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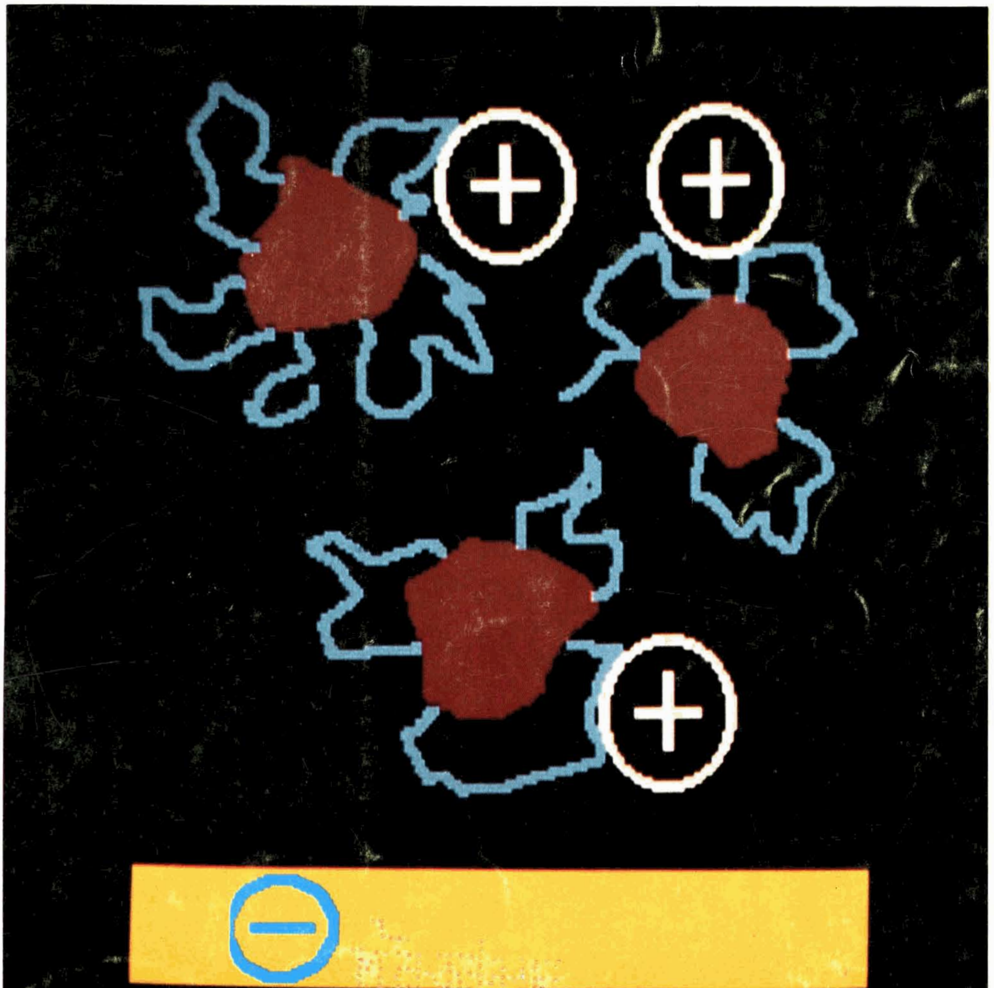
JOCCA



■ Additives

Vol. 72 No. 8 AUGUST 1989

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Contents

Forthcoming Features: September — Coatings for Plastics/R&P Preview, October — Marine & Offshore Coatings, November — Wood Finishes. Contributions are welcomed at least five weeks prior to publication date.

Cover: Stabilization of the dispersion of pigment particles by using polymeric wetting additives (Photo by courtesy of BYK-Chemie).

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Colourgen agreement with BASF Coatings + Inks

Colourgen Ltd, the Warrington-based colour matching specialists, have entered a joint agreement with BASF Coatings + Inks Ltd to promote Colourgen colour matching systems together with BASF Fishburn printing inks.

Mike Williams, Marketing Manager BASF Coating + Inks, said: "It's a perfect match. This package offers the latest advances in technology at an affordable price. After extensive database development work and field testing with Colourgen, the system has now been perfected to give excellent match predictions. Clearly, the way forward is the combination of the ideal base system with a computer colour matching facility."

Croda pigments expansion

Croda Colours Ltd, West Yorkshire manufacturer of dyes, pigments and intermediate chemicals, has acquired the Scolor pigments business of Stratford Colour Co Ltd. The Scolor range will be integrated without change to Croda's complementary existing Forthbrite range.

Beckers Swiss start-up

Wilhelm Becker, the Stockholm-based European Industrial Paint Manufacturer, has formed a company in Switzerland to manufacture and market powder coatings. The company, to be officially known as Becker Pulver Farben AG, has been established on the outskirts of Berne.

Sheen International conference

Sheen Instruments recently held a very successful two-day agents sales conference in Portsmouth, which was attended by their distributors from all over the world. The conference also marked the official launch of the new Sheen Automatic Panel Sprayer.

New identity scheme for International Paint

International Paint has taken on a new image which will signal more clearly that:

☐ International Paint is part of Courtaulds plc.
☐ It is a company specialising in the manufacture, marketing and servicing of high performance coatings.
☐ It is a brands-led business, with a powerful portfolio of leading product names.

To emphasise these important qualities:

☐ International Paint plc — the worldwide holding company — will now be known as Courtaulds Coatings Ltd, and will adopt the Courtaulds group symbol — the C-mark — in the traditional International Paint colours.

COURTAULDS COATINGS

☐ The brands will now be separated more clearly from the individual trading company names to maximise their impact in the market place.

The major global brand — INTERNATIONAL— runs alongside the other main brands — INTERPON (worldwide), TAUBMANS (Australasia), PORTER (USA), PORTER INTERNATIONAL (USA), INTERLUX (North America), EXTENSOR (Europe and North America), and EPIGLASS (Australasia). Together they identify a very comprehensive range of marine, yacht, powder, protective, coil, packaging and consumer coatings, supported by customer service.

☐ The names of the individual trading companies will be largely unchanged, but they will now show the Courtaulds Coatings identity as a visual endorsement on stationery, signs, packaging and vehicles.

The new identity scheme is designed to reinforce the group's strong position in the worldwide coatings market.

M. W. Hardy acquires B & D

M. W. Hardy & Co (Holdings) Ltd, has acquired Bromhead & Denison Ltd, supplier of anticorrosive pigments and mineral extenders. Under a rationalisation scheme B & D Ltd and Hardy Minerals Ltd will merge and the two companies will operate from the Welwyn Garden City premises under the name of Bromhead & Denison Ltd, as the Inorganic Division of the Hardy Group of Companies. The new Board of B & D will comprise Dr M. Kropman (Managing Director) and Mr A. N. Hinton as before and they will be joined by Mr R. P. H. Cohn (Chairman), Mr R. Parker and Mr P. Schonfield from Hardy's.

Yarsley toxicity service

Fulmer Yarsley has updated its toxicity testing service to enable it to comply with the proposed new EEC regulations on toys.

E + E speciality product service

Ellis and Everard's 16 branches located throughout the UK which distribute over 400 commodity chemicals have expanded, offering to the paint and ink industry local delivery and customer service for speciality products.

1990 Queen's Awards

1990 celebrates the 25th Anniversary of The Queen's Awards for Export and Technology. The Queen's Awards Office are expecting a record number of companies to apply during this special year. The Silver Stamp of Success will be the theme for the Silver Jubilee Year of The Queen's Awards which are in two categories: Export Achievement and Technological Achievement. Companies wishing to enter for the award should contact the Queen's Award Office on 01-222 2277.

Products

New thixotropic resins

Croda Resins Ltd, of Belvedere, Kent, has announced that it is to market the new Jagalyd range of thixotropic alkyds. Innovations in the 23-member range include modifications with styrene, polyamide, epoxide and isocyanate.

For further information Enter H199

R. T. Newey wax expansion

R. T. Newey, formed in 1980, has specialised in the production of micronised waxes for use principally in the formulation and manufacture of printing inks and industrial coatings. The product range consists of natural and synthetic waxes in a finely divided (5 to 10 micron) form. The company is currently engaged in expanding its network of overseas agents and distributors. Additionally, in response to customer and market requirements it is expanding its product range to include solvent and water-based wax dispersions.

For further information Enter H200

New print paste thickeners

Allied Colloids have increased their range of synthetic polymers to combat the world-shortage of natural gums for the manufacture of print paste thickeners. The new product is Alcoprint DTP, developed specially as a thickening agent in printing on polyester fabrics with disperse dyes.

Alcoprint RTA — for use in printing on cellulosic fabrics — was launched last year. At that time world prices for sodium alginate and guar derivatives were rapidly rising and supplies from traditional sources were drying up. These synthetic thickening agents are based on Allied Colloids acrylic polymer technology designed as a high technology replacement for the traditionally-used alginate-based thickeners.

The ready availability and relatively stable price of the synthetic polymers have made them very attractive as an alternative. As a result, Allied Colloids have installed an additional manufacturing plant as part of their current £15 million investment programme.

For further information Enter H201

Expanded Pantone 747

BASF Coatings + Inks is offering printers a greater range of colours with the adoption of the Pantone Colour Formula Guide 747XR. A total of 747 variants are possible based on nine basic shades plus black and white.

For further information Enter H202

New flexible rubber paints

R. E. Components Ltd, a subsidiary of Dunlop's Precision Rubber Division, has launched the first range of flexible paints designed specifically to protect rubber and other polymeric engineering components against contamination and decay.

Dunlop flexible paints will withstand considerable wear and remain firmly attached to the most flexible components and those subject to constantly repeated movements. They provide an effective defence against fuel, oils and greases, ozone, UV light, alkalis and acids.

Technologist at R. E. Components believe that there will be a wide variety of applications for these paints in hose, bushes, anti-vibration mountings and wherever engineering components in rubber are subject to surface attack and deterioration.

For further information Enter H203

West Riding Section

The Implications of Just-in-Time

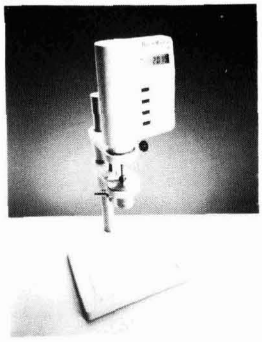
14 September 1989

University of Leeds

Contact Rob Lewis on 0274 569222

Equipment

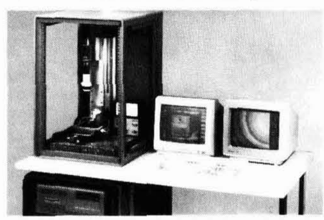
Cone and plate viscosity



Bohlin Reologi AB (Sweden) now offers cone and plate and parallel plate measurements for the V88. This device, in conjunction with Bohlin's Viscosoft V.2.0 software, enables laboratory measurements in cone and plate mode as well as the standard (DIN 53019) concentric cylinders. This option allows inks and pastes to be measured quickly and accurately. Viscosoft enables the V88 to operate at 50 different speeds covering a shear rate range of 20 to 6000 s-1. Barbed fittings for an optional external circulator allow the operator to control sample temperature from 20-70°C.

For further information Enter H204

New surface measurement system



The Nanosurf 488 system available from Euro-Technolgie Ltd is a three-dimensional profilometer that combines advanced computer graphics with a powerful measuring capability. It's applications are widespread, with systems now in use in paint, metal coating and electro-plating finishes.

For further information Enter H205

New Minitest 4000 range

Elektro-Physik have introduced an updated range of the Minitest coating thickness gauges for measurement on steel and non-ferrous metals. The new model 4000 is programmed for use with no less than 12 different probes, which has 9 separate application memories which in turn can be subdivided into 9 application batches giving a total memory of 3,000 readings. The 4000 is also equipped with a bi-directional RS232 interface.

For further information Enter H206

Aerosol shaking — precisely

Aerosol manufacturers and R & D labs need to shake the cans and aspirate them under controlled conditions for QA and development purposes. This is normally done by hand and there is considerable variation between one shake and another. Now there is the PASLab 353 Aerosol Shaker which emulates the user. A variety of canisters and actuators can be fitted and all aspects of the shaking cycle are defined by the operator over a very wide range.

For further information Enter H207

New range of glass balls

A new range of precision ground glass balls from 0.3 to 20 mm diameters for ink manufacture are now available from OBS Machines. Specifically developed for their chemical and corrosion resistance properties, the high precision balls have a standard diameter tolerance of ±0.002 mm.

For further information Enter H208

New colour-in-the-lid paint pack

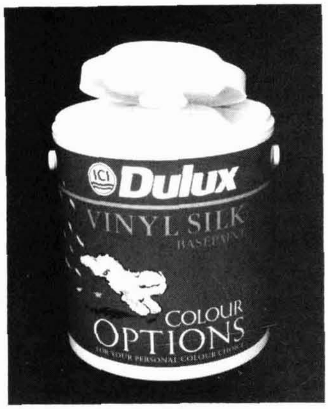
The world's very first colour-in-the-lid paint-colouring system has been launched by ICI Paints, using innovative packaging by Metalbox General Packaging. Described by ICI Paints as an old puzzle waiting for a new answer, Dulux Colour Options provides a completely clean, self-service paint colouring system which lets the customer choose and mix colours in store.

It took five years for ICI to perfect the system, in conjunction with design consultants DCA Warwick and Metalbox. The result is a completely new way of selling paint.

The consumer selects either a Dulux matt or a silk base paint — packed in a Metalbox plastic Fabcan and sealed with a specially-designed lid. The concentrated tinting medium is contained in a plastic capsule and, from a range of colours, the consumer chooses a preferred shade. The capsule is snapped onto the can lid and the whole pack placed in a specially-designed mixing machine. This crushes the contents of the capsule into the can, locking the capsule permanently to the top of the lid. Within 45 seconds the colour is thoroughly mixed and ready to use. At no time does the consumer come into contact with the paint.

A Metalbox-designed spin welding technique enabled the capsule — the inner membrane of which has to totally collapse under pressure — to be robustly constructed in two parts, welded and then filled with paint by Dulux before being capped with a special plug. Attention then focused on the lid, which needed to be reinforced to take the downward force of the capsule in the mixing machine, when two plugs are ejected into the base can to allow the tinter access.

One final problem remained. When the tinter meets the base paint, it lies on top. Even when shaken, some tinter is forced up inside the lid, where it stubbornly sticks and refused to thoroughly mix with the rest. A pre-shake,



User-friendly colouring of paint

devised by Dulux, which occurs before the tinter is released, coats the inside of the lid with base paint, preventing the tinter getting a hold. The net result is an even mix and consistent texture, time after time.

Dulux offer 84 colour options, with no chance of error in mixing and no mess. Customers can go back to the store at any time and remake exactly the same colour with 100 per cent accuracy.

For further information Enter H209

Literature

PA launch module on powder coatings

Continuing the successes achieved with the first eight modules (study packs of either 30 or 60 hours duration) basically on wet paints, PA have now introduced Module SC09 Surface Coatings Technology — Powder Manufacture and Application. This is also for study over sixty hours and consists of audio cassettes with approximately seven hours of tuition, over two hundred pages of study notes and exercises, and a full back-up process with Tutor, Industrial Counsellor and Administration.

For those who would be capable of further study, probably employed in the laboratory or

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technical service areas, a further 30-hour module, SC10, is now approaching completion and will be available about November. The next enrolment session for SC09 will be in September.

For further details of these and the full range of modules contact: Don Clement, Paintmakers' Association, Alembic House, 93 Albert Embankment, London SE1 7TY, telephone 01 582 1185 or 587 1466.

Advanced polymers

"Advanced Polymers & Composites: Creating the key skills" is the title of a new report (89pp) published by the Training Agency. The report covers: Market prospects for advanced polymers and composites; companies involved in the application of the materials; the response of education and training providers; views of higher education institutions; discussions with experts in relevant industry, research and training organisations. For a free copy of the report write to: David Hollis, Training Agency, Room W425, Moorfoot, Sheffield S14 PQ

Dust control in powder handling

The Health and Safety Commission (HSC) has published guidance on the control of dust in powder handling and weighing which was prepared by its Rubber Industry Advisory Committee.

'Dust Control in Powder Handling and Weighing', ISBN 0 11 885495X, is available from HMSO or booksellers, price £6.50.

Meetings

Cellucon '89

On 4-8 September 1989, the 4th international conference on Cellulose: Sources and Exploitation will be held at Cartrefle College, N.E. Wales Institute, Wrexham. Papers of interest (7th September) include the use of cellulose derivatives in the paint & building industry and papers on hydrophobically modified cellulosics and emulsion polymerisation. For further information call 0244 831531 ext 234.

Radtech '89

The first international conference on Radiation Curing Processes by UV and EB will be held on 8-11 October 1989 in Florence, Italy. For further information call the organisers, MGR, on Italy 392-481 3558.

Finishing '89

Finishing '89 Conference and Exposition will be held in Cincinnati, Ohio, on 17-19 October. For further information call the organisers, the Society of Manufacturing Engineers, on USA-313 271 0777.

Surface Analysis

THE Surface Analysis Centre at UMIST is running a 2 day course on General Surface Analysis on 9-10 November 1989. For further information call Lis Smith on 061-228 1249.

People

Expansion for Allied Colloids

The General Industries Division of Allied Colloids is expanding its sales operations with the appointment of three new technical sales representatives. They are:

Gary Jones, working from St. Albans and reporting to the Southern Area manager, Richard Heath.

Alan Carradice, operating from Bury and reporting to Area Manager Lawrence Pyett.

Diana Thompson, covering the North East and reporting to Area Manager Ray Sloan.

All three are concerned with marketing the company's range of resins and additives for printing inks, paints and adhesives.

Joins ICI C & F Board

Mike Parker, Managing Director of ICI (South Africa) Ltd, has returned to Manchester, UK, as Sales Director of ICI Colours and Fine Chemicals. Mr Parker, who joined ICI in 1967, held a variety of sales and marketing appointments for Colours and Fine Chemicals in the UK and Japan before moving to South Africa in 1987.

International Paint appointment

International Paint Protective Coatings Division, based at Felling, Tyne & Wear, have appointed **Ian Rowell**, 33, Specialists Business Manager. Ian will head-up International Paint Protective Coatings' newly launched Specialist Business Group, which provides a full advice, material supply and technical support service to architects, contractors, industry and local government on a wide range of protective coatings.

Starting with International Paint as a Technical Service Chemist, Ian moved into marketing, then sales, eventually taking on a co-ordinating role. Before being appointed Specialist Business Manager he was the Protective Coatings Division's UK Project Co-ordinator.

Ferguson & Menzies New MD Designate

Ferguson & Menzies, the Glasgow-based suppliers of pine and speciality chemicals, has appointed Dr. **Angus I. McLeod**, CChem, MRSC as MD Designate with special responsibility for technology, marketing and product development.

Rheo-Tech appointment

Graham Trudinger has been appointed Sales Manager-Rheology at Rheo-Tech International Ltd.

Key sales appointment at Volstatic

James H. Kenyon, who has 20 years' experience in the powder coating field, has been appointed Sales Director of Volstatic Ltd. ■

Advances in polymeric wetting additives for solvent based coatings

by R. Coates, BYK-Chemie GmbH, Abelstrasse 14, D-4230 Wesel, W. Germany

Summary

Latterly a considerable amount of work has been done on the development of polymeric wetting and dispersing agents for solvent based paint systems. As they are high molecular weight, they give excellent stability of pigments against reflocculation due to the impartation of a positive charge.

They also give the paintmaker the opportunity to produce high quality tinting pastes for tinting systems.

History

In the past, the surface coating trade relied on oils and resins which happened to be both very good binders and excellent at wetting out inorganic pigments.

Fortunately things never stand still and in the field of paints used in industrial applications resins have been designed to give greatly improved durability or performance or both.

There has also been a need to produce resins which will satisfy newer application methods such as UV and powder coatings, to mention two methods. However these newer resins such as polyurethanes, acrylics, epoxies, polyesters etc bring in their wake, problems which were not anticipated, namely good wetting out of pigments. Coupled to this problem was the much greater use of organic pigments to obtain colours which give better gloss and hue. Pigments which have been in common use for a number of years are now considered toxic and this has further increased the use of organic pigments. Originally wetting agents were used such as soya lecithin, salts of unsaturated polyamine acids and higher molecular weight acid esters or solutions of higher molecular weight unsaturated polycarboxylic acid which were available.

