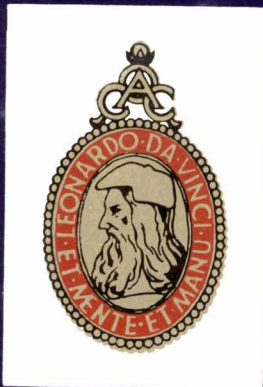


OCCA-34

27-29 April 1981
The Cunard
International Hotel,
London

*see pages 377-380 for details of
the forthcoming Annual
OCCA Exhibition*



J O C C A

JOURNAL^{***} OF THE IL & COLOUR CHEMISTS' ASSOCIATION

**PROFESSIONAL
GRADE**

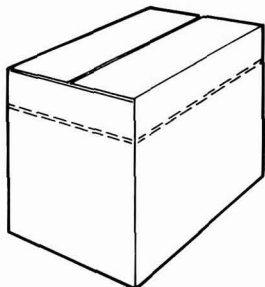
**Amended regulations
pages 382-384**

***** WINNER OF THE 1980 ABC REED INTERNATIONAL AWARD**

Alternative technologies in coatings – the challenge and the response	<i>L. Valentine</i>
Pigmented UV dual cure coatings	<i>A. Noomen</i>
Developments in aqueous powder systems	<i>A. G. North</i>
Modern practices in formulating powder coatings	<i>S. T. Harris</i>

CHEMPAK

The MODERN pack for powder and paste chemicals, and it's RECTANGULAR so there's no more wasted space.



- * Stacks flat when empty
- * Fits neatly onto standard pallets
- * Simple, safe opening
- * Specially treated to take toxic chemicals
- * Lower storage, handling and shipping costs

For further details contact:

**HILLWOOD Ltd, Friars House,
39-41 New Broad Street, London EC2M
phone 01-628-5988 telex 377885**

Reader Enquiry Service No. 103



ELEKTRO-PHYSIK are pleased to announce their appointment as UK distributors for Paint Testing Instruments manufactured by BYK-MALLINCKRODT of Wesel, West Germany.

For technical catalogues, please write or call:

ELEKTRO-PHYSIK

117 King Street, Knutsford,
Cheshire WA16 6EH. Tel: (0565) 51221



Reader Enquiry Service No. 125

Introducing new bright stainless-steel flake pigment.

Available in leafing and water grade

NOVAMET Fine and Standard Stainless-Steel flake pigments are available in both leafing (L) grade and a recently developed water (W) grade. The water grade is particularly useful as a replacement for aluminium pigment. NOVAMET's new, bright 316-L stainless-steel flake does not react with alkaline vehicles. This permits you to avoid generating hydrogen gas.

NOVAMET's water grade stainless-steel flake contains a special lubricant. A lubricant that will not saponify with the vehicles to reduce lustre in your finished coating.

The high specular reflectance combined with proven corrosion resistance makes NOVAMET's Stainless-steel Fine and Standard flake the ideal metallic pigment for decorative coatings and high-performance protective paints.

Get to know more about NOVAMET's new bright leafing and water grade stainless-steel flake pigments.

Typical Characteristics of NOVAMET Stainless Flake

Specular Reflectance (Rs)	>45%
Average Flake Thickness	~1.0 micron
Approximate Bulk Value	0.067 L/kg
Approximate Specific Gravity	3.68
Approximate Apparent Density	1.86 g/cc

**MPD Technology Ltd., Wiggin Street
Birmingham B16 0AJ, ENGLAND Telex 336626**

Reader Enquiry Service No. 130

So you think you're a genius!?



Here's the chance to prove it!!!

If you have exceptional ability and the drive to succeed, there's a challenge for you at International Paint. The fastest moving Paint organisation in the world, rapidly absorbing and exploiting new technology, is thriving in world recession, and looking for talent to man the next phase of expansion. And those talents are wanted right across the board—from

research chemists thru to production, marketing and sales. Specific degree discipline is not important. If you like world travel or employment overseas, welcome the adrenalin that comes from the pressure in an organisation that's quick on its feet, then exploit your genius at International Paint. For further details write to Edward Dowler at the address below.

Profile of International Paint
Sales 1980-81 Employees
£268,000,000 8,000

Profit before tax Pre-tax return on shareholders' funds
£23,400,000 26.9 per cent



**International
Paint**

Felling Gateshead
Tyne & Wear NE10 0JY
Telephone
0632 696111

40 factories in 22 countries

OIL & COLOUR CHEMISTS'



ASSOCIATION

Marine Finishes

Reprints are now available of the OCCA Monograph number 1 on Marine Finishes by Dr T. A. Banfield from the Association's offices. These bound copies reprinted from the February and March issues of the *Journal* cost £2 including post and packaging.

CHLORINATED POLYPROPYLENE
&
CHLORINATED POLYETHYLENE



It'll help you
in formulating
**High build chlorinated
rubber-type paints** for
Ships, Tanks, Bridges,
and other steel works,
with outstanding
exterior durability,
storage stability and
airless sprayability.

Try Superchlon for
your formulations.

For detailed information, please
contact:



Sanyo-Kokusaku Pulp Co.,Ltd.

CHEMICALS SALES DEPT.

1-4-5 Marunouchi, Chiyoda-ku, Tokyo, Japan

Telex: J24279 SKPULP

Cable: SANKOKUPA TOKYO



THINKING COLOUR ? THINK DOMINION COLOUR



DOMINION COLOUR COMPANY LIMITED



A REED INTERNATIONAL COMPANY

NL Chemicals (UK) Ltd
St Ann's House, Wilmslow, Cheshire, SK9 1HG
Tel: (0625) 529511
Telex: 669055



INSTRUMENTS TEST

- ABRASION ✓
- CORROSION ✓
- DEFORMATION ✓
- DRYING TIME ✓
- FINENESS OF GRIND ✓
- GLOSS ✓
- HARDNESS ✓
- IMPACT RESISTANCE ✓
- OPACITY ✓
- VISCOSITY $\frac{10}{10}$ ✓

Consult us - we manufacture them!

SHEEN INSTRUMENTS LIMITED

Sheendale Road, Richmond, Surrey, England, TW9 2JL
Telephone 01-940 0233 and 1717 Telex: 929476 APEX G



JOURNAL of the OIL AND COLOUR CHEMISTS' ASSOCIATION

Hon. Editor: D. S. Newton, AMCT,
CGIA, FICorrT, FIMF, FTSC

Contents

Vol. 64 No. 9

September 1981

Publications Committee:

J. Ambury
T. A. Banfield, PhD, DIC, ARCS,
FInst.CorrT, FTSC
H. I. Bosman, BComm, FTSC
J. Bourne, FTSC
B. A. Canterford, ATSC
J. H. Coy, BA, PhD
T. Entwistle, CChem, FRSC, FTSC
A. W. Fell, BSc, AMCT, ATSC
C. N. Finlay, ATSC
S. R. Finn, BSc, CChem, FRSC, FTSC
H. R. Hamburg, PhD, FTSC
T. Harbottle
T. J. S. Henning
S. Heyes, BSc
A. MacDonald, ATSC
N. McInerney
D. V. Maltman
D. J. Morris
B. E. Myatt
T. W. Slinn, BSc, FTSC
F. M. Smith, BSc, PhD, CChem, FRSC,
CCol, FSDC, MIOP, FTSC
J. R. Taylor, BSc, CChem, FRSC, FTSC
E. G. Warman, FDISA
F. B. Windsor, ATSC

Editorial correspondence should be
addressed to the Hon. Editor, JOCCA,
Oil and Colour Chemists' Association
at the address below.

General correspondence should be
addressed to:

R. H. Hamblin, MA, FCIS,
Director and Secretary,
Oil and Colour Chemists' Association
at the address below.

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

Assistant Editor: D. N. Buddles, BSc

Annual subscription to non-members:
£45.00 (\$100), post free by surface mail,
payable in advance.

Single copies £4.00 (\$10), post free by
surface mail, payable in advance.

© Copyright 1981



Transactions and Communications

Alternative technologies in coatings – the challenge and the response	337
<i>L. Valentine</i>	
Pigmented UV dual cure coatings	347
<i>A. Noomen</i>	
Developments in aqueous powder systems	355
<i>A. G. North</i>	
Modern practices in formulating powder coatings	364
<i>S. T. Harris</i>	
News	374
OCCA News	377
New members	385
OCCA Diary	385

OIL AND COLOUR CHEMISTS' ASSOCIATION
Priory House, 967 Harrow Road, Wembley, Middlesex, HA0 2SF England

The Honorary Editor, the Council and the Oil and Colour Chemists' Association do not accept responsibility for opinions expressed by correspondents or contributors to this Journal. The contents of the Journal are copyright and permission to reproduce Transactions and Communications, in full or in part, must first be obtained from the Honorary Editor

Is there no end to the versatility of SASOLWAX?

Could it be just what you're looking for?
Sasolwax is produced from coal-derived oil which
gives it unique properties.

A pure synthetic hydrocarbon with high melting
point and sharp setting characteristics, it is used
extensively in printing inks, plastics, paints, hot
melt adhesives and many other areas.

For more information, post the coupon today to
Dussek Campbell, sole distributors for
Sasolwax in the UK.

Reader Enquiry Service No. 124

Please send me more information on Sasolwax.
I am particularly interested in its application for _____

Name _____

Position _____

Company _____

Address _____

Tel: _____

I would like a rep. to call YES/NO
I would like a free sample YES/NO



Dussek Campbell Limited
A Burmah Company

Thames Road, Crayford, Kent DA14 0J
Tel: Crayford 526966
Telegrams & Cables: Dussek Dartford
Telex: London 896135

Alternative technologies in coatings – the challenge and the response*

By **L. Valentine**

Berger, Jenson & Nicholson Ltd, Berger House, Berkeley Square, London W1X 6NB, England

Keywords

Miscellaneous terms

application
development
energy requirement
formulation
health and safety
raw material cost

Properties, characteristics and conditions primarily associated with

coatings during application

application characteristics

There is an ancient Chinese toast to one's enemies: "may you live in interesting times". For those of us in the coatings industries, it certainly seems as if someone had that toast in mind in the last five years, and almost certainly for the decade ahead.

In searching for a suitable theme for this keynote address, historical analogies seemed most appropriate. Those of you who have a historical or philosophical bent will be aware of the late Sir Arnold Toynbee's *magnum opus* – "A Study of History"¹ – and his theme of challenge and response. From a comparative study of over twenty great civilisations of the past, Toynbee deduced that the really determining quality in deciding whether a civilisation developed or not was the quality of its response to the challenges it faced – whether these be geographical, climatic or human. Challenge-and-response became the simple – if controversial – model to which Toynbee was able to fit the growth and decay of all major civilisations. Challenge-and-response must be differentiated from cause and effect.

"The effect of a cause is inevitable, invariable, and predictable. But the initiative that is taken by one or other of the live parties to an encounter is not a cause, it is a challenge. Its consequence is not an effect; it is a response. Unlike the effect of a cause, the response to a challenge is not predetermined, is not necessarily uniform in all cases and is therefore intrinsically unpredictable."²

Here is one simple example of Toynbee's thesis. The climatic conditions of a country change drastically and perpetual drought sets in over wide areas – that is the challenge. The response may be widely different, from adoption of a nomadic lifestyle, to the invention of artesian wells and irrigation, or war on a neighbour.

It is important in understanding Toynbee's thesis to appreciate that a harsh environment is not inimical to civilisation, but rather the contrary, as ancient Hellas and especially Athens showed.

Similarly penalisation by human causes, such as that inflicted on various classes, religions or races at various times, may cause a response to the challenge by developing exceptional proficiency in the areas of trade or profession left to those penalised.

And to give a final technological example of the probable stimulus of external challenge, it is arguable – but was not so argued by Toynbee – that the growth of industrial revolution in Britain came from the earlier depletion of natural forests, necessitating an alternative source of energy – coal and thus to coke, steam, iron and the whole industrial revolution.

Now what does this historical analogy have to do with the Conference – "Alternative Technologies?" : everything, I suggest. Just as Babylonian, Attic, or Egyptian civilisations developed as a result of responses to challenges, so have various paint technologies arisen as responses to challenges. We have had a boiled-oil technology, which can be equated to a civilisation, and have evolved to alkyd, nitrocellulose, low solids acrylic technologies or civilisations, and so on. The Nitrocellulose civilisation arose originally to meet the challenge of what to do with the surplus aircraft dope no longer needed after World War I, and by happenstance or otherwise was available to solve the problems (the challenges) of fast drying caused by Mr Ford and his mass production assembly lines.

The Conference is considering a wide variety of new "sub-civilisations" – powder dispersions, radiation curing and so on, each of which is one response to a certain set of challenges peculiar to our particular point in history, and only history will tell which emerge to become important paint civilisations.

There is not sufficient time to develop fully the thesis that paint technologies are fully analogous to civilisations but I invite you to ponder on this theme and see if you do not agree that each sub-technology has arisen in response

*The keynote address presented at the Association's Conference held at Bath, 17-20 June 1981

to some specific challenge, and has an evolution parallel to that of a whole civilisation.

Accepting this analogy as a basis for a survey of alternative technologies in coatings, what exactly are the current challenges and what are, or should be, the responses? First of all, there is certainly no shortage of challenges – economic pressures, retailing revolutions, escalating raw material prices, shortages of raw materials, energy prices, legislation on pollution, health and safety, to name only the most important. It is just as well that we have the comfort of Toynbee's conclusion that a harsh environment is not inimical to civilisation but rather the contrary; we can surely confidently predict that the unprecedented number of challenges will lead to the finest flowering of new technologies (civilisations) that the coatings industry has ever seen.

“Bliss was it in that dawn to be alive,
But to be young was very heaven.”

As technologists, we must see to it that we are young in heart to enjoy the bliss which is sometimes hard to realise amidst the day-to-day pressures!

Let us now examine some of these challenges, and our responses, in more detail.

Economic challenges

Refs. 3-5

Most of the delegates to this Conference are European, and Western Europe has seen a dramatic fall in the rate of economic growth over the last five years or so – after the “oil shock” of 1973. The data in Table 1 highlight this clearly.

Table 1
Growth of output and trade³
(% p.a. in constant prices)

	1968-73	1973-79
OECD total trade	9.0	4.6
OECD trade in manufactures	10.6	5.2
Gross domestic product		
OECD (Europe)	4.6	2.4
UK	3.1	1.5
Germany	4.8	2.4
France	5.8	3.1
Japan	9.3	4.4
USA	3.1	3.0

The rate of growth of trade or of GDP has virtually halved since 1973 and since paint consumption is normally almost directly proportional to the GDP, the implications for the coatings business are clear.

Table 2 shows the production of paint in the major areas, and the growth rates from 1970-1978.

Table 2
Production of paint (million tons)

	1970	1978	Growth rate (% p.a.)
W Europe	4.3	5.1	2.4
N America	4.1	5.1	2.9
Comecon	3.3	4.6	4.1
Asia	1.5	2.3	5.3
Latin America	0.4	1.2	13.9
Africa	0.2	0.4	9.1
Australasia	0.2	0.3	3.6
Total	14.0	19.0	3.9

The growth³ of world output and trade over the next five years is likely to be even more restricted than it has been since 1973. As Lord Kearnton⁴ has put it, “The golden post-war age is truly dead and gone”. He highlights the contrast between the past and the future as follows:

“In retrospect, the period 1946-1973 was a golden age. It was a time when economically everything was propitious – for the OECD countries, for the Comecon block, for the newly industrialising countries, and at a lower level, for the less developed countries. The world experienced the biggest surge forward in prosperity in its history. Wealth creation was spectacular.”

But for the future he predicts:

“Just as cheap oil getting cheaper accelerated world growth, dear oil getting dearer can only act as a brake. The virtuous upward spiral is changing into a vicious downward one.”

If of course you are a paint maker in Brazil, Taiwan or Korea, for example, you can look forward to continuing high growth rates in GDP and paint manufacture – though you may have other problems – but for western countries as a whole the message is clear.

Growth is no longer something to come automatically, for countries or for companies. It is something that will have to be created and fought for. Another leading industrialist, Sir Alastair Pilkington,⁵ has put it very well: “For a company to survive it must cope with the future. For a company to prosper, it must create the future”.

In a growth economy, life is relatively easy, for the efficient and inefficient alike. But in a no-growth economy – a euphemistic way of describing present-day Britain – efficiency in manufacturing, in formulation and in marketing is of paramount importance. The paper by Mr Camina* from the Paint Research Association on automation will therefore be a very timely help to many companies considering how to improve their manufacturing efficiency.

A low growth or no-growth economy also leads to fiercer competition for what remains, and leads to other industries seeking to establish new markets in areas traditionally reserved to surface coatings. The section of

*Scheduled for publication in the December 1981 issue of *JOCCA*

the Conference devoted to "Alternatives to coating*" is a particularly timely reminder of this challenge, and the discussion here should produce some interesting responses!

Incidentally, the nice use of prepositions – "Alternatives in..." and "Alternatives to..." – reminds one of the necessity to get prepositions correct. There is the famous story of the lexicographer who ordered figs and cream. The waitress brought a dish of figs swimming in cream but the customer refused, saying that he wanted figs and cream, not figs with cream. When the waitress asked what was the difference, the lexicographer replied "madam, would you say that a woman and child was the same as a woman with child?"

However, without wishing to be complacent, the demise of the paint industry through the growth of substances that never need painting has been predicted frequently, with the patient showing himself healthier than the paramedic predictor, and paint remains an immensely flexible and efficient way of concentrating durable and protective polymers and pigments where they are most needed – at the surface. Provided the paint industry continues to improve the efficiency of its products – and their methods of application – there must be grounds for optimism that this particular challenge will meet an adequate response.

Energy challenges

Refs. 5, 6

There are numerous other economic challenges confronting the industry, but let us consider a few points now concerning energy – clearly one of the major challenges for mankind of the decade or indeed until such time as cost-effective substitutes for oil and gas are developed.

The subject is immense and there have been several articles comparing the energy requirements of one method of making paint compared with another, or of one method of curing paint compared with another, or of one technology compared with another, such as high solids versus water thinned paints. Important as are these questions, are we asking ourselves the right questions? Should we be starting from here?

Consider first of all, energy usage in paint manufacture – the total energy requirements of a company, not just the energy used in the dispersion stage or in resin-making. A very interesting survey carried out by the TNO⁶ in the Netherlands paint industry has shown that only 20 per cent of the total energy bill of the Dutch paint industry goes in dispersion, blending and mixing processes, virtually all the remainder going on space heating and lighting.

A similar survey by Berger in the UK showed that only 14 per cent of the total energy bill was directly related to paint manufacturing processes (excluding resin manufacture), with 86 per cent going on space heating and other environmental uses. Even if resin manufacture is included, the proportion of energy required for manufacturing processes is only 25 per cent, showing clearly that really large savings in energy will come from insulation and other changes in environmental control, rather than from changes in paint making processes.

Similar thoughts apply to the curing of coatings, especially in the important area of metal finishing. Various figures result depending on the precise assumptions made on temperature, insulation, metal weight, pretreatments and so on, but the following figures – a composite from various sources – would probably be accepted as being in the correct ball-park.

Table 3
Energy usage in paint curing

State	% energy used
Cleaning and phosphating	44-55
Dry off and paint spray	15-20
Stoving	25-35

Whilst nearly all the published debate and polemic is about the relative advantages of one paint system or curing method over another, it is really the cleaning and pretreatment processes which are the largest energy users by far, and which arguably should be the major target for research in energy reduction.

The paint industry will clearly need to continue its efforts to reduce the energy requirements of its products, and in this direction electrocoating and radiation curing are attractive low energy cost systems. Furthermore, much more will need to be done to devise total systems that will minimise the need for separate baking schedules.

In certain types of oven, water thinned coatings are particularly energy-advantageous, where otherwise large volumes of organic solvents would be involved, such as can coatings. It is probable that for two-piece cans at least, nearly all internal lacquers will be water thinned in the near future, the economics of curing being one important advantage.

Another challenge relating to energy arises from the "energy content" or "energy equivalent" of raw materials. The TNO⁶ have again made some interesting calculations on the total energy equivalent of the raw materials used by the Dutch paint industry.

Table 4
Energy equivalents of raw materials for the Dutch paint industry

Class	Energy ($\times 10^{-12}$ joule)
Solvents	4,600
Binders and plasticizers	5,700
Pigments	8,400
Extenders	500
Additives	2,100
Total	21,000

Whilst solvents are the obvious challenge and account

*Scheduled for publication in the November 1981 issue of *JOCCA*

for 20 per cent of the total energy equivalent, and in a sense are wasted once the paint is applied, pigments are the dominant class in terms of energy equivalents. Since energy has to be paid for directly or indirectly, clearly anything that will reduce the usage of pigments will have a particularly beneficial result – to the paint maker, if not to the pigment maker. In this regard, the paper by Dr Ramig* on plastic pigments is particularly interesting, in the further information it reveals on how to build cost-effective microvoids into paint films.

Raw material challenges

The need to conserve raw materials, especially solvents, and ensure efficient paint formulations is obvious and need not be stressed here. What is less obvious, or at least is less often talked about, is the need to improve the efficiency of utilisation of raw materials, by making sure that they are all used on the surfaces to be coated, and do not finish up as waste materials in overspray etc. which, as well as being wasteful, are also extremely costly to handle in waste disposal. In other words, much more attention needs to be paid to the efficiency of paint application, and this is the single most effective factor that can be manipulated to increase the efficiency of usage of scarce raw materials.

It may hurt us as paint manufacturers to develop and recommend processes that will reduce the volume of paint required, but this is the only rational course to follow. Improved electrostatic spray processes, electrodeposition, closed-loop water-booths are all examples of techniques that are making significant contributions, but much more needs to be done. The paint industry – and the paint using industries – have got off with murder in the past in the inefficiency of painting processes, but with the high cost of petrochemicals this is no longer acceptable. The future lies in efficient paint application systems, and it is disappointing to see that there is not a single paper at this Conference devoted to the technology of paint application, and this has often happened in past conferences too. Paint manufacturers, raw material suppliers and engineering companies must work together to develop improved total systems of painting.

As to the raw materials themselves, petrochemicals will clearly need to be the main source for many years, but increasing attention will need to be paid to renewable sources of chemicals. This may take the form of biomass as a prime source of organic chemicals, or natural polymers such as cellulose or starch. It is interesting that a country like Brazil, which already has a considerable production and usage of alcohol as a substitute for petrol, is now at an advanced stage of a programme to substitute natural oils for diesel oil.

The responses of chemists to the challenges of scarcity and price of petrochemicals should provide one of the more interesting chapters of the history of the remainder of this century.

The challenges of legislation

Ref. 7

Until about ten years ago, legislative controls on paint formulation practices were largely restricted to lead and nitro-cellulose. In almost all other regards, the paint for-

mulator was free to choose the most cost-effective formulation that met the end-use specification. Now every paint formulator has someone leaning over his shoulder, giving guidance (sometimes clear, sometimes opaque) on how much of which raw material he can use: that someone is, of course, a Government department or agency connected with health & safety or the environment.

For the hapless technologist engaged in developing new products, there is the additional hazard of charting his way through the jungle of jargon. As an example, in the USA, each state must have its own SIP (State Implementation Plan) to ensure it meets the EPA's (Environmental Protection Agency) NAAQS (Natural Ambient Air Quality Standard). Each SIP must control the VOC (Volatile Organic Compounds) using RACT (Readily Available Control Technology), and the EPA has issued a CTG (Control Technique Guideline) for eight separate painting operations or industries describing the RACT!

These new legislative challenges are amongst the most demanding and time consuming that the coatings industry has to face in its search to find new alternative technologies that will meet the other challenges of the eighties. The task is not eased by the fact that different countries have established different criteria, often leading to diametrically opposite answers from the paint industry. Kwakman⁷ highlighted the dilemma well in relation to high solids coatings. Under current West German and Swedish legislation, the use of high solids coatings does not reduce the concentration of vapours sufficiently in the workplace, and so incinerators (after-burners) are usually still needed even with high solids coatings, producing no incentive to change. But in the United States, the legislation is such that high solids coatings would be acceptable for many types of industrial finishing.

It is unfortunate that such national restrictions will limit the widespread availability of many new technologies and, for any company involved in multinational operations, lead to considerable reduction in efficiency and higher R & D costs.

The response of the paint industry to this legislative challenge must be one of unremitting educative effort, to ensure that "reasonably practicable" are the operative words in any legislation or regulations.

Alternative technologies – industrial paints

Refs. 8-10

It is in industrial paints that the ferment of ideas on how best to meet the challenges of our age is most active.

Economic pressures, raw material prices and scarcity, and especially environmental aspects and legislation have caused an unprecedented burst of activity. Over the last decade or so, each of the "new" technologies has been paraded in turn, each forecast to become a major or even dominant force, as shown in Table 5.

Many of these will be dealt with in this conference, and I do not want to prejudge the discussion on individual topics. Each one, as a paint civilisation, has its strong features favouring growth, and each one has its problems which should respond to further research and development.

*Scheduled for publication in the December 1981 issue of *JOCCA*

Table 5

Electrodeposition
Electrostatic powders
UV and EBC
Water soluble paints
NADS
Emulsion paints
High solids paints
Autophoretic coatings
Aqueous powder dispersions
Electro-powder coatings

The "industrial paint industry" is really a misnomer; it is not *an* industry, but a whole collection of separate industries, some having related technologies, and some having technologies quite specific to themselves. There seems no reason why this should change in the future and therefore my own forecast is that the wide spectrum of end uses represented by industrial finishes will continue to need a wide spectrum of technologies to meet the very wide spectrum of end properties and specifications.

Just as no single chemical type of coating has met all requirements in the past – alkyd, nitrocellulose, acrylic, polyurethane and so on – so no single type of technology characterised by physical type (water thinned, high solids etc.), or curing method or application method dominates the scene. Above all others, the industrial paint business is one characterised by "horses for courses". Each customer or group of customers poses his own peculiar set of challenges that are important to him, and to which we must provide the optimum responses.

Furthermore, the more we learn about industrial paint technologies, whether classified by chemical type or application process, the more we realise that optimum results are often achieved by blending or combining two or more chemicals or processes.

Just as we have learned to blend melamines and alkyds, or vinyls and coal tar, or epoxies and polyesters, so are we just starting to realise the advantages of blending various processes. It is in this area that I forecast one of the most interesting areas of development. Already we see two civilisations – in the form of powder coatings and water thinned coatings – combined in the form of aqueous powder dispersions, as illustrated by the paper by Mr North* at this conference, and the early work by Grow⁸ and later by Ciba-Geigy⁹. No sooner had cationic electrocoat become established as an alternative to anodic electrocoat than it was combined with aqueous powder dispersions to form the EPC or electro-powder coating system¹⁰: three new technologies combined into one.

It is quite possible to have other combinations of these new technologies; radiation curing combined with electrodeposition, emulsion paints with water soluble paints, and so on. Add to this mix of technologies the potentially wide range of chemical types and one can envisage an extremely wide range of possibilities for improved coatings.

And then there is the matter of improved systems

already mentioned in the sections on energy; reverse or inverse processes allied to improved individual coatings may lead to substantial overall improvements in the total costs and performance of a protective system. In this regard, EPC offers a particularly attractive route towards an automated, efficient, low cost protective system, provided certain disadvantages can be eliminated.

If I had to make a forecast for the ten new industrial paint technologies itemised in Table 5, it would be that nine of the ten will grow over the next 5-10 years to varying extents in various end-uses and countries, each one filling some particular set of attributes valued by a group of customers.

The implications are clear; a still more diversified paint industry, offering a still wider spectrum of products, since it is unlikely that any of the existing "low solids organic solvent" technologies will die. This in turn will pose a serious challenge to managements of companies in determining their correct product strategies, but twenty years in the paint business have led me to conclude that nothing ever dies, and it can take a bloody long time simply to fade away!

Alternative technologies – decorative paints

Refs. 11-14

Compared with the ferment of new technologies in industrial paints, there has been apparently less activity in decorative paints. In view of the dominant position decorative paints have in most countries, normally 50-80 per cent depending on the degree of industrialisation, this is surprising, although perhaps a measure of the difficulty of making major improvements to well established products.

There has certainly been no dearth of challenges to the decorative paint business, which according to the theme of this paper should have produced major responses. We have had the overall economic challenges of escalating raw material prices, the retailing revolution with the demise of thousands of small retailers and the growth of multiples and specialist DIY shops, and a steadily increasing proportion of people ready, willing and skilled to undertake tasks normally left to the professional only a generation or so ago.

Yet since the introduction of emulsion paints – in Britain just after the Second World War, earlier in Germany – there has been little dramatic change, but a steady programme of improvement, leading to the dominance of emulsion paints for painting interior walls in some countries, e.g. UK and Scandinavia, and of painting outside walls in other countries, e.g. USA and New Zealand. During the last 30 years, the complex physico-chemical properties of the aqueous phase of emulsion paints have gradually been mastered, usually largely empirically. This mastery has shown itself in modest improvements in quality or, more usually, in reductions in the raw material costs; in the last seven years, following the escalating raw material prices of the "oil shock", the trend to reduction in formulation costs has been paramount. Apart from conventional techniques in cost reduction, there have been two valiant efforts involving high technological input, namely the pioneering efforts of PPG¹¹ in America to develop microvoids, normally by

*See page 355 in this issue

dispersing organic solvents as microvoid precursors, and of Glidden¹² more recently using the plastic pigment approach to develop microvoids without loss of other paint properties. Past PPG work has been extensively documented and need not be elaborated here; I should like to express a personal tribute however to the late Howard Gerhart who drove on this intriguing concept. We shall be hearing more at this Conference on the plastic pigment approach in the paper by Dr Ramig*, and will all surely hope that the concept is as useful as it is interesting.

