ISSN 0030-1337

August 1990
Vol. 73, No. 8

JOURNAL OF THE OIL AND COLOUR CHEMISTS' ASSOCIATION

JOCCA

- The Single Market
- IR & UV Curing Systems

SUPERCHLON
CPO

Super-efficient auto-industry adhesive primer also excels in modern home and industrial product uses.

SANYO-KOKUSAKU PULP CO., LTD.
CHEMICALS TRADING DEPT.
1-4-5, Marunouchi, Chiyoda-ku, Tokyo, Japan
Telex: J 24279 SK PULP
Facsimile: 03(287)6488

Enter H201 on Reader Reply Card

Vol. 73 No. 8 AUGUST 1990

JOCCA

JOURNAL OF THE OIL AND COLOUR CHEMISTS' ASSOCIATION

Honorary Editor and Chairman of the Publications Committee
J. R. Taylor
BSc, CChem, FRSC, FICorrST, FPRI, FTSC

Publications Committee:
A. G. North, BSc, FTSC
B. F. Gilliam, FTSC
L. J. Brooke, ATSC
S. G. Lawrence, PhD, BSc, ATSC
G. W. Fowkes
D. Robinson, LRSC
G. J. Steven, BSc
M. Langdon, ATSC
M. J. Round, MRSC, CChem
J. Bravey, CChem, MRSC
H. Jess
J. Clarke
D. Horne. ATSC
S. Birkett, LTSC
J. G. Pitt
E. Puterman, BSc
R. E. Cromarty, BSc, ATSC MSA Chem
A. T. Hopgood, FTSC
J. Hemmings, LRSC, ATSC
N. H. Seymour, FTSC

General Secretary
C. Pacey-Day
Assistant Editor
P. J. Fyne, MA, DPhil
Advertisement Manager
Miss V. Craik
Publications Consultant
F. Craik

ISSN 0030 - 1337
© Copyright OCCA 1990

ABC
Member of the Audit Bureau of Circulation

SBPIM
The Society of British Printing Ink Manufacturers

An Official Journal of the Society of British Printing Ink Manufacturers and the Paintmakers Association of Great Britain Ltd.

Contents

Cover: 1992 (Design John Law)

Forthcoming Features: September—Additives and Renewable Resources; Process Operation (PO); Pumping; October—Physical Testing; PO, Energy Conservation; European Paint Show; November—Application & Film Formation; PO, Energy Conservation.
Contributions are welcomed at least five weeks prior to publication date.

JOCCA (ISSN 0030-1337) is published monthly by the
Oil and Colour Chemists' Association,
Priory House, 967 Harrow Road, Wembley HA0 2SF, England
Tel: 081-908 1086 Fax: 081-908 1219 Telex: 922670 (OCCA G)
1990 annual subscription rate: UK £82.00, rest of the world (excluding USA) £90.00, USA $180.00. Single copies £8 ($16).
Air freight and mailing in the USA by Mercury Airfreight International Ltd Inc., 2323 Randolph Avenue, Avenel, NJ 07001. Second class postage paid at Rahway NJ. US Postmaster send address changes to JOCCA c/o Mercury Airfreight International Ltd Inc., 2323 Randolph Avenue, Avenel NJ 07001.

Editorial correspondence should be addressed to the Honorary Editor, and general correspondence addressed to the General Secretary at the Association Headquarters.
The Council and the Oil and Colour Chemists' Association do not accept responsibility for opinions and statements expressed by correspondents or contributors to this Journal. The contents of the Journal are copyright and permission to reproduce Transactions and Communications, Features and Horizons, in full or in part, must be obtained from the Honorary Editor.

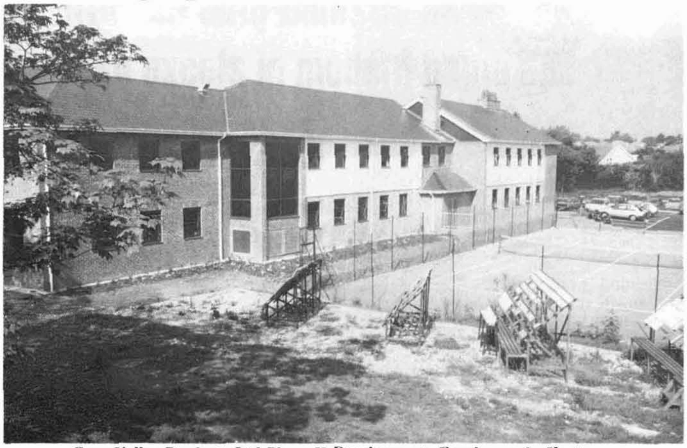
Printed by The Herald Press, 17 Rother Street, Stratford-upon-Avon, Warwickshire CV37 6NB Tel: 0789 66261

Cray Valley Products doubling up

The new development at the Headquarters of Cray Valley Products Ltd has been completed on schedule at a cost of £1.5 million, and doubles available accommodation at the Farnborough (Kent) site.

The Phase II development includes a computer suite; buying and accounts departments; an audio-visual seminar room which seats 35; an information service department with computers connected to world-wide data bases; and some executive offices.

The new blocks are built in the same style as the original development (completed in 1981), and include ample car parking space, tennis court and landscaping. The three new two-storey buildings are linked to the Phase I existing buildings by a covered walkway.



Cray Valley Products Ltd Phase II Development, Farnborough, Kent

Courtaulds aerospace coatings acquisition

Courtaulds is to acquire the industrial coatings businesses of DeSoto Inc for $135 million. This includes its aerospace coatings interests which are located in the US, Canada, UK and Singapore. DeSoto owns DeSoto Titanine Plc in the UK. In 1989 the turnover of the industrial coatings businesses was $122 million. The purchase, subject to DeSoto shareholders' approval and clearance by US regulatory authorities, is expected to be completed from September onwards.

$1.5 million orders for Colourgen

The Colourgen group has won two major multiple orders in the United States, initially valued at $1.5 million. At the same time, Colourgen has signed a joint marketing agreement with Sandoz, one of Europe's leading chemical groups.

Standard Brands Inc, a leading US paint manufacturer and decorating chain retailer, has placed a $900,000 order for Colourgen systems, with the opportunity for further substantial orders later in 1990. Standard Brands has 150 outlets on the US West Coast.

Valspar Corporation, the US paints group, has placed an initial order of $600,000 for Colourgen systems, part of a planned $1 million total order.

The joint marketing agreement with Sandoz is designed to provide a package for the industrial paint market combining colour, colour management and autodispensers.

Tioxide ultra-fine TiO_2

The Tioxide Group is to invest more than £5m in an Ultra-Fine TiO_2 production plant at Tioxide Italia SpA, Scarlino, Italy. The plant will come on-stream in 1991 and will have an initial production capacity of 400 tonnes per annum. The patented Ultra-Fine TiO_2 products have been under development at Tioxide since the early 1980s and have enormous commercial potential.

As a UV absorber and barrier in plastics, Ultra-Fine TiO_2 extends durability in such items as garden furniture. Its use as a UV barrier in food packaging films allows transparency to be maintained whilst enhancing the shelf-life of foods that would otherwise be degraded by UV radiation. In wood finishes it acts as a transparent UV absorber whilst in automotive coatings the Ultra-Fine TiO_2 creates novel 'frost' effects in metallic colours.

Sachtleben supply SPCV

Sachtleben Chemie is to take over the barytes supply activities of Societé des Produits Chimique de Viviez (SPCV, France). SPCV discontinued production at the end of 1989, due to the exhaustion of its recoverable mineral reserves. Sachtleben Chemie has an extensive trade in ground barytes produced by two quarries in Germany which have been in operation for several decades.

Ellis & Everard US acquisitions

Ellis & Everard has entered into conditional agreements to acquire two further chemical distribution businesses in the USA, HVC and Kramer, for a total consideration of £17.9 million.

Following its success in establishing a network of chemical distribution branches throughout mainland Britain, Ellis & Everard has been pursuing a similar policy in the USA (since 1982) and Ireland (since 1987). Since the acquisition of the business of United Chemicals Inc in 1988 the US business has continued to grow, assisted by the further acquisition of Pioneer Chemical Inc. The Group is already a leading distributor in the USA, with annual sales in excess of $220 million accounting for approximately 50 per cent of Group turnover.

HVC is a full range commodity chemical distributor based in Cincinnati, Ohio, and Kramer is a leading regional chemical distributor in New Jersey and the greater New York area.

European carbon black laboratory opens

The International Chemical Company, Columbian Chemicals Company based in Atlanta, Georgia, has officially opened its European Central Laboratory at Avonmouth, England. This £1.25 million investment has one of the most up-to-date facilities of its kind servicing the interests of all users of carbon black throughout Europe.

The research and development facilities of the European Central Laboratory will be available to all Columbian Chemicals Company customers throughout Europe. Staffed by a team of highly qualified laboratory technicians, under the direction of Dr Francis Bomo, the laboratory will assist carbon black users in solving their particular application problems. Covering 700 square metres, the laboratory has a Colloidal and Analytical Department, and an Application Department covering rubber, ink, paint and plastics applications.

SEPTEMBER JOCCA ADDITIVES

Products

High performance perylene pigments

Sun Chemical Corporation, continuing its emphasis on expanding its range of high performance pigments, has announced the introduction of Pigment Red 179, a Perylene red, to the range of organic pigments offered to the coatings and plastics marketplace. A high performance, blue shade red, the plastics grade pigment has been conditioned to give a soft product, as compared to the coatings grade, and is available as the dry color, Sunfast® Perylene Red 229-3379, and as the presscake, Sunfast® Perylene Red 429-0179.

For further information Enter H101

New pearlescent pigment

A new, non-metallic, gold pearlescent luster pigment called Mearlin® Mayan Gold has been introduced by The Mearl Corporation, New York. Exhibiting a rich, gold appearance, this new pigment is offered in both a regular as well as an exterior grade for applications requiring long-term exposure to adverse weathering. Mearlin Mayan Gold is a lustrous, reddish-gold powder. It consists of titanium dioxide and iron oxide coated mica with an average particle size range from 6-50 microns in length. Used alone, Mearlin Mayan Gold produces a deep, rich, reddish-gold effect. It can also be combined with other transparent, organic colorants to achieve unique color tones with a reddish-golden background.

For further information Enter H102

Low formaldehyde woodfinishes

An important technological innovation by Haverhill-based Macpherson Woodfinishes, part of the Finnish multi-national Kemira, significantly reduces the formaldehyde content of all the company's acid catalysed lacquer finishes. Extensive research and development by Macpherson's team has resulted in this new formulation which reduces formaldehyde content to well within the HSE's acceptable environmental limit of two parts per million.

For further information Enter H103

Equipment

New syphon cup

With its easy lid release – featuring a single lever action – Binks' new 1.1 litre/1 quart syphon cup offers fast colour change, ease of cleaning, good operator control and less reject due to dirt.

Developed for Binks' own BBR and 230 range of spray guns, the cup is also fully-compatible with most competitive makes. A special optical nylon filter ensures that the paint is thoroughly filtered before final application.

For further information Enter H104

Centrifugal pumps

Kecol Pumps Ltd has been appointed sole UK distributor by Met-pro Corporation of the USA for the complete range of Fybroc corrosion and abrasion resistant centrifugal pumps. Fybroc manufactures 88 different sizes and types of ANSI horizontal, vertical self priming, cantilever and recessed impeller centrifugal pumps with capacities from 10 to 4,500 gpm and heads up to 400 ft. For abrasive services, there are two different optional materials available – one for moderate abrasion and the other for really tough services like Titanium Dioxide, Diatomaceous Earth, flyash, etc.

For further information Enter H105

New high performance polythene liners

Giant polythene liners used as a moisture and contaminant barrier within IBC & Octabin containers when handling chemical powders and granular products has become a 'best seller' for polythene specialists Palagan Ltd,

who report ¼ million unit sales in the first six months. The liners are made from a new polythene which registers a high dart impact resistance and has been successfully tested in both machine and transverse directions up to 580% elongation.

For further information Enter H106

Literature

Literature in brief

A short-form catalogue from **Albany Engineering** of Lydney, Glos., outlines the company's ranges of gear, double-helical gear, centrifugal, turbine and dosing pumps.

For further information Enter H107

BRE News of Fire Research.

For further information Enter H108

CATALYST – the museum of chemical industry – Newsletter "the Works".

For further information Enter H109

BIP. Application Guide for 'Beetle' Coating Resins.

For further information Enter H110

Wells Krautkramer – two free booklets on Non-destructive testing – X-ray radioscopy and image processing.

For further information Enter H111

Prometheus R & D Newsletter – Intumescent Coatings.

For further information Enter H112

Macbeth Color-Eye 3000 spectrophotometer brochure.

For further information Enter H113

Meetings

FATIPEC 1990

FATIPEC Congrès + Exposition Eurocoat, Nice Acropolis, 17-22 September. Organising Secretariat: AFTPV, 5 rue Etex, F75018 Paris, France. Tel: 33 (1) 47 73 01 23. Fax: 33 (1) 49 00 05 91. (see Back Cover).

COSHH

At a seminar to be held at the Post House Hotel, Gatwick, on 12 September 1990, speakers from Fulmer Yarsley and the Department of Trade & Industry will explain the new COSHH (Control of Substances Hazardous to Health) regulations as they affect the smaller company. More information about the seminar can be obtained from Fulmer Yarsley at Redhill. Telephone 0737 761229.

SDC conference

The Society of Dyers & Colourists is holding an International Conference at St John's College, York, on 12-14 September 1990 and the main theme of the conference will be Profitability through Partnership. Further details are available from Mrs Anita Hallam at the Society's Headquarters, PO Box 244, Perkin House, 82 Grattan Road, Bradford, West Yorkshire BD1 2JB. Tel: (0274) 725138; Fax: (0274) 392888.

Concrete

The Protection of Concrete, 11-13 September 1990, Dundee. Contact: Dr R. K. Dhir, Concrete Technology Unit, Department of Civil Engineering, The University, Dundee DD1 4HN, Scotland.

Technoshop 90

Technoshop 90 will be the largest opportunity for manufacturers to buy and sell new product and process technology. Technology Exchange Ltd, the organisers of the event at London's Heathrow from 2-4 October 1990, expect more than 5,000 licences to be on offer. The catalogue is being published in two volumes each with 35 categories covering a wide range of products and processes. The two volumes cost £220 (plus £10 airmail outside Europe) and are available from The Technology Exchange, Wrest Park, Silsoe, Bedford, England MK45 4HS. The catalogue price includes admission for two to Technoshop.

Surface analysis

CSMA will now be running a 3-day course entitled "Surface and Materials Analysis" to be held at UMIST from 5-7 November 1990. Further details about the course are available from Dr L Smith at Chemserve (061 200 4488) UMIST, PO Box 88, Sackville Street, Manchester M60 1QD.

US environmental regulations

"How Environmental Regulations in the United States Control the Paints and Coatings Industry," a 2-day intensive course 31 October-1 November at the University of Oxford, England. Instructors: Ron Joseph and Karl Spencer. A collaboration between the University of Oxford,

4/7846 E

Beat Corrosion...

...with LIPATON® dispersions

The life of car components depends largely on corrosion protection. Hard use in all weathers demands top products. That is why the well-proven dispersions from Hüls have been further optimised. The two grades, LIPATON X 4520 and LIPATON X 5521, produced by a highly developed process specially mindful of the environment, offer universal compatibility with other water-thinnable binders as well as excellent shear and electrolyte resistance. We were able to increase impermeability and flexibility of the film and reduce the water absorption of the dispersion films. Result: improved corrosion protection.

Application areas: Coatings for engine blocks, oil sumps, suspension components, cardan and drive shafts, tanks and trailer couplings; stone chipping and underbody protection.

Please send for detailed information:

HÜLS AKTIENGESELLSCHAFT
Dept. 1122, D-4370 Marl
Telefax 02365/494179

In U.K. please contact:
HÜLS (U.K.) LTD.
Edinburgh House · 43-51 Windsor Road · Slough · Berkshire SL 1 2HL
Phone 0753/71851 · Fax 0753/820480

hüls

Enter H202 on Reader Reply Card

Department of External Studies and University of California, Berkeley, Continuing Education in Engineering, University Extension. Fee: £500, including course materials and lunch. Information: Tel: +44 (0) 865-270373. Fax +44 (0) 865-270708 (Attention: CPD Unit, External Studies).

People

Memorium – Erich Netzsch

Erich Netzsch, President of The Netzsch Group of Companies, died peacefully on 12 April at the age of 86.

Thirty-one companies now bear the Netzsch family name worldwide, having developed from the former Gebruder Netzsch Maschinenfabrik, which was founded in Selb, Bavaria, in 1873.

Erich Netzsch was one of the great German industrialists who saw The Netzsch Group of Companies rise to hold a worldwide leading position in the field of ceramic process engineering, mixing, milling and filling equipment; pump construction; thermal analysis and filtration techniques.

Obituary: F. K. Daniel

Frederick K. Daniel, founder of Daniel Products Company, recently died at the age of 79.

Mr Daniel was born in Hamburg, Germany, on August 5, 1910. He studied aircraft engineering at the Technological Institute of Berlin, and in 1933 transferred to the University of Zurich, where he became interested in colloidal chemistry.

Upon arriving in the US (1936), he set up a new products development subsidiary of A. C. Horn Co, paint manufacturers in Long Island City, New York.

In 1957 Mr Daniel perceived the need for specialized pigment dispersions and chemical additives for the coatings industry and formed Daniel Products Company in Jersey City, New Jersey. The success of that venture confirms the validity of his original concept. He sold the company in 1978 to Synres Chemical Company (now DSM Resins BV, The Netherlands), and remained as its President and Director until 1982.

Mr Daniel held more than a dozen patents and authored more than 30 papers, most of them dealing with colloidal and rheological aspects of coatings technology.

Henkel management appointment

Terry Edwards will take over as Managing Director of Henkel Chemicals Ltd and its subsidiary companies in the UK and Ireland from 1 September 1990. He will also remain responsible for the Home Improvement & Adhesive Products business centre in the UK and Ireland.

T. Edwards

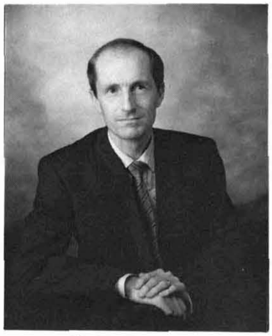
EMS-Grilon

EMS-Grilon (UK) Ltd's current Managing Director, Mr **Reto Fintschin**, has been appointed Sales Director of all subsidiary sales companies and of EMS Technical Thermoplastics. Mr Fintschin will be based at the Parent Company located in Domat/Ems, Switzerland. The new Managing Director of EMS-Grilon (UK) Ltd will be Mr **David Jarvis**. Mr Jarvis returns to the UK Operation following five years' activity in Product and Marketing Management within the Marketing Department in Domat/Ems.

Vaughan for DeSoto

DeSoto Titanine Plc, the Shildon-based paint manufacturers, have appointed **Bob Vaughan** as Production Director to take over from Ernie Talbot, who will now concentrate fully on his responsibilities as Technical Director.

Vaughan (38), a Chemical Engineering graduate from Birmingham, joins DeSoto after 14 years with International Paints. He worked on the modernisation of the production process, which was followed by a spell as Polymer Plant Manager and latterly Production Manager of a major production unit.



R. D. Vaughan

Carri-Med Ltd appointment

Carri-Med Ltd, the well-known specialists in rheological instrumentation, have appointed Dr **Peter Whittingstall** to the position of Applications Laboratory Manager. The position of Applications Laboratory Manager involves providing technical support for overseas distributors, together with customer liaison on technical matters.

Bush Beach Ltd

David Warren, at present the acting General Manager of Bush Beach Ltd, has been appointed its Managing Director. Bush Beach Ltd is trading and distributing products which do not form part of Degussa's manufacturing programme. ■

Getting the complete message about 1992

by the Department of Trade and Industry, 1-19 Victoria Street, London SW1H 0ET, UK

"The single market is here now. Where are you?" This was the question which from large road-side hoardings was confronting people throughout the United Kingdom earlier this year. It symbolises the latest phase in DTI's multi-million pound "Europe Open for Business" campaign to keep British business informed on progress towards the completion of the single European market.

This phase of the campaign was backed-up with media advertising highlighting examples of what some firms are doing to take advantage of the opportunities of the single market; they also emphasised that in addition to DTI, a great deal of help and advice on single market matters is available from private sector bodies such as trade associations, chambers of commerce and other business organisations, not to mention banks, accountants and solicitors.

You can obtain from the DTI a list of those organisations which have indicated that they are able and willing to provide advice to firms on at least some detailed matters relating to the single market. Depending on the organisation, the advice will either be of specific relevance to those firms in a particular sector, or it will cover more general matters. One list comprises national organisations, in particular trade associations and professional bodies; there are a further 11, each of which covers a region of the United Kingdom, primarily comprising local chambers of commerce and other business organisations.

Since February, when the first editions of the lists were published, the number of organisations offering help and advice on the single market has grown. Accordingly, extensively revised editions of the lists – they are called "The Single Market Guide to Practical Help for Business" – are being produced.

