



J O C C A

JOCCA "visits"

GAF

+

CCS

PAGES 202-3

1-3 MAY
1984

PAGES 208-9



Car finishing in Europe – the technological challenge in the 1980s

J. L. Inshaw

Hydrolysed lac-based polyurethane coatings

P. M. Patil, K. Mohan and B. B. Khanna

Organosilanes as adhesion promoters for organic coatings. Part 3: silanes on cadmium, copper and zinc

P. Walker

New insights into the process of adhesion measurement and the interactions at polymer/substrate interfaces

U. Zorll

SURFACE COATINGS

VOL I - RAW MATERIALS AND THEIR USAGE

Prepared by OCCA Australia

As a consequence of the comments and criticisms of the first edition of "Surface Coatings" (1974), it was decided to produce a second edition with a different approach. While it has again been designed to serve as a guide and a reference document for students, it is also intended to provide an up-to-date, in-depth treatment of all relevant areas of paint technology.

The work is presented in two volumes, the first extensively reviewing the raw materials used in surface coatings, and the second the technology of the products that use them. Volume I will also be of considerable benefit to students, technologists and others in related industries such as inks, adhesives, ceramics, textiles and cosmetics, and raw material suppliers. It provides an excellent introduction to polymer science, pigments, solvents and additives. This edition reflects the movement towards aqueous systems: the chapters on alkyds have been reduced in this edition from six to three, and the four solvent chapters combined. Conversely the emulsion chapters have been doubled to six, and three new chapters on aqueous resins added. Volume II, whilst retaining the basic manufacture, application and technology coverage, is based on completely updated contributions. There are additional chapters on lacquers, powder coatings, UV-cured coatings and decorative paint selection. Reflecting the increasing impact of computers, there are new chapters on automated colour matching and applications in resin and coating formulation.

Volume I is to be published in the UK on 1 September 1983. Copies will be available by placing orders (prepayment only) through the Oil & Colour Chemists' Association at £27.50 (inc. p&p in the UK).

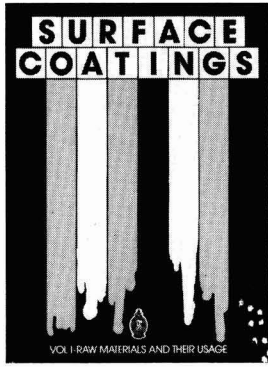
Volume I - Hardback - 408 pp.

Contents

The Past, Present and Future of the Surface Coatings Industry
 Introduction to Polymer Science
 Vegetable Oils
 Oleoresinous Media
 Alkyd Resin Technology
 Manufacture of Alkyd Resins
 Applications of Alkyd Resins
 Polyesters
 Amino Resins
 Phenolic Resins
 Polyurethane Resins
 Epoxy Resins
 Water Dispersible Epoxy Coatings

Silicone Resins
 Acrylic Solution Resins
 Emulsion Polymerization Theory
 Emulsion Properties 1:
 Effect of Monomer Composition
 Emulsion Properties 2:
 Effect of Water Phase and Particle Size
 Emulsion Properties 3:
 Film Formation
 Emulsion Polymers: Manufacture and Testing
 Applications of Emulsion Polymers
 Water-Reducible Resins

Water-Soluble Polymers
 Solvents
 Inorganic Pigments
 Titanium Dioxide Pigments
 Organic Pigments
 Extender Pigments
 Paint Driers
 Paint Additives
Contributors and Reviewers
Appendix: Useful Data and Conversion Tables
Index



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

Please arrange for me to receive copy/ies of "SURFACE COATINGS", Volume I Raw Materials and their Usage at £27.50 each inc. p&p at the following address:
 (BLOCK CAPITALS)

.....

I enclose remittance (payable to OCCA) for £



Sachtleben won't put whites black to front

Sachtleben's unique package of easily dispersible, highly compatible pigments and extenders for all kinds of paint formulations – a package that may well save you money and improve your product.

To find out more simply call Brian Mayhew at Edenbridge.

 » **SACHTLEBEN** «
Chemie GmbH **P.O. Box 100523** **Duisburg**

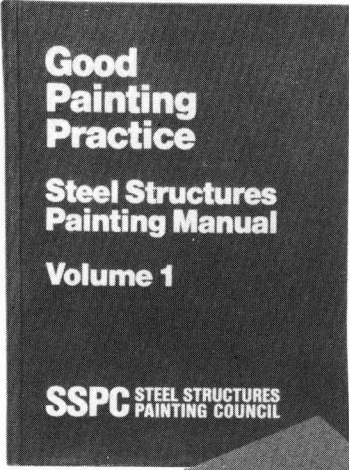
UK Sales Offices: 56 High Street, Edenbridge, Kent TN8 5AJ
 Telephone: (0732) 863694 Telex: 95297.

The Sachtleben Paints Package comprises:–

- Hombitan® TiO₂** 16 different grades of rutile and anatase TiO₂ pigment for all paint formulations.
- Lithopone** The ZnS/BaSO₄ pigment, available in standard, coated and micronised grades.
- Sachtolith®** Pure ZnS high performance pigment, available in standard coated and micronised grades.
- Blanc Fixe** The precipitated, inert, pure white extender in particle sizes from 3µm to 0.8µm, ·N, F and Micro®
- Barytes** Ground and specially treated BaSO₄ in Albaryt®, EWO® and Fleur grades.

38A Bury Old Road, Whitefield, Manchester M25 5TL
 Telephone: (061) 773-2000.

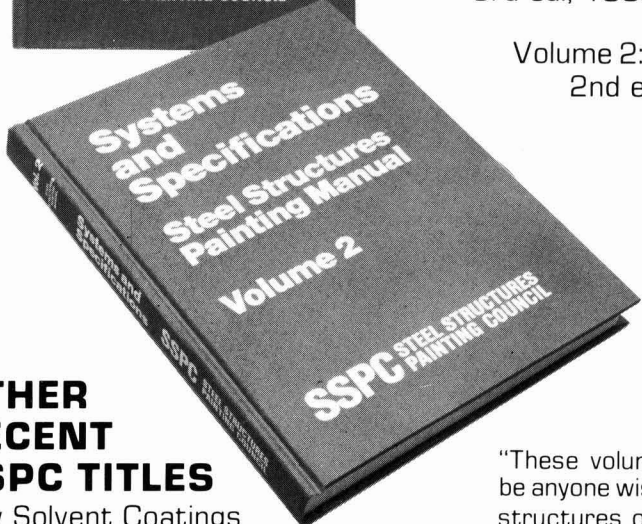
Sachtleben: the right white people for paints



THE NEW STEEL STRUCTURES PAINTING MANUAL

Volume 1: Good Painting Practice
3rd ed., 1982

Volume 2: Systems and Specifications
2nd ed., 1982



OTHER RECENT SSPC TITLES

- Low Solvent Coatings for Structural Steel
- Survey of Existing and Promising New Methods of Surface Preparation
- Performance of Alternate Coatings in the Environment
- Topcoats for Zinc Coatings.

"Think of every expert on steel protection in the United States and you'll be fairly accurate in identifying the roster of contributors to the 51 chapters in Volume 1 and the five chapters and numerous sub-chapters in Volume 2."

-- American Paint and Coatings Journal

"These volumes should be read by anyone wishing to supply coatings for steel structures of any kind, as well as those buying and using the coatings."

-- Chemical Marketing Reporter

"Perhaps everything you might want or need to know about painting steel structures is contained in these two volumes."

-- Public Works

Complete The Following To Order:

All prices include shipping by air and apply only to prepaid orders. Payment in U.S. funds only.

NAME: _____
 ORGANIZATION: _____
 ADDRESS: _____

- Steel Structures Painting Manual in two volumes - \$130.00
- Volume 1, Good Painting Practice \$ 70.00
- Volume 2, Systems and Specifications - \$ 70.00
- Payment Enclosed
- Send Invoice (postage and handling will be added)
- Send Complete SSPC Publication List

SEND TO: SSPC, STEEL STRUCTURES PAINTING COUNCIL, 4400 Fifth Ave., Pittsburgh, PA 15213

JOURNAL of the OIL AND COLOUR CHEMISTS' ASSOCIATION

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

Publications Committee:

H. H. Arbuckle, MA
T. A. Banfield, PhD, DIC, ARCS, FICorrT,
FTSC
H. J. Clarke, FTSC
J. H. Coy, PhD
R. E. Cromarty, BSc, ATSC
S. Falvey, ANZIM
C. N. Finlay, ATSC
S. R. Finn, BSc, CChem, FRSC, FTSC
G. W. Fowkes
V. H. Furuhjelm, FTSC
B. F. Gilliam, ATSC
J. A. Grant, LRSC
R. G. Handley
A. MacDonald, ATSC
D. V. Maltman
P. Marr, PhD
I. Maugham
D. J. Morris
P. W. Munn, BSc, CChem, MRSC, AMBIM
B. E. Myatt
R. H. Philbrick
R. C. Somerville
J. R. Taylor, BSc, CChem, FRSC, FTSC
G. Warman, FPISA

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 & Secretary,
Oil and Colour Chemists Association
at the address below.

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

Assistant Editor: D. N. Buddles, BSc

Annual subscription to non-members:
£55.00 (\$120), post free by surface mail,
payable in advance.

Single copies £5.00 (\$12), post free by
surface mail, payable in advance.

© Copyright 1983



Member of the
Audit Bureau of
Circulations

JOCCAB 66(7) 183-216 (1983)

Contents

Vol. 66 No. 7

July 1983

Transactions and Communications

Car finishing in Europe – the technological challenge in the 1980s	183
<i>J. L. Inshaw</i>	
Hydrolysed lac-based polyurethane coatings	185
<i>P. M. Patil, K. Mohan and B. B. Khanna</i>	
Organosilanes as adhesion promoters for organic coatings. Part 3: silanes on cadmium, copper and zinc	188
<i>P. Walker</i>	
New insights into the process of adhesion measurement and the interactions at polymer/substrate interfaces	193
<i>U. Zorll</i>	
<i>Next month's issue</i>	198
<i>OCCA meetings</i>	198
<i>Company visits</i>	202
<i>News</i>	204
<i>Exhibition news</i>	208
Conference diary	210
<i>OCCA news</i>	214
<i>News of members</i>	214

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

Resins & Pigments

Exhibition 1983 LONDON

**Tuesday 8th & Wednesday 9th November 1983
EUROPA HOTEL
Grosvenor Square London W1**

An informal exhibition for manufacturers of major raw materials used in the production of paints, printing inks and related industries including resins, pigments, solvents and speciality chemicals such as additives and resin components.

Organised by "POLYMERS, PAINT AND COLOUR JOURNAL"

Following the success of shows in London ('78), Copenhagen ('79), Düsseldorf ('80), Milan ('81) and Paris ('82), this new style exhibition returns to London, a city conveniently situated for visitors from all over Europe.

Don't miss this excellent opportunity to discuss your coatings problems with the experts, leading raw materials manufacturers and suppliers.

If you wish to visit this unique exhibition complete and return the form printed below.

Complete and return to "POLYMERS, PAINT & COLOUR JOURNAL" Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS, England Telephone: (0737) 68611 Telex: 948669

Please send me further details of the 6th Resins and Pigments Exhibition being held in London in November 1983.

NAME

STATUS

COMPANY NAME

ADDRESS

COUNTRY

TELEPHONE NO

TELEX

I wish to visit and require Admission Tickets. Please send these to me when available.

Reader Enquiry Service No. 258

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

Reader Enquiry Service No. 112

Car finishing in Europe – the technological challenge in the 1980s*

J. L. Inshaw

5 Oldbury Grove, Knotty Green, Beaconsfield, Buckinghamshire HP9 2AJ, United Kingdom

The present situation in Europe

Phosphating and priming

The major car companies in Europe all use the basic system:

- Clean and phosphate
- Electrodeposited primer
- Surface/sealer
- Top coat

Most plants clean and phosphate by spray using zinc phosphate followed by a chromic rinse and have now nearly all converted to cathodic primer of the PPG type. To date there is very little use of dip cleaning and dip phosphating of car bodies.

Surface/sealers

The surface/sealers used are principally of the alkyd/amino resin and oil-free polyester/amino resin type, although epoxy ester surfacers are used to a small degree. Alkyd or polyester surfacers are found to be more durable than epoxy ester surfacers under both one coat metallics and metallic base coat/clear coat finishes (2coat/1bake), which are transparent to ultraviolet light.

GM (Opel) use a W/B surface in their new plant, with no dehumidification of spray booths.

Top coats

The American and French owned car companies use thermosetting acrylic enamels for solid colours. However, Ford (Europe) and Volkswagen are now very interested in and doing large scale trials with polyester/amino solid colours, because of the better appearance and ultimately the easier attainment of high solids compared with TS acrylics.

In the case of metallics in France and the UK, there is now a definite changeover from thermosetting acrylic one coat metallics to base coat/clear coat (2 coat/1 bake) using polyester base coats and thermosetting acrylic clear coats. This change is expected to be completed by the end of 1982.

The rest of the large car companies (which includes BMW, Volkswagen, Daimler-Benz and Volvo) use alkyd/amino resin solid colours. However, most metallics in Europe are of the base coat/clear coat type (2 coat/1 bake) and the preferred system is a thermosetting acrylic clear coat over a polyester type base coat. It was the German companies who introduced base coat/clear coat

metallics into Europe at about the same time as they were being adopted in Japan.

Polyester base coats are generally preferred in Europe for their easier workability and because they give a more glamorous appearance – brighter metallic effects with more pronounced flip tones.

At one time, doubts existed about the durability of polyester base coats but this was associated with the earlier systems, which in fact were alkyd base coats followed by alkyd clear coats.

In Europe, considerable research work has been carried out on the base coat/clear coat system and now polyester base coats and thermosetting acrylic clear coats can be formulated to give satisfactory durability, e.g. 4-5 years at Florida.

It must also be remembered that the selection of the surfacers is more critical for use under the base coat/clear coat system to eliminate any risk of cracking and delamination.

Spray application methods

Automatic spraying equipment is used on a large scale and much of it is electrostatic. To date, robots are being evaluated by many car companies and are in use on production lines at SAAB in Sweden, and Fiat in Italy.

Ancillary products

Special coatings resistant to stone chipping are now extensively used. These are based on polyester resins crosslinked with masked isocyanates and applied onto the stoved electrocoat primer under the surfacer in a wet-on-wet operation. Depending on the design of the car, they may be applied up to waistline level.

Anticorrosive waxes are frequently applied inside box sections to provide more assured corrosion resistance.

The future

The main factors which will influence change in the future are:

- Economics
- Energy conservation
- Environmental pollution
- Consumerism

Hence, processes will become more automated, less

*Paper presented to the Thames Valley Section on 28 October 1982.

dependant on operators so that consistent quality is more assured and is maintained at a high level with less rejects. This in turn will mean using the best equipment in the most effective manner to apply high solids coatings in shorter processes.

To ensure that this is achieved quickly and in the most economical fashion, closer cooperative efforts will be required between paint suppliers, equipment manufacturers and paint users.

Shorter painting processes, already in use on commercial vehicles (top coat applied direct to electrocoat primer), can be expected to be used. In the first instance on lower cost passenger cars and ultimately on higher grade models, as the processes become perfected. In this application there is particular interest in Europe in the EPC (electro powder coating) process, originally pioneered by the Shinto Paint Company and Honda for applying a high thickness of primer. This is a very elegant concept that could result in a fully automated process for applying primer and surfacer to a car body in a double dip inverted system. The potential savings are considerable. However, further development of the paint is required in order for the process to become widely acceptable.

Important developments for surfacers/sealers and top coats, to meet the required criteria, will be high solids coatings in organic solvents and water-borne coatings. However, in each of these technologies there are important and difficult problems to be overcome. Sophisticated technology will be required to provide the best solution and products which will be robust on the production lines.

High solids paints carried in organic solvents employ low molecular weight resins, which give rise to rheological problems on application. Resistance to sagging is poor and in the case of metallics, control of the aluminium flake is difficult. Appearance thus becomes inferior to the present high standards set in Europe and Japan for both one coat metallics and two coat/one bake metallics.

Water-borne materials have similar defects and in addition there is the problem of evaporation of the water from the film, particularly under conditions of high humidity.

We will now consider these two potentially important technologies in turn:

1. High solids paints carried in conventional organic solvents.
2. Water-borne paints containing a small amount of coupling solvents.

In both of these technologies, a most important requirement is to produce two coat/one bake metallics with the stylistic effects and the same high quality already achieved in Germany and Japan with conventional low solids solvent-borne paints.

An important development has now emerged which offers solutions to these problems in both organic solvent and water media. This is the science of sterically stabilised polymeric particles – polymer dispersions. This important advance has been developed from the work which gave the world NAD paints (non-aqueous dispersions) in the early 1960s.

In a paper of this length it is possible to refer to only a few of the ways in which this new technology can provide solutions to some of the problems of future paint technology.

High solids paints

Conventional technology often relies on a carefully controlled solvent balance to obtain resistance to sagging, adequate flow, resistance to solvent popping, metallic control etc. These important properties are even more difficult to control by solvent balance with the low molecular weight resins necessary to achieve the required high solids. It is preferable to create a situation in which these essential rheological properties are inherent in the resin system and are much less dependant on solvent evaporation. Considerable progress has been made in this direction and the principals have been proven in some commercialised products.

Polymer dispersions can be prepared which are added to the paint in relatively small quantities and which do not affect the viscosity in the can or at the spray gun. However, loss of non-solvent which occurs between the gun and the article being coated causes the polymer particles to move closer together and form flocs. This effect is further enhanced by swelling of the polymer particles in the now solvent-enriched medium. This sets up structure in the wet film on the article very quickly, thus avoiding sagging, and in the case of metallics provides excellent control of the aluminium flakes.

This phenomenon can be used to enable higher fluid deliveries to be used in spraying, leading to shorter spray booths and quicker processes. A range of different polymer dispersions can be produced to impart these unique properties to many types of paint products.

Water-borne paints

Water-borne paints have been known for a long time. But those of present interest to the motor industry, especially top coats, require careful control of humidity and temperature during spraying to bring about effective release of water from the film to achieve acceptable results. Spraybooths of the type required are a high capital cost and expensive to operate.

Experience has shown that water is released more readily from dispersion systems and the first of this type to appear were the slurries. These have already been demonstrated to be workable compositions for some requirements. Very high solids should also be feasible in dispersion systems and this will further facilitate the release of water and improve the economics of the painting process.

These present slurries are essentially powder paints that have been dispersed in a water medium. The various processes for making slurries that have been used are not without their problems. They are lengthy routes of production, high in cost and use a lot of energy. However, the technology will continue to develop and the concept of stabilised polymeric particles can be expected to play a significant role.

One water dispersion system is now in an advanced state of development which is proving important in the control of rheology, particularly in the case of metallic base coats. For example, the low solids necessary for the most glamorous effect required by the German car companies can be produced mainly in water and hence be low polluting. This is possible because of the unique rheology inherent in the resin system, which enables the paint to be fully atomised in the spray gun and yet give very rapid viscosity rise on the article being coated to control the aluminium flakes. Loss of water from the film is rapid and provides the required film shrinkage to produce the desired

stylistic effects. Incidentally, this does produce an acrylic base coat with a metallic appearance very close to that of a polyester base coat.

Pigmentation

In Europe the trend is for cleaner brighter tones and for solid and metallic colours. There is also a strong desire to stop using lead chrome pigments for reasons of toxicity. This means that there is now a definite requirement for organic pigments that possess the cleanliness and brightness of colour of the chrome pigments with the high durability. Whilst opacity is important for solid colours, transparency is required for metallics.

In addition, the highly sophisticated technologies place greater demands on the function of the pigment in the total paint system. Pigments will have to perform in very difficult media compared with those for which they were designed, and the new systems will be subjected to conditions and forces not envisaged a few years ago.

Important factors to be re-considered are:

- Ease and method of dispersion
- Need for new dispersants

- Coating of pigments
- Avoidance of pigment flocculation
- Encapsulation of pigments

Much of this work is being carried out by the paint companies, but there must also be an important role to be played by the pigment manufacturers.

Other future considerations

All the future requirements of finishing materials for the car industry have not been covered in this paper. Significant among those not discussed are:

- Lower temperature curing resin reactions
- Avoidance of all forms of toxicity
- Finishing of various plastics
- The problem of painting a composite body built up of different metals and plastics components

All of these matters are being given a great amount of attention in Europe.

[Received 20 December 1982]

Hydrolysed lac-based polyurethane coatings

P. M. Patil, K. Mohan* and B. B. Khanna

Indian Lac Research Institute, Namkum, Ranchi, 834010, Bihar, India

Summary

Hydrolysed lac, which can be prepared cheaply from the by-products of the lac industry, can be utilised for preparing polyurethane coatings with good flexibility and resistance to chemicals. For this purpose, hydrolysed lac is first reacted with ethylene glycol and dicarboxylic acids such as adipic, phthalic, terephthalic or maleic anhydride for chain extension, and subsequently with 2,4-toluene diisocyanate or Desmodur N, an aliphatic isocyanate.

The compositions based on hydrolysed lac/ethylene glycol/adipic acid treated with Desmodur N gave the best properties even for air dried films.

Introduction

Coatings based on polyurethanes^{1,3} have excellent adhesion, flexibility, weatherability and resistance to impact, abrasion and solvent attack. They also possess outstanding dielectric properties and are suitable for use in making wire coatings and insulating varnishes. These are the reaction products of isocyanates with materials possessing hydroxyl groups and the reaction is capable of being adopted for the production of polymeric compounds from which coatings, fibres, foams, elastomers and adhesives can be developed.

