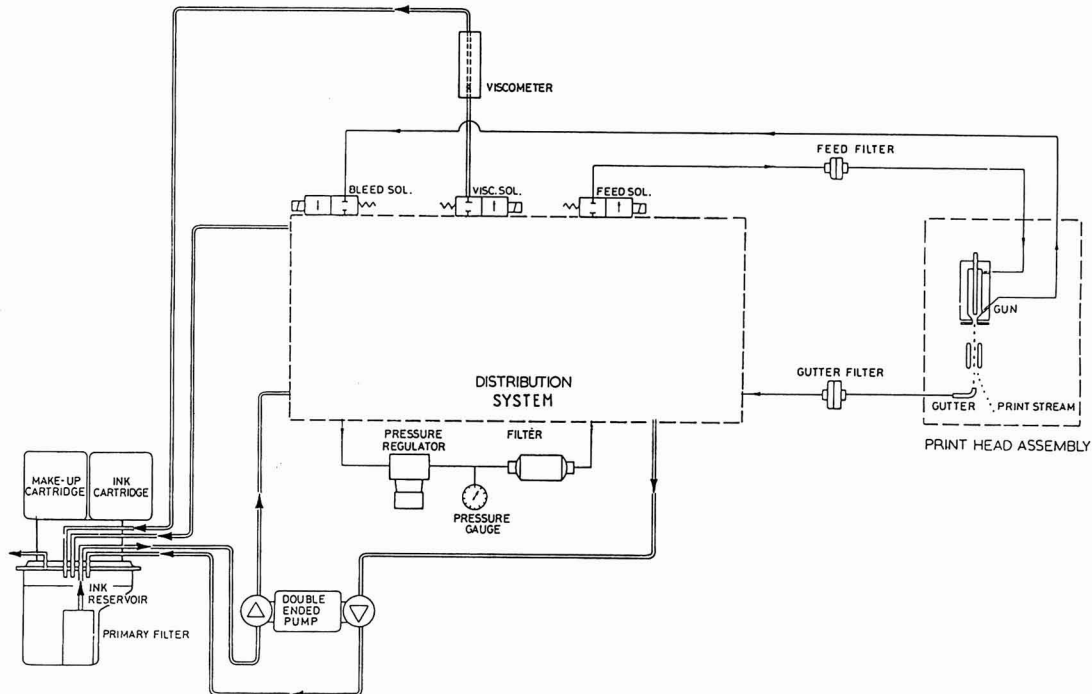


Figure 3. Domino ink system diagram for continuous ink jet.

to form characters ranging in height from 10 to 70mm. These printers operate with water-based or ethanol based inks to print mainly absorbent stock such as boxes and cartons. LCP inks are formulated to ensure that ink does not dry in the nozzle yet dries sufficiently rapidly when printed to avoid smudging. In these printers, the ink is pressurised and drop formation is achieved by the opening of a solenoid valve for up to two msec. The ink is forced through a small nozzle of diameter about 100 μ m and a droplet of volume in the region of 240 nanolitres is ejected with a velocity sufficient to print a box at a distance of up to 1" from the nozzle.

A typical LCP ink formulation described in the patent literature is of viscosity in the range 1.4 to 3.2 cP at 25°C and does not require to be electrically conducting. They are frequently water-based and glycols are usually added to retard nozzle drying. The ink described in one publication⁹ contains 60 to 95% by weight water, 0.05 to 25% dye and 2.5 to 20% of glycol ether.

A recent development in LCP's is Macrojet from Domino Amjet which is unique in that it allows methyl ethyl ketone inks to be used¹⁰. In this printer the novel design of the print head allows the nozzle itself to open and close. The nozzle is normally in the closed position and is opened only when drop formation is called for. The ink for this printer contains a soluble black dye, a resin dissolved in methyl ethyl ketone and a co-solvent. The viscosity is less than 2 cP, the surface tension is around 30 dynes/cm and there is no requirement for electrical conductivity. This ink prints well on impervious surfaces including metals and plastics.

UV curing jet inks

Recent developments in ink jet technology are UV drying inks. These inks are a departure from conventional jet inks

in that they require an external energy source to dry them, therefore they must show marked advantages to the customer to warrant their use in continuous ink jet printing. The advantages of improved resistance to solvents and better rub resistance, lend these inks to security applications and electronic parts marking.

A red ink consisting of red dye, pre-polymer, photo-initiator and methyl ethyl ketone of viscosity 3.5 cP and resistivity 1,000 μ s/cm at 25° C was run in a Domino Solo 4 coder (capable of printing 1185 characters per second). A short character code was printed onto an electrical connector made of glass filled nylon. The ink was cured by exposure to a two inch UV lamp (Primarc) rated at 200 watts/inch, focused by a semi-elliptical reflector into a rectangle 10mm x 50mm at a distance of 30mm from the lamp. The ink dried by evaporation of methyl ethyl ketone and photopolymerisation in less than one second to form a high quality highly legible code. The resultant printed code was resistant to a variety of organic solvents including petrol, diesel oil and brake fluid and met Military Specification 202F.

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Technical progress in new ecologically-safe paint systems and application technology

I. Tonini

Mäder Lacke, Walter Mäder AG, Lacke, Kunstharze, Feinchemikalien Industriestrasse 1, CH-8956 Killwangen bei Baden, Switzerland

Summary

This paper discusses the technical progress in the formulation of ecologically safe paint systems in particular the water-borne and UV curable paints. There are a few application methods which allow reduction of emissions during the painting process, for example the electro-coating process and paint application under high temperature. The latest developments and practical experience in these areas will be described.

The painting of a car body, washing machine or metal furniture is the final important step in the production process and this often involves the use of dangerous chemicals which are hazardous both to human beings and the environment. As a consequence, more and more regulations have become necessary during the last 20 years to minimise dangers from this source.

Rule 66 from Los Angeles was the first to regulate the use and quality of organic solvents in coatings. In 1970, Sweden, Norway and Denmark followed suit, and, in 1974, West Germany also laid down strict rules against air pollution by solvent emission or from degradation products of stove enamelling. It was not until 1986 that regulations governing the use of this type of product became effective in Switzerland.

The regulations indicate to the coating industry, in particular to industrial paint-users, the type and quantity of organic solvent which can be used per day without recourse to special precautions. Introduction of these regulations came as no surprise as the public had been given two years' warning. Prior to and during this period, the coating industry and manufacturers of painting equipment had studied the problem of how to reduce or eliminate organic solvents and degradation products in exhaust air.

The Swiss Paint Manufacturers Association, together with many paint-user associations, has pledged to reduce the quantity of organic solvents in paint application and, consequently in the exhaust air, by approximately 20% within five years. In the early 'eighties', the air pollution in Switzerland involved 35,000 tonnes of organic solvents. A reduction of 20% to 2,800 tonnes of organic solvent in exhaust air is required.

The questions are how can these solvent reductions be obtained and by what environmentally-compatible processes.

Examination of the normal painting process on an industrial scale show three main stages:

1. Pretreatment
2. Paint Application
3. Stoving (drying)

Table 1 illustrates the source of energy used for each step and the types of emission.

Table 1

<i>Energy and emissions</i>			
	Procedure	Kind of energy	Emissions
1.1	Pre-treatment		
1.1	Degreasing	Fuel - Oil Electricity*	SO ₂ sludge (of oil and phosphate)
1.2	Phosphating	Fuel - Oil Electricity*	SO ₂ solutions of phosphate Sludge of Zn-phosphate
1.3	Chromating	Fuel - Oil Electricity*	SO ₂ solutions of chromic acid
2	Spraying/Flash-off	Fuel - Oil Electricity*	SO ₂ solvent vapour Sludge of flocculated paint
3	Stoving	Fuel - Oil Electricity*	SO ₂ solvent vapour degradation products

*only for running of pumps and ventilators/exceptional for heating

In the pretreatment stage, the main source of aerial pollution is from sulphur dioxide produced from fuel oil. The components which cause water pollution can be removed by precipitation and the sludge can be filtered off. Modern pretreatment methods involve degreasing and phosphating at low temperatures of 25°C-30°C and so the consumption of fuel oil is reduced which lowers the emission of sulphur dioxide.

Benefits in minimising aerial pollution at the paint application stage will also have a related effect at the stoving stage.

Examination of Table 1 shows that in addition to sulphur dioxide from fuel oil, organic solvents pollute the air significantly. Spray application results in high concentrations of solvent vapour in the spraying booth. FATIPEC, Amsterdam, in 1980, suggested that 90% of aerial pollution by organic solvents from paint application arises during the spraying process.