DTI originally launched its "Europe Open for Business" in the spring of 1988, setting itself the target of boosting awareness among businesses of the significance of 1992 from the pre-campaign level of less than 20 per cent to 90 per cent. Today, the awareness level exceeds this target, which may leave some people wondering why DTI still feels it is necessary to ram home the single market message.

The problem is that awareness is only the first step. Although more than 90 per cent of business is aware of the single market, only about half is doing anything about it. And it is mainly small to medium-sized firms that seem to be taking the view that, for them, the single market is irrelevant or too far in the future.

As for being too far in the future, some 60 per cent of the measures to complete the single market by the end of 1992 have already been agreed. Just as important is the fact that firms of all sizes throughout the European Community are responding to the new business environment or anticipating changes to come. For example, firms from other Member States are investing or winning contracts in the United Kingdom; others are seeking franchising and agency agreements; and some are changing their product lines. So proclaiming that the "single market is here now" is not just a meaningless slogan. And it is to be hoped that the question "where are you?" will prompt more business people to realise that Britain is as much a part of the single market, and therefore subject to the changes being made to create it, as is France, Germany, Italy or any other of the Member States of the European Community.

Even if you do not do business in other member states of the Community and have no intention of doing so, the single market could still affect your business in Britain, either directly or indirectly. For example, one of your local customers of many years standing may now find a more competitive supplier from across the Channel, or your own suppliers may be changing their business practices. Whether you see the single market as an opportunity to expand existing business or a possible threat to it, the crucial factor is your ability to compete.

Of course, not all firms will need to modify their business operation as a result of the changes the single market is bringing. But no firm can afford to assume that they fall into this category without first finding out what those changes are.

The keystone of DTI's 1992 campaign is a comprehensive and authoritative information service, regularly up-dated and expanded, which provides details of the changes taking place as the single market programme progresses. There is a wide range of literature available, including detailed fact sheets, an action checklist and a quarterly newsletter. There is also an expanding series of booklets on standards and the removal of technical barriers to trade. And specifically for smaller firms, there is a special action guide on how they might address the key issues of the single market. The professions are also catered for and there are detailed publications on such topics as public purchasing, financial services and company law harmonisation.

In addition to these and other publications, there is also DTI's "Spearhead" on-line database which summarises all current and prospective EC measures in the single market programme, EC research and development programmes, and measures relating to health and safety in the environment. Spearhead also includes notifications made under Directive 83/189. These are intended to help avoid the creation of new barriers to trade in Europe by giving the Commission and the other 11 Member States the opportunity to review in draft all new legislation affecting trade or technical barriers. And not, forgetting the personal touch, there are people at DTI and other Government Departments with whom you can discuss specific single market issues.

In addition to these and other publications, there is also DTI's "Spearhead" on-line database which summarises all current and prospective EC measures in the single market programme, EC research and development programmes, and measures relating to health and safety in the environment. and not forgetting the personal touch, there are people at DTI and other Government Departments with whom you can discuss specific single market issues.

So how easy is it to get all this information? Quite simply, you start by telephoning DTI's 1992 Hotline — 081-200 1992 — or by getting in touch with your nearest DTI regional office if your firm is based in England. In Scotland, contact the Industry Department of Scotland; in Wales the Welsh Office or in Northern Ireland the Industrial Development Board. But DTI's information service is no substitute for the private sector when it comes to more detailed, sector-specific help that firms are increasingly looking for. You can therefore, also obtain from the Hotline and other contact points, a list of those private sector bodies mentioned earlier.

You may feel there are areas of weakness in your business operation which could affect your competitiveness and you will want to find out what steps you need to take to strengthen them. In which case you could consider applying for one of DTI's Consultancy Initiatives. They provide expert consultancy advice from the private sector, with DTI paying up to two thirds, in marketing, including export marketing; design; quality; manufacturing systems; business planning; and financial and information services.

Continued on p.331

Standards and the single market

by H. Jotischky, The Paint Research Association, 8 Waldegrave Rd, Teddington, Middlesex TW11 8LD, UK

Within the last few years, standards have moved from the fringe of Community activities right into their centre. During this time, CEN (the European Committee for Standardisation) has transformed itself from the Cinderella of the standards world into a key instrument for achieving the Single Market objective. This has given European Standards both urgency and status. In the words of one commentator[1], "technical standardisation is going to make or break Europe."

The turning point for the European (EN) Standard came in 1985 with the EC Council's 'New Approach' doctrine; it was this which linked European Standards to the White Paper on the completion of the Single market by 1993. The idea of the New Approach is simply this: Directives would lay down the essential requirements for harmonisation, leaving the technical details to be worked out by the two European Standards bodies, CENELEC (electro-technical) or CEN[2]. With one stroke, the two had acquired a new role. With it came a major headache: some 2,500 new standards were urgently needed. Thus by unclogging the legislative bottleneck at the Commission's end, the New Approach erected a technical one further down the line.

This paper will address three principal topics:

- ☐ The philosophy behind European standardisation.
- ☐ The principles and procedures as well as
- ☐ Its problems and implications.

The role of standards

Standards in the Single Market perform a distinct function; that function is nothing less than dismantling the technical barriers in Europe. In particular, they play a role in three main areas?

- ☐ Trade
- ☐ Public Procurement
- ☐ Health & Safety and Consumer Protection

Standards are meant to ensure the free circulation of goods within the European market on the one hand, while guaranteeing certain minimum health and safety or technical requirements on the other.

1. Free trade

Standards play an ambivalent role in trade; they can serve as either a passport or a hurdle. While divergent *national* standards can be used to exclude foreign goods from the market place; *harmonised European standards* can place them on an equal footing with domestic products. Hence the idea of the CE mark, obtained by means of conformity to standards, an EC type-examination or technical approval.

2. Public procurement

Standards can similarly open or close doors in public procurement. Public purchasing in Europe— both works and supply — has been considerably liberalised and extended during the last two years. Four more sectors have now been opened to community-wide competitive bidding, namely transport, telecommunications, energy and water. What they lack, however, are harmonised European Standards. In the absence of a European Standard, preference is given by the procurement directives to international standards, then to the national standards of the authority's country (or failing that to codes of practice). Herein lies a simple recipe for potential abuse. Special procurement standards are now being drafted according to Commission remits.

3. Health & safety, consumer protection

Standards are also an expression of the Community's social policy in the field of health and safety or consumer protection. The Toy Safety Directive was the first of the New Approach Directives to come in force.

4. Technical policy

More recently, standards are also being used for raising the Community's technical profile in certain critical areas, in telecommunications in particular. This underlies the Commission's standard remit during 1989 for an Integrated Services Digital Network.

Principles of European standardisation

Over the years, the Community's standards policy has undergone a gradual evolution. CEN had existed since 1961 — first in Paris and since 1975 in Brussels — but it was not until the 1980s that the EC's attitude became crystallised, culminating in the New Approach. The basic document here is the 1983 Information Directive, as amended in 1988. The underlying principles on which European standardisation is built are these:

☐ **Consensus.** European standards are voluntary, non-mandatory standards.

☐ **Transparency.** National standard institutes were to report any new work undertaken to a central register and to each other. This has given rise to ICONE, a Comparative Index of National and European Standards.

☐ **Standstill.** National standard bodies must not undertake work on new standards once European standards are in progress.

☐ **Transposition.** European standards must be transposed into national standards (usually indicated by dual numbering) and any conflicting national standards withdrawn.

☐ **Weighted majority voting.** this is an innovation which parallels the new procedure in the EC itself. A standard is binding on national standards bodies even if they had voted against it.

At the same time, European standards remain *voluntary*, even though they may have a certain mandatory nature in relation to given EC requirements.

The institutional framework

There are now three principal standardising bodies in Europe:

- ☐ CEN, producing mainstream general standards.
- ☐ CENELEC, its sister organisation in the electro-technical sector, and the latest newcomer
- ☐ ETSI, the European Telecommunication Standardisation Institute.

There are, in addition, certain subsidiary bodies with distrinct sectoral interests, such as ECISS, the European committee for Iron and Steel Standards under CEN[3]. During 1989, the Commission has begun discussions with the three bodies on the formation of a single standards organisation. In fact, the *EC's* entire standards policy is currently under review with a major policy document expected in the near future.

CEN issues several types of standardising documents. Most straight-forward is the *EN* standard which enjoys the benefit of full transposition as a dual-numbered national standard and the withdrawal of conflicting national variants. A

Harmonisation Document (HD) also requires the withdrawal of a conflicting national standard, without the benefit of full transposition. An *ENV* is only a provisional European standard, to be reviewed after two years. *Eurocodes,* or structural design codes for construction products, are the latest addition to the CEN stable; responsibility for these were handed over by the Commission to CEN early in 1990.

CEN (and CENELEC), of course, transcend the EC by comprising in addition the six EFTA countries, that is Austria, Finland, Norway, Sweden, Switzerland and Iceland. CEN's Brussels-based Secretariat has grown considerably in recent years; in 1984, it had a staff of nine; today it has 70. The Technical Committees — there are about 250 of them — bear the brunt of the actual drafting work. The secretariat of each Technical Committee is assumed by the various national standards bodies. In 1989, out of 138 committees Germany held the Secretariat for 51, the UK for 29, France for 24, Italy for 8, Denmark and Belgium for 7 each, but the Netherlands for only 4. TC 139, on paints varnishes and related products, is under the secretariat of DIN.

The new approach procedure

The New Approach has not only increased the workload of the European standards bodies, it has also introduced a new formal structure. Its key characteristic is the Commission *Mandate.* In fact, back in 1973 the Low Voltage Directive had set an early precedent for the current approach in which a European Standards body is left to work out the technical details of a Directive. Over the years, CENELEC had drafted dozens of electrical safety standards without, however, the formalised mandating machinery now in use.

This formal mandate under the New Approach has, in effect, created two types of standards; the *ordinary* EN Standard and the *harmonised* European Standard. The distinction is an important one. Harmonised standards are based on a specific remit from the Commission; they are thus strictly defined both in regard to the procedure and contents. Only harmonised standards are linked with a CE mark. As such, they must fulfil certain basic conditions, namely:

☐ Relate to a *New Approach Directive*
☐ Base themselves on its *Essential Requirements*
☐ As amplified by an *Interpretative Document*
☐ Which is then translated into a formal Commission *Mandate* to CENELEC or CEN.

For each directive, the New Approach has created its own administrative nexus. At the head is the Standing Committee, consisting of two members from each country, accompanied by experts and chaired by a Commission representative. This committee is charged with preparing Interpretative Documents (IDs), one for each of the essential Requirements in the Directive· thus the ID represents the bridge between the Essential Requirements and the resultant standard. Its importance cannot be overstated(it is one this document that the final EC mandate to the standards body is based. Mandates have to be strictly followed; whatever is not explicitly stated cannot be included in the standard. Mandates in turn serve as the basis for either a harmonised European Standard or the guidelines for European Technical Approval (ETA).

It is these harmonised standards, under a direct EC remit in response to a directive, which are given priority today. In return, theEC provides some funding for the Secretariats of the appropriat Technical Committees.

The New Approach Directives

To date, six New Approach Directives have been adopted and five more are in draft form. Together they will give rise to hundreds of new standards (or alternatively entail a prescribed certification stream), The very first such Directive — on Toy Safety — has already come into force in January 1990. thes New Approach Directives are listed in Table 1.

Table 1
New Approach Directives

Subject	Adopted	Effective From
Toy Safety	5/88	1/90
Simple Pressure Vessels	6/87	7/90
Construction Products	12/88	6/91
Electromagnetic Compatability	5/89	1/92
Machinery Safety	6/89	12/92
Personal Protective Equipment	12/89	7/92

The Construction Products Directive (CPD)

The Construction Products Directive — the third to be adopted and to come into effect in June 1991 — has the most direct bearing on coatings. Its aim is to ensure the free circulation of building materials throughout the Community provided they satisfy certain essential technical requirements. Products can satisfy the Essential Requirements in two ways; either by being produced in accordance with a harmonised standard or by technical approval. Such products, which bear the CE mark, cannot be excluded from a national market by legislative means. It is thought that most coatings, in the absence of harmonised standards, would qualify via the approval route. Alternatively, coatings may be declared marginal products and thus be exempt.

Standards under the New Approach revolve around the Essential Requirements in a directive. For the CPD they are shown in Table 2.

Table 2
Essential requirements of the construction products directive

1. **Mechanical resistance and stability**
2. **Safety in case of fire**
3. **Hygiene, health and environment**
4. **Safety in use**
5. **Protection against noise**
6. **Energy economy and heat retention**

These six requirements are expected to give rise to dozens of standards. Interpretative documents were to be drafted by the end of June 1990.

Only the second and third Essential Requirements have a possible bearing on coatings. Intumescent and fire-retardant paints may enter into the second and toxic emissions into the third requirement. For instance, the latter states a "construction work must be designed and built in such a way that it will not be a threat to the hygiene or health of the occupants or neighbours, in particular as a result of any of the following:

☐ The giving off of toxic gas
☐ The presence of dangerous particles or gases in the air"[4].

The draft Interpretative document includes formaldehyde, asbestos fibres, pentachlorophenol, lindane, VOCs, etc., among the listed pollutants in building materials; these could occur in paints, varnishes, wood preservatives, adhesives, sealants, coatings for masonry, etc.

The role of coatings in the CPD remains to be resolved. They could be classified as 'marginal' as distinct from 'critical' products. Much depends on their actual use. They may be marginal in some instances, but critical in others. To date (June 1990), a definitive list of such products has not yet been drawn up. Marginal products will not require the CE-mark and thus be exempt from conformity to standards or technical approval, except on a voluntary basis.

By the spring of 1990, drafts of Interpretative Documents on each of the six Essential Requirements were in various stages of preparation. Views were solicited from industry representatives in a series of seminars organised by the BRE/DOE. A number of potential problems have already appeared as a result of these discussions. The Essential Requirements relate to *buildings* (works) and not to products and it is the task of the IDs to relate these building requirements to the performance of products. Building regulations are enshrined in national law, yet no attempt will be made to harmonise them. Different levels of performance due to climatic conditions will be recognised. However, it seems that the Essential Requirements in the CPD apply to a quite narrow area: only to products that are *regulated* and *traded*. Thus if a country makes no formal rules, no legal obstacle to market access can be said to exist. Similarly, if a manufacturer does not intend to export his product, he need not bother about a CE mark; that he may still wish to for domestic business reasons is another matter.

Other New Approach Directives

The mandatory nature of these New Approach Directives varies with the type of product and the degree of risk involved. Where a distinct health and safety issue is involved — such as with machinery safety or toys — failure to comply with the requirements becomes a criminal offence. In both these cases the CE mark is obligatory; in others, where free circulation is the primary objective, goods bearing the CE mark may not be excluded from the market by legislation, but no legal penalties accrue from not displaying the CE mark.

1. Toy Safety

The Toy Safety Directive is one where compliance is obligatory; it also has considerable bearing on paint. It was the second of the New Approach Directives to be adopted (back in May 1988), but the first to come into force (on January 1, 1990). Its implementation is via the Toy (Safety) Regulations 1989 (SI 1989/1275); the relevent standard is BS 5665, which is a transposition of the harmonised European Standard EN 71. Three parts, dealing with mechanical and physical properties, flammability and toxicity have been published so far; further parts, on chemical toys and other chemical properties, are in preparation.

Every toy *must* bear the CE mark. To supply a toy which does not satisfy the essential safety requirements and does not carry the CE mark is an offence, punishable by up to 6 months in prison and/or a fine of up to £2,000. The method of obtaining the CE mark varies from directive to directive. In the case of toys, there are two ways of meeting the essential requirements: (a) manufacture to the relevant national (i.e. European) standards or (b) manufacture to a model for which there is an EC type-examination certificate. The first method can be used only where standards cover *all* the essential safety requirements applicable to that toy; otherwise the second method *must* be employed[5].

Altogether there are six specific requirements, relating to

- ☐ Physical and mechanical properties
- ☐ Flammability
- ☐ Chemical properties
- ☐ Electrical properties
- ☐ Hygiene and
- ☐ Radioactivity

Of these, the chemical properties are of immediate interest to the paint industry, Accordingly, the bio-availability of certain metals (viz. the soluble extract having toxicological significance) should not exceed the following daily doses (in micrograms): antimony 0.2, Arsenic 0.1, barium 25.0, cadmium 0.6, chromium 0.3, lead 0.7, mercury 0.5, selenium 5.0, Part 3 of BS 5665 states the limits of element migration from coatings as follows (in mg/kg): antimony 60, arsenic 25, barium 500, cadmium 75, chromium 60, lead 90, mercury 60 and selenium 500. However, some uncertainty has arisen regarding these limits on account of the standard deviation data.

2. Personal Protective Equipment (PPE)

PPE is a good example of the convergence of two areas of concern: safety and barriers to trade. This has given rise to two separate Personal Protective Equipment Directives, one based on Article 100A of the Single European Act dealing with the free movement of goods, the other on article 118A on Health & Safety; both were adopted in 1989. Thus Directive 89/656, based on Article 118A, relates mainly to the *use* of PPE (covering employees' obligations, assessment, choice, etc.). In contrast, Directive 89/686, referring to Article 100A, touches on its barriers to trade implications, by aiming at harmonisation. Harmonisation is to be achieved by the CE mark, via standards or technical approval, based on the Essential Requirements set out in the Directive. Products meeting these requirements can carry the CE mark and therefore be sold anywhere in the Community. PPE covers a wide range of products from life jackets to face masks. There are expected to be over 100 European Standards in this area; some — including at least 10 on respiratory devices — have already appeared.

And coatings:

Many other European standards impinge on the coatings industry in one way or another. This includes standards on:

- ☐ Analysis and Testing
- ☐ Spray painting equipment
- ☐ Flashpoint and combustibility
- ☐ Fire testing
- ☐ Wood preservation
- ☐ Packaging and others

European standards are being developed in all these areas. those in wood preservation are particularly plentiful. Progress is also under way on a European standard on masonry paint and wood finishes. These, however, are not *mandated* (harmonised) standards in the strict sense of the New Approach. Nonetheless, they will have the benefit of full transposition — that is, they will appear as dual-numbered British Standards.

Some problem areas

Standards, it has been suggested, will make or break Europe. Much of the completion of the Single Market will hinge on them. Are they going to make it?

The hurdles are immense. Some arise from the process of standardisation, others from the Directives themselves. Unrealistic time scales, limited resources and technical disagreements are also casting big shadows. These problems may be summarised under the following headings:

- ☐ Short time scales
- ☐ Heavy work load
- ☐ Technical complexities
- ☐ National divergences
- ☐ Limitations in Directives
- ☐ Differences in interpretation
- ☐ Patchy coverage
- ☐ Paper solutions

The shortcomings inherent in the standardisation process are easy to see. There are simply far too many standards to be drafted in too short a time. Even under the New Approach — with its 2,500 priority standards instead of the 4,000 originally envisaged[6] — the work load on the committees in an essentially voluntary set-up is far too heavy. The formalised procedure of the New Approach — and the

Continued on p.331

High-solids/high-performance industrial coatings
A market overview of Western Europe and USA

by M. von Dungen, The CHEMARK Consulting Group, Beethovenstraβe 7B, 6000 Frankfurt am Main 1, West Germany

CHEMARK is a leading consultancy group which specializes in studying the technological and market changes occurring in the coatings industry, worldwide, and reporting on the industrial coatings demand trends.

One of CHEMARK's recent projects consisted of exploring the market demand for high solids industrial and high performance protective coatings in two major industrialized regions of the world, namely Western Europe and the United States. This paper focuses on a comparison of the high solids coating technology usage and growth trends in these two specific regions; it will review the technology's end-use markets, its resins demand; it will also provide an outlook for growth products and markets and address some of the technological challenges.

A major cause for the development of high solids technology in the 1970's and 1980's were the environmental protection mandates aiming at reducing the amount of photochemically reactive solvents emitted into the ambient air.

The market penetration of the technology has been facilitated by the fact that many users see this technology as an evolution of the conventional low solids solvent borne systems.

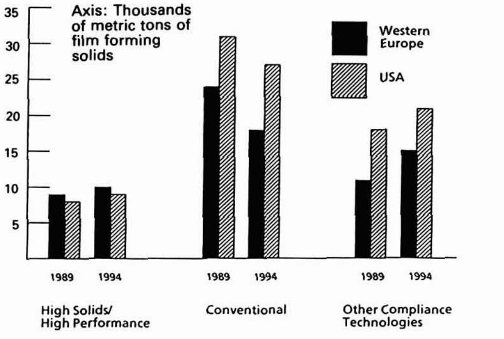
A rather peculiar aspect of the high solids technology usage in industrial coating applications is the difference in solids content, which can vary markedly from end use to end use. CHEMARK arbitrarily sets a minimum of 60% volume solids to define high solids coatings; however, the solids content observed in industrial coatings applications ranges more or less from 45% to 95%!

At present, the usage of high solids technology accounts for nearly 20% of the total Western European demand for industrial and high performance protective coatings (Figure 1). In the United States, on the other hand, the technology controls a smaller share of the same end-use markets, namely 13%. In terms of tonnage consumption, the high solids, high-performance protective coatings consumption also appears to be larger in Western Europe, by about 15%.