Shellac^{4,6}, a natural resin of insect origin, possesses hydroxyl groups and can be reacted with isocyanate at room temperature. The softening and melting points of these modified lacs progressively increase with increasing proportions of diisocyanate⁷. Stable coating compositions have been prepared from shellac and blocked diiso-

cyanates and such compositions are cured by heating in an oven⁸⁻¹⁰. Shellac modified with drying or non-drying oils has been found to be more suitable for reaction with diisocyanates¹¹⁻¹³. Shellac esters^{14,15} can also be reacted with diisocyanates. Textile coatings¹⁶, electrical insulating varnishes¹⁷ and rigid polyurethane foams¹⁸ have also been developed from shellac.

Shellac, on saponification with an alkali and treatment of the resulting solution with a mineral acid, gives a water-insoluble, soft, sticky mass to the extent of 70-75 per cent on the weight of parent shellac; the product is called hydrolysed lac¹⁹. The same can also be prepared from the by-products of the lac industry, which are comparatively very cheap. It is a versatile material of considerable promise for use in the fields of adhesives, cements and glues. The present paper describes work relating to the modification of hydrolysed lac for the preparation of polyurethanes, and to the study of the resulting film properties.

Materials and methods

Hydrolysed lac was prepared from the by-products of the lac industry, such as molamma, kiri etc., by an aqueous alkali extraction process. Toluene diisocyanate (TDI) (synthesis grade, 97 per cent) and Desmodur N were obtained from E. Merck, and Bayer, Germany, respectively. Other reagents were of LR grade.

Preparation of polyesters from hydrolysed lac

Hydrolysed lac was reacted with ethylene glycol at 175 ±

*Present address: Regional Research Laboratory, Hyderabad, India.

Table 1
Preparation of polyesters from hydrolysed lac and their properties

Composition No.	Hydrolysed lac (g)	Ethylene glycol (g)	Adipic acid (g)	Maleic anhydride (g)	Terephthalic acid (g)	Phthalic acid (g)	Acid value
1	100	60	10				27.22
2	100	60	20				31.29
3	100	60		10			22.42
4	100	60		20			25.28
5	100	60			10		30.46
6	100	60			20		35.20
7	100	60				10	28.85
8	100	60				20	39.03

Table 2
Film properties of hydrolysed lac-based polyurethane coatings

Composition No.*	Toluene diisocyanate used (on weight of polyester, %)		Gelation period (h)	Water (48 h)	HCl (1%) (48 h)	NaOH (1%) (24 h)
1	30	AD	48	1	1	0
		B		5	5	0
	40	AD	4	5	5	0
		B		4	5	5
2	30	AD	48	1	1	0
		B		5	5	0
	40	AD	3	4	2	0
		B		4	5	5
3	30	AD	5.5	5	5	0
		B		5	4	5
	40	AD	1	3	2	0
		B		5	5	0
4	30	AD	2.5	5	5	0
		B		5	4	5
	40	AD	45 min	3	2	0
		B		5	5	0
5	30	AD	3	4	4	0
		B		5	5	5
	40	AD	2	2	3	0
		B		5	5	5
6	30	AD	2	4	4	0
		B		5	5	5
	40	AD	1.5	2	3	0
		B		3	3	0
7	30	AD	1	3	4	0
		B		3	4	0
	40	AD	50 min	2	3	3
		B		2	3	5
8	30	AD	50 min	4	4	0
		B		3	4	0
	40	AD	40 min	3	3	0
		B		2	4	0

*Composition numbers correspond to those in Table 1. AD = air drying, B = baked. 0 = film completely removed, 1 = bluish and lifted, 2 = bluish, 3 = loss of gloss and change in colour, 4 = slight loss of gloss, 5 = practically unaffected

2°C for four hours in a three-necked flask equipped with a reflux condenser, electrical stirrer and a thermometer. It was found that the acid value became constant at this stage. After removal of excess ethylene glycol under vacuum, the residue was reacted with different dicarboxylic acids (i.e., adipic, maleic, phthalic and terephthalic) in proportions of 10 and 20 per cent based on hydrolysed lac at the same temperature for two hours, when the acid value became constant. In this way, eight polyesters were prepared (Table 1).

Reaction of polyesters with toluene diisocyanate

The polyesters were dissolved in anhydrous methyl ethyl ketone to make a 25 per cent solution. This was filtered and the filtrate reacted at room temperature with TDI (30 and 40 per cent based on the weight of the polyester) and mixed thoroughly. After 15 minutes films were prepared on clean, dry glass slides and tin panels. On drying, these films were adherent, glossy, flexible, non-tacky and smooth. The gelation period was noted in each case.

Table 3
Film properties of hydrolysed lac-based polyurethane coatings

Composition No.*	Desmodur N used (on weight of polyester, %)		Gelation period (h)	Water (48 h)	HCl (1%) (48 h)	NaOH (1%) (24 h)
1	75	AD	48	5	5	1
		B		5	5	3
	100	AD	12	5	5	5
		B		5	5	5
2	75	AD	48	5	5	1
		B		5	5	3
	100	AD	10	5	5	5
		B		5	5	5
3	75	AD	48	5	5	4
		B		5	5	4
	100	AD	14	4	4	2
		B		5	5	3
4	75	AD	27	5	5	4
		B		5	5	5
	100	AD	8	4	3	2
		B		5	5	3
5	75	AD	24	4	4	3
		B		4	4	4
	100	AD	12	5	4	4
		B		5	5	5
6	75	AD	22	4	4	3
		B		4	4	4
	100	AD	10	5	5	4
		B		5	5	5
7	75	AD	27	4	2	2
		B		4	4	4
	100	AD	12	5	5	4
		B		5	5	5
8	75	AD	25	4	2	2
		B		4	4	4
	100	AD	11	5	5	4
		B		5	5	5
Hydrolysed lac (unmodified)	75	AD	1	5	5	0
		B		5	5	0
	100	AD	40 min	5	4	0
		B		5	4	0

*Composition numbers correspond to those in Table 1. AD = air drying, B = baked. 0 = film completely removed, 1 = bluish and lifted, 2 = bluish, 3 = loss of gloss and change in colour, 4 = slight loss of gloss, 5 = practically unaffected

Air dried films (dried for seven days) and baked films (150°C for 30 minutes) were tested for water, acid and alkali resistance at room temperature. The results are given in Table 2.

Reaction of polyesters with Desmodur N

The polyesters were also treated with Desmodur N, another isocyanate which is an aliphatic polyisocyanate²⁰ and has been reported to give finishes having good weather resistance. When the same was used at up to 50 per cent on the weight of the polyesters, films prepared from these compositions remained tacky even after a fortnight.

However, when the above polyesters were treated with 75 and 100 per cent Desmodur N on the weight of the polyesters, non-tacky, smooth, glossy and flexible films were obtained. Their performance is listed in Table 3.

Results and discussion

As already mentioned, hydrolysed lac is a soft, sticky material and the films prepared from it remain tacky even after long periods. When it is reacted with TDI or

Desmodur N, non-tacky and flexible films are obtained. However, though their water and acid resistance is fairly good, their alkali resistance is extremely poor. Improvement in performance was noticed when in place of hydrolysed lac its polyesters were reacted with a diisocyanate.

From the results listed in Table 2, it is evident that air dried films obtained from polyesters cured with TDI generally show good water and acid resistance but poor alkali resistance. The alkali resistance is improved by baking the films at 150°C for 30 minutes.

Of the eight compositions tried, the one based on terephthalic acid gave the best properties, followed by that based on adipic acid. Generally, 30 per cent TDI was sufficient to bring about the crosslinking.

A similar observation was made when crosslinking was brought about by using Desmodur N. Air dried films showed good water and acid resistance but somewhat poor alkali resistance. The same showed improvement on baking. However, the performance of the resulting compositions was better than that observed when crosslinking was done with TDI. The composition based on hydrolysed

lac/ethylene glycol/adipic acid treated with Desmodur N (100 per cent on the weight of polyester) gave the best results and even air dried film could resist water, acid and alkali.

Acknowledgement

The authors wish to express their thanks to Dr T. P. S. Teotia, Director of the Institute, for his interest during the course of this work.

[Received 7 January 1983]

References

1. Saunder, J. H. and Frisch, K. C., "Polyurethane Chemistry and Technology" Part 1, *Interscience Publishers Inc.*, New York, 1962.
2. Phillips, L. N. and Parker, D. B. V., "Polyurethanes: Chemistry, Technology and Properties", *The Plastics Institute*, London, 1964.
3. Shearing, H. J., *Trans. Inst. Metal Finishing*, 1961, **38**, 166.
4. Misra, G. S. and Sengupta, S. C., cited in "Encyclopedia of Polymer Science and Technology", vol. 12, edited by N. M. Bikales, *John Wiley & Sons Inc.*, New York, 1970, 419-40.
5. Bose, P. K., Sankaranarayanan, Y. and Sengupta, S. C., "Chemistry of Lac", *Indian Lac Research Institute*, Ranchi, India, 1963.

6. Hicks, E., "Shellac Its Origin and Applications", *Chemical Publishing Co.*, New York, 1961.
7. Rao, V. S. and Sankaranarayanan, Y., *Res. & Ind. New Delhi*, 1964, **10**, 299.
8. Skeist, I., Martel, R. F. and Kubler, W. R., US Pat. 3,215,551 (1965), to Gillespie - Rogers - Pyatt Co. Inc.
9. Skiest, I., Martel, R. F. and Kubler, W. R., US Pat. 3,228,782, to Gillespie - Rogers - Pyatt Co. Inc.
10. Dr Beck & Co., GmbH, Brit. Pat. 1,019,668 (1966).
11. Tripathi, S. K. M. and Misra, G. S., *Res. & Ind. New Delhi*, 1968, **13** (3), 129.
12. Tripathi, S. K. M. and Misra, G. S., *Paintindia*, 1968, **17** (10), 7.
13. Tripathi, S. K. M. and Misra, G. S., *Res. & Ind. New Delhi*, 1969, **14** (3), 114.
14. Gupta, P. C., Mukherjee, M. and Sankaranarayanan, Y., *Paintindia*, 1969, **19** (9), 26.
15. Rao, K. N. and Khanna, B. B., *Res. & Ind. New Delhi*, 1978, **23**, 215.
16. Ghatge, N. D. and Shrinivasan, S. R., *Text. Res. J.*, 1971, **41** (1), 78.
17. Ghatge, N. D. and Shrinivasan, S. R., Indian Pat., 121, 538 (1972), to Council of Scientific and Industrial Research, India.
18. Ghatge, N. D. and Gujar, K. B., *Indian J. Technol.*, 1972, **10**, 148.
19. Tripathi, S. K. M. and Khanna, B. B., *JOCCA*, 1980, **63**, 149.
20. Wittcoff, H., *Paintindia*, 1971, **21** (1), 21,32.

Organosilanes as adhesion promoters for organic coatings. Part 3: silanes on cadmium, copper and zinc*

P. Walker

Atomic Weapons Research Establishment, Building SB43, Aldermaston, Reading RG7 4PR, United Kingdom

Summary

Organosilanes of the general formula $R-Si(OR)^1_3$ have been examined as adhesion promoters for two-pack polyurethane and epoxide paints on cadmium plate, copper and zinc when used as pretreatment primers. Torque shear and direct pull-off adhesion tests have shown that significant improvements in initial bond strength can be obtained and this improvement is maintained after exposure to an accelerated weathering cycle.

Introduction

It has been demonstrated in previous papers^{1,2} that the use of organo-functional silanes of the general formula $R-Si(OR)^1_3$, as either pretreatment primers for aluminium and mild steel, or additives in epoxide and polyurethane paints, materially improves the adhesion of the coatings. It was further shown that this improvement in initial adhesion is maintained after exposure to cyclic humidity and accelerated weathering cycles. If the correct organosilane was selected for incorporation into the paints then a stable system was possible, and the improvement in adhesion was still apparent after the paints had been stored for periods up to and including two years.

Cadmium, zinc, and to a lesser extent, copper, are generally regarded as difficult metals to paint, as the initial

adhesion may be low and failures under service conditions are frequent³⁻⁶. Adhesion failures in service have generally been attributed to reaction of the organic binder with the substrate, or reaction of short chain fatty acids arising as decomposition products from the cure or degradation of fatty oil-containing paints^{7,8}.

Any improvement in either the initial adhesion or the residual adhesion after exposure would be of obvious advantage and this present paper describes the work carried out to evaluate organosilanes as pretreatment primers on cadmium, zinc and copper for epoxide and polyurethane paints.

Experimental

The paints, organosilanes, methods of test and panel preparation were as previously described^{1,2}.

The substrates investigated were:

Cadmium plate:	mild steel, cadmium plated to DTD904A \times 0.5 mm
Zinc:	BS849 (98.5%) \times 1.8 mm
Copper:	BS2870/C101 - $\frac{1}{2}$ H \times 0.8 mm

*Parts 1 and 2 appeared in *JOCCA*, 1982,**65**(11), 415; and *ibid.*(12), 436, respectively.

Table 1
Bond strength of paints to cadmium plate – torque shear

Paint/silane	Controls		After 1500 hours AW	
	MPa	psi/ area of detachment	MPa	psi/ area of detachment
Polyurethane/none	46.8	6800/0	38.6	5600/5–60
Polyurethane/ γ -methacryloxy propyltrimethoxysilane	44.8	6500/0–60	46.5	6750/0–5
Polyurethane/ γ -mercaptopropyl trimethoxysilane	48.2	7000/0	49.6	7200/0
Polyurethane/n-beta aminoethyl aminopropyltrimethoxysilane	41.0	5950/0–40	26.2	3800/100
Epoxide/none	36.6	5320/0–40	35.5	5150/5–20
Epoxide/ γ -methacryloxy propyltrimethoxysilane	32.0	4650/50	40.3	5850/20
Epoxide/ β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane	41.0	5950/20	44.3	6430/0–10
Epoxide/ γ -glycidoxy propyl-trimethoxysilane	49.6	7200/0	40.7	5900/40
Epoxide/ γ -mercaptopropyl trimethoxysilane	48.2	7000/0	45.8	6650/0–40
Epoxide/n-beta aminoethyl-aminopropyltrimethoxysilane	40.1	5820/5–30	41.3	6000/20–60

All the coated panels were allowed to cure at room temperature and humidity for 14 days before testing or exposure, and exposed panels were allowed to stand for 48 hours before testing.

Experimental results

Cadmium plate

Reference to Table 1 will show the data for the torque shear bond strengths obtained on cadmium plate. For the polyurethane paint to DTD5580, the control values measured after 14 days clearly show that the initial bond strength to cadmium plate was excellent, even without a silane promoter, and the presence of γ -methacryloxy propyltrimethylsilane and n-beta aminoethyl aminopropyltrimethoxy silane appeared to result in a slightly inferior adhesion as indicated by the area of detachment as opposed to the measured bond strength. The measured bond strength and area of detachment in the presence of the γ -mercaptopyl trimethoxysilane were identical to those of the control. After exposure to 1,500 hours accelerated weathering the adhesion to the non-silane panel had decreased considerably as shown by both the measured bond strength and the area of detachment. An even greater loss had occurred on the n-beta aminoethyl aminopropyltrimethoxysilane treated panel. However, the remaining silane treated panels showed no loss of adhesion and in this respect were considerably superior to the non-silane control.

For the epoxide paint to DTD5555, the control values on the non-silane panel showed a good bond strength but some paint detachment. Only one of the silanes, γ -methacryloxy propyltrimethylsilane, had a lower initial bond strength and again there was detachment of the film. The remaining four silane treatments produced increases in bond strength. Those resulting from the use of γ -glycidoxy propyltrimethoxysilane and γ -mercaptopropyl trimethoxysilane were outstanding.

After exposure to the accelerated weathering cycle for 1,500 hours there was no real loss of bond strength or increase in the area of detachment of the non-silane

Table 2
Bond strength of paints to cadmium plate – direct pull-off

Paint/silane	Controls		After 1500 hours AW	
	MPa	psi/ area of detachment	MPa	psi/ area of detachment
Polyurethane/none	23.4	3400/ 20–100	18.5	2680/20
Polyurethane/ γ -methacryloxy propyltrimethoxysilane	29.8	4320/0	24.1	3500/0–10
Polyurethane/ γ -mercaptopropyl trimethoxysilane	29.1	4220/0	30.0	4360/0*
Polyurethane/n-beta aminoethyl aminopropyltrimethoxysilane	29.1	4220/0	16.9	2450/30
Epoxide/none	25.1	3640/0–30	17.4	2520/30–40
Epoxide/ γ -methacryloxy propyltrimethoxysilane	29.1	4220/0	30.4	4410/0*
Epoxide/ β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane	27.8	4040/15–50	11.7	1700/50
Epoxide/ γ -glycidoxy propyl-trimethoxysilane	28.2	4090/0–10	29.8	4320/0*
Epoxide/ γ -mercaptopropyl trimethoxysilane	29.4	4270/0	26.3	3810/10–30
Epoxide/n-beta aminoethyl-aminopropyltrimethoxysilane	28.2	4090/0	30.4	4410/0*

*Cohesive failure in the paint

control. The measured bond strengths on all the silane treated panels were greater than the non-silane control and appreciably so in the cases of β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane and γ -mercaptopropyl trimethoxysilane. Interestingly, there were two instances, γ -methacryloxy propyltrimethylsilane and the β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane, in which the bond strength was significantly greater after exposure than before. Undoubtedly the best all-round performance with both paints was provided by the γ -mercaptopropyl trimethoxysilane treatment.

Reference to Table 2 will show the data obtained by the direct pull-off method. Clearly, the silane treatment produced an increase in bond strength and a decrease in area of detachment on all the polyurethane painted panels and the values recorded were a measure of the cohesive strength of the adhesive used to bond the specimens. After exposure to the accelerated weathering cycle the measured bond strength fell on all but the panel treated with γ -mercaptopropyl trimethoxysilane. In this case the paint film failed cohesively within a "chalk" layer. The loss of measured bond strength was greatest on the panel treated with an n-beta aminoethyl aminopropyltrimethoxysilane. Although the bond strength of the remaining silane treated panel also showed a fall, it was greater than that of the non-silane control.

All the silane treatments produced an improvement in initial bond strength of the epoxide coated panels with little difference between the three silanes where no paint was detached. After exposure to the accelerated weathering cycle there was a marked decrease in the measured bond strength of the non-silane and the β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane panels. The panels treated with γ -methacryloxy propyltrimethylsilane, γ -glycidoxy propyltrimethoxysilane and n-beta aminoethyl aminopropyltrimethoxysilane showed no loss in bond strength and no film detachment.

Copper

Reference to Table 3 will show the torque shear data obtained on the copper panels. The polyurethane paint

Table 3
Bond strength of paints to copper – torque shear

Paint/silane	Controls		After 1500 hours AW	
	MPa	psi/ area of detachment	MPa	psi/ area of detachment
Polyurethane/none	49.6	7200/0	42.0	6100/5–10
Polyurethane/ γ -methacryloxy propyltrimethoxysilane	48.2	7000/0	45.5	6600/0
Polyurethane/ γ -mercaptopropyl trimethoxysilane	48.4	7020/0	45.5	6600/0
Polyurethane/n-beta aminoethyl aminopropyltrimethoxysilane	48.2	7000/0	37.6	5450/ 30–100
Epoxide/none	43.1	6250/5	43.8	6350/5–10
Epoxide/ γ -methacryloxy propyltrimethoxysilane	47.9	6950/0–5	40.7	5900/0–5
Epoxide/ β -(3,4-epoxycyclohexyl)-ethyltrimethoxysilane	46.8	6800/0	45.5	6600/0*
Epoxide/ γ -glycidoxy propyl-trimethoxysilane	49.6	7200/0	42.0	6100/0–10
Epoxide/ γ -mercaptopropyl trimethoxysilane	49.6	7200/0	45.5	6600/0*
Epoxide/n-beta aminoethyl-aminopropyltrimethoxysilane	48.2	7000/0	40.7	5900/20–80

*Cohesive failure in the paint

Table 4
Bond strength of paints to copper – direct pull-off

Paint/silane	Controls		After 1500 hours AW	
	MPa	psi/ area of detachment	MPa	psi/ area of detachment
Polyurethane/none	27.9	4050/0–30	28.4	4120/10
Polyurethane/ γ -methacryloxy propyltrimethoxysilane	29.7	4310/0	33.9	4920/0
Polyurethane/ γ -mercaptopropyl trimethoxysilane	29.3	4260/0–20	34.5	5000/0
Polyurethane/n-beta aminoethyl aminopropyltrimethoxysilane	29.7	4310/0	34.3	4920/0
Epoxide/none	27.3	3970/10–60	20.2	2930/20
Epoxide/ γ -methacryloxy propyltrimethoxysilane	27.4	3980/0	21.9	3180/30
Epoxide/ β -(3,4-epoxycyclohexyl)-ethyltrimethoxysilane	30.5	4430/0	27.4	3980/0*
Epoxide/ γ -glycidoxy propyl-trimethoxysilane	30.7	4450/0	28.4	4120/0*
Epoxide/ γ -mercaptopropyl trimethoxysilane	29.7	4310/0	23.8	3450/30
Epoxide/n-beta aminoethyl-aminopropyltrimethoxysilane	29.4	4270/0	20.7	3000/10

*Cohesive failure in the paint

had excellent initial adhesion and the torque shear values for all the panels were almost identical. No film detachment was observed in any case. After exposure to 1,500 hours accelerated weathering, lower values were recorded for both the non-silane control and the γ -beta aminoethyl aminopropyltrimethoxysilane treated panel, with some film detachment, particularly so in the latter case. The values for the other silane panels were slightly lower but no film detachment was recorded.