Similarly in solvent based decorative paints, the last 30 years has seen only one major change – thixotropic paints – and better exterior masonry paints.

In terms of new product development, the only lasting major innovation has been the introduction of easy clean emulsion silk finishes, normally referred to as vinyl silks in the UK, and in some countries the acceptance of emulsion gloss paints. Such aqueous gloss paints have not proved acceptable in the UK however, despite vigorous promotions by all major manufacturers, and the goal of a water based gloss paint that is truly a replacement for an alkyd gloss paint remains as much a challenge now as it has done for the past quarter century.

Additionally, one must recognise the development of ranges of heavily textured emulsion based finishes of various kinds, whether “Putz” in Germany or “relief effects” in the UK. Such additions to the range of decorative effects are to be welcomed as being likely to extend the degree of customer satisfaction by offering a wider range of appearances.

But on any absolute scale of innovation, if one could be devised, the efforts of the decorative paint industry have been relatively muted compared with innovations in industrial paints. As one marketing director has recently said¹³ “The cost in using our product is not the product itself. It is the cost of application. . . We have to find ways and means of using our product in such a way as to minimise not the cost of our product, but the cost of using it. Today that means to spend more money on innovative research. . .”

My own company reached exactly the same conclusion and has recently launched a new paint and a new painting system, which we believe will offer the consumer something really different and better. I refer to the revolutionary new painting system “Paintmate”¹⁴ jointly developed by Black & Decker and Berger. Our starting point was that there simply had to be a better way of applying paint than the process which had evolved over millennia, but which was inevitably a compromise.

A paint brush, for example, has to be a reservoir for paint, a device for transferring paint from a can to the surface to be painted, and an application device. Suppose we could separate the roles, and transfer the paint to the brush at just the right rate, and let the user and the brush concentrate on getting the application correct. And the same applies for a roller or pad; would there not be benefits in separating the roles of reservoir and applicator?

Even the paint container itself is a rather primitive device which has not changed significantly for a long time. It is difficult to open, difficult to reseal after use, and easy to spill once opened. Suppose we had a system which

transferred the paint from a container directly to the applicator, without the consumer having to open the lid?

Impossible? No, just difficult! Through the combination of a special plastic tub as paint container, a novel and ingenious system of using CO₂ soda-syphon bulbs as a source of pressure, a special outer paint “pressure pot” and a tube feeding the paint to a variety of applicator heads (roller, pad and brush), we have a system whereby the paint user never need take the lid off a paint can (but simply take a small plug out of the paint tub) and never sees the wet paint until it appears, at just the correct flow rate, on the applicator head (Figure 1.).

Because the flow of paint can be accurately controlled by the user, and because the paint is delivered from “inside” the brush, roller or pad, it is possible to considerably reduce or even eliminate splashing in application, and because there is no tiresome dipping of brush or roller into a paint can or tray, the whole painting process is eased, and made quicker, easier, and cleaner (QEC, QED!).

The system has only recently been introduced, but both companies believe that their joint development has created a painting system that will take much of the tedium out of painting, and stimulate a greater readiness to repaint. After all, practically every other job about the house, from cleaning ones teeth in the morning to slicing bread, drilling holes, cutting the grass or hedge, or cleaning carpets, has been mechanised and made labour-saving in some simple and universally accepted way.

Isn't it time that painting moved away from the techniques first developed by Cro-Magnon man 30,000 years ago, and moved into the 20th century?

Finale

What then is the keynote to be extracted from all the background music and noise as we enter the 1980s – and this Conference? I suggest it is the note identified by Toynbee as characterising whole civilisations – that of challenge and response. The coatings industry has faced many challenges in the past and will produce – *must* produce – adequate responses to those challenges facing it today.

Having begun this lecture with a concept from the broad sweep of history, let me end with another historical perspective. Let us consider the time scale over which paint has evolved. In the long dark years since *Homo habilis* – the tool user – fashioned his first hand tool, 3 million years or 100,000 generations have passed. 99,000 generations of man were to pass before we find any evidence of paint: in the Cro-Magnon paintings of Lascaux and elsewhere some 30,000 years ago. In the 1,000 generations since then, we can note the development of simple paints contemporary with urban life some 300 generations ago, but oil paints were developed only 20 generations ago, and the first man-made binders only 2-3 generations ago, as shown in Table 5. Since then, there has been a spate of developments, still accelerating as this Conference illustrates. Against that background, the sheer immense inventiveness of modern man shows in true perspective, and leaves me at least in no doubt that every challenge will meet an adequate response from the coatings industry.

*Scheduled for publication in the December 1981 issue of *JOCCA*

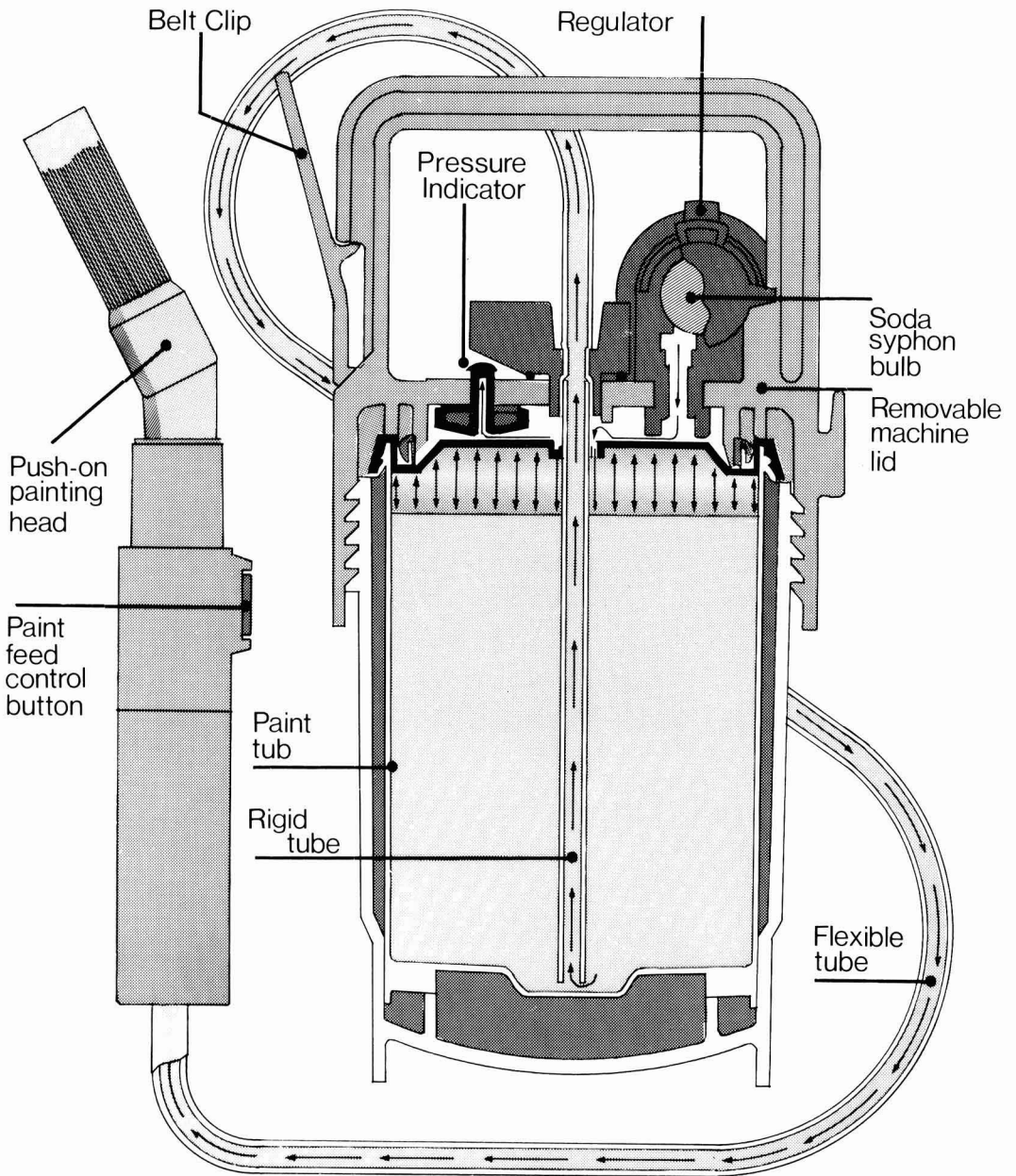


Figure 1. Paintmate

To help our industry provide adequate responses, I offer three quotations to serve as guides. The first – somewhat improbably you may think – is from President Lyndon B. Johnson who in 1973 said: “The fire of progress is lit by inspirations, fuelled by information and sustained by hope and hard work”.

Oscar Wilde, inevitably, summed it up ineffably in his

Table 6
The ascent of man

Generations (30 years ago) (log scale)	
1	Emulsion paints
2	Man-made binders/resins
20	Oil paints
170	Bronze
200	Wheel
300	Weaving
330	Urban civilisation, simple paints
400	Bow and arrow, pottery
1,000	Cro-Magnon, First recorded use of paint
3,300	Neanderthal man
10,000	Man-made shelters
25,000	Use of fire
40,000	<i>Homo erectus</i>
100,000	<i>Homo habilis</i> – man the toolmaker/user

Discussion at Bath Conference

DR F. M. SMITH: Some technologies disappear altogether such as mechanical calculating machines and commercial horse drawn vehicles, some take a minor role but survive or continue in a modified form. The question for the paint industry is whether it can continue, in a modified form, or will it be replaced, and if it survives will there be a smaller number of more innovative companies?

DR L. VALENTINE: *I would think this is so; if you look at the history of individual companies – some continue to succeed, some go into decline and some grow very rapidly. There are still some growing very rapidly in Britain, so I think it is Pilkington's remark: "for a company to prosper it must create the future", that is the most important of the numerous quotations I gave, and I honestly believe that someone somewhere has got to create new and better ways of doing things otherwise we will be in bad trouble in the paint industry.*

DR G. de W. ANDERSON: Dr Valentine distinguished between those responses which are a mere reaction to legislative or economic pressures and the less frequent but important company responses which can make the future. I just wonder about some of the very big changes that might happen, for instance, in the conventional paint industry, inorganic coatings which might give products which would have a 50 year lifetime, could existing companies cope in pricing them correctly and so forth. Again, to expand a shrinking industry some new functional coat-

definition of a grapefruit – “a lemon that had a chance and took advantage of it”.

The coatings industry must see that all its lemons turn into grapefruit! – or the future will be a lemon!

But the last word, inevitably, must go to the Greeks. Plato it was who said: “What is honoured in a country will be created there”. Unless our society – and our companies – truly honour inventiveness, we may yet falter at the final challenge and fail to find the correct response. My hope is that due honour will be paid to inventiveness and that our future will be secure.

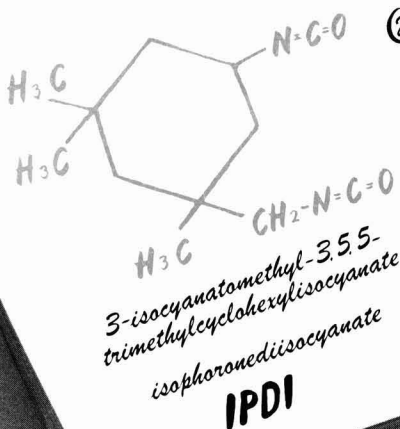
[Received 18 June 1981]

References

1. Toynbee, Sir A., “A Study of History”, *Oxford University Press with Thames and Hudson*, London, 1977.
2. *ibid.*, p. 97, col. 1.
3. NEDO, “Industrial Trends and Prospects”, *Annex NEDC*, 1981, (81) 6.
4. Kearton, The Lord, 10.12.1980, *The Guardian*, p. 16.
5. Pilkington, Sir Alistair, 11.7.1980, *The Guardian*.
6. Paint Letter, summer 1980, *Paint Research Institute TNO*, Delft.
7. Kwakman, L., *PPCJ*, European Supplement, 1 Oct., 1980, p. 42.
8. British Pat. GB 1390265, GB 1433286.
9. *Paint Manuf.*, July/August, 1980, pp. 14-18.
10. British Pat. GB 1407410.
11. Seiner, J. A. and Gerhart, H. L., 1973, *Ind.Eng.Chem. rod Res. Develop.*, 12 (2), pp. 98-109.
12. British Pat. GB 1,516,802.
13. Fearnley, G., *PRA Fourth International Conference*, London, 1980.
14. UK and foreign Patents Pending.

ings, for instance, electroluminescent coatings to take a bigger share of the decorative and building market but which would require the acquisition of electronic technology; or perhaps coatings with other forms of electric effect, paint coatings which would produce ambient lighting or cause electrolysis of water to give hydrogen which is a nice clean fuel, all of which would have great value to Society. Coming back to the original theme, I wonder about the present generation of paint companies and their ability, not just to create such opportunities but to cash in on them as business opportunities. I wonder Dr Valentine, have you any comment on the ability of, shall we say, the majority of present paint companies to cope with such opportunities and if they can't cope, what changes have we got to make in the attitudes of management, employees and indeed shareholders to enable the paint industry to continue to serve society.

DR L. VALENTINE: *I think a number of paint companies are part of major chemical groupings these days and in a sense have access to wider resources than their own to back up future developments of the scale and the degree of technical complexity you are mentioning, but even paint companies on their own can and have gone into quite advanced related technologies. In Japan there are one or two paint companies that are in the specialised pigment area or have gone into liquid crystals and I think that at least any largish paint company has intrinsically got the degree of technical competence and ability to do these things, whether they will or not is another matter.*



- ① Solvent-based polyisocyanates for conventional and high-solids, two-component paints and lacquers.
- ② Solvent-free polyisocyanates for PU compounds and coatings.
- ③ Blocked and blocking-agent-free polyisocyanates for powder coatings.
- ④ Solvent-based, blocked polyisocyanates for stoving enamels.
- ⑤ Solvent-based, blocked PU systems for stoving enamels.
- ⑥ Physically drying PU resins for coating flexible substrates.

The manifold formula for light-stable PU paints and PU compounds.

Diversity of application is a special feature of our proven IPDI. Based on constant development work, the IPDI programme today includes a whole series

of interesting adducts and systems. Why not let our technical service advise you? Your own formula for success is bound to be there. We shall be glad to

send you more information and product samples.

IPDI-based PU raw materials	Suitable co-reactants	Application	Properties
① IPDI-T 1890 S IPDI-T 1890 M	Oxyester Z 1439 Hydroxylated acrylates HS polyester Alkyd resins	Masonry, vehicle and industrial paints Car repair and machine enamels	good drying characteristics, white spirit compatibility, very good weather resistance
② IPDI-H 3150 IPDI-H 2921	Oxyester T 1136 Oxyester V 2922 Polycaprolactones	Solvent-free coatings, PU compounds for technical articles	Soft and flexible to extremely hard compounds with good crack propagation resistance, permanent flexibility and yellowing resistance
③ IPDI-B 1065 IPDI-B 989 IPDI-B 1530 IPDI-BF 1540	Hydroxylated polyester Polyester 3353 Polyester 3356	Powder coatings Powder coatings Blocking-agent-free powder coatings	Coatings with good weather resistance, good flow and high gloss
④ IPDI-B 1370	Oxyester Z 1439 Hydroxylated polyesters, acrylates and alkyd resins	Stoving enamels	Low splitting temperature, one-component paints known for their good PU properties
⑤ PU system UB 1256 PU system UB 909		Coil coating and industrial stoving enamels	High flexibility with good surface hardness
⑥ PU system AV 1122		Finishing flexible substrates	Rapid drying, high gloss and good colour stability

hüls (U.K.) Ltd., Cedars House, Farnborough Common, Orpington, Kent BR6 7TE

Please send me detailed information on

- IPDI
 IPDI based PU raw materials

- ① ② ③ ④ ⑤ ⑥

Please tick number from adjacent table.

Name _____
 Position _____
 Company _____
 Address _____

CHEMISCHE WERKE HÜLS AG
 D-4370 Marl

IPDI PU raw materials

hüls

U.K. Head Office: **hüls** (U.K.) Ltd., Cedars House, Farnborough Common, Orpington, Kent BR6 7TE
 Regional Sales Office: **hüls** (U.K.) Ltd., Byrom House, Quay Street, Manchester M3 3HQ

Brighten up!

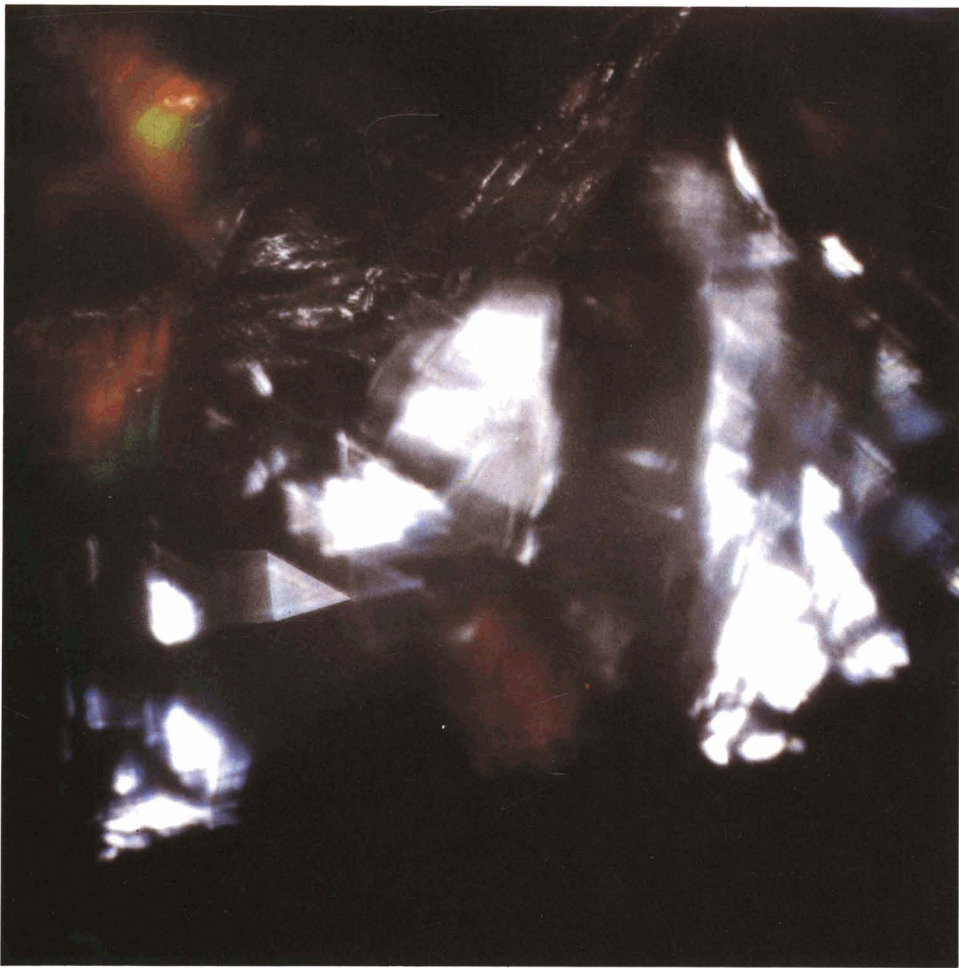
KRONOS*
titanium dioxide

*KRONOS is a registered trademark
of KRONOS TITAN-GMBH.

Brightens, Whitens, Opacifies.
The KRONOS trademark
guarantees Quality, Reliability,
Technical leadership.

NL CHEMICALS (UK) LIMITED

St. Ann's House
Wilmslow, Cheshire SK9 1HG
Tel: 0625/529511, Telex 669055

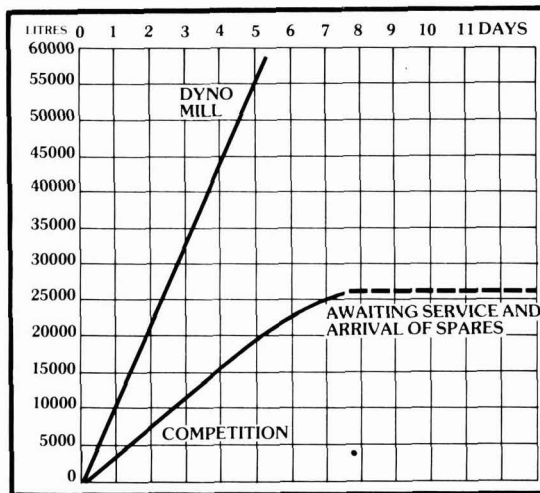


KRONOS TiO₂

Reader Enquiry Service No. 131

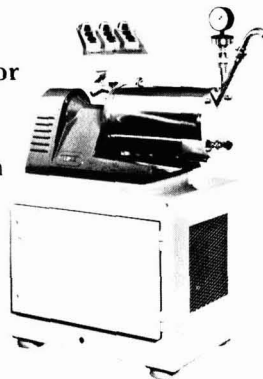
NL Chemicals

THE DYNO-MILL[®] GIVES YOU AN UNFAIR ADVANTAGE OVER YOUR COMPETITION!



HERE IS WHY:

- **Through-hardened** components give extreme durability under adverse conditions
- **Standard** machine handles tremendous variety of products
- No time wasted on cleaning blocked screens
- **Self-clearing dynamic separator** shrugs off heavy, viscous and thixotropic materials
- Grinding beads of glass, zirconium oxide and steel **routinely** used
- Utmost reliability
- Superb engineering guarantees trouble-free operation



For full information, a demonstration or advice make sure you contact



Glen Creston Machinery Ltd
16 Carlisle Road, London NW9 0HL, England
Telephone 01 200 1666 Telex 925791

Enquiries outside the UK and Eire please address direct to the manufacturers:

WAB **WILLY A. BACHOFEN AG**

Mfg. Engineers, Dept. of Application Technology,
CH 4000 Basle 5, Switzerland
Tel. 061 33 55 55 Telex 62564



Control the surface characteristics of your paint with Celite[®] extenders and flattening agents from Johns-Manville.

With Celite extenders you have complete control, from flat to gloss, depending on how much you add. They're pure, inert and non-reactive diatomaceous silica. Their high flattening efficiency results in uniform gloss and sheen reduction, from a silky semigloss to dead flat.

Celite extenders are available in several grades for both solvent and

water-thinned paints. These grades give you the flexibility you need depending on your formulations, desired degree of gloss and sheen reduction, type of dispersion equipment and the desired degree of final film smoothness (up to 5 Hegman fineness).

Johns-Manville Technology has been at work in the paint industry for over 30 years. Let us help you.

Contact Johns-Manville Great Britain Ltd., Parkbridge House, The Little Green, Richmond, Surrey, TW9 1QU, Great Britain, Telex: 928635.



Johns-Manville

Dynamit Nobel

CHEMICALS

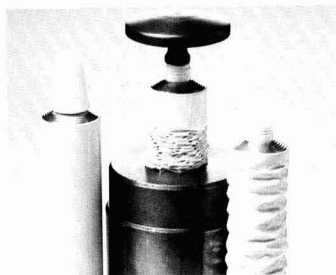
DYNAPOL® L
and lacquers stay in brilliant shape



DYNAPOL® L

A range of high molecular, linear, saturated polyesters, based on terephthalic acid. DYNAPOL L lacquer films have extremely high adhesive strength; they are highly elastic, scratch-resistant and impact-resistant, and they do not yellow with age. Can be stamped and deep-drawn, even under extreme loads. Also tasteless and completely safe in terms of foodstuffs legislation (BGA and FDA). Suitable for use as external and internal lacquer on packagings, and for sterilizable applications.

DYNAPOL L is available with different elasticity and viscosity properties as DYNAPOL L 205, L 206, L 411 and L 850. Main applications: roll-coating on sheet and strip, decorative lacquers for packagings, internal protective lacquers for packagings, coilcoating primers and top-coats, foil lacquers.



DYNAPOL polyesters at a glance:

DYNAPOL	L 205	L 206	L 411	L 850	LH 818	LH 812
Form supplied	Granules	Granules	Granules	Granules	Solution	Solution
Hydroxyl No.	10	5-10	5-10	5-10	15	35
Molecular weight	15000	18000	16000	14000	7000	3000
Glass temperature	70 °C	70 °C	50 °C	40 °C	40 °C	30 °C

Further products in development.

DYNAPOL® LH

A range of linear, saturated polyester resins containing hydroxyl groups. For use in combination with cross-linking resins to obtain top-quality, full-bodied industrial stoving finishes. DYNAPOL LH lacquer coatings are flexible, have good deformation properties and excellent adhesion to a metal substrate, such as aluminium, steel or galvanized steel. Good surface hardness and resistance to weathering and chemicals. Especially suitable for outdoor use particularly in the building industry.



Also suitable for use on packaging materials.

DYNAPOL LH 812 and LH 818 are fully compatible with the high molecular polyesters of the DYNAPOL L range. Their properties may be modified and rendered suitable for specific applications by combined use of DYNAPOL L/LH grades. Main applications: coilcoating lacquers, decorative lacquers for packagings; also suitable for UV printing methods.

DYNAPOL® L DYNAPOL® LH

Our range of products also includes:

DYNAPOL® H

Branched polyester containing hydroxyl groups

DYFLOR® 2000

Polyvinylidene fluoride for EPS and WS coatings

DYNASIL®

Silicic acid ester

DYNATRI® LQ

Specially stabilized trichloroethylene

RHENOFLEX®

Chlorinated polyvinylchloride

ICDAL® TE/TI

Electrical insulating lacquer resins

WITAMOL®

Plasticizers, phthalic acid ester

WITACLOR®

Plasticizers, chloroparaffin

* = registered trade mark

Name: _____

Company: _____

Address: _____

Tel.: _____

Please send me special, detailed information on basic and ancillary materials for surface protection. I am particularly interested in:

E A 1 2 3 4 5 6 7 8



Dynamit Nobel
Aktiengesellschaft
Sparte Chemikalien/M5

D-5210 Troisdorf

Federal Republic
of Germany

At your disposal in Great Britain:
Dynamit Nobel (U.K.) Ltd.
302/308 High Street

GB-Slough (Berks.) SL 1 1 HF

Tel.: 0753/71851
Tx.: 848 243

Dynamit Nobel Aktiengesellschaft
GB Kunststoff-Rohstoffe/Fette-LK

D-5210 Troisdorf
Federal Republic of Germany

Dynamit Nobel
CHEMICALS

Printed on MEDIAPRINT 170 g/qm -
a product of Feldmühle

But many innovations in the paint industry have stemmed from raw materials suppliers, particularly the resin and polymer side of the industry and I would again be looking for some of the major changes to come from them, as they tend, perhaps, to have a higher concentration than most paint companies of research for the future. My fear is that unless the economic pressures that we are all facing at the present subsides somewhat, the willingness of companies to engage in the more speculative research may go down too much. The President of course, may take a contrary view and believe that the Kondratieff cycle is now well on its upswing and the sheer pressure of the problems we have will lead companies to take larger gamblers' throws as a means of trying to develop the business of the future, and I think there is a lot in that, Mr President. It may be that the pressures played some part behind our own company's thinking, otherwise we might have found it hard to justify the amount of time and continued effort we had to put into the Paintmate development over four years.

MR F. D. TIMMINS: I should not encourage your commercialism, but at the same time your Paintmate could be very useful. Will it handle viscous high build paints or are we back to the aerosol stage where you're putting a thin film of something on?

DR L. VALENTINE: *With that particular system, the paint and applicator are designed to match each other and to give a flow rate and an application rate that are within the capabilities of a human applicator. The viscosities are not particularly high but are tailored to provide the right mix of properties including those comparable with existing paint supplied by conventional techniques. If you really want to apply a viscous system it obviously gets increasingly difficult using pressure to drive the liquid through lengthy tubes, and so we have not attempted to go in for that type of high build high viscosity system. What we had to do was to develop a paint which provided adequate opacity and build when applied through this particular device, thus the viscosity characteristics are different from those of conventional emulsion paints. Equally well, as I mentioned earlier in the section on industrial paints, one essential ingredient for the future of the paint industry is to do much more work on application methods of all types of paint whether industrial, heavy duty maintenance or decorative because it is there that a large part of the future lies. We have to make application easier, make it more efficient, less wasteful and more economically attractive on an applied cost basis. The type of application device is going to depend very much on the specific end-use and the substrate.*

MR F. D. TIMMINS: I was thinking in terms of high build chlorinated rubber. You've overcome one problem because the container is attached to the man so if he's going up something like a transmission tower he's not got an awful long fluid line. Have you managed to get high build chlorinated rubber through it?

DR L. VALENTINE: *We haven't tried; our priority was to develop paint systems for the DIY market.*

MR S. VOUT: There is great concern in the United States about the declining quality of housepaints. Will Europe follow this trend of putting price before performance?