Figure 2 depicts the significance of high solids and high performance protective coatings relative to the total industrial coatings market in the two industrialized regions of the world analyzed.

At the same time, distinction has been made between conventional low solids systems which account for about 55-60%, high solids representing about 17%, and other compliance systems such as powder coatings, water borne coatings and radiation curing systems which collectively control about 25%. In both regions, high solids and high-performance protective coatings are growing nearly 6% annually, which is about three times faster than the average growth of the industrial coatings market. During the next few years, the demand growth for high solids will largely be stimulated by the substitution of conventional low solids coatings.

Figure 1
High solids/high performance technology share of the industrial coatings market



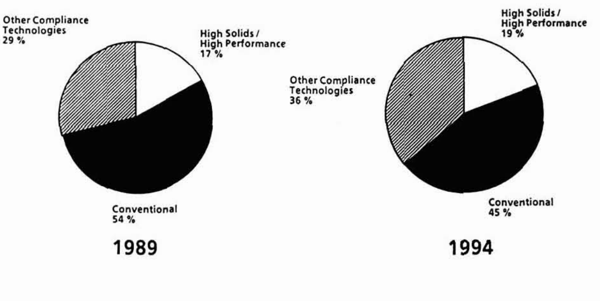
End Uses

The usage of high solids coatings is widely spread over a variety of industrial OEM and protective applications (Table 1). Here is a description of all industrial coating end-use markets, as defined by CHEMARK.

This market can be subdivided into five sectors:

□ *Wood:* wood finishing represents a significant sector accounting for about 20% of the industrial coating demand in

Figure 2
High solids/high performance technology share of the industrial coatings market (Western Europe + USA Combined)



Western Europe. The major segments consist of:
▷ wood furniture and fixtures
▷ flatstock (i.e., wood derived boards, wall panels, parquet floors).
□ *General Metals:* is another large group of end uses generating sizeable demand for conventional industrial coatings. Those, however, are gradually being replaced by compliance coatings.

Typical market segments are:
▷ metal furniture and fixtures
▷ household appliances
▷ heating and air conditioning equipment
▷ machinery
▷ custom coaters.
□ *Transportation:* this sector covers OEM and refinish primers and finishes applied to:
▷ vehicles and vehicle components
▷ aircrafts
▷ rolling stock.
□ *Specialty Metals:* represents specialized end uses such as:
▷ can coatings
▷ coil coatings
▷ pipe coatings
▷ electrical insulation coatings.
□ *Special Substrates:* include non-metal supports such as paper and paperboard and plastic (rigid and flexible).
□ *High-Performance Protective and Maintenance Coatings:* this is a special market sector devoted to the corrosion protection and maintenance of industrial plants and State structures. This sector also includes new construction and maintenance coatings for marine and offshore structures.

Table 1
Industrial coating end-use markets

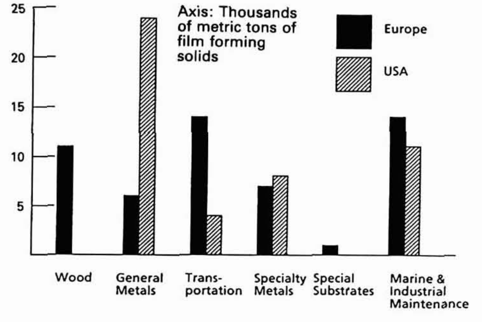
Wood
○ wood furniture and fixtures
○ millwork
○ flatstock (i.e., wood derived boards, wall panels, parquet floors)
General Metals
○ metal furniture and fixtures
○ household appliances
○ heating and air conditioning equipment
○ machinery
○ custom coaters
Transportation
○ vehicles and vehicle components
○ aircraft
○ rolling stock
Speciality Metals
○ can coatings
○ coil coatings
○ pipe coatings
○ electrical insulation coatings
Special Substrates
○ paper/paperboard
○ plastic (rigid and flexible)
High-Performance Protective and Maintenance Coatings
○ industrial new construction
○ industrial maintenance
○ structural steel
○ industrial concrete floors, masonry and cement blocks
○ marine and offshore new construction
○ marine and offshore maintenance

High solids coatings demand

As mentioned before, industrial users tend to view high solids coatings as a natural technological evolution of the conventional low solids solvent borne systems. Developments in polymer chemistry and in coating application processes have facilitated the gradual increase in coatings' solids content. At the same time, some of the end uses have provided particularly favourable circumstances for using high solids technology such as coil coating and appliance coating.

Interestingly, the usage of the technology was found to differ significantly in the two regional markets investigated. Figure 3 illustrates the high solids demand that the various industrial coatings market sectors generate. This illustration also brings to evidence the different end-use orientation of the technology.

Figure 3
High solids/high performance coatings usage comparison Western Europe – USA (1989)



Wood finishing represents one of the major end uses for high solids technology in Western Europe, whereas the demand for this type of product is practically *nonexistent* in the United States. The type of high solids coatings involved consist of high-solids unsaturated polyester and 2-part polyurethane systems. In Western Europe, the usage of this technology is particularly prevalent in Italy.

General metals is one of the largest end-use sectors for high solids in the United States...controlling about 40% of the technology usage. In Western Europe, this sector tends to use other technologies and ranks fourth only among the five industrial coating sectors as far as demand for high solids is concerned. Household appliances represent a significant end-use for high solids in the two regions considered. The coating systems concerned are acrylics for the most part. Other important end uses are machinery and equipment as well as the user group comprising custom coaters and metal fabricators.

In the *transportation sector,* automotive applications generate most of the demand for high solids coatings. In Europe, this demand primarily consists of OEM and refinish primers and primer surfacers (polyester systems); in the United States, high solids formulations largely find use in finishes for commercial vehicles and automotive components. These applications should remain the areas of strong potential for high solids. Potential demand also exists in automobile topcoats, however the solids content of such coatings qualifies as medium solids rather than high solids since, at present, the average high solids content achieved lies below 60%.

The *specialty metal* end uses that currently consume high solids coatings are vinyl plastisols and organosols in can and coil coatings. Pipes is another specialty application which uses high solids, high performance protective coatings.

The Printing Ink Manual

Announcing the 4th edition of a unique and authoritative reference book.

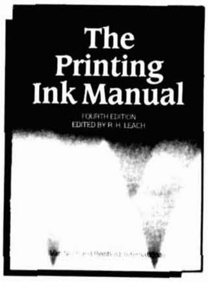
Published 1988

896 Pages

Hardback £50.00

Completely updated and revised, the new material includes:

- **Colour** — The current state of the art on computer-assisted colour matching and colour control.
- **Raw Materials** — this section is completely re-written to reflect the current situation and future trends.
- **Inks** — includes a detailed survey on inks for impactless printing and enlarged chapters on lithographic and flexographic inks.
- **Radiation Curable Systems** — discusses the latest developments in this exciting field.
- **Quality Assurance** — a chapter of essential reading on the testing and rheology of printing inks.
- **Manufacture of Inks and Varnishes** — assesses the latest trends in the manufacture for the different printing processes.
- **Health, Safety and the Environment** — a totally new chapter which surveys legislation, regulations and trends on a world wide basis.



ORDER FORM

Please send me .... copy/ies of **The Printing Ink Manual 4th Edition** at £50 (post free for UK, plus £5.00 (surface mail) and £10.00 (airmail) for overseas postage)

I enclose a cheque made payable to OCCA for

£

Name

Address

Send to: OCCA, Priory House, 967 Harlow Road, Wembley, Middlesex HA0 2SF

An essential source of reference for the printing industry.

Produced on behalf of the Society of Printing Ink Manufacturers.

▲ Editor in Chief: Dr Robert Leach, formerly technical production director of Fishburn Printing Ink Company Ltd.

▲ An Editorial board of top technical directors in the industry.

▲ Contributing authors who are all specialists in their respective fields.

OCCA BOOK SERVICES

Paint and Surface Coatings

Theory and Practice

Edited by R. LAMBOURNE, Technical Manager, INDCOLLAG (Industrial Colloid Advisory Group), Department of Physical Chemistry, University of Bristol.

696 pages; Published 1987; £84.30 (plus p&p UK £2; overseas £4 ASP, £7 airmail).

CONTRIBUTORS

D A Ansdell, Technical Manager, Automotive Products*
J Bentley, Senior Scientist, Research Department*
T R Bullett, Retired Formerly Research Director, Paint Research Association, Teddington, Middx
A Doroszkowski, Research Department*
F K Farkas, Consultant, FKF & Associates
J A Graystone, Technical Manager, Research Department*
R A Jeffs, Retired Formerly with Research Department*
W Jones, Research Department*
R Lambourne, University of Bristol
A H Mawby, Director, Refinish Marketing, PPG Industries (UK) Ltd, Ladywood, Birmingham
Miss J F Rolinson, European Technical Manager for Products and Materials*
T A Strivens, Senior Scientist, Research Department*
G P A Turner, Technical Manager, Industrial Coatings Research*

* ICI Paints Division, Slough

CONTENTS: Paint Composition and Applications—A General Introduction; Organic Film Formers; Pigments for Paints; Solvents, Thinners and Diluents; Additives for Paint; The Physical Chemistry of Dispersions; Particle Size and Size Measurement; The Industrial Paint Making Process; Coatings for Buildings; Automotive Paints; Automotive Refinish Paints; General Industrial Paints; An Introduction to Rheology; The Rheology of Paints; Mechanical Properties of Paints and Coatings; Appearance Qualities of Paint—Basic Concepts; Specification and Control of Appearance; Durability Testing.

Orders can be sent to the association by completing the form below and by **Prepayment** only

ORDER FORM

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

Please supply . . . . copy(ies) of **Paint and Surface Coatings** at £. . . . £84.30 per copy (plus p&p UK £2; overseas £4 ASP, £7 airmail).

Cheques must be made payable to OCCA — Post with remittance to the above address

Name..........

Address..........

....

....

Telephone..........

CAPRICORN CHEMICALS

SPECIALITY PRODUCTS FOR THE SURFACE COATINGS INDUSTRY

LANCO WAX

micronised and classified waxes, easily dispersed by high speed stirring, in most cases

LANCO GLIDD

wax dispersions for maximum convenience

LANCO BEIT

pigment concentrates for solvent based paints

LANCO ADDITIVES

a comprehensive range of problem solvers

FLARE DAYLIGHT FLUORESCENT COLOURS

ranges available to meet the technical requirements of the paint, printing ink and plastics processing industries

DO IT WITH FLARE

Capricorn Chemicals Ltd
Lisle Lane, Ely, Cambs CB7 4AS
Tel: 0353 664974, Telex: 818718 CAPELY
Fax: 0353 664623

Enter H203 on Reader Reply Card

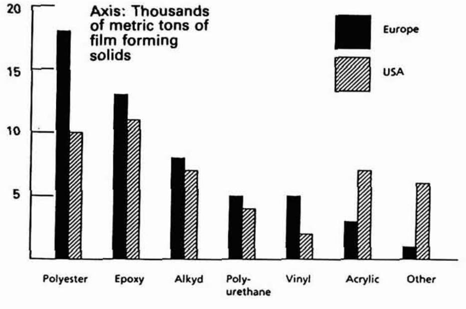
As far as *special substrates* are concerned, paper and plastic finishing represents the smallest end-use sector for high solids technology. (Opportunities should largely exist in the area of rigid plastic substrate coating.)

High-performance protective coatings make the most significant use of high solids formulations. These largely consist of corrosion protective coatings applied onto industrial plants and equipment plus various structures such as bridges and facilities for power generation and distribution. In this sector also, the average solids content tends to be high, in the range of 75 to 95%. The systems used are largely epoxy-and polyurethane-based. This sector should continue generating sizeable demand for high-performance, high-solids coating systems.

Resin species

Six major resin classes serve as base for most industrial coatings high solids formulations; the resin usage pattern does not differ greatly in the two regions considered (Figure 4). In both regions, polyester, epoxy, and alkyds are the prevalent resin species for high solids technology.

Figure 4
High solids/high performance coatings resin usage comparison Western Europe – USA (1989)



Polyester resins, in particular the unsaturated types, are used in significant amounts in wood finishes and automotive primer surfacers in Western Europe, whereas they are used extensively in the general metals sector in the United States.

Automotive primers in Western Europe, plus the general metals sector in both regions generate most of the demand for high solids alkyds.

Epoxy and polyurethane resins find significant use in high-performance protective systems, especially for heavy-duty corrosion protection. As far as the high solids polyurethane demand is concerned, the popularity of wood finishes based upon this 2-part high solids technology is increasing rapidly in Western Europe.

High solids vinyl formulations largely consist of vinyl plastisols and organosols used in coil and can coatings, respectively. They represent speciality metals applications, which, in the case of plastisols, are rather geographically focused in Western Europe; they prevail in Northern Europe.

High solids acrylics find major use in appliance coatings, which represents a relatively sizeable demand, particularly in Western Europe. As mentioned earlier, this success is largely due to the improvements in application methods, which facilitated the gradual increase in the solids content.

Growth products and markets

Like other modern coating technologies, high solids technology, for the most part, experiences high growth in very specific end uses and formulations.

The market areas providing most opportunities for high solids technology usage consist of the following sectors:
▷ transportation,
▷ general metals,
▷ high-performance protective coatings.

The types of formulations exhibiting the highest demand growth rates are based on the following resin species:
▷ polyester,
▷ alkyd,
▷ polyurethane,
▷ epoxy.

In Western Europe, about one third of the high solids, high-performance industrial coatings market is growing at a double digit annual rate, which is twice the rate of growth of the technology as a whole. This growth largely involves the end-use sectors and resin species mentioned before.

In the United States, interestingly, only about 10% of the high solids demand is growing twice as fast as the technology average growth rate.

High-solids coating application processes

A few words to describe the way high solids coatings are applied. In both regions investigated, non-electrostatic spray application methods prevail, although a variety of other application techniques are also in use. While some high solids coatings can be applied with traditional manual and electrostatic application equipment, most high solids coatings require a change in application method or the installation of more modern application equipment. Electrostatic spray and high speed rotation discs and bells represent the more modern methods which are particularly appropriate for the application of high solids.

Technical challenges

Although high-solids technology has been in use for many years, it is still facing a number of technical challenges, which have yet to be overcome.

Viscosity represents a major challenge. The higher the coating's solids content the thicker the viscosity tends to be, which makes coating spray application difficult.

Solvent/Curing Issues: The reduction of solvent usage offers significant advantages as far as safety and economics are concerned. On the other hand, solvent usage reduction leads to increased viscosity, thus flow problems, and slower drying of the coating films. The resulting film tackiness increases the risk of dust and dirt contamination as well as finish defects.

High solids coatings have a smaller "cure window" than conventional coating systems which requires improved management of time, temperature, humidity and cleanliness in the curing stage of the production line.

Film Characteristics: High solids films usually offer excellent chemical and corrosion resistance. They can be applied as high gloss and high build, thick films, which permits the application of one coat only, representing labor savings. Relative low shrinkage provides good edge covering properties. Current shortcomings include air entrapment and solvent popping, the influence of viscosity changes over film thickness control, wetting problems due to high surface tension, low mar and abrasion resistance, and orange peel effect.

Application Issues: The application of high solids/high performance coatings differs significantly from that of conventional low solids systems; however, changing over to the application of high solids systems is easier in many instances than changing over to other compliance coatings. The fact that these coating systems can be applied as one high build coat, plus their relative low sensitivity to temperature and humidity give them an additional competitive edge over other compliance technologies such as water borne coatings for example.

A challenge associated with the application of high solids systems is that of fluid and viscosity handling, different application quality criteria and overspray; the latter is a significant cost factor in the case of high solids and creates additional booth maintenance problems.

Achieving a smooth thin film and uniform film thickness are rather difficult. Other challenges include recoating and repair of high solids coatings. All these problems can be caused by the differences in application equipment requirements, tighter control of paint and paint booth conditions, and the need for more expensive operator training. There is hope, however, that advances in formulative chemistry and in application equipment will eventually minimize these difficulties.

Conclusions

To conclude this market overview of high solids/high-performance protective coatings, the situation can be summarized as follows:

Despite the existing shortcomings of the technology, many industrial coatings users appear to be more familiar and at ease with this technology than with other competing compliance systems (i.e., water borne coatings, powder coatings, radiation curing systems). High solids are frequently viewed as a logical outgrowth of conventional coating technology and a "low cost" solution to their compliance problems. The systems also offer the advantage of a broad colour spectrum availability and low sensitivity to ambient conditions.

The technology has existed for many years and has gradually grown to represent a significant competitive factor in the industrial coating marketplace. The demand will continue increasing as compliance mandates become more stringent, especially in Western Europe. High Solids demand will also be stimulated by further developments in polymer chemistry and application processes. The continued growth of the demand for high solids and high performance protective industrial coatings, however, is anticipated to remain strongly related to specific industrial end uses because of strong competition from other compliance technologies. ■

Based on paper presented to PRA Conference — High Coatings, Frankfurt, Germany, October 1989.

DTI, Continued on p.323

If you do see the single market as an opportunity to start selling, or to increase existing sales in other countries of the Community, then the services available under DTI's Export Initiative could be an invaluable source of advice and practical help. Most of the services are aimed specifically at small to medium-sized businesses, particularly those new to or inexperienced in exporting.

When it comes to the single market, there is no shortage of information, advice and practical help available from a wide range of sources. This article has highlighted what is available from DTI. But your first or next step may be to have a chat with your accountant, bank manager or solicitor. And try your trade association, chamber of commerce, local enterprise agency or local business club. It is to be hoped that the list of such organisations will encourage firms to make greater use of the single market services already available and encourage the organisations themselves to develop further their range of help and advice. All concerned will benefit; members, clients and the organisations themselves.

We are all in the single market. It's here now. ■

Jotischky, H, Continued on p.326

necessity to get things right at the Interpretative Document stage — tends to lengthen the process even before any actual drafting work has begun. Nor should one forget the many technical problems, either at the Interpretative Document or the later technical committee stage. Some arise out of genuine technical uncertainties, others from differing national points of view. There are calculations to be made and divergent national attitudes to be reconciled. Thus the old bottle-neck is still there; it has merely been moved down the line.

Other problems arise from the nature of the Directives, or more specifically their Essential Requirements. Take the CPD. Some of its limitations, e.g., in applying to works not products, are becoming apparent only now. Nothing will be done to harmonise divergent national building regulations. A too narrow interpretation of harmonisation will not serve the cause well.

Patchy coverage is another enemy of the Single Market. Given the time scale and the work load involved, the danger of an *uneven* standards coverage is a real one. In the transitional period at least a multiplicity of standards will persist. In procurement, for instance, the absence of European or International Standards forces one to fall back on national standards. This gives the semblance of harmonisation without the reality.

In fact, the illusion of a Single Market is the greatest danger of all. Will not the paper mountain of standards and directives result in mere paper solutions? For some products — requiring a high degree of safety, such as toys — adherence to standards is obligatory, in most cases it is not. Nor does a CE mark automatically guarantee market entry. It merely means that no country can legislate against such goods. The EC commandment does not say 'Thou shall use European Standards,' but rather 'Thou shall not ban from the market a product that conforms to the essential Requirements of a Directive, as vouchsafed by a CE Mark.' No-one, not even the Commission, can actually force a customer to buy a properly certified product. Market economics and the force of preference or prejudice will still prevail; and herein lies the crux of the problem.

References

1. *BSI in Europe, No 8,* 2.
2. "The New Approach to Technical Harmonisation and Standards," DTI, 1989.
3. "XXIII Report of the Commission of the European Community", Office for Official Publications, Luxembourg, 1989, p.111.
4. "Annex I, the Construction Products Directive", A File Publication, London, 1989, p.30
5. "Toy Safety", Second ed, DTI, 1989.
6. "Financial Times", May 14, 1990, p.4. ■

Edited version of a paper presented at the PRA Symposium "Harmonisation of Standards and Regulations in Europe," Penta Hotel, Heathrow, 6-7 June 1990 and published with the kind persmission of the Paint Research Association.

The development of legislation on TBT antifoulants in the UK and Europe

by R. Abel, Toxic Substances Division, Department of the Environment, UK

This note is based on the abstract of a paper delivered at the seminar on Organotin Antifouling Compositions held at the General Council of British Shipping on 25 October 1989. The environmental problems caused by TBT and the evidence which led the French and UK Governments to take action are described more fully elsewhere[1,2,3].

In essence, the French recognised an association between growth problems of commercially produced Pacific oysters (*Crassostrea gigas*), the introduction of TBT-based yacht paints and high tin contents of affected oysters. Their response was to introduce a ban on the use of TBT on small boats in some areas in 1982, even though a cause-effect relationship had not been proved. This ban was later extended to the whole of the French coast. Oyster growth and the settlement of larval oysters improved in Archachon Bay following the ban, vindicating the Government's action.