The recorded values for the epoxide paint showed that all the silane treated panels gave higher values than the non-silane control, which showed some film detachment. Detachment was also observed on the γ -methacryloxy propyltrimethoxysilane treated panel. After exposure to

Table 5
Bond strength of paints to zinc – torque shear

Paint/silane	Controls		After 1500 hours AW	
	MPa	psi/ area of detachment	MPa	psi/ area of detachment
Polyurethane/none	47.8	6500/0–20	27.1	3940/100
Polyurethane/ γ -methacryloxy propyltrimethoxysilane	41.5	6030/0–60	29.6	4290/100
Polyurethane/ γ -mercaptopropyl trimethoxysilane	48.2	7000/0	38.6	5600/10–60
Polyurethane/n-beta aminoethyl aminopropyltrimethoxysilane	43.7	6350/0–80	37.2	5400/2–100
Epoxide/none	37.6	5450/ 40–100	20.0	2910/100
Epoxide/ γ -methacryloxy propyltrimethoxysilane	35.7	5180/40	28.6	4150/100
Epoxide/ β -(3,4-epoxycyclohexyl)-ethyltrimethoxysilane	43.7	6350/0–10	34.8	5050/90
Epoxide/ γ -glycidoxy propyl-trimethoxysilane	46.8	6800/0	34.8	5050/80
Epoxide/ γ -mercaptopropyl trimethoxysilane	49.6	7200/0	37.9	5500/80
Epoxide/n-beta aminoethyl-aminopropyltrimethoxysilane	41.7	6060/0–50	44.8	6550/0–30

accelerated weathering all the panels showed a loss in bond strength although there was no film detachment on the β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane treated panels, both of which failed cohesively within a chalk layer.

The direct pull-off values are shown in Table 4. It can be seen that although the recorded values for the polyurethane paint were very similar, film detachment was observed on both the non-silane control and the γ -mercaptopropyl trimethoxysilane treated panels. After exposure to accelerated weathering the measured bond strengths were higher in every case, but those for the silane treated panels were higher than the non-silane control and none showed film detachment.

The recorded values for the epoxide paint were very similar although only the non-silane control panel showed film detachment, considerable on some specimens. After exposure to accelerated weathering, two panels, those treated with β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane and γ -glycidoxy propyltrimethoxysilane, were free from detachment. The control panel showed a considerable loss of bond strength.

Zinc

The torque shear values obtained from the zinc panels are shown in Table 5, from which it can be seen that in the case of the polyurethane paint only the γ -mercaptopropyl trimethoxysilane produced an increase in initial bond strength. The remaining silanes produced a lower bond strength with an increased area of detachment.

However, after exposure to the accelerated weathering cycle the recorded bond strengths on the γ -mercaptopropyl trimethoxysilane and n-beta aminoethyl aminopropyltrimethoxysilane treated panels were very much higher than the non-silane control, although there was a considerable area of detachment on all panels.

The values for the epoxide paint clearly showed that all

Table 6
Bond strength of paints to zinc - direct pull-off

Paint/silane	Controls		After 1500 hours AW	
	MPa	psi/ area of detachment	MPa	psi/ area of detachment
Polyurethane/none	29.5	4280/20-80	14.6	2120/10-80
Polyurethane/ γ -methacryloxy propyltrimethoxysilane	22.3	3240/20-80	13.4	1950/10-90
Polyurethane/ γ -mercaptopropyl trimethoxysilane	27.1	3940/0-30	30.4	4410/0*
Polyurethane/n-beta aminoethyl aminopropyltrimethoxysilane	28.7	4170/80	13.2	1920/90
Epoxide/none	20.5	2970/ 60-100	13.4	1950/10-40
Epoxide/ γ -methacryloxy propyltrimethoxysilane	20.5	2970/70	11.6	1690/ 60-100
Epoxide/ β -(3,4-epoxycyclohexyl)- ethyltrimethoxysilane	21.6	3140/5-40	12.1	1750/85
Epoxide/ γ -glycidoxy propyl- trimethoxysilane	29.4	4270/0	14.1	2050/10-60
Epoxide/ γ -mercaptopropyl trimethoxysilane	31.0	4500/0	29.1	4230/0*
Epoxide/n-beta aminoethyl- aminopropyltrimethoxysilane	23.1	3360/ 30-100	23.1	3360/10

*Cohesive failure in the paint

the silanes, with the exception of the γ -methacryloxy propyltrimethoxysilane, produced a considerable increase in bond strength, and in two cases there was no detachment. After exposure to the accelerated weathering cycle the bond strength was reduced on all panels except the n-beta aminoethyl aminopropyl treated panel. Here there was a slight increase in bond strength. In every case the bond strength on the silane treated panel was greater than that on the non-silane control.

Reference to Table 6 will show the direct pull-off data. Comparison of this data with that in Table 5 shows a few points of similarity but some considerable differences. The polyurethane paint results showed that none of the silanes produced an increase in bond strength, rather the reverse. A major point of similarity was that the bond strength on the γ -mercaptopropyl trimethoxysilane treated panel was the highest after exposure to accelerated weathering.

In the case of the epoxide paint, both the γ -mercaptopropyl trimethoxysilane and the γ -glycidoxy propyltrimethoxysilane treated panels showed higher bond strengths than the control and this improvement was maintained in the former case after exposure to accelerated weathering.

Discussion

There is, of course, no reason why the bond strengths of the various paint/silane/metal combinations as determined by the two different test methods should be the same or bear a constant relationship to each other. The torque spanner technique exerts a shear stress on the film and its bond to the substrate and in general induces a greater number of apparent adhesion failures (areas of detachment) at higher failing loads than the direct pull-off method which exerts a tensile stress on the film and bond. Without exception, the failing loads reported in this paper are greater for the torque spanner technique than the direct pull-off. However, if the actual recorded bond strengths obtained from any given series of paints and sub-

strates by the two methods are not compared directly but a comparison made between the observed trends within a series, then agreement between the two methods is reasonably good. In some cases such a comparison is not possible due to the relatively large number of failures to detach films from the substrate.

There are instances in which the trends indicated by the two methods are significantly different, notably on the zinc substrate after accelerated weathering. Here the torque spanner results for the epoxide indicated a marked improvement in retained bond strength on all the silane treated panels. The direct pull-off results indicate a deterioration in bond strength on three out of five silane treated panels. A possible explanation for this apparent anomaly may lie in the fact that the torque spanner tests were carried out on the panels before the direct pull-off tests and without any intermediate handling process. The direct pull-off test was performed on individual squares cut from the test panel. This cutting operation undoubtedly causes distortions, stresses in the film/panel laminate and although the actual test area was as remote from a cut edge as possible, it would seem that the paint/metal bond could be subjected to stress. This being so it is perhaps not surprising that the direct pull-off values are lower and do not always show the same trend. It may be argued that this applied stress can only adversely affect the paint/metal bond, no improvement is likely, and so whereas any adverse disagreement between the direct pull-off and torque spanner results may not accurately reflect the true state of affairs, complete agreement is an accurate reflection. There are instances where the direct pull-off shows an apparently greater retention of bond strength than the torque spanner technique, notably with the polyurethane paint on copper. An alternative suggestion is that if the site of failure is within a boundary layer, particularly a corrosion or reaction product between the paint or substrate, then this layer may well be stronger in shear than in tension. A knowledge of the exact site of failure is central to an understanding of the role and mechanism of the increase in bond strength both initially and after exposure to a hostile environment, and to establishing the reasons for non-agreement between the two test methods. In the absence of this knowledge the pragmatic approach of regarding only those observations derived from both test methods will be adopted. It is appreciated that this approach may well lead to incomplete conclusions.

If the percentage loss of bond strength after accelerated weathering (AW) and the percentage change compared with the non-silane panel are tabulated for each metal, showing the torque values first, it is easier to evaluate the results.

Cadmium Plate

Only the γ -mercaptopropyl trimethoxysilane can with certainty be said to have improved the initial bond strength of the polyurethane paint, although all but the γ -methacryloxy propyltrimethoxysilane improved the initial bond strength of the epoxide paint.

Polyurethane

	% change after AW	% of non-silane
No promoter	-17.6, -21.2	
A174	+ 3.8, -19.0	120.5, 130.6
A189	+ 2.9, + 3.3	128.6, 162.0
A1120	-36.1, -41.9	67.9, 91.4

	% change after AW	% of non-silane
No promoter	- 3.2, -30.8	
A174	+25.8, -14.0	113.6, 144.1
A186	+ 8.1, -57.9	124.8, 67.5
A187	-18.1, -10.8	114.6, 151.2
A189	+ 5.0, + 5.6	129.1, 171.4
A1120	+ 3.1, + 7.8	116.5, 175.0

It is clear from the tabulated values that both the polyurethane and epoxide paints suffered a real reduction in bond strength due to exposure to the accelerated weathering cycle. It is also clear that γ -mercaptopropyl trimethoxysilane (A189) materially improves the retained bond strength of the polyurethane paint and γ -mercaptopropyl trimethoxysilane and γ -beta aminoethyl aminopropyltrimethoxysilane (A1120) improve that of the epoxide.

Copper

Polyurethane

	% change after AW	% of non-silane
No promoter	-15.3, + 1.7	
A174	- 5.7, +14.2	108.2, 119.4
A189	- 8.8, +17.4	108.0, 121.4
A1120	-22.1, +15.5	89.3, 120.0

Epoxide

No promoter		
A174	-15.1, -20.1	92.9, 108.5
A186	- 2.8, +10.2	103.9, 135.8
A187	-15.3, - 7.4	96.1, 140.6
A189	- 8.3, -19.9	103.9, 117.7
A1120	-15.7, -29.7	92.9, 102.4

The tabulated values for the polyurethane paint indicate an apparent divergence between the two methods in that the torque spanner results show a loss in bond strength due to accelerated weathering and the direct pull-off results indicate an improvement. As yet no explanation can be offered for this anomaly but it is clear that both γ -methacryloxy propyltrimethoxysilane (A174) and γ -mercaptopropyl trimethoxysilane (A189) improve the retention of bond strength.

The epoxide results are much more consistent and indicate a loss in bond strength due to accelerated weathering, but in spite of this β -(3,4-epoxycyclohexyl)ethyltrimethoxysilane (A186) and γ -mercaptopropyl trimethoxysilane (A189) produce an increase in retention of bond strength.

Zinc

Polyurethane

	% change after AW	% of non-silane
No promoter	-39.4, -50.5	
A174	-28.9, -39.8	108.9, 91.9
A189	-20.0, +11.9	142.1, 208.1
A1120	-14.9, +53.9	137.1, 90.6

	% change after AW	% of non-silane
No promoter	-45.6, -34.4	
A174	-19.9, -43.3	142.6, 86.7
A186	-20.5, -44.3	173.5, 89.7
A187	-25.7, -52.0	173.5, 105.1
A189	-23.6, - 6.0	189.0, 216.9
A1120	+ 8.1, 0	225.1, 172.3

The results for the polyurethane paint clearly show that although all the silane promoters are adversely affected by exposure to the accelerated weathering cycle, γ -mercaptopropyl trimethoxysilane (A189) produces a marked improvement in the retention of bond strength. In the case of the epoxide paint, the *n*-aminoethyl aminopropyltrimethoxysilane (A1120) treated panel showed practically no change after accelerated weathering and in this respect was superior to the panel treated with γ -mercaptopropyl trimethoxysilane.

In general the zinc substrate showed the greatest change in bond strength after accelerated weathering with cadmium next and copper the least. There is little doubt that the γ -mercaptopropyl trimethoxysilane is the most effective all-round bond strength promoter for both the polyurethane and epoxide paints on all three substrates tested. This finding does not agree with that of previous work¹ on mild steel and aluminium where *n*-aminoethyl aminopropyltrimethoxysilane and γ -methacryloxy propyltrimethoxysilane appeared to be the most effective. This would tend to suggest that the silanes may show some degree of specificity for metals as well as for polymeric binders.

Conclusions

From the work reported it may be concluded that the use of organosilanes as pretreatment primers on cadmium, copper and zinc can produce a marked improvement in the initial bond strength of polyurethane and epoxide paints. The use of γ -mercaptopropyl trimethoxysilane as a pretreatment primer on cadmium, copper and zinc can produce a marked improvement in the retention of bond strength after exposure to accelerated weathering. Not all silane coupling agents are equally effective and some degree of specificity is indicated.

[Received 28 January 1983]

References

1. Walker, P., *JOCCA*, 1982, **65**(11), 415.
2. Walker, P., *JOCCA*, 1982, **65**(12), 436.
3. Godeburg, K. G. and Westbrook, L. R., "Modern Electroplating", 2nd ed., *John Wiley and Sons Inc.*, New York, 1963.
4. "Handbook on Electroplating", 19th ed., *W Canning and Company*, Birmingham.
5. Walker, P., "*VIII FATIPEC Congress*", Verlag Chemie, Weinheim, 1966.
6. Bonner, P. E. and Watkins, K. O., *Ibid.*
7. Bullett, T. R. and Prosser, J. L., *Ibid.*
8. Walker, P., *JOCCA*, 1970, **53**(1), 30.

New insights into the process of adhesion measurement and the interactions at polymer/substrate interfaces

U. Zorll

Forschungsinstitut für Pigmente und Lacke e.V., Wiederholdstrasse 10/1, 7000 Stuttgart 1, Germany

Summary

In accordance with the general tendency to measure adhesion in terms of well-defined mechanical data, studies were undertaken related to the exact application of the pull-off test and to adhesion under conditions of shock loading. Microphotometric systems were found to yield substantially more information about adsorption processes in the context of adhesion phenomena. With respect to the adhesion of polymers to metallic substrates, the role of the surface profile was elucidated as well as the importance of the balance between adhesion and osmotic pressure in the typical filiform corrosion process.

1. Introduction

1.1 Scope

The state of knowledge in the field of adhesion is important not only in the practical application of polymer films but also for understanding bonding phenomena and effects at interfaces in general. Therefore, the task group Adhesion was established within the framework of a programme for scientific studies to be carried out by the working party Supported Polymer Films of the Macromolecular Division of IUPAC.

1.2 Programme

Three directions of work were envisaged at the outset, and an intermediate report on the results is given here. It was felt that more information should be available on:

1. How to measure adhesion as a physically defined quantity.
2. The extent to which molecular data be taken into consideration for describing adhesion effects.
3. The role that can be ascribed to adhesion in the context of corrosion.

The investigations accomplished in this sense as well as the most important conclusions are presented below. For further details, reference to the original documentation of results is recommended.

2. Assessment of adhesion and related phenomena

2.1 Measurement of adhesion under nearly static conditions

2.1.1 Survey of methods

In order to obtain meaningful data about the strength of adhesion – that can be considered as a result of making a composite material in the form of a polymer layer on another material, a metallic substrate for instance – the system of measurement used should allow the calculation or at least the estimation of the stress at the metal/polymer interface. One of the principal methods which can be used, because its concept is based on applying the forces acting at the interface in a well-defined manner, is the pull-off test.

Studies as to the limitations in preparing samples for that test in terms of shape of the specimen and the like have been carried out by Wapler¹, Sickfeld², and Sickfeld and Hosp³. Experiences based on these results have been published by Sickfeld and Raabe⁴.

In contrast to the empirical tests that are very often used in practice, mainly the cross-cut method, some of the newer procedures used to characterise adhesion are from the outset based on a more exact measurement of adhesion strength in terms of the mechanical quantities to be applied in those cases, i.e. in the form of tensile or shear stresses, expressed in N/mm² or MPa respectively.

2.1.2 Pull-off test

Although these methods should lead, in principle at least, to the correct values of the maximum bond strength as a measure of adhesion, the results are influenced by the method of measurement itself, especially when some important factors have been left undefined. More or less all of them are related to the method in which the test assembly to be studied is prepared and subjected to loading during the process of measurement.

With respect to the pull-off test, as standardised now in ISO 4624, an essential source of errors in the test results is the procedure of cementing the cylinder, which effects the transmission of the applied load into the sample. An incorrect cementing procedure can lead to a deviation from the ideal conditions that ought to prevail in the measurement process. Only very cautious handling will guarantee that the required perpendicular position of the cylinder axis with respect to the film surface is in fact attained. Yet, a wedge-like layer of the adhesive between cylinder and polymer film is fairly often encountered under practical circumstances and as a result undue scattering of results may be observed.

2.2 Influence of the shape of sample in the pull-off test

2.2.1 System of measurement

An uneven distribution of the adhesive could only be avoided, mostly with great difficulty, by a substantial variation of the cementing procedure. However, the mechanical arrangement of the sample may be chosen on applying the load, even if the ideal conditions of sample preparation are not fulfilled. A measurement process that remains free from the influence of bending moments becomes possible when spherical symmetry is maintained in the device used for producing and transferring the load to the sample.

The main purpose of such an arrangement can be seen in the fact that the centre of the sphere, any radius of which may be a possible direction of force, is exactly positioned at the interface between polymer film and substrate. In most events, however, sufficient care has to be taken to avoid too large a deviation from the correct place-

ment of all parts of the sample to be studied. The spherical arrangement will thus in virtually any case be the best means to compensate for the remaining deficiencies from the ideal state of loading on which the approach for calculating the adhesion data is based.

Another factor of potential influence is the rate of loading used in the system for measurement of adhesion. There is experimental evidence that the rate of loading affects the adhesion data. A more rapid deformation during the loading process will generally yield somewhat higher values for adhesion strength. Starting from a mode of application of the system in which the risks of bending moments were eliminated, it could nevertheless be shown that the effects of the rate of loading, if any, would be of minor importance. The reason for this behaviour can be seen in the viscoelastic properties of the polymer material, which only leads to an alteration of the response to mechanical loading if the rate of loading is varied over many orders of magnitude.

2.2.2 Adhesive and cohesive failure

Modifications of adhesion data, that can be traced back to various other factors of the measurement device, have been the subject of special studies. These were, however, more directed to the determination of the rupture force measured in carrying out such tests rather than to the adhesion as such, because it was felt that this notion would be more in line with the observation made in practice. According to such results, adhesion failure is rather seldom obtained with polymer films which have been developed for good bonding strength with the related substrate, so that mostly cohesive failure occurs in the course of the measurement process.

But even under this restriction, a complex of factors is obviously affecting the strength of the bond at and near to the interfacial region, and the knowledge now obtained about these effects will undoubtedly be of value in finding new concepts for making reliable bonds in composite systems, of which a polymer film is one component.

2.2.3 Geometrical factors

As far as similarity is concerned in defining the shape of the test assembly, on which the adhesion measurement is to be performed, the diameter of the cylinder cemented to the surface of the polymer film is of no or only of minor consequence with respect to the results measured. If, however, the geometry of the cylindrical shape is markedly different, a situation that can be encountered with some commercial test instruments, a tendency can be observed that can be characterised by an inverse relationship of the bonding strength measured and the diameter of the cylinder.

The reason for this should be ascribed to the stronger effect of bending moments in the case of larger cylinder diameters. These findings once more point to the necessity of compensating for such negative influences.

Most of the current theories of adhesion and bond strength between polymer films and various substrates do not consider any thickness effect of the polymer. They are based on the presumption that the material is homogeneous and thus a thickness effect should not be anticipated. Although this characterisation may be helpful for a first approach, the practical consequences of it are in contradiction with the behaviour of polymer films in reality, because as already mentioned, the physical value which is measured by the pull-off test is the breaking

strength of the system rather than the adhesion strength of the coating.

2.2.4 Elasticity factors

The general tendency which is prevailing in those cases will be a rather lower bond strength under otherwise equal conditions when the thickness of the film is increased. This conclusion has an analogy in the field of testing material strength in general, where, due to less in-homogeneities, smaller samples exhibit higher values of strength, all other parameters being constant.

One of the most important mechanical properties of the polymer film itself, the modulus of elasticity, which to a considerable extent affects hardness and similar features of the polymer layer, was found, however, to be nearly without influence in terms of adhesion. This result should of course not be considered as too unexpected because of the nature of that modulus; it is a characteristic of the bulk polymer material, which will most probably be different from those parts of the film that should be considered in studying the effects occurring exactly in and not far from the interface.

2.3 Variations in the measurement procedure of the pull-off test

2.3.1 Modes of measurement

According to the practical requirements, the pull-off test can be implemented in two ways, either with a cylinder cemented to the surface of the polymer film, in cases where the latter is supported by a sufficiently thick metallic substrate, or in the form of a "sandwich", which is characterised by a more symmetrical arrangement. In this case, cylinders of equal dimensions are cemented to the surface of the film as well as to the reverse surface of the substrate that in general will only be a thin sheet of metal; such an increase of rigidity becomes necessary in order to obtain reliable results. The importance of this provisional measure has been accentuated by the findings in comparative studies, that under otherwise equal circumstances the measured bond strength was up to 60 per cent lower in cases where no additional cylinder was used for the reinforcement of the relatively flexible substrate.

2.3.2 Substrate thickness

The effect of substrate thickness has also been studied to a certain extent so that now a quantitative estimation of the deviations caused by deformation of the substrate can be given. The bending moment attains considerable values up to a thickness of 15 mm. This result was verified by using stress-optical methods for models of the samples ordinarily used in practical tests. An interesting additional fact is that the type of substrate material, for instance steel or aluminium, is obviously of minor consequence in the formation of the bending moment.

3. Behaviour of adhesive joints submitted to local shock loading

3.1 Effects of impact on a polymer film on its substrate

3.1.1 Aspects of stress

Combinations of polymer film and substrate, like those to be found in laminated composites, will generally correspond to specifications formulated with respect to resistance to mechanical loading. Stress concentrations must be avoided as far as possible, not only at the

interface of the components making up the joint but also in the bulk of the material and at critical sites, such as edges and corners or other points of limitation.

Any local increase in stress level, which would be the consequence of a stress concentration, may considerably exceed the average stress on which the design of the composite is based, leading to failure even at a fairly low intensity of mechanical loading. Under the provision that the material is handled or processed carefully, according to the ordinary requirements, the risk of unexpected failure of the system can be excluded in practical terms.

3.1.2 Impact process

One situation, however, with a concentration of stress that is characteristic for the process of mechanical loading often occurs in the course of practical use. Such a situation exists when the composite is subjected to shock or impact on any point of its free surface.