The removal of organic solvents from exhaust air is very difficult and means of reducing or substituting organic solvents in the coatings is required. There are several possibilities of reducing the use of solvent including:

- (a) Powder-Coating Methods
- (b) Waterborne Paints (particularly important)
- (c) High-Solids Paints (lesser importance)
- (d) UV Curable Paints

(Powder-coating and high-solids paints are of little interest in Switzerland at the present time and will not be discussed further.)

In addition, the following application techniques are more compatible with the environment:

- (a) Electrostatic Spray Techniques
- (b) Electrocoating
- (c) Hot Spray Application

1. Waterborne paints

Waterborne paints have been in development for some time to give environmentally-acceptable products. The first waterborne paints were developed in 1938 by Dr Herbert Hoenele. At that time, the concept behind this development was economy rather than ecology.

There are three basic waterborne systems comprising micellar, dispersed and colloidal types. All three types are used in air-drying and baking systems but stoving enamels and primers are mainly based on micellar and colloidal systems. Colloidal systems are favoured since they contain only 3-6% organic solvent whereas the micellar type contain 10-20% organic solvent.

The differences in viscosity between micellar vehicles and colloidal systems is important in paint application (see Figure 1).

Micellar paints show anomalous behaviour on dilution necessitating spray viscosities of 30-40 seconds on DIN-Cup 4, as against 20-30 seconds for colloidal and dispersion paints, at 23°C.

Evaporation conditions are important to stoving enamels in that paint films of conventional solvent-based paints can be stoved after a flash-off period at room temperature. On the other hand, waterborne paints normally pass through an evaporation zone at elevated temperature before stoving.

Air-drying enamels/primers and stoving enamels/primers are of particular interest to the author in the waterborne paint field.

1.1 Air drying products

These products are intended exclusively for industrial application and comprise, enamels/primers based on alkyds and acrylic or polyurethane-modified dispersions.

Paint users in Switzerland first became aware of waterborne paints in 1968 when the Swiss Railway (SBB) started using these to paint wagons and locomotives. This paint was based on an acrylic dispersion and was characterised by high gloss, a stability, good resistance to gravel abrasion and ease of removal of dust arising from braking. Initially, a two-pack epoxy primer was used but currently waterborne dispersions are used both as primers and topcoats.

The main requirements for wagon and vehicle paints (especially for buses) are as follows:

- (a) Excellent anticorrosive properties
- (b) Good gloss
- (c) Excellent durability and hardness of film surface
- (d) Resistance to damage during cleaning

In addition to the above, the use of waterborne paints has

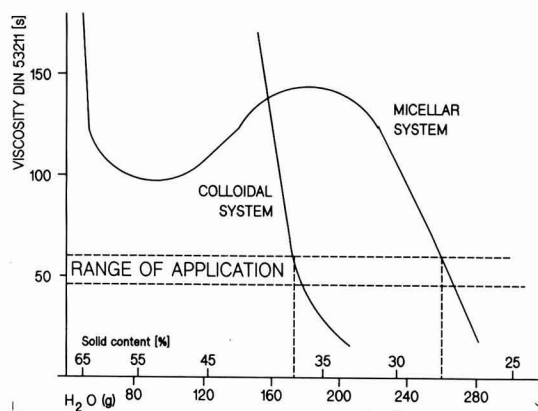


Figure 1. Abnormal flow properties of waterborne paints.

many advantages. During spray application, solvent vapour concentration is at a minimum. There is very reduced risk of explosion and the hygienic conditions of the spray operative are much improved.

Based on 20 years' experience by the author's company, approximately 50 municipal buses were painted with waterborne coatings of the micellar alkyd type. The primer coat was completely chromate-free with anticorrosive properties equivalent to those of a conventional primer. A second primer coat was applied two hours later. After drying overnight, the waterborne topcoat was applied.

The current results indicate that these buses coated in May 1985 meet specification.

In general, waterborne primers/enamels based on alkyd resins are now favoured for painting vehicles including buses, trucks and bulldozers as well as agricultural machinery in Switzerland. The properties/performance of those waterborne paints are considered equivalent to that of solvent-based, alkyd paints in that they exhibit similar drying, hardness, flexibility, resistance to damage, yellowing resistance. In addition, both types of paint give good adhesion to degreased and phosphated steel as well as aluminium (anticorrosive, Peraulaman).

Waterborne topcoats based on acrylic dispersions are not only used on railcars but also as one-coat paints systems on galvanised steel e.g. street-lamps and steel masts.

One-coat system paints based on polyurethane-modified dispersions have been available for some time and due to their excellent drying properties have been used on domestic appliances, instruments and engine components.

Waterborne epoxy two-pack paints are based on epoxy emulsions and are mainly applied to concrete and stone floors.

1.2 Thermosetting paints

This category of paint contains a multiplicity of polymers including alkyds, oil-free polyesters, silicone-modified polyesters, epoxy esters, acrylics and phenolics.

There is a requirement for the paint chemist to consider the correct polymer which will meet the demands of a

specific paint. Waterborne systems offer a limited choice for industrial use which will give similar quality of finish to that from solvent-based paints. However, substitution by waterborne systems is expanding as knowledge grows.

Waterborne thermosetting paints exhibit different application properties to those of solvent-based paints requiring changes in mode of application. For example, waterborne paints spray freely and often give 'sagging' problems unless particular attention is paid to spray viscosity and pressure. However, the author has been able to supply paints of this type with excellent application properties.

The product range available includes:

(a) Primers based on alkyds and epoxy esters with stoving schedules of 20 minutes at 120-140°C.

(b) Topcoats based on alkyds, oil-free polyesters and acrylics with stoving schedules of 20 minutes at 120-170°C.

Stoving temperatures depend on the size and shape of the painted article and the type of paint.

The following practical examples are given:

(a) A thermosetting dipping paint based on an aqueous melamine/acrylic system is used to coat refrigerators internally. The aluminium plates are degreased just prior to painting. All droplets are removed electrostatically, flashed-off for eight minutes at 120°C then stoved at 140°C for 12 minutes. This one-coat system is very resistant to household detergents and acid fumes.

(b) Switch boxes and telephone switchboards are painted with a two-coat system involving iron-phosphate pretreatment followed by coating with an alkyd/melamine primer and air-drying for 12-15 minutes. Finally, the top coat based on an alkyd/melamine is applied wet on wet and flashed-off for eight minutes at 30-40°C then stoved at 140°C for 12 minutes. This one-coat system is very resistant to household detergents and acid fumes.

(c) Application to similar articles as in (b) is by a two-coat system using an oil-free polyester-based electrocoating primer. The panels and girders are pretreated with zinc phosphate and electrocoated with the primer. The primer is pre-dried for 10 minutes at 120°C then coated with an alkyd/melamine topcoat. The article is finally stoved at 150-160°C for 15 minutes. This method of electrocoating primer and topcoat is often substituted by a solvent-based topcoat.

(d) Steel cabinets are iron-phosphated and a single coat of waterborne textured paint based on an oil-free, polyester-based system is stoved at 140°C for 18 minutes after a flash-off time of 12 minutes at 40-60°C. This paint can be used as a textured finish or smooth finish. The textured finish is produced by a single application. This same technique can be applied to steel equipment (one coat), radiators (dipping primer and topcoat), barrels (one coat) etc.

Waterborne systems can be applied by the following methods:

(a) Dipping

(b) Air-spraying (compressed air atomizer)

(c) Airless spraying

(d) Electrostatic spraying

(e) Brushing and rolling with acrylic dispersions

Electrostatic applications require special equipment, otherwise it is only necessary to adjust to the correct viscosity and spray pressure after having selected a suitable waterborne paint.

The disadvantages of waterborne paint are that water is the main solvent and any corrections for evaporation during flash-off, flow, edge covering etc, must be made accurately.

Thermosetting-type paints make it necessary to pay attention to adequate flash-off time, if necessary, adopting elevated temperature.

Air-drying paint should not be used at temperatures below 15°C when humidity exceeds 70% or allowances will have to be made for possible delays in drying. These difficulties can be overcome by careful attention to technical detail.

The fundamental advantages of all waterborne paints is that they are ecologically safe.

2. UV-curable paints

UV-curable paints first appeared for industrial use in the 1970's and thus technology has been developed to the stage where they are now used widely with success. UV-curable lacquers are also used in the manufacture of engravings and printed circuits. A large market for UV-cured systems is in the formulation of printing inks and in lacquers for application to wood and paper. There is also an increasing use of UV-lacquers for coating of plastics.

The question of the effect of formulation of these paints on the ecology is important since they contain a mixture of monomers, oligomers and photoinitiators.

UV-lacquers are normally applied by rollercoating and occasionally by spraying. Furthermore, these lacquers are applied as very thin films so that only small amounts of the product are used and, as a consequence, the monitoring of exhaust air can be readily checked. Offending volatiles are also easily removed.