DR L. VALENTINE: *The same economic pressures are certainly present in Europe as in the USA and therefore a great deal of effort in R & D laboratories; and more D*

than R, has been in terms of at least reducing the cost of the formulation. As to whether there has been a debasement in quality, I don't think it would be proper to comment. It is a source of worry that people have become so concerned about cost reduction, and perhaps we have gone too far in cost reduction and have had blinkers on about production improvements, extension of the range of uses or improving the ease of application of the paint. At the end of the day, paint is competing with lots of other things that take people's time: TV sets, baseball and so on are more readily available for longer hours to more people and, therefore, one has got to find, (a) quicker and less messy application methods and (b) hopefully, lower cost formulations because of petrochemical costs, which are certainly not going to go down and relatively are likely to go up. The cost of paint to decorate a house now is almost a big ticket item, a cost almost comparable to that of major household appliances until quite recently. So, I believe, the industry has got to look both ways: on the one hand at cost reductions – without getting the quality so low that consumers get dissatisfied with paint and turn to vinyls or wallpaper or some other form of decorating the surface; on the other hand we have to find novel decorative effects that will intrigue consumers and make it more attractive for them to undergo the trauma of clearing a room and painting it. So the industry must develop more attractive effects achieved more easily and I think if we keep both these targets in our sights, the business will be all right but if we allow the paint industry to be debased into a white product area then we have a very grim future ahead of us.

MR A. G. NORTH: You mentioned in your discussion Dr Valentine, the use of after burners. I went to a talk a year or so ago by an oven manufacturer who said that the new design of ovens was such that it could burn all the solvent in paint and that it was possible to have a positive energy balance, in other words you would get more energy out of the oven than you actually needed. It isn't possible to get enough energy from the paint solvent to be self starting of course, and therefore, gas or some other fuel must be used, but it is possible to take energy out of the oven in terms of space heating. I wonder if enough attention has gone into this possibility, because it could be concluded – from your comments about the use of energy in the space heating of factories – that it might be useful to go in this direction and not worry too much about the solvent content but worry more about the type of solvent used, e.g. white spirit which is relatively cheap, and to then take the energy content out, with no atmospheric pollution as a result.

DR L. VALENTINE: *Yes, that is a very good line of approach and I think there has to be a greater readiness to play about with processes and integrate them into the total company operation, whether by paintmakers or paint users. Users, perhaps, have it easier in one sense, but more challenging in another, because they usually use very much more energy than the paint manufacturers in the manufacturing processes and it is in that area that I would expect to see lots of benefits along the lines you illustrated.*

MR O. SÄBERG: I certainly find your new application technique interesting. Can you give us any information concerning time or cost savings in numbers or percentages.

DR L. VALENTINE: *This is very difficult because it obviously depends on individuals and their styles of paint-*

ing but we reckon that on the whole one ought to be able to cut down the time of painting by 50 per cent.

Perhaps I did not make the point in the talk but we found that it was possible – by matching roller design in particular – to reduce splashing on application very considerably and so it is possible to develop a much less messy method as well as being much faster.

MR P. WALLGREN: I would like to make the point that the amount of heat required for an oven – if properly insulated – is less than that required to heat a spray booth, although it is a widely-held belief that the opposite is true.

Regarding after burners, it is possible by using them to maintain the necessary heat in an oven without the addition of heat from other sources. This is based on a thorough investigation that has been running for 1 year. The heat from after burners has to be used via heat exchangers but using it for space heating is not a good idea because in summer space heating is not needed, so this heat should be used in the process.

DR F. M. SMITH: To what extent should the industry go beyond just literally “paint making” should it redefine its goals in terms of protection or decoration or an even wider objective?

DR L. VALENTINE: *I think you are quite right Mr President; we ought not to think of ourselves as being necessarily confined to a liquid that is in a can or a tub. But that depends very much on company philosophy as to what they think they can do in the way of marketing, or the managerial talents that they have. The consumer wants more satisfaction, he wants a wider variety of colour effects than he has been able to get with paints in the past – of that I am convinced. Whether he wants texture or other novel effects which can only be achieved by printing, or whether he wants the space age technology that Dr Anderson talked about – pigments that change colour according to the lighting around them and so on – remains to be seen, but I believe it will be up to individual companies to take a decision as to whether they can create that particular type of future.*

Pigmented UV dual cure coatings*

By A. Noomen

Sikkens BV, Sassenheim, Netherlands

Summary

To get an impression of the potential usefulness of isocyanate based UV/room temperature dual cure binders in pigmented high solids coatings, a number of experiments with various pigments were carried out. The cure speed of some pigments and the influence of the type of pigment, initiator system and lamp on the cure speed of white pigmented coatings were measured.

As coatings with yellow and phthalocyanine pigments showed a

very low cure speed under a standard mercury vapour lamp, experiments were carried out with initiators and other lamps to try to get an improvement. Based on these investigations, it can be concluded that pigmented UV/isocyanate dual cure coatings will cure well and can result in layer thicknesses of about 50 microns.

Keywords

Processes and methods primarily associated with drying or curing of coatings

ultraviolet curing

Raw materials for coatings catalysts, accelerators, inhibitors initiator

Properties, characteristics and conditions primarily associated with

coatings during application

curing rate

Les systèmes du peinture du type U.V. dual cure

Résumé

En vue de parvenir à une indication de l'éventuelle utilité en peintures "high solids" des liants du type U.V. dual cure basés sur les isocyanates, et durcissant à la température ambiante, on a effectué une série d'expériences avec divers pigments. La vitesse de durcissement de certains pigments colorés, ainsi que l'influence qu'exercent le type pigmentaire, le système initiateur et la lampe sur la vitesse de durcissement des peintures blanches ont été déterminées.

Puisque les pigments jaunes et également les pigments phthalocyanines montrent une vitesse de durcissement très basse lorsqu'on se sert de la lampe à vapeur de mercure normalisée, des expériences avec des initiateurs et d'autres lampes ont été effectuées, afin d'assurer une amélioration à cet égard. On peut conclure, grâce à ces investigations, que les peintures du type U.V. dual cure peuvent être durcies suffisamment où l'épaisseur de la couche est de 50 microns à peu près.

Pigmentierte U.V. Dual Cure-Systemen

Zusammenfassung

Eine Anzahl von Versuchen mit verschiedenen Pigmenten wurden ausgeführt um die potentielle Nützlichkeit in pigmentierten Beschichtungen der auf Isocyanat gegründeten raumtemperaturhärtenden U.V. Dual Cure - Bindemittel einzuschätzen. Die Härtungsgeschwindigkeit der etlichen Pigmente und auch der Einfluss des Pigmenttyps, des Initiatorstyps und der Lampe auf die Härtungsgeschwindigkeit der Weisspigmentierten Beschichtungen wurden bestimmt.

Denn die Gelb- und Phthalocyaninpigmente zeigten bei der Anwendung einer Normquecksilberdampfampe eine sehr niedrige Härtungsgeschwindigkeit, wurden Versuche mit Initiatoren und mit anderen Lampen ausgeführt um eine Verbesserung in diesem Bereich zu schaffen. Diesen Untersuchungen nach kann es beschlossen werden dass pigmentierte U.V./Isocyanat Dual Cure-Beschichtungen zu einer Schichtdicke von etwa 50 Mikron gut gehärtet werden können.

Introduction

Refs. 1-13

For a long time the UV curing of pigmented coatings has been considered to be a difficult or even insoluble problem¹⁻⁴. Gradually however, signs appeared in the

literature that under optimised conditions the UV curing of pigmented coatings might be possible. Most of the authors described or calculated the curing conditions for white pigmented coatings⁵⁻¹⁰. As the absorption of UV radiation by TiO₂ shows a strong decrease in the near visible region of the spectrum, photoinitiating systems were devised that showed high absorption especially in this area. Examples

*Paper presented at the Association's Conference held at Bath, 17-20 June 1981

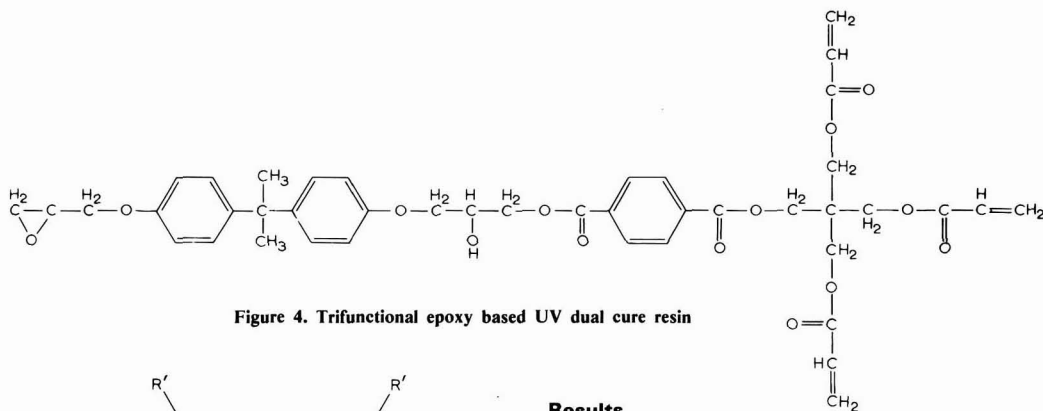


Figure 4. Trifunctional epoxy based UV dual cure resin

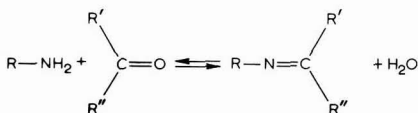


Figure 5. Formation of a ketimine/aldimine compound

resin with a less than stoichiometric amount of acrylic acid; or the half ester of a dibasic acid and a hydroxyl functional acrylate ester. Examples are the reaction products of 1 mole of the diglycidyl ether of bisphenol-A with 1 mole of acrylic acid (Figure 3); or of 1 mole of the half ester of terephthalic acid and pentaerythritol triacrylate (Figure 4).

The residual epoxy functionality can be used for reactions with, e.g. polyamines, polyamides and organic acids¹⁸.

With highly reactive amines a complication in the form of a Michael type addition of the amine onto the unsaturated double bond can appear. This problem can be overcome by using ketimines or aldimines as blocked amines (Figure 5).

Experiments with pigmented coatings

Refs. 5, 7, 8, 19, 21

To get an impression of the potential usefulness of isocyanate based UV dual cure binders in pigmented coatings, a series of experiments were carried out:

- i Testing the cure speed with a number of current pigments.
- ii Estimation of the influence of the type of pigment, initiator and lamp in white pigmented coatings.
- iii Improvement of the cure speed of a coating pigmented with phthalocyanine blue.
- iv Improvement of the cure speed of a coating pigmented with yellow iron oxide.

The adduct of 1 mole of the biuret of hexamethylene diisocyanate and 2 moles of pentaerythritol triacrylate ($f_{ncd} = 1$, $f_c = c = 6$) combined with a stoichiometric amount of an acrylic oligomer (m.w. = ca. 1500) was used in all cases as a UV dual cure binder. Solids content: 85 per cent in toluene.

Results

i Testing of current pigments

The curing behaviour of some pigments which are used in current topcoat formulations were compared. The amount of pigment used was equivalent to the quantity used in a current acrylic-isocyanate coating. The photoinitiator was 2-isopropylthioxanthone, 6 per cent on solid binder.

The line speed that resulted in a touch dry coating after one passage under a Philips HOK (80W/cm) lamp was measured. The distance between lamp and substrate was 40 cm. The layer thickness of the coating, 40 microns.

The results of this experiment are shown in Table 1. It can be seen from these results that the yellow and both phthalocyanine pigments gave notably inferior results.

ii Influence of the type of pigment, initiator and lamp on white pigmented coatings

Because of the great importance of white pigmented coatings, special attention was paid to the possibility of improving the cure speed of UV dual cure coatings pigmented with TiO_2 .

In the first place, it was reported in the literature^{5,7,8} that a beneficial effect on the cure speed could be obtained by the use of anatase instead of rutile TiO_2 , or by the use of a rutile type with a larger crystal size. As a white pigment with low absorption in the near UV region, magnesium titanate was also tested (Figure 6).

Furthermore, a comparison was made between a number of current initiator systems and some potential improvements which were reported in the literature:

- use of a combination of phenantrenequinone and benzophenone¹⁹
- addition of a chloroalkane²⁰
- use of methylphenylglyoxalate as initiator²¹
- addition of chloromethylnaphthalene²²

And finally, a comparison was made of the standard mercury vapour lamp with some lamps containing more blue light in their spectra.

For the evaluation of the effect of the type of white pigment, the pigments were added, 30 per cent by weight

Table 1
Cure speed of current pigments

Pigment	Cure speed m/min
Chinacridone red	3.0
Red iron oxide	2.5
Molybdate orange	2.0
Yellow iron oxide	1.0
Iso indolinone yellow	<0.75
Lead chromate yellow	0.75
Anthrapirimidine yellow	<0.75
Phthalocyanine green	<0.75
Chromium oxide green	3.5
Phthalocyanine blue	<0.75
Prussian blue	3.5
Dioxazine violet	3.5
Rutile titanium dioxide	2.0
Carbon black (UV grade)	3.5

on solid resin. Photoinitiators used were benzildimethylketal (2 per cent) and isopropylthioxanthone (2 per cent). The coatings were applied at a film thickness of 50 microns (dry) and cured under an 80 W/cm mercury vapour lamp. The line speed that resulted in a touch dry layer after one passage under the lamp was measured. Use of anatase TiO₂ resulted in a small advantage. Crystal size did not have any apparent effect. Magnesium titanate produced an improvement over TiO₂ however, and can be used with "normal" UV initiators such as benzildimethylketal (Table 2). A disadvantage of MgTiO₃ is lower hiding power.

The initiator variations were tested in coatings pigmented with 30 per cent by weight rutile TiO₂. Also in this experiment the line speed resulting in a touch dry coating after one passage under the HOK lamp was measured. The results are shown in Table 3. Only the addition of hexachloroethane to benzil produced any improvement over the current initiator systems. The best overall result with respect to cure speed, whiteness and film appearance was obtained with 2-isopropylthioxanthone.

The influence of the type of lamp on the curing of the white coating described above, initiated with 2-isopropylthioxanthone (2 per cent), was also investigated.

Table 2
Influence of type of white pigment on line speed

Type of pigment	Particle size µm	Initiator	Line speed m/min
Anatase TiO ₂	0.16	2-isopropylthioxanthone	2.5
Rutile TiO ₂ - I	0.20	2-isopropylthioxanthone	2
Rutile TiO ₂ - I	0.20	benzildimethylketal	no cure
Rutile TiO ₂ - II	0.26	2-isopropylthioxanthone	2
MgTiO ₃	ca. 0.3	benzildimethylketal	5
MgTiO ₃	ca. 0.3	2-isopropylthioxanthone	6

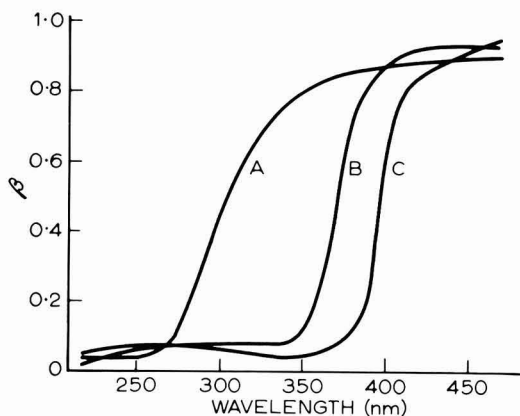


Figure 6. Remission curve of magnesium titanate versus anatase and rutile TiO₂

A = magnesium titanate B = anatase TiO₂
C = rutile TiO₂

This was carried out by comparing lamps with a normal spectral output to those with a more blue output. The lamps compared were: Philips HOK (80 W/cm), Theimer 5058 (200 W/cm) and Hildebrand IST standard (70 W/cm, pulsed) with Theimer 5050 (200 W/cm), Hildebrand IST-AKA 42 (70 W/cm, pulsed) and the Thorn Lightning Graph X lamp (400 W).

Spectra of these lamps are shown in figures 7a-7f. The coatings were applied at dry film thicknesses of 40 and 80 microns and cured at a line speed of 2 m/min under the Philips, Theimer and Hildebrand lamps (ca. 30 sec under the lamp). With the Graph X lamp the time until touch dry was measured.

Results from this experiment are shown in Table 4.

The "blue" lamps produced better curing than the "normal" lamps. With the thicker films, a full cure was obtained only with the Graph X lamp. The cure time was much longer however, than under the mercury vapour lamps.

iii Improving the cure speed of a phthalocyanine blue pigmented coating

It was reported above (i) that a phthalocyanine blue pigmented coating was inferior, with respect to cure speed,

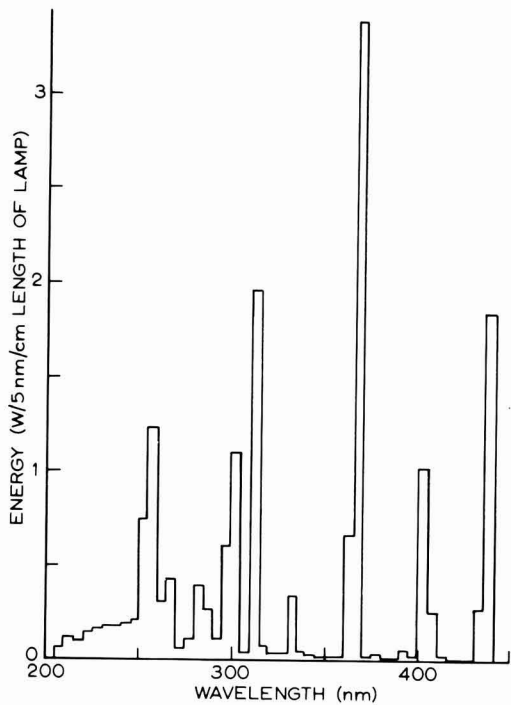


Figure 7a. Philips HOK

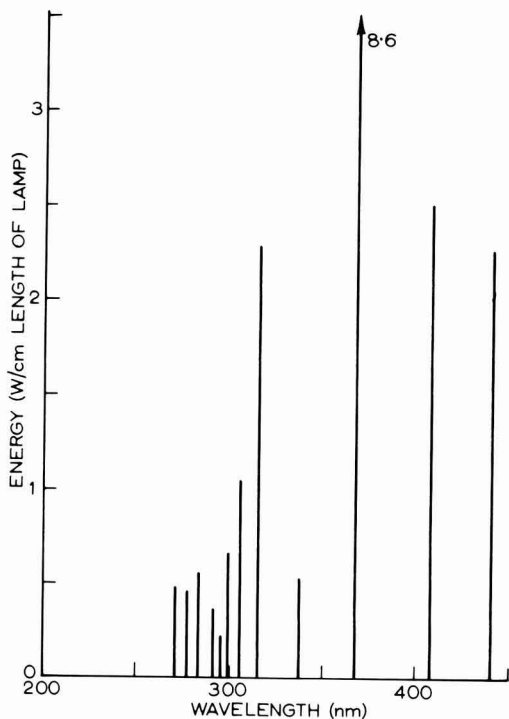


Figure 7b. IST standard

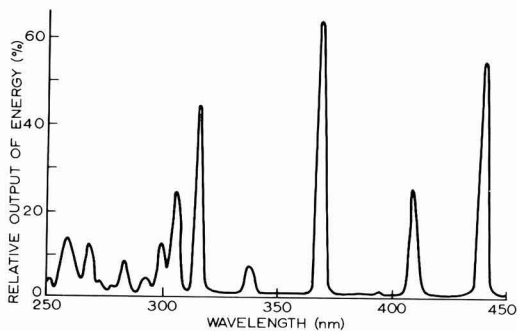


Figure 7c. Theimer 5058

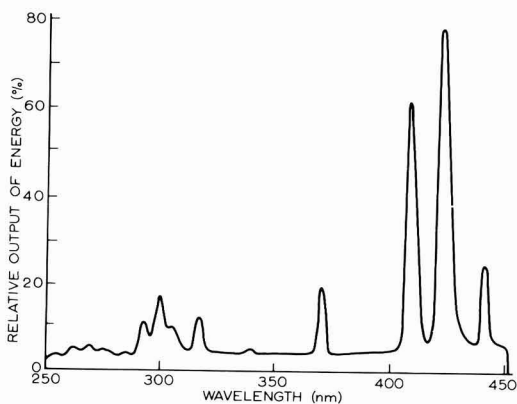


Figure 7d. Theimer 5050

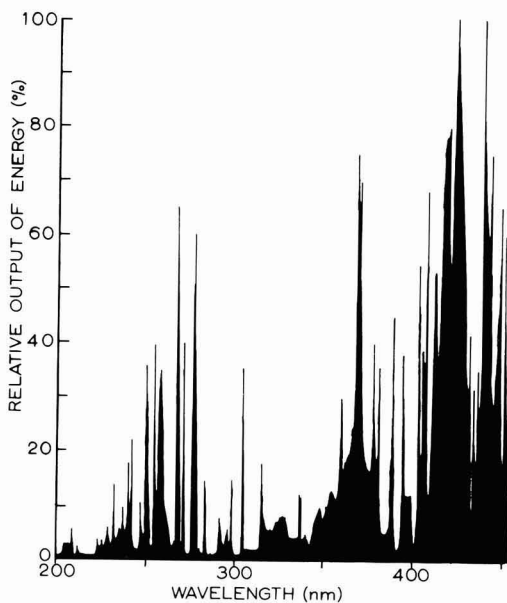


Figure 7e. IST - AKA 42

Table 3
Evaluation of initiatorsystems

Initiator system (% by weight)	Line speed m/min.	Colour	Appearance
1% 2-chlorothioxanthone	2.0	very pale yellow	OK
2% 2-chlorothioxanthone	2.5	pale yellow	OK
2% 2-isopropylthioxanthone	2.0	almost white	OK
2% benzil	2.5	almost white	hazy
2% benzophenone	no cure	white	
2% benzophenone + 2% phenanthrenequinone	1.0	yellow	OK
2% benzil + 2% hexachloroethane	3.0	almost white	hazy
2% 2-isopropylthioxanthone + 2% hexachloroethane	2.0	almost white	OK
2% methylbenzylformate	<0.75	white	
6% methylbenzylformate	1.0	white	tendency to wrinkle
2% benzil + 2% chloromethylnaphthalene	2.5	almost white	hazy

Table 4
Curing with various lamp types

Lamp	Dry film thickness μm	Curing
Philips HOK	40	no full cure
Philips HOK	80	formation of a thin cured skin
Theimer 5058	40	no full cure
Theimer 5058	80	formation of a thin cured skin
Hildebrand IST Standard	40	almost full cure
Hildebrand IST Standard	80	formation of a thick cured skin
Theimer 5050	40	full cure
Theimer 5050	80	formation of a thick cured skin
Hildebrand IST - AKA 42	40	full cure
Hildebrand IST - AKA 42	80	formation of a thick cured skin
Graph X	40	full cure in 1 minute
Graph X	80	full cure in 2.5 minutes

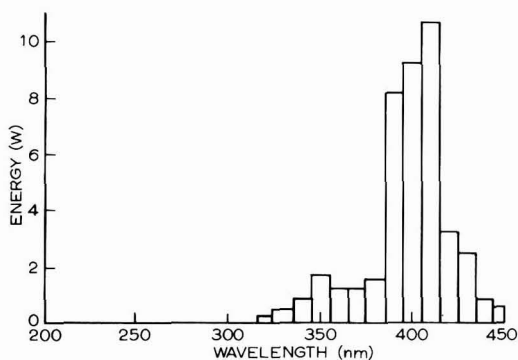


Figure 7f. Graph X

under the HOK lamp. It was found (ii) that "blue" lamps improved the curing of white pigmented coatings.

To investigate the possibility of improving the cure speed of the blue coating too, a comparison between the HOK lamp, the IST-AKA 42 lamp and the Graph X lamp was made.

A coating based on the described resin combination was pigmented with phthalocyanine blue pigment, 5 per cent on solid resin. As an initiator 2-isopropylthioxanthone (4 per cent) was used. The coatings were applied at a dry film thickness of 50 microns. Line speed under the HOK lamp was 1 m/min, under the IST lamp 2 m/min; cure time under the Graph X lamp was 3 minutes. The curing after the UV step and the Persoz hardness after 1 day and 7 days were tested to measure the working of the built in second curing mechanism

Table 5
Curing of phthalocyanine blue pigmented coatings

Type of lamp	Curing after UV step	Persoz hardness (seconds) after UV step +	
		1 day RT curing	7 days RT curing
HOK	no full UV cure	85	146
IST - AKA 42	touch dry	152	238
Graph X	touch dry	160	242

Table 6
Curing of coatings pigmented with yellow iron oxide

Lamp	Initiator	Weight (%) yellow iron oxide on solid resin	Maximum layer thickness μm
HOK	2-isopropylthioxanthone	12	40
HOK	2-isopropylthioxanthone	20	35
HOK	2-chlorothioxanthone	12	40
HOK	2-chlorothioxanthone	20	35
HOK	benzil	12	35
HOK	benzil	20	30
Graph X	2-isopropylthioxanthone	12	75
Graph X	2-isopropylthioxanthone	20	55
Graph X	2-chlorothioxanthone	12	80
Graph X	2-chlorothioxanthone	20	60
Graph X	benzil	12	70
Graph X	benzil	20	60

(Table 5). It can be concluded from this table that with both "blue" lamps good curing was obtained.

iv Improving the cure speed of yellow iron oxide pigmented coatings

The binder combination previously described was pigmented with another "difficult" pigment, yellow iron oxide, at two percentages: 12 and 20 per cent by weight on solid resin. Benzil, 2-chlorothioxanthone and 2-isopropylthioxanthone were used as initiators, 4 per cent by weight in each case. The investigation was into what thickness of film could be cured by a single passage under the HOK lamp with a line speed of 1 m/min, or by exposure to the Graph X lamp for 3 minutes (Table 6). The best result was obtained with 2-chlorothioxanthone under the Graph X lamp.

In the test that followed, the optimum amount of initiator was investigated by the addition of 1 to 8 per cent by weight of 2-chlorothioxanthone, curing for 3 minutes under the Graph X lamp and measuring the Persoz hardness after one day (film thickness 50 microns). The results are shown in Figure 8. The optimum quantity of initiator was found to be 4 per cent by weight.

Finally, an investigation was carried out into the effect

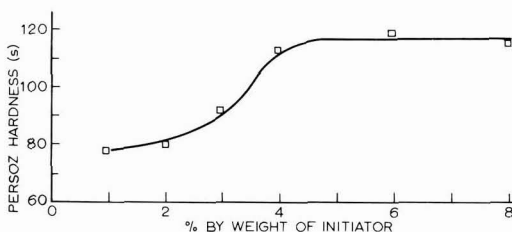


Figure 8. Influence of initiator concentration

of yellow pigment in a mixture of the TiO_2 pigmented coating (described under ii) and the yellow coating (described in this section) (cured with 2-chlorothioxanthone, 4 per cent) on the layer thickness where wrinkling occurs under the Graph X lamp (Figure 9). The yellow pigment was found to produce a strongly negative influence.

Conclusions

Based on the investigations reported here, it can be concluded that pigmented UV/isocyanate dual cure high solids coatings can produce good curing in layer

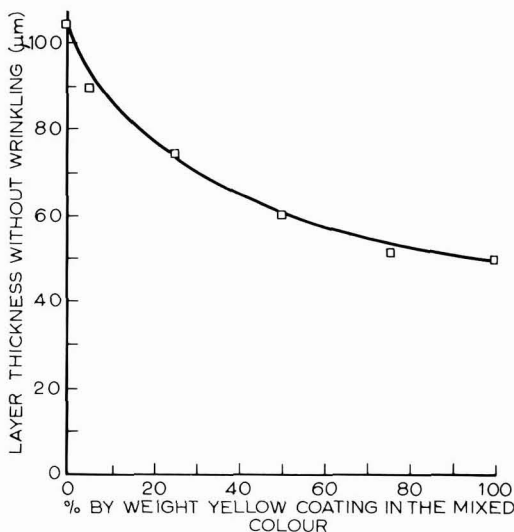


Figure 9. Curing of mixed white/yellow coatings

thicknesses of about 50 microns. Yellow pigments form the biggest problem. A condition for good curing is proper choice of the initiator and the type of UV lamp.

The dual cure approach introduces the possibility of applying UV curable coatings on irregularly shaped, non flat substrates in those areas where fast initial drying is required and time is available for further curing by the built-in second curing mechanism.

[Received 9 February 1981

References

- Deninger, W. and Patheiger, M., *JOCCA*, 1969, **52**, 930-45.
- Barzynski, H., *et al.*, *Chemiker Ztg.*, 1972, **96** (10), 545-51.
- Clark, K. R., *Paint and Varnish Prod.*, 1974, August, p. 44-6.
- Kooistra, M. F., Paper presented at a meeting of SVLFC, Zurich, 1974-09-05.
- Hulme, B. E., *JOCCA*, 1976, **59**, 245-252.
- Pappas, S. P., *et al.*, *J. of Paint Techn.*, 1975, **47**, No. 610, 42-48.
- Hulme, *et al.*, SME Technical paper FC 76-492.
- Hird, M. J., *Pigment and Resin Techn.*, 1976, **5** Dec. 7, 9-14.
- McGinniss, V. D., *ACS, ORPL*, 1975, **35**, No. 1, 118-123.
- Davis M. J., *et al.*, *JOCCA*, 1978, **76**, 256-263.
- Van Oosterhout, A. C. J., *et al.*, *Double Liaison*, 1980, No. 295, 135-146.
- Hencken, G., *Farbe und Lack*, 1975, **81**, No. 10, 916-23.
- Hauser, P., *et al.*, *Fatipex Congress Book XIV*, 1978, 241-7.
- Noomen, A., *Fatipex Congress Book XV*, 1980, part I, 346-59.
- AKZO N.V./Dutch patent application 7702518; App. 1977-03-09; Pub. 1978-09-12.
- AKZO N.V./Dutch patent application 7711121; App. 1977-10-11; Pub. 1979-04-17.
- AKZO N.V./Dutch patent application 790297; App. 1979-04-10; Pub. 1980-10-10.
- AKZO N.V./European patent application 8837; App. 1978-09-07; Pub. 1980-03-19.
- P.P.G. Industries/US patent 4.054.683; Appl. 1976-02-02; Pub. 1977-10-18.
- Rybny, *et al.*, SME Technical paper, FC 76-491.
- Stauffer Chemical Company/Dutch patent application 7609724; App. 1976-09-01; Pub. 1977-03-22.
- SCM corporation/US patent application 3.876.519; App. 1973-05-04; Pub. 1975-04-08.