Polymeric wetting agents

During the last decade the introduction of a new generation of wetting agents for solvent based coatings has taken place. This advance has not only been necessary to overcome the problems of wetting with the newer types of resins but also to extract the full worth of colour strength from the organic pigments. These organic pigments are so much more costly to produce than inorganic pigments so it pays the paint formulator to extract the maximum colour strength from the pigment.

It also has to be pointed out that the ultimate particle size is very much smaller than inorganic pigments. To see how these new polymeric wetting agents compare with traditional wetting and dispersing agents it is helpful to examine Figures 1 and 2.

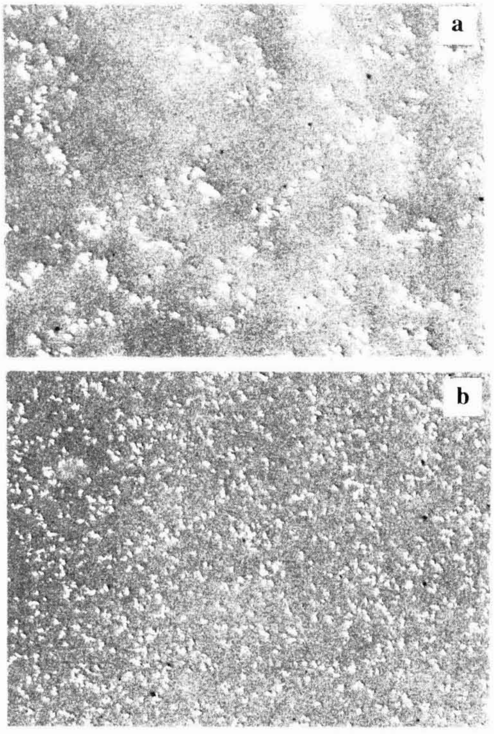
The newer generation of polymeric wetting and stabilizing agents are the subject of patents and are known as the DISPERBYK®-160 Family. This range has a higher molecular weight than common wetting agents and it contains large numbers of affinity groups which are in bunches. The result is that there is exceptionally strong attachment to the pigment. The excellent stability of the dispersion come from the polymer used. This polymer has to have very good compatibility with any of the resins which might be used by the paint maker.

Wetting and dispersion

With the new family of polymeric wetting agents the time taken to disperse pigments will be shortened. This of course leads to a shortening of milling time which in turn gives reduced costs in paint manufacture. Once the pigment is milled it will exhibit its maximum colour strength which will then become stabilized against re-flocculation. This is because the DISPERBYK®-160 Family will impart a positive charge to the pigment regardless of the charge that was originally on that pigment. (Photo 1)

Photo 1

DISBERBYK®-160 stabilizes organic pigments in a two-pack acrylic top coat, the example shown is a quinacridone pigment. (a) with DISBERBYK®-160 and (b) without additive. The small particles in the picture are the pigments. The picture was taken at a 3900x with an electron microscope.



Polarity

The paint formulator would naturally like to have one wetting agent which could be used for all pigments and all different types of coating binders. Unfortunately this dream cannot be fulfilled because the formulator needs to be free to use resins of all polarities and to use pigments from different suppliers and of different types. Although the solvent will play a part, the polarity of the binder is usually the major factor with this type of wetting agent. The wetting agent must have good compatibility with the binder and this is achieved by the "family" concept whereby e.g. a reduction in molecular weight and the variation of molecular design of the

Figure 1

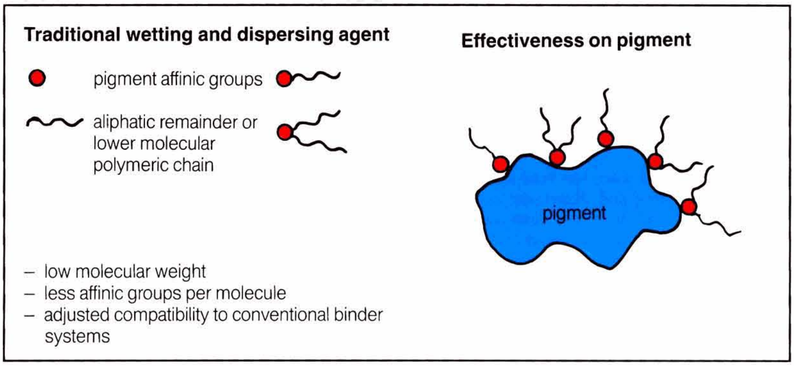


Figure 2

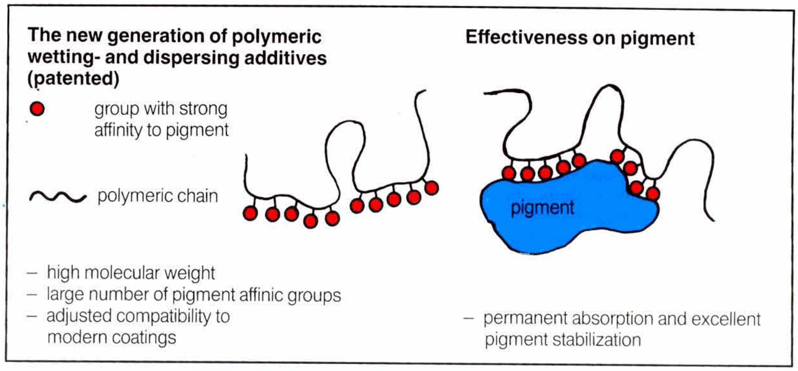
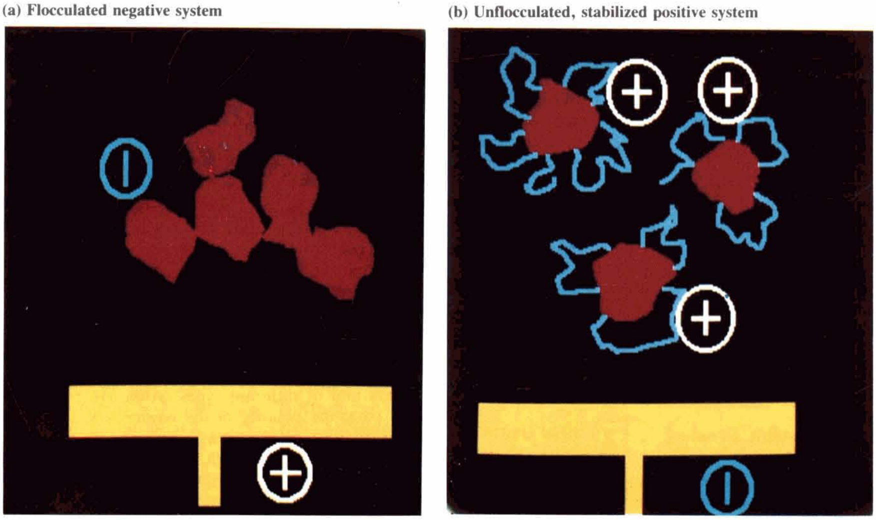


Figure 3

(a) Flocculated negative system

(b) Unflocculated, stabilized positive system



wetting agent improves its compatibility in less polar systems.

Selection

As already mentioned there is a family of polymeric wetting agents from which to choose. This family consists basically of selected polymers which are obtainable in varying molecular weight ranges, and of different molecular structure. The technique is to select the wetting agent that has the highest molecular weight consistent with good compatibility with the required binder. To achieve this a simple test may be conducted by putting a set amount of the binder in a glass receptical and adding a percentage of the wetting agent to this resin. After stirring it will be seen whether the two are compatible although the solution may have to be left overnight to achieve complete clarity.

Required quantity

Unfortunately it is not possible to be categoric about the required amount of additive without experimentation. Generally the percentage of solid matter (non volatile matter) required for organic pigments is 10%-20% and for inorganic pigments far less at 1%-5%. Optimization is normally achieved by conducting a series of tests with the incorporation of the wetting agent at various percentages in the mill base. By running a series of grinds using 10%, 15% and 20% of solid matter of the wetting agent to the pigment for organic pigments and 1%, 3% and 5% for inorganic pigments it will be observed in which bracket the optimum is obtained. Finally by doing a series of tests at different levels within the bracket the optimum additon will be found.

Testing the dispersion

In general the best way to test for dispersion is to incline a clear polyester film which is supported at 65-70 degrees to the horizontal and to pour the paint down it. With this method a rapid result will be achieved and in the case of transparent pigments the results may be observed through the film against a bright light. If the paint film is applied by an applicator such as a wire bar or is sprayed, then a shear has been applied and the result will take longer to achieve. After mixing the previous day the paint may be applied by pouring which will achieve the result which would be found by a method of shearing it, six or more months later.

Stability

The reason why the wetting and dispersing additive gives such stable dispersions is that it imparts a positive charge to the pigment, regardless of the charge on the pigment as supplied by the pigment manufacturer. It was found that a cell consisting of two copper electrodes which were stuck to a glass slide 0.9 mm apart could clearly demonstrate this. The copper electrodes were wired to a 60 volt transformer. The glass slide was put under a microscope. A drop of red paint, consisting of a diluted white paint, tinted with a red pigment paste, was put between the electrodes and the current applied. The visual results are dramatic. Provided the pigment is all charged positively then it will be seen that the paint will move over to the negative pole without flocculation. However if only some of the pigment is charged negatively the result is disastrous. The paint will move over to the positive pole in an unorderly fashion and completely flocculate. This proves that if sufficient of the additive has not been used sooner or later the coating will be unstable (Figure 3).

Titanium dioxide

Undoubtedly the major pigment used in paint making is, of course, titanium dioxide. This is a far more complex pigment than the colour pigments because of the high loading of coatings used. The pigment varies from grade to grade and also manufacturer to manufacturer. It was found that this coating varied tremendously in relation to the charges the pigment had.

Initially a series of white paints were made up with a resin using the polymeric wetting agent and different grades of titanium dioxide.

The same series of white pigments were made up with colour pigments, namely, carbon black, phthalocyanine blue and organic red pigment with the same two resins. The colour paints were used to tint the white paints with the corresponding resins. The tinted paint was applied to panels and after ten minutes were given a rub out test. It was found there was absolutely no correlation between paints made with one of the resins to the other resin in flocculation and colour strength.

The conclusion to this is that the variable results were due not only to the titanium dioxide but to the resins used.

Following from this it could be presumed that the resins were having an unfavourable influence on the charge of the titanium dioxide. In fact the resin was sometimes coating the titanium dioxide preferentially to the wetting agent where the titanium dioxide was highly negatively charged, and this could be seen by a drop of the white paint on the cell described previously and observed under the microscope.

The solution to this problem is to put solvent and wetting agent into a vessel with a slow stirrer. The titanium dioxide is added at a low rate followed by the resin after the titanium dioxide has been wetted out by solvent and wetting agent. Milling then takes place in the normal fashion. Provided this premix-procedure is carried out in the correct order DISPERBYK®-160 Family will always impart a positive charge to the titanium dioxide regardless of its original charge as supplied. So far over twenty different white pigments have been examined and found to give positive results. It can be imagined how beneficial this is to the paint manufacturer who finds that he can confidently use any titanium dioxide available to him in times of shortages worldwide and still obtain a flocculation free result. The premix method can also be used with co-grinds successfully.

Tinting systems for industrial coatings (Figure 4)

The use of tinting pastes is especially economical for companies that require to manufacture mainly small batches of paint, having computerized production and looking for the shortest delivery times. They are also useful where paint makers have bottlenecks with grinding equipments.

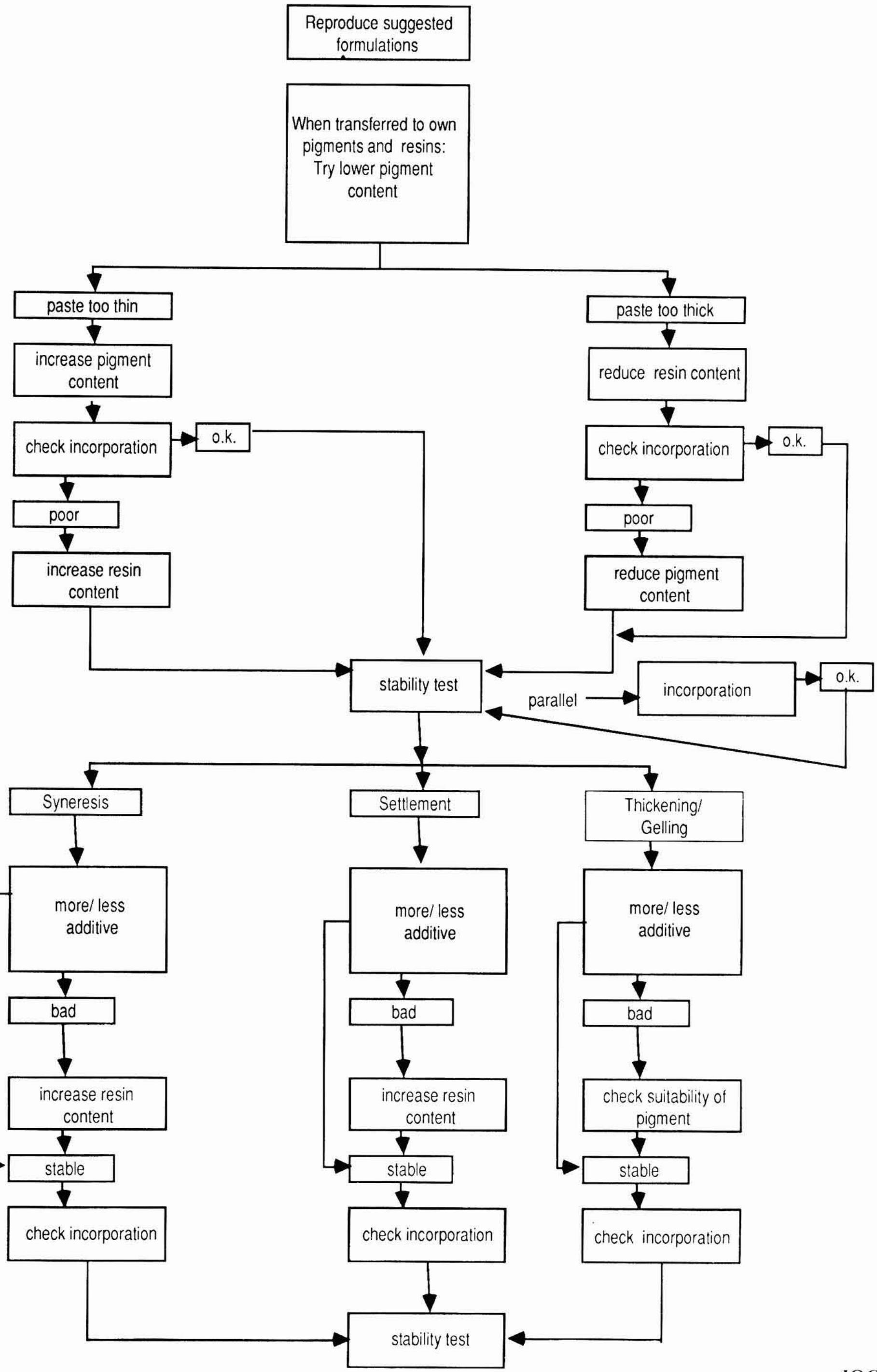
A paint tinter must have stability to both settling and syneresis. They must be free from flocculation and seeding and yet have the highest possible pigment content. To prevent drying out, a resin will be required but this should be at the lowest possible content so as not to dilute the resin required in the base paint. The viscosity must be low to give ease of addition.

A resin must be selected for the pastes, which will be compatible with the range of resins used in the base paints. The range required might be quite limited such as in the automotive refinish trade but can be required to cover the full range of media which might be required for the customers of a general industrial paint producer.

A second consideration is the solvent to use. It was found that if an aldehyde resin is used, the best solvent for solvating the paste resin and the additive is the solvent methoxy propyl acetate (MPA). In the case where an acrylic universal resin is

Continued on p.303

Figure 4
The way to reach the optimum pigment concentration of tinters



The use of wax emulsions and dispersions in the ink and surface coatings industry

by C. J. Auger, Cera Chemie BV, Koningsbergenstraat 5, PO Box 535, 7400 AM Deventer, Holland

Waxes — definition and classification

A dictionary definition will typically state *"any of numerous mixtures that differ from fats in being harder and less greasy and that are principally constituted from higher fatty acids in the form of esters"* or *"any of various natural or synthetic substances resembling wax in physical and chemical properties or both"*.

The latter statement is probably a truer reflection of the situation today. Waxes are now defined upon a more scientific basis, as Table 1 indicates.

Table 1
Wax definition

1. Drop point above 40°C without decomposition. This distinguishes a WAX from an oil or fat.
2. Has a solid consistency at room temperature.
3. Translucent to opaque in appearance. This reflects the amorphous-/crystalline structure.
4. Relatively low melt viscosity above the drop point. This differentiates a wax from a resin or plastic. *(European custom authorities classify a wax as having a melt viscosity of no higher than 10,000 cps 10°C above the drop point).*
5. Consistency and solubility are strongly dependent upon temperature. This relates to properties such as melt viscosity, hardness etc.
6. Capable of being polished under slight pressure. A typical characteristic of most waxes although temperature dependent.

Waxes fall into three general categories: Natural, Modified Natural and Synthetic waxes.

The Natural waxes are widely distributed in nature and may be divided into animal, vegetable, insect and fossil waxes. Examples of the natural waxes are carnauba and beeswax with petroleum waxes and montans being included in fossil waxes. This latter group are also termed Modified Natural waxes as they are obtained by physical and/or chemical refining procedures.

The Synthetic waxes can be split into two groups: The hydrocarbon and non hydrocarbon waxes. The most important members of the former are the polyethylene waxes either synthesised from ethylene or cracked from higher molecular weight polyolefins, and the Fischer-Tropsch waxes. Another key wax type in this class are the oxidised polyethylenes which are obtained from the homopolymer feedstocks.

A typical example of the non hydrocarbon waxes are the amide waxes.

It is very important to understand that each type of wax even within a specific class is very much an individual regarding its physical and chemical properties. These in turn have a profound influence upon how it is converted into a useable form and its subsequent performance behaviour in an ink or surface coating.

This can be deduced from the broad spectrum of chemical structures, physical properties and molecular weight variations shown in Table 2.

Table 2
Classification of waxes

Wax	Source	Structure	Melting Point(°C)
Natural			
Beeswax	Insect	C16-C24 ester	60-65
Carnauba	Vegetable	C24 ester	80-85
Modified Natural			
Paraffin	Fossil	C20-C30 hydrocarbon	52-64
Microcrystalline	Fossil	C20-C30 hydrocarbon	60-100
Montan	Fossil	C20-C36 ester	85-90
Synthetic			
Polyethylene	Ethylene	Straight/ branched (MW1000-5000)	90-120
Polyethylene oxidised	Ethylene	straight-branched (MW1000-5000)	90-140
Fisher Tropsch	CO + H2	straight (MW700)	90-100
Amide	Acide+amine		70-170

Benefits of wax use

One of the main wax types used today are the low molecular weight polyethylenes both homopolymers and their partially oxidised derivatives. Low molecular weight would be defined by a number average ranging from 2000-5000 approximately. This level is of course considerably higher than paraffins, microcrystallines and F-T waxes. This difference renders them tougher and this in conjunction with their varying hardness and slip characteristics makes them ideal additives in inks and coatings. An "additive" in the context we are discussing could be roughly described as concentrations ranging from 0.25-5% on solids.