UV-lacquers usually contain only small quantities of organic solvents. Their cure rate is extremely rapid in that it is normally completed in seconds.

The present range of UV-lacquers suitable for application to plastics are based on epoxy acrylates and polyesters.

Practical applications of UV-lacquers include:

(a) Trays produced in styrene acrylonitrile copolymers are painted with UV-lacquers to protect the printed designs and to give excellent surface hardness.

(b) Safety glasses and visors of helmets, rear windows of cars and dashboards made of PVC or polycarbonates can be coated successfully with UV-curable lacquers. It is well known that these polymers are solvent sensitive and, therefore, it is usual for these surfaces to be rollercoated with the lacquer before these products are fabricated.

(c) In future, headlight lenses will be made of polycarbonate. The application of UV-lacquers hardens and weatherproofs these lenses. Reflectors are made of reinforced, cured polyester and the interior face must be smoothed before vacuum metallisation with aluminium. The application of a UV-lacquer contributes this smoothness. The author is engaged in a project to supply suitable UV-lacquers to coat reflectors and then headlight lenses. Large-scale trials have been in progress for 2½ years and results are still awaited. Laboratory assessment of coated articles show that these exhibit satisfactory resistance to sand abrasion.

(d) UV-lacquers are also used to coat perfume bottles made of polyethylene which not only protects the bottle from scratches but enhances the gloss to that of glass.

Normally UV-lacquers are very useful for protecting soft plastic surfaces and for coating large quantities of articles rapidly. They are economically acceptable since:

- Thin layers are applied
- The painting process is rapid
- The energy consumption is low

The low energy consumption means that electrical energy can be used which avoids the release of sulphur dioxide vapour.

3. Modern paint technology with ecologically-beneficial effects

Ecologically-beneficial surface coating technology includes electrodeposition which is well known in the automotive industry and is now used widely to coat various types of apparatus. Electrocoating is an automatic process which is both favoured ecologically and economically. Ultrafiltration is also important here since it contributes to the success of this process.

Electrostatic painting is still of great importance.

Atomisation is still obtained by air, airless techniques and by rotating bells. Recently the speed of rotation of the bells was increased from 900 revs/minute to approximately 40,000 revs/minute. Electrostatic spraying is beneficial to the environment since it offers better wrap-around properties compared with that of classical spray application. Consequentially, there is a more efficient application, less consumption of paint and reduced emission of solvent to the atmosphere. Modern electrostatic spraying equipment now available allows the use of waterborne paint systems with further benefits in efficiency and to the environment.

Installations using combined electrocoating and electrostatic spraying techniques are in use for the application of two-coat systems. A well-known plant using these application methods is Siemens AG, Berlin, where electrodome apparatus such as refrigerators and washing machines are coated.

Modern paint application usually combines apparatus to burn the solvents and degradation products emitted by the stoving oven and so reduces the ecological problem. In addition, the energy is recovered and re-used.

It is not always possible to use waterborne paints but paint users, particularly jobbing painters are obliged to reduce the solvent emissions in the exhaust air from their workshops. In these cases, hot spray application is often used which allows an average reduction of 25% of solvent and also improves film-forming with faster drying and better flow. Equipment for hot spray application is not expensive and offers simple operation combined with greater efficiency.

In conclusion, whilst it is essential that regulations restricting the emission of solvents are maintained worldwide, the surface coating industry, including the users, have no need to fear the effect of these regulations, since modern coating formulations have been produced to meet these required limits yet give equivalent performance to that of coatings which were previously ecologically unsafe.

occa meetings

London Section

Coatings for concrete

On Thursday, 15 October, at the Naval Club, 38 Hill Street, Mr Helmut Schierbaum, Technical Sales Representative (Surface Coatings, Raw Materials) for Bayer UK gave a lecture on polyurethane coatings for concrete.

Starting with a resumé of the chemistry of polyurethanes showing how this leads to elastomers of good flexibility and strength, Mr Schierbaum then described the problems of variability of concrete making it a potentially difficult substrate to coat.

He followed this with an entertaining slide presentation showing examples of the use of polyurethanes throughout Europe with extended lifetimes of up to 25 years without

failure. Since ancillary costs of repainting are so high, he thus demonstrated the cost effectiveness of polyurethanes, even though they are initially rather expensive.

A lively question time ensued with particular reference to the question whether it was desirable to have a coating which because it prevented the ingress of water also prevented its egress.

The session concluded with a vote of thanks proposed by Mr R. Gough and endorsed by the applause of the gathering.

R. Gough

SURFEX



15-16 June 1988

Harrogate Conference Centre

The last talk of the afternoon session was given by Mr D. Charlton of Bayer who spoke on "Polyurethane – as you like it". In 1937 Prof Dr Otto Bayer discovered polyurethanes by the reaction of polyisocyanates and polyols. In his talk he outlined how this reaction can be tailored to meet specific end-use requirements.

A lively discussion followed both the morning and afternoon sessions. Finally Mr S. Lynn (Chairman of Newcastle Section, Joint organiser with Mr L. Morpeth) gave a vote of thanks to the lecturers and their companies, and thanked the Newcastle Section Committee. He commented that he was pleased to see such a good attendance and announced that a similar student seminar on pigments will be held early next year by the Section.

P. J. Fyne

Silicone Copolymers

The first meeting of the 1987/88 Session took place at St Mary's College, University of Durham, on 1 October 1987, when Mr T. Chield and Dr T. Martin of Croda Resins gave a paper on "Silicone Copolymers for the Surface Coatings Industry: Established and Newer Types". The meeting was sponsored by Croda Resins Ltd.

After historical background information on the Croda synthetic resin plant at Belvedere, Kent, a review of the silicon chemistry, which forms the basis of silicone polymers was presented. This included the formation of chlorosilanes, their hydrolysis and condensation to form a variety of polymers:

- (a) linear: molecular weight 4-5,000: silicone oils, used as flow aids, slip/mar-proofing aids and anti-blocking agents.
- (b) linear: molecular weight 10,000-100,000: silicone rubbers.
- (c) cross-linked/hydroxyl-terminated: high molecular weight: polymers which are high temperature-resisting, chemical resistant, water repellent, light/weatherfast, for stoving (45 minutes @ 200°C). Disadvantages are low flexibility/scratch resistance, poor wetting properties and very high cost.
- (d) silanol-terminated silicone intermediates which can be reacted with alkyd, urethane, acrylic and polyester materials to produce, at much lower costs than (c) types, air-dry or stoving resins with a wide spread of acceptable properties: good flexibility, flow, wetting, chemical/water/weathering/scratch-resistance, compatibility; and shorter cure schedules.

Silicone alkyds with 30% silicone polymer modification were discussed in more detail. The inertness and physical strength donated by the Si-O-Si grouping was demonstrated with a Dew Cycle Weatherometer comparison of weight loss for silicone alkyd versus a typical long oil alkyd: also, by Florida exposure results of weathering, chalking, glass retention of silicone alkyd paints against traditional alkyd, urethane and epoxy types.

The paper concluded with a survey of development areas for silicone resin products. These included:

- (i) bakery tray release coatings
- (ii) silicone polyester for powder coatings
- (iii) UV curing systems

- (iv) de-inking polymers, for easy recovery of paper from newspapers
- (v) Crodasil: a two-compartment high performance clear lacquer for bright metal
- (vi) silicone copolymers with acrylic-modified alkyds
- (vii) lower silicone-content alkyds for cost-effective performance.

After a short, but interesting, question time, the vote of thanks was given by the Chairman, Mr S. Lynn. The members then enjoyed an excellent buffet meal provided by Croda Resins Ltd.

J. Bravey

Manchester Section

BS 5750/Open Tech

Manchester Section's first meeting of the 1987/88 session was held in the Demdyke Suite, Last Drop Village, Bromley Cross, Bolton, on Monday, 5 October 1987.

Due to the sudden illness of Mike Levet, Fred Morpeth chaired his first meeting with 40 members and guests present but no lecturer. To the rescue two knights in shining armour, David Clayton and Don Clements, filled the breach and held a two part discourse on BS 5750 and the Open Tech. courses. Two short and interesting papers were presented, followed by a lively discussion, and the evening rounded off with helpings of Lancashire Hotpot. The Chairman, Fred Morpeth, proposed a vote of thanks to Dave and Don, and to round off an eventful evening West Riding Section, in the guise of Terry Wright, took Manchester Section to the cleaners at liar dice.

Matted coatings for many reasons

Manchester Section's second meeting of the session was held at the St James' Club, Manchester, on Monday, 2 November 1987, where 50 members and guests were privileged to hear a paper entitled "Matted Coatings for Many Reasons" presented by Herr Achmed Elbrechter of Degussa A.G., who is on his final lecture tour before retiring.