Generally, there is a certain loss of kinetic energy for the body striking the surface. The consequences of such an energy transfer into the composite have thus to be scrutinised. Several effects are conceivable, namely deformation in the elastic and plastic sense, homogeneous fracture within the polymer layer is of special interest here, and also a process of interfacial delamination in the vicinity of the site of impact.

3.1.3 Idealised conditions

There is a remarkable variety of conditions under which impact loading may happen in practice. It is necessary to resort to a certain degree of idealisation, applicable for the definition of the stress field to be considered in the case of local and transient forces acting upon the surface. One reason for using such idealised conditions can be seen in the fact that the procedure of shock loading can be carried out experimentally without too much disturbance from secondary factors.

An idealisation is also necessary for the experimental approach to the interfacial delamination process. Fortunately in both cases the solution to the problem can be obtained in a fairly simple way. The details of this procedure for studying adhesion under shock conditions have been elaborated by Zorll⁵.

3.2 Stress distribution at the interface and in the polymer film

3.2.1 Impact parameters

Ideal conditions for the duplication of the real impact process can be obtained by using a spherical body. This is because data necessary to define kinetic energy and momentum are mass and radius of the sphere and the velocity at the moment of impact, which can easily be determined. The measurement of the force that the body is exerting will not be an equally simple procedure, because data about the time of impact must be available in such a case. But since this is not an obstacle in principle, it should be considered as an experimental problem to be solved by means of short-time measurement techniques, which would probably also lead to further information about the details of the shock loading process.

It may be sufficient to start from normalized forces for the consideration of the stress field generated in the composite. The laminated composite to be tested is subjected

to impact loading by a spherical body that impinges perpendicularly to the surface. The consideration of the stress field is limited to the polymer layer and the upper portion of the substrate.

3.2.2 Conditions at the interface

One feature of the stress field is that it exhibits strictly rotational symmetry. Thus only dilatatory stresses of the azimuthal and radial type need to be considered in the bulk of the material. It may be sufficient only to mention the existence of such types of stress here, because the primary interest rests with the stress components appearing at the interface. The stresses in the bulk material, however, lead to typical fracture useful for control purposes. They will be noticed only if the level of stress is high enough.

As far as the interface of the composite is concerned, where the main interest lies, there are two types of stresses, compressive stresses and shear stresses. The effects of both of them must be considered, for these stresses will be responsible for any delamination process that is caused by impact loading.

3.2.3 Approximations

Some remarks as to the approximations are in order. First, the stress field is essentially the one which is applicable for static loading. In other words, transient processes which are certainly involved in the shock loading procedure have been deliberately neglected, retaining the simplicity of the relationships.

Second, the viscoelastic character typical of polymers has been ignored in discussing the stress field and its consequences. This seems justified in respect of the short time span in which the shock process is effective. Under such circumstances, even viscoelastic materials will appear similar to purely elastic bodies.

There is a lack of knowledge about the extent to which the simple expressions for stresses, used in the assessment of the interfacial adhesion, are applicable in context with the approximations mentioned. So it is advisable to consider the conclusions regarding the stress field as more or less semi-quantitative and as not exact, in contrast to what might appear at a first glance because of the good correlation mostly found in explaining pertinent delamination phenomena on this theoretical basis.

3.3 Relationship of phenomena of interfacial delamination

3.3.1 Stress distribution

According to the model mentioned, compressive stresses as well as shear stresses will be effective at the interface. Both stresses can be calculated as a function of the radial coordinate with the thickness of the polymer layer as a parameter. By the way, this quantity affects the intensity and the distribution of the stresses considerably.

The compressive stresses obviously level off fast with increasing distance from the impact axis, where they attain a maximum. The existence of compressive stresses as such will be beneficial because they will support the interfacial adhesion by the very nature of the stress.

On the other hand, the shear stresses, which become zero at the centre, that is on the impact axis by reason of symmetry, generally show a maximum for a certain value

of the radial coordinate. They also tend to disappear, but not as fast as the compressive stresses.

The delamination area, appearing under the combined effects of the two types of stresses mentioned, will consist firstly of a central region, where the compressive stress has prevailed and thus only cohesive failure can be expected, and secondly of an annular zone, determined by the effects of shear stresses. This type of stress, however, leads to delamination in the strict sense of the word, so that adhesive failure will be prevailing in the outer portions of the delamination area, which is, of course, of circular shape.

3.3.2 Compression and shear effects

All these effects depend strongly on the level at which the stresses become effective, in other words, on the thickness of the polymer layer. As a rule, the area of detachment, with its portions determined by compressive and shear stresses, will appear the more extended – but, of course, with correspondingly lower intensities of the stresses – the greater the thickness is. Since the degree of intensity may be raised easily, in principle at least, by resorting to a higher kinetic energy of the impinging body, this relationship can be of special use for the determination of interfacial adhesion in composite systems, where the polymer layer is of a higher thickness.

The delamination area in a composite thus consists of the central area (cohesive failure) and the annular region (adhesive failure). The diameter of the whole area can serve as a measure of the adhesion strength. Up to its value, the shear stresses have been adequate for the delamination to occur, with due consideration, of course, of the influence of the layer thickness.

Under otherwise equal conditions, the area of detachment can be used as an orientating figure for the bonding strength at the interface. This will often be sufficient in practical terms if a fast assessment of the adhesion quality is looked for, as in, for example, laminated composites.

4. Correlation between molecular data and adhesion phenomena

4.1 Determination of chemically adsorbed polymers

4.1.1 Chemical factors

Chemical reactions at the interface, that may enhance the strength of adhesion or even form the very basis of the bonding process, can be pursued to a sufficient extent by means of model substances behaving virtually in the same way as the real polymer material.

In general, a separation can be made between chemical reactions as such and physical interactions which only lead to less strength of bonding for various energy and geometrical reasons.

As a method that combines accuracy of measurement with limited instrumental requirements, a photometric system can be used to distinguish between the types of contact making up the components of the interfacial bond. In some favourable cases, even a semi-quantitative analysis becomes possible. This method has been developed by Kollek and Brockmann⁶.

4.1.2 Photometric system

The system comprises a double beam photometer and an integrating sphere mounted into the sample compartment.

One advantage of the device can be seen in the fact, confirmed by several experiments, that the results are less affected by any changes of surface roughness, as compared to measurements of reflectivity, which may be negatively influenced in that way. On the other hand, optical differences can be revealed, by using this technique, that are related to the behaviour of treated and untreated metal surfaces.

On applying the method, one can assess the degree of chemical reactivity at the surfaces of aluminium and its oxide between these materials and phenolic resins of the type used in the formulation of primers. An interesting result is obtained by evaluating the specific types of reaction products formed at the interface. They are characterised to a remarkable degree by exhibiting a non-stoichiometric composition. The hydrolytic stability of these compounds is obviously fairly high, according to the experimental results.

If the range of wavelengths in the photometric system is restricted to ultraviolet regions, where a maximum of absorption is to be anticipated, for instance 275 nm in the case of phenolic resins, any changes in the absorption level can be determined when the state of the surface is measured before and after adsorption.

4.1.3 Extinction coefficients

The differences thus obtained could be expressed in extinction units in order to obtain data approximately proportional to the concentration of resin molecules adsorbed on the surface. The extinction coefficient of the various compounds, however, should be of similar order of magnitude. The microscope photometer arranged in that way provides for measurements in an area of at least $0.5 \times 0.5 \mu\text{m}$, but analysis of the surface is facilitated if somewhat greater squares are being used, such as $10 \times 10 \mu\text{m}$. By scanning a total of $200 \times 200 \mu\text{m}$, the then 400 single results yield a map-like representation of the distribution of resinous components adsorbed on the surface.

There is presumably a certain correlation between local differences of adhesion and those in-homogeneities observed by using the method mentioned; this relationship has still to be elucidated in further experiments.

4.2 Influence of specific forms of the surface profile

4.2.1 Surface profile and composition

The durability of an adhesive bond under the influence of various climatical factors is not only a property of practical importance. It can also be used as an indicator as to what extent a situation of bonding is primarily governed by the effect of molecular contacts at the interface. In order to achieve meaningful results regarding the stability of the bond of a polymer film on a metallic substrate, not only the characteristics in terms of profile and composition of the metal surface should be known, but also the properties of the polymer material itself.

The possibilities of water adsorption at the interface as well as those of changing the mechanical film properties during the ageing process should thus be identified. Studies on these effects were carried out by Brockmann, Henemann and Kollek⁷.

4.2.2 Micromorphological aspects

As far as the metallic surface is concerned, the micromorphology of it has been found to play a decisive

part in all processes intended to bring about a bonding strength of sufficient degree at the interface. For instance, durability as well as strength of the bond become the higher, in the case of anodized aluminium surfaces, the more the morphology of the profile is developed.

It is, however, also necessary that the molecular size of the polymer material is maintained below certain limits in order to make use of the potential that the then sufficiently small molecules may penetrate into the structure offered at the prepared surface by capillary forces and the like. There should be no doubt that the molecules of a phenolic resin, as used for primer formulations, will lead to a strong mechanical connection because of the small size of each individual molecule as compared to that of prepolymerized epoxy resins, which may turn out to be too large for very fine surface structure as the substrate.

4.2.3 Bonding stability

Another problem that should be satisfactorily solved in establishing the conditions for strong and durable bonds is that of the mechanical stability which can be maintained within the surface region of the substrate; in the case of metals mostly that of the oxide layer. Some of those structures seeming adequate for mechanical clamping of the polymer film do not appear stable enough; the phosphoric acid anodizing of aluminium alloys is a typical example, while in the same case the anodizing process with chromic acid leads to a much more resistant surface structure.

It has further been shown in appropriate experiments that the simple idea of considering the polymer in the cured state as without any structure cannot be sustained. The formation of typical structures has already commenced as soon as the smaller groups of the polymer penetrate into the microstructure of the surface, while the prepolymerized species do not fit into those features of the profile. On the other hand, the different reactive groups of the polymer may cause some degree of agglomeration which also leaves a certain structure.

4.2.4 Internal structure

Such an internal structure is, of course, a substantial influence on the level of adhesive strength and, still more important, on the type of delamination in the case of a failing bond. In general, the cohesive type of failure will thus be prevalent, even if the first inspection would lead to the opposite conclusion, i.e. adhesive failure. By means of high performance surface analytical test methods, it has been proven in a series of carefully performed experiments that the surface of the substrate after detachment of the polymer film is covered with small amounts of the latter remaining on the surface because of sufficiently strong bonds overcoming the cohesive strength.

5. Effect of adhesion in the corrosion process

5.1 Balance with osmotic pressure in filiform corrosion

5.1.1 Phenomenological aspects

The role of adhesion in the more complex phenomenon of filiform corrosion, which is one of the typical corrosion processes, occurring at specific values of relative humidity, has been further elucidated. These results are due to van der Berg, van Laar and Suurmond⁸. Loss of adhesion of a polymer film which is supposed to give sufficient protection to the metallic substrate will always be observed if the

osmotic pressure, which is increasing in the thread-like zone of damage, exceeds those forces at the interface on which the strength of the bond is based. A certain modification of the osmotic effects is caused by the degree of rigidity which is prevailing in the polymer film itself as well as in the iron gel complex that forms the membrane acting in the osmotic process.

It is remarkable that the rate of corrosion, which is taking place in the course of the filiform development, does not depend so much on the permeability of the polymer film nor on the degree of passivation of the steel surface. On the contrary, there is a fairly close relationship between the rate and extent of corrosion and adhesion. Even in the case of conversion layers on the surface of the substrate, the increase in corrosion protection is to a certain amount compensated for by the decrease in potential for mechanical clamping of the polymer film and its consequences in terms of adhesion. Thus, the controversial results with regard to corrosion protection, obtained with zinc or iron phosphates, can be explained sufficiently. It is probable, therefore, that cohesion in the zinc phosphate layer occurs only occasionally.

5.1.2 Loss of adhesion

In general, the detachment process during filiform corrosion is a consequence of a special development, in which the active head of the corroded zone is transformed into the non-active tail. At a specific moment, the front line of the filiform system may be resting, while the borderline between head and tail portions passes through different stages that all finally lead to a minimum of the volume of the head portion, which carries all the electrolytes resulting in an increase in concentration.

The osmotic pressure within the liquid filling this portion is increased accordingly, so that after attaining the minimum mentioned, the bond strength of the polymer film and its substrate is overcome and a mostly sudden shift of the front line will occur. The exact moment of this event is obviously governed by the extent of adhesion between polymer and substrate material, the leading role of which in context with the whole process thus becomes evident.

5.2 Role of adhesion in context with surface structure

5.2.1 Surface preparation

Modifications of that procedure can be caused by special treatment of the surface before it is covered by the polymer film. For instance, sandblasting of the steel surface, as compared to simple vapour phase degreasing, results in a slower growth of the filiform corrosion or, in other words, better adhesion between polymer layer and substrate. At the same time, the filiform thread appears less flat.

If one assumes that the final shape of the filament is fixed when its head is being formed, it becomes clear that it will primarily be the hydraulic pressure in the head portion which, after exceeding a certain threshold value, produces detachment of the film as such.

5.2.2 Effect of bonding forces

The details of that process are, however, determined by the proportion of forces related to adhesion and to deformability, so that the specific shape of the profile of the head portion is dependant on the balance of those effects. The

general conclusion is that any assessment of adhesion, or more precisely of the bonding forces at the interface of polymer and metallic substrate, cannot only be restricted to the contact area of both materials but should be based also on a consideration of the phenomena in the adjacent regions.

6. General conclusions

Adhesive bonds are very often used in practice. For the special case of the bonding of polymer films to various substrates, widespread application of this type of composite has been made in the field of organic coatings as well as in that of adhesive materials.

Thus, the findings to which individual efforts in the task group Adhesion have lead, can be transformed into practical recommendations with respect to measuring the adhesion strength of those materials, to making the optimum use of the structural details in molecular and

geometrical terms, and to defining the role of adhesion in the realm of corrosion protection.

[Received 18 January 1983

References

1. Wapler, D., *Farbe Lack*, 1976, **82**, 589.
2. Sickfeld, J., *JOCCA*, 1978, **61**, 292.
3. Sickfeld, J. and Hosp. E., *Farbe Lack*, 1979, **85**, 537.
4. Sickfeld, J. and Raabe, H. J., *Farbe Lack*, 1981, **87**, 653.
5. Zorll, U., *Proc. of XV. FATIPEC Congress*, Amsterdam, 1980, Vol. 3, 94.
6. Kollek, H. and Brockmann, W., "Detection of surface contamination in metal bonding", in "Surface contamination", (ed. K. L. Mittal), Vol. 2, New York, 1979, 713-721.
7. Brockmann, W., Hennemann, D. and Kollek, H., *Int. J. Adh. Adhesives*, 1982, **12**(1), 33.
8. van der Berg, W., van Laar, J. A. W. and Suurmond, J., *Proc. 3rd. Internat. Conf. Org. Coatings Sci. a. Technol.*, Athens, July, 1977, Vol. 1, 188-207.

next month's issue

The Honorary Editor has accepted the following papers for publication. They are expected to appear in the August issue:

The efficient use of surface coatings* by R. A. Fidler

Surface coatings in relation to external wall insulation* by M. Wilkinson

The need for speed and accuracy in efficient production of surface coatings* by R. J. McCausland

Automated Paint Manufacture* by J. Boyden and W. Ollett

Linear polymonosulphide and polysulphide polymers – general survey, recent developments and applications* by J. Brossas and J. M. Catala

*Paper presented at the OCCA Conference, York, 15-18 June 1983. The relevant discussions that took place will also be published in this issue.

**OCCA
meetings**

Irish

New applications for emulsion polymerised acrylic solution resins

At a meeting of the Irish Section held at the Clarence Hotel, Dublin on Friday 21 January 1983, Mr B. Wood of Goodyear presented a paper entitled "New applications for emulsion polymerised acrylic solution resins".

The manufacture of emulsion polymerised acrylic solution resins was described. Styrene and acrylic monomers are polymerised in a water phase and the resin is then coagulated, washed, dried and packed as granules.

The main difference between a solution resin and dispersion resin and their influence on the properties of coatings were discussed.

The emulsion polymerised styrene acrylic solution resins were shown to be well-established in flat exterior masonry coatings and their newer application for exterior textured masonry coatings, waterproofing sealers, anti-corrosion paints and as film forming rheological agents was described.

Information regarding membership of OCCA is obtainable from the Association's offices, see contents page for address.



Shown on the left is Mr B. Wood of Goodyear who presented a paper to the Irish Section on 21 January 1983; the Section's Chairman, Mr D. Pountain, is shown on the right

The importance of particle size distribution to avoid cracking and pinholing of textured coatings was emphasised and a test method developed by the Bureau Veritas laboratory in France to assess the performance of exterior textured coatings was explained.

The use of cement as an extender in emulsion polymerised styrene acrylic resins to give a waterproofing sealer which may be applied to wet surfaces was discussed.

Work on the use of a styrene acrylic solution in anticorrosion paints to give high build, improved non-

Nose ahead.



VESTURIT, the binder for cross-linkable paint systems

The car industry makes high, sometimes mutually contradictory, demands of paints for coating metal and plastics components:

- Corrosion protection
- Chip resistance
- Weathering resistance
- Scratch resistance
- Flexibility
- Permanent colour
- Gloss retention
- Adhesion

Today, only high-grade binders, which also lend themselves to

the latest technology of low-solvent and water-thinnable systems, can offer all these different properties. Stoving finishes and plastics coatings based on VESTURIT are used in the car industry, for instance for:

- Car fillers
- Car finishing coats
- Chip resistant coatings
- All kinds of accessories

You will find more details in the VESTURIT brochure which gives

you comprehensive information and helps with ideas for solving paint technology problems.

**hüls (U.K.) Ltd., Cedars House,
Farnborough Common,
Orpington, Kent BR 6 7TE**

Please send me your
VESTURIT brochure

Name

Position

Company

Address

Telephone

**CHEMISCHE WERKE HÜLS AG
D-4370 Marl**

hüls

VESTURIT

Saturated polyester resins

Reader Enquiry Service No. 259

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

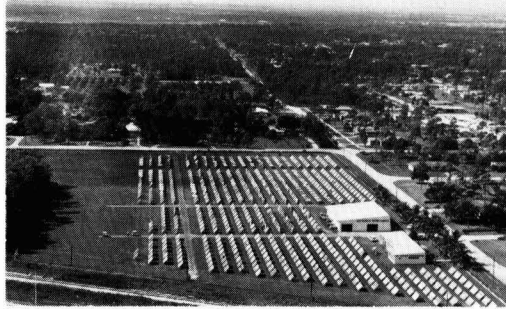
AT YOUR SERVICE to develop finer, more durable products

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

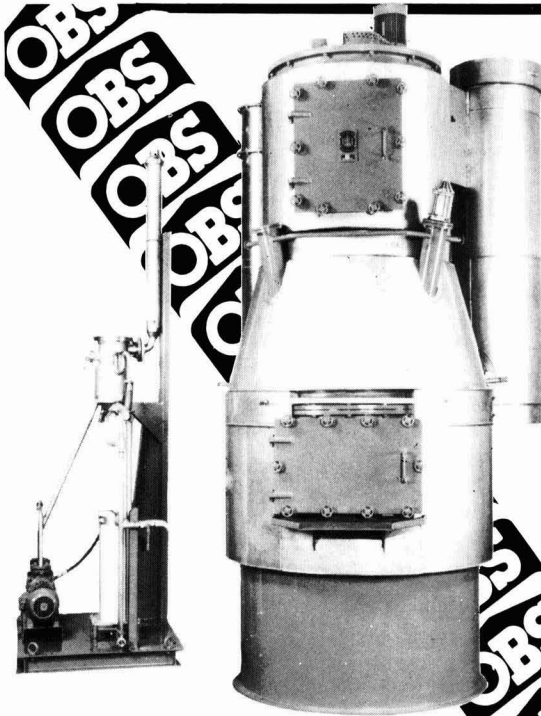
Sub-Tropical Testing gives fastest Natural Weather tests available for * paints * chemical coatings * plastics * textiles * fabrics * related products *

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



**EFFICIENT SOLVENT
 RECOVERY IS NOW
 A REALITY — WITH OBS**

The problems associated with solvent recovery during manufacturing processes are now a thing of the past thanks to the range of maintenance free SRP Solvent Recovery units from Ateliers Sussmeyer.

The equipment, operating on a direct heat transfer and distillation principle, is reliable and economic in operation, and represents the culmination of many years of research and development.

There are six models in the range, all designed to cope with the slurries from a continuous operating period of 8 hours, with installed power ratings from 4.5 to 25HP, and monthly production capacities from 9,600 to 153,000 litres of clean solvent.

For further information contact OBS Machines at Milton Keynes — sole sales and service concessionaires for the U.K. and Eire.

OBS MACHINES LIMITED

Unit 34 Heathfield, Stacey Bushes,
 Milton Keynes, MK12 6HR
 Tel. Milton Keynes
 (0908) 313186 or 313373
 Telex: 825663 (OBSUK G)

Reader Enquiry Service No. 257



There is more to ECC than meets the eye

As many of our customers in the Paint and Polymer industries already know, there's more to English China Clays than china clays from England. Because our ability to develop new and specialised products has helped us to become the world's leading supplier of white minerals.

In the field of calcium carbonates, ECC have developed ultra-fine Polcarb for the PVC industry, a range of carbonates for the Paint industry, talcs for the Polymer industry, and Claytone gelling agents to improve the stability

and application properties of a wide variety of solvents and resins.

ECC work regularly with customers to develop new or improved grades of calcined clay to meet the stringent

requirements of the Paint and Polymer industries.