By the beginning of 1985, oyster growth failures and shell deformities had also been seen in the UK and laboratory experiments by the Ministry of Agriculture, Fisheries and Food (MAFF) had established the role of TBT. Some TBT toxicity data were also becoming available for other species. It was recognised that problems were likely to occur wherever large numbers of small boats were concentrated in shallow enclosed waters with poor exchange. Monitoring results for 1982-84 showed high ambient concentrations, a reflection of the high leach rate of the paints and the slow degradation of the TBT, once released.

The Government decided that it was necessary to reduce water concentrations to safe levels and, in a consultation paper in February 1985, proposed restrictions which effectively would have banned TBT use on small boats except for those made of aluminium. There was, however, a very strong lobby against the proposals. While these offered no serious challenge to the scientific evidence on which the case for action was based, Ministers did not feel able to override the objections without stronger evidence of environmental damage. The paint industry were given time to develop alternatives and the Environment Minister announced a package of measures in July 1985. These included regulations on the retail sale of the most damaging paints; a voluntary notification scheme for new antifoulants; the preparation of guidelines for cleaning and repainting; the setting of an environmental quality target (EQT); and the development of a research and monitoring programme.

The first UK Regulations were introduced in January 1986 under the Control of Pollution Act (COPA). They prohibited the retail sale of copolymer paints containing more than 7.5% tin in the dry film. Non-copolymer paints could contain a maximum of 2.5%. This effectively banned the sale of free association paints based solely on TBT, considered to be potentially the most damaging. The Regulations were policed by Trading Standards Officers who were provided with lists of approved paints.

An EQT of 20 ng/l was established at the end of 1985. This was intended as a guide to what might be an acceptable level on the basis of the scientific evidence available at that time. It had no statutory basis, but served as a reference value for the monitoring programme.

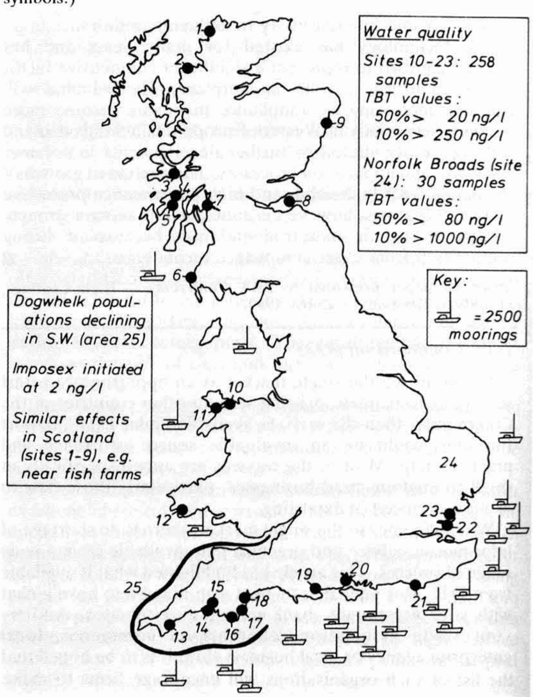
During 1986, water samples were collected by MAFF around the coast of England and Wales, concentrating on those areas with the highest densities of pleasure craft (see Figure 1). Samples were also taken in the freshwater Norfolk Broads. In the south-west of England, the Plymouth Marine Laboratory were monitoring water quality and investigating the effects of TBT on dogwhelks (*Nucella lapillus*) and their suitability as monitors of contamination. The Department of Agriculture and Fisheries for Scotland have relied heavily on dogwhelk monitoring to identify and discriminate between sources of TBT.

By the autumn of 1986 (see Figure 1) it was clear that the EQT was being exceeded in many places by wide margins[4] and that the Regulations had not led to marked decreases in concentrations. In addition, new problems were apparent including very high levels in freshwaters derived from pleasure boats[5] and high values near fish farms from the use of TBT net treatments[6]. Dogwhelk populations were shown to be declining in the south-west because TBT interfered with their reproductive systems[7] and similar effects were observed in Scotland[8]. These were initiated at perhaps 2 ng/l and, more generally, it was now clear[4] that there was no safety margin between environmental concentrations and those known to be toxic (see Figure 2).

January 1987 saw a revised COPA Regulation which lowered the allowable tin content of copolymers from 7.5% to 5.5%, but this was replaced in May 1987 by Regulations banning the retail sale of antifouling paints containing triorganotins and the sale of net treatments containing triorganotins[9]. These were augmented by the Control of Pesticides Regulations 1986[10] which applied to antifouling

Figure 1

The UK's 1986 monitoring programme for TBT. (1-6 Lochs Laxford, Ewe, Spelve, Crinan, Sween, Ryan; 7-8 Firths of Clyde, Forth; 9 Aberdeen; 10 Conwy; 11 Menai Strait; 12 Milford Haven; 13 Fal; 14 Tamar; 15 Plymouth; 16 Salcombe; 17 Dart; 18 Teign; 19 Poole Harbour; 20 Beaulieu; 21 Brighton; 22 Crouch; 23 Blackwater; 24 Norfolk Broads; 25 dogwhelk monitoring sites around south-west. Number of moorings on each section of coast indicated by yacht symbols.)



© Crown Copyright

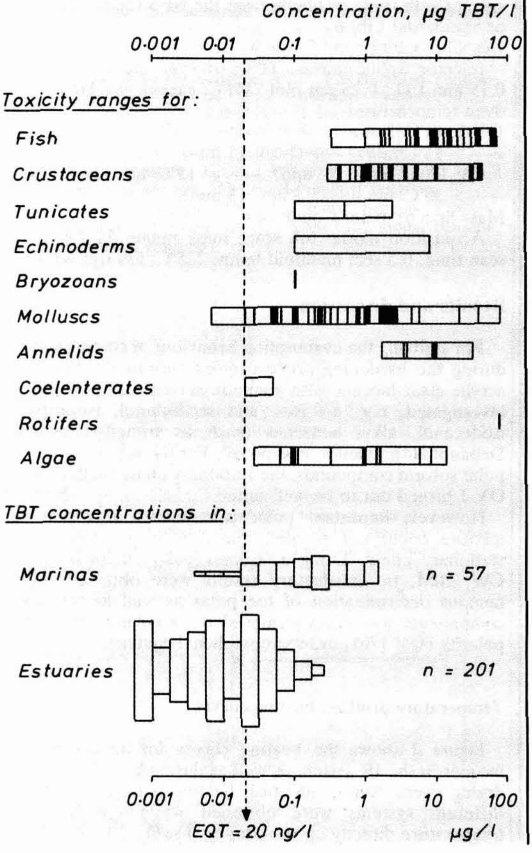
paints from 1 July 1987. They provide that no antifoulant can be advertised, sold, supplied, stored or used unless approved by Ministers.

On the advice of the Advisory Committee on Pesticides, paints containing triorganotins are not permitted for use on vessels under 25 metres or in mariculture. In addition, such paints may only be supplied, wholesale, in containers of 20 litres or more and must be labelled to show restricted use. The registration and approval of new antifoulants is administered by a technical secretariat in the Health and Safety Executive. Lists of approved paints for retail sale are regularly updated and supplied to Trading Standards Officers.

In the European Community, the Eighth Amendment to the Marketing and Use Directive (76/769/EEC) was adopted by the Council on 21 December 1989[11]. It contains provisions on antifouling paints which are very similar to the UK regulations except that they apply to organotins rather than simply triorganotins. They also prohibit the use of mercury and arsenic in any antifouling paint and UK approvals are already in line with this. The Directive must be implemented by all member states by June 1991.

Figure 2

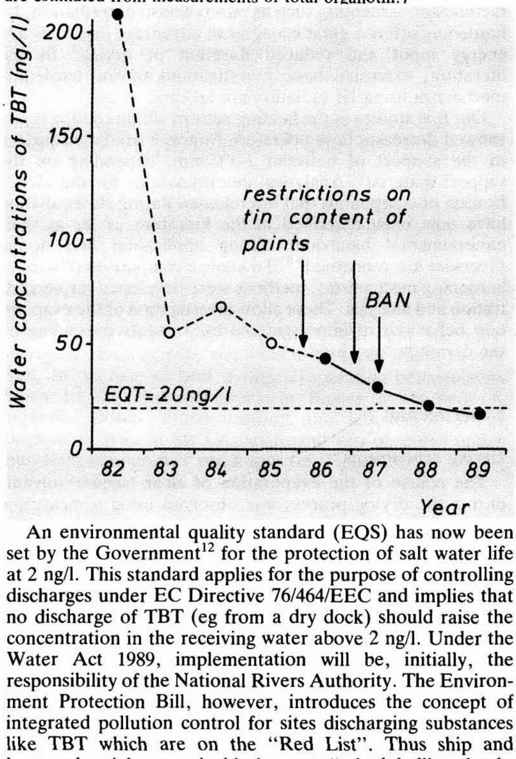
Comparison of the toxicity of TBT to marine organisms with the measured concentrations in 1986 and the environmental quality target (EQT). (For each group of organisms, the vertical lines in the boxes represent individual results of toxicity tests taken from the literature and reviewed in Reference 4. Solid areas represent several close or coincident results. The 258 water sample results are displayed as frequency distributions.)



Since the 1987 ban there have been substantial improvements in water quality in the UK (see Figure 3), particularly noticeable in marinas. Oyster farmers have been able to re-establish stocks in some areas which had been previously abandoned as rearing areas. There is still some way to go, however, before concentrations fall to levels which allow the recovery of dogwhelks, the most sensitive species.

Figure 3

Changes in water concentrations of TBT in the River Crouch at Burnham. (Values displayed are averages for each year for the months April to September. For 1983 to 1985, TBT concentrations are estimated from measurements of total organotin.)



An environmental quality standard (EQS) has now been set by the Government[12] for the protection of salt water life at 2 ng/l. This standard applies for the purpose of controlling discharges under EC Directive 76/464/EEC and implies that no discharge of TBT (eg from a dry dock) should raise the concentration in the receiving water above 2 ng/l. Under the Water Act 1989, implementation will be, initially, the responsibility of the National Rivers Authority. The Environment Protection Bill, however, introduces the concept of integrated pollution control for sites discharging substances like TBT which are on the "Red List". Thus ship and boatyards might conceivably become "scheduled" and subject to control by HMIP.

Inputs of TBT to estuaries from dry docks are potentially damaging and the Government has issued guidelines for the safe application and removal of antifouling paints[13]. These have been implemented to good effect by eg Devonport Management Ltd and the Ministry of Defence have also drawn up a draft code of practice for their own yards and for commercial yards carrying out work on naval vessels. Others will need to follow this lead to ensure compliance with the EQS.

On the basis of research carried out so far, large vessels in normal operation are thought not to contribute significantly to the general levels of TBT found in the marine environment[14]. A House of Lords Select Committee, however, has suggested that a ban on the use of TBT in antifouling paints is warranted for all marine applications.

Further research is being carried out by the Government and by industry to inform discussion of this point.

It seems clear that any action on large vessels would have to be taken in the international context and preliminary moves have already been made in this direction. The Paris Commis-

Continued on p.336

Analytical determination of the evaporation behaviour of coating solvents during IR irradiation and heat drying

by J. F. Rankl, M. Huber,* G. Grienberger* and G. Bonn*, Herberts GmbH., Wuppertal 2, FRG
* Institute for Radiochemistry, University of Innsbruck, Innrain 52a, A-6020 Innsbruck, Austria

Introduction

The hardening of coatings by means of IR radiation is already currently used[1,2]. In comparison with conventional methods of hardening, such as purely thermal irradiation, IR hardening offers a great economical advantage due to its low energy input and reduced duration of drying. In the literature, extensive basic investigations of the hardening mechanism using IR radiation are lacking.

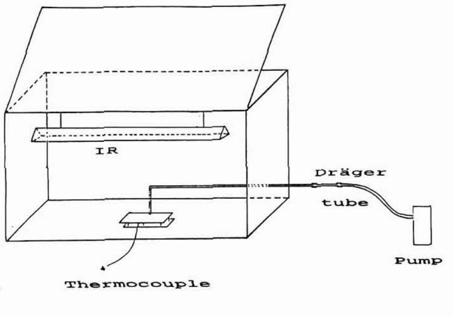
Our first studies of the heating pattern within coating layers showed decreases in temperature from the irradiated surface to the support of between 1-3°C/mm, depending on the support material[3]. Analytical determinations for the identification of compounds that are released during IR irradiation have only been described in the literature as far as their environmental behaviour during application and drying processes are concerned[4-6]. To allow a comparison of various hardening mechanisms, methods were developed for concentration and analysis. These allow investigation of the evaporation behaviour of important coating solvents depending on the drying process used.

Experimental

Drying experiments

The course of the evaporation of clear lacquer solvents during the drying process was observed using a measuring device allowing gas samples to be taken at given intervals (Figure 1). Withdrawal of the samples was performed by means of a glass tube installed just above the coating surface, a pump (COMPUR 4903, 75 ml/min), and a Draeger tube (activated carbon type B), by which all substances emitted from the coating are absorbed. Following CS_2 elution, the analytical determination was carried out by means of gas chromatography/mass spectrometry (GC/MS). Drying of the 60 µm lacquer was effected either in the IR radiator or in a drying oven. In all cases the lacquer (i.e. MS acryl clear lacquer), the coating thickness, and the measuring conditions were the same. The distance between the sample tube (glass, 7 mm i.d.) and the coating surface was 1 cm. The temperature during irradiation was continuously registered, using a thermocouple. The IR oven (type CPC, SFB Spezialfilter und Anlagenbau GmbH & Co., Friolzheim, FRG) was preset to 600°C and preheated for approximately 1 hour. The distance between radiator and surface was 25 cm. Iron plates (7 x 15 x 0.1 cm), resting on three needles for heat insulation, were used as support. The drying oven was preheated to 150°C.

Figure 1
Measuring device for IR drying



Analytical procedures

The analysis method for HRGC/FID-MS was carried out using three capillary columns of different polarity.

OV-1: 25 m x 0.32 mm I.D., 0.10 µm film, MEGA capillary columns Laboratory, Milano, Italy

OV-1701: 25 m x 0.20 mm I.D., 0.25 µm film, PIERCE Rockford, Ill., USA

CW-20M: 25 m x 0.32 mm I.D., 0.45 µm film, MEGA capillary columns Laboratory, Milano, Italy

The gas chromatographs used were a Carlo Erba HRGC 5160 MEGA SERIES and a CARLO ERBA GC 6000 VEGA SERIES, Milano, Italy; MS was a FINNIGAN MAT ION TRAP DETECTOR 700 (Bremen, FRG). Some of the peaks were identified by comparison of the acquired mass spectra with those available from the NBS (National Bureau of Standards) Library.

Gas Chromatography Conditions:

Injector: Split/Splitless, 260°C; transfer-line: DB-5, 1.2 m x 0.15 mm I.D., 0.25 µm film, 280°C; carrier gas: Helium 5.0; oven-temperature:

OV-1: 40°C (3 min) — > 10°C/min → 90°C ——> 15°C/min ——> 245°C (1 min)

OV-1701: 60°C (3 min) ——> 15°C/min ——> 200°C ——> 30°C/min ——> 250°C (3 min).

Mass Spectrometer Conditions:

Acquisition mode: full scan; mass range: 35–200 AMU; scan time: 0.5 sec; manifold temp: 225°C; library; NBS.

Results and discussion

For studying the evaporation behaviour of coating solvents during the hardening process under various conditions, an acrylic clear lacquer with common solvent composition was investigated, e.g. n-, iso-, and sec-butanol, isopropanol, isodecanol, alkyl benzenes (such as trimethyl benzene, Depanol N4), xylenes, and petrol. For the separation of low polar solvent compounds, the stationary phase methylsilicone OV-1 turned out to be well suited.

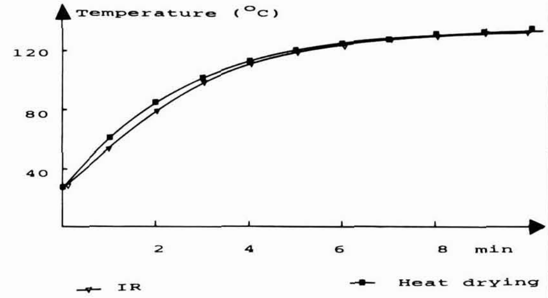
However, important polar components of the solvent mixture could not be determined with this very apolar stationary phase. Using a strongly polar stationary phase, CW, 20M, no satisfactory results were obtained. Simultaneous determination of the polar as well as the apolar components was easily achieved on a column of medium polarity (OV 1701, cyanopropylphenyl-coated).

Temperature profiles, heating curves

Figure 2 shows the heating curves for an acrylic clear lacquer in the IR system as well as during heat drying in the drying oven. Almost identical heating patterns of the two different systems were obtained when measuring the temperature directly on the coating layer.

Figure 2

Heating curves. Comparison of temperature vs. time for IR and thermal drying of an acrylic clear lacquer.



IR drying

The gas chromatogram of volatile solvent components after two minutes of IR irradiation, using the apolar stationary phase OV-1, is shown in Figure 3. Since this analytical system did not prove suitable for the quantitative determination of the alcohol components, the same eluent was combined with a medium polar phase (Figure 4). The components were identified by GC/MS. Studies of the evaporation behaviour as a function of IR irradiation time were subsequently carried out by means of GC/FID, following MS identification.

Figure 3

Total ion current chromatogram of alkyl benzenes – evaporated solvents/IR system

Heating time . . . 2 min, chromatographic conditions: apolar stationary phase OV-1 (see Experimental section). Peak identification: 0 . . . 1,4 Dimethyl benzene, 1 . . . 1,2 Dimethyl benzene, 2 . . . 1,3 Dimethyl benzene, 3 . . . Isopropyl benzene, 4 . . . n-Propyl benzene, 5 . . . Ethyl-methyl benzene, 6, . . . 1,2,3 Trimethyl benzene, 7 . . . Ethyl-methyl benzene, 8 . . . 1,3,5 Trimethyl benzene, 9 . . . 2 Methyl-propyl benzene, 10 . . . 1 Methyl-2-propyl benzene, 11 . . . Trimethyl-benzene, 12 . . . 2 Ethyl 1,4-dimethyl benzene, 13 . . . 2-Propenyl benzene, 14 . . . 1-Methyl-3-propyl benzene, 15 . . . Diethyl benzene, 16 . . . 2-Ethyl-1,4-dimethyl benzene, 17 . . . 1-Methyl-2-propyl benzene, 18,19 . . . Dimethyl benzene

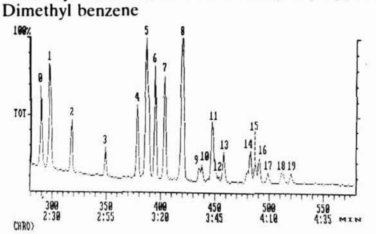


Figure 4

Total ion current chromatogram of alkyl benzenes and alcohols

Chromatographic conditions: medium polar stationary phase OV-1701 (see Experimental section). Peak identification: 1 . . . n-butanol, 2-20 . . . alkyl benzenes

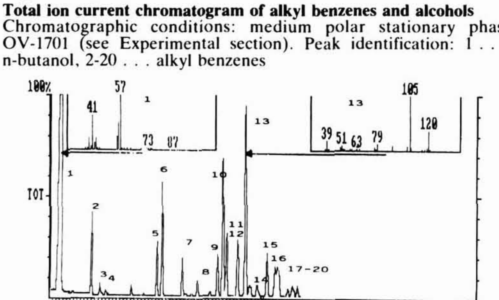
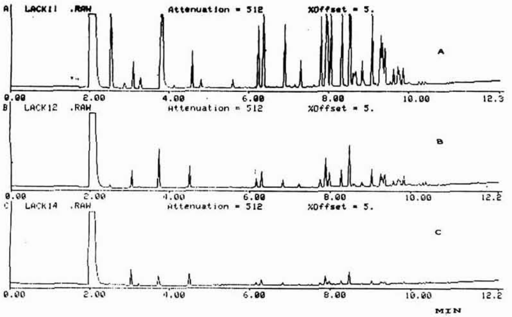


Figure 5 shows coating solvents released by IR drying and detected by GC/FID as a function of irradiation time at 2, 4 and 8 minutes.

Figure 5

Component pattern changes during IR drying

Gas chromatograms used in the quantitation of evaporated lacquer solvents from an IR drying system after A . . . 2 min, B . . . 4 min, C . . . 8 min. Chromatographic conditions: GC-FID, OV-1701, see Experimental section



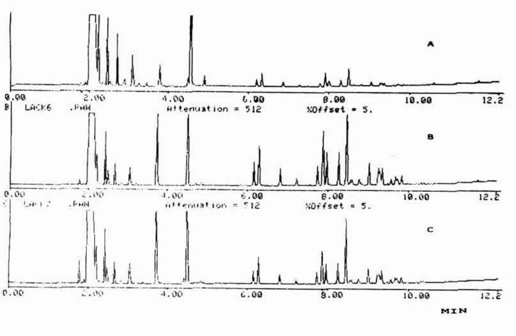
Heat drying

To compare both drying methods (IR and thermal), analogous investigations were made in a preheated drying oven. In the case of heat drying, evaporation behaviour as shown in the chromatograms in Figure 6 resulted. A markedly slower evaporation of the individual solvent components than in the IR experiment was observed under equivalent temperature conditions (cf. Figure 2).