The lecturer commenced by outlining the history of matt coatings, showing how they had been used for decoration on furniture and wood panelling, for example in stately homes, over the centuries. This led onto a discussion of the current uses of matt finishes such as office furniture, laboratory equipment, camouflage paints and coil coatings, where a matt finish will show less colour drift on long term exposure.

Herr Elbrechter went on to outline the ideal characteristics of matting agents, which should be easily incorporated, have high matting efficiency, good suspension, good mar resistance, and efficiency unaffected by over dispersion.

Matting agents work by producing a controlled roughening effect on the coating surface, resulting in diffused light reflection. The ideal particle size would be of the order of four to five microns, but it is not practical to

obtain this on a commercial scale and therefore they tend to have quite a broad particle size distribution.

Herr Elbrechter completed his lecture by outlining the range of products offered over the years by Degussa, initially TT600 introduced in 1955, through to TS100 introduced in 1975, and the various parameters which affect the efficiency of matting agents.

The lecture was followed by a lively question and answer period and the vote of thanks was proposed by David Love, after which those present were able to participate of a buffet sponsored by Degussa A.G.

M. G. Langdon

Midlands Section

Curing studied by dielectric analysis

The first lecture this session of the Midlands Section was held on the 15 October 1987 at the Clarendon Suite, Stirling Road, Edgbaston, Birmingham. Members and guests heard Mr Paul Hodgson of Tioxide UK give a talk on "Dielectric analysis techniques for studying cure of surface coatings". The speaker said that dielectric analysis utilises the polar groups that are present in a cross-linked polymer to indicate its state at any time in the cure process. The principle involves applying a dynamic electrical stress to the coating and the dipoles present align themselves to the field. Because these polar groups are attached to other molecules, their mobility is restricted. During curing there results an increasing restraint on dipole mobility and the response of the coating to the applied electric field changes. The degree of cure is obtained by subjecting the coating to a temperature rise and determining the temperature at which the dissipation factor peaks.

The speaker continued his talk by describing the construction of an instrument which he referred to as a 'dielectric spectrometer'. It consisted of a programmable oven, an AC bridge, a radio amplifier and an x-y-t recorder. The sample under test is clamped between two electrodes, a small voltage is passed between them and the resulting current measured.

For the final part of his talk Mr Hodgson described how this technique can be used for studying the effect various surface treatments of Titanium Dioxide have on the cure of surface coatings and how this can affect their ultimate durability. Dielectric analysis can also be used to study the cure of powder coatings. Here a modified electrode is used and by measuring the various dissipation peaks it is possible to determine the melting point, onset of cross-linking, gel-point and degree of cure of the powder.

Throughout his talk the speaker showed numerous slides showing the construction of the Spectrometer and the results of the various experiments that were carried out.

After the talk there was a lively question and answer session. The meeting closed with a vote of thanks proposed by Mr E. Wallace, who thanked Mr Hodgson for an interesting and informative lecture. He also thanked

Tioxide UK Limited for sponsoring the meal afterwards.

B. E. Myatt

Thames Valley Section

Tinting Systems

The first meeting for the 1987/88 session was held at the Crown Hotel, Amersham, at 6.30 pm on 24 September 1987. The speaker on this occasion was Mr Rudy Ammerlaan of Nuodex Colortrend BV.

The subject of the talk was 'Industrial and Decorative Tinting Systems'. Mr Ammerlaan commenced by outlining the experience with the established 'Universal Colourants' based on monoethylene glycol and water with special blends of surfactants. Much effort had been made to improve these so that good hiding could be achieved at normal film thicknesses with the minimum dosage of colourant, and therefore, the minimum reductions in quality of finish.

The requirement for industrial tinting systems posed extra problems of compatibility due to the range of binder systems employed. A tremendous amount of compatibility testing had been carried out to find an acrylic vehicle which showed an extremely wide compatibility range. It was also necessary to find surfactants which were neither water soluble nor water sensitive and solvents which are non red label and conformed to Rule 66 in the USA. This work had resulted in a patented modified acrylic resin system upon which the colourants could be based. The colourants had a very wide range of compatibility but should not be regarded as 'Universal' and evaluation was required in customers' systems before use to determine if extra additives were required.

The stringent quality control of both outgoing colourants and incoming raw materials was outlined. This stringent control enabled customers to be certain of excellent colour consistency and allowed these colourants to be used in automated systems for batch production, colour correction by colour computer and in-can tinting.

Nuodex have developed an industrial system based on 10 colourants and 10 bases which gives the full range of 147 RAL colours yet does not require greater than 5-10% addition of colourants for any particular shade.

G. Drinkwater

Scottish Section

BS 5750

The interest in this subject was evident by the large attendance of over 50 members and visitors at the Hospitality Inn on Thursday, 10 September.

Mr Reg Easy, General Manager of Yarsley Quality Assured Firms Limited, made the presentation. The following is a résumé by Mr Easy of his talk which went a long way to clarify the major issues regarding Quality Assurance.

occa meetings

First, what is meant by Quality is 'fitness for purpose' meeting customer requirements and not to be confused with grade. Assurance is having documented evidence that activities and actions have been carried out effectively.

BD 5750/ISO 9000 is a standard which states the minimum requirements for a Quality Management System and is in three parts:

- Part 1. Design, manufacture and installation.
- Part 2. Manufacture and installation.
- Part 3. Final inspection and test.

A company can apply to be registered to the appropriate part in terms of company business requirements.

A company establishing a Quality system should first carry out a survey of existing methods and record the findings against the appropriate part of BS 5750. Once this has been done the deficiencies in the system will be highlighted, and can be dealt with, and the whole system documented. With this approach there will be the least amount of disruption to the company, as many of the existing practices will meet the standard requirements. The degree of documentation must be considered carefully, as Quality assurance is about utilisation of resources, people working together and doing the job correctly first time, not about creating unnecessary paper work. With the correct approach, a company can reduce its Quality costs (ie rework, scrap, power and manpower) by improved efficiency and increased market share.

Registration to BS 5750 will assist a company, who will be allowed to display the registration mark on literature and letterheadings. However, to ensure that maximum use of registration is made, applicant companies must check whether a certification body is accredited by the Government in the NACCB for a scope, covering the products and services offered by the applicant company.

To date YQAF Ltd is the only certification body accredited to register companies that carry Research and Development and/or manufacture chemicals, paints, adhesives, sealants, putties, waxes, polymer based products and specialist chemicals. Therefore companies can use the logo shown.

A vote of thanks was proposed by Mr Nigel Baird.

R. A. Hunter



Note: The use of the Accreditation Mark indicates accreditation in respect of those activities covered by the accreditation of certificate 005.

company visits

Glasureit

BASF Coatings & Inks Ltd of West Drayton have now introduced to the UK market their new refinishing system—Glasureit 18 Line—for commercial transport vehicles. There are about 2 million commercial vehicles in this country, of which about 550,000 are of 3½ tons and over; the new system is intended for these larger trucks. Until recent years these vehicles often had a poor appearance, but users now realise that they can be a good advertisement for the company.

The 18 Line System comprises a complete range of products—body fillers, primers, primer fillers, hardeners and topcoats—which together make up systems for all commercial vehicle body substrates. The finishes are based on BASF's latest two-pack acrylic technology with isocyanate hardeners, and a mixing system using 20 base colours enables over 3,000 shades to be provided. The new formulations have improved opacity and film build so that only 2 or 3 coats are required, reducing labour and vehicle downtime. The finishes have good sprayability, overspray absorption and minimal tendency to run, making them especially suitable for the finishing of large vehicles—better in these respects than adapting car two-pack systems to achieve high class results.

T. Banfield

occa news

new members

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

Ordinary members

- Akhtar, A. S., BSc (*General Overseas – Pakistan*)
- Desai, S., BSc (*General Overseas – USA*)
- Faleschini, P. (*Transvaal*)
- Govendor, V., BSc (*Natal*)
- McElwee, A. D., BSc (*Natal*)
- Moodley, P. B. (*Natal*)
- Naidoo, K. S. (*Natal*)
- Naidoo, R. C. (*Natal*)
- Naidoo, S. N. (*Natal*)
- Norris, N. M. (*Natal*)
- O'Mara, E. G. (*Irish*)
- Pacey-Day, C., BSc, BA (*Midlands*)
- Raposo, B. (*Ontario*)
- Reilly, S. J. (*Transvaal*)
- Saxena, Y. C., MSc (*Scottish*)
- Wilson, C., BSc (*Scottish*)

Associate member

- Williams, B.H. (*London*)

Registered student

- Day, K. M. (*West Riding*)

Manchester Section Dinner Dance



Manchester Section Dinner Dance held at the Piccadilly Hotel on 16 October 1987: Front row (left to right) Frank Redman, immediate past president standing in for the President who was abroad; Peggy Redman; Betty Seymour, whose husband Norman, Vice Chairman of Manchester Section, is standing extreme left; Fred Morpeth, Chairman Manchester Section; Vera Morpeth; Chris Pacey-Day, General Secretary, Sylvia Lorden. Also shown attending are members of the Manchester Section Committee and representatives of other sections with their wives. These included Jim and Joy Hemmings, W Riding; John and Edna Inshaw, Thames Valley; Simon and Irene Lawrence, Scotland; Simon and Barbara Lynn, Newcastle.