And with extensive milling and storage facilities in the UK, Belgium and Italy, ECC can supply the whole of Europe – rapidly, reliably and economically.



ECC International PAINT & POLYMER DIVISION

ECC International Ltd., John Keay House, St Austell, Cornwall PL25 4DJ England
Telephone: St. Austell 4482 Telex: 45526 ECCSAU G

Please send me further details of ECC calcium carbonates and other products for the Paint and Polymer industries.

General interest Special interest (specify)

Name Title

Company

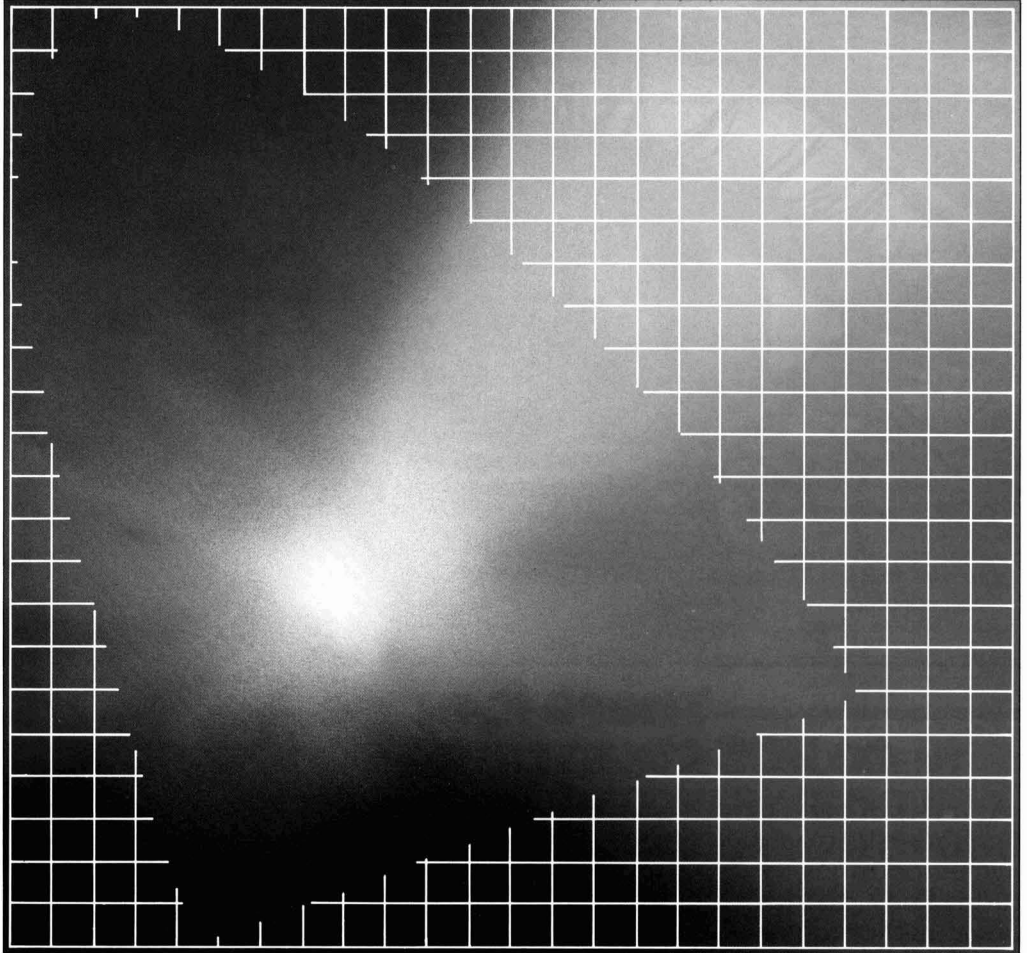
Type of industry

Products manufactured

Address

JCA 7/83

UV/VISIBLE SPECTROPHOTOMETRY



Show your true colours

...with the new Pye Unicam colour measurement system

Would you like the chance to measure colour – perfectly – but feel you can't justify an inflexible analyser?

At long last you have a chance to show your true colours, thanks to a new colour measurement system based on the world's finest high performance UV/VIS spectrophotometer – the Pye Unicam PU 8800.

■ It attains the highest possible standard of accuracy for colour or colour difference measurements.

■ It is the only non-dedicated system with an integrating spheroid conforming completely to CIE recommendations.

■ Sophisticated software offers a variety of measurement modes and observer angles, up to six illuminants, user programs and storage of spectral data.

■ You can adapt the system in moments to other UV/VIS applications – including specular reflectance, colorimetry, log A and 1st/4th derivative scanning.

■ It costs less than most dedicated colour measurement systems.

To find out more circle **reader inquiry number 85** and give us the opportunity to show you our new system in its true colours.

Pye Unicam Ltd

A SCIENTIFIC AND INDUSTRIAL COMPANY OF PHILIPS

York Street Cambridge Great Britain CB1 2PX
Telephone (0223) 358866 Telex 817331



**Scientific &
Analytical Equipment**

PHILIPS

yellowing and using lower aromatic solvent systems than conventional systems was illustrated.

A special styrene acrylic resin which acts as a film forming rheological agent and gave lower vacuole formation in high build chlorinated rubber coatings was presented.

The presentation finished with the application of exterior textured masonry coatings and waterproofing sealer.

The meeting concluded with lively discussion and a vote of thanks to the speaker was proposed by Mr P. McCrudden.

R. Somerville

Ontario

The use of hyperdispersants in printing inks

Mr Frank Parton of ICI gave his presentation to 40 members and guests. Mr Parton started with a theoretical explanation of how hyperdispersants function. He first described how surfactants operate in aqueous systems, with the hydrophobic part bonding to the pigment surface and the hydrophilic chain extending out into the surrounding aqueous phase. He then showed how hyperdispersants operate in an analogous manner in solvent systems, with one end bonding to the pigment surface, and the other end extending out into the surrounding solvent. It is this solvated chain which prevents reagglomeration of the dispersed pigment particles.

The speaker went on to describe the advantages that may be obtained by the use of these dispersants:

- Less energy is required since the pigment particles do not reagglomerate.
- Greater productivity is obtained since pigment loadings as high as 50 per cent may be used in the millbase.
- Increased flexibility results since one concentrated dispersion can be let down into a number of vehicle systems.
- Improved strength may be obtained.
- Superior print quality is achieved with better gloss, transparency, sharpness and density.

Specific examples and current research areas were then described in some detail, including work on extending the concept from hydrocarbon systems to those containing oxygenated solvents. Mr Parton also explained the advantages of incorporating the hyperdispersants at the pigment making stage where optimum coverage of the pigment surface may be expected.

Following a question and answer session, the vote of thanks was proposed by Mr Alan Gray.

The next three meetings of the Ontario Section will be held at the Cambridge Motor Hotel with a bar at 6.00 p.m. and dinner at 7.00 p.m.:

21 September 1983 Mr William Bartsch of Ciba-Geigy will speak on "Pitfalls of pigment selection".

19 October 1983 Student night. A senior executive 1983(7)

OCCA meetings

from a major printing ink firm will speak with special emphasis on education and training.

16 November 1983 Mr M. Patterson of Buhler will speak on "Dispersion equipment".

P. Marr

Newcastle

Popular polyurethanes

The February meeting of Newcastle OCCA, held at the normal St. Mary's College venue in Durham City, proved to be far the most popular meeting of the 1982-83 season. The 45 members and visitors who attended were a feast for the eyes of the regular Occaholics who work so hard for the Section in an attempt to encourage this level of attendance at every meeting. The free buffet, supplied by the staff of St. Mary's College, was a feast which all enjoyed, and hopefully helped seduce some of the high turnout to return to future meetings.

However, it was undoubtedly the topic of the lecture which drew so many, all hoping to gain that little extra which would help them and their companies to succeed in today's most exacting and most lucrative of coatings' markets. The lecture was presented by Mr D. Charlton of Bayer's Coatings Resin Section and was entitled "Polyurethanes - heavy duty aspects".

The lecture began with a philosophical review of man's inventiveness, which led to the creation of clothes, buildings, ships, cars, bridges etc. and how all these material things revert to nature by decaying, rotting, rusting and crumbling. This in turn drew man's creative genius even further to produce coatings to protect and preserve his material belongings, and of course in the view of Bayer the most supreme group of protective coatings are those based on polyurethanes.

A quick review of the basic polyurethane chemistry was presented outlining both 2-component and 1-component systems, with the later subdivided into moisture cured systems and monofunctional alcohol blocked systems, which are cured by heat. The general performance and advantages of polyurethane systems were clearly defined particularly in comparison with epoxy systems. These were itemised as:

- (a) Superior corrosion resistance and weather resistance giving long life coatings.
- (b) Faster dry/cure at lower temperatures than epoxies. Urethanes quoted as being at least 0.5 to 1 hour faster to cure at 5°C.
- (c) Application of urethanes to damp substrates does not result in either poor performance or poor adhesion.
- (d) Light fast polyurethane coatings with very good colour and gloss stability compared to epoxies can be produced.

Finally Mr Charlton invited anyone requiring any more specific information to contact him after the formalities, and many took advantage of his invitation.

During "question time" immediately following the lecture it was obvious that the industry was very concerned about the toxicological properties associated with isocyanates/polyurethanes for almost half the questions were on the safe use and handling of them, a point which had not once been mentioned in the lecture itself. A synopsis of all Mr Charlton's answers played down this aspect of the systems, indicating that handling precautions were basically the same as other materials, and that air fed masks should be worn particularly in spray applications as the atomised spray must not be inhaled as it could lead to sensitization. In general he stated that there was no difference, toxicologically, between 1-pack and 2-pack systems with the greater emphasis being on the isocyanate type, i.e. MDI (methylene diisocyanate) safer than TDI (toluene diisocyanate) types. As far as combustion products were concerned, he again indicated that there was obvious concern within the industry because of the toxic fumes which could result from fire, but this purely depended upon the temperature of combustion.

Questioned on how the carbon dioxide and water by-products of the cure mechanisms could escape the film when it was reputedly impermeable to them, Mr Charlton claimed that the film remained "open" and only became impermeable when the by-products had escaped and the crosslink mechanism was complete. With regard to choice of hydroxy terminated crosslinking agents in 2-pack systems, he answered that polyesters gave the best gloss, with acrylic superior to polyols. Acrylics were best for concrete applications because of the high pH of the substrate.

Overall an enjoyable evening, the like of which more in the industry should be encouraged to attend.

I. Mim

Manchester

Paint under railway service conditions

This student lecture, attended by 31 members and guests, was given by Mr D. M. Bishop at the All Saints Lecture Theatre, Manchester Polytechnic on Wednesday 23 February 1983.

David Bishop is Section Head of the Coatings and Corrosion Laboratory, BR Research, RTC, Derby.

On an initial complimentary note, David's lecture was very comprehensive both in content and time scale. Therefore, for reasons of brevity, plus the fact that David has presented much of this material in papers published in *JOCCA* and is due to present a lecture at the OCCA Conference, York, we must report in the following manner.

The slides, numbering approximately 50, illustrated subjects including: 1864 – the first Laboratory at Crewe. 1935 – the opening of the Research Laboratories in Derby. Various grades of micaceous iron oxide, a pigment used in corrosion resistant coatings employed by BR and others for coating structural steelwork etc. Various media used for MIO paints, zinc phosphate pigments, impact damage, metal cleaning, phosphating, steels, fires – BS 476 – spread of flame.

- (e) Superior anti-chip coatings can be produced, particularly from high build polyurethane systems.

Mr Charlton spent some time describing the Bayer work on high build coatings based on moisture cured systems. One such system described was for use as an anti-chip primer for the underbodies, wheel arches, sill and door panels of automobiles. The complete system outlined was for an electrodeposition primer, the high build polyurethane anti-chip primer with a build of 75 microns compared to a conventional 40 microns primer, and then a conventional top coat.

A 280 microns high build primer using micaceous iron oxide was described, and it was then demonstrated that builds as high as 400 microns could be achieved by the introduction of 10 per cent talc, and up to 550 microns could be achieved with 15 per cent talc. These much thicker films substantially improved anti-chip resistance, reputedly without any loss in any other properties.

Coatings such as this could be used to advantage over virtually any rough surface such as structural steel, metal tanks, rough concrete and plaster. Indeed polyurethanes were claimed to be ideal for factories such as bakeries and breweries where high humidity gave problems of bacterial and fungal growth because polyurethanes prevent growth as the coatings themselves contained no nutrient. It was interesting to note that Mr Charlton stated that fungicidal additives could be made if necessary in extreme cases.

New concrete normally has a pH in excess of 12, but this falls as carbonation occurs with the ingress of carbon dioxide and water until the surface powders, and in the case of steel mesh reinforced concrete exposes the steel which then begins to rust. Selection of the correct grade of concrete can reduce carbonation, but the most effective protection is the use of either a 2-component polyurethane polyol system or a 2-component polyurethane hydroxy-acrylic system, both of which are effective because they are impermeable to both water and carbon dioxide.

Mr Charlton concluded by reporting some of the most outstanding performances achieved with polyurethanes over the years. Included in those mentioned were:

1. Steelwork in Bayer's works coated with a 2-component system 25 years ago still requires no attention as the film is still intact.
2. The oldest 1-component coating on a bridge in Lyons still requires no attention.
3. Tests in the splash zones of sea water with a moisture cured zinc rich primer and a moisture cured top coat were so far very good.
4. Pigment silos, resin plant pipework, gas holders and a hydrochloric acid tank in Bayer's plant all had polyurethane coatings with good integrity after five years.
5. "Vast amounts" of polyurethanes were successfully used in the wood furniture industry in Italy, though they had not made an impression on that industry in the UK.

The slides were complimented with verbal reference being made to the comprehensive analysis of MIO paints using X-ray and SEM techniques. Media: linseed oil – 1900-1963; tung oil – 1963-1983; urethane oil – 1983...

Vehicle cleaning – ballast debris in summer, iron/manganese from level crossing and brake blocks, there are regional differences.

Reference was also made to zinc phosphate pigment, the influence of media on paints and coach fires.

The discussion period following the lecture was as varied as the lecture and points raised included the use of urethane foam as insulation, and the merit of fire testing using moving coaches as opposed to the normal stationary methods.

Ray Stott gave a vote of thanks on behalf of the Manchester Section which received unanimous approval.

Recent developments in colour difference equations

Forty members and their guests were present on Monday 14 March at the All Saints Lecture Theatre, Manchester Polytechnic to hear Mr K. McLaren who is the director of R&D at Instrumental Colour Systems Ltd, Newbury.

Keith McLaren, who is Chairman of the Society of Dyers and Colourists in its centenary year, commenced his lecture by making the following observations:

Colour is purely subjective; it has no relationship to academic qualifications;
not new – defined/devised 1850 by James Clark Maxwell;
shades – red/yellow/blue + white pigment;
human eye can perceive one million colours.

The lecturer then posed the leading question – in terms of quality control can instruments decide whether we have a good commercial match? The answer is complex because of the primaries, the x, y and z values, used to define colour. Colours cannot be arranged logically in a colour card due to 3D aspect.

Keith then made historical references to the work of Forsius, a Swedish monk in 1600, who defined white light before Newton! And the American artist, Albert Munsell, who devised a colour reference system.

Further subjects covered by the lecturer included: CIELAB colour space diagram; recognition of the colourist pioneers in the textile industry; professional colourist – wrong at 17 per cent of matches; pioneers – J. P. Coats – computer match prediction – 10,000 standard shades; McDonald – JOCCA, comprehensive review; 1949 – ANLAB – Adams and Nicholson; 1969 – McLaren ↔ Davidson/Freid, USA.

Instrumental Colour Machine – in use in 50-60 dye houses – successful in the paint industry – lack of feed back.

1930s – Hardy, USA;
1947 – recording spectrophotometer – ICI, Blackley;
1983 – modern spectrophotometer/VDU/hard printer

New, five seconds evaluation time by production or laboratory staff – one moving part, single number shade passing at last.

1983(7)

**occa
meetings**

The 75 minutes lecture was followed by a discussion period that was comprehensive and included reference to Marks & Spencers' store lighting – Phillips TL84 – £1 million per annum saving, but metameric colour matching not acceptable, CMP saved the day – now TL84 in colour matching cabinet. He also replied in the affirmative to the use of JPC 1979 in relation to prussian blue in paint and that no colourist can evaluate chroma, apply JPC functions to ANLAB and CIELAB and he confirmed the equal reliability of the latter two systems.

Frank Courtman's vote of thanks was applauded at length, thus concluding a very comprehensive/informative lecture.

Pretreatment – the key to plastic finishing

Held on Wednesday 23 March 1983 at the All Saints Lecture Theatre, Manchester Polytechnic, this student lecture was delivered by Brian Pollard of Crown Paints Ltd, Darwen.

Commencing his lecture on the need for coating plastic and a comparison with other substrates, the lecture then gave many examples:

Improvement of mar resistance; improvement of resistance to solvents/chemicals; reduction of dirt pick-up/retention; prevention of plasticiser migration, i.e. PVC; prevention of degradation by UV; reduction of permeability; presentation of colour uniformity in relation to mixed substrates or variation in plastic master batches.

The various parameters met when formulating coatings for plastics can include the following:

Air drying of two-pack catalysed system; flexibility to match the substrate; excellent adhesion, mar resistance, light stability, weather resistance.

Pretreatment is paramount! Removal of all contamination including dust, mould release agents etc. In addition to solvent cleaning or abrading, increasing the surface tension of the plastic prior to coating by corona discharge is very efficient. If components are too bulky then alternatives such as flaming, oxidation with chromosulphuric acid, benzophenone and UV irradiation are used.

Influence of paint on properties of plastics

Brian Pollard continued his lecture with a gentle dig at sales personnel requesting coatings for unspecified plastics. Two very important factors that influence performance are:

1. Influence of impact strength – the more flexible the paint film the less the effect on impact strength. The extreme of a hard film can be seen in metallised plastic surfaces in which the impact strength is found to be particularly pronounced.
2. Internal stressing – all plastics contain internal stresses to a varying degree. If such components are dissolved

occa meetings

or swollen by solvents on their surfaces, the stresses may be released resulting in fine cracks being formed in the plastic components. Two plastics most affected are ABS and polystyrene.

After dealing with "Short term maximum thermal stability of plastics" in tabular form, the lectures continued

company visits

GAF's radiation curing

An informal meeting arranged by GAF to highlight their product range for radiation curing was held at their European headquarters, Esher, Surrey on 3 May 1983.

Emphasis was on the quality improvement of V-Pyrol®/RC, GAF's brand of the liquid vinyl monomer N-vinyl-2-pyrrolidone. This has a purity of 99 per cent minimum, good stability, a very pale colour, low odour, low toxicity and low volatility. It is widely used as a reactive diluent in radiation-curable inks and coating systems. It copolymerises readily with a number of oligomers, acrylates being commonly chosen because of their relatively low susceptibility to oxygen inhibition. With monofunctional acrylates at a 1:1 molecular ratio, V-Pyrol®/RC copolymerises rapidly when films are exposed to high energy electron beam or ultraviolet radiation; a photoinitiator is required in UV curing systems, and additives such as surfactants, adhesion promoters, pigments, fillers and flattening agents are generally included. Curing may be effected in air or in nitrogen. The low viscosity (2.07 cp at 25°C) and good solvency for oligomers lead to low viscosity formulations. The cured coatings or inks exhibit good adhesion and film properties on a range of substrates.

GAF also announced their intention to test market in Europe their range of radiation curable coatings. In particular Gafgard® 233 is an abrasion resistant coating for use on flexible substrates such as solar control window film, flexible packaging and mirrored surfaces. The abrasion resistant properties are especially important on plastic ophthalmic lenses, car windows and similar applications where retention of optical clarity is required. In addition, the coating resists staining and has good resistance to solvents, acids and bases. Incidentally, as might be expected, Gafgard® 233 contains V-Pyrol®/RC.

Finally, attention was drawn to another GAF product, M-Pyrol®, their brand of N-methyl-2-pyrrolidone. This liquid has high polarity and is miscible with water and a range of other solvents; being biodegradable and virtually non-toxic, spills may be hosed into drains. It is recommended as a safe solvent for such applications as a coupling solvent for water-borne urethanes, also for tank clean-

with reference to "Types of systems in painting plastics"; cross-referenced with the classification of plastics by type: ABS, polyethylene, polypropylene, plasticised PVC, rigid PVC, GRP, polycarbonate, PU rigid foam, PU thermoplastic foam.

Alternative treatment systems: surface preparation, adhesion primer, 2-pack polyurethane, 1-pack polyurethane, acrylic, polyester, vinyl acrylic, solution vinyl.

After an interesting discussion period, Ray Stott concluded the lecture by proposing a vote of thanks which was acknowledged enthusiastically.

F. B. Windsor.

Further information from the publishers of the titles reviewed can be obtained by completing the Reader Enquiry Service form at the back of the Journal.

ing, where its comparatively high cost is offset by being distilled and re-used.

T. A. Banfield

Company background

GAF Corporation is a leading manufacturer of chemicals and building material. The corporation employs more than 6,500 people and has sales of about \$750 million. Listed on the New York Stock Exchange, the company has 13.3 million common shares and 3.0 million convertible preferred shares outstanding.

A leader in sophisticated chemical and other technologies for many years, GAF and predecessor companies achieved many firsts – including the first flexible roll film, the first American aspirin, the first ready-to-lay asphalt roofing. GAF's technological leadership is recognised in the development and application of acetylene derivatives and surfactants, a word coined by GAF scientists.

GAF's chemical group began as Albany Aniline and Chemical Company in 1868. That company became Hudson River Aniline and Color Works in 1882, and in 1905 became the first American producer of aspirin. A series of name changes and ownerships followed. Later known as the Grasselli Dyestuffs Company, the name was changed to General Aniline Works in 1929. A few months later the company was integrated into American I.G. Chemical Corporation, GAF's predecessor.