Figure 6

Component pattern changes during thermal drying

Gas chromatograms used in the quantitation of evaporated lacquer solvents from drying oven after A . . . 2 min, B . . . 4 min, C . . . 10 min. Chromatographic conditions: GC-FID, OV-1701, see Experimental section



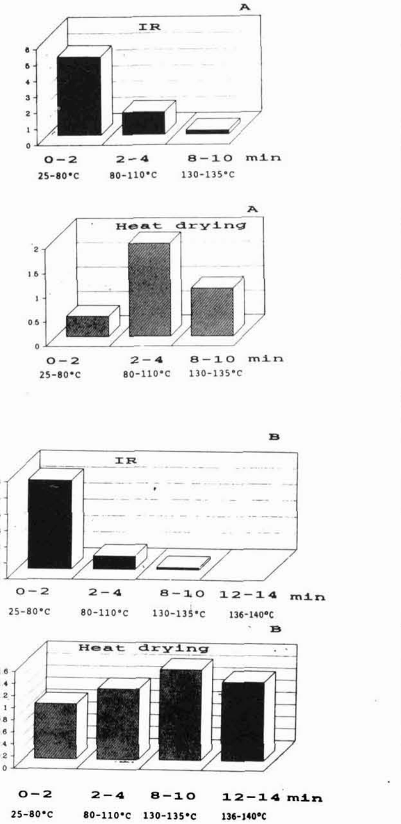
Comparison of IR and heat drying

In Figure 7 a,b, two components (A=1,2-dimethyl benzene, B=n-butanol) are given as an example for different evaporation behaviour in the IR system and in the drying oven. All other volatile solvents identified by GC/MS also showed an analogous difference in the evaporation kinetics. For an overall comparison of the data, the given values had to be standardized as regards gas volume and temperature.

In case of the IR system, the major part of the solvents left the coating within the first two minutes, whereas by heat drying the solvent emission maximum appears only after several minutes, although both support plates showed equivalent temperatures at corresponding times (cf. Figure 2). This behaviour can be explained by direct absorption of radiation by the solvents during IR drying, so that they leave the coating before the surface of the support plate has reached their respective boiling points. On the other hand, heat drying causes the solvent components to evaporate both on account of support heating and layer heating.

Figure 7

Comparison of the evaporation behaviour of lacquer solvents in IR and thermal drying systems: A . . . typical evaporation behaviour of alkyl benzenes (1,4-dimethyl benzene), B . . . n-butanol



The coatings treated in the IR radiator and the drying oven ceased to be adhesive after ten minutes. However, the surface of the coating dried in the drying oven appeared rather rough, while the coating hardened in the IR system was homogenously smooth and dense.

Up to now the diluent composition has been formulated according to the evaporation behaviour during heat drying in order to achieve high smoothness and brilliancy during the hardening phase.

The present results indicate that solvents evaporate considerably more quickly and differently when IR radiation is used. These investigations therefore allow the lacquer chemist to formulate new diluent systems for the respective lacquers. At the same time economic and environmental factors of the new compositions can be taken into account.

Acknowledgement

The authors would like to thank Prof. O. Bobleter and Dr. M. Breuker for helpful discussions.

Literature

1. Kirst, W., *Deutsche Farbenzeitschrift,* 1971, 39, 335.
2. Schnackig, A., *Farbe und Lack,* 1977, 83, 1061.
3. Rankl, J. F., Grienberger, G. and Bobleter, O, *Farbe und Lack,* 1989.
4. Sturies, F., *VDI-Nachrichten,* 1971, 25, 19.
5. Wenderdel, H. and Knappe, E. *Farbe und Lack,* 1976, 82, 1112.
6. Wenderdel, H. and Knappe, E., *Deutsche Farbenzeitschrift,* 1976, 30, 503. ■

Abel, R., Continued from p333

sion, who deal with pollution of the north-east Atlantic from land-based sources, have recommended that contracting parties should take effective action to eliminate pollution by TBT of the inshore areas of the convention waters. They have invited the International Maritime Organisation to consider the appropriateness of restricting the use of organotins on sea-going vessels. IMO took note at their September 1988 meeting and are expected to return to the issue at future meetings. In the meantime the Paris Commission have recommended[15] that procedures and technology should be developed for reducing emissions from dry docks and that the contracting parties should stimulate implementation of these measures. Progress in this area is likely to be important in determining the extent of future controls.

Acknowledgements

The views expressed are those of the author and do not necessarily reflect UK Government policy. Crown copyright and user rights are reserved.

References

1. Alzieu, C., Proc. Oceans 86 Organotin Symposium, Washington DC, 1986, 1130-1134.
2. Abel. R. et al., Proc. Oceans 86 Organotin Symposium, Washington DC, 1986, 1314-1323.
3. Abel, R. et al., Proc. Oceans 87 Int. Organotin Symposium, Halifax NS, 1987, 1314-1319.
4. Waldock, M. J. et al. Applied Organometallic Chemistry, 1987, **1,** 287-301.
5. Waite, M. . et al., Applied Organometallic Chemistry, 1989, **3,** 383-391.
6. Davies, I. M. et al., Proc. Oceans 87 Int. Organotin Symposium, Halifax NS 1477-1481.
7. Gibbs, P. E. et al., *J. Mar. Biol. Ass. UK,* 1987, **67,** 507-523.
8. Davies, I. M. et al., *Marine Pollution Bulletin,* 1987, **18,** 400-404.
9. The Control of Pollution (Anti-Fouling Paints and Treatment) Regulations 1987, Statutory Instrument 1987 No. 783, HMSO.
10. The Control of Pesticides Regulations 1986, Statutory Instrument 1986 No. 1510, HMSO.
11. Council Directive amending for the Eighth time Directive 76/769/EEC, OJ L398 (30 Dec. 1989), 19-24.
12. Department of the Environment/Welsh Office, Joint Circular 7/89 (DOE) 16/89 (WO), 1989, HMSO.
13. Department of the Environment, "Shipyards and the marine environment: guidelines for applying and removing antifouling paint", 1987, DOE leaflet.
14. Waldock, M. J. et al., Environmental Technology Letters, 1988, B9B, 999-1010.
15. Paris Commission, Tenth Annual Report, 1989. ■

Infra-red stoving of paint on plastic

by J. O'Connell, Electricity Association, 30 Millbank, London SW1P 4RD, UK

The installation rate of electric infra-red (IR) equipment continues to show a healthy, upward trend.

As the number of novel applications increases, it is clear that IR systems will continue to make a significant contribution to industrial efficiency and productivity.

Over the last five years the Electricity Industry has recorded approximately 500 successful projects each year involving infra-red heating for process use. Averaging 50kW per project one in three installations is utilized for general light industry, and one in six installations is used by each of the vehicles and metal manufacturing industries. The most common applications are for heat setting of coatings (63% of projects), non-metal heating (24% of projects), and heating for mechanical processes (7% of projects). A further 400 plastics heating projects averaging some 70kW each have been recorded yearly.

A growth in the number of powder coating projects reflects the growing awareness of the advantages of powder coating finishes. One-coat finishes can halve labour costs, can facilitate automation, and can be used where anti-pollution requirements are severe.

Changes in vehicle finishing technology have led vehicle manufacturers to use infra-red paint rectification ovens which have improved production rates and reduced costs.

The introduction of low-temperature thermosetting paints has brought the advantages of infra-red technology to vehicle repairers that were previously only available to vehicle manufacturers. These advantages include: finish quality, application speed and simplicity, compactness, and the absence of dust problems.

Parallel developments in plastics manufacture have led to materials offering ease of fabrication and that can be injection moulded into intricate shapes. They resist corrosion and offer savings in weight while reducing costs.

They are painted to provide suitable colour, gloss and texture, to hide surface defects such as injection points and flow lines, to protect the plastic from light and weathering, and to give a more abrasion and scratch resistant coating. Metallic paints are also used on some plastic components to protect electronic circuits from radio frequency interference. The most commonly painted plastics are; polyamide (nylon), glass fibre-reinforced plastics and polyurethane.

Stoving of painted plastics depends on the paint reaching its curing temperature before the plastic reaches its deformation temperature; successful stoving can be obtained with a temperature difference of only a few degrees between the paint curing temperature and the plastic deformation temperature.

Electric infra-red heating techniques have been widely adopted by industry primarily for their ability to reduce total production costs. Their ability to heat products rapidly to a pre-determined temperature reduces paint curing times and leads to significant savings in floor space. The equipment is cost-effective, easily installed, reliable in operation and needs little maintenance. Clean, safe and adaptable, electric infra-red ovens allow optimum factory layout and promote an efficient working environment.

As long ago as the 1930's, infra-red heating was used to cure enamelled car bodies. The only practicable emitter available at that time was the low-wattage carbon filament lamp, but even as limited as this system was it was sufficient to establish the value of IR systems in speeding production.

Today, industry rightly expects every kilowatt-hour to make a maximum contribution to production.

The notion that infra-red techniques are somewhat mysterious and difficult to apply still exists. This mystique is probably because the behaviour of product, when subjected to IR radiation, cannot always be readily predicted.

In the design of an IR oven for a particular application, estimates have to be made regarding the power density, the optimum wavelength, the residence time, and the emitter-to-product distance. These four parameters can be reliably established by sample testing with a multi-wavelength IR oven simulator to provide a practical starting point for a sound and efficient oven design.

Infra-red sample testing services are available throughgout the United Kingdom in the Electricity Companies and certain equipment suppliers. Long-, medium-, and short-wave radiation are provided from IR emitters, producing source temperatures of 700°C, 950°C and 2200°C, respectively. Most tests carried out for prospective customers show that electric infra-red heating is applicable to a very wide range of products and shapes, including solid three-dimensional objects. Savings in energy, space, and time are usually possible compared with existing forced-air ovens. Therefore, the decision to carry out heating trials with each new product is a prudent step.

The ability of an electric radiant oven to heat products rapidly is due to three main factors:

- The heat from the source is conveyed to the product by electromagnetic radiation in the appropriate waveband and does not rely on air circulation as a heat transfer medium. The heat rays can be transmitted through a vacuum if necessary. Correct choice of wavelength to match the absorption characteristics of the product optimizes the transfer of energy.
- The heat source usually runs at a much higher temperature than the product to be heated. (Heat transmission is proportional to the difference in the absolute temperatures to the fourth power, and is directly proportional to the surface area of the emitting source). Because an appreciable temperature differential normally exists between the IR emitter and the product, a high rate of heat transfer is constantly maintained. This fact is true even at the end of the heating cycle.
- The radiant heat can be directed at the product by reflectors, thereby intensifying the heat available.

Comparison with convection ovens

Dramatic reductions in heating time, oven size, and energy input can be achieved, compared with convection ovens. Irrespective of whether an IR oven is used for paint or powder curing, moisture evaporation, ink drying, or mass heating of plastics and metals, a ten-to-one reduction in oven residence time is typical. Savings in space are, therefore, very significant, and this potential can be further expanded by installing a lightweight IR oven above ground level (i.e., on a gantry or suspended from the roof).

Energy consumption for a given duty can be reduced to about a third or a quarter of the consumption of a convection oven, with the added advantage that the product will not be affected by air turbulence. This is important in certain paint and powder coating processes because the number of rejects caused by airborne dust in a convection oven can be greatly reduced or even eliminated.

The contra-flow principle

Infra-red radiant heating has always been popular for process heating and curing paint on flat or low-profiled materials with large surface areas in relation to their thickness. The recent development of the IR contra-flow oven enables the quick and successful heating of a wider range of composite objects of multiple cross-sections.

Developed by Process Equipment Development (PED) Ltd., the contra-flow corridor oven, makes efficient use of the hot air generated by the IR emitters. This is particularly important when using metal-sheathed elements operating in the range 650 to 750°C, since the heat output is fairly evenly divided between radiant and convective components. The air in intimate contact with the emitters becomes heated, creating convection currents. These would normally rise to the top of a corridor oven and escape to the ventilation hood through the conveyor track aperture. By using small low-velocity air blowers, the contraflow oven reverses this natural upward flow of hot air to give a downward air current over the work pieces.

Upon reaching the closed floor of the oven, the air is drawn in inside the cavity wall ducts and is returned in a downward direction from the top. The outer panels of the ducts are insulated to retain heat, while the inner panels, which are primarily reflectors, also provide heat to the air passing upward through the cavity. The inner panels are reflectors because they face the transverse radiation across the oven space from emitters mounted on the opposite wall of the oven. These air circulation patterns alternate along the whole length of the oven, causing a gentle swirling action so that, with suitable jigging, complex shapes are evenly heated.

This technique offers several important benefits, including an increase in thermal efficiency through the improved utilization and contribution of the hot air to heat the workpieces, and an equalizing effect on temperature differentials in the workpieces as they proceed along the conveyor, as is sometimes the case with purely radiant ovens.

The oven walls, therefore, can be moved inward on rollers. to provide a working gap sufficient for the free passage of aligned workpieces. This process increases the radiant energy transfer to the workpieces and also leads to higher air temperatures.

Contra-flow ovens are in constant demand by the paint and powder finishing industries, especially for curing complex metal components.

Where solvent-based paints are used, some venting to the atmosphere is, of course, necessary to maintain safe working conditions within the oven walls.

Matching IR and plastic characteristics

For most plastics infra-red wavelengths greater than 2μm are readily absorbed at the surface, and little penetrates below the surface layers. At wavelengths of less than 2μm the majority of the radiation penetrates deeply into the plastic and may be transmitted through it (Figure 1).

Addition of translucent colouring material causes little effect at wavelengths above 2μm but at shorter wavelengths the penetration depth is greatly reduced. Opaque pigments based on titania reduce depth of penetration for wavelengths of less than 3μm, as a consequence of scattering at the interface between the pigment and the base material.

For some plastic, such as polypropylene, spherulites are formed as the plastic is cooled through the crystalline temperature range. Rapid cooling produces a fine spherulite structure which appears visually transparent. Slow cooling delays crystallization between the spherulites, so the boundaries between them are less pronounced and cause less refraction, so infra-red cannot penetrate so far (Figure 2).

As the temperature of a plastic rises, the greater the depth of penetration obtained by infra-red (Figure 3).

Figure 1

Penetration depth in differently coloured polystyrene

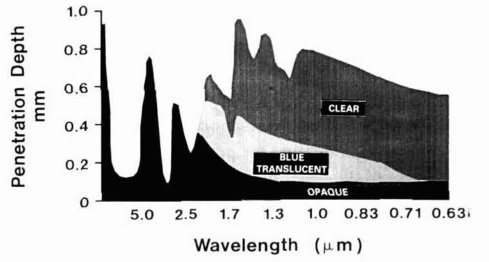


Figure 2

Penetration depth in PP having different structures

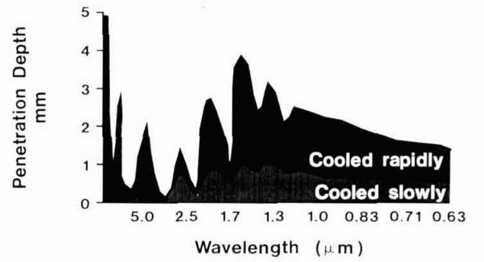
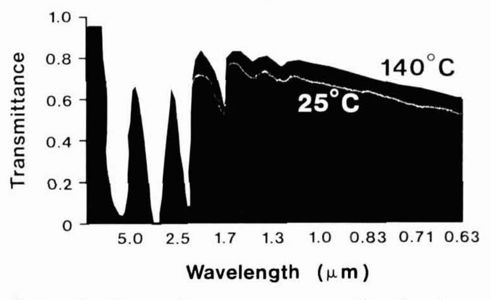


Figure 3

Transmittance of PP at different temperatures



Convection losses always accompany radiant heating and these influence the temperature profile. Sometimes they are deliberately enhanced to prevent surface overheating but in most cases they result from natural convection, and always reduce the surface temperatue induced by the radiant heating.

Nylon moulded parts have good resistance to solvents and show no stress crazing or cracking tendency. Surface absorbed moisture can amount to between 2 and 8%. For this reason the most suitable paint systems are those which combine with water or are relatively hydrophilic.

It is likely that glass fibre-reinforced plastics will need to be degreased and freed from adherent dirt before painting. A solvent such as isopropanol can be used for this purpose but a check should be made to ensure there has been no attack on the surface of the moulding which could give rise to defects in the paint coating. Washing equipment which produces a water spray has been found particularly effective.

Where a high quality finish is required such as for external parts of motor vehicles the surface to be painted should be of quality indistinguishable from metal surfaces. Moulding defects may be filled with suitable stopper compounds and painted over with normal stoving finish systems.

In the motor vehicle industry semi-rigid polyurethane foam is being used to an increasing extent. The main reasons are the elastic deformation behaviour, the weight saving and the ease of shaping. However, blisters and pores may be present in the surface layer of the foam moulded components. Release agents, usually waxes are used to facilitate demoulding and these may result in a poor paint finish. After-cleaning is indispenable, and a degreasing plant may be the most effective route for large scale operation. A suitably flexible priming coat is used onto which a two-coat metallic finish is applied.

Maintenance of IR systems

Infra-red emitters cannot, of themselves, produce atmospheric pollution since no combustion takes place. This helps to prevent spoilage and contamination of the product, and also means that the heaters and the reflective enclosure stay clean for long periods in a clean working environment. Therefore, maintenance is minimal and extremely simple. When replacement is required, it is usually a straightforward job for any maintenance electrician.

The emitters which are the easiest to replace are lamp bulbs. No tools are required for this task, but even this is seldom an urgent job since a multi-lamp oven would not suffer a serious drop in efficiency with the random failure of a few lamps. A continuous outflow of clean air around the lamp body prevents the ingress of pollutants and solvents. These lamps should run for 5,000 hours with correct operation and maintenance. Quartz tubes, are normally retained by spring clips, with connecting tails of flexible metal strips taken to adjacent terminal posts. Enclosures are normally designed to incorporate easily removable panels, giving ready access to replaceable items. Thus, down-time can be reduced to a minimum. The life expectancy of short-wave tubes is up to 5,000 hours, and the medium-wave tubes should operate satisfactorily for several years. Ceramic emitters have a life expectancy of several years, but can be easily changed by removing one spring clip from the back of the emitter and disconnecting the flexible tails. Maintenance times for all emitters are reckoned in minutes so that servicing can take place at opportune times (i.e., during scheduled stops in production). The metal-sheathed element is probably the most robust infra-red source available. The element spiral is embedded in magnesium oxide, a mineral insulation which is compacted inside a nickel-chromium tube. This element can withstand thermal and mechanical shocks, and the efficiency is scarcely affected by surface tarnish or dirt. A life of several years can be expected even under the most arduous working conditons.

In addition to the benefit of low maintanance of IR equipment, all the necessary work can be carried out by one trade (electrical) whereas with fuel-fired ovens there could be occasions when other trades would have to be available to rectify a fault and re-commission the oven.

Safety

Two aspects of safety need to be considered: the effects of IR emission on personnel, and the measures adopted to enable IR systems to operate in potentially hazardous environments.

Personnel safety

IR heating is based on the simple principle of passing an electric current through a length of resistance wire. The resulting heat is, therefore, as safe as any other industrial or domestic heat source. The effects of IR radiation are of a purely thermal nature. However, with a short-wave lamp bulb and quartz tubes, personnel should be shielded from prolonged direct glare. Damage to the eyes from thermal radiation is rare and occurs only in relatively small number of specialist trades, such as glass blowers, who may stare at an incandescent source frequently without using the providing eye protection.

Unfortunately, the word "radiation" causes apprehension in some industries about the possible danger of IR heating, but the fears are generally more imagined than real. To put the situation into perspective, the domestic use of infra-red emitting appliances, such as radiant fires, cooker hot plates, and lamp bulbs, is universally accepted.

Environmental safety

IR ovens are frequently operated in areas where flammable solvents are continuously evaporated. Clearly, it would be difficult and costly to construct flameproof enclosures for such environments since the range of operating temperatures attained by industrial emitters extends from 700 to 2,200°C. Safe conditions, however, are maintained by introducing a continuous flow of clean air into these ovens to ensure that the operating conditions never approach the lower flammable limit of the solvent in use. The Department of the Environment advises the introduction of 60 cubic metres of fresh air at 60°C into an oven for every litre of solvent evaporated. If properly applied, this safety measure will not seriously impair the efficiency of an oven since the air itself absorbs only a very small amount of the radiant energy available.

Guidance on safe practices

The British National Committee for Electroheat (BNCE) has produced guidelines information to assist designers, installers and users to comply with the Health and Safety at Work Act.

Acknowledgements

The author gratefully acknowledges information provided by the following companies: Macpherson Industrial Coatings, Carrs Paints Limited and Royalite Plastics Ltd.

Literature sources

Infra-red radiation in the Processing of Plastics: Precise Adjustment — the Key to Productivity, K Esser et al, Advances in Polymer Technology, Vol 7, No 2 1987, John Wiley and Sons Inc.

Further information is available from the British National Committee for Electroheat (BNCE), 30 Millbank, London SW1P 4RD. ■

Paper presented at the PRA Symposium–Coatings for Difficult Substrates, Harrogate, 14-15 May 1990.