Waxes as additives to coatings and inks have a beneficial influence on the following:

Coatings

1. Mar Resistance: As little as 0.25-1.0% on solids content is beneficial in NC lacquers, baking enamels, organosol coatings, acid curing and force drying finishes. The secret to the improvement is the reduction in the coefficient of friction. Thus objects striking the surface have a greater tendency to slide or slip over the surface than to damage it.
2. Anti-blocking: The presence of wax will prevent blocking in wood and metal finishes which are stacked shortly after drying. Typical examples would be acid curing and force drying finishes for wood baking enamels, varnishes for metal sheets or coils.
3. Slip and formability: A key property of polyethylenes is

their use in other industries as external lubricants and processing aids. The principles are applicable to the coatings industry and their properties make them useful in metal finishes which must undergo forming or embossing after application.

4. Anti-settling and anti-sagging: Polyethylenes display thixotropic behaviour when dispersed in aromatic and aliphatic solvents. This is a valuable property when they are added to pigmented finishes when good anti-settling characteristics are imparted. The thixotropy is also useful for anti-sagging character.

Thixotropic behaviour is also exhibited by the EVA Copolymers and this coupled with the extremely fine particle size of EVA dispersions enables them to be used to good effect in automotive finishes.

5. Flatting: Polyethylene dispersions are effective flatting agents in a wide variety of finishes. The degree of flatting is very much dependent upon the particle size of the dispersion: this is governed by choice of the polyethylene and the solvent or solvent mixture.

As flatting agents they are particularly interesting as they have a fine balance of other useful properties: excellent transparency, smoothness, soft silky feel, chemical inertness and non-settling behaviour.

6. Abrasion resistance: Waxes including polyethylenes improve abrasion resistance to a significant degree.

7. Metal marking resistance: A dark mark can occur on coil coated and thermosetting acrylic enamels if struck by a metal object. This tendency is reduced or the mark is more easily removed if the finish contains wax.

Inks

1. Rub resistance/Scratch resistance: Waxes, including polyethylenes are employed as additives to almost every ink type which encompasses Letterpress, Lithographic, Gravure and Flexographic. Thus, the waxes are used from dispersions in a wide variety of solvents ranging from oils, aliphatics and aromatics to glycols and water.

The main functions are to improve scuff and scratch resistance, to reduce blocking or offsetting of stacked sheets, and generally modify the coefficient of friction or slip.

Dispersion techniques and equipment

In order to incorporate wax into inks and coatings it has to be converted from a granular, prill, flake or coarse powder form into a finely divided dispersion. This can be effected in a wide range of solvents: Water, Glycols, Esters, Aliphatics, Oils and Aromatics. Dispersions in water may be together with surfactant in which case the term emulsion is applied.

The technique employed largely depends on the end application, the solvent which can be used and the nature of the wax. Techniques commonly applied are:

1. Emulsification

In this procedure the polyethylene is combined with a surfactant and other additives and provides the means of obtaining the very finest of particle sizes.

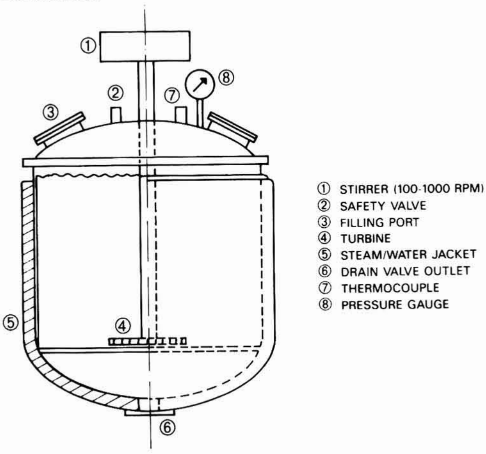
To effect emulsification the polyethylene must be partially oxidised in order to build-in functional groups such as carboxyls.

The early emulsifiable polyethylenes tended to be rather soft and low melting, altogether not very suitable for modern day inks and coatings. Now, very hard, tough and high melting types are available. These are preferred for inks and coatings.

Non-ionic, anionic and cationic emulsions can be produced and even within these divisions varying properties can be obtained by attention to the emulsifier system and production procedure. All these classes and their variants are essential to meet the increasingly specialised demands of a wide variety of applications.

The technique for emulsification of the very high melting polyethylenes requires very specialised equipment and the procedure is termed "Pressure Emulsification". Essentially it involves adding the oxidised polyethylene, surfactants, water and other additives to a chemicals reaction vessel, capable of withstanding at least 5 kg/cm^2 pressure (Figure 1). The processing parameters are critical in terms of stirring, reaction time and cooling procedure. Equally important is the care and attention which goes into the surfactant selection and quality control procedures on all ingredients. In general, for reliable and consistent results a lot of experience and skill is absolutely essential.

Figure 1
Emulsification



Reference has been made to particle size and to illustrate the levels attainable through surfactant choice and production technique some print outs from a particle size analyser are shown in Figure 2.

AQUACER 502 is a general purpose emulsion based on one of the hardest and highest melting oxidised polyethylenes available. It can be seen that a large proportion of it has a particle size of 0.1 microns with a spread of up to 7-8 microns. The cumulative curve indicates that the majority of the particles are no greater than 5 microns. It is very much an industry standard as the ideal additive to clear water based finishes.

AQUACER 537 has been specially designed to have a broader and larger particle size range of up to about 30 microns. It is of particular value in pigmented systems.

Figure 3 shows the frequency and cumulative distributions of a waterbased dispersion (without emulsifier) purely for comparitive purposes.

AQUAMAT 208 has been specially designed as a flatting agent which also imparts good surface smoothness. It can be clearly seen that the range of particle size is up to a maximum of 50 microns with approximately 50% being over 10 micron.

2. Mechanical method (cold milling)

Generally done with polyethylenes at a concentration of 20-30% by grinding into solvent and/or binder in a ball or pebble mill. Cold milling may be done with any solvent or

Figure 2

Emulsion particle sizes (frequency and cumulative distribution) for (a) AQUACER 502 and (b) AQUACER 537

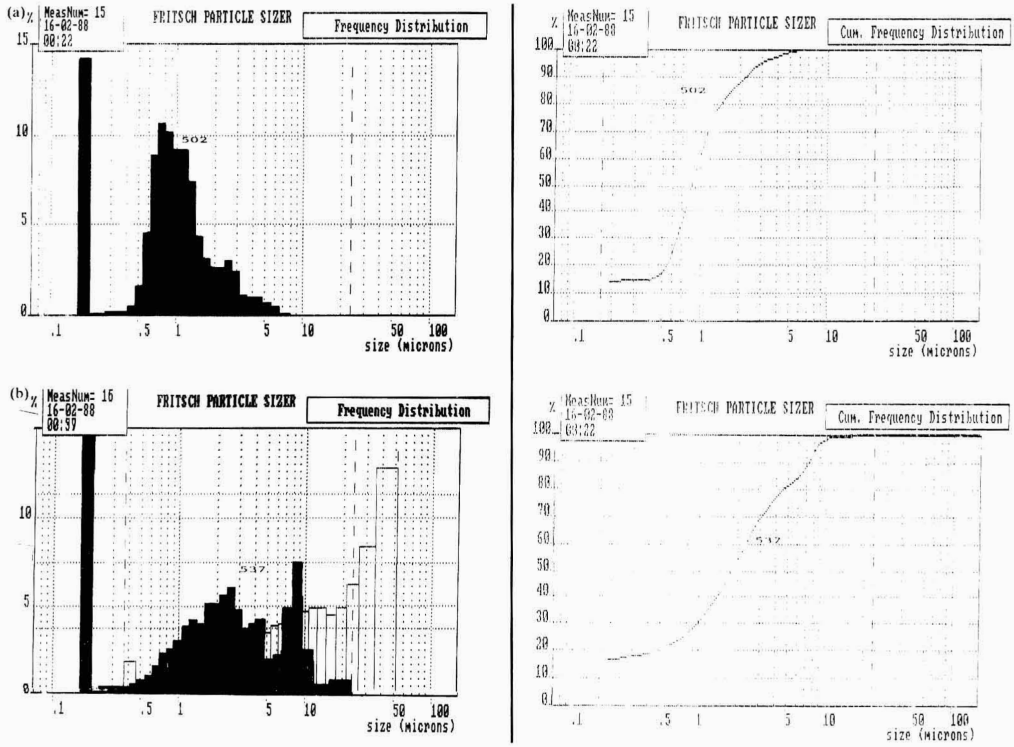
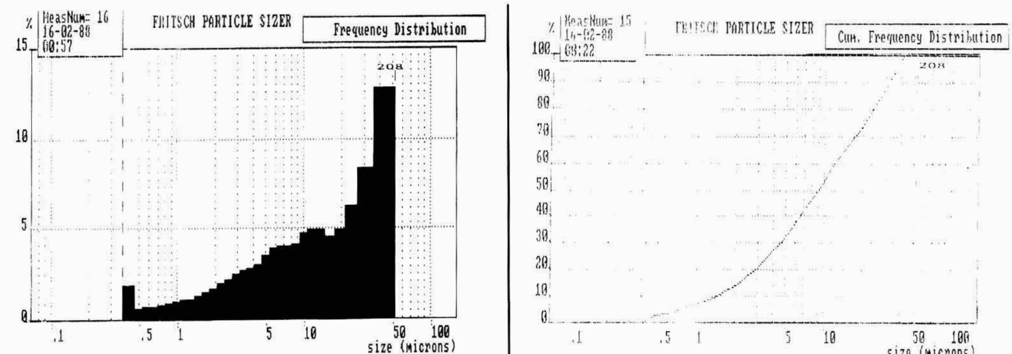


Figure 3

Waterbased dispersion particle sizes (frequency and cumulative distribution) for AQUAMAT 208



mixture and gives good process control and reproducability although is time consuming. Mechanical break down of the polyethylene occurs and also swelling of the particles particularly if aromatics are used. This can be limited by the use of polar solvents. The concentrate can be stirred into the inks at any stage of manufacture.

3. Solution mechanical

Frequently employed in the preparation of paste compounds for letterpress and litho inks. A mixture of about 25% polyethylene with 75% of binder and/or oil is heated until the polyethylene is dissolved. The hot solution (at 120-150°C) is poured onto a cold three roll mill where the dispersion is formed and further milled.

4. Solution precipitation

Polyethylenes are soluble in hot hydrocarbon solvents both aromatic and aliphatic. They are not soluble in highly polar

Continued on p.312

The crosslinking of emulsion polymers with zirconium chemicals

by P. J. Moles, Magnesium Electron Limited, PO Box 6, Clifton Junction, Swinton, Manchester M27 2LS, UK

There have been several articles written on the use of zirconium compounds to crosslink solution polymers. The fundamental chemistry has always been described in terms of interaction between the polymeric zirconium species and carboxyl and/or hydroxyl groups.

These reactions are shown in Figures 1 and 2. It is not intended to go into this in any more detail here as it has been covered in previous publications[1,2]

Figure 1

Interaction of AZC with hydroxylic polymer solutions.

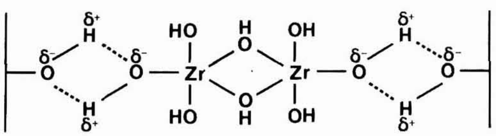
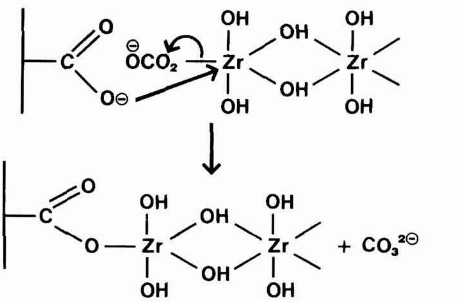


Figure 2

Interaction of AZC with carboxylated polymers.



Recently we have been investigating the usage of zirconium compounds to crosslink emulsion polymers. conventional thinking has always assumed the chemistry to be similar to that found in solution. This has now been further investigated.

Zirconium chemicals are used commercially to improve the properties of emulsion polymers. Typically, ammonium zirconium carbonate, an anionic polymeric zirconium species, as shown in Figure 3, can be used with styrene-acrylic and other copolymer emulsions to improve the water resistance, solvent resistance and heat resistance of the polymer.

In an effort to improve the observed physical properties, and understand the mechanism of polymer emulsion interactions this reaction has been studied. Emulsion polymers differ from solution polymers in a number of ways.

Emulsion polymers, almost by definition require some sort of surface stabilisation of the polymer particle, to retain the emulsion stability. This stabilisation may be derived from the chemical nature of the polymer itself or from added surfactant stabilisers. It is suffice to say that the surface of a stable polymer emulsion particle will be rich in polar functional groups.

In our studies with zirconium compounds, initial work with emulsions has shown that carboxylation in the polymer backbone is required to improve the desired properties and the stabiliser system used with the emulsion is of critical importance. As a general rule of thumb anionic surfactants are more reactive towards zirconium compounds than non-ionic surfactants. This tends to manifest itself as viscosity increases or as coagulation in extreme cases. It is however by no means assured that anionic surfactants cause problems with zirconium compounds. A major problem in determining what is going on lies in the difficulty in obtaining information on the surfactants used commercially.

In our preliminary work two commercial emulsion polymers have been used. Both are known to be used commercially with zirconium chemicals to improve the end properties.

The emulsion polymers used in this study can be described as follows:

Emulsion 1: A carboxylated styrene-acrylic copolymer

Emulsion 2: A carboxylated acrylic copolymer with an anionic/non-ionic surfactant system.

Two approaches were taken to this study. the effect of zirconium compounds on the mechanical properties of the emulsion system was studied by the use of dynamic mechanical analysis (DMA). End properties were studied by standard water resistance and solvent resistance testing.

The preliminary results are presented below:

Water and solvent resistance studies

Ammonium zirconium carbonate was added to the polymer emulsion, a film was cast then dried.

The result summarised in Table 1, indicate that solvent resistance is markedly increased by the addition of zirconium. Water resistance is little changed as measured by water immersion testing but wet rub or wet scrub, an aggressive abrasive test, shows the benefit of using zirconium. This point is being investigated further.

Hence based on these data there seems to be some sort of beneficial reaction between the zirconium compound and the polymer emulsion.

Table 1

	Water Resistance[(b)]		Solvent Resistance[(c)]	
Addition Level[(a)]	0%	5%	0%	5%
Emulsion 1	—	—	30	11
Emulsion 2	57	120	1063	175

(a) Addition level of ammonium zirconium carbonate
(b) Percentage increase in weight after immersion in water
(c) Percentage increase in swelling after immersion in acetone

DMA studies

Dynamic mechanical analysis studies of films containing zirconium compounds failed to show any significanmt change in properties such as modulus and Tg, compared to thep ure emulsion. Although not fully analysed the initial conclusion for the DMA work is that the zirconium has little effect on the bulk properties and the effects noted above are due to surface reactions only.

Following from these initial studies zirconium chemistry has been investigated and current work centres on modifying

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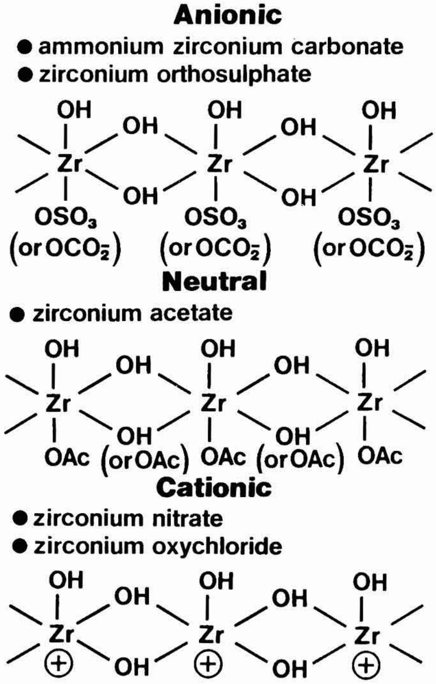
Figure 3
Useful structured representations of polymeric zirconium species.



the zirconium polymer size and the role of chelating ligands. This work is still in hand but indicates that changing the nature of the zirconium complex can alter the end properties.

Conclusions

The initial work we have performed indicates that with polymer emulsions, the zirconium reacts with surface functionality and this can give improvement in water and solvent resistance. The exact nature of this interaction is under further investigation and will be reported.

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1. Farnworth, F., Jones S. L. and McAlpine, I., "Speciality Inorganic Chemicals", R. Thomson E., RSC. London 1981, 165.
2. Moles P. J., PRA Symposium, Water Based Coatings, London 1987. ■

Continued from p.295

required, xylene gives excellent results against syneresis and settling. Short oil alkyd universal resins may also be used.

The polymeric additives which deflocculate pigments are effective for both organic and inorganic pigments equally. For the selection of the additives the requirements of the final paint systems into which the tinters have to be incorporated, must be considered. Therefore, resinous-like higher molecular weight and deflocculating wetting and dispersing additives are suitable.

The selection of which member of the polymeric wetting agent to use will depend on the polarity of the tinter system.

Finally due regard must be made to the bases to which the tinters are added. If they contain titanium dioxide they should be stabilized with a positive charge. ■

The world paints market towards 2000

by ICI Paints, Wexham Road, Slough SL2 5DS, UK.

Summary: The market today

□ The world paints and coatings market is estimated to be worth about £20 billion at supplier prices.

□ The entire industry is undergoing a period of dramatic restructuring with acquisition and divestment of businesses the order of the day, as the major league international companies battle for global position.

□ There are 10,000 producers worldwide. In 1980 the top ten paint companies accounted for some 20 per cent of the total world markets. This year they account for about a third. By the year 2000 they could well account for up to half. The stakes are high and competition is fierce. ICI Paints leads the world markets overall, with a competitive ratio of 1.7 over its closest competitor.

□ ICI Paints operates 64 manufacturing plants in 29 countries and has licencees in a further 14 giving it unrivalled geographic spread.

□ Overall market growth has been slowing down in the established industrialised regions which account for three quarters of world paints usage. Potential for high overall market growth is mainly in the newly industrialising countries. Therefore growth among the paint majors in established industrialised countries has been primarily by market consolidation — organic growth at the expense of competitors, or acquisition of businesses to expand their portfolios within the core markets upon which they have chosen to concentrate.

□ Apart from market consolidation, other reasons for the increase in international competition include:
— globalisation of customers, e.g. motor industry or packaging (food and drink can coatings)
— technically sophisticated high added value products require levels of expenditure in R&D which need to be recouped in international markets to justify investment.

1. Paint and coatings industry in a changing environment

○ Socio-economic and technological trends in the world economies and increasing interdependence between countries are leading to significant changes in the production and marketing of paints.

○ Mature high volume paint markets in the industrialised countries of North America, Europe, Japan and Australasia will maintain volume, and demand higher performance and added value products and services; with high volume growth markets in the newly industrialising countries and particularly Asia-Pacific region (Figure 2).

○ Concentration and globalisation will sustain volume growth for the market leaders and provide the resource base to support technology and innovation to meet evolving consumer needs in converging world markets. (Figure 1).

Figure 1

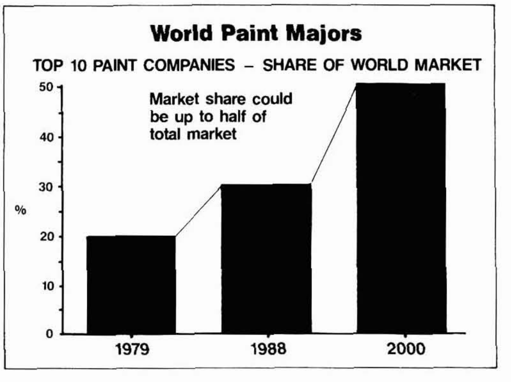
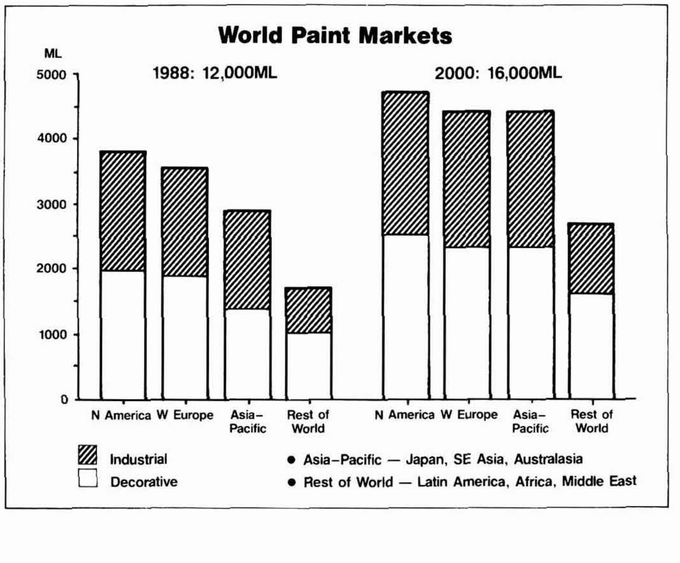


Figure 2



○ Corporate strategies will focus increasingly on the underlying dynamics of the consumer and customer environments in shaping business towards the 21st century.