GAF entered the building materials field in 1967 when it acquired the Ruberoid Company in mutual recognition that building materials manufacturing would require increasing levels of technology. Ruberoid was founded in 1886. Its acquisition and the subsequent growth of the product line has made GAF the world's largest manufacturer of asphalt roofing. It produces both glass-mat and asphalt saturated felt shingles and roll roofing.

On 26 April 1929, the American I.G. Chemical Corporation was incorporated in Delaware. The name was changed to General Aniline & Film Corporation in 1939 and to GAF Corporation in 1968.

In early 1942 the company was taken over by the United States government and administered by the Office of Alien Property. On 9 March 1965 it was sold by the United States Justice Department in a public stock offering and is now a widely held US corporation.

Reader Enquiry Service No. 25

ACS's London launch

Kirstol Ltd, agents for Applied Color Systems of Princeton, New Jersey, formally introduced the VCS-10 Visual Color System at a recent presentation in London.

This instrument closes a major gap in current communications technology by enabling a colour to be originated and then communicated in identical terms to anyone with a similar piece of equipment.

In due course the Visual Color System will be capable of being linked to Applied Color Systems' Color Control System to formulate to selected colour requirements. Paint will then be able to be dispensed using ACS's Colorant Dispensing System either on experimental or full production scales.

The Visual Color System synthesises colours using Maxwell's colour disc mixing principle. In this, segmented colour discs representing seven colours, including black and white, are spun at about 1,800 rpm to give a colour. The proportion of each disc that is visible can be varied whilst the discs are spinning and the values displayed digitally. Alternative illuminants and masks to give different viewing areas for colour matching are available.

Demonstrations showed that the machine was capable of matching both pale and dark colours quickly and that it was well designed and constructed. If taken up by purchasers of paints, textiles, etc. they would become obligatory for manufacturers of these products.

The company

Applied Color Systems was founded by the current president, Don Hall, together with three colleagues in 1970. All of them are specialists in particular industrial disciplines with colour application, and this philosophy of

company visits

development of instrumental systems related to the end users own problems and requirements for their particular industry has been carried on throughout the developing stages of the company. Indeed, it is said that the major successes achieved by ACS in its applications to: paint, ink manufacture, printing, plastics, cosmetics and textiles have been due to extremely close collaboration with these industries, and the development of software which works well and is user friendly.

The proof of this is in the 700 plus systems working throughout the world which includes some 150 systems in Europe.

ACS has always believed in the absolute necessity for continual research development and some four years development work has gone into the production of the Visual Color System.

It is not now a matter of whether computerised colour control systems work, but rather an acceptance that the systems work and the question is how they relate to a company's particular requirements.

One of the most significant developments has been the acquisition of ACS by Armstrong World Industries with the clear intent of adding its resources to ensuring ACS maintains its pre-eminent position in the field of computerised colour control.

Reader Enquiry Service No. 26

K. H. Arbuckle

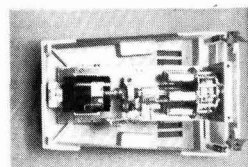
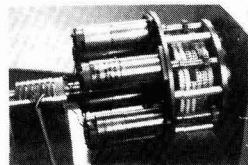
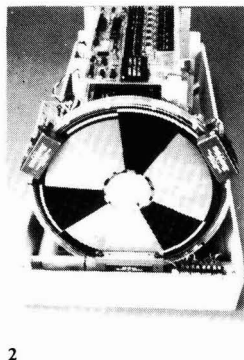


Figure 1. The Visual Color System (VCS) from ACS allows the virtually instantaneous creation of new colours and the precise numerical communication of colour. In addition to providing a common and understandable colour language between users, there is already a prototype VCS unit linked to an ACS Computer Color System and Colorant Dispensing System. This prototype enables the matching or origination and/or communication of colour leading to production of paint of the required colour. Figure 2. A frontal view of the interior of the Visual Color System showing the disk pack and the optical sensors positioned at 10 o'clock, 2 o'clock and 6 o'clock. The optical sensors "read" the length of the white bars along the circumference of the disk pack. Figure 3. Close-up of planetary gear motors and gearing mechanism. These motors control the operation of the gears which in turn control the operation of the individual disk segments. Figure 4. Overhead view of the interior of the system, showing main motor at rear, dedicated planetary gear motors and gearing mechanism

Printing technology spurs ink development

Advances in ink manufacture are continuing, but, says Key Note Publications in its new report on printing inks, it is the rapid advancement in printing technology which is providing the real spur to ink development. Ault & Wiborg was responsible for supplying the ink for the world's first automatic keyless inking process, which was featured in the Anilox web-offset press. Ink jet printing, the non-contact, computer-directed printing process with numerous applications is on the inkmakers frontier of progress.

To meet the challenge of keeping ink development abreast of printing technology, says the report, many new inks are being developed by the original equipment manufacturers. However, some ink manufacturers are now responding to the challenge, with the search for ink with perfect drying qualities being a major goal at the moment as they try to meet the needs of the ever increasing speeds of modern presses. Lorilleaux & Bolton has introduced two quick setting inks, both originating in the company's French laboratories. Catalytic curing promises to be a cold drying system which has yet to become fully operational, so low temperature setting inks continue to be researched. Mander-Kidd's DBC range of heatset web and offset inks was the first to hit the 100°C barrier and UV curing, which is subject to much experimentation, offers a viable alternative for special applications such as screen printing, metal lithography, carbon packaging and printing on heat sensitive materials. Water-based inks for flexography and gravure present yet another research problem for ink manufacturers, the companies at the forefront being Coates, Croda and Ault & Wiborg.

Key Note draws attention to those aspects of company policy which have been dominant recently. Streamlining, for instance, prompted Croda Inks to shut one of its plants and concentrate production; whilst Lorilleaux & Bolton were forced to relocate. Coates, in an effort to strengthen its position, has separated its ink and non-ink operations and under this scheme two new companies were formed early in 1982 in order to better serve distinct market sectors. Ault & Wiborg also reorganised early in 1983 in order to streamline its two ink businesses. Their new structure has created separate divisions, namely Newspaper Inks, Graphics Publication Gravure, Paste Inks and a combined Ault & Wiborg/Redcliffe Liquid Inks division.

Amidst all the recent restructuring

Further information on any items mentioned below is obtainable by completing the *Reader Enquiry Service* form at the back of the *Journal*.

there have been instances of expansion. Dufay Bitumastic during 1981 invested heavily in its Richardson Printing subsidiary, eventually resulting in a 25 per cent increase in group profits for that year. 1982 saw expansion programmes undertaken by such firms as Shackell Edwards, who are gearing themselves for the web-offset market; Fishburn, who opened a new liquid ink plant; and Ault & Wiborg, who are extending into laboratory and technical services.

Reader Enquiry Service No. 31

Zinkwit's silicate activities go to Unilever

Unilever has acquired the silicate activities of Zinkwit Nederland BV in Eijsden, and will vest these within a Dutch subsidiary company to be called Crosfield Chemie BV. The new company will work closely, particularly in the continental European market, with Unilever's UK business, Joseph Crosfield & Sons Limited, which has long been active in the production and sale of silicates.

Crosfield Chemie will continue to make use of a number of the services and facilities of Zinkwit Nederland. About 50 employees will transfer to the service of Crosfield Chemie.

Reader Enquiry Service No. 32

Contract packing

Multicraft is a new contract packing company established in Hull which specialises in packaging liquids, pastes and adhesives. Tins, tubes, bottles and aerosols can be handled and there are also facilities for shrink, skin and blister packing.

The new company is a subsidiary of Humbrol and can therefore draw on considerable experience in packaging techniques, materials purchase and quality control; a total production planning system can be provided if necessary to meet fluctuating demand.

Considerable warehouse capacity is available together with established UK transport, plus easy access to Rotterdam and the EEC through the port at Hull.

Reader Enquiry Service No. 33

Distributor for Sheen

Sheen Instruments has announced the appointment of Surfatec, Knutsford, Cheshire as distributor for the north of England and Scotland.

Surfatec is already well-established in the surface coatings industry and its appointment is made in order to strengthen Sheen's customer service capability throughout the UK.

Reader Enquiry Service No. 34

B.I.E. Anticorrosion and T.C. Inspection merger

B.I.E. Anticorrosion and T.C. Inspection Ltd have merged with effect from 1 June 1983. The new organisation will be known as B.I.E. Anti-Corrosion Limited incorporating T.C. Inspection.

This merger will combine the capabilities and expertise of both companies and will enable the joint company to offer clients a more comprehensive service and to strengthen their position in the market place.

The managing director of the new company will be Tony Cunningham, who has had wide experience in the anticorrosion field both onshore and offshore. He has played a leading role in the recent development of training schemes for painting inspectors and is an approved inspector for both the ERS Approval Scheme and the new NACE Coatings Inspector Training and Certification Scheme. He is currently Secretary of the London Branch of the Institute of Corrosion Science and Technology.

Both companies will continue to service their existing contracts but with the benefit of additional resources. The day to day administration and lines of communication will remain unchanged.

Tony Allen will continue to have an involvement in the company alongside Graham Rush and Karl Roberts.

Reader Enquiry Service No. 35

products

Resin and pigment preparations from BASF

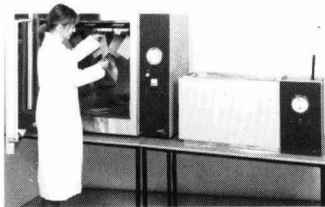
Luwipal 066, supplied by BASF, is a new solvent-free hexamethoxymethylmelamine resin for highly reactive acid-curing lacquers and flexible stoving finishes.

Also new from BASF is a new line of pigment preparations under the name Sicospers. They are pumpable multi-purpose pastes for non-aqueous systems (with the exception of unsaturated polyesters) and do not contain any binder. The first two representatives of the new product line have been named Sicospers Blue 6901 and Sicospers Blue 7101. The former contains an alpha-phthalocyanine blue (Heliogen Blue L 6901), and the latter a beta-phthalocyanine blue (Heliogen Blue L 7101 F). The solvent phase in both cases consists of high-boiling aromatic hydrocarbons and glycol esters.

Reader Enquiry Service No. 36

Humidity and salt-spray cabinets from Fisons

A new range of humidity corrosion cabinets, with price very much in mind, has been designed by Fisons Environmental Equipment.



Two of Fisons' new range of humidity corrosion cabinets

These cabinets are designed specifically to perform to the requirements of BS3900: Part F2 (BLS-30-CT-900) and similar international specifications.

The cabinets, in three sizes, are constructed of mild steel with stoved acrylic textured finish on the exterior. The interior is all stainless steel, welded and vapour sealed. A stainless steel mesh shelf is provided on which painted steel samples can be hung. The temperature range is 42°C to 48°C and they have the required amount of air circulation.



The new salt spray corrosion cabinet from Fisons Environmental Equipment, model number 450SS

The new salt spray corrosion cabinet from Fisons, model number 450SS, is intended for testing paint and other metal protection materials. It meets all ASTM, BS and DIN specifications. The cabinet is an all plastic construction with a clear, domed cover to prevent droplets forming on test samples. The cover is also sealed in a water trough set into the top of the main cabinet. All instruments are housed in a separate compartment which is easy to use and is protected by a clear plastic cover.

The trays have correctly angled slots for panel samples allowing for maximum flow of the salt spray throughout the interior chamber.

Reader Enquiry Service No. 37

Environmental cabinet

An addition to the Credit range of machines from John Godrich is the Credit Environmental cabinet with a temperature variation from -70 to +150°C. These units can be supplied with the option of controlled humidity and are available going down to -40°C only, should this be required.

These upright, front opening cabinets are designed for manual settings, but can be supplied with a programmer to vary temperature and humidity.

Reader Enquiry Service No. 38

ACS software package

Applied Color Systems Inc. has announced a new computer program package which allows users to store, retrieve and explode up to 5,000 formulas quickly and accurately. Forrex is designed for use with ACS Computer Color Control Systems.

The program package allows costs and ingredient data to be easily updated and maintained. It is also a useful sales tool, allowing material costs of products to be quickly determined and prices to be quickly quoted to customers.

The program stores information by formula, by ingredient and by colourway (for printing applications).

Three basic reports can be created: a formula worksheet, a formula costing report, and an ingredient current cost report. The formula work sheet provides formula identification, ingredient names, concentrations and scaled-up batch amounts. Formulas may be entered from the keyboard or retrieved from memory. The formula cost report provides all this information in addition to the cost of each ingredient and the total cost of the formula.

For printing applications, data is organised by colourway. Batch size for each formula in a colourway can be entered by the operator or calculated from a coverage factor and specified length of run. The ingredient cost report shows the cost of all currently stored ingredients.

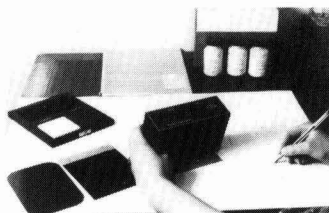
Reader Enquiry Service No. 39

Colour communication

ACS recently launched in the UK its Visual Color System. This instrument can be used to originate colours, for colour matching and finally colours so arrived at can be reproduced exactly in any other VCS thereby communicating colour between laboratories, manufacturers etc.

JOCCA was represented at the launch and a report appears under "company visits" on page 203.

Reader Enquiry Service No. 40



Sheen's Pocket Glossmeter

Pocket gloss meter

Sheen Instruments has made an addition to its range of gloss meters with the introduction of the 100 Pocket Glossmeter (150 × 100 × 50 mm). Although small it is a precise instrument for the measurement of the specular gloss of paints, plastics and similar materials in conformity with ISO 2813, BS 3900.D5, ASTM D523 and DIN 67530. The Pocket Glossmeter is available with either 60° or 20° angles.

Features include: automatic control of lamp brightness to compensate for ageing lamps, robust construction and design for long term reliability, digital display reading to 0.1 gloss units and automatic hold facility to minimise battery usage.

Reader Enquiry Service No. 41

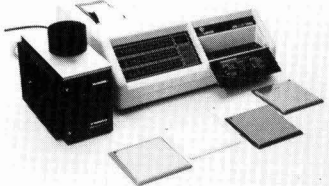
Dr Lange LFM3 Tricolour

The Dr Lange LFM3 Tricolour is a spectrophotometer using the tristimulus method in full compliance with DIN, CIE, ASTM and ISO standards. The unit comprises two principal components – the microprocessor controlled data unit and the colorimeter head.

The data unit has a sheet-foil keyboard, three 5-digit LED displays and an integral metallised paper matrix printer to document the test results. A nine-position program switch allows selection of the desired colorimetric data.

The instrument calculates data selectively for C or D65 standard illuminants and 2° or 10° standard observers. Data stability is ensured by ± 0.1°C temperature stabilisation.

Reader Enquiry Service No. 42



The Dr Lange LFM3 Tricolour

Radiation curing

GAF recently held an informal meeting to highlight its product range for radiation curing. A representative for *JOCCA* attended and his report appears under "company visits" on page 202.

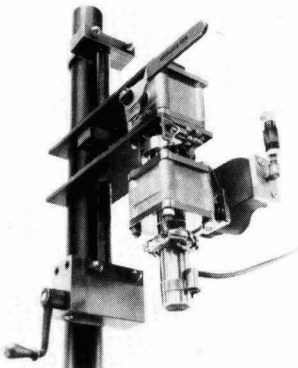
Reader Enquiry Service No. 43

Modular HPLC columns

Modular Preparative HPLC Columns are stainless steel columns (one inch in diameter) that can be used separately or stacked by using a unique Modular Adapter to form custom length columns. They are available from HP Chemicals Inc. in any lengths from 5 cm upwards custom made, or pre-cut at the following lengths: 5, 10, 20, 30, 40 and 50 cm.

The columns can be used with a low-pressure (100-1,000 psi) or a high-pressure (1,000-6,000 psi) solvent delivery system.

Reader Enquiry Service No. 44



The ultrasonic filling head assembly from Beltron Corp.

Mechanical to electronic filling conversion

Mechanical filling machines can be converted into electronic filling machines with the addition of an ultrasonic filling head assembly from Beltron Corp. Now available separately, without stand and conveyor, the head assembly can be attached with eight bolts onto any filling machine, eliminating mechanical pistons, check valves, hoppers and other equipment.

Retrofitting enables the owner of insufficient or inoperative equipment to dramatically upgrade his filling line to present-day standards while utilising parts of his existing filling machine such as stand, conveyor and capper.

Reader Enquiry Service No. 45

New GAF filter

GAF has added a new filter vessel to its range at the top end of the scale. The RB-10BL has been introduced to work in areas where high flow rates and large filtration surfaces are necessary.

The bag filter model RB-10BL is available as a standard vessel in either mild or stainless steel. It works with an operational and differential pressure of 6 bars. The total surface for filtration amounts to 4 m², which allows liquids to filter in volumes up to 360 m³ per hour.

The actual filtration is done through 10 Snap-Ring filter bags, which can be chosen, according to the product to be filtered, in five different fibre materials in a range from 1 to 800 microns.

The separated residues are retained inside the filter bags. Access to the bags is obtained by lifting the cover hatch. Because of the size of this vessel the cover hatch is opened by using the built-in hydraulic system. The used bags are easily changed and replaced with new ones. The bag system is then ready to work again.

Reader Enquiry Service No. 46

Protection against odours, fumes, toxic gases and particles

Astec Environmental Systems Ltd has developed a new range of fume absorbing masks designed to cope with a variety of harmful gases and odours commonly found in industry. Four types of masks are available, each incorporating the unique Bandor charcoal cloth.

The FAM-1 Odour/Nuisance Mask is particularly effective when used in kitchens, laboratories, the petroleum industry, slaughter houses and sewage works.

The FAM-2 "Hospital" Mask is



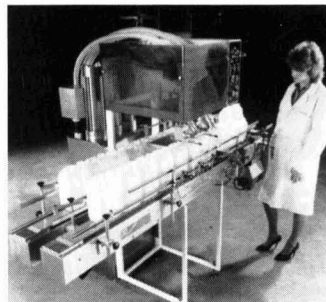
One of Astec's new range of fume masks

designed for protection against particles as well as gases and vapours.

The FAM-3 Laboratory Mask gives the highest protection of the range of masks and is the equivalent of the Ministry of Defence Mask for use against nerve gas. It gives excellent protection against particles, fumes and gases.

The FAM-4 Industrial Mask has an additional foam layer and gives significantly greater protection than the FAM-2. It is recommended for industrial applications where fumes, toxic gases and particles may be a problem.

Reader Enquiry Service No. 47



New filling machine from Paxall

Twin-track traversing head filling

Twin-track, traversing head machines capable of filling up to 150 containers a minute with liquid food, cosmetics, paint or chemical products have been added to the Bexuda liquid filling machine range by Paxall.

The new machines have up to eight in-line filling heads traversing between twin, continuous running, variable speed conveyors and are capable of handling liquids of all viscosities and fine solids-in-suspensions.

Machines can be equipped with up to eight 1 litre or six 5 litre capacity double-acting, self-priming product pumps each feeding a filling head to fill from 50 ml to 1 litre and from 250 ml to 5 litre capacity containers respectively.

Filling heads are rapidly adjustable for height and are equipped with clamp-on non-drip nozzles. Accuracy of filling is a minimum guaranteed ± 0.25 per cent by volume on all measures since accuracy is not affected by variation of air pressure with filling speed.

Reader Enquiry Service No. 48

Waste water cleaning

A new low priced Split-O-Mat has been developed for companies wishing to clean small quantities of industrial waste water to a standard which will allow discharge to sewer.

Waste water is pumped into the reactor tank and mixed with treatment chemical EC2000, which adsorbs and absorbs the

flow out of the reactor onto a disposable filter fabric. This allows clean water to flow to drain and the retained sludge is collected at the end of the machine.

Reader Enquiry Service No. 49



The Graco Model 700

Automotive refinishing gun

Graco (UK) Ltd has designed a range of spray guns and accessories specifically for the automotive refinishing market.

Well-known and highly respected for its work in paint circulating and applications systems in high volume production areas, Graco has now turned its attention to the very important market sector of vehicle refinishing.

There are three guns in the line up, models 600, 700 and 800. Each gun is designed for different volume applications, but the company believes that the Graco 700 is ideally suited to automotive refinishing, and with its suction feed attachments will prove to be very popular.

Reader Enquiry Service No. 50



The Voss electronic magnetic stirrer

Electronic stirrer

Voss Instruments (part of the Sheen Instruments Group) is now marketing a range of electronic magnetic stirrers. With no moving parts they offer a long life. They have a wide speed range of 300

Other features include: accurate, stable, reproducible control of speed; minimal heating effect; self centring device to locate follower; silent running.

Reader Enquiry Service No. 51

literature

HunterLab Instruments

HunterLab has announced the availability of a new brochure which describes its complete line of instruments for measuring colour, gloss, haze and other appearance properties of materials. The brochure includes information on spectrophotometers, tristimulus colorimeters, glossmeters and hazemeters, and on-line colour monitors.

Reader Enquiry Service No. 52

BSI publication

BS 1000(66/66.0):1983 UDC 66/66.0 "Chemical technology. Chemical engineering, production and processing, operations and plant Gr 8" has been published by and is now available from the British Standards Institution.

Reader Enquiry Service No. 53

meetings, etc.

OCCA Convention

OCCA Australia is holding its Silver Jubilee Convention with Exhibition from 28 September—1 October 1983. The venue will be the Southern Cross Hotel, Melbourne.

A convention leaflet is available by contacting the Association's offices at the address shown on the contents page.

International congress on fat

The Oil Technologists' Association of India is to host the 17th "Congress of the International Society for Fat Research" from 4-9 November 1984. The dates have been chosen so that delegates will also be able to attend the AOCS "Palm Oil Conference" in Kuala Lumpur scheduled to start 11 November. It will be the first time the congress is held outside Europe or the USA.