OCTOBER JOCCA – PHYSICAL TESTING

An evaluation of the performance of tin-based flame-retardant paints

by R. S. Bains and P. A. Cusack, International Tin Research Institute, Kingston Lane, Uxbridge, Middlesex, UB8 3PJ, UK

Abstract

The flame-retardant properties of zinc hydroxystannate and zinc stannate have been assessed in unfilled and titanium dioxide-filled polyester resins, used as model systems in this work, and in a typical alkyd resin-based gloss paint. The inorganic tin additives are found to be highly effective flame retardants in a chlorinated paraffin wax-containing polyester and, furthermore, exhibit marked synergistic effects when used in combination with TiO_2 filler in a halogenated resin formulation.

$ZnSn(OH)_6$ and $ZnSnO_3$ give exceptional flame-retardant performances in a TiO_2/chlorowax-containing gloss paint system. It is found that an experimental paint containing only 1% $ZnSn(OH)_6$ gives a film which has a higher flame-retardant rating than that of a coating produced from a proprietary Sb_2O_3- containing gloss. On the basis of these findings, it is suggested that these novel tin-based systems should merit serious commercial interest.

Introduction

Over the last decade, the paint and coating industry has made great progress in developing coatings which are highly effective in retarding the spread of flames. Two distinct types of flame-retardant paints are commercially available, these being intumescent coatings, in which a voluminous insulating char is formed on exposure to heat and flame, and non-intumescents, which appear to act by producing gaseous flame-inhibiting species during thermal decomposition.[1]

Although intumescent coatings are generally more effective in terms of their fire-resistance, they appear to have a number of inherent disadvantages which are not evident in non-intumescent systems. In particular, they usually require at least two applications, have poor appearance and only cover about half the surface area that an equal volume of a non-intumescent coating does[2]. In addition, intumescent paints tend to be hygroscopic and some of the active flame-retardant components can be removed by leaching, washing or weathering[2].

Non-intumescent coatings are generally based on alkyd resins, into which an organic chlorine compound is incorporated either as a reactive or a physical additive.[3] Improved flame retardancy is achieved through the addition of a synergist, typically antimony trioxide[3], However, flame-retardant systems based on Sb_2O_3- halogen combinations are known to exhibit poor smoke emission characteristics[4], and it is likely that this factor will be subject to stringent legislation in the near future.

Two novel inorganic tin additives, zinc hydroxystannate, $ZnSn(OH)_6$, and zinc stannate, $ZnSnO_3$, have recently been introduced as potential replacements for Sb_2O_3 in halogenated polymer formulations[5,6]. Previous work at I.T.R.I. has shown that these essentially non-toxic tin compounds are highly effective flame-, smoke-, and carbon monoxide- retardants in halogenated polyester resins[7], which are chemically similar to the alkyd resins used in gloss paints. This paper reports an investigation into the flame-retardant performance of $ZnSn(OH)_6$ and $ZnSnO_3$ in both unfilled and titanium dioxide-filled unsaturated polyester formulations, used as model systems, and in a typical alkyd resin-based gloss paint.

Experimental procedure

Materials

Zinc hydroxystannate and zinc stannate were supplied by Alcan Chemicals Ltd., Gerrards Cross. The other additives used in this work were titanium dioxide (RCR-2 grade, Tioxide U.K. Ltd., Billingham) and Cerechlor 70 (I.C.I. PLC, Runcorn).

The polyester resins used were 'Stypol R1264/6' (28% bromine as dibromoneopentylglycol), Freeman Chemicals Ltd., Ellesmere Port, and 'Crystic 471 PA LV' (halogen-free general purpose resin), Scott-Bader Co. Ltd., Wellingborough. Both resins contain styrene as the crosslinking agent.

'Superlux' non-flammable boards (Cape Boards and Panels Ltd., Uxbridge) were used for paint evaluation tests, and the commercial flame-retardant paint studied was 'Timonox' white gloss (Macpherson Paints Ltd., Bury).

Sample preparation

(a). Polyester resins

The additives were mixed into the resins using a Silverson high-shear mixer in order to give a homogeneous dispersion of the solid particles. The brominated resin formulations were cured using 1.5 wt.% high activity methyl ethyl ketone peroxide ('Stypol SC-24') as catalyst and 0.5 wt.% cobalt accelerator ('Stypol SA-11'). Halogen-free polyester formulations, which were pre-accelerated, were cured using 2 wt.% 'Crystic Catalyst M'. In each case, the addition levels used were chosen to give gelation times of approximately 10 min. The resins were poured into silicone rubber moulds and allowed to cure at room temperature for 16 h, followed by postcure at 70°C for 3h.

(b). Paints

A standard white gloss formulation containing 70.6% solids was used in these experiments, with a Cerechlor 70 level of 20% w/w and tin additive levels of 1-3% w/w in the wet paint. The board panels were each subjected to two coats of paint, the first coat being rubbed down prior to application of the second.

Flammability evaluation

Flammability of the resin and paint film samples was determined by measurement of their limiting oxygen indices (LOI's), largely in accordance with ASTM D2863[8], using a Stanton Redcroft FTA module.

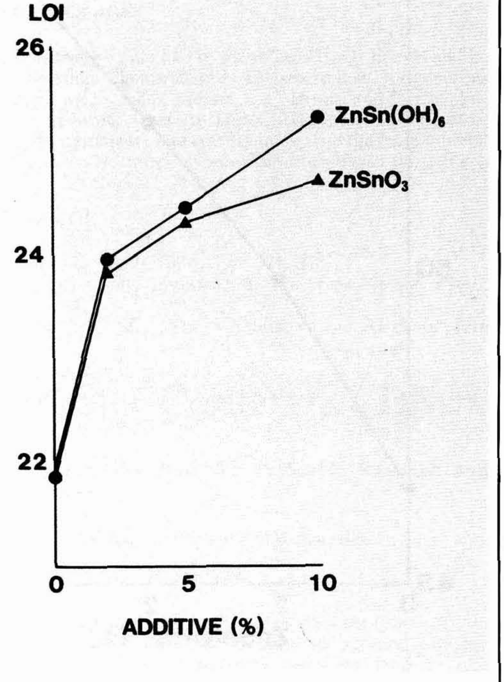
Results and discussion

Polyester resins

Initially, the effect was investigated of addition of either zinc hydroxystannate or zinc stannate, at levels of up to 10% on the flammability of a polyester resin formulation containing 15% Cerechlor 70 (a chlorinated paraffin wax containing 70% chlorine by weight). the data obtained, illustrated graphically in Figure 1, indicate that both $ZnSn(OH)_6$ and $ZnSnO_3$ are effective flame retardants when used in combination with the chlorine source in the polyester system. The effectiveness of the tin additives in relation to that of the chlorine alone can be ascertained from the fact that incorporation of Cerechlor 70 at a level of 15% (equivalent to 10.5% Cl) elevates the LOI of the resin from ca.19 to ca.22, whereas 2% additions of either $ZnSn(OH)_6$ or $ZnSnO_3$ lead to further increases in LOI to ca.24.

Figure 1

Effect of inorganic tin additives on the flammability of polyester resin containing 15% Cerechlor 70.



In order to investigate the effects on flammability of chlorine variation in the polyester resin, $ZnSnO_3$ was incorporated at a level of 2% into resins containing 0-40% Cerechlor 70. The results obtained are shown in Figure 2 and it is evident that an increase in chlorine content leads to a sharp concomitant increase in the LOI of the plastic.

These studies on polyester resin model systems were extended to determine the effect of titanium dioxide filler in combination with the tin additives, both in the absence and presence of a halogen source. Although TiO_2 exhibits little flame-retardant effect in a halogen-free resin formulation, a marked elevation in LOI is observed when the filler is incorporated at a level of 50% into a commercial brominated polyester which contains 28% Br as the reactive intermediate, dibromoneopentylglycol (DBNPG), (Table 1). This observation is consistent with a synergistic effect in which the TiO_2 is not simply acting as an inert filler, but is also involved in a chemical interaction with the bromine present in the resin. Interestingly, previous work on TiO_2 in combination with various halogen sources has indicated that the oxide is more or less ineffective as a flame-retardant synergist[9].

Partial replacement of the TiO_2 filler with either $ZnSn(OH)_6$ or $ZnSnO_3$ leads to beneficial flame-retardant effects in both the halogen-free and brominated polyester formulations (Table 1). The degree of improvement is modest but significant in the non-halogenated resin, with the hydrated compound markedly outperforming its anhydrous analogue, presumably due to endothermic dehydration[10]:

$$ZnSn(OH)_6 \longrightarrow ZnSnO_3 + 3H_2O$$

Figure 2

Effect of Cerechlor 70 content on the flammability of polyester resin containing 2% $ZnSnO_3$.

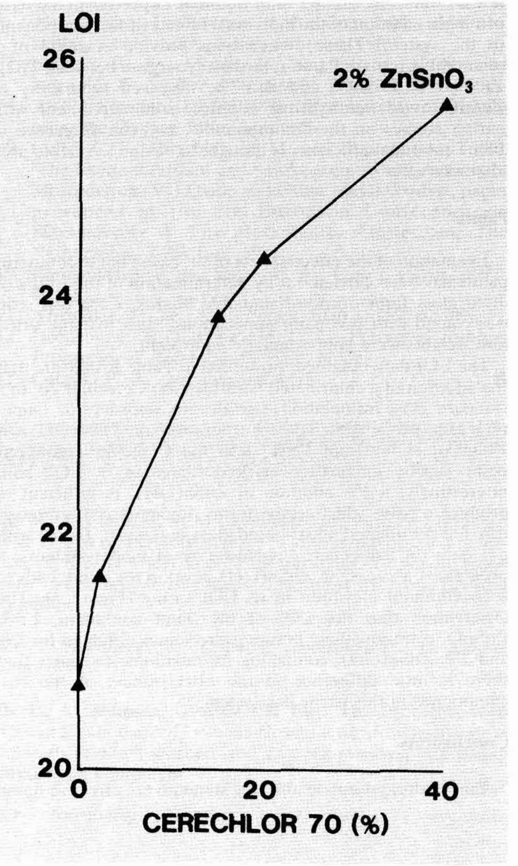


Table 1

Flammability data for unfilled and TiO_2-filled polyester resins

Resin	TiO_2 (%)	$ZnSn(OH)_6$ (%)	$ZnSnO_3$ (%)	LOI
Halogen-free	—	—	—	19.1
Halogen-free	50	—	—	20.5
Halogen-free	45	5	—	23.4
Halogen-free	45	—	5	21.4
Brominated*	—	—	—	38.8
Brominated*	—	5	—	56.0
Brominated*	—	—	5	56.1
Brominated*	50	—	—	50.1
Brominated*	45	5	—	74.4
Brominated*	45	—	5	83.6

* Resin contains 28% Br as dibromoneopentylglycol (DBNPG).

Such a reaction could result in a withdrawal of heat from the substrate, with a consequent retardation in the rate of thermal degradation of the polymer. A similar mode of action is known to operate in fire-retardant systems based on other hydrated compounds, including alumina trihydrate[11] and magnesium hydroxide[12].

Zinc hydroxystannate and zinc stannate have been reported to be excellent flame- and smoke-retardants for brominated polyesters based on DBNPG[7] and, in the present work, both additives give considerable increases in the LOI of such a resin (Table 1). Furthermore, partial substitution of TiO_2 by these tin compounds results in exceptional elevations in LOI which are greater than would be expected on the basis of simple addition of the individual effects of the components of the system. These observations provide evidence of a remarkable ternary flame-retardant synergism between TiO_2, $ZnSn(OH)_6$/$ZnSnO_3$ and Br. The observed superiority of $ZnSnO_3$ over the hydroxy additive is in agreement with earlier studies on these compounds[7], and the difference in flame-retardant efficiency is thought to be due to surface area characteristics[13].

Paints

Evaluation of the effectiveness of tin-based flame-retardant paints has been carried out by determination of the LOI's of dried gloss films on non-flammable boards. Each test strip was coated with two paint applications, such that the dried film weights were approximately equivalent.

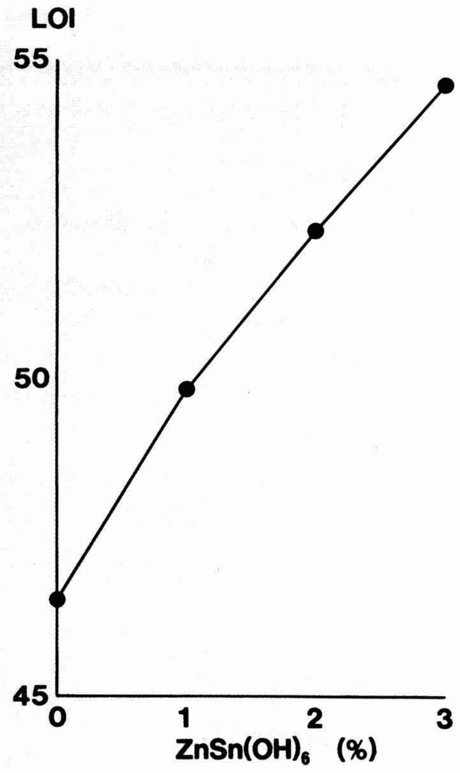
The LOI data obtained, presented in Table 2, indicate that the addition of a chlorinated paraffin wax, Cerechlor 70, to a standard gloss formulation, significantly improves its flame-retardant properties. The incorporation of $ZnSn(OH)_6$ or $ZnSnO_3$, at levels of 1-3%, into the Cerechlor-containing paint results in further marked increases in LOI and, interestingly, a 1% addition of $ZnSn(OH)_6$ is sufficient to produce a paint which outperforms a commercial antimony trioxide/chlorinated alkyd-based gloss in the test. In line with out data on halogenated polyester resin model systems, a progressive increase in $ZnSn(OH)_6$ level in the paint leads to a concomitant elevation in its LOI rating (Figure 3). The observation that the LOI of the paint containing 1.5% $ZnSnO_3$ is intermediate between the values obtained for 1% and 2% $ZnSn(OH)_6$-containing formulations, indicates that there is little difference in the effectiveness of the two compounds in this particular system.

Conclusions

Zinc hydroxystannate and zinc stannate are effective flame retardants when incorporated at levels of up to 10% into a chlorowax-containing polyester resin formulation. A progressive increase in either tin additive level or in chlorowax content results in a concomitant elevation in the LOI of the plastic.

Figure 3

Effect of zinc hydroxystannate on the flammability of Cerechlor 70 - containing gloss paint coatings on non-flammable board.



Titanium dioxide pigment is more or less inert as a flame-retardant filler in a haiogen-free polyester resin, whereas it significantly increases the LOI of a brominated polyester

Table 2

Flammability data for painted non-flammable board samples

Paint system	Cerechlor 70 (%)	$ZnSn(OH)_6$ (%)	$ZnSnO_3$ (%)	Coating weight(g)*	LOI
Standard gloss	—	—	—	0.59	41.1
Standard gloss	20†	—	—	0.65	46.5
Standard gloss	20†	1	—	0.63	49.8
Standard gloss	20†	2	—	0.59	52.3
Standard gloss	20†	3	—	0.63	54.6
Standard gloss	20†	—	1.5	0.65	50.3
Timonox‡	—	—	—	0.52	48.2

* Weight of dry paint per strip.
† Equivalent to 14.1% Cl by weight.
‡ Commercial Sb_2O_3/chlorinated alkyd-based flame-retardant paint.

formulation. Partial replacement of a relatively small proportion of the TiO_2 with either $ZnSn(OH)_6$ or $ZnSnO_3$ results in a significant increase in LOI for the halogen-free resin, and an exceptional LOI elevation for the brominated polyester. There is clear evidence for the existence of a remarkable ternary (Br-TiO_2-Zn/Sn) flame-retardant synergism in this system.

$ZnSn(OH)_6$ and $ZnSnO_3$ are very effective flame-retardant additives in alkyd resin-based gloss paints which contain TiO_2 pigment and chlorowax. An experimental paint containing 1% $ZnSn(OH)_6$ and 20% Cerechlor 70 is superior to a commercial antimony trioxide/chlorinated alkyd-based flame-retardant gloss, when assessed in LOI tests on coated non-flammable boards.

Acknowledgments

The authors would like to thank Drs. B. O. Brown and B. Kerr, Freeman Chemicals Ltd., Ellesmere Port, for generous gifts of polyester resins, Messrs. S. C. Brown and D. Chaplin, Alcan Chemicals, Gerrards Cross, for supplying samples of zinc hydroxystannate and zinc stannate, and the International Tin Research Institute for permission to publish this paper.

References

1. Wake, L. V., *JOCCA*, 1988, **71**, 378.
2. Touval, I. and Freiman, A., *Paint & Varnish Prod.*, 1972, **62**, 61.
3. Lyons, J. W., 'The Chemistry and Uses of Fire Retardants', Wiley-Interscience, New York, 1970, p.244.
4. Pitts, J. J., in 'Flame Retardancy of Polymeric Materials', ed. Kuryla, W. C. and Papa, A. J., vol. 1, Marcel Dekker, New York, 1973, p.133.
5. Cusack, P. A. and Fontaine, P. I., 'Investigations into Tin-based Flame Retardants and Smoke Suppressants', paper presented at Chemspec '88, Frankfurt, West Germany, 22nd March 1988. Published as: *Speciality Chemicals*, 1989, **9**, 194.
6. Cusack, P. A., Killmeyer, A. J., Brown, S. C. and Tingley, L. R., 'Flame-retardant Inorganic Tin Additives which Suppress Smoke and Carbon Monoxide Emission from Burning Polyester Resins', paper presented at the 44th Annual Conference of the Composites Institute, Dallas, Texas, USA, 6-10th February 1989.
7. Cusack, P. A., Monk, A. W., Pearce, J. A., and Reynolds, S. J., *Fire & Materials*, 1989, **14**, 23.
8. ASTM Standard D2863:1970, 'Flammability of Plastics using the Oxygen Index Method'.
9. Cullis, C. F., Hirschler, M. M. and Thevaranjan, T. R., 'The Flame-retardant and Smoke-suppressant Activity of Molybdenum(VI) Oxide and Other Metal Oxides', paper presented at the 8th European Conference on Flammability & Fire Retardants, Amsterdam, The Netherlands, 7-8th June 1984.
10. Ramamurthy, P. and Secco, E. A., *Can. J. Chem.*, 1971, **49**, 2813.
11. Hirschler, M. M., *Dev. Polym. Stab.*, 1982, **5**, 107.
12. Hornsby, P. R. and Watson, C. L., *Plastics & Rubber, Processing & Applications*, 1986, **6**, 169.
13. Cusack, P. A., unpublished work. ■

Chester Conference Discussions

Perstorp Creative Base for Profitable Research and Development

by Mr S. Nordberg, Perstorp AB, Sweden

Published in July 90 JOCCA

Dr M. Dare-Edwards, Shell Chemicals UK Ltd: 1) how do you manage the situation with a decentralised research strategy that short-term product/business pressures tend to rule against the devotion of time to innovative research projects? 2) On an *individual* basis, with only a limited number of working hours in the day, it is very easy for short term technical problem solving (for production or marketing of products) to take precedence over technical *development* research. How do you force or encourage your staff to spend sufficient time on the latter (including the support/direction of extra-mural research)?

Mr S. Nordberg: 1) With free money from Research foundation or President's Fund or Environmental Fund. 2) We form project groups for specific tasks.

Mr R. H. Munn, Cray Valley Products Ltd: I note you have acquired six companies in the last fiscal year. What criteria do you apply in deciding whether or not to acquire and do you place more emphasis on acquisition of new businesses or increased market share?

Mr S. Nordberg: The Business Areas are most interested in exploiting market shares. Pernovo new businesses in number 50/50%

Mr M. A. Claridge, SCM Chemicals Ltd: With decentralised R & D how do Perstorp manage: 1) the avoidance of duplication of R & D effort and 2) the problem of "not invented here" when transferring ideas/suggestions from one division to another?

Mr S. Nordberg: 1) Research co-ordination, 2) Always impossible.

Dr L. A. Simpson, Tioxide UK Ltd: The problems with decentralisation are: 1) you may lose out on cross-fertilization between research workers and 2) costs involved in possibly duplicating equipment.

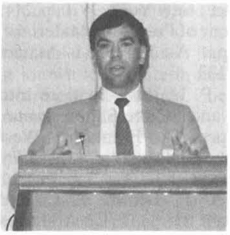
Mr S. Nordberg: 1) No, there are other ways, 2) Very little.

Dr S. G. Lawrence, Ciba-Geigy Pigments Plc: When a chemist has generated a new idea which is then given the go-ahead, does he/she go with the product through its various stages of development, or does it go from one department to another with different people being in charge at various times?

Mr S. Nordberg: We try to let the same person be responsible for the project.

Mr J. Gent, Fulmer Yarsley: How do you manage the idea or concept originating from marketing into R & D: a) Mainstream activities and b) Out of mainstream business.

Mr S. Nordberg: I can give away money for feasibility studies direct to people lower down in the organisation without strict rules up to £10,000. ■


S. Jacques


J. F. Watts


D. Wallace


C. N. Tuck

PRA Conference – Coatings for Difficult Substrates

Over 90 delegates attended a 2-day Symposium on "Coatings for Difficult Substrates" organised by PRA on 14-15 May 1990 at the Moat House International, Harrogate.

Dr Nigel Whitehouse of PRA, Chairman for the first day, welcomed delegates and introduced the first speaker, Mr Steven Jacques of Syntha Pulvin who spoke on "Performance Requirements for Powder Coatings used in Architectural Cladding and Extrusions". In his talk he described the prime performance requirements sought for architectural powder coating, these being Adhesion, Gloss Retention, Colour Stability and General Weatherability. To supply the market properly, he commented, it was also essential to consider architectural requirements. For example, powder coatings must provide adequate edge protection especially in marine environments.

In another architectural example he discussed formulation for structural glazing where the mechanical fixing of glass is dispensed with, leading to the construction of mirror-like "Dallas" buildings which are unbroken by protruding lines of transoms or mullions. In this construction the sealant must adhere to both glass and the coating. Extensive tests have shown that different coloured coatings performance varies and therefore selection of the correct coating was important. He then went on to discuss application, for example, advice to the customer on drainage points, jigging points, avoidance of different gauge metals could help to maximise lifespan. Mr Jacques closed his talk stressing that architects' specifications should carefully consider the environment to which the coating will be exposed.

The second paper of the morning session was presented by Dr J F Watts of the Dept of Materials Science of the University of Surrey, who spoke on "Surface Characterisation of Plastics with respect to Adhesion of Organic Coatings" In his talk he described the two major analytical techniques used to investigate adhesion; the surface chemical analysis of organic polymers is dominated by X-ray photoelectron spectroscopy (XPS) and secondary ions mass spectrometry (SSIMS). These two methods probe the surface layers to 4mm and 1.5mm respectively and are essentially complementary. He then went on to discuss these two methods in detail.

The third talk of the morning session was presented by Mr Derek Wallace of the De la Rue Company who spoke on "Effect Coatings for Plastics". In his extensive and wide-ranging review he discussed application techniques and effects produced. His talk was also enhanced by an impressive eye-catching stand in the symposium hall featuring examples of these coatings.

The fourth talk of the morning session was presented by Dr C N Tuck of International Paint who spoke on "Electromagnetic Interference Shielding". In his talk he discussed the importance of EMI in terms of current and impending legislation – E C directive currently a consultative document which refers to BS 6527 (89/336/EEC on EMC). He then described the methods for EMI shielding of plastic enclosures: Vacuum Deposition, Zinc Arc Spraying, Electroless Plating, Conductive Plastics, Conducting Polymers, Conductive Coatings. He concluded his talk with a comparison of the three most widely used methods.

Following lunch, Mr R R Engelhardt of the Amoco Chemical Co spoke on "2-Component Isopolyester Urethane Coatings for Plastics". In his talk he discussed the development of high solids versions of these coatings designed especially for automotive applications. The resin system is a low MW hydroxyl functional polyester composed of equimolar parts of isophthalic and adipic acid in addition to neopentyl glycol and trimethylol propane. The resin is crosslinked with aliphatic polyisocyanate resins based on

J. Bernie

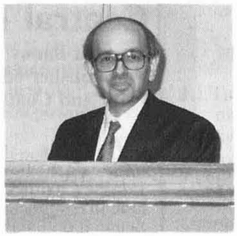
M. G. Wilson

N. Thomas

K. G. Lewis

R. R. Engelhardt

D. Blundell



B. Martin

J. O'Connell

hexamethylene diisocyanate.

The second paper of the afternoon session was presented by Mr Derek Blundell of Industrial Coatings who spoke on "Vapour Injection Cure of Two-Pack Polyurethane". In his paper he set out to show how a novel coating process –vapour injection cure can cope with difficult substrates. As an example he described how a VIC system can deal with SMC (Sheet Moulding Compound).

The third paper of the afternoon session was presented by Mr B Martin of Herberts who spoke on "Coatings for Automotive Exterior Plastics". In his paper he discussed a wide range of automotive plastics, pretreatment processes and coatings.

The final paper of the afternoon session was presented by Mr J O'Connell of the Electricity Association who spoke on the "Infra-Red Stoving of Paint on Plastic". In his paper he compared IR ovens with convection ovens and discussed the recent development of the IR contra-flow oven. (see p. 337).

Mr John Bernie, Managing Director of PRA, Chairman for the second day, opened the morning session and described the projects that the PRA are currently involved with on coatings for difficult substrates: Coatings for Wood is a £0.8 million DTI funded project and sponsored by some 20 companies; Steel coatings is a DOE awarded project on NAD alternatives to PVC plastisols; Self-stratifying coatings is an EEC BRITE programme.

The first paper of the morning session was presented by Mr M G Wilson of Liquid Plastics Ltd who spoke on "New Coatings for Glass". In his paper he discussed a new moisture-curing single pack polyurethane coating system that can cover windowskylights without any break in the coating. He then described its properties which include UV/Chemical/Fungal/Hydrolysis resistance and it will provide shatter-proofing, water-proofing, draught-proofing, together with a reduction in heat loss.

The second paper of the morning sesion was presented by Dr Noreen Thomas who spoke on "Coatings for Rusty Steel: Where are we now?" In her comprehensive paper she discussed the factors causing the premature failure of coatings and various mechanisms proposed for the protection of rusty steel.

The third paper of the morning session was presented by Dr K G Lewis of British Steel Technical, Welsh Laboratories, Port Talbot, who spoke on "Characterising various Zinc-Coated Surfaces". In his paper he reviewed the range of production methods of hot-dip and electroplated zinc and zinc-alloy coated steels currently available. The properties of painting these metallic-coated steels were also discussed.

The final paper of the morning session was presented by Dr N R Whitehouse of PRA who spoke on "Coatings for Galvanised Steel: Solid Paint – Powder". In his paper Dr Whitehouse discussed a PRA managed 3-year major research project on the polyester powder finishing of zinc and zinc alloy coatings. The project was funded by the DTI and nine commercial organizations. The powder coating process involves

1) Cleaning of the zinc surface
2) Pretreatment – phosphating-chromating
3) Drying off
4) Degassing, heating 20°C above the curing temperature of the powder
5) Then the surface is powder coated

The objective of the project included an understanding of the process factors affecting the appearance and durability of organic powder finishes especially problems caused by craters and pinholes. He then went on to summarise some of the results of this study:

1) Degassing is beneficial
2) No significant difference between chromate and phosphate pretreatment
3) The galvanizing process is important
4) No significant difference between powders from different UK manufacturers

The second talk of the afternoon session was presented by Dr A J Fream of Mebon Limited who spoke on "Coatings for Galvanised Steel". In his talk he discussed the duplex system – a combination of a paint system and a zinc coating produced by galvanising. He commented that modified vinyls have given excellent

N. R. Whitehouse

A. J. Fream

R. King

R. Kennedy

performance over the past ten years and in future years there will be an increase in the use of water-borne systems.

The third talk of the afternoon session was presented by Mr Robin King of Robin King Associates who spoke on "Organic Coatings for Aluminium: Some problems and Solutions". Two different types of aluminium are generally coated: Extrusions and Sheet. The secret to success is providing good adhesion between the coating and the substrate, the optimum method is by the use of chromate conversion coatings; anodizing is now being used for environmental reasons. The purpose of the coating is to provide colour for architectural applications. Mr King then went on to describe the various coatings methods.

The final talk of the afternoon session was presented by Dr Richard Kennedy of PRA who spoke on the "Selection of Coatings for Non-Ferrous Metal Through Expert Systems". The Coating Selector project was developed by the PRA in conjunction with CORI (Belgium), EOLAS (Ireland) and DTI (Denmark) and was 50% funded by the EEC SPRINT initiative. In his talk he described the advantage of an expert system over a database in the selection of these coatings.

Mr John Bernie of the PRA closed the meeting with a vote of thanks to speakers and was pleased to note that the symposium had attracted overseas delegates. He also commented that in Europe 4.5 billion ECU is available to fund research projects. The BRITE programme has 150 mECU for collaborative projects and he invited European companies and organisations to contact him to discuss possible projects prior to the next round of EEC funding assessments.

A selection of these papers will be published in future issues of JOCCA.

P J Fyne ■

K-WHITE

ANTI-CORROSIVE NON-TOXIC PIGMENT

BROMHEAD & DENISON LTD.

7 Stonebank, Welwyn Garden City, Hertfordshire AL8 6NQ

Telephone (0707) 331031

Central Europe Show drew 78 exhibitors

By Abel Banov
Co-publisher/editorial: American Paint and Coatings Journal

Budapest — Fate couldn't have improved the timing of the first Central Europe Coatings Show, which was held here in conjunction with the Ninth Seminar on Lacquer and the Paint Industry, whose sponsor was the Hungarian Chemical Society.

Coming as it did in late March, just long enough after the lifting of the Iron Curtain to permit the area's technologists to get their bearings, the show —like the preceding Seminar — drew an attentive audience from Czechoslovakia, Poland, Hungary, Rumania, and Bulgaria, from Central Europe, and from Turkey, Italy, and Greece.

Showing their wares at the exhibition were 78 raw material suppliers from many parts of the European continent, the United Kingdom, and the United States.

Exhibitors based in the United Kingdom, or having divisions there included; ICI Resins; Lawrence Industries; Cray Valley Products Ltd; Lubrizol; Allied Colloids; ECC International Ltd; FMJ International Publications Ltd, sponsors of the show; and PMC Specialties Group.

Perhaps because of growing awareness of environmental matters and because consumers are more concerned with quality, the single product group with attention by most exhibitors appeared to be viscosity control agents. Allied Colloids, for instance, featured a new alkali-activated associative thickening agent, Rheovis CR, found to be highly effective in low-cost formulations needing added scrub resistance and was found to have slightly pseudoplastic behaviour, while another version, Rheovis CRX, is distinguished by its greater power to impart viscosity and hence offers more shear-thinning.

Akzo showed a range of thixotropes for both solvent-based and water-based paints, ranging from organoclay materials to hydrogenated castor oil-based products, and then modified clays for aqueous coatings.

Lubrizol offered Ircogel, a liquid rheology control additive for solventless urethanes, epoxies and high solids systems, with the added role of anti-settling agent. RHEOX, a US company formed recently from NL Industries, showed a range of rheology-control additives for both liquid and powder coatings, including novel products from its line of bentone-derived thickeners.

Schewegmann GMBH & Co., of West Germany, exhibited its Schwego Pur 8050, which allows aqueous systems to show application properties similar to that of alkyds and with improved storage stability and antisettling. Servo Delden BV showed SER-AD-PU, a new thickener provided by Nuodex, an American additive manufacturer. AKZO offered its Perchem rheology control additives, and BASF also had a thickener line at its exhibit.

Cell GESMBH, of Austria, showed Tafigel, its polyurethane thickener for aqueous systems; and Rohm & Haas offered its line of Acrysol thickeners.

Ernst Jager Fabri Chemischer GMBH, of West Germany, achieved thixotropy by a different route. It achieves it through a new resin system that imparts "sterochemical thixotropy", which, unlike other thixotrope resins, can use in many instances any kind of solvent, although some versions can't use polar solvents. The product can withstand 120°C and is useable for alkyds, epoxies, polyesters, acrylics and urethane. Another feature is that under some circumstances, stucco or wrinkled effects can be obtained when it is included. One version of this new type of resin provides anti-sag control.

Dispersion aids

Considerable exhibit space was devoted to inducing the Central European technologists to improve their dispersion capabilities. Efka Chemicals, of Holland, offered Polymer LP 7980, a modified polyacrylate with self-emulsifying properties, which is aimed at dispersing difficult organic and inorganic pigments while improving gloss and colour strength and reducing flocculation and flooding. Since the product is not water soluble, it is not affected by water. The product is intended for use in water-reducible industrial coatings and for baking enamels, including medium or short oil alkyds. The material is not yet useable for long oil alkyds, because a suitable drier has not yet been found.

Low molecular-weight, anionic water soluble dispersants were offered by Allied Colloids. Versions include a sodium salt of a polycarboxylic acid and an ammonium salt. The product is described as permitting high loading of pigment, and consequently, a very fluid slurry.

Daniel Products, of the United States, showed its multi-functional pigment dispersants, which speed dispersion and prevent flocculation. Rohm & Haas exhibited its Orotan dispersants.

BASFS Laropal A 81 is a polycondensation resin derived from urea and aliphatic aldehydes with broad compatibility and solubility. It is described as suitable for all-purpose solvent-reducible pigment pastes. Because it has low viscosity, concentrations as great as 70 percent are possible, although 40-60 percent are usually the most satisfactory.

Anticorrosives

BASF also offered another product in a class that was well represented at the show. That was its Acronal S 760, a new polymer dispersion for aqueous anticorrosion paints. The product, is a self-crosslinking acrylic-styrene copolymer dispersion. The booth featured examples of a paint based on the system that was applied over a zinc-rich epoxy primer at a tank farm with a highly corrosive industrial atmosphere. Four years later, the surface had no signs of corrosion.

Lawrence Industries featured the line of Halox anticorrosive pigments, manufactured in the USA by Hammond Lead Co., and also a line of tannin-stain inhibitors. Dr Hans Heubach, of West Germany, featured a full line of metal oxide and modified zinc phosphate pigments and formulations for using them.

Anticorrosive effects of epoxies and urethanes were stressed in booths of Cray Valley, GAF, Reichold, Rohm & Haas, and Silberline.

An interesting line of resins claimed to protect against corrosion was featured by Ernst Jager, of West Germany. One product is a blend of an alkyd with an acrylic emulsion. The water-reducible product requires water as its only solvent, and no coalescing agent is needed. Their product is reported to dry in 15 minutes and to be rain-proof in 20 minutes at 5°C. The material is also used in wood stains.

Laroflex LR 8829 is an anticorrosive vinyl chloride copolymer offered at the show by BASF. Some versions were also offered for road marking, masonry finishes and for plastics.

What was described as a hydroxy acrylic resin for two-component applications was given considerable attention at the DSM Resins booth. Uracron XP 474 is used for clear and pigmented coatings for refinishing autos and trucks and for high-performance industrial finishes and Uramex ZA is a modified urea melamine formaldehyde resin used for acid-curing wood coatings, where free formaldehyde must be neglible.

Colorants

Sun Chemical Corp. provided a surprise with its new line of perylene high-performance pigments, in effect announcing that it was joining the limited number of producers of this product. With Hilton Savis, it was one of the few exhibitors of organic colors, but inorganics and metallics were prominently displayed.

Cappelle Gebroeders N.V., of Belgium, featured transparent iron oxides, while Benda-Lutze Werke exhibited its line of metal powders and aluminium pastes.

Silberline introduced new high-performance aluminium pastes for automotive use, especially for base coat/clear coat, which it helped popularize in past years. The Mearl Corp. had its line of pearlescent pigments, as did E. Merck, which also showed photoinitiators. Day-Glo Color Corp, had its fluorescent pigments on exhibition as did Radiant Color Inc. Hitox showed its buff titanium dioxide, while Sachtleben showed its titanium dioxide and ultra-fine barium sulfate. Resins were amply represented by a host of producers featuring epoxies, urethanes, polyesters.

Wood coatings

Wet adhesion on wood substrates primed with alkyds was a feature stressed for DSM's Uramul XP 232, a pure acrylic dispersion. The material is described as suitable for exterior or interior transparent and opaque stains, or for gloss paints for the do-it-yourself market. Also at the booth were materials demonstrating a long-oil emulsion that has no amine and is crosslinked by waterborne driers and is used for exterior stains and primers. The resin is based on a low-rosin tall oil.

Cray Valley's exhibits put heavy emphasis on its new two-pack acrylics for high performance industrial coatings and its novel range of alkyds for exterior wood finishes.

Acetoacetate chemistry, which it pioneered, was stressed at Eastman Chemical's exhibit, along with its line of polyester raw materials and Texanol coalescing agents.

Rust-converter formulations using ICI's Haloflex resins was a feature of that company's booth along with new additions to its acrylic and urethane lines.

Considerable attention was given to the exhibit of Amoco Chemical Co. and its intermediates for various urethane and polyester and alkyd specialty formulations. Its information on two-component urethane coatings for plastics drew special attention. ■

OCTOBER JOCCA: EUROPEAN PAINT SHOW PREVIEW

Symposium

J.i.T. for world class

Bob Trick of Huddersfield Polytechnic, one of the speakers at the OCCA West Riding Symposium on "Implications of Just In Time" Autumn 89, was centre stage of a one-day conference held on 7 March jointly by Huddersfield Poly and the Inst of Industrial Managers. The well-attended event was entitled "J.i.T. for World Class" and focused on lowering of unit production costs through production of the right quality in the required time.

Chris Farman from Coopers & Lybrand Deloitte drew comparisons between conventional costing of activities, and the more positive attitude of Focused Cost Management where emphasis is placed on the cost control of activity and the reduction of activities failing to add value.

Aphorisms flowed thick and fast
"avoid false vindication of overheads"
"make-one, move-one"
"mobilise the intellectual resources of the workers, you pay for their hands but their brains come free".

The conference ended on a high note with a rousing presentation by Joe Booth of a case study of J.i.T. principles applied to the engineering company York International.

K. Smith ■

CALL FOR PAPERS

JOCCA is seeking technical papers for publication in the February 1991 issue on **Polymers and Resins**

Papers are invited from research organisations, raw material suppliers and paint manufacturers covering the latest technological and scientific developments in this field.

Papers should be a maximum of 10,000 words (10A4) and may include up to 25 tables, figures and graphs (combined total). Magnetic media is also acceptable (3½ or 5¼ floppy discs with ASCII and generic word processor files). Deadline for the February issue is 10 December 1990.

For further information contact Dr Peter Fyne Tel: 01-908 1086; Fax: 01-908 1219.

Photopolymerisation & Photoimaging Science & Technology
Norman S. Allen — Editor
Elsevier Applied Science, 1989
Price £53, pp310,
ISBN 1-85166-370-3

This is an interesting and well written book. Its appearance is timely, owing to the current and ever increasing demand for knowledge in phototechnology.

As the preface indicates, this book is meant to be a comprehensive and up to date text in the science and technology of free-radical addition polymerization, cationic polymerization, photolithography, photocrosslinking, photografting, photochromic imaging and topochemical polymerization. The editor has I believe made an excellent job of putting together a series of individual chapters on the above topics, each by a prominent specialist or specialists in that particular area. This is even more praiseworthy, bearing in mind the international aspect of the specific chapter author's concerned. These are drawn from England, Italy, USA, France, the Netherlands and Japan.

The various subjects are treated in sufficient detail to give at short notice a good understanding of each topic. This book should therefore be especially valuable to polymer chemists and technologists involved in both the photocuring and photoimaging industries. It will appeal to both the novice and expert. For the former the book provides an excellent introduction to the terminology used and superb references. For the latter, the expert, there is as with all realms of knowledge, something further to be learnt or viewed from a different angle.

Chapter one by Dr Hageman at Akzo Chemie in the Netherlands, reviews concisely the photoinitiators and photoinitiation mechanisms of free radical polymerization processes. I had to search very hard to "nit-pick" and could only find a slightly misplaced quantum of energy "hγ" scheme 1, page 2, an error due I am sure to the printers! An excellent chapter, emphasising mechanistic aspects of both established and new carbonyl containing systems and as the author claims with no pretence of being exhaustive.

Chapter two by Dr Peter Pappas from the USA, who is well-known for his books and other publications in the UV curing field, describes photo-initiated cationic polymerization. It is written with his usual clarity of style.

Chapter three, by Drs Turner & Daly of Eastman Kodak in America, describe the chemistry of photoresists with an industrial bias.

The chemistry and processes of both photolithography and photocrosslinking materials are admirably described.

A more unusual field of expanding importance is dealt with in chapter four by Professor Bellobono from Milan University, Italy, concerning photografting processes onto polymers. The description of this is very lucid.

This is followed in chapter five by photochromic processes, written by Dr Jacobson in London, at the Central Polytechnic. Again, this is an ever increasing photo topic of importance, well written by an expert in the photoimaging field who carefully explains the property of certain materials to undergo a reversible change in the colours they absorb when exposed to light of different wavelengths.

Chapter six is perhaps a not too well-known topic to most industrial chemists, concerning four-centre type photopolymerization of diolefin crystals. This solid state photopolymerization is complex in nature and makes fascinating reading, being a departure from the more usual liquid state photopolymerization. It is very well presented by Professor Hasegawa from Japan at the University of Tokyo.

Professor Fouassier from France describes in chapter seven, the excited state properties of photoinitiators as seen from the use of lasers. Laser technology is becoming even more important in the electronics industry with these latest developments where use is made of the fact that they produce powerful, highly directional monochromatic, and coherent beams of light for fine detail work.

The last chapter is a most interesting one, presented on the post-cure stability of radiation-cured resins. As stated by Dr Allen, this is a much omitted topic. Along with his co-authors for this chapter he has put the record straight concerning the thermal and photo-oxidative stability and photo-yellowing of radiation-curable resins, i.e., the weatherability of UV cured resins.

In summary, the illustrations, tables, figures and reaction mechanisms in the book are well presented. This book concerning the ever expanding topic of photopolymerization and photocrosslinking will I am sure grace the shelves of many academics, industrial scientists and technologists involved in these areas.

C. Roffey
National Printing Ink Co Ltd ■

MANCHESTER SECTION
TOWARDS A GREENER COATINGS INDUSTRY
20-21 September 1990

Multiphase Polymers; Blends and Ionomers

L. A. Utraki and R. A. Weiss (Editors)
American Chemical Society, 1989,
Price $119.95

This volume is number 393 in the well established American Chemical Society Symposium Series. It includes 21 chapters, each by one or more experts in their field, and covers a variety of aspects of multiphase polymers, including new materials, characterisation, thermodynamics, rheology and interpenetrating networks. Both fundamental science and applications are covered and the authors are drawn from both academia and industry.

The term "Multiphase Polymers" covers both blends, where two or more homopolymers or copolymers are mixed together, and ionomers. This latter term was introduced by Du Pont in the early 1960s for their materials which consisted of predominantly non-polar polymer molecules carrying a minority of ionised functional groups. Such polymers have a phase-separated type of morphology, since the ionic groups gather into essentially isolated domains in a sea of non-polar material.

The materials described in this book are of considerable theoretical interest. There main use industrially has been as membranes, for example in fuel cells. Thus there is very little of interest here for the polymer chemist in the surface coatings industry. In fact there have been two studies of ionomers for use in surface coatings, including my own which was published in JOCCA, but neither is referred to in this book. Indeed the index has no entry for either "coatings" or "surface coatings". Hence, although I enjoyed browsing this book and am a better polymer chemist for having done so, I do not feel that I could recommend the book for readers of JOCCA

J. Nicholson
Laboratory of Government Chemist ■

BOOK REVIEWERS

Book Reviews — if you would like to review books for JOCCA please let us know the subjects and the level (technology or science) of books you would be interested in.

London Section

Channel tunnel

The 52nd Annual General Meeting of the London Section was held on Thursday, 19 April 1990 at the Naval Club, Mayfair, London. The meeting was followed by a presentation on the Channel Tunnel Project given by Mr Richard Storer of Eurotunnel.

Mr Storer began by outlining the relationship between Eurotunnel and Transmanche Link (TML). The latter have been subcontracted by Eurotunnel to build the tunnel. Eurotunnel are the owner/operators. The project is the result of collaboration between both the French and British Governments. An international consortium comprising over 200 banks is loaning the bulk of the money required to finance the project.

A total of three tunnels are being constructed under the Channel between the Shakespeare Cliff at Dover and Sangatte in France. In addition to this three tunnels are also being excavated between the terminal at Folkestone and the Shakespeare Cliff at Dover. The tunnels comprise two running tunnels (one in each direction) and a service tunnel. The tunnel is recognised as the longest undersea tunnel (at 39 kilometres) in the world. The running tunnels will be able to accommodate passenger trains, freight trains and shuttles which carry cars, lorries and heavy goods vehicles.

The most advantageous rock strata were chosen for excavation of the tunnel and the tunnel follows a layer of chalk marl under the Channel. The tunnels are bored by large TBMs that have rotating heads to cut segments of the chalk out. These machines are guided by laser to ensure that tunnels from both sides of the Channel meet. The tunnels are then lined with pre-cast concrete segments. All spoil from the workings is taken to Shakespeare Cliff on the English side where an area of sea is being reclaimed. All spoil on the French side is being crushed and mixed with water before being pumped away as slurry.

Environmental and conservation concerns have played a major part in the design of the terminal at Folkestone. This can be seen in the design of the access arrangements for road traffic to pass from motorway to shuttle and vice-versa.

Mr Storer concluded by saying that this was the most exciting construction project of this century. The keen interest of the audience was highlighted in the prolonged question session. Mr David Shepherd proposed a vote of thanks and this was followed by a buffet sponsored by the section.

G. J. Steven ■

Natal Section

Epoxy compounds application in building and civil engineering industries

The initial introduction of epoxies led to as many successes as failures. Epoxies were not a universal system. After numerous tests the various formulating parameters such as type of resin, viscosity, diluents to reduce costs, curing agents and fillers became better understood. Initially customer resistance was very high as engineers would not believe the properties conferred on by epoxies. Subsequent work resulted in a far better acceptance of epoxies and resulted in epoxies often being specified in design and repair work for structural engineering.

This was stated by Mr Lou Müller of Resiflex when he presented a paper on the use of epoxies at an OCCA Natal meeting held on 24 April 1990. The lecture was well illustrated with an overhead projector.

After Mr Müller had answered many questions from the floor, Professor David Williams-Wynn proposed a vote of thanks to Mr Müller and thanked Resiflex for sponsoring the meeting.

E. Puterman ■

The evolution of paintspray equipment from conventional to robotic control electrostatic

The term transfer efficiency is the ratio of material which is deposited on the surface being sprayed to the amount leaving the spraygun.

This definition was used by Mr Paul Dobson of Edward Searle CC when he presented his paper to an OCCA Natal meeting held on 15 May 1990. In the case of conventional spraying the transfer efficiency is around 50%. Sometimes it is as low as 20% if it is used on tubular or wire products. The problem is that there is roughly nine volumes of compressed air to one volume of paint and this high volume high pressure air hits the surface causing turbulence and bounce-back commonly referred to as overspray.

The airless spray principle was probably developed from garage grease and wash pumps. This led to a substantial improvement in transfer efficiency – in the order of 60 to 70%.

Further improvements were effected with the introduction of the electrostatic spray gun. When this was combined with the centrifugal atomizer, transfer efficiencies in the order of 95% could be attained in a well tuned system.

Mr Dobson then illustrated his paper with a video on an electrostatic bell system at a motor assembly plant in South Africa. Here the system applies the prime coat to their full range of body styles. The fully computerised robotic spray system consists of four vertical reciprocating robot arms mounted with turbo bells and one overhead horizontal arm mounted with two bells. This system is unique in that it automatically identifies 19 different body styles by measuring the various profiles with photo-electric cells, then feeds this information to the computer which in turn programmes the robots in that particular body style movement.

Following questions and answers by Mr Dobson, Mr Robin Archer proposed a vote of thanks to Mr Dobson.

E. Puterman ■

Transvaal Section

Dispersions

On Wednesday 18 April, Mr Eric Sharpe of TechniChem Sales spoke to the section on "Universal colour dispersions".

He explained the advantages of using the E line pigment dispersions for non aqueous industrial finishes and the Q line for aqueous finishes. All the dispersions are based on the highest quality resins and the pigments used are all identified by manufacturer and percentages used in the dispersions.

Since the "E" line dispersions would be used to pigment all types of industrial vehicles, it was no longer necessary to have a dispersion line in-plant for each vehicle type and this would reduce the inventory.

After a lively question time, the vote of thanks to both Eric Sharpe and TechniChem Sales who sponsored the evening, was given by Steve Reilly.

P. Lind ■

OCTOBER JOCCA PHYSICAL TESTING

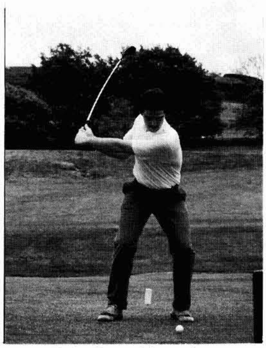
Northern Sections

Tony McWilliam Golf Trophy

This annual trophy was held on Thursday, 24 May 1990 at Bradley Hall Golf Club, Halifax. This course is most interesting with a variety of natural hazards. It is well maintained and the greens in particular were in excellent condition.

The organisers were sorry to note a low level of response for this competition and only 12 players teed off. However, this in no way spoiled the enjoyment.

The competition is run for all northern sections, but on this occasion only teams from West Riding and Manchester competed. A subsidiary competition is run for guests of members and this was decisively won by Dale Crystal as well as achieving the best score for the competition as a



Dale Crystal in action

whole. The winning team were Terry Wright, Cyril Williams and John Everett from Manchester Section and the trophy was duly presented. There were, however, sufficient prizes for all the competitors and the day was

West Riding Chairman Rob Lewis in a hole

finished off with an excellent meal in the 'Bunker' Restaurant.

It remains to be seen whether this competition can continue to stand on its own or whether it will, like so many others, be amalgamated into a larger golfing occasion.

G. C. Alderson ■

Manchester Section

Treasure hunt

A new event was added to our social calendar this year, namely a Car Treasure Hunt.

Despite circulation in JOCCA and by whips notice the numbers taking part were exceptionally poor. Seventeen members and friends in 6 cars set out from Coates Lorilleux factory at Milnrow, Rochdale, on Sunday 24 June 1990.

The rather wet weather did not deter the intrepid hunters, who, after a short manoeuvrability test, travelled through Milnrow, past Hollingworth Lake to Littleborough, Walsden, Lumbutts and finally to Hebden Bridge. The route involved main and side roads, with the negotiation of hairpin bends and narrow bridges requiring good driving skill. During the journey clues had to be answered and several treasures collected after deciphering their anagrams. A Highway Code questionnaire was also included.

Once in Hebden Bridge further clues were answered on a short walkabout whilst attempting to obtain the password from a JOCCA carrying pedestrian.

A short trip to the Tythe Barn Inn brought the hunt to an end, where papers were marked and food and drink consumed to put both body and soul together again.

A grand total of 228 points could have been scored, however to win the booby prize Phil Slater and colleagues amassed 25 points. Second prize was awarded to Miss Leach and friends from ICI with 142 points. The first prize after much diligence by his wife, son and friend went to Graham Fielding with a score of 178 points.

All present indicated that the afternoon had been thoroughly enjoyable and asked when the next 'hunt' was to be.

Thanks were duly accorded to Scott Bader for donating a prize and to Mike Nixon and family for organising and marshalling the event.

(Another hunt will only be arranged if a larger attendance can be guaranteed. Please write to G. Fielding, Secretary, or N. Seymour, Chairman, if you wish to support this social, family event.) *M. Nixon* ■

Classified Advertisements

SERVICES

LOOKING TO EXPAND?

- appointment of distributors
- exploitation of technology
- patents and trade marks
- licence agreements

For expert advice contact

MORGAN CONSULTANTS

Expertise from over 30 years practical experience of all major developed and third world countries. Many contracts negotiated and concluded in Europe, China, South America, Korea, Phillipines, etc., etc. wide experience of surface coatings and plastics.

16 Upperway, Upper Longdon, Rugeley WE15 1QA
Tel: 0543 490475 Fax: 0543 257138

Enter H301 on Reader Reply card

ANALYSIS · TROUBLE SHOOTING · RESIN FORMULATION

Paints · Resins · Printing Inks

Electropaints a Speciality

LEDGER SCIENTIFIC

Unit 5, Dyffryn Industrial Estate, Hengoed, Mid Glamorgan CF8 7RJ. Tel. 0443 816614

Enter H302 on Reader Reply card

JOCCA CLASSIFIED

can be placed by contacting Victoria Craik by
Telephone: 081-908 1086
Fax: 081-908 1219

CONFERENCE

Iron Oxides in Colorant & Chemical Applications.

A two-day international conference in Washington D.C., 25-26 September, 1990.
For details of topics, speakers, meeting arrangements, etc., contact Falmouth Associates, 170 U.S. Route One, Falmouth, Maine 04105 USA. Tel: 207-781 3632 Fax: 207-781-4177.

Enter H303 on Reader Reply card

SITUATIONS VACANT

BUREAUTECH SCIENTIFIC STAFF AGENCY

Top jobs for chemists experienced in the polymers, paints, inks, adhesives and surface coating industries. We cover the entire spectrum from technician to M.D.
Our service is friendly, fast and free.
Please send your full c.v., including salary required, desired job and location, to:-
B.S.S.A., 46 Selvage Lane, Mill Hill, London NW7 3SP.
Telephone: 01 959 3517
Enquiries also welcomed from employers.

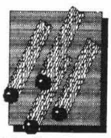
Enter H304 on Reader Reply card

SERVICES

PROBLEMS WITH SURFACE COATINGS?

for full chemical analysis of a vast range of materials...

Contact Dr Andrew Swift on
061 200 4441 (Fax 061 200 4443)



C•S•M•A

THE CENTRE FOR SURFACE AND MATERIALS ANALYSIS
UMIST PO BOX 88
MANCHESTER M60 1QD

A Partnership between UMIST and AEA TECHNOLOGY

Enter H305 on Reader Reply card

SHELLACS NATURAL RESINS GUMS & WAXES

A. F. SUTER & CO. LTD.
Swan Wharf 60 Dace Road
London E3 2NQ
Tel 01-986 8218. Tlx 919056 SUTERS G
Contact B. A. Slater

SWANLAC
ESTABLISHED 1906

Enter H306 on Reader Reply card

SERVICES

R & D SUPPORT

With our modern laboratory facilities
we are at your service

Industrial chemical research
Process research & development
New product ranges
Yield optimisation
Novel synthetic routes
By-product stream utilisation
Quality control procedures

- SURFACTANTS
- OILS, FATS & WAXES
- ORGANIC INTERMEDIATES
- HETEROCYCLICS

St Andrews ChemTech International Ltd

Technology Centre, St. Andrews, Fife KY16 9SR Scotland
Telephone 0334 76890. Fax 0334 76493

Enter H307 on Reader Reply card

PLANT & MACHINERY

Winkworth MACHINERY LIMITED **OFFER**

Winkworth Heavy Duty 'Z' Blade Mixer Model 31Z. Approx. 21 litres working capacity. Jacket Hydraulic Tilt. 40h.p. two speed drive.
Winkworth ½ litre Stainless Steel Laboratory 'Z' Blade Mixer.
Gardner 800 Litre Stainless Steel 'U' Trough Mixer (two available).
Laboratory Perspex 'Y' Cone Blenders.
Russell 20" Vibratory Sieves.
Pascall Laboratory 3 Roll Mill.
Sharples Stainless Super Centrifuges (3 available).
Send for latest list.
Winkworth Machinery Limited, Willow Tree Works, Swallowfield, nr. Reading, Berks. RG7 1QX.
Tel: 0734 883551. Fax: 0734 884031. Telex: 847967.

Enter H308 on Reader Reply card

Fairfield Dalton Ltd

Home Office Stores,
The Common, Parbold,
Near Wigan. Lancs, WN8 7DB
Tel: (02576) 3198/2025
Fax: 4246. Telex: 67603.

NEW EQUIPMENT FOR SALE:

S/STEEL SCRAPED WALL PANS, Jacketed, Vac, Pressure.
VICKERS WORSAAM 'Z' BLADE S/S Mixers — New!
LARGE INVENTORY OF EQUIPMENT:
SILVERSON 10, 15 & 20hp; 10hp Flash Mixer.
LODIGE MORTON Ploughshare Mixers, M/S & S/S.
GUEDO Jktd Underarm Mixer; KELLIE Pulper Mod. 2JA.
DRIVER SOUTHALL 53" x 36" VIB Sieve.
MASTERMIX, 10hp, 24" diam. Trifoil Impeller, 0-300 rpm.
VEEDERROOT Batching, Wayne, Rhodes & Taylor Flowmeters.
BAKER PERKINS 'Z' Blade Jktd SS Mixers.
TORRANCE MIXER, 50hp, 38" diam. Trifoil Impeller, 0-180 rpm

SEND FOR FREE CATALOGUE & BROCHURE — NOW!

Enter H309 on Reader Reply card

SITUATIONS VACANT

No. 1 in Europe – Leaders Worldwide

Tioxide

TEAM LEADER VACANCY

Tioxide Group is a world leader in the production of titanium dioxide pigments.

We now have a vacancy for a Team leader to lead a group of scientists and technicians improving and developing new pigment grades to form the basis of our product range in the future. It is envisaged that the work will involve designing products specific to customer requirements and will therefore involve building close links at a technical level with our customers. The job will be based at our Central Laboratories in Stockton on Tees.

Candidates should be graduates with experience in industry, aware of the needs of Tioxide's customers who are mainly in the paint, plastics, rubber and printing ink industries and used to motivating teams designing products specific to customer requirements.

Personal qualities which the ideal candidate will need include drive, the ability to encourage creativity and good communication skills.

We offer a salary in the range of £25,000 – £30,000 together with non-contributory pension and a profit share scheme, a company car, generous holiday entitlements, plus other benefits.

If you would like to join us, please contact Mrs Sarah Todd for an application form at Tioxide Group PLC, Haverton Hill Road, Billingham, Cleveland, TS23 1PS, Telephone: (0642) 370300 ext. 6317. Completed applications should be returned by 27th August 1990.

Step up with JOHNSTONE'S PAINTS

DEVELOPMENT CHEMIST DECORATIVE PAINTS

An experienced paint chemist is required to work on the development and formulation of all types of decorative paint.

Applicants must ideally be qualified to a minimum of 'A' level standard or equivalent with several years' experience in a Surface Coatings Development Laboratory.

The ability to motivate effectively is considered important as the successful candidate will head their own section.

A salary reflecting the experience and potential of the candidate will be offered.

Please reply in writing with a full c.v. to:

The General Manager
Johnstone's Paints PLC
Stonebridge House
Edge Lane
Droylsden
Manchester M35 6BX

DEXTER PACKAGING PRODUCTS DIVISION — THE DEXTER CORPORATION

DEXTER PACKAGING PRODUCTS

CHEMIST

The Dexter Corporation, a U.S. based company with operations worldwide, is looking to recruit a chemist for its Deeside operation.

The Packaging Products Division manufactures coatings for the beer, beverage and food packaging industry in the UK.

A sound knowledge of paint formulation and manufacture is required, with experience gained from at least three years in a technical capacity in the coatings industry. Preferably qualified to degree level or equivalent in chemistry. We envisage the successful candidate will have a varied and challenging position within the technical area.

Salary is negotiable, commensurate with qualifications and experience.

Applications in writing with full curriculum vitae to:

Ian C. Thomson,
Administration Director,
Dexter Packaging Products,
Parkway, Deeside Industrial Park,
Deeside, Clwyd CH5 2NN

SITUATIONS VACANT

A world class future

DEVELOPMENT CHEMISTS

Coil Coatings
To £22K + Benefits Slough

In a constantly changing Industrial Environment, we're looking for people in a class of their own.

Every so often, something superior is created which stands apart in a class of its own. The product of excellence. And so it is a commitment to excellence that will set ICI Paints apart from its competitors. In keeping with this philosophy, our Coil Coatings business has recently reorganised its European Operation to reflect market changes and opportunities. As a result we now have two vacancies for Development Chemists.

The people we seek are of graduate calibre with proven experience in coil coating paint development, and the foresight and application to achieve the exacting demands of our industrial clients. Reporting to the European Technical Manager, you will research and develop new products and technologies.

Initiative, a creative approach and excellent communication skills, combined with a real enthusiasm for the job in hand, will stand you in excellent stead for rewarding career development within the company. If you can demonstrate strong leadership skills, the potential is there to assume rapidly increasing responsibility. Proficiency in written or spoken German would be an advantage.

Salary is dependent on experience and qualifications, and the outstanding benefits package includes 25 days' holiday, profit share after qualifying period, pension and health schemes, and holiday bonus.

Please send full career details together with current salary to: Faith Jones, Personnel Department, ICI Paints, Wexham Road, Slough SL2 5DS, or telephone (0753) 877019 (24 hour answerphone service) for an application form.
ICI is an equal opportunities employer. Applications are welcome from both sexes and members of all ethnic groups.

ICI **Paints**

THE BRITISH RESIN MANUFACTURERS' ASSOCIATION

RESIN INDEX 1989

112pp, Comb-binder

ORDER FORM

To: OCCA, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF, U.K.

Please forward .... copy/ies of **Resin Index 1989** at £40 (post free U.K., plus £3 for overseas)

I enclose a cheque for £ .... made payable to OCCA.

Name ....

Address ....

....

XX[th] European Congress of Technicians
of Paints, Varnishes, Adhesives and Printing Inks
of the

FATIPEC

NICE • ACROPOLIS
FROM 17th TO 20th SEPTEMBER, 1990

INTERNATIONAL EXHIBITION OF PAINTS,
VARNISHES, ENAMELS, ADHESIVES and PRINTING INKS

EUROCOAT'90

where, on a space of 5,000 square metres, will be presented the latest technological innovations in the fields of

- WORLDWIDE CHEMISTRY • INDUSTRIAL ENGINEERING • LABORATORY EQUIPMENT
- MEASURING AND INSPECTION EQUIPMENT • APPLICATION AND PRODUCTION EQUIPMENT • PACKING AND PACKAGING EQUIPMENT

SCIENTIFIC PROGRAMME
AFTPV 5 rue Etex F. 75018 PARIS
Tel. 33 (1) 47 73 01 23 - Fax 33 (1) 49 00 05 91

EXHIBITION, ORGANIZATION AND INVITATIONS
IDEXPO 21 avenue de la Division Leclerc F. 94230 CACHAN
Tel. 33 (1) 46 65 18 34 - Fax 33 (1) 46 63 26 00 - Telex 250170

Enter H204 on Reader Reply Card