Paint and coatings industry: Role and performance

○ Role in the economy:
Continual upgrading of products for the protection and enhancement of:
— a country's infrastructure of buildings and structures including houses, offices, factories, farms, bridges, retail outlets.
— the products of manufacturing industry including transport, machinery and equipment, packaging, furniture, household appliances.
— covering a range of substrates: metals, wood, plastic, concrete, glass.
○ Within the chemical industry — paints and coatings are one of the group of consumer and speciality effect chemicals:
— including relatively high value-added and technologically intensive products (measured by R&D/Innovation, Marketing and Advertising).
— with increasing need for product and marketing innovation in response to consumer, economic and environmental forces.
○ Paints and coatings are a consistent profit performer and cash generator based on market leadership through concentration on selected market sections and segments, many of which are becoming increasingly global in dimension.
○ For international companies with well managed operations (organised for global as well as country-centred needs) the rewards of scale and synergy will be increasingly significant.
○ ICI Paints Group is the most global and largest paint company with a turnover of £1.5 bn and well positioned to maintain leadership of the industry.

2. World paint markets: Size and Growth

○ The world market for paint is forecast to achieve modest volume growth averaging 2.5-3% p.a. towards 2000 (somewhat higher by value): an increase from 12,000 million litres (£20 bn at suppliers prices) to 16-17,000 million litres (£28-30 bn). This relates to a moderate growth scenario for world GNP at upwards of 3.5% p.a. — a higher rate than the 1980's. (Table 1).
○ The high levels of paint usage in industrialised countries will be maintained and rather more strongly in North America than Europe, whilst only modest growth will be achieved in Japan due to adverse effects of industry moving to offshore plant locations. Forecast paint volume growth is below GNP rates in these markets, reflecting the maturity of major sectors in the painting of existing building stock and a largely replacement demand for consumer durables. (Table 1).
○ In Western Europe, five countries account for 75% of the paint sales of which Germany accounts for nearly one quarter as the largest industrial base and Spain will have the highest rate of growth. (Figure 3).

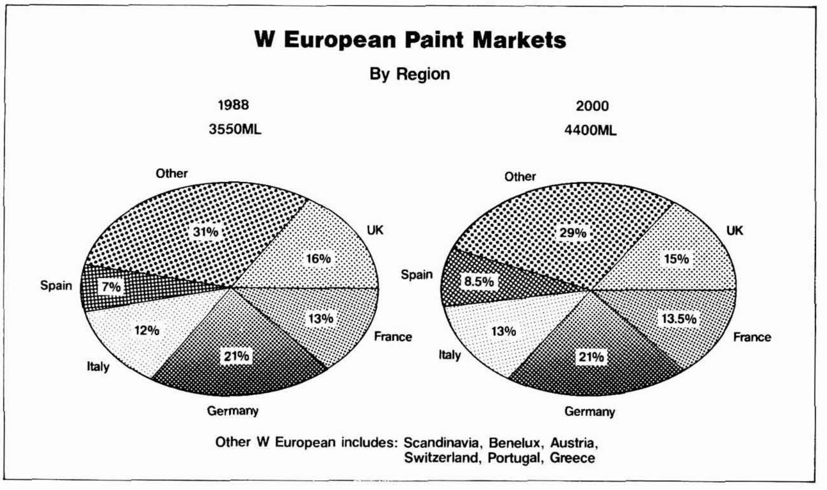
Table 1

World paint market growth rates: 1988-2000

	% p.a. by Volume	GNP
N. America	>2	3
W. Europe	<2	3
UK	1-2	2.5
France	2-2.5	3
Germany	2	2.8
Italy	2-3	3.3
Spain	3-4	3.5-4
Other	1-2	2-3
Asia-Pacific	4	4.5-5
S.E. Asia	5-6	5-6
Japan	2.5-3	4-5
Australasia	2	3
Rest of World	3-4	4
Total	2.5-3	3.5

• S.E. Asia: including China, Indian sub-continent, Korea
• Rest of world: including Latin America, Africa, Middle East
Sources: Bank and Agency projections of GNP

Figure 3



○ A feature of these mature markets is the increasing demand by customers for higher performance and added-value products and services so unit values generally will rise, as well as compensating for reductions in unit volume arising from changes in product mix.
○ Newly industrialising countries: paint volume will increase substantially in line with GNP rates of growth with expansion of infrastructure of buildings and manufacturing base, notably Asia-Pacific region. In Asia-Pacific, Korea, Taiwan, Hong Kong and Singapore have incomes per capita approaching those of poorer European countries. China, India and Indonesia with large populations will have increasing demand for paints despite continuing low average income per capita.
○ Into the 21st century, North America and Europe will continue to account for more than 50% of the world paint volume, whilst Asia-Pacific region including Japan and Australia will increase share to around 27% of world total by 2000: Making three regions of approximately equal size. These are the three regions in which ICI business is concentrated.

World paints by market sector

(Table 2 and Figures 4 and 5)

○ **DECORATIVE PAINTS: which account for 50% of total paint volume are forecast to increase at 2.5-3% p.a.:** including some growth in the developed markets of N. America, Europe and Australasia with increases in household formation, location shift of populations and attention to improvement of the home environment. The USA will remain buoyant in terms of population growth and decorative paint sales: with less growth in the highly developed UK and Scandinavian markets. There is further potential for DIY development in Germany, France, Italy and particularly Spain: as well as Japan despite major cultural differences. The professional sector demand will be stimulated by socio-economic trends including ageing and more fragmented households.
○ Penetration of non-painted substrates for doors, windows and trim will continue but new housing design (e.g. partition walls) is not expected to make a significant impact because the housing-stock which accounts for around 85% of paints volume only gets replaced by plus or minus 15% in a decade. Also, traditional construction methods are being maintained, for example with continuing high usage of wood panelling for house exteriors in the USA.
○ Products are already mainly water-based, but there will be continuing demand for improved performance and convenience products offering consumers more choice backed by service. Major national brands backed by innovation will maintain leadership in the market place.
○ In newly industrialising and developing economies, a high proportion of decorative paints are for new construction and for a growing maintenance market essentially for professional painters with little DIY usage. Growth rates will approach those of GNP for paint volume including replacing of low quality tempera/chalk and water-based products. There will be increasing opportunities for global/regional companies to gain from international product and marketing expertise

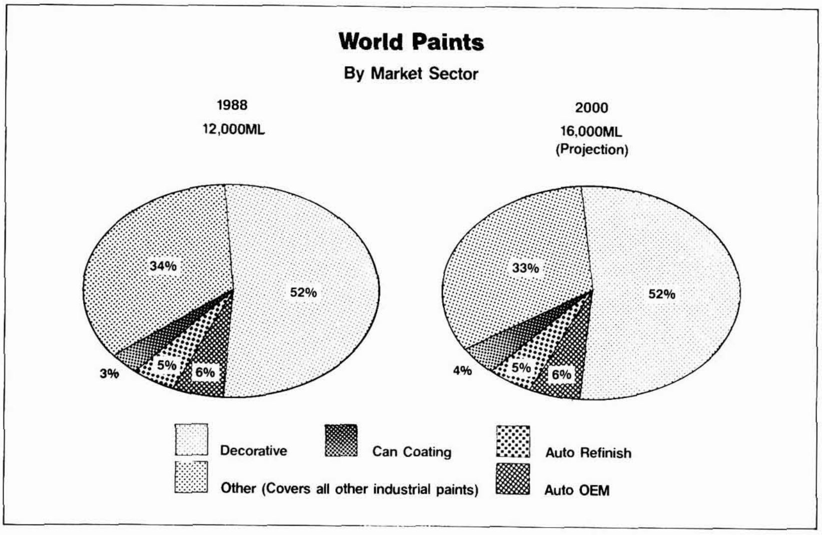
Table 2

Paint volume growth — by market sector (% p.a.): 1988-2000

	World	Industrialised Countries	Newly Industrialising Countries
Decorative	2.5-3	2	3-5
Packaging			
Can Coating	3-4	1-3	>10
Auto OEM	2.5	2-2.5*	4
Refinish	2-2.5	1-2	6-7
Industrial	2-2.5	1-2	5-8
Powder	7-10	5-8	>10

* Japanese auto OEM production declining
• Industrialised countries — N. America, Europe, Japan Australasia (OECD members)
• Newly industrialised countries with growth rates in line with GNP whilst within OECD countries such as Spain and Turkey have similar growth characteristics.
Sources: Agency studies for end-use sectors

Figure 4



adapted to these markets, dependant on the strength of the local managed operations. Hong Kong is an example of a market with growing demand for innovative decorative products.

○ **AUTOMOTIVE: there will be steady increase in car registrations at around 2% p.a. with higher growth upwards of 5% p.a. in newly industrialising countries.** Car ownership is already high in industrialised countries of N. America, Europe, Australasia and Japan, but still considerably short of saturation levels which vary by country depending on local conditions.

○ Car production is forecast to increase in N. America and Europe (average 2-2.5% p.a.) but with reduction in Japan because of shifts in production to overseas market locations. This will be compensated in part by exports to the newly developing countries as well as home market demand.

○ There will be continual improvement in vehicle performance including efficiency, safety, design, anti-pollutant features met by increasing flexibility in manufacture. In turn, higher added-value paints for coating metals and plastic composites, non-polluting, durable and quality finish will be sought together with increasing commitment to painting process and just-in-time inventory and single sourcing by model.

○ Refinishing paints suppliers will meet increasing demands for higher performance, higher added-value products and service to customers.

○ **PACKAGING:** in industrialised countries major shifts in consumer demand for convenience foods, etc, have restricted demand for food cans although major penetration by plastics has been at the expense of glass. Most buoyant demand has been for drink cans in the USA market but with demand growing in Europe. Major growth potential is in developing countries for food and drink cans. Economics of can manufacture and preferences of consumers and retailers are expected to maintain demand into the 21st century with increasing demands for high performance added-value products to meet global specifications.

○ **INDUSTRIAL** paint markets are low growth in mature manufacturing industries of industrialised countries: but with high growth in line with or above GNP in newly industrialising countries.

○ Traditional solvent-based paints are declining with replacement by higher solids, water-based and powder coatings (100% solids) particularly to reduce atmospheric pollution. Powder coatings are a high growth segment in Europe and N. America for a range of end-uses including domestic appliances. Precoating of metal (coil coating) is a growth segment as customer industries can avoid the painting process. Both powder and coil are high growth sectors from currently low levels of penetration.

○ Such innovative, economically and environmentally desirable products will achieve further growth with penetration of markets in newly industrialising countries, meeting new demand rather than having to replace existing practices.

3. Market concentration and globalisation

The paints industry is undergoing a period of dramatic restructuring with acquisition and divestment of businesses — with world paint majors focusing on core businesses and global leadership.

Major forces:

○ **International customers:** Auto/OEM
Packaging/Can
Marine
Industrial
Household Appliances

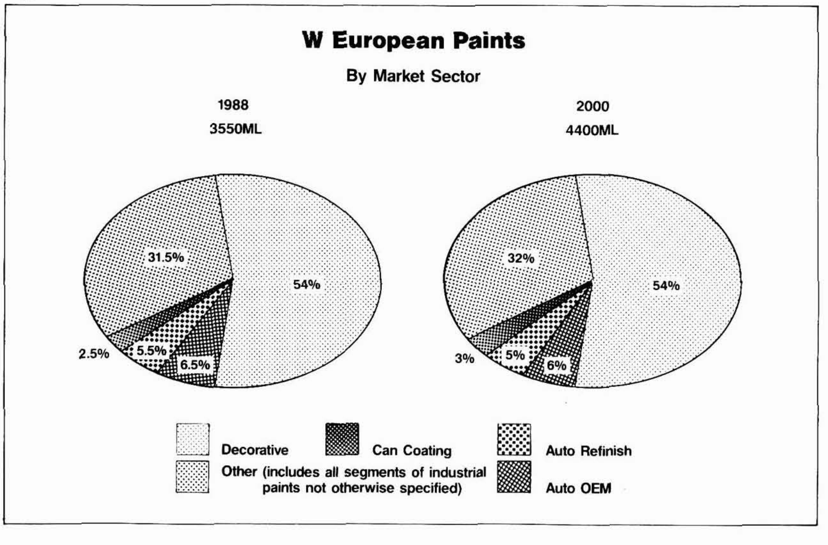
Rationalisation of suppliers by major customers.

○ **Increasing high added-value products.**
Technically sophisticated.
R&D commitment of resources needs international markets to justify investment.

○ **Converging markets and distribution patterns.**
International management synergy.

○ **Scale economics and product differentiation**
— entry costs rising fast.
— environmental and safety costs.

Figure 5



Consequences of globalisation

Globalisation in technical, industrial markets is producing the following sequence:
— "Global" customers preference for "global" suppliers.
— Large paints world groups developing, technology lead, through high R&D expenditure.
— Majors less prepared to licence technology (other than with fellow majors who have strengths to trade).
— Widening gap between majors and middle-sized competitors.
In decorative paints world markets are converging in terms of consumer demand and marketing characteristics.

Pressures on medium-sized competitors

— Lack of accreditation in large volume, high technology customers.
— Inability to keep up with the majors in R&D expenditure.
— Pressure forcing companies out of high technology markets into commodity markets.
— Profit squeeze, cost squeeze, lower R&D effort, etc.
— Environmental and safety costs.
Towards 2000 increasingly growth will be achieved by organic means by global companies gaining advantages in product differentiation and operating efficiencies through global synergy. Regional companies will find it increasingly difficult to keep pace.

Concentration and competition

○ The rate of restructuring of the world paint industry has been accelerating through the 1980's, with acquisition and divestment of businesses.
W. Europe: More than 200 acquisitions since 1980 of which around 30 in 1988 so that foreign ownership of paint companies is now high.
(Germany 16% . . . . UK & Italy 25% . . . . France & Spain 40%)
USA companies account for only 5% of European paint industry, but represent 25% of auto OEM sector in Europe.
N. America: 30-40 acquisitions in the past year with European companies owning 20% of the industry.
Japan: Remains local ownership and Japanese majors have so far been investing only in Asia.
RoW: European ownership has been significant in parts of Africa and Asia-Pacific since days of 'empire'. Also in S. America by US and European companies.
○ The paint industry will remain highly competitive as well as being highly concentrated: competition will be generated by global operations with increasing share in national markets by foreign companies.

Market concentration by business

Major sectors:
○ Decorative: Because national distribution strength is important, no one company dominates on a world or regional basis, but ICI is leader (7% world share including market leadership in USA, UK, France, Canada, Australia plus prominent positions in Germany, Asia and parts of Africa).

Further regional concentration by supplier and retail customer groups will occur with scope for international marketing brands.
○ Packaging & Can Coatings: Highly concentrated globally; top 5 companies account for 60% of world market with ICI clear market leader.

Further concentration will occur in supplier and customer industries (food and drink) with market growth in EEC and developing countries: several leaders are regional only, notably Japan.
○ Auto Refinish: Highly concentrated globally: top 5 companies account for 57% of world market. ICI ranks no.3 worldwide and as a leader in Europe and Asia-Pacific region.

Further concentration in Europe and developing world countries will occur.
○ Auto OEM: Highly concentrated globally: top 5

Figure 6

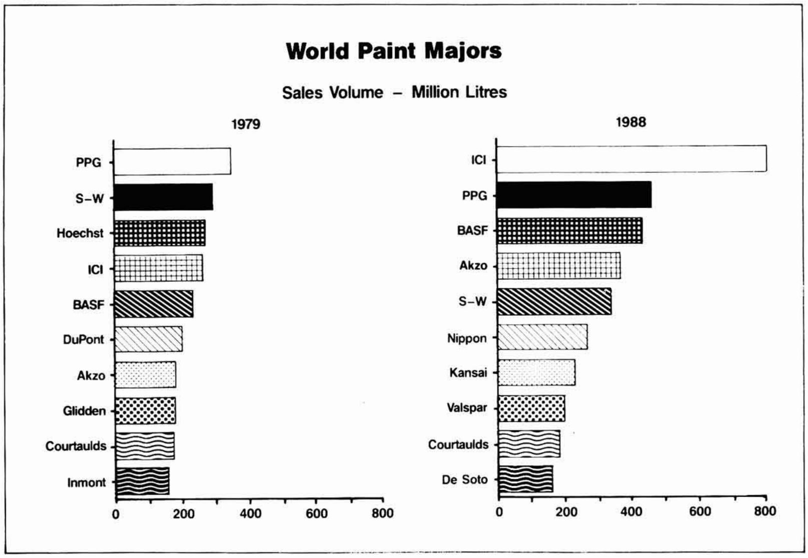


Figure 7

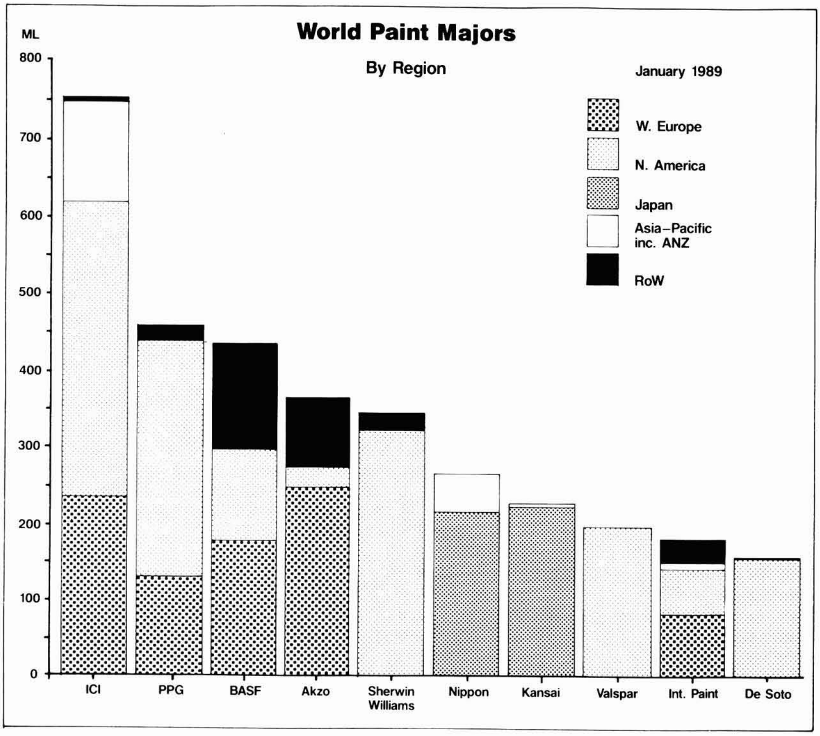
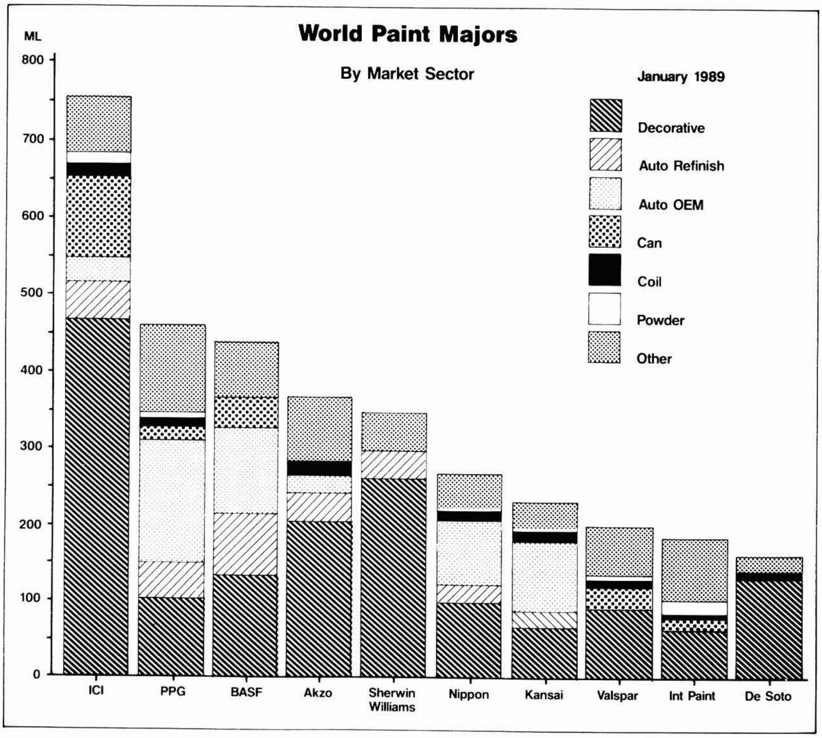


Figure 8



companies account for 70% of world market: ICI with DuPont one of top 5 in Europe and ICI alone leader in 'Rest of World' territories.

Three world groupings are expected to dominate by mid-1990's. Japanese suppliers and auto producers becoming more global. Single sourcing by model i.e. increasingly one manufacturer will supply all paints for a particular model of car whilst a competitor will be asked to supply for another model.

High growth sector

○ Powder Coatings: A growth market with major usage in N. America and Europe: leaders merging including ICI in N. America, Europe and Australia.

Further concentration will occur by end-use market sectors with EEC development and with growth in developing markets.

World paint majors

There are 20,000 manufacturers competing worldwide.

In 1979: Top 10 companies accounted for 20% of the world paint market.

In 1988: Top 10 companies accounted for 30% of total world paint market.

In 1995: top 10 companies **could** account for upwards of 40% of total world paint market.

○ Top 10 paint majors are:

ICI	UK
PPG	USA
BASF	Germany
AKZO	Holland
Sherwin Williams*	USA
Nippon*	Japan
Kansai*	Japan
Valspar	USA
International Paint	UK
De Soto	USA

(Bung y Born operate solely in South America and so not shown on World Paint Majors charts).

* Solely paint companies.

The League of Paint Majors has been transformed during the past decade (Figures 6-8) ■

This article is based upon part of the presentation given by Herman Scopes, Principal Executive Officer of ICI Paints at Slough on 9 June 1989.

Continued from p.300

solvents. The solubility of the many different polyethylenes available is indicated by their cloud point: the temperature at which the hot solution becomes cloudy, upon cooling. This will alter with the concentration of the polyethylene in a given solvent. It will also be influenced by the physical and chemical properties of the polyethylene (or copolymer) chosen.

Following solubilisation, the dispersion is prepared by cooling under higher shear conditions. The cooling rate is extremely important and the more rapid it is the finer the particle size will be. This cooling procedure is referred to as "shock cooling". The manner in which it is accomplished is generally by adding cold solvent to a hot concentrated solution (a few degrees above its cloud point) although it may also be effected by pouring the hot concentrate into cold solvent. The shock cooling method produces very fine dispersions which, depending upon the concentration will exhibit varying degrees of gel structure, some will be thin whilst others will be stiff.

This technique requires a detailed grasp of the behaviour of polyethylenes in solvents in order to achieve a consistent level of reproducibility particularly regarding particle size distribution.

5. Micronised waxes

These are extremely fine particle size powders of polyolefins produced by a high energy collision process in which coarser material is broken down. The size attainable is of the order of 5 microns with a distribution typically from 2-20 microns.

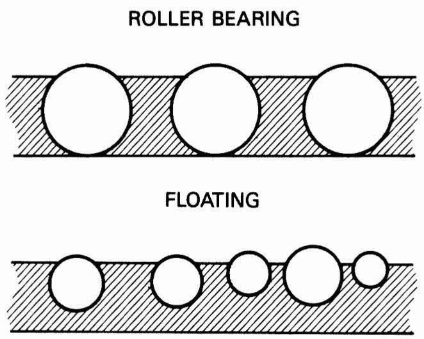
They are designed as "stir-in" powders and are relatively easy to disperse by, for example, a high speed dissolver. Normally no further particle size reduction is necessary. However, should this be desirable most breakdown further following a short ball-, pebble-, or three roll milling operation.

They are widely used in both the ink and coatings industry.

Mechanism of wax action

There are two theories (Figure 4) each of which are supported by a number of arguments coming from practical observations.

Figure 4
Wax mechanism theories



1. Roller bearing: Waxes have an evident action in modifying the surface properties of a film. It is thought that the beneficial effects are the results of the particle size being equal to or slightly larger than the film thickness. Firstly, migration to the surface would be impossible in high viscosity coatings. That this does not occur is evidenced by the beneficial action of wax in offset inks. Secondly, wax theoretically would have insufficient time to migrate to the surface in fast drying films. This is exemplified by the action in flexographic and gravure inks.

2. Floating: Based upon the belief that wax particles float to the surface. Possibly the strongest argument is that emulsions with an average particle size of 0.1 microns and therefore considerably smaller than film thickness, are extremely effective in water based finishes. Further, in this respect, for example in a polish, rubber and scuff marking tests will show up widely diverging results dictated by the hardness of the wax. Also significant differences in slip can be measured.

There are merits for both theories although the true state may be a combination of the two. It is evident, for example that matters of relative density, viscosity and compatability-incompatability enter into the equation. ■

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Electron beam curing and grafting processes in the surface coatings industry

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Summary

The potential of radiation curing technology in the surface coatings industry is discussed, particularly recent developments in the electron beam (EB) technique. A comparison is made between EB and UV as radiation sources for this work. The importance of concurrent grafting occurring during cure is demonstrated for improving the properties of the finished product. The chemistry of EB curing is briefly reviewed together with examples of current applications particularly in the paper coatings area. An economic evaluation is given of an EB cured pigmented coating on paper.

Introduction

Radiation curing is a valuable technique for a variety of applications in the surface coatings industry[1-6]. The process utilises 100% solids resins systems, is essentially solvent free with minimal environmental pollution, possesses low energy consumption, the equipment is compact, the systems cure at room temperature in a fraction of a second even in the presence of pigments and fillers and, most importantly, the technique leads to the preparation of new products not capable of being made by other methods. Both electron beam (EB) and ultra violet light (UV) sources are used as initiators in these processes. The two areas are expanding rapidly at the present time with growth in the UV field being particularly strong. A limiting factor affecting the speed of expansion of EB is the large initial cost of the equipment relative to UV. EB is currently used essentially for large volume lines running at speeds of up to 500 metres/min or pigmented systems especially thick films.

In the present paper, recent developments in EB curing as it applies to the surface coatings industry will be discussed. The chemistry of the technique will be briefly reviewed with emphasis on the differences between EB and UV. This aspect is important since EB and UV are essentially complementary techniques in the radiation curing field. In many of these EB processes, the ability to observe concurrent grafting with cure on the surface is valuable since such grafting reactions can lead to improved properties in the finished film, especially increased adhesion. The possibility that common intermediates exist in both EB grafting and curing will be discussed, as will aspects of the economics of EB processing. Some recent trends in EB developments in the surface coatings industry will be mentioned.

Chemistry of EB curing

In practice, radiation curing involves the rapid polymerisation of an oligomer/monomer mixture to give a material which can also be cross-linked. With a self-shielded electron beam processor, electron energies up to 400k V are frequently used as high energy radiation sources to initiate the polymerisation[7-9]. By contrast, with UV, very fast curing rates are achieved with the aid of sensitisers and high performance 300 W per inch lamps. In EB applications, when oligomers and/or monomers are exposed to energetic electrons from a low energy EB machine, both radical and ionic species are formed. From basic radiation chemistry work, it has previously been assumed that if curing reaction occurred above 25°C, participation of ions in the process was minimal, however, recent extensive mass spectrometic studies[10] show that ion lifetimes, particularly negative ions, can be significant even at temperatures in excess of 25°C.

Thus, with appropriate functionality of monomers and oligomers in the prepolymer mixture, the mechanistic roles of cationic and anionic processes in addition to free radical reactions should be considered in the overall curing processes (Equations (1)-(7), where RH is simple monomer or oligomer, e_p is the impinging primary electron, e_s represents a low energy electron (1-2eV) detached from RH or produced from e_p by collisional loss of kinetic energy and e covers electrons with energies between e_p and e_s). The presence of moisture can also influence the participation of ions in a radiation polymerisation reaction[11].

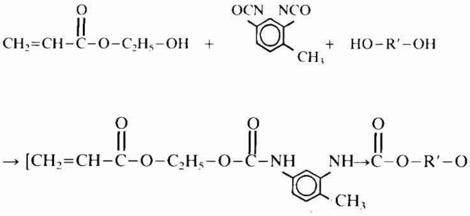
$$RH \rightarrow R' + H' \quad (1)$$
$$RH + e_p \rightarrow RH^{+} + e_s \quad (2)$$
$$RH + e_s \rightarrow RH \quad (3)$$
$$RH + e \rightarrow R^{-} + H' \quad (4)$$
$$R' + H \quad (5)$$
$$RH + e \rightarrow R^{+} + H + e \quad (6)$$
$$R^{-} + H^{+} + e \quad (7)$$

With respect to the resins used in any EB curing system, the basic component is the oligomer which is relatively viscous and requires the addition of monomers as reactive diluents to, not only adjust the rheological properties of the resin for application, but also to speed up cure by cross-linking processes. The structure of the reactive diluent can thus be critical in determining properties of the finished film such as flow, slip, wetting, swelling, shrinkage, adhesion and migration within the film as curing proceeds[2]. The reactive diluent can be either monofunctional or multifunctional, the latter generally being preferred because of the possibility of enhanced cross-linking occurring during cure. The principle parameters involved in choice of reactive diluent are solubility, odour, viscosity per se and ability to reduce the viscosity of the medium efficiently, volatility, functionality, surface tension, shrinkage during polymerisation, glass transition (Tg) of the homopolymer, affect on speed of overall cure and toxicological properties. The last of these is very important since for practical applications many of the available monomers, particularly multifunctional acrylates are unsuitable because of high skin irritancy as determined by the Draize rating[3], ratings of 1-2 being considered acceptable is shown below. Tripropylene glycol diacrylate TPGDA, shown below) is one of the

$$CH_2{=}CH{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}O(C_3H_6O)_3{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}CH{=}CH_2$$

widely used monomers in EB curing work, possessing good solvency for acrylated prepolymers, low Draize rating, relatively low viscosity, high speed of cure with acceptable viscosity reduction powers although in the last repect not as efficient as hexane diol diacrylate which unfortunately has a relatively high Draize rating.

The other major component in the EB resin is the oligomer which is essentially a prepolymer of relatively low molecular weight (≈3000) prepared by monomer polymerisation or the acrylation of a backbone polymer such as a polyurethane, polyester, polyether or epoxy[1-6]. A representative acrylation reaction is shown in Equation (8)


(8)

for the synthesis of a typical urethane acrylate using hydroxy ethyl acrylate as acrylating agent. Acrylate based oligomer/monomers are the most frequently used in EB curing, however, prepolymer mixtures, oligomers and monomers containing any functionality are theoretically capable of being utilised. One of the major limiting factors is the dose required to cure the resin, usually 2 megarads for cellulosic type coatings, any higher dose leads to degradation of the cellulose. The ability of an EB machine to deliver high doses in short periods of time is vital to the success of curing processes. Currently EB machines delivering 1500 megarad metres/minute, i.e. 1 megarad at 1500 metres/min or more conveniently 3 megarads at 500 metres/min are available for curing under an inert gas (generally nitrogen). Extensive research is presently being performed to overcome this oxygen inhibition to give an air cure system with its obvious advantages.

The dose required to cure is also dependent on the chemical structure of the oligomer/monomer used. This is because, for most resin systems, EB curing is predominantly a radical polymerisation reaction (i.e. ionic processes are minimized) and high molecular weight polymers are obtained by favouring the propagation process at the expense of termination. Usually propagation is favoured by restricting the mobility of the growing polymer chains either by raising the viscosity of the oligomer/monomer mixture or by raising the molecular weight of the oligomers used in the curing composition. In general, the former process is preferred since it results in greater flexibility in the application of the oligomer/monomer mixture. Curing is also favoured under conditions where polymerisation starts at low radiation doses and results in a Trommsdorff effect. Thus the important chemical properties that effect the speed of cure are the composition and concentration of monomers and oligomers, the frequency and type of unsaturation in the polyfunctional monomers and oligomers, and the molecular weight of the oligomer. The conclusion that cure speed can be increased by increasing both the frequency of unsaturation and the molecular weight of the oligomer has to be treated with caution since, in some instances, higher unsaturation frequency may decrease cure rate due to steric effects whilst higher molecular weight oligomers may cause solubility problems and difficulty in subsequent application of the mixture[12].

In order to complete the radiation cure system for practical applications, additives are required for the oligomer/monomer mixture to control factors such as gloss, flow, slip, opacity and UV stability. In addition to incorporating beneficial properties to the finished film, these additives may also simultaneously lead to detrimental effects such as wrinkling, shrinkage and most importantly poor adhesion. The role of additives is thus important in curing since in the presence of additives essential to give the film its basic properties, optimisation in film performance becomes a compromise where the maximum properties of each additive may not be realised.

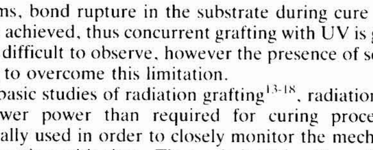
Role of concurrent grafting during curing

The ability to achieve concurrent grafting during radiation curing of films onto substrates can be valuable since, under these conditions, a true carbon-carbon bond is formed between the coating and substrate. Many important properties of the resulting cured film are thus improved if such concurrent grafting occurs, particularly adhesion and flexibility. For many commercial uses, a carbon-carbon copolymer bond at the interface is not required since interaction energies originating from charge-transfer forces or hydrogen bonding are sufficient to give the required adhesion for a particular purpose. With relatively non-polar substrates, particularly the polyolefins, satisfactory bonding at the surface during these rapid cure treatments can be difficult to attain. With EB, concurrent grafting will virtually always occur since the energies of the impinging electrons are sufficiently high to readily break bonds at the surface of the substrate, thus creating sites for copolymerisation to occur (Equations (9), (10), where P_oH represents polyolefin and M, the monomer in the oligomer mixture). A diagrammatic representation of

$$P_oH \rightarrow P_o' + H' \qquad (9)$$

$$P_o' + M \rightarrow P_oM' \qquad (10)$$

grafting is shown in Equation 11. By contrast, with UV


(11)

systems, bond rupture in the substrate during cure is not so easily achieved, thus concurrent grafting with UV is generally more difficult to observe, however the presence of sensitisers tends to overcome this limitation.

In basic studies of radiation grafting[13-18], radiation sources of lower power than required for curing processes are generally used in order to closely monitor the mechanism of the reaction with time. Thus cobalt-60 is often utilised for grafting processes rather than EB and smaller UV sources than the 300W per inch used in curing for UV grafting.

Typical grafting data obtained with a UV source (Philips 90W high pressure lamp) using the copolymerisation of styrene to polypropylene as a representative system are shown in Table 1. It will be observed that solvents are utilised in these grafting reactions, the presence of certain solvents enhancing grafting[18] to some substrates. Although UV/EB radiation curing resin systems are usually solvent free, the functionality in the solvent indicates the type of group which, if present in the oligomer/monomer mixture, may enhance

grafting during cure.

In Table 1 it is clear that the presence of the sensitiser, benzoin ethyl ether, enhances grafting. Inclusion of additives like urea also increase grafting yields at certain monomer concentrations[19]. For a comparison of the relationship between curing and grafting processes, the additive concept is important since additives are essential in curing formulations to optimise the properties of the finished film. Thus in EB and UV curing processes, silanes and fluorinated alkyl esters are two representative additives which are used to improve slip and flow in the final product. The data in Table 1 for the effect of these two additives on grafting show that (i) the silane is a retarder due presumably to the repulsion effect of silicon atoms when adsorbed at the grafting interface and (ii) the fluorinated alkyl ester improves grafting yields. Most important, is the result when the multifunctional acrylate is added to both silane and fluorinated alkyl ester systems (Table 2). In each case the presence of the multifunctional acrylate leads to large enhancements in grafting and thus the effect of this acrylate overrides the detrimental effects of even the silanes. Since such multifunctional acrylates are used in curing formulations to control viscosity and achieve cross-linking with speed of cure, judicious choice of such acrylate in the oligomer/monomer mixture can lead to graft enhancement during cure with beneficial properties to the completed product. The data in Tables 1 and 2 have been obtained with sensitised UV sources, however analogous results have also been obtained with cobalt-60[19] and these are relevant to EB curing reactions. This multifunctional acrylate concept is thus generally applicable to UV/EB curing processes.

Table 1

Effect of organic additives† (urea, silanes, fluorinated alkylesters) on radiation grafting of styrene to polypropylene initiated by UV*

Styrene in methanol (% v/v)	Graft (%) N.S.	B	B+U	B+U+Si	B+U+FE
20	<5	<5	<5	<5	<5
30	<5	35	30	18	23
40	<5	39	46	31	53
50	<5	17	19	13	16
60	<5	14	13	9	19
70	<5	14	11	7	10

* Irradiated 8 hr at 24 cm from 90W lamp at 20°C; N.S.=no sensitiser

† B=benzoin ethyl ether (1% w/v); U=urea (1% w/v); Si=silane (1% v/v); Z-6020 supplied by Dow; FE=fluorinated alkyl ester (1% v/v); FC-430 supplied by 3M; polypropylene film (0.06 mm) ex-Shell; Other experimental conditions are described in Ref. 18.

Table 2

Effect of TMPTA in presence of organic additives on radiation grafting of styrene to polypropylene initiated by UV*

Styrene in methanol (% v/v)	Graft (%) N.S.	B	B+U	B+Additives +TMPTA†
20	<5	<5	<5	260
30	<5	35	30	588
40	<5	39	46	711
50	<5	17	19	368
60	<5	14	13	283
70	<5	14	11	131

* Conditions as in Table 1; additives used were urea, silane and fluorinated alkyl ester; †TMPTA=trimethylol propane triacrylate (1% v/v).

Current applications of curing

Radiation curing technology is currently being used in a wide range of fields[5]. Theoretically any conventional surface coating system can be adapted for EB or UV processing. At the present time, expansion of the technology into the graphics arts industry is particularly strong especially with cellulosic substrates. This trend is very evident with EB, the relevant areas where EB processing is actively exploited being shown in Table 3. Of the fields listed in the table, printing, coating and metallising of paper are demonstrating the best growth with wood panels and particle board the equivalent in timber. These developments are utilising the advantages of EB, namely fast line speeds (up to 500 m/min with paper), big volume throughput, low pollution and processing of pigmented finishes to give final products that are either unique in properties or economically cheaper than their equivalents made by alternate thermal technologies.

Table 3

Typical EB/UV Radiation Curing Processes Used with Cellulosics*

Printing†	Gift wraps
Coating†	Greeting cards
Lamination†	Decorated paper
Silicone Release	Shopping bags
P.S. Adhesive†	Wood panels†
Photographic paper†	Particle board†
Metallising†	

* Processes listed here are representative of the applications. The list is not meant to be complete.

† Areas where EB is extensively used, the remainder are essentially UV applications.

Economics of processing

One of the main difficulties encountered in the acceptance of EB by industry is the relatively high initial cost of the equipment $750,000) especially compared with UV ($50,000). In this context, EB possesses a number of advantages when compared with UV, namely (i) the cheaper price of the resin since no sensitiser is required (ii) the greater flexibility in the resin formulation since acrylates are virtually essential for free radical UV curing whereas EB is amenable to any functionality of oligomer or monomer and (iii) the big volume of product capable of being processed quickly. Fortunately there is now sufficient data available from current lines for accurate processing costs to be determined for most EB processes, particularly with paper, to enable a choice to be made between EB and UV for a particular application.

In Tables 4-6, the economics of a pigmented EB coating process on paper are outlined. For this application, the hourly costs of running a typical low energy electron beam machine in Australian dollars are computed at $333.0, assuming one shift, 80% utilisation of available beam time, the need for two plant operators and five years amortisation of the equipment (Table 4). Equivalent running costs computed per m^2 of paper used are shown in Table 5 to be $1.23 x 10^{-2}. The overall cost of the process per m^2 of paper used is calculated to be $2.5 x 10^{-1} (Table 6). The significant feature of the last figure is that it is approximately half the cost of an equivalent process carried out thermally. This difference in price reflects the energy costs associated with thermal curing, including solvent recovery or after-burning, expenses for explosion protection, larger space requirement, time in the oven etc. In this instance these results demonstrate the significant economic advantages of the EB process.

Table 4

Typical running costs (per hour) for EB pigmented paper coating process

Parameter	Cost per hour ($A)
Electricity	12.00
Inert gas	76.00
Maintenance	17.00
Labour†	19.00
Water	4.00
Capital‡	205.00
Total	333.00

* Assumes one shift, 80% utilisation (i.e. 1500 hours/year).
† Two plant operators.
‡Five year amortisation.

Table 5

Typical running costs (per m^2) for EB pigmented paper coating process*

Paramater	Cost per m^2 ($A)x$10^4$
Capital†	96.0
Electricity	6.0
Water	3.0
Labour	9.0
Maintenance	8.5
Inert gas	0.5
Total	123.0

* Operating speed of 300 m/min. (i.e. 23,000 m^2/hour).
† Five years amortisation.

Table 6

Overall costs for EB pigmented paper coating process*

Parameter	Cost per m^2 ($A)
Base paper	0.12
Paint	0.12
EB running†	0.01
Total	0.25

* Uses base paper ($2000/tonne) of 60 gsm base weight coating to 10 gsm with paint at $12.00 per kg.
† Table 5.

Conclusions

Radiation curing continues to expand strongly in world markets, particularly in the surface coatings industry and especially in the graphic arts section of the field. Both EB and UV techniques are being used as complementary curing technologies for these applications. The role of diluent monomers, particularly the multifunctional acrylates, is important in these processes since the presence of such materials in the resin can enhance concurrent grafting during cure leading to improved properties, including adhesion in the finished film. Although the initial costs of EB equipment are relatively high, an economic evaluation of an EB pigmented process for coating paper indicates that such a radiation cured technique would lead to considerable financial benefit when compared to the thermally cured alternative.

Acknowledgement

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Presented at a 1988 meeting of OCCA New Zealand.

Profitable R&D

Chester Conference Paper: Winner of the Ellinger-Gardonyi Award

by I. A. Macpherson, Ciba-Geigy Pigments, Hawkshead Road, Paisley, Renfrewshire PA2 7BG, UK

Summary

The performance of Research and Development is much less easily determined in terms of productivity than that of a sales or production function. It is often argued that the Research and Development innovation should be insulated from such mundane comparisons or that the measure used is inappropriate.

These arguments are examined in the context of industrial Research and Development and its relationship with its academic counterpart and suitable criteria for measurement are discussed.

Without identification of what is meant by R&D and the timescales over which its influence is to be measured, further discussion will be meaningless. So let us look at a few definitions.

R&D is Research, Development and Applications.

Research: Is the acquisition and extension of knowledge and understanding of all the factors influencing a particular area of human thought or endeavour (chemical, medical, engineering or social, or political,) — and the identification of new possibilities.

Development: Is the focusing of the knowledge base towards the solution of specific problems associated with putting into practice ideas which are already identified.

Application: In Ciba-Geigy we have identified this activity separately from the other two because of its importance. In this area very close technical contact is maintained with customers so that problems and opportunities may be identified more readily and that solutions from R&D may be guided towards the best fit for both customer and supplier.

Profitable: Providing a value greater than the effort or resource required. In the industrial sector 'profitable' usually means cash value. In other areas, however, 'value' can take on totally different meanings. Who would put a "cash" value on research into controlling the 'Greenhouse effect' or AIDS or mental illness . . .?

The international and national level

Turning firstly to what is happening at international and national level, the world at present appears to be undergoing a major environmental change in industrial economic terms. New technical frontiers are emerging from the older technology of basic industry. The response of the different leading nations to these changes reflects their national politics, economics and needs.

The USA is attempting to obtain benefit from concentrating its education, industry and funding of R&D into high-technology areas.

Japan now finds itself in the lead in a number of technologies after successfully assimilating Western technologies for many years. As a result a whole series of integrated changes have been made in education, industry, and financial institutions which will generate the skills and environment needed for innovative leadership rather than efficiency of exploitation.

West Germany has also responded centrally, concentrating on the medium technology industries which form the major manufacturing pillars of the economy.

In the UK, the market economy principle implies minimum government interference and central control. The consequence is that the responsibility for R&D reverts to the private sector which must therefore find the funding to support it. The pressure on the UK higher education system by bodies such as the UFC is clearly intended to apply pressure to the academic world as well as to the industrial sector to bring this about. Direct R&D funding from the UK government is highly concentrated into Defence, Electronics and Aerospace with the remaining medium-and low-tech industries being left to find their own solutions.

There are believed to be clearly established relationships between the economic growth of a country and the level of R&D it sponsors. The UK has a reducing number of personnel engaged in R&D in contrast to most other countries. Despite this the economy is apparently growing reasonably well although still not as fast as for countries which support higher levels of R&D.

In the UK also, therefore, major changes are taking place in the areas of education, academic R&D and industrial R&D sponsorship in response to the same evolutionary forces influencing global technology.

Are these issues relevant to a small company or a division of a large multinational? Can parallels be drawn between the national level and the company level?

Company level

Understanding what is happening at the macro scale is vital to determining the future environment for any issue. R&D is no exception. The demographic timebomb which will result in substantially smaller numbers of students in higher education in the UK in the mid 1990s coupled with the present orientation of the younger generation away from traditional science and technology in favour of law, accountancy, medicine etc, will have a major impact on the available competent resource. No company will escape the consequences of this and the changing national approach to the funding of R&D in multinational companies.

In the UK these combined pressures require each industrial concern, large or small, to make clear provision for the well being of the resource required for its future technical requirements. R&D function is a strategic centre not a profit centre.

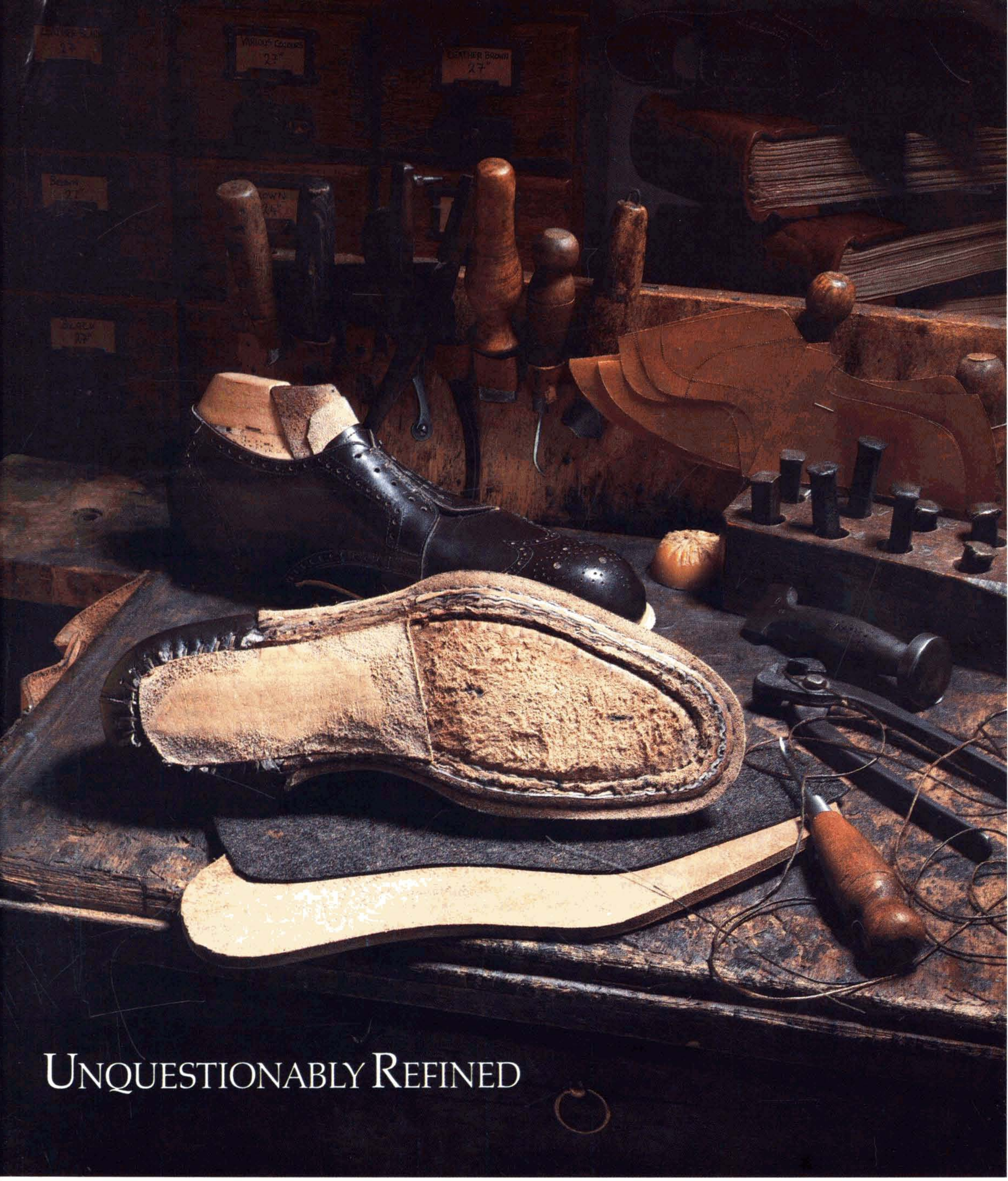
The profitability of R&D should be examined in this context.

In order to assess profitability some measurement must be made. This is a much more difficult issue than in some other industrial functions. Production for example can use ratios such as tonnes per man per week.

Measurement of R&D effectiveness could include:

- ☐ The number of papers or patents published
- ☐ Market share ÷ R&D percentage of Period costs
- ☐ The turnover from new products less R&D costs
- ☐ The reduction in process costs less R&D costs.

All could be valid depending upon the objective of the work and who makes the judgement. We can examine this at two levels and two timescales. The senior management of an organisation will in addition to present profitability require assurance that the future technical basis for the company is



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being laid and the timescale will reflect this, typically being 5 to 15 years. Measurments of profitability in this framework can look very different from those designed to satisfy the more immediate demands of small companies and operating Divisions of large multinationals where timescales seldom extend beyond 5 years.

In essence we are all individually the judges. We may accept what someone else offers as a view or we may not but we must identify and agree the criteria to be used otherwise our opinions will not be accepted by others.

At the operational level in an industrial environment measurements such as:

- ☐ Contribution after services ÷ R&D costs
- ☐ Turnover from New Products ÷ R&D costs

are probably the most useful but will themselves require definition and even modification according to circumstances. Systems can be modelled to take advantage of differing local tax situations.

Future technology

R&D investment ratio =

$$\frac{1.5 \times \text{R\&D expenditures}}{1.5 \times \text{R\&D expenditures} + \text{cash flow}} \times 100$$

Present technology

Capital investment ratio =

$$\frac{\text{capital investment} - \text{tax credit}}{\text{cash flow}} \times 100$$

Total technology

Technology investment ratio =
R&D investment ratio + capital investment ratio

Ratios which show investment in technology as 60 to 100% of Cash flow are guaranteed to gain attention. The measurements used should be selected to match the purpose of the organisation. I personally favour "Turnover from New Products ÷ R&D Costs" as representing a good measure of functional effectiveness. Let us look more closely at this.

Every commercial organisation knows its Turnover and usually can break this down by product. "New Products" is open to interpretation and can be defined differently in different circumstances — If defined as 'Products launched within the last x years' then a timescale framework is set which should match the type of business and its perceived needs, where x is related to the product life cycle. What is not defined is the number of New Products or the level of customer confidence.

One major new product every 6 years would create an entirely different image in the market from 10 incremental improvements each year. 'New Products' requires agreed definition in terms of significance of advance according to business needs.

R&D Costs are the total costs of implementation i.e. R&D scale-up, evaluation control, launch, including hidden costs such as depreciation etc. according to accounting methods used.

Having set the criteria — what level of performance is acceptable?

A company in a survival crisis will have a different view from a stable organisation looking towards establishing a strategic position. As a result the agreed figure for acceptable performance may vary with time and economic situation. A central function or venture unit will have different views from an operating division or small company.

The people

Like most areas of human endeavour the prime factor is the people involved — as individuals and as an organised group. In all cases the values must be agreed with the people concerned. The measurement of the profitability or efficiency of an R&D group is so tied to the objectives of the organisation that a clear view of these linked to the measurements to be used is essential. The act of measurement provides the focus for the group activities and must be selected to be relevant to the organisation's needs. What factors influence the performance of R&D people towards profitability?

In the case of R&D we can add to the usual list of motivation, organisation, etc. The element of creativity.

Creativity and Profitability are not the same but the first is essential to the second.

Creativity is the ability to make something new. It may be a new product for washing dishes or a new theory of cosmology. It brings new understanding and solutions to problems and issues.

The idea that this happens in a blinding flash of light in an otherwise black vacuum is totally fallacious. It comes from dedication and very hard work — fanaticism even. The brain has evolved over millenia and the understanding of its workings is still one of the great unknown frontiers of science. Each individual brain is also conditioned by the experience it has gathered in its own lifetime. Inventions do not happen in books or databases or even project teams. The information and knowledge held there must be acquired by a single brain, and must then be applied to a specific problem for the patterns to be recognised and the solution formed.

All human brains are very good at pattern recognition, analysis decision making and action. We would not have evolved so far otherwise.

But all are different — with different knowledge or experiences. Acquisition of relevant knowledge and constant digestion and restatement and analysis of the problems increase the chance of success. Interaction with others is a key element in the modern approach to problem solving. The progress in communications and information technology greatly increases the efficiency of teams of problem solvers.

There may be a quantum step taken in the creative mind at this stage but it does not happen without the proverbial 99% perspiration generated, assimilating relevant data and examining them in a variety of contexts. Nor is the process completed with the quantum shift of thinking. The idea must be identified, tested and refined to match the problem. Here there is a strong link with academic research since it is still the main stimulus for new information and new thinking unbounded by the constraints of business franchise. It is, of course, also the training ground for the future industrial R&D staff. A first degree is about knowledge acquisition, understanding and retention but a research degree is the result of the training in the application of this knowledge to problem solving. Too few of the higher education establishments seem to be giving proper emphasis to the mental approaches to problem solving — most are far too interested in the results. It is natural for industry to focus on the results of R&D in terms of products, patents, even strategic positioning. One of the prime outputs of higher education is the future staff of industrial R&D units. I think it is quite remarkable that so few candidates from UK universities have learned anything of the mental processes involved in R&D problem solving. Many PhD students are used as technicians and gain specific practical skills and do excellent work, publishing many papers but learn nothing of the philosophy of R&D. Task orientation for research students can lead to an empirical approach and narrow mindedness and an inability to self generate. With increasing pressure on the academic world to "pay their way" this trend is increasing. It is particularly perplexing when it is realised that training in thinking as opposed to memorisation of facts is known to improve significantly the performance of students in creative problem solving.

The result is often that when presented with new problems in industry recently trained researchers do not know how to approach them unless they fit closely their existing skills. Mostly industry is not geared to teaching philosophy and expects new recruits to contribute immediately and may be quite unprepared for the 18 months to 2 years adjustment required by most new graduate recruits.

This sets a key premium on the selection of new graduates with appropriate creative abilities into R&D groups rather than using the R&D group as a training ground in the appropriate technology prior to career development in general management.

Studies on creativity are not precise and opinions vary on how all the influences interact to form creative people. Some educationalists now agree, however, that the massive acquisition of knowledge typical of secondary and first degree tertiary education in this country depresses creativity. It can be argued that the creativity of typical science professionals might follow a pattern something like Figure 1.

It is a pity that the way we teach our young people has such an influence on such a valuable attribute. It is to be hoped that the Information Technology revolution will provide such open and easy access to information that education will in the future be more about the use of information in problem solving and innovation than the acquisition of the information itself. It would be very desirable for vigour and creativity to peak at the same time.

There is clear evidence that creativity is stimulated by problems being presented under mildly stressful conditions. Time stress and competitive pressure are important elements in enhancing creativity in an R&D team and should not be ignored or removed either in industry or the academic world. The decline of creativity in later years is interesting since it is not necessarily associated with decrease in brain function. The problems and stresses of the elderly are no less real but their solutions are not normally measured in the same way as conventional R&D.

Here we see a fundamental comparison between Industrial R&D and Academic Research. If this is not recognised then a number of major misdirections are likely to result. I believe that Academic Research and some medical/social research can be considered profitable even though measurement in cash terms is not possible. This has major implications for the way funding is considered.

Academic and Industrial R&D are of course closely linked and do in fact feed from each other. Neither can stand alone in the present climate but equally one should not totally dominate the other.

This is a classic example of a growing critical gap between supplier and customer. In this case I believe it is the responsibility of the customer (industry) to state clearly its needs and influence the education system towards meeting them even if this eventually means direct funding, provided this is coupled with reductions in the present taxation system which now provides the central funding.

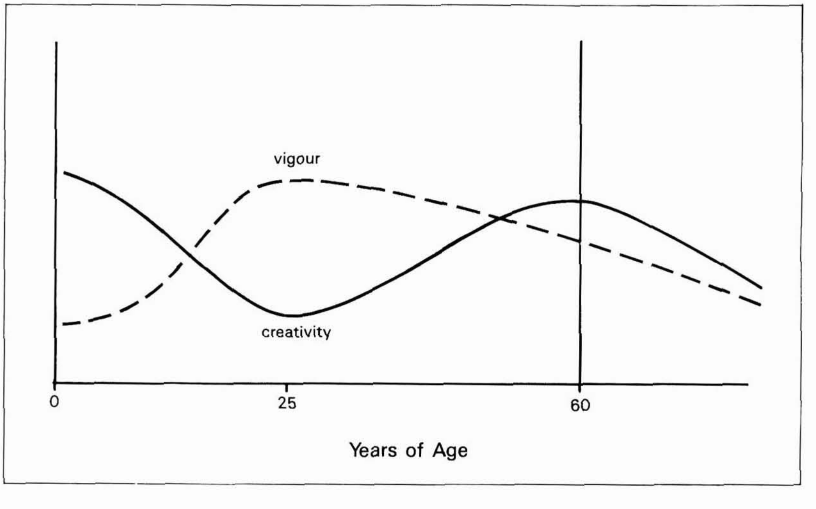
Profitable R&D does not arise from the invention, however, no matter how creative it might be. Profitability is not achieved until the whole process of commercialisation has taken place. The cost and effort of the co-operation and problem solving between different disciplines needed at this stage are substantially greater.

Here organisation and attention to detail play a far more important role. Persuasion, interactive skills, selling (both internally and externally) are key attributes e.g. persuasion of the home organisation that any investment required should take place. Persuasion of the customer that the solution offered is the "right" one. All departments must be receptive to innovation and ideally should themselves be inventive. Innovators appreciate innovators. Those who are not, don't.

Most organisations have R&D plans well integrated with their needs. Success will therefore normally fall within a recognised framework but other functions must be prepared for the results of successful R&D. Production functions must be prepared to accommodate new processes. Marketing departments must adapt strategies in the light of the progress made by their own R&D departments as well as competition. Integrating a plan is one thing, integrating the output of R&D, particularly if it is unexpected, is quite another. Nevertheless in industry the profit comes from the commercialisation, and the success rate of R&D is critically dependent on how well its output is exploited by its own sponsors.

This in turn is influenced by how well its people are able to sell their ideas to their own companies.

Figure 1



This does not mean that R&D people must all have skills in advocacy as well as science. A mix of skills and abilities is essential for any successful group —large or small. The planning and organisation of such a mixture of attributes is of course critical. Most people in a co-operative enterprise will be happy to focus on a series of problems presented to them. R&D is no exception. Even many R&D staff feel uncomfortable if presented with a totally open-ended exploration.

The selection of the targets then, is, together with the selection of the people, a major foundation stone for profitable R&D.

Guidelines for profitable R&D

Concept of Role:	Expectations of R&D by the Business-Sponsor Expectations of R&D by R&D Expectations of R&D by the Customer
Market Knowledge:	Customer's perceived needs Customer's real needs Market's evolutionary direction Competitor's activity
Programme Planning:	Analysis of needs Specification for success Feasibility assessment Priority assignment Resource allocation Checks on acceptability
Project Management:	Visible elements Timescales Criteria for success Monitor progress Check acceptability with sponsors and customers

Prescription for success

Integrated R&D:	Internally integrated Integrated with rest of business Single site
People:	Selection Motivation Guidance Training Stimulation Understanding of context

There are so many good reasons for the customer being the starting point for this part of the process that it is quite surprising that customer orientation is one of the 'new' themes being propagated by the consultancy business these days. It is not just that "he who pays the piper calls the tune" as is sometimes quoted. Following this cliché probably causes inefficiency since it can imply that the R&D unit does what it is told and that the solution is defined by the customer or even worse the salesman.

R&D depends on objective facts and proven information. Subjective opinions often hamper.

Blind acceptance that "the customer is always right" is scientifically unacceptable.

The benefits come from the knowledge and understanding in some depth of what problems the customer is facing or, better but more difficult, will face. If your customer has a problem which can be well described now by him there may be profit in it for you but you can be sure all your competitors are looking at the same problem. Efficiency of service is more important here. It takes time and confidence even technical partnership for the longer term opportunities to be identifiable. Any project portfolio should be a balance of these.

What other elements should go into the planning of a project portfolio? The third major element after people and customer orientation, I believe, is *focus*. R&D in this country used to get the name for being inventive but falling down at the commercialisation steps. I believe that focus in the Project portfolio helps focus not only the R&D resource into achievable targets but also helps the rest of the organisation to accept the consequences of success at R&D stage in terms of implication for the business. Dissipation of effort chasing after attractive new ideas before the existing ones have been exploited properly is an occupational hazard in any R&D group. It must not be eliminated but it should be focussed and guided.

Focus can be interpreted as concentration in a small number of core activities to the exclusion of all else. This may be successful in production or marketing and even for the later stages of Development. Much of the inventiveness however in Research comes from the association of notionally unrelated ideas.

Research in the boundary areas between established disciplines tends to move faster. This should be borne in mind during project selection and concentration applied to the exploitation. Innovation stands a better chance if there is interdisciplinary involvement.

Current company theory is to be lean and fit. This applies to its R&D group also and a vigorous selection and pruning procedure is essential for the project portfolio.

All this is good "modern" industrial theory. A word of caution is, however, appropriate at this point. No R&D function should be immune from the fortunes of its parent organisation. When the parent is under financial stress the R&D function like any other must draw in its belt and must exploit rapidly what it has in hand for the survival of the whole. This can be very successful, but must not become a way of life. Exploitation without renewal of the knowledge base will just as surely result in long term starvation as will failure to respond result in a more immedediate collapse. Swinging the orientation of a group of people between knowledge generation and exploitation is not easy and takes time. This applies equally to industrial, academic, national and international R&D. The present squeeze on the academic institutions in the UK and the shortening of timescale for R&D throughout the Western world has resulted in many of the researchers in Universities attempting to turn themselves into exploiters and servicers of industry's immediate needs. Once established this orientation will be difficult to reverse to one of knowledge generation. It is better to maintain a balance at all times and buffer somewhat the immediate pressures.

I believe that the strategic economic position of both a nation and a company can be viewed in terms of these dimensions —

People, Technologies, Markets.

In both cases R&D is the link between the possibilities of the technologies and the needs of the market. The effectiveness of the utilisation (or orientation) of the people determines the future profitability of the company or the nation. Managers, be they Chief Executives, Deans of Faculties or Research Managers, making decisions influencing the size, funding and direction of R&D must understand the complete contexts and timescales involved.

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Chester Conference

*B*y the time the week before the Conference was reached I was utterly convinced that this particular one would be the last. However, by the time June 20 was reached more delegates had registered than at Eastbourne as indeed had very many more partners than on the previous occasion. In all fairness it can be said that, as far as those attending were concerned, the occasion was an undoubted success and so I have had to alter my opinion.

Before entering upon a constructive critique of it, I wish to report on the actual events. The technical sessions were well attended throughout the whole programme, never falling below 85% or so. No one paper was panned by everyone as interest varied as might be expected and presumably because all presentations were satisfactory in their way.

As far as the social programme was concerned, if one can go by the comments made, this was certainly thoroughly enjoyed by all, especially when everyone was officially free as on the Thursday evening. The trip on the Lady Diana was certainly a memorable event, everything was right — the weather, the scenery, the food (and drink!), the band and, of course, the company. "Well done Tony! 11/10" as one delegate said to me. Even a famous sea lion turned out to greet us.

The staff at the Grosvenor Hotel were very helpful and the establishment was conducive to the sense of occasion. Virtually the last event was there — the dinner — which was well attended and made complete by an excellent delivery of the toast to The Association by the Lord Bishop of Chester (I have told the gunpowder gag many times since!). This was a fitting end to what had started with a successful golf competition (won by the Manchester Chairman, Norman Seymour) and a

Norman Seymour receiving the Sam Sharp Cup from the President, John Bourne.

Guest of Honour – The Bishop of Chester and Mrs Baughen being welcomed by Mr North, the new President, and Mrs North.

Association Officers and Conference Delegates with the Canadian Flax Mission which included the President of the Canadian Paintmakers' Association. Association Officers: F. Redman (Past-President), fourth right, J. R. Taylor (Hon. Editor), fifth right, and A. C. Jolly (Hon. Conference Officer), seated far right.

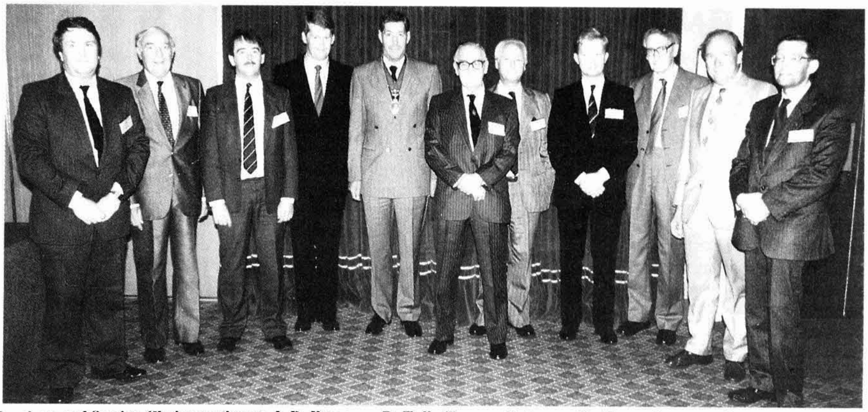
Dinner in the Watergates' "prison" mainly for the overseas visitors, who had a whale of a time, followed by a tour of Chester's City Pubs (history of course!).

What of the future?

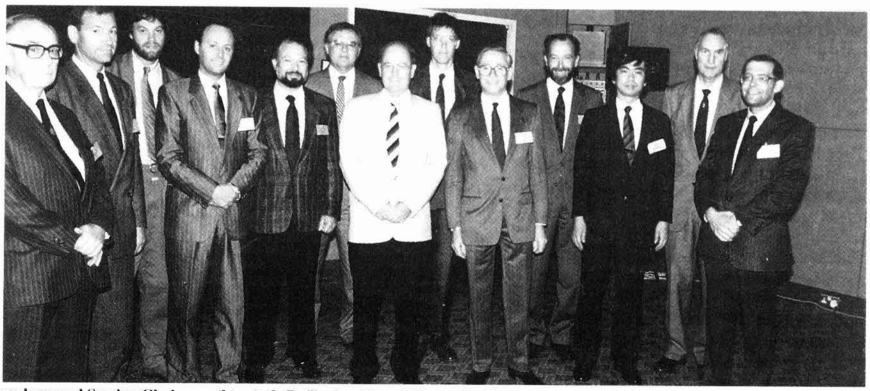
*A*s I have said, when the registration of delegates virtually dried up in March and Chris Pacey-Day and I had to prune the original plan, omitting the final dance, the Town Crier's participation etc., I was convinced that was the end of conferences for OCCA. At this point I felt that the future lay with seminars and symposia run by the Sections on subjects of wide, even perhaps topical and temporary interest, eg Fire Protective Coatings after "King's Cross" and the periodic highlighting of acid rain and the resultant carbonation of concrete. However it would seem the conference style, albeit modified, still has a place as a prestigious event for a prominent professional Association such as OCCA.

Just to say "start again from scratch" does not help. We all know that there are well defined formats which are the inevitable outcome of an organised rethink — workshops, seminars, symposia or conference. Accepting that a conference style fulfils a particular function we can learn by experience. We now know that to interest the majority of the membership of OCCA we must have a subject that is of personal interest and capable of persuading the "powers that be" in a particular concern that it will be cost effective to agree to an employee attending. We also know that since more delegates will attend as individuals, a dinner dance at the culmination of the proceedings is "not on" and that a conference dinner is,

Chester Conference Review



Day 1 Speakers and Session Chairmen (l to r): J. B. Emerson, R. Tully-Turner, D. Lyons, D. Pirret (Keynote), J. Bourne (President), J. R. Taylor (Hon. Editor), E. V. Carter, M. Heuts, D. J. Walbridge, S. Nordberg and L. Lawrence (Hon. R & D Officer).



Day 2 Speakers and Session Chairmen (l to r): J. R. Taylor (Hon. Editor), E. Van Acker, C. Vrouwendvelder, S. Gôthe, O. Le Blanc, A. H. Hughes, J. Gent, M. Oosterbroek, A. J. Hinton, I. A. Macpherson, T. Kobayashi, S. J. Mitchell (BPVLC Past-President) and S. Lawrence (Hon. R & D Officer).

To accommodate these various considerations it might be viable to make the subject of each biennial conference "the current state of the art". Thus most areas of involvement in the surface coating industry would be covered and such conferences could become the centre of reference for the world-wide industry.

If overall cost is a consideration, then confining a conference to univeristy towns would mean that delegates' accommodation could be split between college rooms and hotels in the town or city. This stratagem would cater for all tastes.

I have issued a questionnaire for consideration by the Executive and Council members. One factor that must be considered is that a full, well structured "market research" operation, that is with full involvement of Sections, will take time and endanger the possibility of fixing up a conference in 1991 exactly as required. To get exactly that which we wished for at Chester necessitated starting preparational work in 1986!

Any genuinely constructive suggestions from members would be most welcome and if they are strictly of this nature, direct contact with me as soon as possible will not be jibed at.

Cambridge in 1991 has been agreed to by Council, but is it to be a reality? Over to you!

A. C. Jolly ■

Technical Papers

The OCCA Chester Biennial Conference was a success regarding the number of excellent papers which were given over the two days. It was noticeable that the room used for the conference in the hotel was fully occupied at all times by the delegates, even late on Friday afternoon.

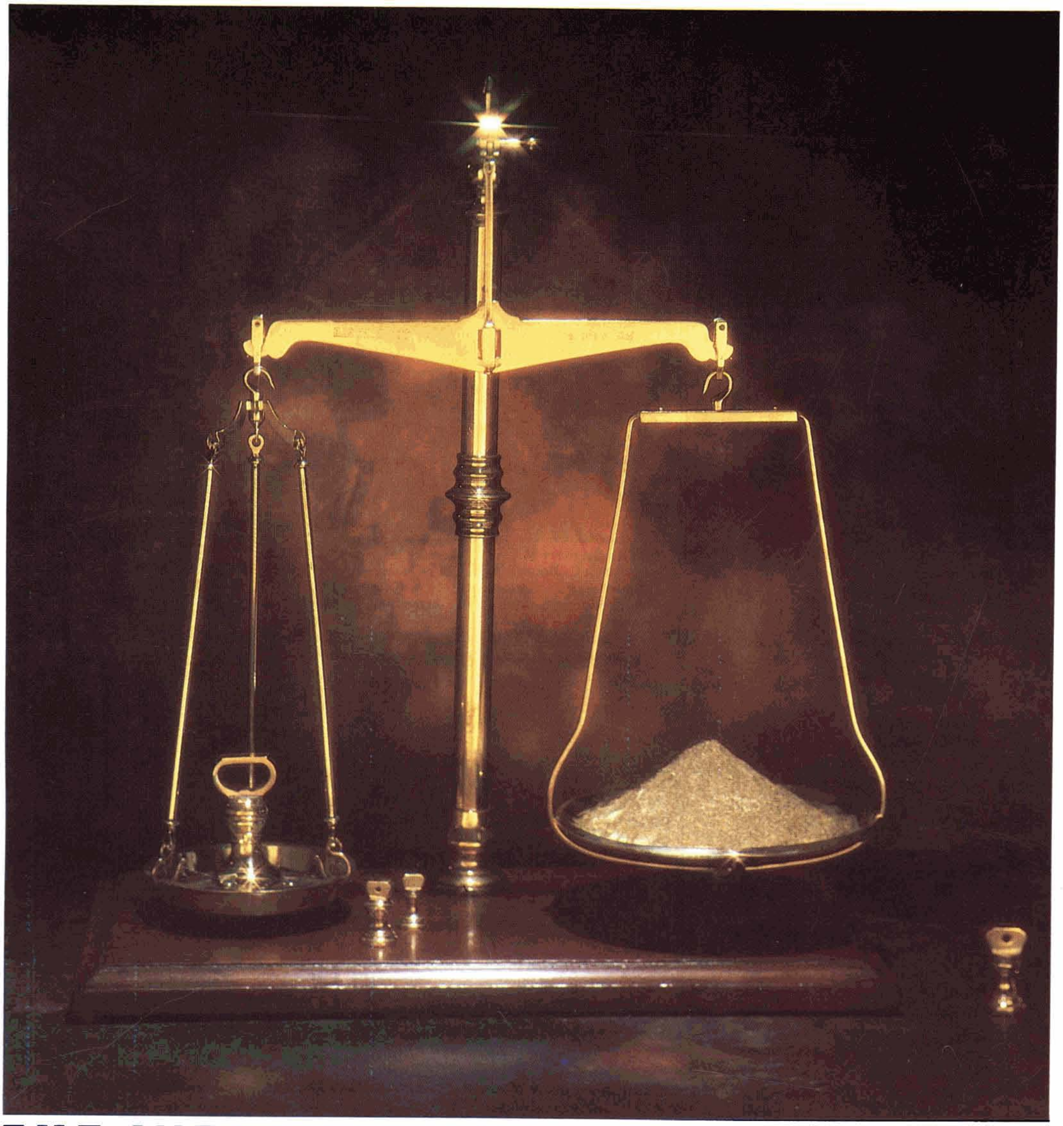
All aspects of Research & Development were covered and excellent papers were given on the general subject of company strategy for successful R & D by Prof I. Macpherson, S. Nordberg and R. Tully-Turner. Excellent papers were also presented on the subject of specific R & D case studies.

In the traditional manner of OCCA Conferences each paper received the usual questions from delegates who required further details on the subject of the lecture or possibly did not always agree with the sentiments expressed in the paper. Questioning of the speakers certainly added to the liveliness of the proceedings.

The slides and overhead acetates were generally satisfactory and for future conferences and symposia there will be made available, last autumn, to speakers an OCCA leaflet on "The Preparation of Slides and Overhead Acetates".

J. R. Taylor ■

▷ ▷



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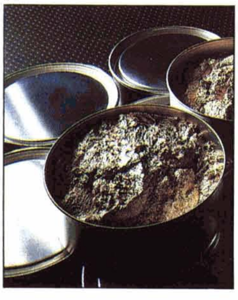

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OCCA AGM

Some forty members and Association guests attended the Association's AGM on Friday, 23 June at the Chester Grosvenor Hotel. The AGM followed the close of the final technical session of the Chester Conference in the Westminster Suite of the Hotel, the venue for the Conference technical sessions.

President John Bourne chaired the meeting supported by Honorary Secretary Les Brooke, Honorary Treasurer Brian Gilliam, President Designate Graham North and senior staff.

At the start of the meeting Members stood in silent tribute to the 12 Association members who had died in the period since the previous AGM at Harrogate. Members particularly remembered Past President Harry Keenan in their silent tribute.

Les Brooke introduced the Annual Report, highlighting the great success of SURFEX 88, the modernization and refurbishment of Priory House, the development of the Journal and the very successful Section activities during the year under review.

Introducing the Annual Accounts, Brian Gilliam referred to the very satisfactory surplus of income over expenditure, largely attributable to the SURFEX Exhibition, but with strong contributions from investment income, the Sections, advertising and the sales of publications. The increased activity by the Association had incurred additional headquarters' expenditure but these had been funded by an increased surplus from the Association's commercial activities.

The Association had also invested in the modernization of Priory House and this expenditure had been funded from the reserves built up over previous years. The healthy financial position of the Association enabled increases in subscriptions to be kept in line with inflation.

The Honorary Treasurer also referred to the Ellinger-Gardonyi Bequest which had now been registered as a charity and in future years would enable significant income to be contributed to education and training activities and to the removal of VAT from membership subscriptions.

In the absence of questions from the meeting, the President proposed the adoption of the Annual Report and Accounts which were approved unanimously.

The Election of Honorary Officers and Elective Members of Council were confirmed together with the election

10th Anniversary ICCATCI meeting held on 22 June (l to r): C. Pacey-Day (OCCA General Secretary), C. Bourgery (FATIPEC General Secretary), J. Roire (FATIPEC Past-President), J. Bourne (OCCA President), Ms A. Chauvel (FATIPEC President), G. H. Munro (OCCA Vice-President, S. Africa), R. Geiger (FSCT President), Mrs Bourgery, Dr Y. Oyabu (JSCM President).

Dr Smith, OCCA Past-President, OCCA founder member of ICCATCI, was awarded a commemorative medal on this anniversary.

of Graham North as the Association's President. The General Secretary announced the names of Chairmen of Sections elected to serve on Council.

The meeting approved resolutions setting the level for UK and Overseas Subscriptions and reappointed auditors for 1989.

The AGM then moved to the less formal items on the agenda, commencing with presentation of the Jordan Award to Iain Melville for his paper entitled "Wood Finishes – Field and Laboratory Tests", which is to be published in the November 1989 issue of JOCCA. The Jordan Award comprises a Certificate and £200 and is made for the best contribution to the science or technology of surface coatings by a member of the Association of any nationality working in either the academic or industrial fields who is under the age of 35 at the date of application.

The Chairman then announced that the first Ellinger-Gardonyi Medal would be awarded to Professor Ian

Iain Melville receiving the Jordan Award from the President.

Macpherson of Ciba-Geigy for his paper entitled "Profitable Research & Development" which had been judged by the Awards Committee to be the best paper presented at the Chester Conference. The Ellinger-Gardonyi Award, which comprises a sterling silver medal bearing the image of Dr Ellinger, will be awarded at OCCA national conferences which include refereed papers. Professor Macpherson was unable to be present to accept his award and arrangements will be made for him to receive his Medal at the Scottish Section Dinner Dance in 1990.

Fred Morpeth and Norman Seymour moved a vote of thanks to retiring Council Members and Honorary Officers, both motions being received with enthusiasm by the meeting. The General Secretary called upon Tony Jolly to move a vote of thanks to retiring President John Bourne, an invitation that Tony, who had been given more than his customary five minutes' notice, was able to respond to in his typically amusing and forthright manner. In summarising John Bourne's achievements Tony clearly felt that the President's major commitment had been in developing closer relations with Overseas Sections and organisations through his extensive visits abroad during his two year presidency and was probably the area for which John's period in office would be most remembered. The thanks of the Association were expressed in the warm acclamation of the motion.

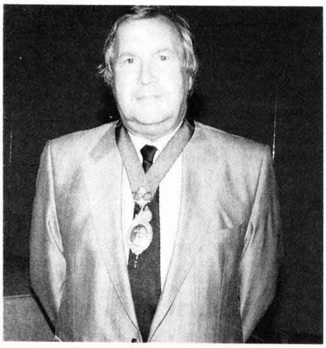
The President then undertook his final official duty when he handed over the insignia of office to incoming President Graham North (biographical details OCCA News), using the customary words for the occasion "Albert Graham North, in accordance with the resolution passed at this AGM, it is now my duty to invest you with the Insignia as President of this Association and I charge you to guard well the interests of our Association and at all times to uphold the dignity of your high office".

In response, President Graham North thanked John Bourne and presented him with a Past President Medal and Hilary Bourne a bouquet of flowers and the Association's gift of a Crown Derby Ginger Jar. In her turn Hilary passed her President's Lady's Medallion to Jean North and wished her well during Graham's term of office.

Further presentations were made by Jim Geiger on behalf of the FSCT and Dr Oyabu on behalf of the JSCM.

The meeting then closed with an invitation to Past President John Bourne to host the concluding event of the Conference, a dinner for overseas guests and delegates in the presence of the Bishop of Chester.

C. Pacey-Day ■



Graham North, OCCA's new President, with the Presidential Insignia.

Jean North (right) receiving the President's Lady's Medallion from Hilary Bourne.

John Bourne (left) receiving the Past-President's Medallion from Graham North.

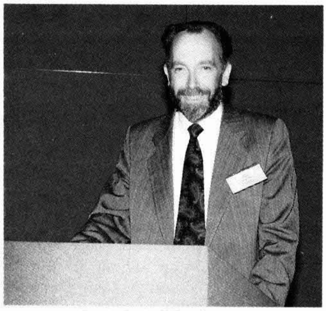
The AGM Minutes will be included for Members as an insert with the September Journal.

Inaugural Ellinger-Gardonyi Award Paper

Professor Ian Alexander Macpherson was a recipient of the inaugural Ellinger-Gardonyi Medal for his paper entitled "Profitable Research & Development", presented at the Chester Conference. The award of the Medal was granted by the Awards Committee, under the Chairmanship of Dr Simon Lawrence, the Association's Honorary Research & Development Officer, for the best paper presented at the Conference, based on the technical quality of the paper and its relevance to the theme of the Conference. Papers previously published or presented were excluded from consideration.

The sterling silver medal carries the likeness of the late Dr Marianne Ellinger, a great devotee of OCCA Conferences and through whose generosity the Ellinger-Gardonyi Trust has been established. Grants made from the income of the Trust will enable the Association to promote and sponsor educational and training initiatives within the surface coating sector and thus fund projects which otherwise would not be able to proceed.

The medal will be awarded at all subsequent OCCA Conferences where papers are received prior to publication and the Awards Committee consider the subject matter of the conference worthy of the award.



Prof. I. A. Macpherson

Prof I. A. Macpherson is a graduate of Glasgow University, and obtained his PhD from there in 1963. He joined Ciba-Geigy in 1962 as a Research Chemist and is currently Technical Manager for Ciba-Geigy Pigments PLC at Paisley, Scotland, with worldwide responsibilities for R & D, Application, QC and Analytical aspects for azo and phthalocyanine pigments. He is also a visiting Professor of Chemistry at Paisley College of Technology.

Prof Macpherson's Conference Paper begins on p.318 ■

Visit

Norman Seymour, Chairman of the Manchester Section, reflects on his recent visit to the opening of

CATALYST: Museum of the chemical industry

The pattern of the last decade to utilise various buildings and areas of the industrial revolution is continued in this museum. Housed in the old William Gossage building on the banks of the Mersey at Widnes within the shadow of Runcorn Bridge, it gives from its observation room a fine panoramic view of many important sites of the British Chemical Industry, while inside it displays the development of the Chemical Industry in the North West, chronologically portraying the impact of this on peoples everyday lives. As its name suggests it is a museum which will modify and increase interest in this field without itself being changed.

It is at the moment far from complete but the main showpiece is a roof observation gallery, reached by an external glass panelled lift showing, along with a panoramic view of over 20 chemical plants in the area, that the sandbanks of the Mersey exposed at low tide are golden sand and not grey mud! This gallery aptly names "Industry" on view is the first of the permanent exhibitions, showing the development of the Chemical industry in the North West and its impact on everyday lives. The range of products presented on the trade stand shows such varied products as cars, clothes, plastics, paints, wallpaper and washing powder, although the paint can shown is not one of the more famous names of that area. The old fashioned kitchen does however show a packet of Gossages Magical Soap, from the era when they were the largest soap makers in the world. There are many working exhibits, one showing the thixotropic properties of non drip paint. While tape recordings, video presentations and some historical photographs depict work experiences of over 50 years ago: A most interesting working exhibit is based on analysing fragrances made locally and used in many well-known products.

Lord Leverhulme when opening the museum recalled memories of the old Gossage works and hoped its success would grow as a most interesting look at the North West Chemical Industry. Mr A. E. J. Yelland in reply stated more money is being funded to complete the work, a sum of £2.2 million is the target. It was pointed out that within an hour's drive live 15% of the UK population which according to Dr Gordan Rintoul, the director, will attract 100,000 visitors each year.

For further information of the museum call 051-420 1121. ■

Book Reviews

Exterior Durability of Organic Coatings

by E. V. Schmid,
FMJ International Publications Ltd 1988
Price: £39 Softback ISBN 0-86108-315-6

The author of this book has successfully covered all aspects of the complex physics and chemistry of exterior durability of metals, wood and concrete. It is the first "small" book of its kind, as far as the reviewer is aware that covers this subject in one publication.

The author at the end of each chapter has given excellent references to the subjects discussed in the text. Eric Schmid was formerly the Technical/Research Director of a Swiss Paint Company and as might be expected the references to specifications for methods of test are mostly those of the German DIN type rather than the BSI Specifications mentioned in the text.

There are many references to OCCA Papers and to the OCCA Monograph No 3 1986 by E. V. Schmid on the Painting of Zinc Surfaces etc.

This book contains 334 pages and the chapters are headed:
Chapter 1. The Fundamentals; The weather; Macro/Micro.
Chapter 2. Deterioration of unprotected substrates.
Chapter 3. Part 2. The loss of the protective effect. Degradation of organic coatings by weathering.
Chapter 4. The loss of adhesion.
Chapter 5. Iron and steel surfaces.
Chapter 6. Coatings on metallic zinc surfaces and zinc-rich primers.
Chapter 7. The protection of light metals.
Chapter 8. Masonry paints.
Chapter 9. Exterior coatings for timber.
Chapter 10. Painting of PVC compounds.
Appendix: Colour photographs referred to in the text.

The author has fallen into the familiar trap of calling accelerated weathering apparatus weatherometers which is the well-known registered trade name of the "Weather-o-Meter" apparatus produced by the Weather-o-Meter Corporation. On page 199 the author refers to "Chlorinated polyvinyl chloride" when it appears that he is refering to actually chlorinated hydrocarbons e.g. chlorinated rubber.

Examples are given of paint formulations applied to various areas such as bridges, shipping etc., with corresponding photographs of the actual painted structures.

The book contains a large amount of useful information and would be a valuable asset to any paint laboratory.

An Introduction to Corrosion Control

by Technology Advance Experts
Colour Publications PVT Ltd, Bombay
Price $25 Hardback

This book is an inexpensive hardbacked book and has been printed by a photographic method.

The authors have attempted to cover most aspects of corrosion in a 165 page book. There are many obvious typographical errors due to proofing errors in the printing, for example, metallographic is often spelt incorrectly and technical errors such as "Zn02" when referring to "Zr02" in the corrosion of alloy steel containing Zirconium. There are also some novel descriptions of parts of ships such as "Tips of ships" when discussing cavitation corrosion at the bow of the ship (page 15).

Each of the 12 chapters have been written by Indian experts and their CV's are given in the appendix. The chapters discuss: 1. Forms of corrosion; 2. Corrosion failures;

3. Metallographic examination and microstructure of metal alloys; 4. pH, potential diagrams a basic exposition; 5. Polarization diagrams; 6. Protective coatings; 7. Alloying for corrosion resistance; 8. Surface modification; 9. Passivity and corrosion inhibition; 10. Electrochemical protection; 11. Analysis cost of corrosion; 12. Engineering of corrosion control measures.

There has been a useful attempt to cover nearly all the aspects of corrosion in one volume and this book would be a useful addition, especially in S. E. Asia for which the Technology Advance Centre (Regd) was set up in Madras to inform readers of the advances in the science and technology of corrosion.

J. R. Taylor ■

OCCA Meetings

Ontario Section

Narrow web water based inks

At the last technical meeting of the session on 17 May, Mr Christopher Shaw, Technical Sales Manager of J. F. Ink & Colour Ltd., discussed "Developments in Water Based Inks for Narrow Web".

Mr Shaw explained that while the Canadian narrow web ink market is worth about five million dollars in annual sales, it is widely fragmented and therefore requires a very high level of sales service and technical specialization. By way of example: one printer may have as many as five different presses, designed for different types of work and with running speeds varying from 20 to 200 metres per minute. The supplier to this market must be willing to make small quantities, sometimes of new products which may never be repeated, and must be able to turn around orders in zero to three days.

Quality control at every step is essential. One consideration is that the print runs tend to be short, and long run-ins for on-press adjustments are out of the question. Another is that a relatively minor variation at one stage can lead to a flood of problems downstream, since a single one-tonne batch of vehicle or colour base may be used in many different inks for dozens of different customers. Mr Shaw suggested that quality assurance can be enhanced by operating all the laboratory functions as a single integrated unit, incorporating product development, production quality control and customer technical service.

Raw materials, he stated, must match the needs of the process. For most label work, colourants must withstand 72 to 100 hours of machine exposure. Dispersions are preferred over dry pigments, because of their high strength and the factors of speed and convenience in production. Vehicles must provide adhesion, transfer, flexibility, gloss, solvent release and drying, and rewettability, as well as properties specific to each application (such as product resistance).

Concerning the use of water based inks in this market, Mr Shaw noted that virtually all narrow web shops traditionally have run solvent and most pressmen have had little or no experience with water. He believes that an extremely important part of his firm's responsibility is to help customers to make the conversion by training press operators, both on their own presses and at the ink plant.

Water based inks have been used on standard paper labels for some time, according to the speaker. However, the quality is being improved dramatically, especially in process colour, with the use of photopolymer plates and sharper-printing inks and with the progress that is being made in operator education.

The main development in the industry is the growing use of water inks on synthetic substrates, including polyethylene, polypropylene, styrene, Mylar and even vinyl. Often, new film and laminate systems are introduced and promoted for their packaging properties, with little consideration being given to their printability. Surface tension characteristics are most important. Mr Shaw suggested that treatment of the print surface is necessary; in-line treatment is ideal, but is not available in many shops. Dyne levels of 42 to 45 give the best results. Levels of 38 to 40 are manageable, but often require the addition of a primer or the use of an adhesion promoter in the ink.

The speaker gave the following as examples of water based narrow web applications or improvements that are very recent:

□ More resistant over-lacquers. Most consumer product and speciality labels are now UV coated, but catalyzed water systems are making inroads.

□ Improved fluorescents. New fluorescent "dye" dispersions produce flexo inks that are much stronger than the old pigmented types. They also have much better rheology and can be run at higher speeds.

□ Improved metallics. Although further improvements are being sought, new treated aluminium grades and new bronze powders are much more stable than their predecessors.

□ Phosphorescent inks for novelty applications.

□ Temperature indicator inks, containing temperature sensitive microcapsules.

As to the future, Mr Shaw suggested that UV water flexo inks are not very far down the road.

The speaker ably answered a number of questions from the floor. He then showed an excellent collection of printed samples, which convinced even the sceptics in the room of the very high quality of work that is now being produced with water based inks on narrow web flexo presses.

The acting Chairman (standing in for Mr. Pratt, who, we were led to believe, was away having a baby) thanked Mr Shaw for his fascinating presentation that clearly was based more on experience than on theory. He then presented the framed speaker's certificate, to a round of appreciative applause.

J. F. Ambury ■

News of Members

OCCA'S new President: Graham North

Our new President was educated at London University, where he gained a BSc with Honours in Chemistry, and subsequently attended the Harvard Business School, where he was awarded an MBA. Graham North has spent his entire business career with Cray Valley Products, occupying a variety of posts and is currently Managing Director. He is also director of the parent company Coates Lorilleux Ltd. He is a past Chairman of the British Resin Manufacturers' Association and has been Honorary Treasurer of the Paint Research Association.

Graham North is the author of technical papers on a number of subjects, including thixotropic resins, electrodepositions, radiation curing and ecological studies and has given lectures throughout Europe and North America.

Spectra appointment

N. L. Hester ATSC has been appointed Research and Development Manager at Spectra Brands Plc, Newquay (Part of the Burmah-Castrol Group). In his new position Mr. Hester will supervise research and development of car care products including aerosol paints and 'Simoniz' polishes.

Northern Sections

The McWilliam Golf Trophy

If last year's competition was played under exceptionally good conditions, this year's was certainly played under exceptionally bad ones. At least one golfing umbrella blew inside out and most competitors arrived back at the 19th soaked. However, the first half of the competition was relatively dry and some reasonably good scores were recorded. The course was in good condition and is very enjoyable to play.

This year the trophy was won marginally by the West Riding Section, the top scorer being Mike Wood for West Riding with 33 points. Other members of the team were Roger Wells and Philip Jones with 29 points each. The winning guest was Stuart McPherson with 27.

Top scorers of the Manchester team were Brian Lamb and Brian Falder with 30 points each and Walter Ollett with 29.

The day was rounded off with a welcome meal and presentation of prizes.

G. C. Alderson ■

Hull — Manchester — West Riding

West Riding "Roses" Games Evening

Tuesday 16 May, the Scotland Pub, Gomersal.
IT DIDN'T RAIN!
IT DIDN'T NEARLY RAIN!
(previous events were sub-aqua)

Our fourth West Riding vs Manchester games evening was a serious affair as W. Riding had lost the last two matches.

Manchester fielded a team of 24 against W. Riding's 14. Fortunately we'd invited Hull to join us and although only 3 turned up (probably due to the others not wanting to leave the flat lands for the rarified mountain atmosphere) we were very pleased to join them up. Manchester Section chairman, Norman Seymour was gracious enough to allow a couple of less committed Lancastrians to assist the Yorkshire team. I thought they looked a bit uncomfortable playing bowls left handed. One kept falling over but fortunately he wasn't badly concussed due to the cloth bag protecting his forehead. However, his mate soon picked him up, and even though their hobble ropes got a bit tangled, it only stopped play for a few minutes each time.

The scoring:
Bowls — Evens
Cribbage — Manchester
Dominoes — Evens
Handicap Connect 4 — W. Riding but we'd played our ace (ex Manchester member Pete Stanton — West Riding's new Social Secretary). He played a game of Liar Dice against 5 Manchester lads and won. (Cards please to Peter Stanton, Ward 21, Leeds General Infirmary).

Norman Seymour with full ceremony returned the Roses Shield but the occasion was somewhat marred by some completely unnecessary remarks about "the scoring, and it wasn't only the dice".

A superb buffet was served and then to cap it all a West Riding lad won the bottle of Scotch raffled on the buffet cicket number.

A great evening with a great "Section". I'm sure Manchester were pleased to attend. Hull members — remember for next year "Its down hill on the way home!"

R. Lewis ■

Newcastle Section

Golf Tournament

The Newcastle Section Golf Tournament was played at Wearside Golf Club on the 9th June.

The eighteen members and guests enjoyed ideal weather for their round, this being reflected in the scoring.

The winner of the B.T.P. Trophy for members of the Newcastle Section was Norman Norris with 38 points.

Norman Norris (left) receiving the B. T. P. Trophy from Newcastle Chairman, David Neal.

The winner of the trophy for visitors was Bill Jack with 39 points.

The Chairman of Newcastle Section, David Neal presented the trophies and thanked those companies who had donated prizes, he congratulated the winners of the two competitions both of whom were winning for the first time.

D. J. Neal ■

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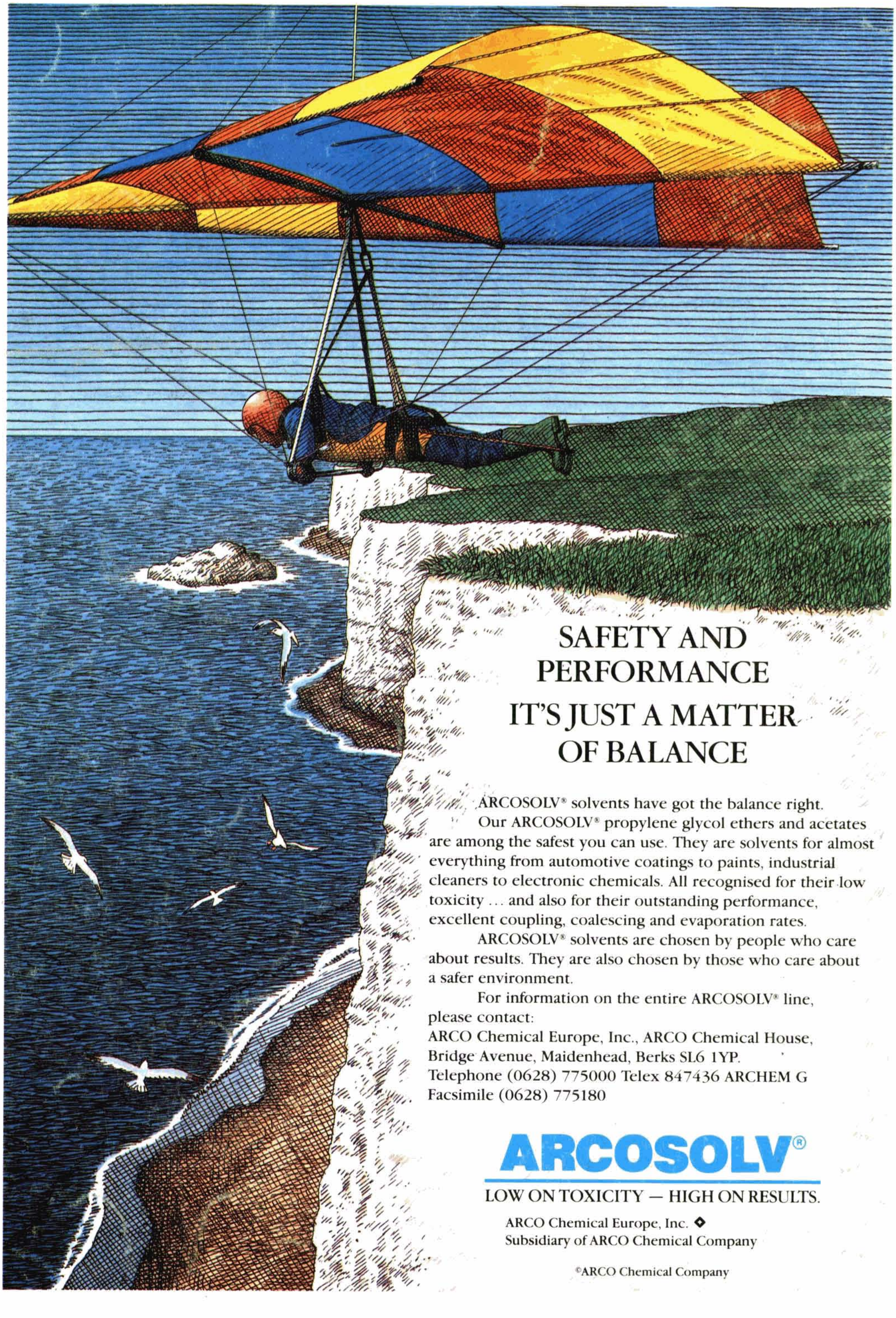

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