Phosphating and pretreatment course

The continuing popularity of its two-day technical training course in "Phosphating and metal pretreatment" has prompted Pyrene Chemical Services Ltd to announce a further presentation from 21-22 September 1983. Places on the course are restricted to a manageable number for laboratory practice purposes and recent demand has been so encouraging that Pyrene has already organised an

news

additional session to its announced 1983 programme. Early bookings for September are advised.

Further information is available from: Lorraine Way, Training Course Registrar, Pyrene Chemical Services Limited, Ridgeway, Iver, Bucks; Tel: 0753 651812.

people

Hoechst UK has announced the following appointments within the Pigments Department, based at Hoechst's northern headquarters offices at Stainland, near Halifax.

Mr Eric Taylor, previously general manager, has been promoted to departmental director.

Following the retirement of Ken Bowker, Tony Perry has been made sales manager.

Adrian Abel takes over Tony Perry's position as marketing services manager and Steve O'Brien becomes laboratory supervisor.



Mr P. W. Groves, who joined International Paint plc on 1 April, has been appointed to the board as finance director.

Peter Groves was deputy chief accountant of ICI's Petrochemicals and Plastics Division.



With effect from 1 May 1983 Mr P. A. Kimberley was appointed marketing director of the Adhesives and Sealants Division of Burmah Speciality Chemicals Ltd. He succeeds Dr Brian Burrows who has taken up the new appointment of regional director (Europe).

Mr Kimberley joined the Burmah Group in 1978 and since the formation of Burmah Speciality Chemicals Ltd has been business development manager at the company's Swindon head office. He is succeeded in this position by Mr C. R. Kirkland.

Another appointment within Burmah Speciality Chemicals is that of Mr P. M. Jones as managing director of Industrial Adhesives Ltd. Mr Jones, who joined IAL in 1966, was previously technical director of the company.



1-3 May 1984

OCCA-35

Cunard International Hotel,
London

THE INTERNATIONAL FORUM FOR THE SURFACE COATINGS INDUSTRIES

- Lecture facilities
- Audited attendance
- Competitions welcomed
- Reduced advertising rates for exhibitors

Details of next year's exhibition were published in the June issue of *JOCCA* and the Invitation to Exhibit will be despatched in July from the Association's headquarters.

The Exhibition Hall at the Cunard International Hotel will be covered throughout with carpet tiles and thus the shell stands for exhibitors, other than heavy equipment manufacturers, will not have platforms. Platforms, under the shell scheme will, however, still be provided by the Association for heavy equipment manufacturers. Arrangements are also being made for rooms on the mezzanine floor to be available to exhibitors as well as some "stand space only" in the Drake Suite on the mezzanine.

Further details of the exhibition will appear in the August and subsequent issues and any organisation which has not received an Invitation to Exhibit in recent years and wishes to do so should contact the Director & Secretary at the Association's offices (see outside back cover) as quickly as possible.

In order to help potential exhibitors a list of questions (*italics*) often asked by organisations, together with answers, has been compiled and printed below.

Member of the



Audit Bureau
of Circulation

Member of the Association



of Exhibition Organisers

My Organisation will be exhibiting at OCCA-35 and to help with our planning we would like to clarify a few points such as - Do we have to show a new product each year?

No. This has never been one of the objects of the exhibition which is to present commercial and technical information and the Committee readily appreciates that companies may not have new products to show each year, but they will have information which has arisen during the year which will be of interest to visitors both in research and development.

Do I need a large stand?

No. The smallest unit of the shell scheme measures 4.5 m² and it is possible on a stand of this size to include seating and panels together with literature.

Everything of course depends upon the way in which your display is made to attract the attention of visitors!

What is included in the shell scheme?

The shell scheme provides carpeted floor (but for heavy equipment manufacturers a platform will be provided inside the shell at their request and they will be responsible for re-inforcement as necessary), white pre-finish walls, a felt covered fascia with pine trims at top and bottom, a name board in white with black lettering on each side and a muslin ceiling, stand numbers are also displayed.

Do I have to use the Association's shell scheme contractor for our display?

No. There is no obligation to use the shell scheme contractor, but contractors used must be those who are listed by the

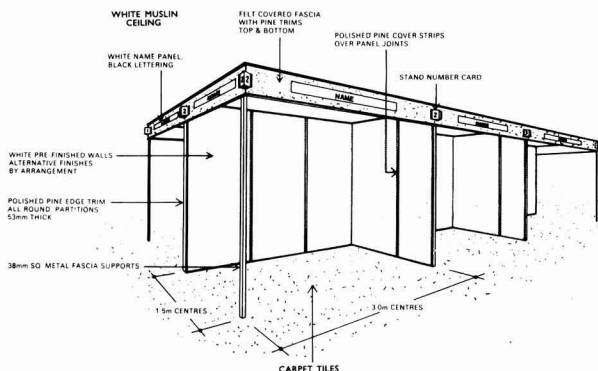
British Exhibition Contractors Association. In the Invitation to Exhibit, the Association shows a list of contractors for other services such as cleaning, flowers, furniture, forwarding agents, heavy machinery removal experts, but there is no obligation to use these particular contractors. However, it will be appreciated that only one firm of electrical contractors can be allowed to operate on the shell scheme in the Exhibition Hall and the same naturally applies to those wishing to have telephones installed on their stands.

How do I set about giving a lecture at the Exhibition?

Space is included on the application to exhibit form for this purpose and the Association will provide a 35 mm slide projector and screen without charge. Early application for the lecture facilities

exhibition news

STANDARD SHELL SCHEME SHOWING SINGLE UNITS ONLY



Note: In addition, a few complete rooms for exhibitors and "stand space only" in the Drake Suite (all without shell scheme) are available on the Mezzanine, where the Lecture Hall is situated

is advisable since it will be appreciated that the number of lectures which can be given is limited by the time available.

One idea we have is to give a lecture highlighting a particular aspect of our activities, both technical and commercial. Is there any restriction on choice of subject?

No. They can be on commercial, marketing or technical themes.

Will the lectures be publicised?

Yes. They will not only be publicised in *JOCCA*, but a notice board will be situated in the entrance giving the lectures which will be presented each particular day.

Is the list of those attending a lecture made available to the exhibitor concerned?

Yes. But only to that exhibitor.

Will the exhibition be held annually or biennially in future?

The Council has decided that in the present economic climate the exhibition will alternate with the Association's biennial conference. So those who do not exhibit in 1984, will not be able to take part in another OCCA exhibition until 1986.

Is the exhibition cost effective?

Very much so. It is a full three day exhibition and you will have seen the sort of visitors attracted to this unique display.

*I saw the list of countries, job functions etc. mentioned in the article in the June issue of *JOCCA*. Can I get a copy of the Exhibition Data Form?*

Yes - just telephone or telex the

Association's Offices (Tel: 01-908 1086 or Telex: 922670). Do not forget that this Exhibition has been registered to publish an Exhibition Data Form through the Exhibition Data Division of the Audit Bureau of Circulations to the standards laid down by the Joint Industry Committee.

Can I organise a competition on my stand?

Yes. The Association welcomes any feature which enlivens the atmosphere of the show without detracting from its overall purpose.

As an exhibitor can I get special rates for advertising in the Association's Journal.

Yes. In 1984 the *Official Guide* will be combined with the April issue of *JOCCA* and special (reduced) rates will be offered to exhibitors. Remember *JOCCA* goes to 80 countries, has an estimated average readership of over 22,000 per issue and won the Audit Bureau of Circulation's prestigious Reed International Award for its Media Data Form in 1980. Why not ask for a copy of the Media Data Form? You will soon see the benefit of reaching such a large and influential readership at such a low cost. Remember also that *JOCCA* complements the Exhibition - it contains papers on new developments such as those given at the Association Conference on the "Efficient use of surface coatings". It is not only widely read, but is retained as a work of reference, so your advert has a long life.

Can I serve alcoholic drinks on my stand?

Yes.

Does the Association look unfavourably on small "give aways".

No. If chosen carefully these are often

of considerable value in putting over a technical or commercial point and reminding visitors of your stand.

I have some panels left over from another exhibition which would interest visitors. Can I use them?

Yes, provided of course that they comply with the fire regulations. The exhibition is inspected by the local authority and the fire brigade, but this is a matter on which the contractor you use can advise you.

If I use one of the rooms on the mezzanine, will I have to instal lighting, telephones and carpets?

No. These are normal hotel rooms with carpeting and lighting and you save the telephone installation charge as the telephones are already there, but they are of course routed through the hotel switchboard. Early application is advised as these rooms will be allocated upon receipt of completed application forms, together with first half instalments.

Is there any other arrangement for stand space only at OCCA-35?

Yes, in the Drake Suite on the mezzanine floor, where "space only" stands will be available in two depths (3 m or 4.5 m), the length depending upon exhibitors' requirements. They will be allocated on a first come - first served basis, upon receipt of completed application forms, together with first half instalments.

Are there direction signs?

Yes. These are arranged by the Association.

Does OCCA provide seating areas?

Yes. This is a feature of OCCA exhibitions to allow visitors and exhibitors to hold informal talks.

Will the exhibition be widely advertised?

Yes. The Association has arrangements with sister organisations abroad to publicise the exhibition, but in addition it places advertisements in relevant periodicals in the UK and abroad. Press Releases are, of course, sent out at regular intervals.

If I have any other questions, whom should I approach?

The OCCA staff at Priory House will be only too willing to help you, and many exhibitors, particularly new ones, have found their assistance of considerable value in the past. Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF. Tel: 01-908 1086. Telex: 922670.

YORK CONFERENCE

15-18 June 1983

The efficient use of surface coatings

The Viking Hotel, York was the venue for the Association's Biennial Conference which was held from 15-18 June 1983. York was a new venue for an OCCA Conference and proved to be very popular with delegates, particularly those from overseas, there being representatives from the following sixteen countries: Australia, Belgium, Canada, Denmark, Eire, Finland, France, Holland, New Zealand, Nigeria, Norway, Portugal, South Africa, Spain, Sweden and USA.

Nineteen papers were presented in four sessions, the last of which comprised short presentations to form a discourse session (an innovation introduced at the

1981 Bath Conference). The papers will be published in due course in this *Journal* together with discussions. At this Association's conferences it has long been the practice to send pre-prints of the papers to delegates several weeks in advance so that the lecturers only introduce their papers. This allows for longer discussion periods than at many other conferences. The purpose of the discourse session was to encourage as many delegates as possible to participate in the discussion period and this seemed to have been fully achieved. The sessions took place in the mornings and afternoons of Thursday and Friday. All the technical sessions were well attended and

it was often necessary for the session Chairman to curtail discussion in order to keep to the times scheduled.

The Association has always arranged a full social programme for the benefit of both delegates and their families and at York these included a theatre party, a golf tournament, a trip along the River Ouse and coach tours to Harewood House, Castle Howard and a tour of York City. The thanks of the Association are recorded to Mrs Stephanie Gilliam (wife of the Hon. Treasurer), for her assistance in acting as courier for the river trip and coach tours and for arranging a new feature for the Conference - a



Lecturers and chairmen of sessions: (front row, left to right) Mr van der Stoep, Mr Louis Floyd, Mr J. R. Taylor (Hon. Research & Development Officer), Mr D. J. Morris (President), Mr D. S. Newton (Hon. Editor), Mr R. J. McCausland, Mr R. B. Tennant, Dr A. Gamble; (back row) Mr D. N. Buddles (Assistant Editor), Mr J. Boyden, Dr M. Marshall, Dr A. Carrick, Mr W. Ollett, Mr R. R. Blakey, Mr K. Kleive, Dr M. Wilkinson, Mr T. J. Lund, Dr E. Miller, Mr R. A. Fidler and Mr T. Graham

conference diary



Shown above is Stephanie Gilliam, wife of the Hon. Treasurer, who helped with the organisation of the social events

raffle at the dinner and dance – which was much enjoyed.

Wednesday 15 June

The first main function of the Conference was the customary reception of overseas delegates by the President, Honorary Officers of the Association and the Director & Secretary, which was held in the Castle Suite of the Viking Hotel. The Association was pleased to welcome representatives of other societies in the international alliance: Mr G. Abelsnes (President of SLF) and Mrs Abelsnes, Mr A. Clark Boyce (President of FSCT) and Mrs Clark Boyce, and Mr B. J. Lourey (President of OCCAA). M R. Capanni (President of FATIPEC) was not able to be present at the Conference but the Secretary General, M C. Bourgery, and Mme Bourgery joined the Conference on the Thursday.

After dinner, a meeting of the lecturers and the session chairmen was called by the Honorary Research & Development Officer (Mr J. R. Taylor) to discuss the way in which the technical sessions of the Conference would be conducted.

Thursday 16 June

At 9.15 a.m. the President welcomed delegates to the Conference and declared the Conference open before handing over to Mr J. R. Taylor, who had arranged papers for the technical sessions and who acted as chairman of the first session. The Association records its thanks to Mr Taylor for the excellent technical programme arranged. During the morning a trip on the "White Rose" on the River Ouse was organised for delegates' families and this was very enjoyable.

After the first technical session the President and Mrs Morris welcomed all those

attending the Conference at an informal reception.

In the afternoon delegates' families were able to take a coach tour to Harewood House and a golf tournament was also arranged. As well as the Sam Sharp OCCA Conference Golf Trophy there was competition for a further trophy this year, the additional trophy being kindly presented by Pearson Panke Ltd, which had ingeniously incorporated silver replicas of cross hatch cutters, used for the cross hatch adhesion test (BS 3900 E6).

The technical session in the afternoon was chaired by Mr R. B. Tennant. After the session a meeting was held of the International Liaison Committee which was attended by delegates for FATIPEC (M C. Bourgery, Mme Bourgery and Mr M. J. Roire, a Past President), for OCCAA (Mr B. J. Lourey, President), for FSCT (Mr A. Clark Boyce, President) and for OCCA (President, President Designate and Director & Secretary). In the evening a party was arranged for the Theatre Royal, York.

Friday 17 June

The third technical session, under the Chairmanship of Mr T. Graham (technical director, Crown Paints), took place in the morning. For the families of delegates a guided tour of York was arranged.

During the morning a meeting took place to finalise the aims of OCCA International. This was attended by the President, the President Designate, Mr B. J. Lourey (President, OCCAA), Mr Eric Timm (Hon. Secretary of Transvaal

Section, representing the South African Division), Mr C. Butler (Representative, Auckland Section), Dr F. M. Smith (Representative, Wellington Section) and the Director & Secretary.

At 12.30 p.m. the President and Mrs Morris held a reception for Council members, overseas presidents, session chairmen and lecturers.

In the afternoon, the final technical session was chaired by Mr F. Palmer (Senior Corrosion Engineer, BP International). A coach tour to Castle Howard (where the television serial *Brideshead Revisited* was filmed) was arranged for delegates and their families.

The Association records its thanks to Mr D. S. Newton (Hon. Editor) and to Mr J. R. Taylor (Hon. Research and Development Officer) who helped at each of the technical sessions by distributing question forms for the discussion, and to Mr D. N. Buddles (Assistant Editor) who assisted lecturers with the presentation of slides, recorded the discussions and was present throughout the sessions to help delegates.

Immediately following the final technical session the Association held its Annual General Meeting at 4.30 p.m., a report of which will appear in the *Journal*.

In the evening the final event of the Conference took place, the Association dinner and dance, which was held in the Henley Suite of the Viking Hotel. Prior to the dinner, guests were received by the President (Mr D. J. Morris) and Mrs Morris, together with the Lord Mayor and Lady Mayoress of York.

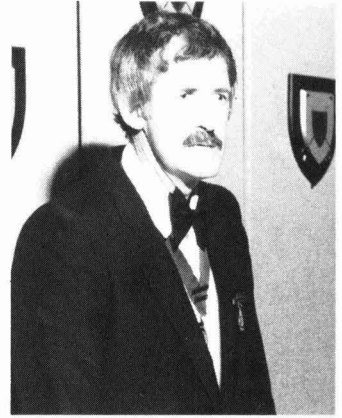


The overseas presidents who attended the York Conference (left to right): Mrs Abelsnes, Mr G. Abelsnes (President, SLF), Mrs Morris, Mr D. J. Morris (President, OCCA), Mrs Clarke Boyce, Mr B. J. Lourey (President, OCCA Australia), Mr A. Clarke Boyce (President, FSCT)

conference diary



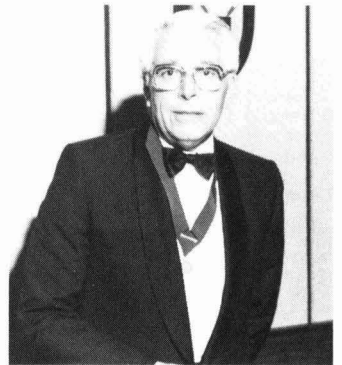
Prior to the dinner, the delegates were received by the President and Mrs Morris and the Lord Mayor and Lady Mayoress of York



Mr R. H. Hamblin, Director & Secretary (left), Mme Bourgery (centre) and M C. Bourgery, Secretary General, FATIPEC (right)



The Manchester Section Cocktail party held at the Conference on Friday 17 June



The main speakers at the dinner were (top to bottom): Mr B. J. Lourey (President, OCCAA), Mr D. J. Morris (President, OCCA) and Mr A. Clark Boyce (President, FSCT)

The conference photographer was Jim Kershaw

conference diary

After the dinner, following the loyal toast by the President, the toast to the Association was proposed by Mr B. J. Lourey (President, OCCAA) who complimented the Association on the organisation of the Conference and the opportunity which it had afforded to discuss and agree on the aims of OCCA International, which he felt would be of considerable benefit to both OCCA and OCCAA. The President replied on behalf of the Association and thanked Mr Lourey for proposing the toast to the Association in such a flattering manner. He welcomed delegates, lecturers and chairmen of sessions and thanked them all for their contribution to the success of the Conference. He extended a particular welcome to the presidents and representatives of those societies in the international alliance and he had a special welcome also for the ladies who added colour and grace to the occasion. In his speech he referred to his travels to overseas sections of the Association and to other organisations (the OCCAA Convention, the FATIPEC Congress and the FSCT Convention) and he ended by proposing a toast to the Association's guests and the ladies. Replying on behalf of the guests, Mr A. Clarke Boyce (President, FSCT) extended the thanks of all guests for the hospitality shown by the Association during the week and, on behalf of the FSCT, he made presentations to the President, the President Designate and the Director & Secretary. Following Mr Clarke Boyce's speech the investiture as President of Mr C. N. Finlay, who had been elected President of the Association at its Annual General Meeting that afternoon, took place.

Mr D. J. Morris invested Mr Finlay



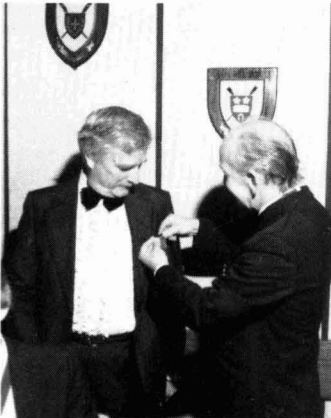
The new President of OCCA, Mr C. N. Finlay (right), being congratulated by his predecessor, Mr D. J. Morris, after receiving the Presidential Insignia

with the Presidential Insignia, using the traditional form of words:

Cecil Newton Finlay, in accordance with the resolution passed at the Annual General Meeting this afternoon, it is now my duty to invest you with the Insignia as President of this Association and I charge you to guard well the interests of our Association and at all times to

uphold the dignity of your high office.

In return, Mr Finlay presented Mr Morris with his Past President's medallion, inscribed with his name and years of service, which would serve as a memento of his Presidency and his work on behalf of the Association. In this he had been ably supported by Mrs Morris, and Mr Finlay thanked her for the gracious way in which she had assisted the President



Mr D. J. Morris (left) receiving his Past President's Medallion from Mr C. N. Finlay (President)



Mrs Morris was presented with the gift of her choice, a pair of binoculars, by Mr C. N. Finlay (President) as she and Mr Morris (Past President) would be devoting more time to their hobby of bird watching



The new President's Lady, Mrs Finlay (right), receiving the President's Lady's Medallion from the outgoing President's Lady, Mrs Morris

both at home and overseas. He presented Mrs Morris with a gift of her choice – a pair of binoculars.

Mrs Morris, in a warmly applauded speech, thanked Mr Finlay and the members of the Association for the presentation and explained that, following his Presidency, Mr Morris and she would be devoting some spare time to bird watching so that the gift of binoculars was a happy choice as a constant reminder of his period of office. She had very much enjoyed the last two years and took the opportunity of thanking the Director & Secretary for his constant

help during that time. She concluded her speech by presenting Mrs Finlay with the medallion worn by the President's Lady. Mrs Finlay thanked Mrs Morris for the medallion. Following the speeches, dancing took place to the Lincoln Four in the ballroom and during the evening the Sam Sharp Conference Golf Trophy and replica was presented by Mrs Finlay to Mr S. T. Harris, winner of the competition. The Pearson Panke Trophy was awarded to Mr A. J. Maddy. After the draw for the raffle, dancing continued in the ballroom until 1 a.m., when the President wished all those who had attended the Conference a safe journey home.

Saturday 18 June

Following breakfast, delegates dispersed and it was expected that many who had attended would be present at the next Conference, which is scheduled to take place in Edinburgh in June 1985 (to coincide with the 50th anniversary of the Scottish Section). It was generally agreed that the Conference had been highly successful, and that the arrangements and the customary smooth running of the Conference could be attributed in no small way to the efforts of the Director & Secretary (Mr R. H. Hamblin) and the members of the Association staff.

OCCA news

news of members

George M. Scott retires

On 31 March of this year Mr George Scott, 57, retired from his position as managing director of Sigma Paints (Thailand) Ltd in order to take up the post of managing director, Sigma Coatings Malta. Unfortunately on 29 March Mr Scott suffered a stroke in Bangkok which has caused him to withdraw from business and return to the UK.