Discussion at Bath Conference

MR A. G. NORTH: This is a comment as much as a question. There is a commercial plant in the USA using the dual cure system in a rather clever way. The system is an acrylic monomer isocyanate, similar to the one you described. The coating is applied to a plastic sheet and cured under an electron beam to a reasonably cured stage. The plastic sheet is then moulded into car components, bumpers and things of this sort, and the acrylic isocyanate or hydroxy-isocyanate reaction then takes place over a period of time so that the coating hardens after. Turning this into a question, it would seem that the future of dual cure systems might be in this two stage curing rather than doing the whole thing in one go.

MR A. NOOMEN: We have also been thinking along these lines. For instance automotive coatings, we think it would be possible to cure with UV as a fast first step and reach touch dryness with the second reaction, after which the car could be driven out of the spray booth where it would cure further.

DR K. BORER: What is the solids volume and is the trapped solvent deleterious?

MR A. NOOMEN: About 30 per cent by volume. Because of the non-reactive solvent, we need a flash-off time. This can be a disadvantage, but we avoid toxic monomers in the air on spraying of the coating.

MR G. A. ZERLAUT: Have you considered zinc titanates, especially the ortho stoichiometry with its higher refractive index than magnesium titanate and its greater transmittance in the pertinent ultraviolet region compared to anatase and rutile TiO₂?

MR A. NOOMEN: We have not tested them.

DR A. RAMIG: Concerning the effect of TiO₂ particle size on cure speed, approximation from light scattering theory predicts an optimum size well outside the commercially available range. Do you agree?

MR A. NOOMEN: Yes, this is supported a little by what I have said. In the commercially available types we did not find a useful difference, hardly any difference at all.

DR A. RAMIG: But if you went outside that, do you think you might find a difference?

MR A. NOOMEN: Yes.

Developments in aqueous powder systems*

By A. G. North

Cray Valley Products Ltd, St. Mary Cray, Kent BR5 3PP, England

Summary

A comparison of coatings produced from thermosetting pigmented powders applied by electrostatic spraying and the same products dispersed in water demonstrated only minor differences in performance. To reduce the complexity of manufacture, coatings were then made in which the same com-

bination of resin, pigment and additives were dispersed in water by ball milling. The resultant coatings gave surprisingly well integrated films which approached powder coatings in performance and which, when made at relatively low levels of pigmentation, had acceptable gloss and appearance.

Keywords

Types and classes of coatings and allied products

powder coating

Processes and methods primarily associated with application of coatings and allied products

electrostatic spraying
spraying

drying or curing of coatings

stoving

Types and classes of structures or surfaces to be coated

steel

Raw materials for coatings

binders (resins, etc.)

epoxy resin
polyester resin

Développements en revêtements en poudre dispersés à l'eau

Résumé

Une comparaison des films présentes par revêtements en poudre pigmentés et thermodurcissables, et qui ont été appliqués par pistoletage électrostatique, avec ceux présentes par les mêmes produits dispersés à l'eau ne met en évidence que de petites différences à l'égard du rendement. Afin de diminuer la complexité du procédé de fabrication, on a préparé des revêtements en faisant, au moyens d'un broyeur à billes, une disper-

sion aqueuse de la résine, du pigment et des adjuvants. Les revêtements qui en résultaient ont étaient à peu près aussi bons que ceux des revêtements en poudre proprement dits, et ils possédaient en même temps un brillant et un aspect à la fois convenable, pourvu que le niveau de pigmentation fût relativement faible.

Entwicklungen im Gebiet der wässrigen Pulverlacksystemen

Zusammenfassung

Ein Vergleich der elektrospitzlackierten Beschichtungen aus pigmentierten hitzehärtenden Pulverlacken mit denselben Produkten, die in Wasser dispergiert werden, zeigen nur geringen Leistungsunterschiede. Um die Herstellungsschwierigkeiten zu vermindern, wurden Beschichtungsmittel aus Harz, Pigmenten und Additiven, die durch Kugelmahlen in Wasser

dispergiert wurden, gemacht. Die entstehenden Beschichtungen darstellten überraschend gute einheitliche Filme, die sich der Pulverlackleistung näherten und die annehmbaren Glanz und Aussehen haben, wenn sie zu etwa niedrigen Pigmentierungsniveau hergestellt würden.

Introduction and object of work

Refs. 1-7

The idea of dispersing powder coatings in water is at least ten years old, but has recently received more attention as a means of producing coatings which combine the ecological advantages of powder coatings with the ease of application and use of liquid paints. Powder coatings approach the ideal in that they vary between 90 and 100 per cent effective solids, they can be applied in thick coatings and now that acrylic and polyester systems are avail-

able in addition to the initial epoxy coatings, a wide range of performance characteristics can be achieved including excellent external durability. The main disadvantages of powder coatings in use are the difficulty of producing thin films, the need for stoving temperatures that are higher than economically desirable and with the most common method of application by electrostatic spraying, the overspray collected is different in particle size distribution to the original powder.

The film thickness limitation has been progressively reduced by improvements in technology and whereas 50

*Paper presented at the Association's Conference held at Bath, 17-20 June 1981

or 60 microns was the previous limit, coatings can now be produced at half this thickness. However, for many large volume applications, as typified by office furniture, thicknesses of 15-20 microns are adequate, and it is difficult to see how conventional powder coatings can achieve such film thicknesses. These require powders of smaller particle size because with a self limiting application process such as electrostatic powder coating, it can normally be expected to give cured film thicknesses of similar magnitude to the diameter of the largest particles. Whilst powder coatings can be made at smaller particle size or selected by classification, these fine powders do not flow easily, having a high angle of repose, and they also present a potential explosion hazard under practical working conditions.

The use of lower stoving temperatures requires a low melt viscosity at the chosen temperature and a curing mechanism which will not be triggered during melt processing of the powder. A practical limit is normally set by the tendency of a powder to sinter at high ambient temperatures and the standard ASTM test for powders, for example, requires non-sintering at 50°C.

The accumulation of fines in overspray limits the re-use of powders in many cases because they not only reduce powder flow but also the flow and gloss in the coating. More recently developed application equipment, in which the powder forms a cloud surrounding the objects to be coated and where there is continuous powder recirculation, can prevent the build up of fines, but this process is not universally applicable.

The process of dispersing a powder coating in water and then using this slurry as a liquid paint can, in theory, lead to a reduction in all three problems. Wet grinding of the powder can reduce particle size without powder flow or explosion hazards and the presence of water reduces sintering with low melting point polymers, and application by any method appropriate to liquid paint will not give rise to particle classification effects. The use of slurry paints which are alternatively known as "aqueous powder

suspensions" has a number of other potential advantages including the use of existing application equipment, elimination of the colour change problem on production lines and, in theory at least, the possibility of tinting by the use of aqueous dispersions.

Disadvantages include an extra manufacturing stage, the need for additives to wet and suspend the powder particles and to prevent flash rusting. The presence of water probably has little effect on the energy needed to cure, but introduces the need for a short flash off time. Another potential problem is chemical instability resulting from hydrolysis of polymers or curing agents.

The first part of the work described in this paper concerns preformed powder coatings dispersed in water and deals with the choice of additives, the effect of grinding conditions, stability of resulting dispersions and the comparative performance of these dispersions against the original powder coatings.

The procedure of dry mixing pigment, resins, curing agents and additives and combining these in an extruder, followed by cooling, crushing, powdering, classifying, dispersing in water, grinding and stabilising, is expensive in labour, equipment and energy and retains some of the problems of powder coating, such as shade correction and production of highly pigmented systems. Powders have been made by spray drying of solution paints, but the cost of processing, the need for solvent recovery, and vapour explosion limit hazards all make this unattractive. However, for aqueous powder dispersions a technique has been developed whereby a solvent based paint is sprayed or stirred into water to form discrete globules. If the solvent is water soluble, then this will migrate into the water layer. The solid particles can then be removed by filtration and are then redispersed in water with any required additives. The aqueous solution of solvent which may typically be acetone is separated, for example, by distillation and the solvent re-used. A number of patents^{1,2,3} describe this process and a schematic diagram from one of these is shown in Figure 1. The process has

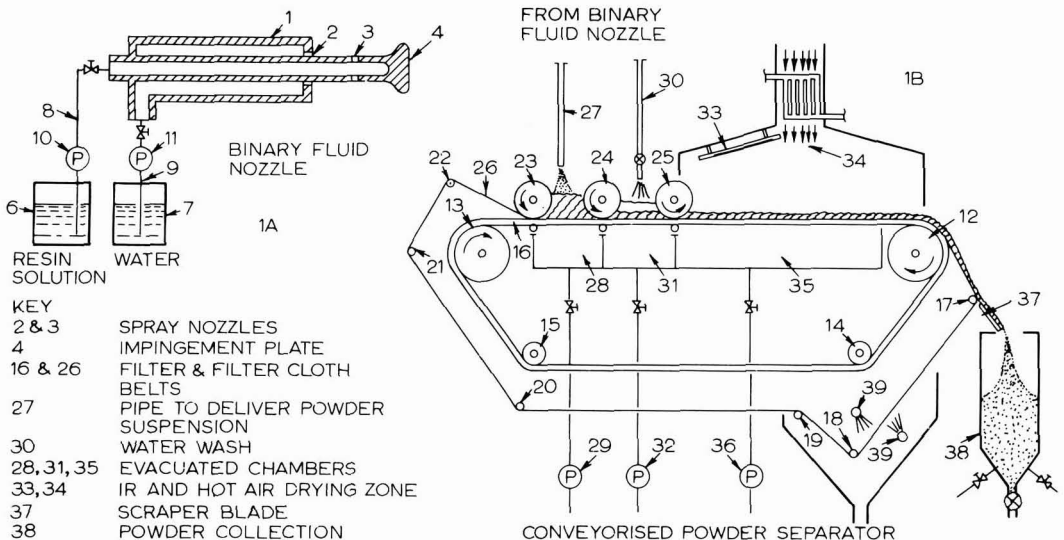


Figure 1

limitations when used for the production of powder coatings, but obviously has advantages if the powder is used in the form of an aqueous dispersion. The main disadvantage is the requirement to recover solvent from the aqueous solution.

Obviously aqueous dispersions of powdered resins can be combined with water soluble resins and early uses of this technique were disclosed in patents for electrodeposition coatings^{4,5}. In later developments^{6,7}, powder coatings were added to cationic or anionic water soluble polymers to give a system that was electrodeposited and where the curing stage gave rise to a homogeneous film. The coating using cationic resin has achieved commercial success for the priming of car bodies and components. It consists typically of a conventional epoxy powder coating dispersed in a water soluble resin resulting from the reaction of epoxy resin and diethanolamine. It produces thick films but has rather low throwing power and so is often followed by a high throwing power aqueous solution coating as a wet on wet process. These particular coatings were conceived as a method of electrodepositing powders and so the ratio of powder to water soluble resin is normally over 1 and typically 4-5 with the pigment being dispersed into the powder. Direct dispersion of pigment and resin into aqueous media is a more attractive process than the use of a pigmented powder, so the main study in this paper has been on what are referred to as "separate component aqueous powder suspensions".

It is possible to conceive of a spectrum of coatings ranging from powdered resin and pigment dispersion to those with a minimal amount of water soluble resin needed to wet and suspend the pigment and resin powder, and so on to a system where a powdered resin is used to modify the final performance or increase the effective solids content at application of a water based coating.

Aqueous powder dispersions

Refs. 8-10

Experimental

Powder coatings were made by premixing pigment, curing agent, resin and additives followed by dispersion on a heated two roll mill. After crushing, the product was ground to an average particle size of 50 microns.

Table 1
Powder compositions (% by weight)

Formulation No.	1	2	3
Titanium dioxide	32.70	32.65	27.30
Synolac 4200	32.70		
Synolac 4201			55.13
Synolac 4202		32.65	
Epoxy resin*	31.95	31.93	2.72
Blocked isocyanate*			13.64
Modaflow†	1.96	1.96	0.62
Stannous octoate	0.37	0.49	
Dibutyl tin dilaurate			0.27
Benzoil	0.32	0.32	0.32
	100.00	100.00	100.00

*As Table 5 †Monsanto Ltd

Aqueous powder dispersions were made by high speed mixing of the powder, water, wetting agent and additives. In some cases the powder was milled overnight in a ceramic ball mill, either dry or as an aqueous dispersion.

Powder coatings were applied by electrostatic spraying and aqueous dispersions by the use of a conventional air spray gun. Most coatings were applied to untreated mild steel and stoving was carried out in fan circulated ovens at the appropriate temperature.

Formulations

The resins used were:

Synolac 4200, a carboxyl functional polyester for use in powder coatings when cured with epoxy resin.

Synolac 4201, a hydroxyl functional polyester resin designed for use in powder coatings when cured with blocked isocyanate adducts.

Synolac 4202, a similar resin to 4200 but with a lower glass transition temperature (T_g) and melt viscosity.

Formulae used are listed in Table 1.

Choice of dispersing agents and additives

Initial experiments on pre-made powders demonstrated that the choice of surfactant was important in obtaining a dispersion that had controlled flocculation to prevent hard settlement but which allowed easy handling in a spray gun. Work with a mixture of surfactants giving HLB (hydrophilic to lipophilic balance) values between 4.3 and 15.0 indicated 7 as the optimum figure. At lower HLB values the dispersion was excessively pasty, whilst at higher values, hard sedimentation took place in a few days. From a variety of products examined, the optimum surfactant for dispersion and subsequent dispersion stability was found to be a combination of Tween 80 and Span 80 as used in the HLB series. Tween 80 is a polyoxethylene (20) sorbitan mono-oleate (HLB 15.0) and Span 80 is sorbitan mono-oleate (HLB 4.3).

Table 2
Some effects of thickeners and additives
in aqueous powder suspensions

Additive	Result
Ethyl hydroxycellulose	Satisfactory viscosity control but loss of gloss and slight loss of chemical resistance and colour
Polyethylene oxide homopolymer	
Polyacrylic acid	Poor stability but might improve with pH control
Polyacrylamide, medium or high molecular weight	Poor spraying characteristics but might improve with pH control
Polyacrylamide, low molecular weight	High content needed
Hexamethoxymethyl melamine	Poor film compatibility
Partially methylated hexamethylol melamine	Thickening on storage

Table 3
Comparison of performance of powder coating and aqueous powder suspensions

Stoving schedule Average film thickness Powder resin system	Powder electrostatic	Sprayed aqueous suspensions	
	30 minutes at 180°C 65 microns Synolac 4200 and epoxy resin	30 minutes at 160°C 65 microns Synolac 4202 and epoxy resin	
Cross hatch adhesion	100%	100%	100%
after overstove + 30 min	100%	100%	100%
Pencil hardness	H	H	H
Erichsen, mm	1.0	1.0	1.8
Gloss, 60°	69	61	86
after overstove	68	63	85
Gloss, 45°	47	33	72
after overstove	44	34	71
Gloss, 20°	28	17	32
after overstove	24	17	32
40% sulphuric acid 48 h	unaffected	unaffected	
40% sodium hydroxide 48 h	unaffected	unaffected	
50% acetic acid 48 h	unaffected	unaffected	
Lipstick stain	very slight	very slight	unaffected
Boot polish stain	moderate	moderate	moderate
Yellowness index	0.58	6.76	5.36
after overstove	0.52	9.52	7.24

Table 4
Examination of colour differences
with powder and aqueous powder suspensions

Coating	Yellowness index			Colour difference ΔE between 0.5 and 1.5 hours
	0.5 hour stoving	1.0 hour stoving	1.5 hours stoving	
White on Synolac 4200 electrostatic powder	0.58	0.52	1.17	0.80
aqueous powder suspension	6.76	9.52	9.04	2.7
White on Synolac 4202 electrostatic powder	0.08	-0.9	-0.98	2.1
aqueous powder suspension	5.36	7.24	7.27	1.0
Powder coatings 1 and 2 from Table 1				
Colour difference: steel versus aluminium panel overstoved	0.3 0.6		use of blocked isocyanate 1065B versus control without any in	4.6

The aqueous dispersions have a very low viscosity under shear and resemble pigment dispersions rather than normal paints, so the use of various thickeners was examined. In general, thickeners produce adverse side effects but they can be used in controlled quantities where limitations can be accepted. In Table 2 some of the materials tested are listed together with disadvantages that were noted.

Other additives may be desirable and these include anti-foam agents to prevent foam in the mill which can reduce grinding efficiency, and materials to prevent flash rusting. Sodium benzoate was found effective for the latter problem.

Results

In tables 3 and 4, comparisons are made between powder coatings applied by electrostatic spray and their aqueous

dispersion counterparts. It will be seen that performance is largely unaffected by application from an aqueous dispersion but there is a slight loss of gloss and whiteness, probably due to the effect of the surfactant. The differences are acceptable for most applications and could probably be reduced or eliminated by further examination of surfactant type and level. Maximum discolouration was obtained with a blocked isocyanate cured coating and this was at a level which would be unacceptable in a domestic appliance coating.

A number of attempts were made to reduce the particle size of the powder coatings in aqueous dispersion in order to produce lower thickness coatings. In these tests, both dry and wet ball mill grinding were employed for periods of up to 72 hours, but the particular powder coatings examined did not reduce in particle size sufficiently to produce thin film coatings. This is in contrast to published information on epoxy coatings^{8,9,10} but may relate to the

rather more friable nature of epoxy powders, compared with the polyester materials used in the present study. Since the main objective of the work was to develop aqueous dispersions using separate components, the emphasis was switched to these systems which are described in the next section.

Separate component aqueous powder dispersions

Ref. 11

Experimental

The general procedure adopted was to take the resin components and after a pre-grind stage, pass these through a microniser to reduce them to a fine powder. Particle size of the powder depended to some extent on the specific resin used, but in general, particles varied from about 10 to about 50 microns. This micronised resin was then mixed with pigment and dry ball milled overnight in a ceramic mill. The effect of this dry grinding is shown in figures 2, 3 and 4 which represent the unmilled resin-pigment mixture, the same after a four hour grinding period and the same after 24 hours respectively. The main effect, initially, is to reduce oversized particles, but continuous attrition takes place and after 24 hours most resin particles fall in the size range 5-25 microns. There is evidence that the pigment present assists the size reduction of the resin particles since grinding is less effective when resin is ground alone.

After the dry grinding stage, water was added with selective additives and wet milling took place for a further overnight period. Many variations were examined including separate wet milling in the absence and in the presence of the surfactants. The general problem experienced is that wet milling without surfactants gives rise to highly flocculated mixes which do not grind owing to reduced ball tumbling, whilst the presence of surfactants often leads to excessive foaming which also prevents satisfactory grinding. As experience was gained in the choice and use of additives, improvements in grinding efficiency were obtained, so that the coatings which were used for the comparative performance experiments had resin particle sizes in the range 5-15 microns.

After milling, the coatings were adjusted, if necessary, with further additives, then sprayed onto mild steel panels using a larger than normal spray gun orifice and after a 10 minute flash-off period, stoved at the appropriate temperature.

Formulations

Most of the coatings made were based on a combination of the acid functional polyester, Synolac 4200, and a bisphenol epoxy resin of epoxide equivalent 850-940. The acid functional polyester of lower T_g , Synolac 4202, was also employed to give better pigment wetting and flow during the stoving stage. A urethane system based on the hydroxy functional polyester Synolac 4201 cured with a blocked isocyanate was also examined, but the physical nature of the isocyanate adduct required that it be freeze ground before adding to the mill base.

Typical formulae employed are listed in Table 5 and it is these compositions which were compared for performance with electrostatically applied powder coatings and the aqueous powder dispersions using pre-made powders. It will be seen that the formulae all incorporate the mixed

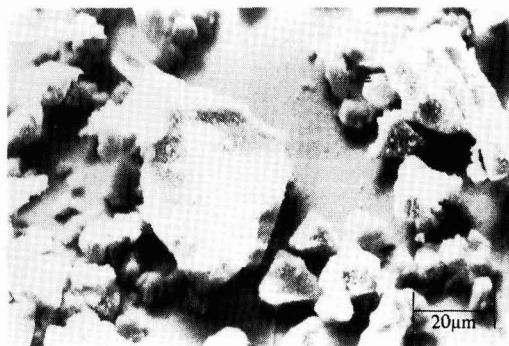


Figure 2. Unmilled resin pigment mixture

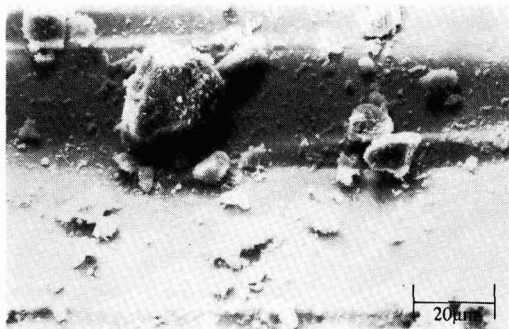


Figure 3. Resin pigment mixture milled for 4 hours

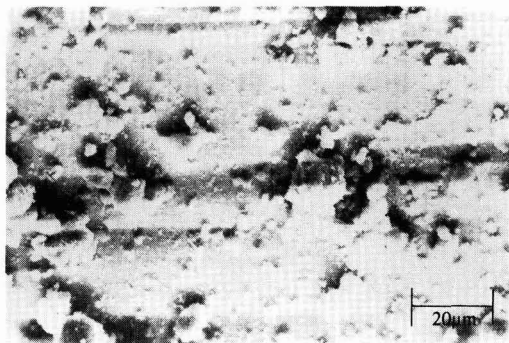


Figure 4. Pigment resin mixture milled for 24 hours

surfactant, which was found effective in the dispersion of powder coatings, and they also contain sodium benzoate to prevent flash rusting.

In the course of the work it was observed that where water soluble resins were added to modify film properties, there was a pH drift on storage when an acid functional polyester resin was used, presumably due to the reaction of base with the acid groups on the surface of the resin particle. This pH drift was essentially complete within two days and is shown in Table 6.

The original concept of the work was that solutions of water soluble resin would be needed to stabilise the disper-

Table 5
Separate component aqueous suspensions (SCAPS)

	White gloss I	White gloss II	Black gloss	Iron oxide primer
Titanium dioxide	10.40	10.80		
Carbon black			1.15	
Red iron oxide				10.80
Blanc fixe				18.85
Strontium chromate				3.32
Synolac 4200*	14.86		14.40	8.24
Synolac 4201*		24.69		
Epoxy resin†	14.86		14.40	8.24
Blocked isocyanate‡		6.17		
Flow control agent§	0.20	0.21		
Sodium benzoate	0.24	0.25	0.18	0.30
Water	57.36	55.89	67.43	48.49
Span 80¶	1.62	1.54	1.90	1.37
Tween 80¶	0.46	0.45	0.54	0.39
	100.00	100.00	100.00	100.00
Total solids %	40.3	41.9	30.0	49.5
Vehicle solids %	33.4	34.8	29.1	24.6
Pigment/binder ratio	0.35:1	0.35:1	0.04:1	2:1

Generalised process. Charge resins, pigments and dry additives to ball mill, grind overnight. Add water and surfactants, grind overnight. All coatings may be reduced with up to 10% by volume of water before spraying.

*Cray Valley Products Ltd †Vebe Chemie 1065B ¶Atlas Chemicals Ltd
 ‡Epoxide equivalent 850-940 §Byk Mallinkrodt Ltd VP.360P

Table 6
Drift in pH of resin/powder dispersion at room temperature

Powder percentage on solution resin	pH				Comments
	Initial	1 day	2 days	7 days	
0	7.7	7.8	7.8	↑ no change ↓	
10	7.6	7.5	7.6		
30	7.3	6.8	6.8		
50	7.3	6.6	6.5		
50	7.7	6.8	6.7		
50	8.5	7.1	7.0		added ammonia added ammonia

Powdered resin Synolac 4200 (polyester acid value 70-100)
 Solution resin Synaqua 845S, tertiary amine solubilised acid functional acrylic resin

sions of pigment and powdered resin and to provide satisfactory film coalescence. However, surprisingly good coatings were produced without any water soluble resin being present, so work was concentrated on dispersions of resin and pigment with appropriate additives.

In the pre-made powder coatings discussed in a previous section, a pigment/binder ratio of 0.5:1 with titanium dioxide was commonly employed, but a rather lower pigmentation was found to be optimum in the separate component system. This is illustrated in Table 7 from which a pigment/binder ratio of 0.35:1 was chosen for further work. It will be noted that at very low pigment levels cissing takes place, which is not too surprising as during the curing operation two resins will be present differing in melting point and melt viscosity, so pigment obviously helps to reduce mobility of the coating.

The dispersions are thixotropic and of low high shear

viscosity so the optimum dilution for spraying needs to be established by trial and error. In Table 8, the effect of solids on appearance was examined which demonstrated the value of using the highest solids that could conveniently be sprayed.

Results

In Table 9 the previous comparison of a powder coating with an aqueous powder suspension is extended so as to include the separate component finish, which, as will be seen from the cross hatch results, has good film integrity and at the lower pigmentation used, has a gloss which is comparable with the corresponding powder. There is a slight increase in staining and the film was slightly yellower. This is due, in part, to the lower pigment level.

Many other pigmentations were examined with the general finding that good coherent coatings of reasonable

Table 7
Effect of pigment/binder ratio in separate component white

Pigment/ binder ratio	Flow	Film thickness (microns)	Film defects	Gloss, 45°	Gloss, 20°
0.5	fairly good	40	none	56	10
0.4	good	50	slight cissing	56	11
0.35	very good	50	slight cissing	72	19
0.3	good	60	slight cissing	57	11
0.2	very good	70	severe cissing	65	16
0.1	excellent	60	severe cissing	80	37

All systems based on Synolac 4200, epoxy resin and titanium dioxide and applied at 37% solids. Slight cissing could be cured with flow control additive VP.360P.

Table 8
Effect of solids on thickness and appearance of
separate component white

Total solids %	Opacity	Flow	Film thickness (microns)	Gloss, 45°	Gloss, 20°
45	good	moderate	65	51	9
40	good	moderate	65	47	8
37	good	good	70	37	5
35	moderate	good	45	49	9
30	poor	moderate	45	46	7
25	poor	poor	30	43	6

System as Table 7 - 0.5:1 pigment/binder ratio

gloss could be produced with most common pigments. Combinations of pigments such as phthalocyanine blue and titanium dioxide gave completely homogeneous colours, and examination of the coatings under the electron microscope (Figure 5) showed no residual surface structure that could be related to the original resin particles. If higher pigmentation levels were used, then a noticeable surface structure was obtained and Figure 6 shows this for the primer formulation given in Table 5. In addition to the surface structure, the electron microscope photograph also shows fissures with a width of around 20 microns and a length of about 100 microns. These fissures were evenly distributed across the coating and may be a mud cracking phenomenon which is not visible to the naked eye. Such mud cracking has been seen with aqueous powder suspensions and might be corrected, as suggested in a patent¹¹, by the addition of glycols. Salt spray testing showed generalised rusting of the substrate, but when overcoated with a suitable finish, excellent results were obtained as indicated in Table 10, where data is also presented on one coat white finishes. Even with the structure in the primer, the coating gave 100 per cent cross hatch adhesion and an Erichsen indentation of 6.4 mm, as a 30 micron film.

Subsequent work has demonstrated that additions of Calgon S (sodium hexametaphosphate) at the grinding stage can improve efficiency, probably because a less thixotropic ball mill composition is obtained with little or no foaming. An appropriate level is 0.5 per cent of sodium hexametaphosphate based on resin solids and this gives rise to a typical formulation and process as follows:

White gloss aqueous powder system using separate components

Part A	Titanium dioxide	9.77
	Synolac 4200, pre-micronised	13.95
	Epoxy resin, pre-micronised	13.95
	Flow control agent VP-360-P	0.19
	Sodium benzoate	0.22
Part B	5% Calgon S* in water	3.77
	Water	33.68
	Span 80	0.95
	Tween 80	0.27
Part C	Water	22.44
	Span 80	0.63
	Tween 80	0.18
		100.00
	Total solids	33.7%
	Vehicle solids	30.9%
	Pigment/binder ratio	0.35:1

Instructions:

- (i) Charge Part A to mill and grind for 16 hours.
- (ii) Charge Part B to mill having premixed water and surfactants and grind for 16 hours.
- (iii) Charge Part C, mix and discharge.

*Albright & Wilson

Work is continuing on the effectiveness of post additions of anodic and cathodic water soluble resins, on the

Table 9

Comparison of performance of powder coating and separate component aqueous powder suspension (SCAPS)

	Application method	
	Powder electrostatic	SCAPS*
Cross hatch adhesion	100%	100%
after overstove	100%	100%
Pencil hardness	H	H
Erichsen, mm	1.0	0.8
after overstove	1.3	1.4
Gloss, 60°	69	66
after overstove	68	59
Gloss, 45°	47	52
after overstove	44	31
Gloss, 20°	28	19
after overstove	24	13
MEK Swab 60 seconds	unaffected	slight loss of gloss
Lipstick stain	very slight	slight
Boot polish stain	moderate	slightly inferior
Yellowness index	0.58	13.39
after overstove	0.52	15.34

*White gloss 1 from Table 5

long term stability of the dispersions produced and on the effect of additives to improve film coalescence, particularly at higher pigment/binder ratios.

Conclusions

Powder coatings may readily be dispersed in water using small quantities of surfactant with an HLB value of around 7. Little difference in performance is observed compared with the same powder applied electrostatically except for slight discolouration which may respond to further investigation.

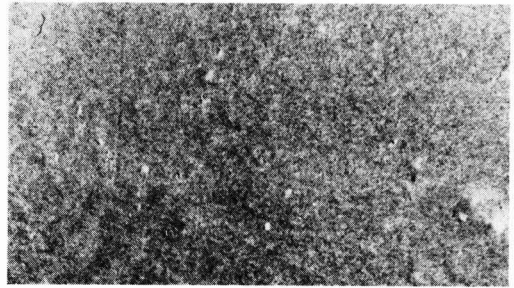


Figure 5. Surface of stoved separate component APS panel showing pigment particles but no resin structure (plate width equivalent to 50 microns)

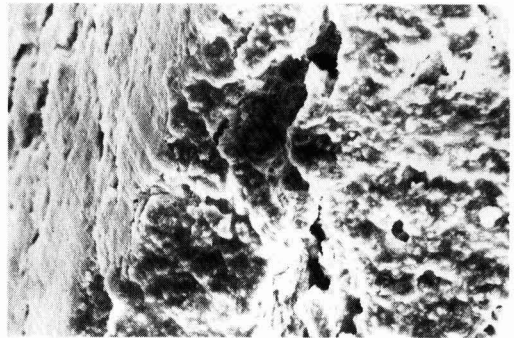


Figure 6. Primer formulation showing fissure

A promising new type of coating has been developed in which pigments, resins and appropriate additives are ground together in water so that the particle size of the resin is reduced to around 10 microns. Examination under an electron microscope shows that good film integrity is obtained in the more lightly pigmented systems and the

Table 10
ASTM salt spray results

Panel	Stoved for 0.5 h at (°C)	Blistering	Creep from scratch (mm)	Rust under coating
Single coat				
4200 powder	180	none	3	none
4200 APS	180	none	3	none
4200 SCAPS	180	slight	3	none
4201 APS	180	none	3	none
4202 APS	160	moderate	3	very slight
Solvent oil free polyester	150	severe	3	severe
Over 4200 SCAPS primer (180°C)				
4200 powder	180	none	4	none
4200 APS	180	none	3	none
4200 SCAPS	180	none	4	none
4201 APS	180	around scratch	4	none
4202 APS	160	around scratch	3	none
Solvent oil free polyester	150	slight	4	none

Duration 200 hours; substrate, degreased mild steel

performance of the final coatings approaches that of powder coatings made with the same resins. At higher pigmentation levels the films may have micro-porosity but they still have good mechanical properties and perform well when finished with a non-porous coating. These separate component aqueous powder dispersions contain no volatile organic material. They can be applied at higher solids contents than aqueous solution coatings and can be expected, after further development, to give rise to lower curing schedules and lower film weights than are currently possible with powder coatings.

Acknowledgements

Thanks are due to Steve Turner, Roland Topping, Kevin O'Hara and Ken Smith for laboratory work and advice, and Derek Wilson for stereoscan photographs.

[Received 15 April 1981]

References

1. British patent 1,390,265
2. Ramsay, R. J., *PPCJ*, 1981, Vol. 17, 7 Jan.
3. British patent 1,576,782
4. British patent 1,164,153
5. British patent 1,164,154
6. British patent 1,407,410
7. British patent 1,432,200
8. Bruggerk *et al.*, *Modern Paint & Coatings*, 1979, vol. 53.
9. Aqueous Powder Suspension Coatings, *Paint Manufacture & Resin News*, 1980, July/August, 14.
10. Provisional Instruction Sheet, Ciba-Geigy, APS Paint Systems, October 1979.
11. British patent 1,521,354

Addendum

Since the paper was written it has been found that further improvements in surface appearance and gloss can be obtained by use of a self condensing resin. Such a material is a product Synolac 4250 containing carboxyl hydroxy and epoxy groups. A typical formulation using this resin is:

Blue gloss SCAPS finish

Part A	Phthalocyanine blue	0.16
	Titanium dioxide	8.20
	SYNOLAC 4250	23.96
	Flow control agent VP360P	0.16
	Sodium benzoate	0.19
Part B	5% Calgon S in water	3.24
	Water	28.95
	Span 80	0.78
	Tween 80	0.23
Part C	Water	19.30
	Span 80	0.52
	Tween 80	0.15
	30% polyvinyl pyrrolidone solution in water*	14.16
		<hr/>
	Total solids	36.6%
	Vehicle solids	30.8%
	Pigment:binder ratio	0.3:1.0

Charge Part A to ball mill and grind 16 hours. Charge Part B to mill after premixing water and surfactants and grind for 16 hours. Premix Part C and add to ball mill charge.

*BASF

Discussion at Bath Conference

DR A. RAMIG: Many powder coatings can normally achieve a salt spray resistance of 1000 hours or more. Do you expect products developed from the aqueous powder concept to achieve this kind of performance?

MR A. G. NORTH: At this point we can see no reason why they shouldn't. They are fully integrated films. We used one weeks salt spray purely as a quick sorting test.

DR R. SCHWINDT: You showed us very interesting results from salt spray tests. Did you do any testing of durability, either outdoors or artificial weathering?

MR A. G. NORTH: Not at this stage. The work has been continuously developing and each week brings some improvement. The particular system I have shown you is an epoxy polyester type and it will have reasonable durability but there's no reason why the coating shouldn't be extended to other more durable systems.

DR M. L. ELLINGER: Can the discolouration seen on steel panels be avoided by a suitable surface pretreatment, such as phosphating?

MR A. G. NORTH: The samples shown were not pretreated but obviously it is possible to reduce iron staining by suitable pretreatment.

MR B. P. F. GOLDIE: Isn't the poor colour of the aqueous dispersed coating on steel due to flash rusting which is a common fault with water based systems?

MR A. G. NORTH: Yes it is.

DR L. VALENTINE: You referred many times to ballmilling - can you use alternative types of dispersion equipment, e.g. high speed dispersers, equally satisfactorily?

MR A. G. NORTH: I think not, grinding seems to be necessary. As I mentioned, economics come into this. It would be feasible but more costly to supply a resin which was of sufficiently small particle size to use a high speed disperser. I think the wet stage could be high speed dispersed, but at the moment we think the economics are most attractive with a dry grinding stage to start with. Also, something probably happens in the dry grinding stage other than just particle size reduction because we can't achieve the same order of performance without dry grinding even when using smaller particle size resin particles.

Modern practices in formulating powder coatings*

By S. T. Harris

The Old Rectory, Nether Whitacre, West Midlands B46 2DU, England

Summary

In the early days of thermosetting powder coatings the compounding techniques of the plastics industry were adopted by the coatings technologist without any background knowledge of the rheological behaviour of solvent-free, hot melt mixed systems. A decade of investigative development with resins, curing agents, pigments and an appreciation of the role of additives has produced standard practices for formulating sophisticated powder coatings.

This paper considers the melt flow properties of resins and the

influence of molecular weight spread and viscosity upon the levelling of the cured film. The effect of varying the curing agent, the stoving temperature and the contribution of pigment type and loading are also considered.

After a brief discussion of the role played by additives in thermosetting powder coatings the paper concludes with a speculative account of the various paths of future development.

Keywords

Types and classes of coatings and allied products

powder coating
thermosetting coating

Properties, characteristics and conditions primarily associated with

materials in general

viscosity

raw materials for coatings and allied products

softening point

dried or cured films

gloss

Raw materials for coatings

binders (resins, etc.)

acrylic resin
epoxy resin
phenolic resin
polyester resin

prime pigments and dyes

titanium dioxide

catalysts, accelerators, inhibitors

accelerator
hardener

Les techniques modernes de la formulation des revêtements en poudre

Résumé

Pendant la période initiale de la mise au point des revêtements en poudre thermodurcissables les technologues ont adopté les techniques de confection que l'on utilisait à l'industrie de matières plastiques, sans en même temps aucune connaissance réelle du comportement rhéologique des systèmes mixtes, fusibles et exempts de solvant. Une décennie de développement en ce qui concerne les résines, les durcisseurs, les pigments, liée à une compréhension du rôle joué par les adjuvants ont abouti à la mise au point des pratiques étalons pour formuler les revêtements en poudre fort évolués.

En cet exposé on donne une considération des caractéristiques

d'écoulement en fusion des résines et de l'influence qu'exerce l'écart des poids moléculaires et également la viscosité sur l'étalement du film durci. On considère l'effet des changements de l'agent de durcissement et de la température d'étuvage, et d'ailleurs l'influence qu'exercent le type et la quantité de pigment.

Après une brève considération du rôle en revêtements en poudre thermodurcissables que jouent les adjuvants, on conclut en offrant une spéculation sur les diverses possibilités à l'égard du développement à venir.

Die moderne Formulierungstechnik für Pulverlacke

Zusammenfassung

Obwohl die Pulverlacktechniker am Anfang der Entwicklung von hitzehärtenden Pulverlacken keine reelle Kenntnis von dem

rheologischen Verhalten der lösungsmittelfreien heisschmelzbaren Gemischsystemen besaßen, nahmen sie die

*Paper presented at the Association's Conference held at Bath, 17-20 June 1981

Verarbeitungstechnik der Kunststoffindustrie an. Eine jahrzehnte Untersuchung hinsichtlich der Harze, Härtungsmittel, Pigmente, sowie ein Verständnis für die Rolle der Additive haben Normaltechnik zur Formulierung der ausgearbeiteten Pulverlacke hervorgebracht.

In diesem Aufsatz werden die Schmelzfließfähigkeiten der Harze sowie der auf den Verlauf des härtenden Films wirkenden Einflusses der Molekulargewichtstreuung und der Viskosität

betrachtet. Die Wirkung des Härtsersaustausches, der Einbrenntemperatur sowie der Einfluss des Pigment -typs und -gehalts werden auch betrachtet.

Nach einer kurzen Diskussion über der Rolle in hitzehärtenden Pulverlacken, die Additive spielen, wird der Aufsatz mit einer Spekulation auf die verschiedenen Künftigentwicklungsrichtungen beendet.

Introduction

It must be appreciated at the outset that the market for thermosetting powder coatings is still dominated by epoxy resin, and the recent upsurge in polyester resin usage is almost entirely complementary to this established market. The remarks are mostly concerned with investigative work carried out on epoxy resins but many of the conclusions are likely to be applicable to polyester and acrylic resin systems.

Choice of resin

Refs. 1-6

A formulator of modern thermosetting powder coatings has two main problems. The need to decrease overall film thickness of the cured coating and to reduce the time and temperature factors of the stoving schedule. These must be achieved without affecting the flow and appearance of the film, and this becomes increasingly more difficult as the fusion temperatures of the powder particles and the temperatures at which curing commences come closer together. There is barely enough time for the melt viscosity to achieve the mobility for efficient levelling before it is overtaken by the onset of gelation. It is appreciated that a resin may be chosen with a lower glass transition temperature, lower melt viscosity and lower molecular weight spread in an attempt to extend the period between melt flow and curing, but this approach invariably results in a reduction of physical properties with poorer powder handling and storage.

Melt viscosity depends only on temperature for thermoplastic resins, but for thermosetting resins this is also time dependent. Klaren¹ demonstrated this effect by measuring the viscosity/time profiles of a standard powder system subjected to different rates of heating. The results showed that a lower melt viscosity was obtained by an increased rate of heating, and a more practical demonstration of improved film flow with domestic appliance powder coatings was reported by Drew².

It did not take the formulator long to realise that epoxy resins which were considered to be equivalent in basic properties were often different in melt flow characteristics, but the most significant adjustments of melt flow viscosity were effected by mixing the epoxy resin with a compatible resin component or by partial esterification with dimeric acids. The effect of a relatively small resin modification was shown in the comparison of two resins from Ciba Geigy, by Brugger and Gempeler³ (Table 1). Solution viscosities of these resins do not differ greatly but the effect upon melt viscosity is pronounced.

Viscoelastic measurements on resins cured with a substituted dicyandiamide hardener demonstrate the effect

Table 1

Temperature (°C)	Melt viscosities (Nsm ⁻²)	
	GT 7004	GT 7203
120	47,000	163,000
140	8,300	3,800
160	2,600	1,300
200	400	250

of the resin type upon the rheology. Figures 1, 2 and 3 show the behaviour during curing of the two powder grade epoxies (Ciba Geigy) GT 7004 and GT 7203 and the comparison with a standard coatings quality resin GT 7084. The heat up rates were 22-24°C/minute from 90-200°C.

The physical characteristics of these resins are shown in Table 2.

Table 2

Resin	Epoxide equivalent (approx.)	Melt viscosity at 175°C (Nsm ⁻²)	Softening point (°C) ring and ball
GT 7084	880	1.0	95
GT 7004	760	1.0	99
GT 7203	650	0.8	88
GT 1999	920	1.1	90

Figure 1 illustrates the normal melt behaviour of a conventional epoxy system and the features of a powder grade epoxy system are shown in Figure 2. Closer control of molecular weight spread is reflected in the lower epoxide equivalent value and the slightly higher initial melting point. Higher reactivity is a consequence of this selection with a predictable reduction in the time spent at minimum viscosity. It is desirable to extend this period at minimum viscosity without detriment to the cure cycle. Figure 3 shows the modified epoxy GT 7203 remaining at minimum viscosity for a considerably longer period and the expected improvement in film flow is achieved without reducing the curing time.

It should be noted that the minimum viscosity of the GT 7203 system is not as low as that attained with the GT 7004 system, although the initial viscosity of the resin is significantly lower. This is probably due to the poorer compatibility of the GT 7203 system with the substituted dicyandiamide hardener.

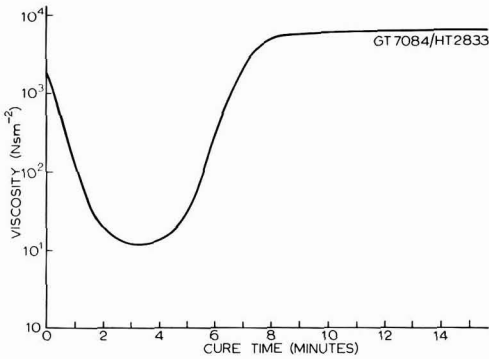


Figure 1.

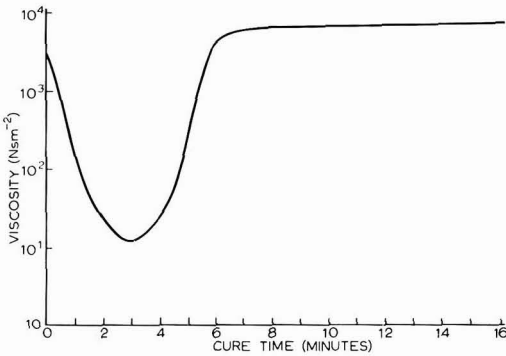


Figure 2.

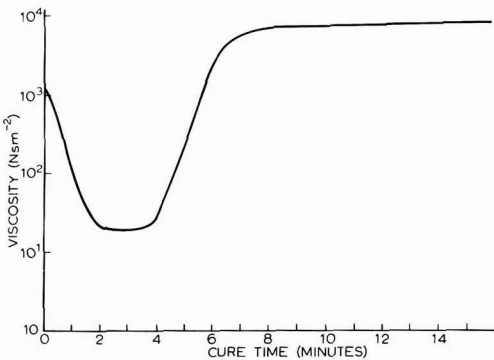


Figure 3.

An alternative method for improving the melt flow characteristics of epoxy resin is chemical modification by partial esterification with dimeric acids. A product of this type is marketed by Ciba Geigy under the reference GT 1999 and although a viscoelastomeric assessment of this powder resin is not available, the physical characteristics are shown in Table 2. Dimeric acid modification improves the flow simply by reducing the resin reactivity and lowering the melting point. This type of product gives excellent film flow properties and is most useful for formulating smooth matt finishes.

In combination with carboxyl terminated polyester resins, it is possible to formulate powder coatings with good flow and high gloss levels which are eminently suitable for decorative purposes.

A method for assessing the non-isothermal viscosity change during the curing cycle is the rolling ball technique which has been applied to powder coatings by Nakamichi⁴.

A small ball is embedded in the coating on an inclined substrate and the velocity of the ball is followed as a function of time. Viscosity is evaluated from the reciprocal velocity in accordance with the following:

$$\eta = K \frac{1}{V}$$

$$K = \frac{2 \sin \alpha (\rho_K - K_1 \rho_F) g r^2}{q K_2}$$

where K_1 and K_2 are constants, ρ_K is the density of the ball, ρ_F is the density of the liquid, r is the radius of the ball, α is the angle of inclination, g is acceleration due to gravity, η is the liquid viscosity, and V is the velocity of the ball.

Low molecular weight epoxies and modified versions give a linear relationship approximating to:

$$\eta = \frac{15.2}{V}$$

The fixed experimental conditions were:

steel ball weight	216 mg
angle of inclination	30°
film thickness	80 μm
substrate	steel panel

There are some limitations to this method but it is simple to apply and there is good agreement between flow and film appearance when the area under the reciprocal viscosity/time curves is determined.

The relative amount of flow (A) can be calculated from viscosity measurements determined by other methods and Nakamichi has translated results by McKay⁵ in the manner shown in Table 3.

The effect of resin type upon the performance properties has been discussed briefly in relation to the melt flow properties, and the influence upon this property of closer molecular weight control and resin modification has also been discussed.

It is possible, however, to manufacture epoxy resins to the same specification and still obtain considerable variations in reactivity with the same commercially available hardener.

Table 4 shows the comparative gelation times at 180°C of four commercially available epoxy resins reacted with four commercially available hardeners.

Significantly different gel times occur with the two accelerated dicyandiamide systems and this may be due to the poor compatibility of these hardeners with epoxy resins.

Table 3
Melt viscosity behaviour of a powder grade epoxy resin with various curing agents

Curing agent	Minimum viscosity η min (Nsm^{-2})	Time of η min (sec)	Heating rate ($^{\circ}\text{C}/\text{min}$)	Relative flow A_t
Dicyandiamide	100	180	23.5	1.00
Dicyandiamide + imidazole	300	120	24.0	0.23
<u>Modified dicyandiamide</u>				
A	150	180	24.0	0.68
B	500	135	28.0	0.11
C	90	180	24.0	0.70
D	170	150	24.0	0.33
<u>Modified acid anhydride</u>				
E	150	150	20.0	0.47
F	180	135	24.0	0.35
G	220	130	25.0	0.26

Table 4
Gelation times at 180°C

Resin	Accelerated dicyandiamide HT 2831 (Ciba Geigy) (sec)	Accelerated dicyandiamide DX 107 (Shell Epikure) (sec)	Substituted dicyandiamide HT 2833 (Ciba Geigy) (sec)	Polyfunctional acid HT 1947 (Ciba Geigy) (sec)
1	40	65	145	235
2	160	280	210	205
3	50	85	170	208
4	65	115	125	240

It is interesting to note that resin 2 has the slowest gelation rate with the accelerated and substituted dicyandiamide systems but the fastest rate with the polyfunctional acid.

The reactivity of epoxy resins with a particular hardener is influenced by changes other than those of equivalent weight, viscosity and softening point of the basic epoxy.

In Table 5 a range of epoxy powder grade resins are cured with the same substituted dicyandiamide hardener and the physical properties of the powder coating films are compared.

There are several points of interest in Table 5.

In the comparison of resins 6 and 8 the figures for Kofler bench gel times are identical but the time to full cure of the resin 8 system is 33 per cent longer.

As a general rule the mechanical properties improve with increasing molecular weight of the epoxy resin but this is not evident in the results quoted for systems 4 and 8.

If the coating is deficient in flexibility or adhesion, then these faults must relate to inconsistencies in the rate of curing or the inability of the coating to adequately "wet" the substrate. In view of the anomalies between gel time and full cure shown by systems 6 and 8, it is probable that the faults are caused by the lack of uniformity during the

curing cycle. Widespread variation in the molecular species could influence the smoothness of the cross-linking reaction and the presence of catalytic amounts of impurities could be another factor.

The parameters which effect pigment wetting during the hot melt compounding of thermosetting epoxy powder coatings have been assessed in a comprehensive development programme undertaken by Warren⁶.

More than ninety powder coatings were prepared by hot melt compounding. The formulations were based upon one grade of titanium dioxide with variation in the pigment loading. Several grades of epoxy resin and a range of hardeners were employed in this assessment.

The hardener systems were:
anhydride – trimellitic anhydride
acid type – Ciba Geigy HT 1947
polyester – commercial polyester – acid value 70-100
substituted dicyandiamide – Ciba Geigy HT 2844
accelerated dicyandiamide – commercially available product
phenol novolac resin – Ciba Geigy XD 4049

Epoxy resin grades were:
(A) A "4" type BPA epoxy resin of EV 1.20-1.40. This is a general purpose resin for powders.
(B) A "3" type BPA epoxy resin of EV 1.25-1.45. Designed to give high reactivity, high gloss and good flow with acid/anhydride hardeners.

Table 5

Resin	Epoxide equivalent	Softening point °C (R & B)	Kofler gel time (minutes)			Time to full cure at 180°C (minutes)	Gloss 60° head	Erichsen distensibility test mm [microns]	Reverse impact mm [microns]	Flexibility 1.25 cm mandrel bend [microns]
			150	180	200					
1	625	77	18.0	8.0	3.5	26	96	9.7 [85]	0.6 [100]	fail 90° [70]
2	862	98	19.0	8.4	3.8	27	105	9.2 [85]	2.5 [70]	pass 180° [80]
3	769	95	18.0	8.0	3.5	26	99	10.0 [80]	2.0 [95]	pass 180° [90]
4	833	100	19.0	9.5	4.5	28	102	9.0 [100]	0.6 [90]	pass 180° [90]
5	909	100	17.0	7.0	3.5	20	102	9.0 [90]	2.0 [85]	pass 180°C [80]
6	714	98	16.0	6.5	3.0	18	102	8.3 [90]	2.5 [105]	pass 180° [80]
7	735	98	18.0	7.5	3.5	24	105	9.8 [85]	2.5 [95]	pass 180° [90]
8	793	100	16.0	6.5	3.0	24	107	8.3 [100]	2.5 [110]	fail 40° [105]

- (C) A dimerized acid modified "4" type epoxy resin incorporating some features of resin B. EV 1.00-1.20.
 (D) A "4" type epoxy resin for general purpose powder coatings but differing slightly from resin A. EV 1.20-1.45.
 (E) A "3" type epoxy resin version of D. EV 1.38-1.65.
 (F) A "3" type epoxy resin of wide molecular weight distribution. EV 1.45-1.65.
 (G) A "3" type epoxy resin similar to resin B. EV 1.25-1.40.

Each powder coating film was assessed by gloss measurements as a direct means of evaluating pigment wetting characteristics.

The first set of graphs (figures 4-9) show the effect of hardener type upon a standard epoxy resin. A drastic fall off in gloss level is shown in Figure 5 which is probably due to the limited compatibility of the acid hardener. The significant gloss reduction in Figure 6 is more difficult to explain since the resinous polyester hardener would be expected to have reasonable compatibility with the epoxy resin. A possible explanation is the temperature of extrusion, since epoxy/polyester systems benefit from a higher processing temperature.

The advantages of the substituted dicyandiamide are clearly evident in figures 7 and 8 in the comparison with accelerated dicyandiamide.

Figures 10-16 illustrate the effect of varying the resin type with a substituted dicyandiamide curing agent. Although the resin B type systems have higher gloss levels at low pigmentation, there is a marked falling off of gloss at high pigment loadings.

Acid type hardeners give high gloss readings at low pigment levels (figures 17-23).

In recent years the high cost of energy has helped to promote the market for powder coatings, but the pressures have been on the powder formulators to reduce the high stoving temperatures to effect even greater fuel economies.

This has brought about the development of resinous hardener systems, more highly reactive resins or catalysed versions of standard powder coatings resins.

Dow Chemical have introduced a resinous phenolic hardener with accelerators incorporated which can be used to cure epoxy resins or epoxy novolacs. This new type of hardener has a lower melt viscosity than the epoxy resin and the hybrid system exhibits improved film flow properties.

It is now possible to produce powder coating films with excellent mechanical properties when cured at temperatures of 120-140°C for 10-20 minutes.

A whole new range of polyesters have been developed for low temperature curing epoxy systems, but many of these products have poor storage stability and the film flow is considerably reduced.

The role of additives in powder coatings has been limited to flow control polymers based upon polyacrylate systems.

Whilst these are ideal for controlling the surface tension of the molten film they do not improve the compatibility of the resin and hardener, nor do they affect the ability of the binder to improve pigment wetting.

There is no doubt that wetting agents can be incorporated in powder coating premixes to significantly improve pigment wetting, but there is no published literature on this aspect of powder formulations.

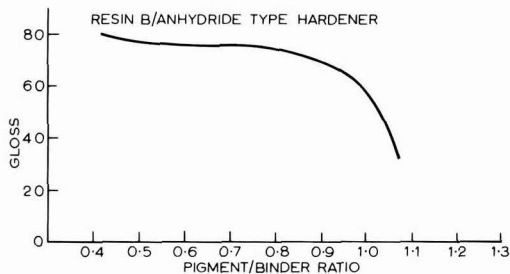


Figure 4.

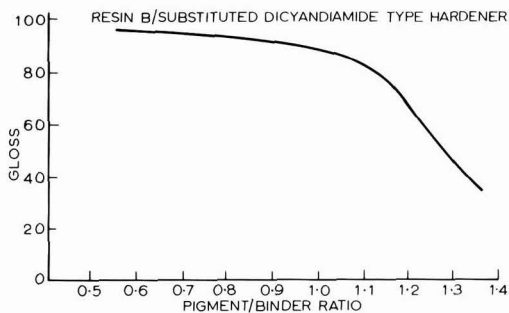


Figure 7.

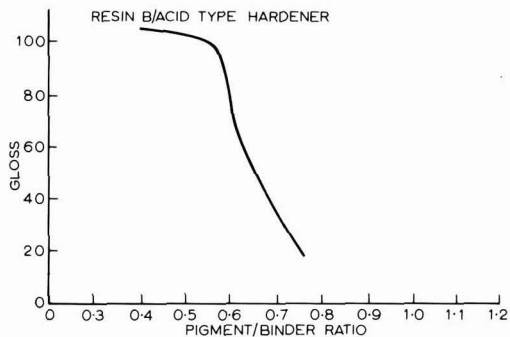


Figure 5.

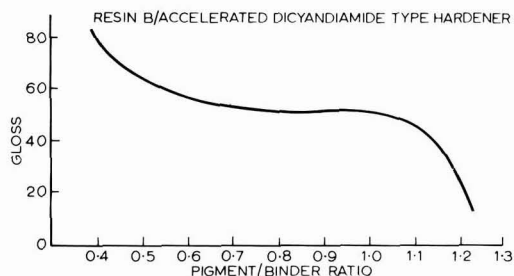


Figure 8.

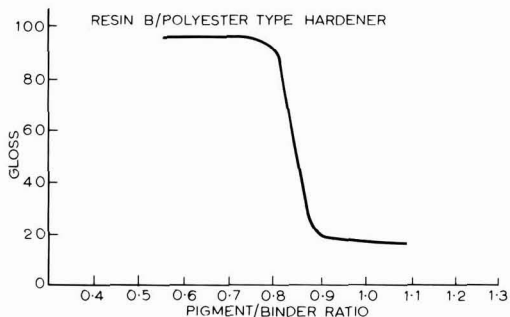


Figure 6.

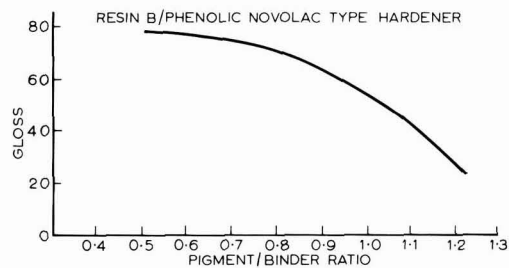


Figure 9.

The effect of additives upon the deposition efficiency of the powder coating is another unexplored area of formulation.

In 1973, at the OCCA Conference in Eastbourne, the author predicted a number of future trends in powder coatings development towards the year 2000. With almost two decades to this target, at least half of the predictions have been realised. When the earlier article was written the energy crisis was not even a foreseeable factor in powder development – now it has become the predominant motivation of the formulator.

Which of the earlier forecasts have been realised?

The increasingly active role of the physicist is apparent in the work which has been commissioned by powder manufacturers to investigate the fundamentals of electrostatic charge acceptance and powder conveyance.

Large automatic plants are often designed to maintain a

fluidised powder cloud and thereby improve deposition efficiency.

Freeze grinding techniques are widely used to increase the efficiency of the comminuting mill and to effect closer control of particle size distribution.

The development of resinous hardener systems is perhaps the most significant advance in modern powder formulation.

Conclusion

These discussions have highlighted the important modifications to resin and hardener systems which have influenced the formulation of modern powder coatings.

There are advantages to be gained by closer control of the specifications for epoxy resins during manufacture, and it is likely that newer techniques for controlling the size and distribution of the molecular species will provide

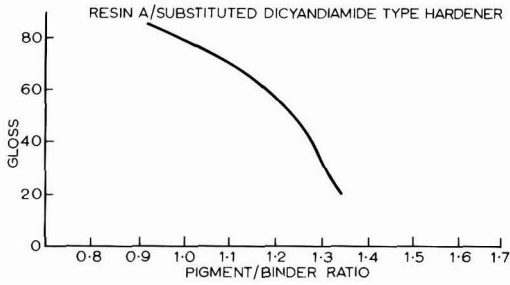


Figure 10.

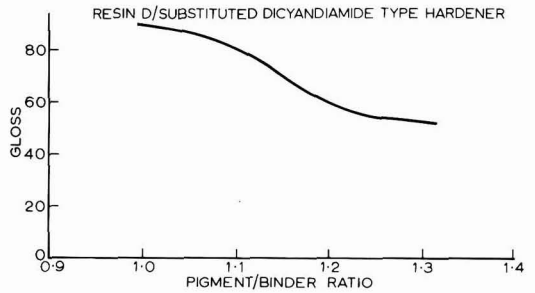


Figure 14.

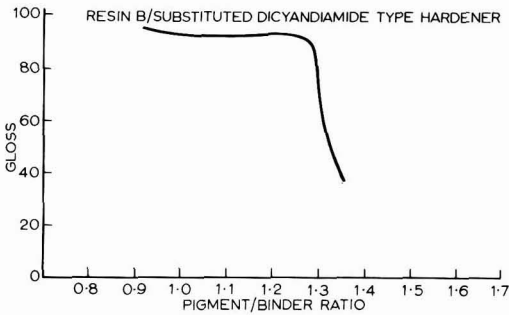


Figure 11.

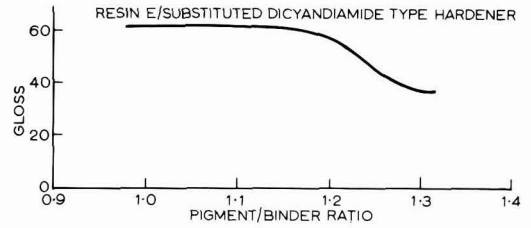


Figure 15.

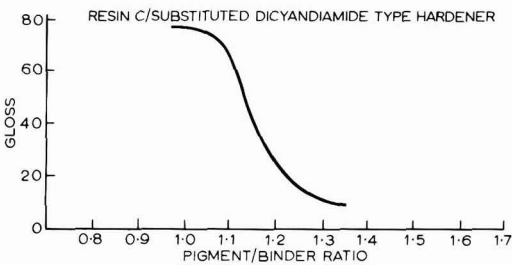


Figure 12.

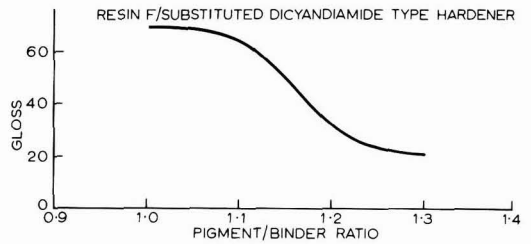


Figure 16.

further improvements in film appearance and performance.

The development of resinous hardeners has been sidetracked by the commercial necessity to incorporate at least 50 per cent of polyester resin to cross-link the more expensive epoxy resin. There is a no-mans-land of opportunity for development of closely controlled resinous hardeners between the 5 per cent levels of the dicyandiamide curing agents and the 50 per cent incorporation of polyesters.

Hot melt techniques for powder manufacture will have to be replaced by alternative methods with the advent of highly reactive powder systems. There is no practical alternative to hot melt compounding at the present, but significant changes are forecast within the next five years.

Manufacturers of electrostatic powder spray equipment have failed to solve the problem of applying uniformly fine powder coatings in the range 15-20 μ m, and this will give greater impetus to the commercial acceptance of finely divided powders in aqueous suspension for thin film applications.

Radiation curing of powder coatings will become a commercial reality within the next decade.

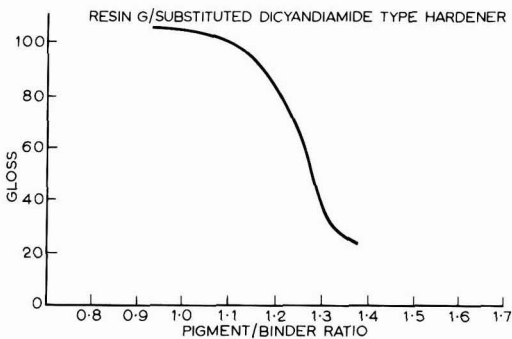


Figure 13.

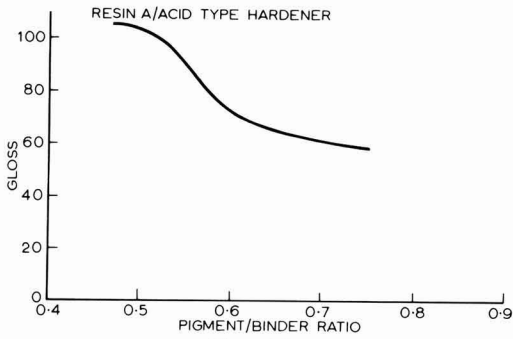


Figure 17.

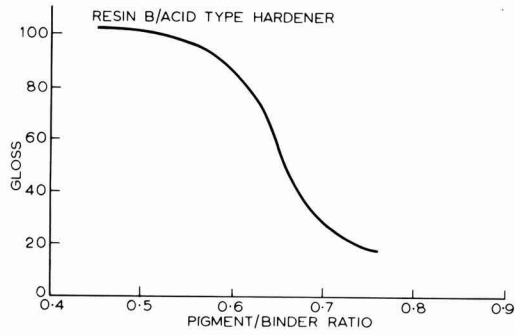


Figure 18.

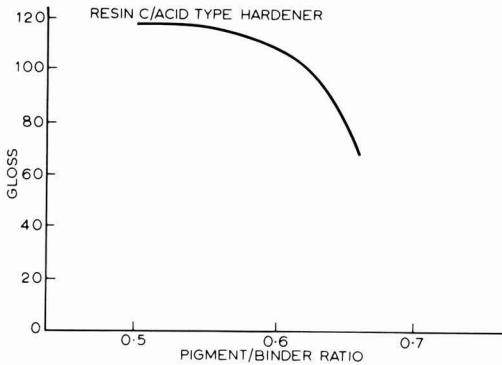


Figure 19.

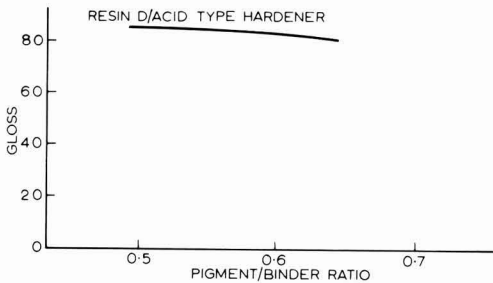


Figure 20.

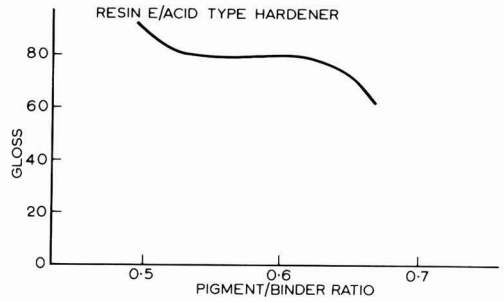


Figure 21.

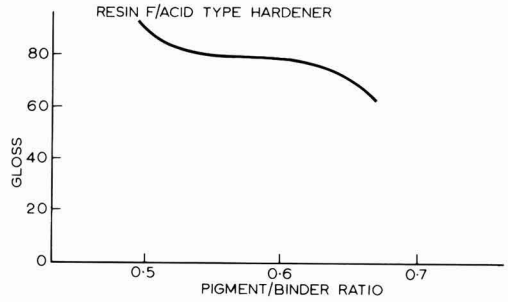


Figure 22.

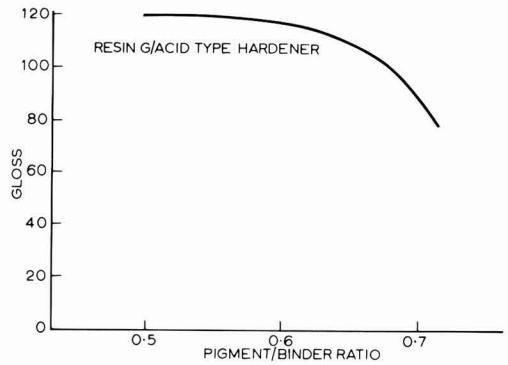


Figure 23.

Acknowledgements

The author wishes to thank Ciba-Geigy Ltd, Shell Chemical, Dow Chemical and Emser Werke for permission to use published and un-published data in this presentation.

[Received 28 April 1981]

References

1. Klaren, C. H. J., *Fatigue papers*, 1974.
2. Drew, E. W., *Paint Manuf.*, 1977, **47**, 11-12.
3. Brugger, M. and Gempeler, M., *Double Liaison*, 1975, **22**, 171-5.
4. Nakamichi, T., *J. Japan Soc. Colour Mater.*, 1978, **51**, 528.
5. McKay, A., *Paint Manuf.*, 1974, Sept., 25.
6. Warren, P., Ciba-Geigy, Duxford, England.

Discussion at Bath Conference

DR R. SCHWINDT: May I make a comment from the standpoint of a TiO_2 producer. You mentioned that TiO_2 producers have done very little work on powder coatings. This is true with regard to published papers. We haven't published any but we have, in fact, done a lot of basic work on finding out whether powder coatings need special pigments and up to now we have not found this necessary. On the other hand, we did a lot of development work on liquid paints and we developed special pigments when we found they were needed. But for powder coatings, the existing pigments fulfil all the demands of the powder coatings producers.

MR S. T. HARRIS: I still think that it is in your best interests to increase the amount of TiO_2 to levels of 1:1 pigment:binder instead of the 0.5:1 levels that exists at present. There must be a commercial motivation to work on this problem?

DR R. SCHWINDT: Of course, but only if you cannot solve the problem with an existing pigment.

MR S. T. HARRIS: I would like to see a programme of work similar to the Ciba-Geigy evaluation of different resin systems with one grade of TiO_2 at varying levels. If the various grades of TiO_2 were examined in one resin system it would be interesting to observe the changes in film properties with increasing pigment loading.

MR L. VALENTINE: Could Mr Harris elaborate on the cryptic prophecy at the end of the paper that, whilst there is no alternative to hot melt compounding at present, there will be within the next 5 years.

MR S. T. HARRIS: We have to try to combine the processes of extrusion and fine grinding. At present we mass the components together and break the product into discrete particles. If we wish to obtain particles of predetermined size then we should take finely divided components and build them up. I have firm ideas for an alternative process but it is too soon to discuss the principle. My results to date lead me to believe that a significant change in powder manufacturing method is feasible.

DR G. de W. ANDERSON: Mr Harris, you found difficulty in spraying very fine powders to give thin coatings. Are there any equipment problems which should be drawn to the attention of PRA's Spray Equipment Manufacturers' Group or does the solution lie elsewhere, perhaps in powder formulation?

MR S. T. HARRIS: The problem of spraying fine powders is mainly due to difficulties of air entrainment. The viscous drag effect of the air between gun and article reduces deposition efficiency and the need to maintain adequate ventilation in the booth causes the particles to be drawn away before they can be effectively deposited. These are purely physical parameters and it is doubtful whether reformulation would improve the deposition of fine particles. I feel that the powder should not be projected on to the article and it would be better to attract the fine particles from a fluid reservoir and minimise air current movements. The electrophoretic process can convey fine powders on to the article and this may be the means of applying thin powder films. Powder coating is a simple process and it should be possible to devise a more simple coating procedure than that of air assisted electrostatic spray. We always tend to elaborate application processes

because they are adaptations of the more complicated wet paint techniques. A fresh approach is required to the problems of powder coating and I believe that the acquisition of powder coating by the paint industry has done little to promote its development as an alternative to paint.

DR G. de W. ANDERSON: If I can press the point, are you suggesting a harder look at alternatives like tribo-electric guns and perhaps better designed spray booths, which might have a more controlled air flow whilst still fulfilling the requirements of worker safety?

MR S. T. HARRIS: Yes, and it is also essential that the comparative deposition efficiencies are assessed for each powder coating. Manufacturers formulate powder coatings with slight differences due to choice of resins, pigments, hardners and the relative quantities of each and there are often wide differences in the ease of electrostatic deposition. What is the correct specific resistivity for optimum deposition and how can this be measured? I am not aware that any fundamental work has been carried out in this field. There has been a lack of liaison and general neglect in defining the precise parameters for optimising the deposition properties of powder coatings.

MR F. D. TIMMINS: Mr Harris, you made the point that maybe powder coatings would have got off to a better start had it been a new, separate technology. The problem is, you can have something that is good but how do you spread the news; there are many good ideas going begging in this country because there are no organisations to support them. It had to be the paint people because they had the organisation: the sales force, the technical service and everything that goes with it, advertising and so on. Powder coatings had to be taken over by an existing organisation, and it was, after all, replacing paint.

MR S. T. HARRIS: It is the insistence of the paint people that powder coatings are a replacement for wet paints that has stifled the growth of powder coatings. I have always regarded powders as complementary to paints and there were markets outside the traditional paint markets where powder coatings could have been profitably introduced. The paint industry has lost business over the years to the plastics industry and the advent of powder coatings offered a good opportunity to attack some areas of the plastics market.

MR F. D. TIMMINS: The other question I would like to ask is, when you mention alkyds, what are the curing temperatures you have got down to?

MR S. T. HARRIS: It is possible to stove at 140°C for the short time of 10-15 minutes. I have seen references to curing schedules of 120°C but this is getting dangerously close to the melting point of the product and the film flow would suffer.

MR P. WALLGREN: The main reason why powder coatings have not been more widely used in areas where protection is very important, for example cars, railway coaches etc., is that powder coating corrosion resistance is not high enough. We have tested between 40 and 50 different powder types, none of which have produced effective corrosion protection on steel. If someone develops such a coating we will gladly test it since, for the car industry, the ideal situation would be to prime with a thick film of powder coating - removing the necessity of a

second coat – and then apply the top coat. I have to point out here, that salt spray testing is definitely not the way to examine outdoor durability. Salt spray testing doesn't correlate with outdoor performance. With alkaline resistant binders it is easy to get many thousands of hours "resistance" because of the alkaline environment created during the test procedure. Outdoors the environment is acid due to the presence of SO₂ especially in industrial areas where these vehicles are mainly used. Recently a paper was presented in Sweden which clearly showed that low amounts of SO₂ in humid conditions start corrosion, then of course salt etc., can accelerate it, and, therefore, a

new test must be developed where the presence of low amounts of SO₂ is included.

MR S. T. HARRIS: If it can be done with a wet paint system, there is no reason why a correctly formulated powder coating should not produce comparable or even better performance.

MR P. WALLGREN: I don't agree, we never get the performance from powder coatings that we do from wet systems, so wetting has some effect on the resulting corrosion resistance, but how is not known.

Next month's issue

The Honorary Editor has accepted the following papers for publication. They are expected to appear in the October issue of the *Journal*:

Caprolactone in surface coatings by *B. E. Bailey and J. Lister*

Obtaining opacity with organic pigments in paints by *H. Schäfer*

Alternative means of controlling paint viscosity/temperature phenomena by *N. Reeves*

Precision spectral ultraviolet measurements and accelerated weathering by *M. L. Ellinger and G. A. Zerlaut*

news

Du Pont licenses Japanese pigment manufacture

The Du Pont company has licensed Kikuchi Color and Chemical Corporation of Tokyo to produce Krolor pigment colours in Japan. Under the terms of the agreement, Kikuchi has received a licence to make, use and sell such pigments under Japanese patent 699310.

The pigments are silica-encapsulated lead chromate and lead molybdate. They are used in the paint and plastics industries for their heat stability, chemical resistance and lightfastness properties.

Reader Enquiry Service No. 21

Change of address

From 1 September 1981 the new address of The Society of British Printing Ink Manufacturers Ltd will be: Pira House, Randall's Road, Leatherhead, Surrey KT22 7RU, telephone: Leatherhead 78628.

Reader Enquiry Service No. 22

Tor takeover Leete

Tor Coatings Limited, the Birtley based paintmakers, has acquired A. Leete & Co. Ltd. Leetes have been paintmakers since 1826. Tor Coatings have bought the business from Derek Leete, the great grandson of the founder.

This acquisition marks the beginning of substantial business expansion by Tor in London, southern England and overseas. The presence of a London factory will permit rapid local service when necessary whilst the bulk of production will be channelled up to the Birtley factory thus increasing job opportunities for the future on Tyneside and Wearside.

Apart from general paints, A. Leete & Co. Ltd have specialised in mould and fungi resistant coatings for the food and drink industries.

Guy Readman, Alan Turner and Gordon Carr - all of Tor Coatings - have been appointed directors of A. Leete & Co.

Reader Enquiry Service No. 23

Further information on any items mentioned below may be obtained by circling the appropriate *Reader Enquiry Service* number on the form at the back of the *Journal*. Enquiries will be forwarded to the organisation concerned.

ITI awarded contracts

ITI Anti-Corrosion Ltd, the recently created coatings inspection company, has been awarded two contracts by British Petroleum and one by the British Gas Corporation.

Reader Enquiry Service No. 24

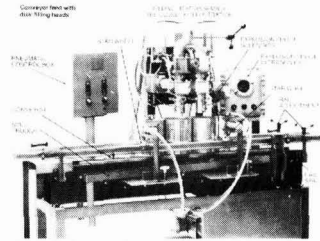
new products

Filling machine employs sonar

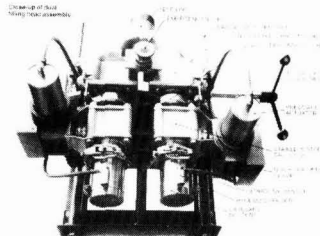
A new automatic filling machine for paint and stain from Beltron employs an ultrasonic filling system to control fill height.

Called Spectrum 1, it operates on the same principle as sonar, transmitting ultrasonic pulses down to the surface of the rising liquid in the container. A sensor measures the reflected pulses calculating the height of the liquid 2000 times a second. Once the level reaches a pre-selected height, a stainless steel ball valve automatically closes, instantly stopping the flow of the liquid without drippage. The ultrasonic fill height control is insensitive to ambient conditions and can be adjusted during operation by turning a single handle. Colour change-over is possible in less than five minutes and uses between 1-4 pints of solvent. The unit can accommodate from quarter pint cans up to 55 gallon drums, and is available in automatic and semi-automatic models.

Reader Enquiry Service No. 25



The Beltron ultrasonic automatic filling system equipped with dual filling head



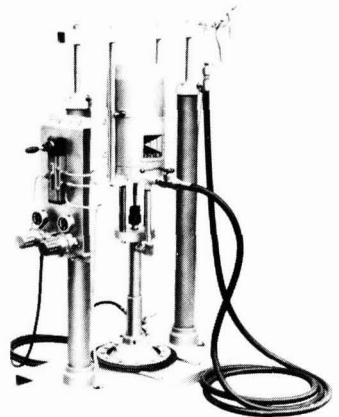
Close-up of the dual filling head

Solvent resistant powder coating

TI Drynamels Ltd has introduced a new epoxy-polyester powder which has been developed to give an improvement in solvent resistance over those presently on the market.

Expected to be of particular interest to users in the domestic appliances market, the new product can cure at a stoving schedule of 160°C (article temperature) for 10 minutes.

Reader Enquiry Service No. 26



The Kremlin 50-20 extrusion pump connected to an M75 spray gun

New pump for resins, glues, mastics and putties

Kremlin Spray Painting Equipment Ltd has introduced the Kremlin 50-20 extrusion pump for use with thick glues, resin bonding materials, mastic putties and the like.

The trolley-mounted pump is operated by compressed air and can give a variable fluid pressure output of up to 300 bars. At the high pressures, lengthy pressure hoses, 5 metres or more, can be used to feed the Kremlin M75 extrusion gun.

Reader Enquiry Service No. 27

Adhesive dispenser

Ciba-Geigy has announced a new dispensing machine which has been specially designed for use with the Araldite 2000 range. The machine will accurately meter and dispense two-component adhesives by the operation of a single lever.

Reader Enquiry Service No. 28

New B & T stirrer and centrifuge

Baird & Tatlock has launched two new pieces of standard laboratory equipment. One is a solid state magnetic stirrer called the Flatspin, it employs a rotating magnetic field generated by fixed coils eliminating the problems of lubrication and balancing.



Baird & Tatlock's solid state magnetic stirrer

The operating coils can be removed from the stirrer and in a variant are encapsulated in a polypropylene housing enabling use in difficult conditions, such as under water, inside ovens and in corrosive atmospheres.



The Mark IV Auto Bench Centrifuge

The second new piece of apparatus is the Mark IV Auto Bench Centrifuge. The machine features lid interlock, out of balance cut out with indicator, and automatic braking.

Reader Enquiry Service No. 33

Self-priming plastic coating

Timeguard Protective Coatings has produced an air drying, self-priming modified PVC protective coating, it is self-etching and can be applied directly onto any previously prepared metal or concrete surface to give chemical and abrasion resistance in a variety of service conditions.

The product, known as Timesol, is resistant to all the acids, alkalis, oils and other chemicals to which plasticized PVC is known to be resistant.

Timesol can be brushed or airless spray applied. It is claimed to have outstanding resistance to UV, weathering, impact and abrasion in both exposure and immersed service conditions.

Timesol is reportedly an ideal coating for marine containers, which are subjected to constant movements during loading and unloading, and a single coat at 125 micron will give a maintenance free life without any discolouration due to UV in excess of 20 years or the designed life service of the container.

Reader Enquiry Service No. 30

New pigment from Hoechst

Hoechst has introduced a new pigment into the Hostaperm E Series. This product, Hostaperm Red EG Transparent, is the yellowest of the series, and has a very pure shade. Its high transparency is claimed to make it ideal for the production of metallic finishes. Chemically it is a substituted linear transquinacridone pigment. It is chemically equivalent to Hostaperm Red EG, which is designated Pigment Red 209 (No. 73905).

Its main application will be for automotive finishing, especially in combination with transparent iron oxides.

Reader Enquiry Service No. 31

Acrylic wallpaper paste

The development of a liquid which on dilution with water immediately forms a lump free, ready for use wallpaper paste has been announced by the General Industries Division of Allied Colloids.

The product – designated Collafix 404 – is an acrylic wallpaper paste and has been developed in close co-operation with Polycell who have taken an exclusive distributorship for the UK and Eire.

The basic problem in producing such a product has been to develop a sufficiently concentrated polymer. The degree to which this has been achieved is shown by the fact that in practice a small container of 200 grams of concentrate is added to four, five or six litres of water, depending on the weight of the wallpaper to be hung.

Reader Enquiry Service No. 32



The WS Liftips drum handling equipment for controlled discharge

Drum handling from KEK

KEK has announced the introduction of the WS Liftips drum handling equipment which provides product discharge at controlled flow rates.

Drum loading is assisted by a drum roller conveyor and quick release cargo hold assembly, lifting is controlled by an electrically operated chain hoist complete with low voltage pendant control panel, and controlled tipping of material is achieved by angle of discharge and a unique vibrator drum carriage. The steady flow of material enables operators to carry out other tasks during the feed operation.

Gross contamination of product is eliminated with this system by feeding direct from a stock storage bin. The unique feed action prevents surging of materials and hence minimises spillage and, it is claimed, in applications such as mixing the controlled feed offers improved solids in liquid dispersion.

High density packing is achieved by the combination of pouring and vibrating the material into containers or freight drums. An optional dust extraction canopy provides control at the point of discharge when dealing with light or dust prone materials.

Reader Enquiry Service No. 29

Paintstripping

Stripine Peel Away, from Pilgrim Trading Ltd, is a new paint stripper capable of removing 14 coats of paint in one application. The product, a white powder, is mixed with water to produce a fine paste and applied to the paint surface. A fibrous polypropylene blanket is laid on the prepared surface of the paint and left for as long as is necessary depending upon the age and depth of the paint: for ten coats about three hours is required. The paint adheres to the blanket which when lifted off, lifts the paint as a single skin, leaving the surface clean and undamaged. The blanket can then be washed in water and re-used.

As the product doesn't contain methylene chloride it does not present the hazard to health associated with most other paintstrippers.

The applications for the product in industry as well as in the domestic market are many, for instance, BBC Television reportedly uses Stripine for stripping paint from fibre glass scenery. The British Museum uses it for cleaning delicate antique cornices and friezes, and architects are now specifying Stripine for removing paint from stonework, hitherto very difficult without damaging the surface.

Reader Enquiry Service No. 34

Self-crosslinking water based urethane dispersions

Witco is introducing a new range of water based urethane dispersions to the UK market for use in the formulation of high performance protective coatings for PVC, metal, wood, concrete, textiles, paper and cork.

The dispersions have the ability to crosslink upon drying at room temperature - without the use of additions - to produce, it is claimed, premium urethane coatings that are tough, have superior adhesion and flex properties and are resistant to solvents, abrasion, weathering and hydrolysis.

Witcobond W Series dispersions can be used straight from the drum or compounded into specific formulations. Application can be spray, roller or flow-coating techniques. All products can be used at room temperature.

Reader Enquiry Service No. 35

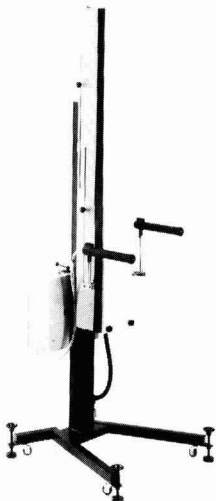
Automatic pneumatic reciprocators

Ravarini Castoldi has announced a new family of pneumatic reciprocators claimed to be particularly suited to industrial painting. The pneumatic reciprocators are air driven machines with a 1200mm max stroke. They employ a patented rodless cylinder, which reduces by half the height of the machines compared to a conventional type.

The reciprocating element is suitable for both vertical and horizontal mounting and can be easily placed at the required height on its support column to suite any working condition. The stroke can be varied from zero up to the maximum by means of outside controls, and the speed can also be varied.

The pneumatic reciprocator can easily handle two spraying units, even if at a considerable distance apart.

Reader Enquiry Service No. 36



Pneumatic reciprocator for industrial painting

literature

Decision making for small companies

The Chemical and Allied Products Industry Training Board has published a booklet entitled "Strategic decision making in a small independent family owned chemical company".

Reader Enquiry Service No. 37

Viscosity, flocculation, gelling etc.

Meyhall has made available samples together with a brochure on Guar and Guar derivatives which can be used to control the viscosity, flocculation, suspension, gelling etc., of solutions, mixtures, suspensions and so on.

Reader Enquiry Service No. 38

Masonry finishes

Goodyear Chemical Division has recently issued a brochure showing the range of exterior masonry finishes that can be formulated using Pliolite resins.

Reader Enquiry Service No. 39

meetings, etc.

Chemical recovery

Under the title CHEMRECON '81 the Chemical Recovery Association is holding a one-day conference on 12 November in Hendon, London to pass on information about the important role which chemical recovery can play in modern manufacturing operations. For further information contact: Industrial & Commercial Communications Ltd, 697 Warwick Road, Solihull, West Midlands B91 3DA.

Continuous emulsion polymerisation

The Macro Group UK is holding a symposium entitled "Continuous emulsion polymerisation" at the Society of Chemical Industry Lecture Theatre, Belgrave Square, London. It is to be held on Thursday 24 September 1981. For further details contact: The Secretariat, Society of Chemical Industry, 14/15 Belgrave Square, London SW1X 8PS.

Surfactants symposium

The Chemical Auxiliaries Group of IMRA is organising a symposium on "Surfactants - trends in selected markets" to be held on 4 December 1981 at the Cafe Royal, Regent Street, London. For further details contact: Margaret Everard, IMRA Office, 11 Bird Street, Lichfield, Staffs WS13 6PW. Tel: Lichfield (05432) 23448.

appointments

New general manager of Rentokil's damp proofing service is 33 year old **Gordon Keith** of East Grinstead, Sussex.

A chemistry graduate of Aberdeen University, Gordon was marketing manager of Rohm and Haas Ltd's polymers division before joining Rentokil as an executive.

John Topp has been appointed managing director of Kirklees Chemicals based in West Yorkshire from 1 July 1981. He takes over from **Donald W. Komrower** who will be responsible for all chemical and industrial paint activities in the SPL Group, including those of the recently acquired Bestobell Paint and Chemicals Company.

Super solvents

Are possible Governmental Health and Safety regulations, coupled with emission control, of special concern to you when formulating new surface coatings?

Maybe you are looking more carefully at water based systems, or just trying to reduce or eliminate diluents which you consider toxicologically unacceptable.

Try M-PYROL® or BLO® Solvent

Both solvents have outstanding ability to dissolve polymers (e.g. Epoxies, Alkyds, Acrylics and Urethanes); both can be diluted infinitely with water, and both are miscible in most organic solvents. And with Flash Points of 95°C and 98°C (Open Cup) respectively, fire hazard will not be a problem.

Of course you have a low order of toxicity

and are biodegradable. M-PYROL® will even help as a pigment dispersant!

So when you reformulate with safety in mind: think SUPER SOLVENTS think M-PYROL® and BLO®

Please send me further information on the GAF Super Solvents.

M-PYROL® BLO®

Name:

Position:

Company:

Address:

Tel:

GAF (Great Britain) Limited,
Tilson Road, Roundthorn, Wythenshawe,
Manchester M23 9PH, England, Tel: 061-998-1122.

GAF

Chemicals

Quality products for
Coatings



AT YOUR SERVICE to develop finer, more durable products

The fast, economical weather tests of

SUB-TROPICAL TESTING SERVICE, INC

established 1929

Sub-Tropical Testing Service is known and utilised world wide

Our 53rd Year



Send for free
Sub-Tropical colour
brochure

**Sub-Tropical Testing gives fastest Natural Weather tests available for * paints
* chemical coatings * plastics * textiles * fabrics * related products ***

Wir waren die ersten, welche einen Prüfdienst dieser Art für Lacke, Kunststoffe, chemische Beschichtungen, Stoffe und Gewebe aller Art, Farbstoffe und verwandte Erzeugnisse in den U.S. möglich machten.

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

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

Reader Enquiry Service No. 117



THE INTERNATIONAL FORUM FOR

CUNARD INTERNATIONAL HOTEL



THE SURFACE COATINGS INDUSTRIES

LONDON 27-29 APRIL 1982

Motif designed by Robert Hamblin.

34TH ANNUAL EXHIBITION
OF THE
OIL & COLOUR CHEMISTS' ASSOCIATION
CUNARD INTERNATIONAL HOTEL
LONDON · 27-29 APRIL 1982

The world's most important international exhibition of raw materials, plant and equipment used in the Paint, Printing Ink, Polymer, Colour, Adhesives and Allied Industries.

TUESDAY	27 APRIL	09.30 - 17.30
WEDNESDAY	28 APRIL	09.30 - 17.30
THURSDAY	29 APRIL	09.30 - 17.30

ADMISSION FREE

Copies of the Invitation to Exhibit and application forms obtainable from the Director & Secretary (Mr R. H. Hamblin) at the following address:

Oil & Colour Chemists' Association,
Priory House, 967 Harrow Road, Wembley, Middlesex,
England, HA0 2SF
Telephone: (01) 908 1056 Telex: 922670 (OCCA G)

Reader Enquiry Service No. 200

Savinyl

*Savinyl

A complete range of bright, brilliant solvent soluble dyes

Advantages:

1. Can be combined with one another
2. Mixed shades are possible, even bronze, copper and gold tones
3. Ideal properties for colouring transparent lacquers, metallic paints, hammer finishes, spirit lacquers, wood stains and glazes
4. Highly suitable for printing inks for packaging materials, especially flexographic and gravure inks for aluminium as well as inks for ballpoint and felt-tipped pens
5. Readily combinable with most common binders

...printing inks for packaging materials

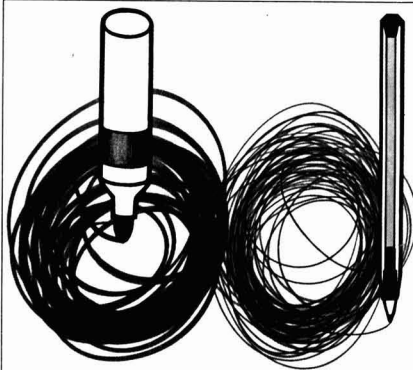


...wood stains



...inks for ballpoint and

...transparent lacquers



felt-tipped pens

SANDOZ

SANDOZ LTD
CH-4002 Basle

SANDOZ PRODUCTS LTD
Calverley Lane, Horsforth,
Leeds LS18 4RP
Telephone: 0532 58 46 46

SANDOZ office and we'll send you one right away.

SANDOZ

about *Savinyl - a complete range of brilliant, bright solvent soluble dyes for paints, lacquers and printing inks. If it's missing, ring your nearest

 »SACHTLEBEN«

BLANC FIXE MICRO®

The new micronised Blanc Fixe extender from Sachtleben, that's already reducing costs and increasing gloss.

Blanc Fixe Micro is easier to disperse than all other comparable extenders: saving time, energy and wear on equipment. Micro has a low binder demand, a high filling capacity and is suitable for high gloss enamels.

So, if your business involves white or coloured top coats; primers and fillers; gloss emulsion paints; colour pigment preparations; powder coatings; printing inks or artists' colours, just contact us for the full story.

 »SACHTLEBEN«

Chemie GmbH

D4100 Duisburg 1

UK Sales Offices:

56 High Street, Edenbridge, Kent TN8 5AJ

Telephone: (0732) 863694. Telex: 95297

38A Bury Old Road, Whitefield, Manchester M25 5TL

Telephone: (061) 773 2000



Motif designed by R. H. Hamblin

OCCA-34 Exhibition

27-29 April 1982

Cunard International Hotel
Hammersmith, London W6

OCCA news

THE INTERNATIONAL FORUM FOR THE
SURFACE COATINGS INDUSTRIES

General information

The Exhibition Committee of the Oil and Colour Chemists' Association is pleased to announce the arrangements for the 34th Annual Exhibition which will be held from 27-29 April 1982 at the Cunard International Hotel, Hammersmith, London W6.

The Cunard International Hotel is able to offer both exhibitors and visitors to the Exhibition a selection of restaurants, a coffee shop, bars, shopping facilities and other services available in most hotels.

As well as the traditional type of stands, several suites and rooms will be available for those companies who wish to use that type of facility to exhibit, or to entertain their visitors in addition to their stands.

Theme for the Exhibition

The aim of the Exhibition is the presentation of commercial and technical information relating to raw materials, plant and equipment used in the paint, polymer, printing ink, colour, adhesive and allied industries, both in their manufacture, processing and application.

The Exhibition Committee will be particularly pleased to welcome exhibits from companies relating to the new energy efficient, low-polluting technologies, including powder coatings, high solids coatings, radiation curing, water-based coatings and other developments.

Exhibition Data Form

The Association completes the Exhibition

Data Form certified by the Audit Bureau of Circulations (which conferred the distinction on the Association's Journal of the 1980 Reed International Award for the completion of the best media data form from a society or association - a truly prestigious achievement) and details which are being used in the completion of this year's Exhibition Data Form will be of interest to readers; copies of the Exhibition Data Form should be available in August on application to the Association's offices.

Completion of the Exhibition Data Form, the attendance and details regarding exhibitors, has not only to be audited by the Association's auditors (Coopers & Lybrand), but analysed to the satisfaction of the Audit Bureau of Circulations and this naturally means that only the cards fully completed by visitors can be used



The Cunard International Hotel, Hammersmith, London, venue for OCCA-34, 27-29 April 1982

OCCA news

for the purpose of analysing attendance by countries, job function and products manufactured.

International forum

OCCA-33 in April 1981 drew exhibitors from ten overseas countries. Many exhibitors were surprised at the number of worthwhile enquiries which they obtained and figures given below show the very high level of the attendance attracted to this annual forum for the surface coatings industries which can claim to be the leading exhibition of its kind in these industries.

An analysis of the registration cards completed at the entrance to the 1981 Exhibition showed that visitors to the Exhibition were drawn from the following 37 countries.

Argentina, Australia, Austria, Belgium, Canada, Cyprus, Denmark, Egypt, Eire, Finland, France, East and West Germany, Hungary, Iceland, India, Israel, Italy, Japan, Kenya, Libya, Netherlands, New Zealand, Nigeria, Norway, Poland, Portugal, South Africa, Spain, Saudi-Arabia, Sweden, Switzerland, Turkey, UAE, Uruguay, USA and Zimbabwe.

Over 16 per cent of visitors completing cards came from overseas and an analysis of cards (both from the UK and overseas) by job function confirmed that the OCCA Exhibition has not only a wide appeal but is also able to attract the top level of the industries, as follows:

Description	Percentage
Director/Owner	15.11
Management	21.90
Section Head	
Group Leader	3.87
Chemist/Physicist/ Technologist	18.48
Lab Assistant/ Technician	11.75
Sales & Marketing	18.73
Buyers	2.41
Administration/ Secretarial	2.10
Lecturer/Student	0.63
Other	1.08
Cards not completed	3.94

The products manufactured by visitors were:



A delegation from Japan being greeted at the Information Centre at OCCA-33 by the Director & Secretary (Mr R. H. Hamblin) on the right

	Percentage
Paints	21.98
Coverings and Coatings	5.14
Resins	6.79
Pigments and Dyes	8.76
Dispersants and Solvents	1.46
Inks and Graphic materials	8.19
Plastics	1.33
General chemicals	9.84
Other	25.65
Cards not completed	10.86

Dates and times

The thirty-fourth annual OCCA Exhibition, which will be a three-day event, will be open as follows:

Tuesday 27 April 1982 . . 09.30 to 17.30
 Wednesday 28 April 1982 09.30 to 17.30
 Thursday 29 April 1982 . 09.30 to 17.30

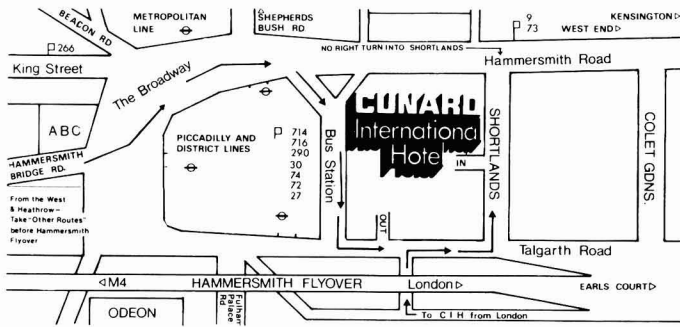
Travel facilities

The Cunard International Hotel is situated near Hammersmith Station on the Piccadilly Underground Line, between Heathrow Airport and the centre of London. Visitors from overseas may board the Piccadilly Line at Heathrow Central station in the Airport complex, which will take them direct to Hammersmith station or to central London where they may be staying.

Car parking space at the hotel will be limited, but there is a large NCP car park close by in Kings Mall. However, those travelling to the Exhibition by car are advised to leave their vehicles outside central London and to travel to the Hotel by the Underground system.



The Committee was pleased to note that several exhibitors featured competitions at OCCA-33 on their stands. The winner of the competition shown on the above stand (Victor Wolf Ltd) was Mr R. K. Dobell of NL Chemicals whose guess of 7213 was closest to the number of beans in the jar; the actual number was 7209. He won the prize of a dozen bottles of wine



Location of the Cunard International Hotel



Dinner Dance, to which the principal officers of other societies and associations will be invited.

Invitations to Exhibit

Invitations to Exhibit have now been sent out, together with application forms, to those companies who have exhibited at previous OCCA Exhibitions or have requested information for OCCA-34. Any organisation which has not previously shown at an OCCA Exhibition and would like to receive details should write to the Director & Secretary at the Association's offices: Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF, Telex 922670 (OCCA G), Tel: (01) 908 1086.

Discourse Sessions

As an innovation in 1982, the opportunity is being afforded to exhibitors to present short discourses of 30 minutes each in a lecture room at the Hotel on a commercial theme concerning the background to their exhibits, their companies' future development, research programmes, new products etc. These discourses will take place at selected times in the morning periods of the exhibition and will be chaired by members of the Association. Those exhibitors wishing to avail themselves of this facility, for which no charge will be made to exhibitors, should send a statement of the discourse they wish to present and if possible the name of the lecturer and the title of the discourse when submitting their application to exhibit form. The programme will be subject to the approval of the Exhibition Committee and will be published in the *Journal* and in the *Official Guide*.

Association Dinner Dance

Exhibitors will be aware that the Association's Biennial Dinner Dance at the Savoy Hotel, London would normally be held in May 1982, but it has been decided on this occasion to organise the Dinner Dance on Wednesday 28 April (the middle day of the Exhibition) so as to afford exhibitors and others the opportunity of entertaining their

customers at this prestigious function. Full details will be circulated to exhibitors. Any other organisations interested in participating and wishing to have further details should inform the Director & Secretary at the Association's offices to enable the necessary forms to be sent to them at the end of 1981. Will exhibitors please note that it is the Committee's wish that they do not organise other social events on the evening of 28 April 1982, so as to afford the maximum opportunity for both exhibitors and visitors to be present at the Association's



Visitors came from 37 countries to OCCA-33, see data opposite



Two of the three large signs in the foyer at OCCA-33, one pointing to the registration area and the other to the lifts for those visiting exhibitors on the third floor



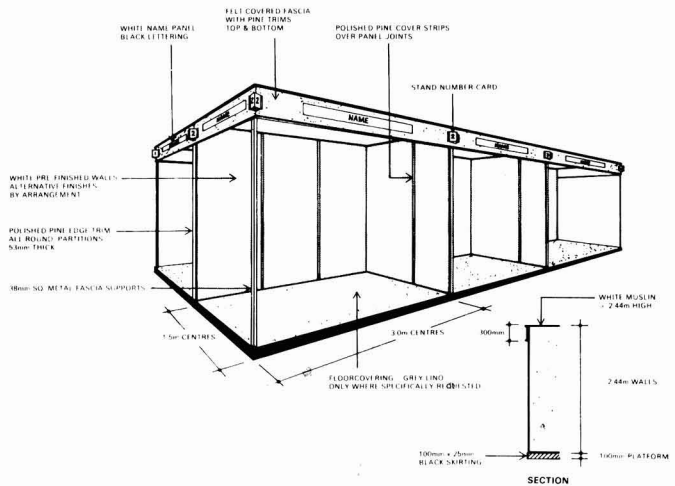
The photograph shows the busy registration desks at OCCA-33 which were permanently manned by four commissioners to direct visitors

Official Guide

It is intended, as in previous years, to publish the *Official Guide* to the Exhibition several weeks in advance so that it may be sent to visitors to enable them to plan the itinerary for their visits. The *Official Guide* will contain descriptions of the exhibits together with much other useful information for visitors, including maps of the exhibition areas, details of facilities, an analysis of exhibits, travel information etc. Advertising space in the *Official Guide* will be offered to those companies participating at the Exhibition, but space may also be available to other organisations. Full details of the availability of advertising space, rates, special positions etc., may be obtained from the Assistant Editor at the Association's offices.

Motif and layout of the Exhibition

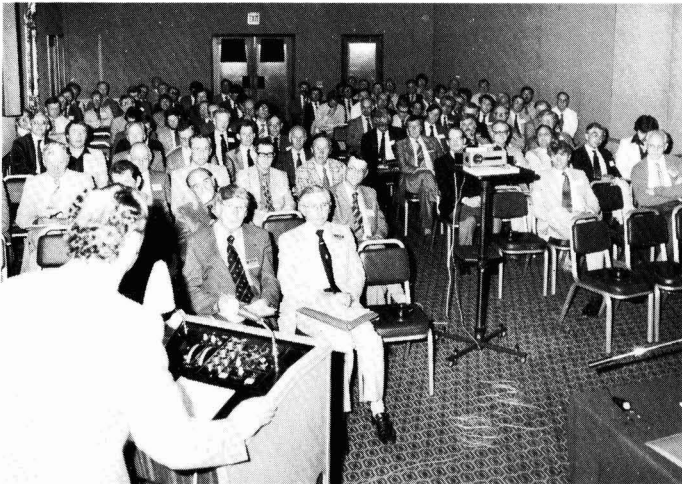
The motif of the Exhibition is in three



The standard shell scheme in the New Exhibition Hall

colours (green, red and yellow) and all these colours are carried throughout the planning of the Exhibition and the printed matter by the designer of the Exhibition, Mr Robert Hamblin (Director & Secretary of the Association). Thus the *Official Guide*, the information cards in six languages, exhibitors badges, registration tickets and directional signs will contain the motif; and the Information Centre (also designed by the Director & Secretary) will display not only informa-

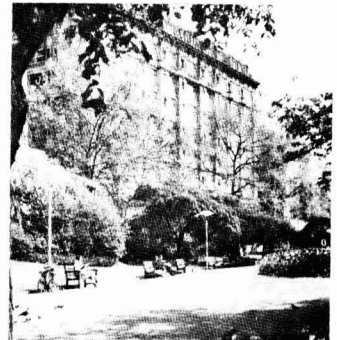
tion about the Exhibition but also about the other. Association activities: membership, the professional grade, publications (including the monthly *Journal*) and the Biennial Conference. The felt trims to the fascias of the stands will be in the same shades of green and yellow, and red carpet will be laid in the New Hall. A diagram showing a sample of the shell units provided is shown on this page. The charge per unit at OCCA-34 will be £550, plus VAT.



As an innovation at OCCA-34, exhibitors are being offered the opportunity to present short discourses on commercial or technical themes during some periods of the exhibition in a separate room. The sessions will be chaired by members of the Association

The photograph above shows a session at the Association's highly successful Bath Conference in June 1981 on "Alternative Technologies in Coatings" at which a discourse session provoked a lively discussion.

The photograph below shows a view of the Savoy Hotel, London from the Embankment Gardens. The Embankment entrance to the Savoy Hotel leads to the Lancaster Room, where the Association's Biennial Dinner and Dance will be held on 28 April 1982 to coincide with OCCA-34, thus giving an opportunity to exhibitors to entertain clients at this important Association function.



OCCA news

Mrs Olivia Worsdall

Members of the Association will be saddened to learn of the tragic death of Mrs Olivia Worsdall, wife of the Honorary Social Secretary of the London Section and currently an elective Council member, on Thursday 6 August. Mrs

Worsdall was well known to members of the London Section of which Mr Worsdall was Honorary Secretary for many years and Chairman, 1957/59.

The condolences of the Association were extended to Mr Worsdall and flowers were sent by both the Association and the London Section.

Report of Council Meeting

A Meeting of the Council of the Association was held at 2 p.m. on 14 July at the Great Northern Hotel, Kings Cross, London N1 9AN with the President (Mr D. J. Morris) in the chair. There were 22 members present.

In accordance with Article 50, the Council elected Mr J. T. Tooke-Kirby to complete the term of service of Mr J. Smethurst, an Elective Council Member who had died since the last Council meeting in April.

The President extended a welcome to all members serving on Council for the first time, both at home and abroad, and to those returning to Council after an absence.

It was reported that Mrs E. Stretton would represent the Association on the BSI Committee PHS/14 Viewing Conditions. It was further reported that the paper to be given on behalf of the Association at the FATIPEC Congress in Liege in May 1982 would be given by Dr L. A. Sampson on "Mechanical properties of weathered paint films".

The dates of the Council Meetings for the forthcoming session were agreed.

Consideration was given to the appointment of Committees of Council and representation of the Association on other organisations and these were agreed.

It was reported that at the Annual General Meeting held on 19 June, Mr F. D. H. Sharp, Mr F. B. Windsor and Mr H. C. Worsdall had been duly elected to serve on Council for 1981-83 and that Mr J. R. Taylor had been elected as Hon. Research & Development Officer.

Reports were received on the Bath Conference, the arrangements for the 1983 Conference which was scheduled to take place at York, the 1985 Conference which would be held in Scotland as part of the 50th Anniversary Celebration of the Scottish Section, and the 1981 (OCCA-33) Exhibition. It was noted that the Association had completed the Exhibition Data Form, the contents of which were audited by Coopers & Lybrand (the Association's auditors) and accepted by the Audit Bureau of Circulations Ltd. A full discussion also took place on the future arrangements for the Exhibition and it was noted that the next exhibition (OCCA-34) will be held at the Cunard International Hotel, Hammersmith, London W6, 27-29 April 1982.

A report was received on the number of members whose 1981 subscriptions had not yet been received.

The Hon. Editor reported that in order to get the pre-prints for the Conference away on 1 June, it had been necessary to drop back the publication date of the *June Journal* and the publication of the *July Journal* had been delayed because of translation difficulties with a German paper. However, it was hoped that with the September issue, the publication date would revert to the first week in each month, as this issue – and subsequent issues – would contain the papers from the Conference. The Reader Enquiry Service was still attracting a large number of requests for information.

The Hon. Technical Education Officer reported on the first meeting of a working party which he had set up with representatives from the Paintmakers' Association, the Society of British Printing Ink Manufacturers and the Association. The Director & Secretary reported

that, at a meeting of the Professional Grade Committee held earlier in the day, two Fellows had been admitted, one Associate transferred to Fellowship and five Associates had been admitted; two applications had been deferred for further consideration. He also reported that the amended regulations for admission would be published in the September issue, the 10th anniversary of the introduction of the Professional Grade.

A report was received on the meeting of the international Co-ordinating Committee held at Bath which had been attended by representatives from FATIPEC, FSCT, SLF and JSCM and the need for action on information requested. It was agreed to confer Commendation Awards upon Mr Norman Cochrane (West Riding Section) and Mr Colin Barker (Manchester Section) in recognition of their long and outstanding service to the Association particularly at Section level.

Various Section reports were noted and the arrangements for Section circulars in the forthcoming session were clarified, it being explained that a separate blue sheet would be included in each issue of the *Journal*.

As the President would shortly be leaving on a visit to South Africa, where he would meet the three Section Chairmen, Council extended their best wishes to the President and Mrs Morris for a happy and successful visit and asked that the greetings of Council should be conveyed to the South African Sections.

There being no other business, the President thanked members for their attendance and declared the Meeting closed at 4.50 p.m.

Manchester Section

1981 OCCA Northern Sections Golf Tournament

The second event in this competition was held on Thursday 25 June 1981 at Pannal Golf Club, Harrogate. The main prize was the Tony McWilliam Trophy, open to OCCA members only and competed for on the day by members from the

Manchester, West Riding, Hull and Newcastle Sections. The Scottish Section, though invited, unfortunately were unable to attend on this occasion. The 27 entrants included several members' guests.

A singles stableford competition with a maximum allowance of 18 strokes was the format with the tee reserved from 1.30 p.m. After an excellent buffet lunch and drinks the initial three players drove off beneath a dry but overcast Yorkshire sky.

The weather remained basically fine but the quality of the golf was infinitely variable. This variation included the celebrated "double figures" to an excellent gross three by Ron Hardy of the West Riding Section at the 458 yard 12th hole.

Frank Redman, Chairman of the Manchester Section and a confirmed non-golfer drove (by car) to the 19th hole and after an excellent three course dinner pre-

OCCA news

sented the prizes which were allocated thus:

Tony McWilliam Trophy – won for the second year by the Manchester Section team comprising:

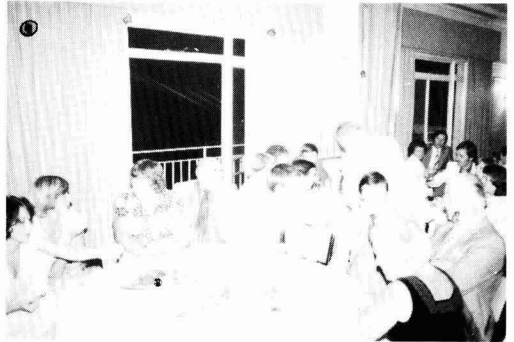
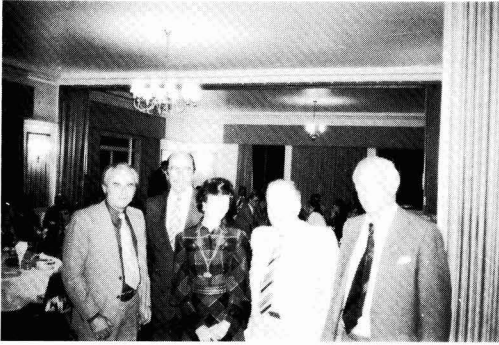
B. Carroll	32 points
R. Ashton	29 points
M. J. Booth	27 points
D. Clayton	27 points
J. Roberts	26 points
J. Godson	25 points

In addition to the trophy, each team member received an individually engraved plaque.

The best return of the day was achieved by Colin Purdy with 39 points, Ron Hardy of the West Riding Section had 35 points and the highest scoring guest was Alan Morson with 35 points.

There was general agreement that the event had been successful even with reduced numbers due to the economic depression and competing golf events, therefore a provisional booking for 10 June 1982 has been made, confirmatory details will appear in *JOCCA* nearer the date.

F.B.W.



Shown above are two photographs taken at the recent Transvaal Section's AGM. In the left hand photograph are seen (from left to right): D. Nemeti, Harry Bosman (Hon. Publications Secretary), Helen Gaynor (Hon. Treasurer), Eric Timm (Secretary) and Bob Rouse (Chairman).

In the right hand photograph (from left to right) are: Maria Ramsay, Janni Kidger, Pauline Lind, George Lind, Toni Law, Alan Kidger and visitors from the UK, Jack and Vi Smith (Photographs courtesy of Geo. Warman Publications (Pty) Limited).

Optional Professional Grade for Ordinary Members

Regulations for admission to the Professional Grade – Amended February 1981

A. Licentiate

1. Shall be an Ordinary Member of the Association and have been an Ordinary Member or Registered Student of the Association for not less than one year.
2. Shall have attained the age of 22.
3. (a) Shall be a Licentiate of the Royal Society of Chemistry in Coatings Technology or another relevant subject, such as advanced analytical chemistry, colour chemistry or polymer science.

the Technician Education Council in Coatings Technology or other relevant subjects (or equivalent SCOTEC qualification).

OR (c) Shall have passed Higher National Certificate or Higher National Diploma in a relevant subject (or equivalent SCOTEC qualification).

OR (d) Shall hold the Full Technological Certificate of the City and Guilds of London Institute in a relevant subject.

OR (e) Shall be a graduate in a relevant subject.

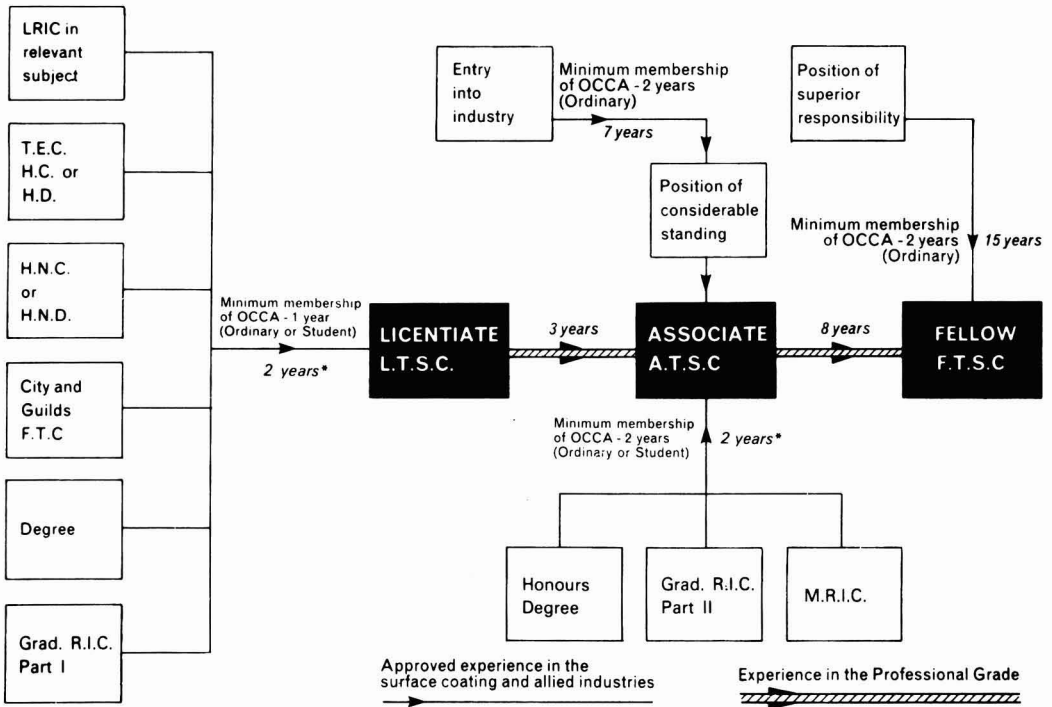
OR (f) Shall have passed Part I of the examination for the Graduateship of the Royal Society of Chemistry or Council of Physics.

OR (g) Shall have passed such other qualifications as approved by the Professional Grade Committee from time to time.

4. Shall have attained approved experience in the science or technology of coatings. It is not expected that sufficient experience would be gained in a period of less than two years in the industry. Approved experience may be gained before, during or after the qualifica-

Note: For the sake of simplicity, reference is made only to UK examinations etc., but equivalent qualifications overseas will naturally be accepted.

Routes to the Professional Grades



*Not necessarily after qualification – see regulations.

Note: At present there is no restriction on Students up to 21; between 21 and 25 a certificate from the employer or college confirming the course being taken is required.

tions in paragraph (3) above have been attained.

- Shall be required to satisfy the Professional Grade Committee, or some other body approved by the Professional Grade Committee in a *viva voce* examination and submit a dissertation on a subject directly associated with the science and technology of Surface Coatings or allied materials previously approved by the Professional Grade Committee.
- Shall normally be sponsored by three Ordinary Members of the Association in the Professional Grade (either Associate or Fellow at least one of whom is a Fellow). A sponsor will usually be a person who has knowledge of the career of the applicant. The candidate shall be in a position to furnish the name of a referee acceptable to the Committee, who can be contacted in confidence, if required. The referee will have a full knowledge of the candidate's technical and scientific achievements to date and could be the applicants employer.
- Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

B. Associate, being already a Licentiate

- Shall, since his election to the Licentiate, have practised the science or technology of coatings for not less than three years.
- Shall provide evidence acceptable to the Professional Grade Committee of his increased professional skill and maturity since his election as a Licentiate.
- Shall have published work which, in the opinion of the Professional Grade Committee, is of a sufficiently high standard OR may be required to submit a thesis or dissertation on a topic previously approved by the Professional Grade Committee OR shall hold the City & Guilds of London Institute Insignia Award.
- MAY be required to satisfy the Professional Grade Committee or some other body as approved by the Professional Grade Committee in a *viva voce* examination.

The nomination of a referee for a *viva voce* examination will normally be for those whose work could be of a highly confidential nature or for overseas candidates.

- Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.

A sponsor will usually be a person who has knowledge of the career of the candidate. The candidate should be in a position to furnish the name of a referee acceptable to the Committee, who can be contacted in confidence if required. The referee will have a full knowledge of the candidate's technical and scientific achievements to date and could be the applicant's employer.

- Shall have paid the fee stipulated by Council and have paid the current subscription payable by an Ordinary Member.

C. Associate, not already a Licentiate

EITHER

- Shall be not less than 24 years of age.
- Shall be an Ordinary Member of the Association and have been an Ordinary Member or Registered Student of the Association for not less than two years.

3. Shall hold the Graduateship of the Royal Society of Chemistry or Council of Physics or a University or Council of National Academic Awards degree recognised by the Royal Society of Chemistry or Institute of Physics as giving full exemption from the Graduateship examination.
4. Shall have attained approved experience in the science or technology of coatings. It is not expected that sufficient experience would be gained in a period of less than two years in the industry. Approved experience may be gained before, during or after the qualifications in paragraph (3) above have been attained.
5. Shall normally be required to satisfy the Professional Grade Committee or some other body approved by the Professional Grade Committee in a *viva voce* examination.

The nomination of a referee for the *viva voce* examination will normally be for those whose work may be of a highly confidential nature or for overseas candidates.

6. Shall normally be sponsored by three Ordinary Members of the Association in the Professional Grade (either Associate or Fellow) at least one of whom must be a Fellow.

A sponsor will usually be a person who has knowledge of the career of the candidate. The candidate must be in a position to furnish the name of a referee acceptable to the Committee, who can be contacted in confidence if required. The referee will have full knowledge of the candidates technical and scientific achievements and could be the applicant's employer.

7. Shall have paid the fee stipulated by Council and have paid the current subscription payable by an Ordinary Member.

OR

8. Shall be not less than 30 years of age.
9. Shall be an Ordinary Member of the Association and have been an Ordinary Member of the Association for not less than two years.
10. Shall have been engaged in practising the science or technology of coatings for not less than seven years and shall have attained a position of considerable standing in the industry, with appropriate responsibility for technical and scientific matters within the company.

It would be helpful if he had contributed to the knowledge and understanding of surface coatings

technology by lecturing or by the publication of articles. He will also have shown himself to take a keen interest in the work of the Association by being an active member of his Section and by attendance at lectures etc., whenever and wherever possible.

11. Shall normally be required to satisfy the Professional Grade Committee in *viva voce* examination of his professional competence and also be required to submit a dissertation on a subject agreed by the Committee. In cases where the subject is of a highly confidential nature the use of a referee agreeable to the Committee may be asked to examine the dissertation.
12. Shall normally be sponsored by three Ordinary Members of the Association in the Professional Grade (either Associate or Fellow) at least one of whom must be a Fellow.

A sponsor will usually be a person who has knowledge of the career of the candidate. The candidate must also be in a position to furnish the name of a referee acceptable to the Committee who can be contacted in confidence, if required. The referee will have a full knowledge of the candidate's technical and scientific achievement and could be the candidate's employer.

13. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

D. Fellow

Note: This is the senior award of the professional grade. The Professional Grade Committee will require substantial evidence of professional maturity in the science or technology of coatings although commercial experience will be taken into account in assessing the merits of candidates.

1. Shall be not less than 33 years of age.
2. Shall have been an Ordinary Member of the Association for not less than ten years.
3. Shall have made outstanding contributions to the science and technology of coatings or reached a position of eminence in the industry **through the practice thereof.**
4. EITHER (a) shall have been an Associate of the Professional Grade for at least eight years and shown continued development.

OR

- (b) shall have not less than fifteen years' experience in the science and tech-

nology of coatings in a position of superior responsibility.

5. Shall submit, with the application, an account of experience, with due reference to scientific and technological interests, achievements and publications.
6. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade, all of whom must be Fellows, (who should submit a supporting commentary to the Professional Grade Committee).
7. It would be helpful if he had contributed to the knowledge and understanding of surface coatings technology by lecturing or by the publication of articles. He will also have shown himself to take a keen interest in the work of the Association by being an active member of his Section and by attendance at lectures etc., whenever and wherever possible.
8. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

The fees payable with the application are as follows:

Fellow—£10.00	Associate—£6.00
Licentiate—£3.00	
(Plus VAT at standard rate).	

Application

Completed application forms should be returned, together with the appropriate remittance, to the Director & Secretary at the Association's offices (except in the case of those Members attached to the Cape, Natal, Transvaal, Wellington, Auckland and Ontario Sections, who should address their forms to their Section Hon. Secretaries).

The Committee wishes it to be known that members rejoining the Association after a period in other industries may include length of service as an Ordinary Member before their resignation as part of the qualifying periods for entry into the Grade.

Students wishing to apply for entry into the Professional Grade must first make application in writing for upgrading to Ordinary Membership, giving the reasons for their eligibility for such regrading. Applications, together with the appropriate remittance, should be addressed as for application for admission to the Professional Grade.

Potential applicants are recommended to give the fullest possible details of their appointments, including the number and type of staff under their control, and indicating to whom the applicant is responsible, as this aids the committee considerably in its deliberations.

The following elections to membership have been approved by Council. The Section to which each new Member is attached is given in italics.

new members

Ordinary Members

BINNING, DAVID ARTHUR, Shell Chemical NZ Ltd, Box 2091, Wellington, New Zealand (*Wellington*)

DAVIES, ILONA LYNN, BSc, 112 Carmont, Carrington Heights, Durban, Natal, Republic of South Africa (*Natal*)

DAVIES, TREVOR LAURENCE, Tergo Industries Ltd, PO Box 47-111, Ponsonby, Auckland, New Zealand (*Auckland*)

DENISON, BRIAN, B.Tech, FRSC, FSDC, 100 West End Drive, Horsforth, Leeds LS18 5JX (*West Riding*)

DURRANI, AMANULLAH, AMIChemE, 87/1-A Lala-Rukh Wah-Cantt, Pakistan (*General Overseas*)

EAMES, KEITH REGINALD, FInstPet, MICorrT, BIE Anti-Corrosion, 30 The Avenue, Watford, Hertfordshire WD1 3NS (*London*)

EVANS, ALAN BRUCE, BSc, ANZIC, ANZIM, 47 Calcutta Street, Khandallah, Wellington 4, New Zealand (*Wellington*)

GILLEZEAU, ROGER ANTHONY, 24 Gittens Flats, McKenzie Road, Maraval, P-O-S, Trinidad (*General Overseas*)

HUNKIN, CHRISTOPHER WADE, MSc, c/o Ciba-Geigy NZ Ltd, PO Box 1562, Christchurch, New Zealand (*Wellington*)

LEVIN, LOUIS PHILIPPE, 54 Montgomery Drive, Winston Park, Gillitts 3603, Natal, Republic of South Africa (*Natal*)

PARRIS, WILLIAM FRANCIS, 82 Cluny Road, Plimmerton, New Zealand (*Wellington*)

PROUSE, COLIN RONALD, 59A Marewa Road, Hataitai, Wellington, New Zealand (*Wellington*)

RASTOGI, ANIL KUMAR, BSc, Bazigarán Street, Moradabad, India (*General Overseas*)

SHEATH, ALAN, 10 Pelorus Place, Pakuranga, Auckland, New Zealand (*Auckland*)

STEAD, GRAEME RUPERT, BSc, M&R Cohen Coatings (Pty) Ltd, PO Box 225, Germiston, Republic of South Africa (*Transvaal*)

WILSON, HAMISH RUDD, BSc, Mobil Oil NZ Ltd, Box 2107, Christchurch, New Zealand (*Wellington*)

YAP, PETER CHEE CHONG, BSc, Nissan Datsun Manufacturing Ltd, PO Box 541, Manurewa, New Zealand (*Auckland*)

Associate Members

MADARA, JAMINE M.K., City Square Post Office, PO Box 59376, Nairobi, Kenya (*General Overseas*)

MOGFORD, BRIAN RALPH, 1/236, Campbell Road, One Tree Hill, Auckland, New Zealand (*Auckland*)

MODLA, MICHAEL, 48 Brook Street, Cheadle, Cheshire (*Manchester*)

PAYNE, DOUGLAS, 29 Linwood Avenue, Mt Albert, Auckland 3, New Zealand (*Auckland*)

MÜHLEBACH, HANS, Sandoz Products (Pty) Ltd, PO Box 50371, Randburg, Republic of South Africa 2125 (*Transvaal*)

Registered Students

HORTON, DAVID ANTHONY, 145 Balmoral Road, Wordsley, Stourbridge, West Midlands DY8 5JW (*Midlands*)

SOLYMOŠI, ANNAMARIA, 323 Frere Road, Glenwood, Durban 4001, Republic of South Africa (*Natal*)

Details are given of Association meetings in the United Kingdom and Ireland up to the end of the third month following publication.

September

Tuesday 1 September

West Riding: "The principles of emulsion polymerisation" by D. G. W. Dargan of Kirklees Chemicals Ltd, at the Mansion Hotel, Roundhay Park, Leeds 8, commencing at 6.30 p.m.

Wednesday 9 September

Manchester: Golf Tournament at Stockport Golf Club, commencing 1.30 p.m.

Monday 21 September

Irish: "Development of printing ink varnishes" by Mr I. Drury of Lawther

Chemicals Limited, at the Clarence Hotel, Wellington Quay, Dublin 2, commencing 8 p.m.

Thursday 24 September

Midlands: "The DWI can - production and decoration" by L. A. Jenkins, Metal Box Limited, Executive Suite, County Cricket Ground, Edgbaston, Birmingham, commencing 6.30 p.m.

London: Chairman's Evening "Colour and railways" by B. F. Gilliam, Chairman, London Section, at the Great Eastern Hotel, Liverpool Street, EC2, commencing 6.30 p.m. The 1981 Jordan Award will be presented at this meeting.

occa diary

Thames Valley: Visit to Charles Wells Ltd, The Brewery, Bedford.

Friday 25 September

Midlands: Ladies' Night, Botanical Gardens, Birmingham. Details to be announced.

Bristol: "Chain stopped alkyds" Mr J. Wilson, of B & N Chemicals Ltd, to be held at the Post House, Cardiff.

occa diary

October

Thursday 1 October

Newcastle: From this point we can only go up" by L. H. Silver, Silver Paint and Lacquer Ltd, at the Students' Common Room, St Mary's College, Elvet Hill Road, Durham, commencing 6.30 p.m.

Friday 2 October

Hull: Annual Dinner Dance at the Willerby Manor Hotel, Willerby, Hull, commencing at 6.45 p.m.

Monday 5 October

Hull: Joint meeting with the South Humberside Chemical Engineers at the Angel Hotel, Market Place, Brigg, South Humberside, commencing at 6.45 p.m. D. High of British Bridge Builders Ltd will be talking about the technical aspects of the Humber Bridge.

Tuesday 6 October

West Riding: "Plastic packaging today and tomorrow" by Ove Leth-Jørgensen, J. Walker and P. Jones of Superfos Packaging (UK) Ltd, at the Mansion Hotel, Roundhay Park, Leeds 8, commencing 7.30 p.m..

Wednesday 7 October

West Riding: Chairman's golf trophy meeting. Knaresborough Golf Club, 1.30 p.m.

Thursday 8 October

Midlands Section - Trent Valley Branch: "Computers used in colour prediction and formulation control" by J. P. Ferguson of Instrumental Colour Systems, at the Sutton Centre, High Pavement, Sutton-in-Ashfield, Notts, commencing 7.15 p.m.

Scottish: "Vehicle finishing" by A. Gower and R. Findlayson, Lothian Paints, at the Albany Hotel, Glasgow, commencing 6 p.m.

Friday 9 October

Manchester: Committee Meeting at ICI Ltd, Piccadilly Plaza, commencing at 3.30 p.m.

Manchester: Lecture "The potential of sugar as a chemical feedstock" by K. J. Parker of Tate & Lyle, at the Manchester Polytechnic, New Administration Building, All Saints, commencing at 6.30 p.m.

Thursday 15 October

Thames Valley: "Colour measurement" by D. A. Plant, at the Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing 6.30 p.m. for 7 p.m.

Midlands: "Driers for paint" by D. J. Love, Manchem Limited, at the Calthorpe Suite, County Cricket Ground, Edgbaston, Birmingham, commencing 6.30 p.m.

Friday 16 October

Manchester: Annual Dinner Dance at the Piccadilly Hotel, Manchester.

Scottish Section - Eastern Branch: Annual kittles match in the Murrayfield Indoor Sports Centre, Edinburgh, commencing at 7.00 p.m. prompt.

Tuesday 20 October

Bristol: "Pigmentation of white printing inks" by T. Entwistle, BTP Toxide Ltd, at the George and Dragon, High Street, Winterbourne, North Avon, commencing 7.15 p.m.

Thursday 22 October

London: "The use of microprocessors in the Paint Industry" by D. C. Lilley, Management Services Manager, MacPherson Industrial Coatings, at the Great Eastern Hotel, Liverpool Street EC2, commencing 6.30 p.m.

Friday 23 October

Irish: "Why thixotropy?" by Mr R. Munn, Cray Valley Products Limited, at the Clarence Hotel, Wellington Quay, Dublin 2, commencing 8.00 p.m.

Friday 30 October

Midland Section - Trent Valley Branch: Hallowe'en Buffet and Dance. Details to be announced.

November

Monday 2 November

Hull: First Ordinary Meeting. F. Dunstan of Perkin Elmer Ltd will be discussing "The application of modern analytical techniques to the surface coatings industry", at the Grange Park Hotel, Willerby, Hull, commencing 6.45 p.m.

Tuesday 3 November

West Riding: "Toxicology with particular reference to proposed draught EEC regulations dealing with labelling and packaging for paint products" by P. Bourne of Shell Chemicals (UK) Ltd, at the Mansion Hotel, Roundhay Park, Leeds 8, commencing 7.30 p.m.

Thursday 5 November

Newcastle: "Cost effective alkyd resins" by A. F. Everard, Berger Resinose Chemicals, at the Students' Common Room, St Mary's College, Elvet Hill Road, Durham, commencing 6.30 p.m.

Friday 6 November

Irish: Annual Dinner Dance, at the Clarence Hotel, Wellington Quay, Dublin 2, commencing 8.00 p.m.

London: Ladies Night, Hamilton Hall, the Great Eastern Hotel.

Monday 9 November

Manchester: Committee Meeting at Crest Motel, Bolton, commencing at 3.30 p.m.

Manchester: Lecture "The dispersion of pigments - theory and practical experience" by L. Gall, BASF, at the Manchester Polytechnic, New Administration Building, All Saints, commencing at 6.30 p.m.

Wednesday 11 November

Manchester: Student Lecture "Alkyd resins and their use in surface coatings" by A. G. Robinson, Synthetic Resins Ltd, at the Manchester Polytechnic, New Administration Building, All Saints, commencing at 4.30 p.m.

Thursday 12 November

Midlands Section - Trent Valley Branch: "The painting inspector" by J. Fowles-Smith, at the Sutton Centre, High Pavement, Sutton-in-Ashfield, Notts, commencing 7.15 p.m.

Scottish: Joint meeting with SDC "Energy resources - conservation and utilisation" by M. Slessor of the University of Strathclyde, commencing 7.30 p.m.

Wednesday 14 November

Scottish Section - Eastern Branch: "Resins for water dilutable flexographic and gravure printing inks" by George Brown of Harlow Chemicals who are sponsoring this lecture, to be held in the Murrayfield Hotel, commencing 7.30 p.m.

Wednesday 18 November

London: One day symposium at Thames Polytechnic, Woolwich, SE18. "Ink technology - a survey of current practices".

Thursday 19 November

Thames Valley: "Electrostatic methods" by Volstatic Ltd, at the Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks, commencing 6.30 p.m. for 7 p.m.

Midlands: "Living with lead legislation" by A. Cowley from ICI, at the Calthorpe Suite, County Cricket Ground, Edgbaston, Birmingham, commencing 6.30 p.m.

Friday 27 November

Bristol: Ladies' Evening, "Natural pigments - from flowers to red wines" by C. F. Timberlake from the Long Ashton Research Station, at the Great Eastern Hotel, Liverpool Street EC2, commencing 6.30 p.m.

OIL & COLOUR CHEMISTS' ASSOCIATION—PUBLICATIONS



New fourth edition now available

The Introduction to Paint Technology, of which 20,000 copies have already been sold, forms an excellent introduction to the whole field of surface coatings and related technologies. The fourth edition contains the important addition of a glossary of the terms used in the book together with explanations of their derivations. The text has been thoroughly revised and updated to incorporate recent advances in technology of the surface coatings industries.

Price: £5.00 (US \$12.00)

Paint Technology Manuals Works Practice

This publication, which is of great use both to the practical man within the industry and the student entering the industry, is concerned with the practical aspects of making paints. As very little has been published on this subject, a fairly broad coverage is attempted including factory layout and organisation, paint and media manufacturing processes, legal aspects and safety precautions.

Price: £3.00 (US \$7.00)

Biennial Conference PREPRINTS

The Association organises an international Conference every two years and preprints of the papers are prepared for delegates. A strictly limited number of the following are available to those who wish to have the complete bound sets of papers.

1977 Eastbourne *The conservation of energy, materials and other resources in the surface coatings industries.*

Fourteen papers presented. Price £5.00 (US \$12.00)

1975 Scarborough *Performance of surface coatings—does reality match theory?* Seventeen papers presented. Price: £5.00 (US \$12.00)

1973 Eastbourne *Towards 2000.* Sixteen papers presented. Price: £5.00 (US \$12.00)

UV

Ultraviolet polymerisation and the surface coatings industries

The Association has published two volumes on this subject comprising 23 papers presented at Symposia, forming an authoritative work of reference for this rapidly developing technology.

Special offer: £10.00 (US \$24.00) for both volumes purchased together.

UV2

Monograph No. 1. MARINE FINISHES. Now available Price £2.00 (US\$5.00)

ORDER FORM

To: **Oil & Colour Chemists' Association,**
 Priory House, 967 Harrow Road,
 Wembley, Middlesex HA0 2SF, England.

I enclose remittance of £ (US \$)to cover the cost.

Name: _____

Please send me copies of the books as listed below:

Address to which books should be sent:

Prices include postage and packing (surface mail).

Formula 81

The Multi-Coloured Trade Fair

This international trade fair for the paint, paint products and printing-ink industries is now to be held for the second time. In 1980, the fair attracted nearly 4000 visitors.

The visitor to Formula 81 will gain an overall view at this fair, of the latest technological developments in the paint and printing-ink industries. The exhibition programme will also include materials, patent products and mechanical aids for the treatment and regeneration of water, air and waste matter.

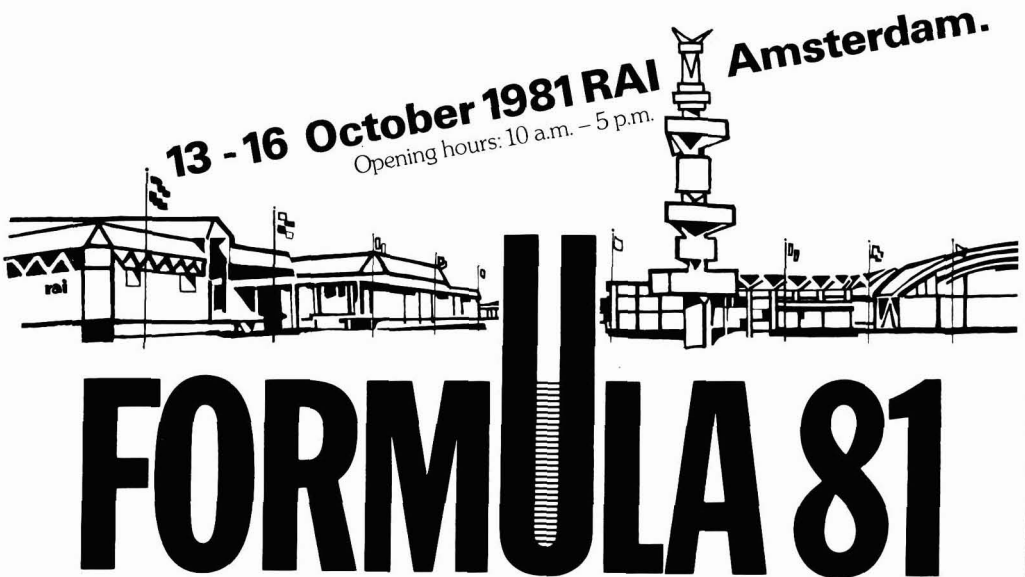
Broad orientation

Formula is to be held simultaneously with Eurofinish/VOM and Euromaintenance. This will give the visitor to Formula the

chance to acquaint himself with all that is new in the way of finishing products, maintenance materials and techniques.

Congress

During Formula, a three-day international congress is to be organized. Its theme is: developments and research in the paint and printing-ink industries. The speakers at the congress will focus on practical issues. They will discuss such subjects as the applications of surface treatment techniques in the building trade, the chemical industry and the car industry. Paint research institutes from the Federal Republic of Germany, Belgium, Great Britain and The Netherlands will also cooperate in the congress.



International trade fair for the paint, paint products and printing-ink industries.

CLASSIFIED ADVERTISEMENTS

APPOINTMENTS

CHEMIST/TECHNOLOGIST

Required for Research and Development Department. Applicants should be qualified to HNC or equivalent and preferably have experience in the formulation and testing of coatings and compositions of all types, but especially epoxy. Salary dependent on qualifications and experience. Contributory pension scheme.

Assistance with relocation expenses can be given if appropriate.

Please apply, giving brief details and requesting an application form to:

**Mrs H. Symonds,
Colas Products Limited,
Riverside, Saltney, Chester CH4 8RS.**

RECONDITIONED EQUIPMENT FOR SALE

**Flame-Protected Battery Electric
Forklift Trucks!!!**

SPECIAL NOTE!!! Due to the recession we are offering a genuine 20% discount for one month only.

Flame-protected to Group 2 (gases and vapours). Counterbalance and Pedestrian types available. Suitable for Chemicals, Paints and allied industries. Re-conditioned to an exceptionally high standard. Issued with load test certificates and guaranteed.

**SPEED ELECTRICS,
2 Thackerays Lane, Woodthorpe, Nottingham
Tel: 0602 268723**



APPOINTMENTS

Interested in Reward for Effort?



seek a young, energetic,

PAINT LAB EXPERT

interested in **SELLING** the world renowned

ERICHSEN

*high quality instruments for
assessment and measurement of
paints and other finishes,
colours and gloss*

Previous sales experience not vital

C.V. to
S. G. Panke
Man. Dir.

PEARSON PANKE LTD
1-3 Halegrove Gardens, London NW7 3LR

EQUIPMENT FOR SALE

FOR SALE

2 Off - 60 gallon Heavy Duty Planetry Cox Mixers, complete with Pans.

Triple Roll Mills, new and reconditioned, 40", 30", 24", and Hyd. Lab. Mill.

Vickers Keenomix Planetry Mixer.

Monteni Bead Mill 15 Litre Two Containers.

Hobart 12 Litre Mixer.

Contact:

**Mr E. Newton,
Engineering London
Limited,
60 Verney Road,
London SE16 3DL
Tel: 01-237 5171**

AGENTS

**OVERSEAS
AGENCIES**

For import-export and collaboration in India. Specific business proposals invited. Indian exporter on USA tour. Visiting London end of September '81. Mr BHARAT OZA, **CONSOLIDATED AGENCIES, 152-06, 84th Drive, Jamaica, 11432, New York; or 55 Jamanadas Mansion, Matunga CR, Bombay 19, Telephone: 484909 and 485158.**

APPEALS

Available now

**Souvenir Programme
of the Hyde Park
ROYAL FIREWORKS
DISPLAY**

Limited numbers available on receipt of a cheque or postal order for £1.50 from:

Harrington Kilbride & Partners
141 Cricklewood Broadway
London NW2 3AY

**Proceeds to International
Year of the Disabled**

JOCCA

READER ENQUIRY SERVICE – SEPTEMBER 1981

For further information circle items listed below:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120
 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140
 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160
 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180
 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200

Name

Job Title

Company

Address

Please also send information on the following items relating to the above:

Country Telephone

Photocopy or cut out this form and send to:

Journal of the Oil and Colour Chemists' Association

Priory House, 967 Harrow Road, Wembley, Middx., HA0 2SF, England

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

AT ANY TIME DAY OR NIGHT
 TELEX YOUR CLASSIFIED FOR JOCCA
 Telex 922670 (OCCA G)

INDEX TO ADVERTISERS

Further information on any of the products advertised in this *Journal* may be obtained by circling the appropriate number on the *Reader Enquiry Service (RES)* form above. The *RES* numbers are shown in brackets below. Enquiries will be forwarded to the organisations concerned.

C		J	
Chemische Werke Hüls A.G. (123)	vii	Johns-Manville (105)	x
D		M	
Dominion Colour Co. Ltd (128)	iii	MPD Technology (130)	Cover
Dussek Campbell Ltd (124)	vi	N	
Dynamit Nobel AG	Insert	NL Chemicals (131)	viii
E		Q	
Electro-Physik (125)	Cover	Q Panels Co. (132)	Cover
G		R	
GAF (Great Britain) Ltd (126)	xi	RAI Gebouw BV (122)	xvi
Glen Creston Machinery Ltd (127)	ix	Rigal Chemical & Process Plant Ltd	Insert
H		S	
Highgate & Job Limited (115)	Cover	Sachtleben Chemie GmbH (116)	xiv
Hillwood Ltd (103)	Cover	Sandoz SA (133)	xiii
I		Sanyo Kokusaku Pulp Co. Ltd (112)	ii
International Paint	i	Sheen Instruments Ltd (134)	iv
		Sub-Tropical Testing Service Inc. ... (117)	xii

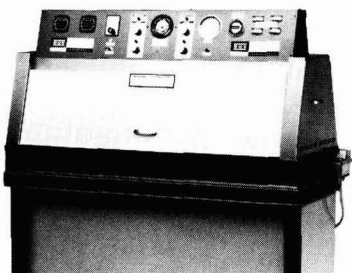
A better deal in Test Panels

Can you afford to ignore this great deal from the worlds leading manufacturer of steel and aluminium test panels? With prices upto half that of other manufacturers this has got to be the best deal available in test panels today.

Our newly opened U.K. office and warehouse ensures fast delivery.

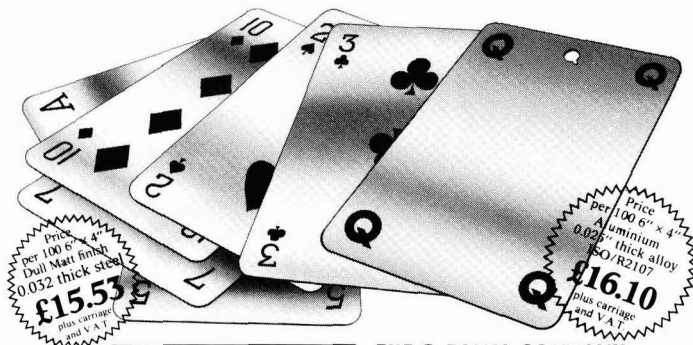
Q-Panels offer the following advantages.

- Supplied clean and ready to use. No degreasing.
- Manufactured from high quality low carbon steel providing a consistent test surface.
- Available from stock in a wide range of sizes and surface finishes.
- Samples available upon request.



Q.U.V.—Accelerated Weathering Tester simulates the damaging effects of sunlight and moisture. Advantages of the design include faster tests, closer control, and reduced operating costs.

Reader Enquiry Service No. 132



Q-PANEL

THE Q-PANEL COMPANY

102 Taylorson Street, Ordsall,
Salford M5 3HA.
Telephone: 061-872 1152

SYNTHETIC ESTERS



TECHNICAL FATTY OILS

FISH, NEATSFOOT AND LARD OILS

HIGHGATE AND JOB LIMITED

35 REGENT ROAD, LIVERPOOL L5 9TB

Phone: 051-207 0447

MURRAY STREET, PAISLEY Phone: 041-889 3207

Reader Enquiry Service No. 115

OIL & COLOUR



CHEMISTS'

ASSOCIATION

THE INTERNATIONAL FORUM FOR

CUNARD INTERNATIONAL HOTEL



THE SURFACE COATINGS INDUSTRIES

LONDON 27-29 APRIL 1982

ANNUAL EXHIBITION

27-29 APRIL 1982

Motif designed by Robert Hamblin.

COMPLETE AND RETURN THIS COUPON FOR A COPY OF THE INVITATION TO EXHIBIT

To: Director & Secretary, Oil & Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF ENGLAND
Telephone 01-908 1086 Telex 922670 (OCCA G)

We are interested in exhibiting at OCCA-34 (27-29 April, 1982, Cunard International Hotel, London). Please send us a copy of the Invitation to Exhibit.

BLOCK LETTERS PLEASE

Reader Enquiry Service No. 200

Printed by Campbell Graphics Ltd, Newcastle upon Tyne NE6 1AS and Suite 108, Temple Chambers, Temple Avenue, London EC4. Tel. 01-583 3190

25-2-82
-4.9.11.15.85