Midlands Section

Ladies' Night

Once again, Penns Hall Hotel, Walmley, Sutton Coldfield, was the venue for the Midlands Section Ladies' Night held on the 30 October 1987. Une Soirée Française was the theme for this year's evening. An accordionist, in typical French costume, greeted guests at the reception and also played at the tables during the dinner.

Dr G. Lewis, dressed as Napoleon, Chairman of the Midlands Section, in his speech, gave thanks to the hotel and its staff for their theme dress. Among the guests welcomed by the Section were Mr J. Bourne, President of OCCA, and his wife, Mr C. Pacey-Day, General Secretary OCCA, Mr F. Morpeth, Chairman of the Manchester Section, and his wife, and Mr G. Gough, President of the Birmingham Paint Varnish and Lacquer Club, and his wife. Dr Lewis thanked the committee, especially Mr B. Fowler, Secretary, and Mr A. Eades, Treasurer, who unfortunately was ill in hospital, for the hard work they had put in to make the evening a success. He also thanked his secretary, Mrs Norma Hall, for her assistance. Everyone wished Mr Eades a speedy recovery.

In response, the President, dressed as an onion seller, thanked the Section for inviting him and spoke of his recent visits to Dallas for the FSCT Paint Show, to

JR in Dallas



From left to right: Mr Ted Saultry (former President, OCCAA) and Mrs Saultry; Mr John Bourne (President, OCCA) and Mrs Bourne; Mr Grahame Fowkes (Vice President, OCCA) dining out during their recent visit to the FSCT 1987 Paint Show in Dallas.

Japan for their 60th Anniversary Celebrations and to Singapore to discuss the setting up of an OCCA Branch. He said he wanted to get more people active in OCCA and not have stagnant committees.

After the speeches it was cabaret time and the audience were entertained by the Irene Turner Dancers, who also returned in the band interval to dance the Can-Can. After the cabaret, dancing commenced to the "Take Five" group and continued until 1 am—everyone having a thoroughly good time.

B. E. Myatt

Scottish Section

Ladies Evening

There was a good turnout of members and guests to the Ladies Evening held on Friday 18th September at the Normandy Hotel, Renfrew. The subject of the evening was 'Accidental Woodcarver'.

There were two speakers on this theme firstly Mr Harry Hunter who explained how he changed his hobby into a full time

Australian Visitor



Ted Saultry (former President OCCAA) on the left being welcomed by Chris Pacey-Day (Gen. Sec. OCCA) to Priory House.

South African Visitor



Prof D. E. A. Williams-Wynn (Vice President, OCCA) being welcomed by OCCA staff to Priory House. Left to right: Mrs H. Pooley, Mrs P. Stringer, Mrs J. Reynaud, Prof Williams-Wynn, Mrs I. Jenkins, Mrs Y. Waterman.

job. Demand for his hand carved walking-sticks has escalated since he first started up his business. He now receives orders from many parts of the world and exhibits samples of his work at various international trade fairs. As Mr Hunter claims "He is a man who has got it made". Perhaps not in money terms but certainly in terms of job satisfaction, this was evident in his enthusiasm when talking about his new career.

The second speaker was Mr Eric Gillanders who although retired now specialises in making Spinning Wheels as well as carving many other artifacts of great beauty. Mr Gillanders gave an amusing talk on this specialist subject during which he invited ladies from the audience to try their hand on the spinning wheel he brought along. Judging by the reponse there are not many ladies in the Glasgow area able to operate a spinning wheel, nonetheless there is a big demand for this piece of equipment particularly when it has an antique look about it.

The Vice Chairman Ron Hill proposed the vote of thanks to Mr Gillanders and Mr Hunter after which a buffet was enjoyed by all.

R. A. Hunter

Scottish Section

East v West Skittles

The annual East v West Skittles match took place on Friday 2 October at the Murrayfield Indoor Sports Club, 25 Rose-

burn Street, Edinburgh. 27 members and friends turned out for this sporting event.

As a few East team members failed to appear on the evening, Tom McMahon persuaded two female and one male players to defect from the West to even the sides at 12 each. Both Captains Simon Lawrence (West) and Tom McMahon got scoring off to a brisk start with strikes in the first frame which not all other team members were able to emulate. The scores at the interval left the East trailing by 39 points, but after further refreshments and sandwiches the west lead was reduced to 30 points, to retain the Newton Cup for the fourth consecutive year, even though Tom's coaching for the West defectors produced the leading Female and Male players. Simon Lawrence expressed thanks to Nigel Baird and Tom McMahan for their organisation of another successful and enjoyable evening.

The results of the match were as follows:

Scores

Newton Cup - Team Event - Scottish Section (capt. Simon Lawrence): West 1342 pts, East 1312 pts (wooden spoon - capt. Tom McMahon).

Individual Prizes

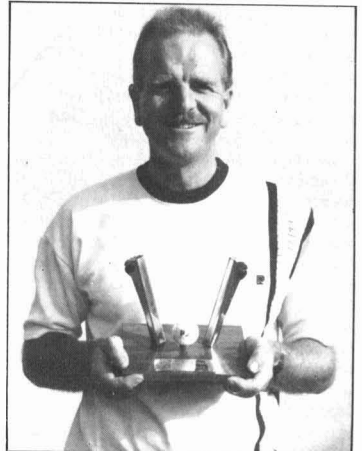
Ladies (E=East, W=West): 1st 105pts Jackie Phibbs (E), 2nd 95pts Sheila Jack (W), 3rd 82pts Pamela Jeffs (E), Booby 66pts Anne Gibson (W). Gents: 1st 178pts Willie Golder (E), 2nd 156pts Tom Kirkwood (W), 3rd 140pts Brian Donaldson (E), Booby 98pts Donald Reece (E).

N. D. Baird

News of Members

Robert Hamblin, former Director & Secretary of the Association, has been elected Upper Warden of the Wax Chandlers' Livery Company of the City of London.

Graham Erskine receiving the Pearson Panke Trophy won at the Eastbourne Conference Golf Tournament.



G W Erskine

OCCA ties at £4.25 each are now available from the Association's offices, with a single Association insignia on either a blue or maroon background.

Around the Council Chamber

The Great Northern Hotel was the venue for the October meeting of Council. 22 members made the trip to London, including Peter Birrell from Ontario. Noticeable absentee was President John Bourne who was overseas representing the Association at the Dallas Paint Show and in the Far East. In his absence, Immediate Past President, Frank Redman, took the Chair.

The meeting opened on a sad note as Council stood in silent tribute to the work and memory of Past President, Frank Sowerbutts and Past Chairman of the London Section, John Hawkey. Both will be sadly missed.

Council considered proposals that Honorary Membership be conferred on Cecil Butler and Bob Hamblin. The contributions of both members to the development of the Association was acknowledged by speakers and it was unanimously resolved that Honorary Membership be conferred.

Honorary Treasurer, Brian Gilliam, presented the half year accounts, estimates for the second half of the year and the outcome of the Eastbourne Conference. Some members were disappointed at the lack of support for the Conference, but were reminded by the General Secretary, Chris Pacey-Day, attending his first meeting of Council in post, that the Conference also served as the Association's principal occasion to receive and return hospitality to guests and overseas visitors. Council accepted that the Association had a responsibility consistent with its international role, but were concerned that each Conference should, at the very least, achieve a surplus. Ken Arbuckle and other speakers asked a number of searching questions concerning the 1987 out-turn and in particular sought reassurance that the Association would break even for the year. Brian Gilliam was able to reassure the meeting that a break even position would be achieved.

The General Secretary proposed that the Association explore the possibility of using the services of a professional advisor to handle the Association's surplus funds and it was agreed that the Finance Committee should be allowed to progress the matter. The meeting was conscious of the uncertainty in the stock market and felt that professional advice should ensure that the Association's assets were well managed.

Council noted that 139 members had been removed from the register for non payment of subscription. Although this

was fewer than in 1986 there was still concern at this number of lapsed members. On a happier note it was reported that 111 new members had joined plus 12 reinstatements. Honorary Editor, Don Newton, reported that there was a variety of good quality papers in hand for the Journal and that the latest monograph entitled "Determination of the solid content of paint (by volume)" was soon to be published. Council were pleased to learn that, after a gap of almost ten years, the President had called a meeting of the Publications Committee when consideration would be given to a change in style and presentation of the Journal and the formation of a Management Committee charged with the day to day control of the Journal.

Honorary Research & Development Officer, John Taylor, proposed that the theme for 1989 Chester Conference would be "Profitable Research & Development" and outlined his proposals for keynote lecturers and sessions. Council accepted



FROM THE GENERAL SECRETARY

this innovated theme for the Conference. Section representatives were urged to support the Conference by submission of papers and attendance of their Sections. Members who were looking for an opportunity to visit South Africa were encouraged to submit papers for the South African Division's September 1988 Symposium "Chemistry, Coatings, Auxiliaries - Some Advances", to the General Secretary without delay.

Newly appointed Honorary Technical Education Officer, Arthur Hopgood, reported on the progress of the Paint-makers' Association Open Tech Project which had now reached module 8. The names of students who had successfully completed all modules would be released to OCCA with a view to recruiting such students into membership.

Honorary Conference Officer, Tony "Chester" Jolly, enthusiastically reported on the preliminary arrangements for the Chester Conference in 1989. An excellent social programme had already been arranged and his proposals were welcomed by the meeting.

Honorary Exhibition Officer, Fred Morpeth, reported that only 10 stands remained unsold for SURFEX 88 and the event had already shown a clear profit.

The General Secretary reported that at the meeting of the Professional Grade Committee held prior to Council, one Fellow and three Associates had been admitted. Discussions were taking place *Contd on p. 378*

The first stage of the Association's computer project has seen the transfer of the manual register of members to a computer database. Members will first be aware of the change when they receive their copy of the Journal and notice that the old labelling system will have been replaced by computer generated labels.

Some members will find that this issue of the Journal has been mailed using the new labels and all copies will be mailed under the new system early in the New Year.

The format of the new labels is different to the old labels and hopefully they will be much clearer!

The layout of the new label is shown below:

①	②	③	④
MOD	0	0	9999996
Mr M Smith			
99 High Street			
Chester			
Cheshire			
AB1 7EF			

KEY: 1=Branch, 2=Membership grade, 3=Additional journal copies, 4=Membership number

Please make a note of your new membership number and include it in all correspondence. If there are any amendments to your address please notify Priory House without delay.

professional grade register

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

Candidates for the Licentiatehip are reminded that dissertations are no longer required but written evidence on a subject directly associated with surface coatings has to be submitted.

List of successful candidates

As laid down in the report of the Working Party on Education, Training and Qualifications which was adopted on the institution of the Professional Grade, a list of those members in the Grade is published in the December issue of the *Journal* each year. The 16th such list appears below and includes the names and members resident in 35 countries.

The sections to which members are attached are given in italics.

Fellows

Addenbrooke, Brian John (*Midlands*)
Anneveldt, Jan Johan Willem (*Transvaal*)
Apperley, Thomas William James (*West Riding*)
Arbuckle, Kenneth Harold (*London*)
Archer, Harold (*Manchester*)
Arnold, Michael Henry Miller (*London*)
Ashworth, Norman (*Manchester*)
Astfalck, Anthony Noel (*Transvaal*)
Atherton, Donald (*Scottish*)
Bailey, John Noel (*Newcastle*)
Banfield, Thomas Arthur (*London*)
Barrett, Ronald Leon (*Scottish*)
Bayliss, Derek Arthur (*London*)
Bester, Lawrence Percy (*Natal*)
Bhumkar, Chidanand Jayram (*General Overseas — India*)
Birrell, Peter (*Ontario*)
Bishop, Eric Harold Abbott (*West Riding*)
Bloomfield, Kenneth Vincent (*London*)
Boroky, Joseph Stephen (*General Overseas — Australia*)
Bosman, Herman Izak (*Transvaal*)
Bourne, John Robert (*Midlands — Trent Valley Branch*)
Boxall, John (*Thames Valley*)
Bridle, Peter Frederick (*London*)
Brooks, Leo James (*London*)
Brown, Arthur Ernest Girdlestone (*London*)
Burwell, Barry (*Manchester*)
Butcher, George Alfred (*Midlands*)
Butcher, Kenneth William George (*Manchester*)
Butler, Cecil (*West Riding*)
Caffery, George Francis (*London*)
Campbell, George Alexander (*Manchester*)
Canterford, Barry Albert (*London*)
Carr, William (*Manchester*)

Carter, Eric Victor (*Newcastle*)
Chessman, Clifford Reginald (*Transvaal*)
Churchman, Anthony Edward (*London*)
Clarke, Harry James (*Midlands*)
Clement, Donovan Harry (*Midlands*)
Colborn, Douglas Charles (*Thames Valley*)
Cole, Derek (*General Overseas — Australia*)
Collier, Claude William (*Midlands — Trent Valley Branch*)
Collings, Arthur Geoffrey (*London*)
Coupe, Raymond Richard (*London*)
Courtman, Frank (*Manchester*)
Coverdale, Peter Frederick Muir (*Midlands*)
de Jong, Jan Lauwrens (*Transvaal*)
Dowsing, George Frederick (*London*)
Draper, Patrick Albert (*Natal*)
Duligal, Eric Arthur (*Transvaal*)
Dunkley, Frederick George (*Midlands — Trent Valley Branch*)
Easton, James Douglas (*General Overseas — USA*)
Eglington, Roland Alexander (*Natal*)
Field, Lawrence Edward (*Natal*)
Finn, Stanley Russell (*London*)
Froggatt, Joshua John (*London*)
Fullard, John Edward (*Transvaal*)
Furuhjelm, Viktor Henrik (*General Overseas — Finland*)
Garratt, Peter Garth (*General Overseas — Austria*)
Gate, Peter Atholl Jackson (*Transvaal*)
Geddes, Kenneth Raymond (*Manchester*)
Giesen, Mathias Franz (*General Overseas — Germany*)
Gillian, James Graham (*Manchester*)
Gollop, Percy Lionel (*London*)
Gosling, Harry (*Manchester*)
Goyal, Ramkumar Bhanwarlal (*General Overseas — India*)
Graham, Thomas (*Manchester*)
Grainger, William Alan (*Irish*)
Grover, Donald Henry (*London*)
Hackney, Thomas (*General Overseas — New Zealand*)
Haken, John Kingsford (*General Overseas — Australia*)
Hamburg, Herman Rudolf (*London*)
Hanson, Robert Philip (*Newcastle*)
Hill, Derek Alfred Wheeler (*London*)
Hill, Gilbert Victor Geoffrey (*Thames Valley*)
Hill, Lawrence Albert (*General Overseas — Australia*)
Hipwood, Hubert Allan (*London*)
Hodgson, Kenneth Vickerson (*London*)
Holbrow, Gordon Leonard (*London*)
Hoppgood, Arthur Thomas Robb (*London*)
House, Dudley James (*Natal*)
Hutchinson, Geoffrey Herbert (*Scottish — Eastern Branch*)
Inshaw, John Lesley (*Thames Valley*)
Iyengar, Doreswamy Raghavachar (*General Overseas — USA*)
Jacob, Basil (*Thames Valley*)
Johannsen, Ralf Peter (*Cape*)
Johnsen, Svend (*General Overseas — Denmark*)
Jolly, Anthony Charles (*Manchester*)
Jones, George Francis (*London*)
Kalewicz, Zdzislaw (*General Overseas — France*)
Kane, Joseph Richard (*Newcastle*)
Keenan, Henry Wilfred (*London*)
King, Raymond John (*Midlands*)
Kotwal, Hoshidar Peshotan (*General Overseas — Pakistan*)
Kut, Sigmund (*London*)
Landmann, Axel Wolfgang (*London*)
Lasser, Howard Gilbert (*General Overseas — USA*)
Lewis, Fred (*Manchester*)
Ley, John Barry (*Thames Valley*)
Lomas, Harold (*Ontario*)
Lunt, Walter Richard (*West Riding*)
Martin, Christian Pierre (*General Overseas — France*)
McLean, Angus (*Scottish*)
McMillan, Stanley (*Newcastle*)
McQuirk, Peter John (*Midlands*)
Mitchell, John Edmund (*Manchester*)
Mitchell, Seward John (*Midlands*)
Monk, Cyril James Henry (*Bristol*)
Moon, William Robert (*Manchester*)
Morgans, Wilfred Morley (*London*)
Morpeth, Frederick Johnson (*Manchester*)
Morris, David (*General Overseas — Nigerian Branch*)
Munn, Raymond Henry Edward (*London*)
Munro, Hugh Anderson (*Scottish*)
Newton, Dennis Sydney (*Bristol*)
Newton, Donald Stringer (*Bristol*)
Nutt, William Owen (*London*)
Oostens, Emile Elie Eugene (*General Overseas — Belgium*)
Pace, Graham (*Thames Valley*)
Patel, Shirish Manibhai (*Ontario*)
Pettit, Michael Robert (*London*)
Piggott, Kenneth Elliot (*Natal*)
Polaïne, Sidney Alan (*London*)
Porteous, Barry Milroy (*Ontario*)
Prigmore, Maurice Henry (*Bristol*)
Raaschou Nielsen, Hans Kristian (*General Overseas — Denmark*)
Rampley, Dennis Neil (*London*)
Ray, Stanley Arthur (*Midlands*)
Rechmann, Heinz (*General Overseas — Germany*)
Redman, Frank Benson (*Manchester*)
Reid, John Rodney Stanford (*Natal*)
Raleigh, Albert Kenneth (*General Overseas — Australia*)
Robson, Gordon Reginald (*Manchester*)
Roe, David Edwin (*London*)
Rouse, Robert Earnshaw (*Transvaal*)
Rubin, Wallace (*London*)
Rudram, Arthur Thomas Stephen (*London*)
Saunders, Laurence Frederick (*Transvaal*)
Seymour, Norman Henry (*Manchester*)
Sharpe, Eric Edward Victor (*Transvaal*)
Shepherd, Joseph (*Newcastle*)
Silsby, Denys John (*Midlands*)
Simon, Raymond (*Irish*)
Slade, Harold Aitken (*London*)
Smith, Eric (*West Riding*)
Smith, Francis Mark (*Manchester*)
Smith, Harry (*Manchester*)
Smith, John George Nixon (*Newcastle*)
Stead, Graeme Rupert (*Transvaal*)
Stoodley, Keith Herbert (*London*)

professional grade register

- Stoyle, Francis Wilbert (*Irish*)
Stretton, Elizabeth (*Manchester*)
Tate, Donald Howarth (*Newcastle*)
Taylor, John Roberts (*Bristol*)
Thukral, Prem Sagar (*London*)
Timm, Eric Ralph (*Transvaal*)
Tooth, John Henry Collins (*London*)
Turner, John Harry Wallace (*Manchester*)
Valentine, Leslie (*London*)
van Londen, Anton Matthijs
(*General Overseas — Netherlands*)
Walker, Peter (*Thames Valley*)
Watkinson, Leonard James (*West Riding*)
Weineck, Terrence Graham
(*General Overseas — Portugal*)
Whiteley, Peter (*Midlands*)
Wilkinson, Thomas William (*Hull*)
Willis, Gervase Hewitson (*Manchester*)
Windsor, Frederick Barry (*Manchester*)
Wood, George (*London*)
Woodbridge, Richard John (*Bristol*)
Worsdall, Herbert Charles (*London*)
Young, Hugh (*West Riding*)
- Associates**
- Abel, Adrian George (*West Riding*)
Acey, John Arthur (*London*)
Adams, John Charles (*Midlands*)
Adams, Terry Ernest (*London*)
Adefarati, Francis Babasola
(*General Overseas—Nigerian Branch*)
Akam, Richard Brian
(*General Overseas—Hong Kong*)
Anthony, Alan Sydney (*London*)
Armstrong, Herbert Walter Maynard
(*London*)
Arnold, Alan Edward (*Midlands*)
Arnold, Frank (*Manchester*)
Ashton, Ronald (*Manchester*)
Asiedu-Dompfeh, Jonathan (*London*)
Asubonteng, Samuel Kofi
(*General Overseas—Ghana*)
Attwood, Stephen Charles Jackson
(*Transvaal*)
Bains, Ranjit Singh (*London*)
Baldwin, George William (*Manchester*)
Bandyopadhyay, Basabjit
(*General Overseas—India*)
Barnes, Peter James (*London*)
Barry, James
(*Midlands—Trent Valley Branch*)
Batch, Alan James Edward (*London*)
Beadle, Roy William (*London*)
Bell, Brian Robert (*Midlands*)
Bell, Eric James (*London*)
Bentley, Major Gordon (*West Riding*)
Berberi, Anwar Edmond
(*General Overseas—Lebanon*)
Bird, George Donald Chaplyn (*Midlands*)
Bolan, Ion Barrow (*Newcastle*)
Borer, Keith (*Newcastle*)
Bose, Sunil Kumar (*London*)
Bourne, Jonathan Paul
(*Midlands—Trent Valley Branch*)
Brooke, Leslie John (*Bristol*)
Byrns, Arthur Robin (*Cape*)
Calderbank, John Thomas (*Manchester*)
Campsey, Lesley John Randall (*Ontario*)
Carr, Robin Gordon (*Newcastle*)
Cartwright, Jeffrey (*London*)
Catchpole, David (*London*)
Catherall, Kenneth David (*Midlands*)
Chambers, Anthony (*London*)
Chaudhry, Mudassar Iqbal
(*General Overseas—Pakistan*)
Chebsey, Maurice (*Manchester*)
Chellingsworth, Horace Thomas
(*Midlands*)
Chippington, Kenneth Alan (*Bristol*)
Chua, Ah Guan
(*General Overseas—Singapore*)
Clarke, Raymond John (*Ontario*)
Clayton, David Walter Norbury
(*Manchester*)
Clausen, Hans Christian (*Natal*)
Coates, John Allen (*Manchester*)
Cole, Francis William (*London*)
Constantinides, Erricos (*London*)
Cordwell, Terrence Allan
(*Midlands—Trent Valley Branch*)
Cowie, Edward Bruce
(*General Overseas—Malta*)
Cox, Garth Anthony (*London*)
Cromarty, Ronald Earling (*Transvaal*)
Cunnington, Robin Roy Carol (*London*)
Dalton, Frank
(*General Overseas—Denmark*)
Davis, Brian Frederick James (*London*)
Davis, Reginald Albert (*Bristol*)
Dent, Graham John (*Manchester*)
Devine, James (*Transvaal*)
Donkersley, Brian (*West Riding*)
Downham, Stephen Airey (*Manchester*)
Drury, James Roland (*Transvaal*)
Dunn, Paul Alan (*London*)
Durdley, Alan James (*Newcastle*)
Dury, Ian Clifford James (*Thames Valley*)
Eaton, Michael George (*Thames Valley*)
Ekeh, Godwin Chukoemeka
(*General Overseas—Nigerian Branch*)
Eylers, Petrus Gerardus
(*General Overseas—Zimbabwe Branch*)
Fairless, Joseph
(*General Overseas—Netherlands*)
Fell, Alan William (*Thames Valley*)
Fernades, Larry Raphael Francis Joseph
(*London*)
Finlay, Cecil Newton (*Newcastle*)
Fisher, Leslie Alexander (*Natal*)
Flood, Geoffrey Terence (*Scottish*)
Flynn, Roy (*West Riding*)
Ford, Keith Sydney (*Manchester*)
Formanek, Leopold
(*General Overseas—Czechoslovakia*)
Freund, Kurt Alfredo
(*General Overseas—Ecuador*)
Gallon, Mark Robert (*Manchester*)
Gascoyne, John (*Midlands*)
Gaynor, Helen McDonald (*Transvaal*)
Gibson, Anne McArdle (*Scottish*)
Gibson, Frank (*Manchester*)
Gibson, John Carrington (*Hull*)
Gilliam, Brian Frederick (*London*)
Greeff, Mattheus Philip (*Transvaal*)
Green, Basil Ray
(*General Overseas—Trinidad*)
Green, Brian James (*London*)
Greenfield, Eric (*Midlands*)
Griffiths, Henry James (*Midlands*)
Gunn, David John (*Midlands*)
Gunn, Reginald (*Bristol*)
Hamilton, Alexander (*Scottish*)
Harris, Edward Murray (*Scottish*)
Harrison, Cyril Geoffrey (*Hull*)
Harty, David Basil
(*General Overseas—Australia*)
Hasnip, John Anthony (*Hull*)
Hemmings, James (*West Riding*)
Herriott, Charles Edward (*London*)
Hester, Nigel Lewis (*Bristol*)
Hickman, Edwin Peter (*Midlands*)
Hill, Raymond Forsyth (*Scottish*)
Hitchmough, Rex Henry (*London*)
Holden, William Desmond (*Manchester*)
Holmes, Peter Neville (*Irish*)
Holt, Clifford (*West Riding*)
Honiball, Alan Edward (*Scottish*)
Hopkins, Francis Glenn
(*General Overseas—New Zealand*)
Horn, David Michael William
(*Thames Valley*)
Howarth, Graham, Alistair (*Manchester*)
Howes, Edward John (*London*)
Hughes, Anthony Harold (*Manchester*)
Hutchins, Robert John (*London*)
Hutchinson, Martin Alfred (*West Riding*)
James Tudor Herbert (*Irish*)
Johnstone, James William (*Manchester*)
Kaye, Dennis David (*London*)
Kenna, Frank William (*Manchester*)
Kerr, Michael Anthony (*Manchester*)
Kirkwood, Thomas (*Scottish*)
Kirklew, Charles Wesley
(*General Overseas—USA*)
Kitchen, John Robert
(*Midlands—Trent Valley Branch*)
Laker, Bernard George (*London*)
Lakshmanan, P. R.
(*General Overseas—USA*)
Lander, Wilfred Terence (*Hull*)
Lang, Robert (*Scottish*)
Langdon, Donald Robert (*Ontario*)
Langley, Robert (*Scottish*)
Lawrence, Simon Gaynor (*Scottish*)
Le Maistre, Paul Francis (*Midlands*)
Lever, Colin (*Manchester*)
Lewis, Geoffrey John (*Midlands*)
Lewis, John David (*Thames Valley*)
Low, Charles
(*General Overseas—Australia*)
Mandagi, Willy
(*General Overseas—Indonesia*)
Marples, Peter (*Transvaal*)
Maynard, Albert William David (*London*)
McCallum, Ian Robert (*Scottish*)
McClean, Michael Dennis (*London*)
McDonald, Kennety Roy (*Natal*)
McFetridge, John Henry
(*General Overseas—New Zealand*)
McKay, John (*Manchester*)
McMillan, James (*Scottish*)
Mehta, Ramesh Mulshanker (*London*)
Mephram, Brian Edwin (*London*)
Mikucki, Wiktor (*London*)
Mogilnicki, Waclaw Stefan (*Transvaal*)
Moore, Frank Roden (*West Riding*)
Moore, James (*Thames Valley*)
Moss, Noel Sydney (*London*)
Mouallem, Mouhammad
(*General Overseas—Syria*)
Mun-Gavin, Patrick William James (*Natal*)

professional grade register

Murray, Keith Allen (London)
Myers, Gordon (Natal)
Mynett, Raymond John (Midlands)
Naess, Erik (General Overseas—Norway)
Newman, Derek George (Thames Valley)
Nicholson, John William (London)
Norman, David (Midlands)
Norton, Douglas Kent (Midlands)
Notley, Malcolm Anthony Leslie (London)
Ohene-Kwadade, Kofi (General Overseas—Ghana)
Parry, Martin Gerald (London)
Payne, Edward James (Manchester)
Payne, Kenneth (Bristol)
Pessall, Robert George (Midlands)
Piper, Norman William (Manchester)
Potter, Arnold John (Hull)
Proudley, Philip Miles (West Riding)
Pursglove, Alan Bryce (West Riding)
Pyett, Albert Lawrence (Manchester)
Quorn, Peter James (Transvaal)
Rackham, John Michael (Newcastle)
Redpath, Neil Douglas (Newcastle)
Reeve, Frank Nicholson (Transvaal)
Rickell, David (Manchester)
Roberts, Peter David Mynwy (London)
Robinson, Arthur Graham (Manchester)
Robinson, Francis Derrick (Hull)
Ronson, David James (General Overseas—New Zealand)
Rothwell, Gerald William (London)
Russell, Frederick Charles (London)
Russell, George Rowland Michael (Transvaal)
Saadatjou, Naghi (General Overseas—Iran)
Saggarr, Anoop Kumar (London)
Saville, Rowland Whincup (West Riding)
Say, Terence Edwin (General Overseas—USA)
Scheinost, Bernd (Natal)
Sharpe, David (London)
Sheath, Alan (General Overseas—New Zealand)
Shepherd, David William (Bristol)
Silverwood, David (Manchester)
Smith, Brian James (London)
Smith, Harry Bertram (London)
Spaargaren, Albert Arend (Natal)
Spargo, Robert (General Overseas—New Zealand)
Springett, Robert Arthur Edward (London)
Staples, Peter Graham (London)
Stott, Raymond (Manchester)
Surinphong, Julian Suriya (General Overseas—Thailand)
Talwalkar, Vinayak Sakharam (London)
Tape, Brian William Charles (General Overseas—USA)
Taylor, Richard Anthony John (London)
Taylor, Terence (Manchester)
Thornton, Philip Joseph Martin (Irish)
Tillyer, Richard Brian (Midland)
Tilak, Girish Yeshwant (General Overseas—India)
Topping, George David (London)
Tooke-Kirby, David Henry (London)
Toovey, John (Thames Valley)
Trevitt, Edwin William (London)

Triggs, Francis Cyril (London)
Troparevsky, Alejandro (General Overseas—Argentina)
Tye, Terence Thomas (Midlands)
Van der Merwe, Hendrik Albertus Johannes (Natal)
Vickers, James Edward (General Overseas—New Zealand)
Wagenvoort, Marinus (General Overseas—New Zealand)
Waller, Andrew George (West Riding)
Walters, Peter (General Overseas—New Zealand)
Webb, John Peter (London)
Whaley, Alan Roy (Manchester)
Whalley, James (General Overseas—Denmark)
Whatling, Allan (Bristol)
Whetley, Kenneth Valentine (Irish)
Whetstone, Peter John (London)
Whiteside, Alexander Edward (General Overseas—Australia)
Wilcox David Joseph (Manchester)
Wilkes, David Graham (Midlands)
Wilkinson, Roy Rowley (Manchester)
Williams, Cyril (Manchester)
Woof, John Clifford (Bristol)
Wu, Andrew Chi Kit (General Overseas—Hong Kong)
Zakaria, Anis (Manchester)
Zissell, Martin John (London)

Licentiates

Babatunde, Abimbolu A. S. (General Overseas—Nigerian Branch)
Belt, Adrian Mark (Midlands)
Birkett, Stephen (West Riding)
Gill, Trevor George (London)
Hayles, John William (London)
Langham, Christopher (London)
Leonard, Mark (Manchester)
Leonard, Michael William (London)
Mulji, Ajai (London)
Pratt, Douglas Edward (Ontario)
Richardson, Robert Keith (London)
Rowntree, Randal Peter (Manchester)
Sawyers, Olatunji Pekun (General Overseas—Nigerian Branch)
Shroff, Farrokh (Ontario)
Stanton, Peter Roy (West Riding)
Taylor, David (London)
Timbrell, John Arthur (West Riding)
Wilkinson, Stephen James (Manchester)

Approved affiliated body— OCCA New Zealand

Fellows

Aitken-Smith, Frank Joseph
Caldwell, David George
Gooch, Colin
McKean, James Newlands
Sharp, Peter Frank
Slinn, Thomas Walter
White, Robert Arthur
Whitfield, Thomas

Associates

Assink, Jo
Bluck, Ross Steele
Clark, Michael Denis Thomas
Dalzell, Kerry Wayne

Eltringham, James Norman
Foster, Alan Howard
Fry, Jack Ian
Greenall, Brian John
Horsfall, Anthony John
Jenkins, Brian Gordon Allan
Jones, Geoffrey Peter
Leathley, George Derek
McCapra, Ronald
Ness, Robert Alexander
Provan, Andrew Wilson
Sewell, Anthony Robert
Stephenson, Robert Perry
Thorburn, Alan McGregor
Wright, Graham Leslie

OCCA news

Contd from p. 375

with OCCA Australia in connection with a common professional grade.

The General Secretary reported on the initial modernisation of equipment at Priory House including the installation of computers and a long overdue replacement telephone system. Don Newton questioned whether the Association should invest in a facsimile machine which he believed would significantly improve the communications between the office and the Association's printers.

The suggestion was enthusiastically supported by the meeting and it was agreed to proceed with the purchase and installation of a facsimile machine.

professional grade

At the meeting of the Professional Grade Committee held on 22 October 1987 the following admissions were made:

Admitted to Associateship

Bandyopadhyay, Basabjit (General Overseas—India)
Mogilnicki, Waclaw Stefan (Transvaal)

Admitted to Associateship through

approved affiliated body
Foster, Alan Howard (Auckland)

Transferred to Fellowship through

approved affiliated body
McKean, James Newlands (Auckland)

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- (N) - News
- (OM) - OCCA Meetings
- (ON) - OCCA News
- (R) - Reviews
- (SC) - Short communications
- (T) - Transactions and communications

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