Mr Scott, well-known in the industry and in OCCA circles, commenced his career during the war years with Montgomerie Stobo and Company (now no more), saw service in the oil fields of the Middle East, then became chief chemist with the Shalimar Paint Company Calcutta. But the bulk of his career was spent with Federated Paints Scotland where for a period of nearly 20 years he controlled their technical activities ultimately becoming their technical director. It was during this time that he pioneered surface coatings for the atomic energy industry and developed a keen interest in the training of young people. For his services in this latter field he was honoured by the Painting Craft Teachers Association by the award of honorary life membership and concurrent with his Federated Paints activities was for several years chief examiner for the London City and Guilds Institute's final year building science paper.

A life fellow of the Royal Society of Arts, Mr Scott became the founder chairman of the Scottish Section of the Institute of Corrosion Technology of which he is also a life fellow. Inventor of

Information regarding membership of OCCA is obtainable from the Association's offices, see contents page for address.



three patents, Mr Scott with a flair for languages, travelled to many parts of the world particularly in connection with patented anticorrosive materials.

It was not surprising when the original share structure of Federated paints altered dramatically that he soon afterwards accepted the appointment of technical director for Berger Jenson Nicholson East Africa where in Nairobi Mr Scott became founder Chairman of the East African Paint Oil and Colour Society and inaugurated in Africa the first ever London City and Guilds paint technology course.

Coming back to this country in 1975, Mr Scott joined Sigma Coatings UK from whence he was seconded three years ago to Thailand in order to take up the post of Sigma Thailand's managing director.

George returned to Buckingham in June where he joined his wife, two school-teacher daughters and his son, who is just completing public school education at Fettes College. He hopes to renew his interest in photography and intensively pursue speech therapy in order to overcome one of his stroke handicaps, perhaps thus becoming involved again with occasional lecturing activities.

Manchester Section

1983 – informal buffet dance

Friday 18 March was the date, RAFA Club, Sale, Cheshire the venue for a repeat success in the Section's social calendar. More than 150 members, guests, wives etc. attended this function which commenced at 8 pm and which was concluded at 12.30 hours the next day!

Dancing skills varied infinitely and were under the direction of Timmy Gee and his Disco.

After an excellent buffet the dancing was interrupted for a period by the now well established RAF Wings Appeal. This traditional fund raising event was achieved by target practice on a bottle of the hard stuff using coinage of the realm and raised approximately £50.

It is hoped to repeat the event in 1984, perhaps with a comedian support variation, and hopefully with Arthur Thornhill still in the pilot seat.

F. B. Windsor

Eastern Branch

Scotch whisky – an appreciation

Following the annual general meeting held at the Murrayfield Hotel, Edinburgh on Wednesday 6 April 1983, an interesting talk entitled "Scotch whisky – an appreciation of the processes and the product" was presented by Mr Kenneth W. Delahunt of Scottish Grain Distillers Limited.

Mr Delamont gave a comprehensive account of the origin and legal definitions of Scotch whisky, making the point that whisky cannot be called such until it has been matured for a minimum period of three years. This immediately puts other

products, namely white spirits like gin and vodka, at an advantage as they can be sold as soon as they are produced, therefore saving the cost of financing large stocks and having to estimate sales three years ahead.

The production processes for the making of malt whisky and grain whisky were examined in detail, the main difference being malt whisky is produced by a batch process and distilled in a traditional copper pot still, the starch source being malted barley. The grain spirit on the other hand is produced from maize and is distilled in a continuous process with modern plant.

Mr Delahunt explained that grain spirit is not normally bottled but blended with a large number of single malts to produce

the standard blended Scotch whisky in its familiar brand names. Single malts are also bottled but have a limited market as they are more expensive and distinctive in taste. A whisky with a high proportion of malt to grain spirit and matured for longer periods is often sold as deluxe whisky.

The evening was rounded off by the company examining and tasting a wide range of samples that were on show which were brought along courtesy of Scottish Grain Distillers, and an indication of the interest in this subject was the number of questions from the floor.

A vote of thanks was proposed by the Chairman Mr E. Sinclair.

E. P. Sinclair



London Section

Annual general meeting

The 45th annual general meeting of the London Section was held on Thursday 21 April 1983 at the Rubens Hotel, Buckingham Palace Road, London SW1 under the chairmanship of Mr B. F. Gilliam. The annual report was presented by the Honorary Secretary, Mr A. J. Newbould. He said that the September and January meetings had been sponsored by Rohm and Haas and by Tioxide International respectively. In this new venture for the London Section these two companies generously provided buffet and refreshments for those attending. The generosity of our sponsors is very much appreciated by our Committee and our thanks are extended to them.

After the last annual general meeting the Committee decided to return to the Princess Alice at Forest Gate, E7 for our meetings so as to be able to take advantage of the lower hiring and refreshment costs. The combination of this venue and the activities of our two sponsoring companies in inviting guests was most successful in increasing attendance at our evening meetings. Members were urged to continue to support the Committee's technical programme and to participate in the related social activities.

Ladies' night at the Royal Chace Hotel was a well attended and enjoyable evening. A very favourable response was received from companies supporting the event and the same venue has been booked for Friday 2 December 1983.

The report was accepted unopposed.

Dr T. A. Banfield, Honorary Treasurer, presented the financial report covering the year to 31 December 1982. He referred to the reduction in costs of evening meetings due to change in venue. There had been a surplus on both the ladies' night and on the golf tournament but in the absence of symposia (in 1982) there had been no income from this source.

The report was accepted unopposed.

The election of Honorary Officers was proposed from the chair and accepted.

As a result of a ballot of members for the election of three committee members, Mr P. L. Gollop, Mr N. C. Locke and Mr H. C. Worsdall were elected to serve for the period 1983-5.

Mr F. D. Sharp was elected unopposed to the position of Chairman.

Ontario Section

Annual general meeting

The annual general meeting was held on 13 April 1983. The outgoing Chairman, Mr D. Laming, reported on the highlights of the 1982-83 session, and the Treasurer, Mr F. Grootveld, filed his report. The slate of Officers and Committee members presented by Mr A. Gray was unanimously elected. Mr Gray, the incoming Chairman, was presented with the Chain of Office and expressed his thanks to the retiring members of the previous Committee.

Dates for the meetings of the 1983-84 session were set as follows:

1983	1984
21 September	18 January
19 October	22 February
16 November	21 March
14 December	18 April
	23 May



Mr Gray (incoming Chairman) being presented with the chain of office by Mr Laming (outgoing Chairman)



Members of the 1983-84 Ontario Section Committee shown at the AGM held on 13 April. Standing (left to right): Mr F. Grootveld (Hon. Treasurer), Mr S. Patel (Member), Mr R. Purnell (Vice-Chairman), Mr I. Sharples (Member), Mr T. Crooks (Member), Mr J. Ambury (Membership Officer), Mr D. Pratt (Member), Mr W. Fibiger (Education Officer), Mr D. Wilson (Hon. Secretary). Seated (left to right): Mr A. Gray (Chairman), Ms G. Batzer (Member), Mr D. Laming (outgoing Chairman)

OCCA news

Mr Sharp proposed a vote of thanks to the outgoing Chairman, Mr B. F. Gilliam, for his enthusiasm and support given to the Section during his period in office. The retiring Committee members and honorary officers were also thanked for the service they had given to the Section. Presentations were made to Mr B. F. Gilliam and Mr H. C. Worsdall by the Committee in appreciation of their work.

In discussion the Chairman was asked whether or not colleges or polytechnics had been considered as venues for evening meetings. In reply Mr Gilliam said that they were unable to offer comparable social facilities to those available at the Princes Alice.

Colour in heraldry

Following the AGM of the London Section at the Rubens Hotel, Mr J. J. Froggatt presented a lecture well

illustrated with slides on the subject of "Colour in heraldry".

The room was surrounded by posters showing various aspects of heraldry and the members and their guests enjoyed a most interesting talk.

Mr Froggatt said that heraldry was introduced into Western Europe in the middle of the 12th century and that the object then was of identification in battle. Bold contrasting designs, recognisable by their followers, were used on coats over armour, on shields and on horse cloths.

Formal rules cover the structure of a coat of arms and include the relative positions of the two metals, five colours and various furs that can be used.

Examples of full achievements of Earl Mountbatten and members of the Royal family illustrated the close links between heraldry and history. A personal note was introduced showing the coat of arms of Mr J. Tooke-Kirby. Kirby was a name for a cross bearer and this is shown on his coat of arms.

Coats of arms became widely used by civic, corporate, ecclesiastical and collegiate authorities and by craft guilds. Illustrated were achievements of Dyers

Section, Mr B. Gilliam, West Riding Section, Mr R. Chappell, and the Midlands Section, Mr D. Kimber, and their wives, and the Director & Secretary, Mr R. H. Hamblin.

The President replied on behalf of the guests. The formalities over, the evening was completed with dancing to the Ted Hooper Band. A very enjoyable evening was had by all, thanks to the support from the raw materials suppliers and the organisation by messrs G. Fowkes and R. Saunders.

J. R. Taylor

and Colourists, Distillers, Painters and Stainers, and Glaziers Guilds.

Those for Painters and Stainers included an example of punning heraldry where the supporters are panthers which are similar to American leopards called painters.

Examples of funeral hatchments, arms found in stained glass in churches, embroidery and pub signs were also shown. Mr and Mrs Froggatt had been very busy cycling around the country taking these slides.

It was of interest to know that Noel Heaton was a supplier of metallic oxides used in the stained glass industry as well as paint. These heat stable oxides could be mixed with powdered glass and gum arabic and after being painted onto glass would be fused into it by heat. A wide range of colours can be produced from these metallic oxides.

The ensuing discussion concern was expressed in the apparent conflict that coats of arms could either be granted to someone of respect in the community or by anyone paying the £800 fee.

In giving the vote of thanks Mr J. Tooke-Kirby referred to the most interesting and well-prepared talk given by Mr Froggatt and to the assistance given by Mrs Froggatt in making the evening so enjoyable and was pleased to be able to thank them both.

K. H. Arbuckle

Bristol Section

Annual ladies' night

The annual ladies' night took place on Friday 25 March at the Unicorn Hotel, Bristol with 130 members and guests attending. The Chairman, Mr G. W. Fowkes, in a humorous speech welcomed the guests including the President, Mr Morris, and Mrs Morris, the President of the Birmingham Paint Varnish and Lacquer Club, Mr R. Tennant, and Mrs Tennant, the chairmen of the London



Shown at the annual ladies night of the Bristol Section are: (front row, left to right) Mrs Saunders, Mrs Chappell, Mrs Morris, Mrs Fowkes, Mrs Kimber, Mrs Tennant, Mrs Gilliam; (back row) Mr R. Saunders (Vice-Chairman, Bristol Section), Mr R. A. C. Chappell (Chairman, West Riding Section), Mr G. W. Fowkes (Chairman, Bristol Section), Mr D. J. Morris (President), Mr D. Kimber (Chairman, Midlands Section), Mr R. Tennant (President, BPVLC), Mr B. F. Gilliam (Chairman, London Section), Mr R. H. Hamblin (Director & Secretary)

Obituary

William A. Allman

It is with great regret that we announce the death of Bill Allman on 25 April 1983. Bill Allman was an active member of the Manchester Section for over 30 years and had been with W. & J. Leigh & Co. since August 1940. His early days were spent in the R & D Laboratories until going into the forces (1944-1948). He was commissioned in the army and served in India.

On his return he was appointed works chemist in 1948 and studied at Manchester College of Technology obtaining his AMCT in 1952.

He became production manager in 1966, works manager in 1970 and was appointed works director in 1974.

Mr Allman, who had suffered ill health for some years, had earned the high respect and affection of his colleagues and all with whom he came in contact. He was dedicated to his work and will be sadly missed.

We extend our sympathy to his family.

J. Nugent

JOCCA

SITUATIONS WANTED

Position of Responsibility Sought

Industrial chemist (MSc, CChem, MRSC, ATSC) and member seeks position of responsibility with supplier or user of raw materials of Paint, Surface Coatings, Ink and Allied Industries.

Reply in confidence to **Box No. 528**

Printing inks. Qualified chemist, mid-fifties seeks employment. Any opportunity including sales and service considered. **Box No. 534**

APPOINTMENTS

COATING FORMULATOR

E. Wood Ltd is a long-established and expanding speciality paint manufacturer involved in a wide range of products. These include high-duty chemical resistant and maintenance coatings, paints and lacquers for plastics, industrial finishes, marine and decorative paints.

Opening for stimulating and satisfying development work, with diversity rather than specialisation in a narrow field.

Applicants should be experienced, and have a creative flair for the development and formulation of surface coatings at the bench. Experience in formulating lacquers; or epoxies, vinyls, anti-corrosive finishes, etc. desirable.

Excellent opportunity for advancement within a growing company, which has extensive international affiliations. Salary commensurate with experience. Four weeks holiday, pension and insurance scheme. Profit sharing.

Please write in strictest confidence to **Technical Director, E. Wood Ltd, Talbot Works, Stanstead Abbots, Ware, Herts. SG12 8DP.**

APPOINTMENTS

KIPPS EXECUTIVE APPOINTMENTS

PAINT TECHNOLOGIST ZIMBABWE

Our client, a Harare based subsidiary of a large international industrial group, requires the services of an experienced Paint Technologist.

Candidates for this position must meet the following criteria:

- ★ Hold a formal Paint Technology qualification or a BSc (Chemistry).
- ★ Have had extensive experience in Paint Technology, covering general paint testing and manufacture.
- ★ An in-depth knowledge of general coating formulations which should include as many of the following paint types as possible:

Automotive and Industrial paints
Wood finishes
Heavy Duty coatings

- ★ Hopefully have a knowledge of resin production.

The successful candidate will enjoy a number of excellent benefits which include:

- ★ A highly competitive salary.
- ★ Free air passages for employee and family.
- ★ Generous removal expenses.
- ★ Four weeks' free accommodation on arrival.
- ★ Settling-in allowance.
- ★ Annual bonus.
- ★ Home ownership scheme.
- ★ Medical, Pension/Life Assurance cover.
- ★ Outstanding recreational and sporting facilities.

Zimbabwe is undoubtedly one of the most beautiful and climatically attractive countries in Southern Africa, and in which all members of the family can lead a healthy and congenial existence.

Applications, together with full personal and career details should be sent to the undersigned without delay.

ANNE SIEVWRIGHT

**11th FLOOR, MICHAEL HOUSE, BAKER AVENUE, HARARE
TELEPHONE 704881 (9 lines) Telex 4571 ZW**



SURFACE COATINGS TO RESIST CORROSION

For the latest products and materials

VISIT

CORREX 83

Fifth in the successful series of Industrial Corrosion Prevention Exhibitions and Conferences.

11-13 October 1983

Cunard International Hotel, Hammersmith, London W6

For details of the Conference and Exhibition contact:-
Miss Lorraine Butler,
Correx '83,
30 Calderwood Street,
London SE18 6QH
01-855 7777

Consultants to the Conference:-
R. J. P. Nicklin & Co. Ltd.,
International Consulting and
Quality Assurance Engineers.
Tel: 0709 60675

OCCA CONFERENCE YORK 15-18 JUNE '83

A number of preprints of the papers presented at the Association's York Conference are available at £15 (inc. p&p). The preprints contain 17 of the 19 papers presented (two were received too late for inclusion) and are printed to the same standard and in the same format as *JOCCA*. The papers published are:

Session I

Formulation including manufacture:

"The efficient use of surface coatings", *R. A. Filder*;
"Surface coatings in relation to external wall insulation",
M. Wilkinson; "The need for speed and accuracy in
efficient production of surface coatings", *R. J.
McCausland*; "Automated Paint Manufacture",
J. Boyden and W. Ollett; "Linear polymonosulphide and
polysulphide polymers - general survey, recent develop-
ments and applications", *J. Brossas and J. M. Catala*.

Session II

The use of computers and other advanced techniques in
surface coatings:

"Solving paint problems with computers", *J. van der
Stoep*; "Introduction to computer technology", *G. T.
Eady*; "NMR analysis of paint media", *M. Marshall*;
"Efficiency and change in metal decoration", *A. A.
Gamble*.

Session III

Maintenance of quality and prediction of performance:
"Quality Control and standardisation in the titanium
pigment industry", *R. R. Blakey*; "Prediction of perfor-
mance of exterior wood coatings", *E. R. Miller*;
"Mechanistic model for corrosion protection via paint",
F. L. Floyd, R. G. Groseclose and C. M. Frey; "Acoustic
emission - further unpublished results of the new techni-
que for the study of paint performance during environ-
mental exposure tests", *T. A. Strivens and M. S. Bahra*;
"Wood protection - the interaction between substrate and
product and the influence on durability", *A. Underhaug,
T. J. Lund and K. Kleive*.

Session IV

The efficient use of coating application:

"Quality Control of coating application", *D. A. Bayliss*;
"The use of modern application equipment and its
efficiency", *M. G. Eaton*; "Fire retardant paints", *D. M.
Bishop, D. Bottomley and F. G. R. Zobel*.

To obtain a copy/ies complete the form below and send
with remittance to the address as shown.

To: OCCA, 967 Harrow Road, Wembley,
Middlesex HA0 2SF, UK

Please send . . . copy/ies of the York Conference Preprints
at £15 each to the following address:
(BLOCK CAPITALS)

.....
.....
.....

I enclose remittance (payable to OCCA) for £

INDEX TO ADVERTISERS

Further information on any of the products advertised in this Journal may be obtained by completing the Reader Enquiry Service form. The Reader Enquiry Service numbers are shown in brackets below.

C		
Chemische Werke Huls AG	(259)	v
Correx 83	(256)	x
E		
ECC International Ltd	(222)	vii
O		
OBS Machines Ltd	(257)	vi
OCCA-35	(500)	Cover
OCCA Conference Preprints		ix
P		
Pigment International	(228)	Cover
Resins & Pigment Exhibition	(258)	iv
Pye Unicam Ltd	(260)	viii
Q		
Q-Panel	(262)	Cover
S		
Sachtleben Chemie GmbH	(242)	i
Sanyo-Kokusaku Pulp Co. Ltd	(112)	iv
Steel Structures Painting Council	(261)	ii
Sub-Tropical Testing Service Inc.	(117)	vi
Surface Coatings		Cover

JOCCA

READER ENQUIRY SERVICE JULY 1982

Name

Job Title

Company

Address

.....

Country

Telephone

For further information on adverts or editorials
enter the Reader Enquiry Service Number/s below.
This enquiry will be forwarded to the company/ies
concerned.

Photocopy or cut out this form and send to:

JOCCA

Priory House, 967 Harrow Road, Wembley,
Middx., HA0 2SF, England
Telephone: 01-908 1086
Telex: 922670 (OCCA G)



TOUS COLORANTS POUR TOUTES INDUSTRIES



Pigment International

Europe's leading distributor of surplus **PIGMENTS, DYES and CHEMICALS.**

BP 12 77330 Ozoir La Ferriere France
Tel: (6) 029-6613 Telex: Alpanil 690161 F

Agents in Europe

United Kingdom

Acrol Ltd.,
Unit C2 St. Michael Industrial Estate
Oldgate, Ditton, Widnes,
Cheshire. WA8 8TL
Tel: 051 424 1341

Belgium

Ets. Robert Stiernon,
61, Rue du Prince Royal,
Bruxelles 1050
Tel: (02) 513 1852/3/4
Telex: 24329 MOLRY

Italy

Asco del Dr. Italo Calleri
Via Zvara 22,
Milano 20126
Tel: (02) 42 37 461
Telex: 313058 SHULTE I

In North America contact:

Albanil Dyestuff Corp.
POB 5179 Greenville St.,
Jersey City 07305 NJ, U.S.A.
Tel: NY (212) 227 5177/8
NJ (201) 792 1244
Toll Free (800) 526 3192

**WISH TO BUY OR SELL? CONTACT US:
GERMANY? AGENT WANTED!**

Reader Enquiry Service No. 228

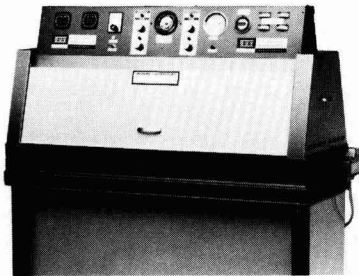
A better deal in Test Panels

Can you afford to ignore this great deal from the world's leading manufacturer of steel and aluminium test panels? With prices up to 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.

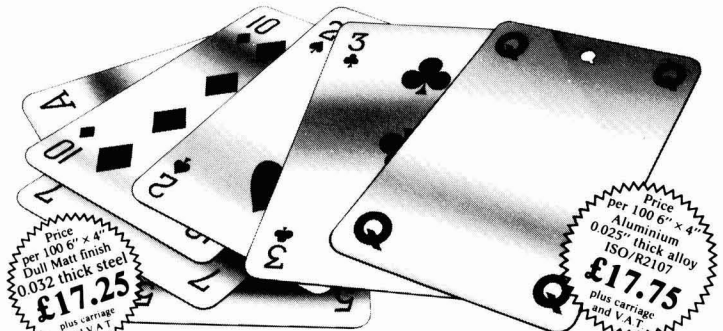
Q-Panels offer the following advantages.

- 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. 262



Q-PANEL

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

OIL & COLOUR CHEMISTS' ASSOCIATION



LECTURE FACILITIES



COMPETITIONS WELCOMED



SPECIAL ADVERTISING RATES



AUDITED ATTENDANCE

**1984
1-3 MAY
LONDON**

**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-35 (1-3 May 1984, Cunard International Hotel, London). Please send us a copy of the Invitation to Exhibit

BLOCK LETTERS PLEASE

NAME: ADDRESS:

TELEPHONE: