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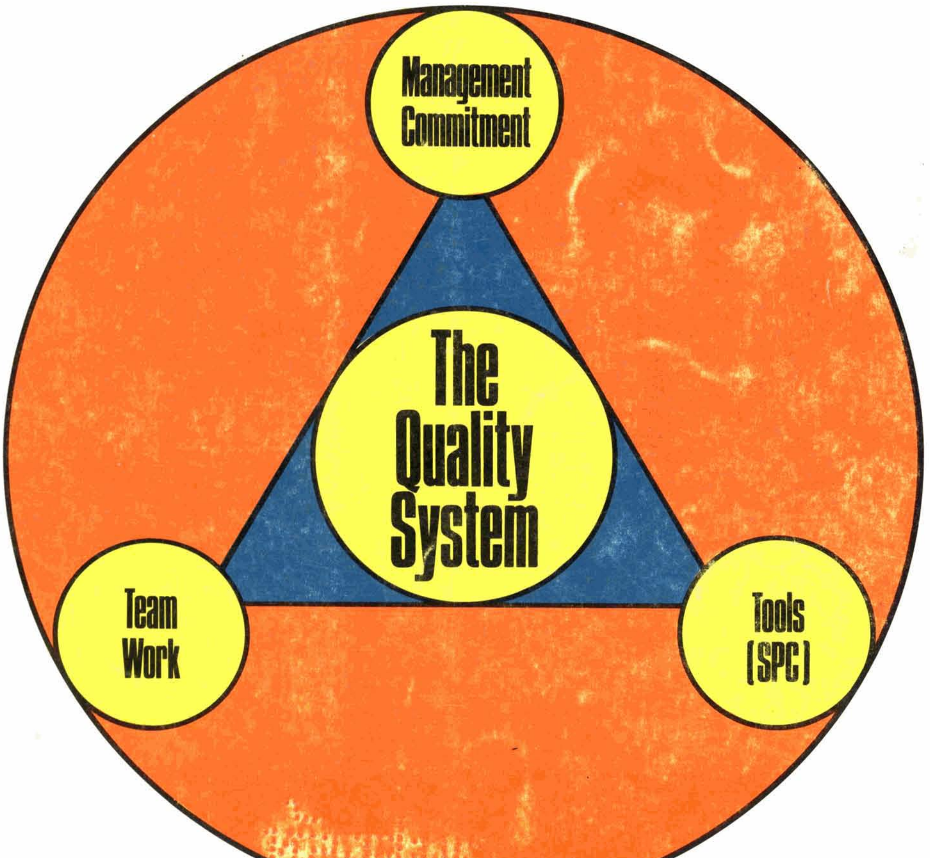
JOURNAL OF THE OIL AND COLOUR CHEMISTS' ASSOCIATION

JOCCA

THE TQM MODEL



- Just-in-Time
- SURFEX 90 Preview

▷ SURCON 91 ◁

Developments in the Science of Surface Coatings

SURCON 91 ▷ SURCON 91 ▷ SURCON 91 ▷ SURCON 91 ▷ SURCON 91 ▷ SURCON 91 ◁ SURCON 91 ◁ SURCON 91 ◁ SURCON 91 ▷ SURCON 91 ▷

Following a major review of the organisation, technical content and style of its Biennial Conference, the Association has relaunched its major technical event under the generic title of ''SURCON — Developments in the Science of Surface Coatings''. The new series of Conferences will continue to be held bienially, at different locations within the United Kingdom, but will have as their sustaining theme, reviews of major areas of scientific interest to the world-wide organic surface coating community. Different topics may feature at successive Conferences, reflecting technical changes within the industry, but the driving force for the nomination of topics and the selection of papers will be scientific and technical developments.

For SURCON 91 the four topic areas to be presented will be Raw Materials, Environmental Impact, Inks and Coatings Technology and Performance Assessment. Each topic session will comprise an invited review paper and supporting papers developing the technical theme of the review.

A Conference Management Committee has been established under the Chairmanship of the Honorary Conference Officer, Tony Jolly, and includes the Association's President, Graham North, Honorary Research & Development Officer, Simon Lawrence and Honorary Editor, John Taylor.

SURCON 91 will run from 12-14 June 1991 and will be held at the Moat House International Hotel, Stratford-upon-Avon.

Offers of papers have already been received from:

- Akzo Corporation — The Netherlands
- Ciba-Geigy Plastics — United Kingdom
- Tioxide (UK) Ltd — United Kingdom
- Ciba-Geigy Corporation, Pigments Division — USA
- Cray Valley Products Ltd — United Kingdom

The Conference Management Committee now invites interested companies and individuals who wish to present papers at SURCON 91 to contact Simon Lawrence at Ciba-Geigy Pigments, Hawkhead Road, Paisley, Renfrewshire, PA2 7BG. Scotland. Tel: 041-887 1144; Fax: 041-840 2283 for further information.

Abstracts should be submitted no later than 1 June 1990 and complete papers submitted by 1 October 1990.

All contributed papers will be reviewed by the Technical Committee and will be given between 15 - 30 minutes for presentation.

Vol. 73 No. 2 FEBRUARY 1990

JOCCA

JOURNAL OF THE OIL AND COLOUR CHEMISTS' ASSOCIATION

ISSN 0030 - 1337

Contents

Cover: The TQM Model — see page 60 (Design: John Law).

Forthcoming Features: March — Adhesion; Process Operation (PO), Filtration, April — Polymers and Resins; PO, Metering Equipment, May — Can Coatings. Contributions are welcomed at least five weeks prior to publication date.

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Editorial correspondence should be addressed to the Hon Editor, and general correspondence addressed to the General Secretary at the Association Headquarters.

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Paintmakers Association heads European drive for the safe use of paint

*T*he PA has just launched the UK phase of a pan-European Campaign aimed at professional painters nationwide. Half a million copies of "Your Health & Painting", a free booklet offering simple and practical advice on safe painting practices, will be distributed to companies, trade unions and individuals.

The booklet has been produced in consultation with two employers' associations (NFPDC and BDA) and a major trade union in the building industry (UCATT). Advice and guidance has also been provided by the Health & Safety Executive.

The booklet, supported by CEPS will eventually be translated into all European languages. **A copy of the booklet is enclosed with this issue of JOCCA.** Further copies may be obtained from Tony Newbould at the PA (Tel: 01-582 1185).

Poster to publicize booklet

British Steel coil coating line

*W*hite Young Project Engineering has successfully concluded its involvement in a major project at British Steel's Shotton Works on Deeside. The project involved the £32.5m installation of a coil coating line (production >3,000 tonnes/week) which electrolytically coats wide cold reduced strip with either zinc or zinc/nickel for corrosion resistance. White Young Project Engineering assisted British Steel with the specification and procurement associated with the equipment supply and construction contracts, expediting, inspections during manufacture and construction supervision together with detailed project planning and control.

BASF expands capital investment

*B*ASF will be increasing capital expenditure to DM 4.7b (+15%) for 1990. This will include: Ludwigshafen, W. Germany - DM 280m on a new acrylic acid plant, DM 230m on an application technology laboratory and an administration centre, DM 130m residue incinerator and DM 200m sludge incineration; Antwerp, Belgium - DM 1.3b steam cracker, DM 300m ethylbenzene and styrene production facilities.

PAID acquisition

*T*he Leeds based printing ink manufacturer PAID Ltd has acquired the Coatings and Compounding division of John Waddingtons Cartons. Waddingtons Coatings started during the 2nd World War to manufacture inks "in-house" for security reasons, today this division manufactures screen inks, paints and coatings many under licence and secrecy agreements.

Refit for Binks' Demonstration Centre

*B*inks-Bullows has completed a £0.2m refit programme for the 5,000 sq. ft. spray painting customer demonstration centre at Brownhills, Walsall, West Midlands. The new facilities include

demonstration units covering all the latest types of spray painting application equipment, including robots and electrostatic bells and discs, together with manual and conveyorised spray booths.

ICI Resins

*F*urther to the news item that appeared in December 89 JOCCA on p470. ICI Resins wishes to point out that the expansion in the powder coatings field as described is in the manufacture of polymers suitable for inclusion in powder coatings formulations and that these resins will be available to powder coatings manufacturers.

News in Brief

Daishowa Forest Products Ltd, has sold its **Dominion Colour Company** business to Japan's largest inorganic pigment producer, Kikuchi Color and Chemicals Corporation, with Headquarters in Tokyo, Japan.

Nippon Paint Co Ltd. will change name to Nippon Paint (Europe) Ltd from January 1990.

A leading Dutch custom coater, Kamp's Moffel, has specified two **Volstatic** electrostatic powder coating systems as the main finishing plant at a new factory which it has opened at Emmen, Holland.

DataStor Systems Ltd., the Cheshire based specialists in computer controlled batch weighing and process control systems has achieved a "double century". The Company recently announced that Century Oils of Hanley has taken out the one hundredth DataStor Service Contract.

Following the October 89 acquisition, **RTZ Chemicals** will become Rhône-Poulenc from the end of January 1990. **Manchem Limited** will continue to exist as a legal entity.

Pipeline Induction Heat Ltd has formed a new division called Pipeline Integrity Management in Burnley, UK for pipeline corrosion mitigation.

FATIPEC International Co-ordinating Committee Meeting, New Orleans, 1989. Standing (R to L): F. Morpeth (OCCA); C. Pacey-Day (OCCA); A. Clarke Boyce (FSCT); R. Tennant (FSCT); D. Pawsey (FSCT); C. Bourgery (FATIPEC); N. Bourgery; J. Ballard (FSCT); T. F. Johnson (FSCT); A. Poluzzi (FATIPEC); J. Roire (FATIPEC); R. F. Ziegler (FSCT). Seated (L to R): C. Dorris (FSCT); T. Saultry (OCCA Australia); A. Chauvel (FATIPEC); J. Geiger FSCT); A. G. North (OCCA); I. Kumano (JSCM); D. MacDonald (OCCA-New Zealand); S. Goethe (SLF).

US FOCUS

By Abel Banov
Co-publisher of the American Paint and Coatings Journal

FSCT chooses Weitz, a Canadian, to be president-elect

The Federation of Societies for Coatings Technology, at its Annual Meeting in early November, at New Orleans, named Kurt F. Weitz, of Indusmin Div., Falconbridge Corp., an active member of the Toronto Society, as president-elect.

He will serve during the presidency of John Ballard of the Kurfees Co. Ballard succeeds James E. Geiger, of Sun Coatings, Inc., who received the distinguished service award for his outstanding contributions to the progress of the industry while in office and before.

Although the organization is primarily based in the USA, selection of Weitz, a Canadian, shows its international orientation. Included among its member societies are groups in Birmingham, England; Mexico; and New Zealand, in addition to Montreal, Toronto, and Vancouver, in Canada.

The George Baugh Heckel Award, the highest honor accorded by the Federation went to Ruth Johnston-Feller, who is associated with the Mellon Institute and Carnegie-Mellon University's research center. Her recognition was for work in colorimetry in the past two decades.

Technological advances highlighted the annual meeting

Using "Coatings Worldwide - Meeting the Needs of the Nineties" as its theme, the 67th Annual Meeting and 54th Annual Trade Show of the Federation offered an unusually large number of new developments, many of them concerned with products and procedures to reduce solvent content so that formulators would be able, with minimum hardship, to meet increasingly rigid environmental constraints.

Others were concerned with coating plastics and formulating self-priming coatings and numerous excellent papers were concerned with testing; scientific explanations for various phenomena associated with coatings application and performance; and improved formulations, in general.

First place in the competition for the coveted Roon Foundation Awards went to Prof. John K. Gillham and G Wisanrakkit, of Princeton University for their paper on "The Glass Transition Temperature as an Index of Chemical Conversion for a high Tg Epoxy/Amine system: Chemical and Diffusion controlled reaction Kinetics" in which they showed that Tg can be used as a parameter to monitor the isothermal cure of a tetrafunctional aromatic amine and difunctional epoxy system. They showed a one-to-one relation between Tg and conversion, which is independent of cure temperature.

An award for delivering the best paper prepared by a Society went to the Detroit Society for "Poly(Epoxy-Urethane Acrylic) Interpenetrating Polymer Network's (IPN's) for Primer Application. In the research, the urethane triol acrylic macromonomer was crosslinked by free-radical polymerization of the pendant double bonds and the hydroxy-functional epoxy was crosslinked by a blocked isocyanate curing agent.

Measurements were carried out to show effects of amine terminating agents on functioning of the epoxy, notably on such physical properties as corrosion resistance, impact strength and adhesive strength, among others. This paper was a follow-up to a paper on earlier aspects of the research.

Work on IPN's was also reported by a team from Eastern Michigan University. "Solubility Studies on IPN Modification of Acrylate and Methacrylate Systems" was the title of the paper presented by Pravin K.

Kukkala, whose work was in collaboration with John C. Graham, and Shwu-Shya-Shyu. They studied swelling and solubility characteristics of IPN systems based on 1,4 butane diol dimethacrylate and 1,4 butane diol diacrylate as crosslinkers.

They concluded that swelling and solubility characteristics are related to IPN modifications to a greater extent than with simple crosslinked systems, although IPN's possess enhanced solvent resistance in comparison with normal crosslinked polymers. Their paper also correlated glass transition temperatures to different sequential methods and different levels of crosslinking monomer used in the IPN synthesis.

Among the more interesting papers presented at the technical sessions was one by a team from CasChem, Inc., on "A Second-Generation Modifier for Low VOC Polyurethane and Melamine Coatings." Cheryl N. Blomquist, Richard S. Offin, and Clayton Crawford discussed a second-generation reactive diluent, derived from ricinoleic acid and based on experience with a graft polyol. The new polyol is 100 percent nonvolatile with low viscosity.

VOC's of 2.8 lbs/gal., or less, can be achieved, they reported, with improved sprayability. Accelerated weathering studies have also demonstrated improved gloss retention and color stability. Used as a modifier for melamine coatings, the new diol can produce coatings at 2.6 lbs/gal VOC, or less, without any loss of color at a typical melamine bake-cycle.

"Two-component Isopolyester Urethane Coatings for Plastics" were covered in a paper by Stephen H. Shoemaker, of Amoco Chemicals Co. He said the resin system for the high-solids, product was a low-molecular weight hydroxyl-functional polyester with equimolar parts of isophthalic acid and adipic acid, in addition to neopentyl glycol and trimethylol propane.

The resin, he said, is crosslinked with aliphatic polyisocyanate resins based on hexamethylene diiocyanate. The resulting coatings air-dry or cure at low temperatures, making them suitable for heat-sensitive thermoplastics.

The product, he observed, is desirably balanced in flexibility and hardness and exhibits excellent impact strength, elongation, abrasion resistance and chemical and moisture resistance.

Japanese scientists from Dainippon Ink & Chemicals, Inc., presented results of studies using a non-isocyanate product to provide high performance coatings. N. Shitai, M. Ooka, and H. Tanaka used a novel crosslinking system to combine an acrylic copolymer containing tertiary amine groups with a silane compound having a glycidyl group and an alkoxy silyl group in the same molecule. The resulting polymer provides coatings with fast-dry, hardness, weather resistance and adhesion to a large number of substrates.

Another group of Dainippon researchers reported on "Room Temperature Crosslinking Urethane-Acrylic Composite Polymer Emulsions." They reported on the chemical reactions and the desirable characteristics of the emulsions they produced.

Roger A. Heckman, ARCO Chemical Co., presented a paper on "The Reaction of Hydroxylated Solvents with Isocyanate Resins," in which he set forth results of using a glycol ether solvent with secondary hydoxyl groups to react with an isocyanate, rather than traditional esters or ketones. He found that desired polyol-isocyanate reactions were able to compete effectively with the solvent-isocyanate reaction so that performance properties are not affected.

Products

Golden pearlescence

The Mearl Corporation, New York, NY, has introduced Mearlin (R) Aztec Gold, the newest addition to the company's expanded offering of golden pearlescent lustre pigments which now consists of 17 different grades. Mearlin Aztec Gold is an environmentally safe, non-metallic lustre pigment. It consists of mica platelets coated with titanium dioxide and iron oxide. Average particle size ranges from 6-50 microns in length. The resulting effect seen is a deep, rich, golden-orange color exhibiting intense lustre.

For further information Enter B301

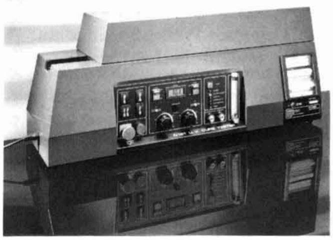
New AC lacquer

A revolutionary new non-yellowing acid catalysed lacquer has been introduced by Macpherson Woodfinishes. This clear lacquer may be used to overcoat white or pastel shades and is suitable for all light woods. Used as a topcoat, it can help protect wood from the uneven and unsightly fading which occurs when surfaces are exposed to sunlight. A special feature of this innovative new product is its low formaldehyde content.

For further information Enter B302

Equipment

New UV-cure tester

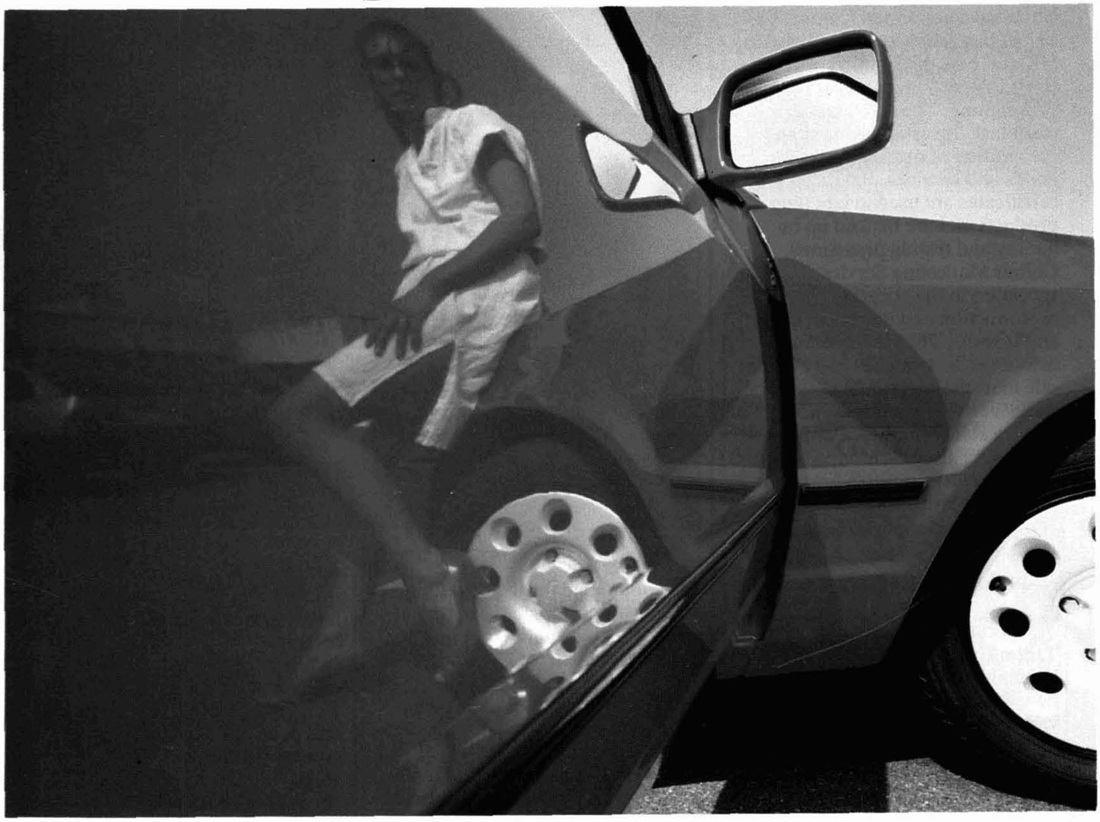


Thomas Swan & Company Limited has introduced the N121 UV-Curetester which was developed in co-operation with Leeds University's Department of Colour Chemistry.

Ease of use is a major feature of this instrument. In operation, the substrate — with a coating of wet, uncured film — moves at a pre-set speed whilst in contact with a fixed probe, within a controlled UV-irradiated environment. As the ink or varnish cures, changes in resistance to the motion of the sample are recorded and presented as a graph. This shows the characteristic cure profile and the irradiation received by the coating.

For further information Enter B303

Shining through.



Coating raw materials from Hüls – they are binders, crosslinkers, synthetic resins, PU raw materials, hardeners, components for powder coatings, coating powders, dispersions, solvents, plasticisers, dispersion and wetting agents, emulsifiers, catalysts and additives – a rounded programme for the paints and coating industry. Coating raw materials from Hüls – today more than ever, that means research and development for new products with higher environmental quality from an aspect of raw materials and energy conservation, searching for tailor-made formulations and realistic testing. Coating raw materials from Hüls – what also shines through is close cooperation with producers and users.
We'll make your problem our problem. Because we at Hüls want you to shine through your products. Hüls (U. K.) Ltd., 43-51, Windsor Road. Slough, Berkshire SL1 2HL.

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hüls

RAL — Colour Marketing Services

The RAL Deutsches Institut in Bonn have appointed Colour Marketing Services Ltd of Ipswich, UK and Eire distributors of their RAL Colour Presentation Programme. The RAL has as a main task the establishment and recognition of quality marks for goods and services. RAL certificates are used in labelling of products and are backed up by quality and testing provisions. Colour Marketing Services specialise in the accurate reproduction and display of colour and texture. They manufacture colour cards, swatches and point of sale material for paints, wallcoverings, laminates, inks, textiles and cosmetics. Colour Marketing also research, advise and design creative, effective answers to colour display problems.

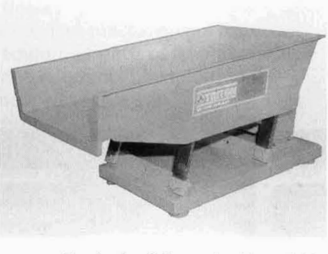
For further information Enter B304

New design E/Mag feeders

Vibrating equipment specialists Triton Engineering are re-launching their extended range of new design electro-magnetic vibrating feeders. This range now includes totally enclosed troughs as standard for sealed system feeding.

Based on their original proven open trough feeders, the new Triton design uses strengthened trough assemblies for even longer, trouble-free operation. Covers on larger feeder bases are now eliminated to simplify routine inspection of power units and spring systems.

The range covers 32 machines of which 14 are stainless construction. Throughputs vary from under 1 kg/hr to 45 TPH and all feeders include a separate controller for stepless feed-rate adjustment.



For further information Enter B305

Revolutionary containers

Project Eureka — this has been the code-name for the development of a revolutionary and exciting new concept in packaging for emulsion paint. Produced for Crown Berger Europe by Reed Plastic Containers, this totally original pack is being used to market "Advance", a new one-coat emulsion paint which Crown claims to be the first really significant innovation in this field for 25 years. The introduction of Advance follows Crown's success with "Solo", a gloss paint that needs no undercoat. In addition, Reed claims that the new container is the first major development in emulsion paint packaging since the launch of its own award winning "Paintainer" all-pastic lever-lid can in 1982.

The new pack for Crown Advance paint, produced at Reed's Blackburn factory, is a 2.5-litre container utilising components manufactured from PET and polypropylene. The main body of the container, which has a square section with rounded corners, is injection stretch blow moulded from PET, and a brush wiping device is punched out from a sheet of the same material. Other components are a collar, handle and lid injection moulded from polypropylene. Point-of-sale impact, brand image projection and directions for use are provided by a printed PVC shrink sleeve, which incorporates a clear, transparent section.

When assembled, the new container — designed for Crown Berger by Packaging Innovation and developed in close collaboration with Reed — features a wide aperture for ease of brush access. The transparent PET body of the pack allows the consumer to see the actual colour of the paint, instead of having to rely on charts or a reproduction of the shade on a label.

The specially shaped handle which, when folded down fits flush into the collar, is more comfortable than the conventional style and is positioned off-centre. This is designed to allow the container to be tipped one way to get the brush in and out with ease. The handle design also enables the container to be tipped the other way, allowing paint to be poured into a roller tray over a special 'lip'. Another important design feature, the lip eliminates problems of dripping paint down the outside of a container, or into the gutter around the top so that it sticks to the lid when it is replaced.

The brush wiping device helps overcome the problems caused when a decorator wipes paint on the rim of a can. Welded inside the neck this enables excess paint to be wiped back into the container to allow correct loading of the brush.

A further major design feature is the closure, which allows easier opening and improved resealability.

Its revolutionary square cross-section allows the new container to be handled with maximum utilisation of storage and transportation space. The shape and size of the pack also enables retailers to stack it easily and to make effective use of valuable shelf space in their stores.

For further information Enter B306

Meetings

Control of waste in the paint industry

A 2-day international conference on "The Control of Waste in the Paint Industry" will be held on 27-28 March at the Heathrow Park Hotel, Heathrow, UK. For further information call 0234 853605.

Quality assurance in metal finishing

On 21 March 1990 the Metal Finishing Association will hold a conference on the above topic at Hinckley, Leicestershire. For further information call 021-236 2657.

Liquidex 90

Acompletely new exhibition, covering all aspects of the handling, storage, processing and transportation of every kind of fluid will take place from 3-5 April 1990 in Hall D at the Exhibition Centre in Harrogate, and its 70 participating companies will be displaying a wide range of products, including storage vessels, tanks, drums, pumps, valves, mixers, blenders, actuators and controllers, weighing and measuring devices, process control equipment — and much more. Ticket Hotline on 0895 56751.

OPEN TECH Surface Coatings Technology

The Paintmakers Association will be commencing another session of Open Tech study from the end of February. This session will now include the latest 30 hour module on Powder Coatings — Formulation Principles which has been produced to follow the one on Manufacture and Application, which has now been successfully piloted by 27 students.

Any enquiries or applications please write immediately to Mr Don Clement at P. A., Alembic House, 93 Albert Embankment, London SE1 7TY.

I Chem E 1990 Courses

The Institution of Chemical Engineers will be holding the following powder courses: 3-6 April, Getting Started in Powder Technology, Bradford; 9-11 April, 2-phase Separation with Cyclones, Bradford; 18-19 April, Enlargement and Compaction of Solids, Bradford; 16 May, On-Line Monitoring of Particle Size, London; 17 May, Porosity and Surface Area of Particles, London. The I Chem E are also holding: 27-29 March, Liquid Filtration, Loughborough; 2-3 April, Chemical Analysis — Instrumental Methods, Nottingham; 2-5 April, Control and Management of Batch Production, Teeside Polytechnic. For course details call 0788 78214.

Literature

Literature Miscellaneous

Carri-Med CSL Rheometer. Colour brochure describing the Carri-Med Controlled Stress Rheometer.

For further information Enter B307

Scott Bader — Brochure on "New Acrylic Dispersions for exterior wood coatings — Texicryl 13-777 and Texicryl 13-666".

For further information Enter B308

Brüel & Kjaer new catalogues on "Gas Detection Limits — Gas Monitors using various optical filters" and "The dawn of a new era in gas monitoring".

For further information Enter B309

Mearl: 4 page brochure — Discovering the Colorful World of Mearl Pearlescent and Iridescent Luster Pigments.

For further information Enter B310

NTIS — US National Technical Information Service — 160 million pages from universities, government research departments and industry from over 100 countries. Microfiche/paper. ILI. Free search request.

For further information Enter B311

Degussa — 48p colour brochure on "Matting Agents for Paints".

For further information Enter B312

CALL FOR PAPERS

JOCCA is seeking technical papers for possible publication in the August 1990 issue on the feature—1992, the year of the European Single Market. Papers should cover research or technical matters of particular relevance to the European surface coating industries, including reviews and reports on European collaborative projects. Papers are also invited from public and private research organisations within European countries, describing the work undertaken and particular areas of expertize.

Papers should be a maximum of ten pages (in double-spaced lines) and may include up to ten tables, graphs and illustrations (combined total). To be considered, please send a 50-word abstract or brief outline by 1 May 1990 to John Taylor, Honorary Editor, JOCCA, The Wolds, 51A Porth-y-Castell, Barry, South Glamorgan, CF6 8QD. Deadline for the September issue is 15 June 1990.

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

People

BASF appoints new Chairman

BASF has appointed Dr **Juergen Friedrich Strube** as chairman of the board of executive directors of BASF Aktiengesellschaft, succeeding Dr Hans Albers who retires following the annual meeting on 28 June 1990. Dr Strube is currently responsible for foam plastics, polyolefins and PVC, information systems, and the Brazil and Latin American regional divisions.

Dr J. F. Strube

Beckers restructures for 1990's

Leading Swedish Paint Manufacturer, AB Wilh Becker, has announced a major restructuring of its European Industrial Coatings operations. The Swedish owned company has split its operations into three distinct business areas. These are Becker Powders, Becker Industrial Coatings and Becker Acroma — the Wood Finishing Business Area.

A number of senior appointments in the U.K. become effective from January 1990. **John Lyon** is promoted to Managing Director of Bekcer Industrial Coatings, with responsibility for all coil coatings and general industrial activities, and **Eddy Moules** becomes Managing Director of Becker Acroma.

Geoff Longstaff, formerly Managing Director of Beckers U.K. operations becomes Business Area Manager — Powder across Europe and the US, and is promoted to Vice President of AB. Wilh Becker. He will also act as non-executive chairman of the UK Group. **Aled Roberts** remains as Managing Director of Becker Powders in the UK. **Bill Rising** is appointed Controller for Becker Powders Business Area, covering all Powder operations within the Becker Group.

DeSoto appointment

County Durham-based paint manufacturer DeSoto Titanine has appointed **Peter Fisk** as chairman, in addition to his role as managing director. He has been with the company for 35 years — the last ten as managing director. His appointment is seen as a vote of confidence in the present management by the company's new owners DeSoto Inc of Illinois, USA.

P. Fisk

Bayer UK appointment

Bayer UK, the chemical and pharmaceutical group, has appointed Dr **Michael Hughes** as director of the Organic Chemicals division, following the retirement of Bob Briscoe, the former director of the division. Mike Hughes, an organic chemist, joined Bayer UK in 1974 as a product correspondent with the Inorganics division and in 1986 moved to the Organics division.

Fred Morpeth (R), Managing Director of Foscolor congratulating Stan Jones on his appointment to the board.

New Director for Foscolor

Foscolor Limited, the Wigan-based manufacturer of pigment chips and concentrates, have announced the appointment of **Stan Jones** as Director.

Stan joined Foscolor in 1978 when the company was part of the Foseco group and participated in the management buyout which took the company into independence in April 1988. The new appointment reflects the subsequent growth of the company which has seen sales increase by 150% and staffing levels by 60%.

Stan, who was previously Sales Manager, will be spending more time on general management and the company will shortly seek to strengthen its sales department.

NEWCASTLE STUDENT SEMINAR
PAINT MANUFACTURE
24 APRIL 1990, DURHAM

Corrigenda

Gardner et al, "The rate of hydration of zinc phosphate incorporated in a paint film", JOCCA, 1990, 73(1), 16 the co-Authors' surnames should read Seyd and McAra and not Seydt and McArn.

Morcillo et al, "Underfilm Corrosion of Steel . . . ", JOCCA, 1990, 73(1) 24. Table 1 — the lower of two sub-tables, Column 1 SO_4^{2-} should read Cl^- and, Column 2 $FeSO_4$ should read NaCl.

Guide For Authors

JOCCA

Introduction

The Journal of the Oil & Colour Chemists' Association (JOCCA) is published monthly by the Oil & Colour Chemists' Association (OCCA) for its world-wide readership in over 80 countries. 3,500 copies are published each month and research shows that more than 22,000 Directors, Managers, Chemists and Technologists read each issue.

JOCCA is published for the advancement of knowledge in the science and technology of coatings and inks, the materials comprising them and their manufacture, use and performance. Its editorial policy is determined by an advisory committee of surface coating scientists and technologists supported by professional staff.

The Honorary Editor invites the submission of wide ranging contributions within the following categories; technological and pure research academic papers, including reviews of research activities, papers presented at OCCA Section meetings, papers applying research to industrial use, papers in support of editorial features, papers on processing operations from equipment manufacturers, industrial market surveys, reports on surface coating meetings, book reviews and *Letters to the Editor*. All manuscripts will be assumed to be original work and to have been unpublished and not under consideration by any other organisation; not copyrighted unless by Government agencies; and, to have been submitted for appropriate clearance by the organisation with which the author is affiliated, if such clearance is necessary.

JOCCA has first right to the publication of papers presented at its Conference and at Section meetings and symposia.

Papers in which proprietary products or processes are promoted for purely commercial purposes are not acceptable for publication, but abstracts from such papers may be included in the News Section. Authors are strongly recommended to contact the Honorary Editor directly if they are uncertain of the standards required of their papers. Technical papers submitted by publicity or public relation departments often require major revision before publication.

Manuscript Copies

Two copies, if possible, should be sent to the Assistant Editor, JOCCA, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF, UK.

Manuscript Preparation

The papers should be typewritten in double spacing on one side only on A4 (210 × 297mm) paper, with at least 25mm margins around all four sides. The name and business address of the principal author, in sufficient detail for postal purposes, should appear on the first page of the paper.

Papers stored on magnetic media may be submitted for publication, provided that they are accompanied by two printed copies, 5¼ or 3½ in soft discs are acceptable. The files should be presented as ASCII and generic word processor files with extensions .TXT and .WP respectively. The wordprocessor programme should be specified. Please contact the General Secretary for further information.

Manuscript Style

Language

All contents of JOCCA will appear in the English language.

Title

Keep the title as brief as possible consistent with defining the subject matter covered in the paper. Complicated titles cause problems for abstracting services.

Authors

Give complete names and correct company affiliations and addresses of all authors.

Abstract

A 50 – 75 word English language abstract should accompany the manuscript. Avoid exceeding this length, if possible. The abstract should indicate the scope of the paper, the conclusions and everything novel in it. Whenever possible, abstracts will be translated into German and French and be published in a special editorial section at the front of the Journal. If possible, authors should provide translations of their abstracts in German and French.

Presentation Data

If the paper has been presented at a meeting of one of the Association's Sections or to some other technical group, list the name of the organisation and the date of presentation. If someone other than the author presented the paper, this should be noted. Papers presented to, but **not** published by, organisations other than OCCA must be released before they can be considered for publication in JOCCA.

Text

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1. Hoppe, M., *JOCCA,* 1988, **71**, 237.

2. Kelch, W. and Endriss, H., *Farbe und Lack,* 1981, **87**, 104.

   Kaempf, G., Papenroth, W. and Holm, R.J., *J. Paint Tech.,* 1974, **46**, 598.

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4. H. Linton, US Patent 3.470.007.

   C.P. Boekel, European Patent EP 0138753.

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Right first time

Through total quality management

by Professor John S. Oakland PhD, CChem, MRSC, FSS, FIQA, FAQMC, MASQC, MBIM, European Centre for Total Quality Management, University of Bradford, Management Centre, Emm Lane, Bradford, West Yorkshire, BD9 4JL, UK

Introduction

Total Quality Management (TQM) is a new way of managing to improve the effectiveness, flexibility, and competitiveness of a business as a whole. It involves whole enterprises getting organised, in each department, each activity, and each person, at every level. For an organisation to be truly effective, every single part of it must work properly together, because every person and every activity affects and in turn is affected by others.

TQM is also a method of removing waste, by involving everyone in improving the way things are done. The techniques of TQM can be applied throughout an organisation so that people from different departments, with different priorities and abilities communicate with and help each other. The methods are equally useful in finance, sales, marketing, design, accounts, research, development, purchasing, personnel, computer services, distribution, and production.

TQM helps companies to:

▷focus clearly on the needs of their markets
▷achieve a top quality performance in all areas, not just in product or service quality
▷operate the simple procedures necessary for the achievement of a quality performance
▷critically and continually examine all processes to remove non-productive activities and waste
▷see the improvements required and develop measures of performance
▷understand fully and in detail its competition, and develop an effective competitive strategy
▷develop the team approach to problem solving
▷develop good procedures for communication and acknowledgement of good work
▷review continually the processes to develop the strategy of never-ending improvement.

Today's business environment is such that managers must strive for competitive advantage to hold on to market share, let alone increase it. Consumers now place a higher value on quality than on loyalty to their home-based producers and price is no longer the major determining factor in consumer choice. Price has been replaced by quality and this is true in industrial, service, hospitality, and many other markets. Consumers have ever increasing expectations and this presents renewed challenges for the TQM concept.

The quality chains

The most widely accepted definition of quality is 'meeting the customer requirements' and this is vital, not only between two separate organisations, but within the same organisation. There exists in each department and office, a series of suppliers and customers and this creates a number of interlinked quality chains (Figure 1) which may be broken at any point by the requirements of the customer, internal or external, not being met. The chains of quality have to be managed, and this must involve everyone and be applied throughout an organisation.

Prevention not detection

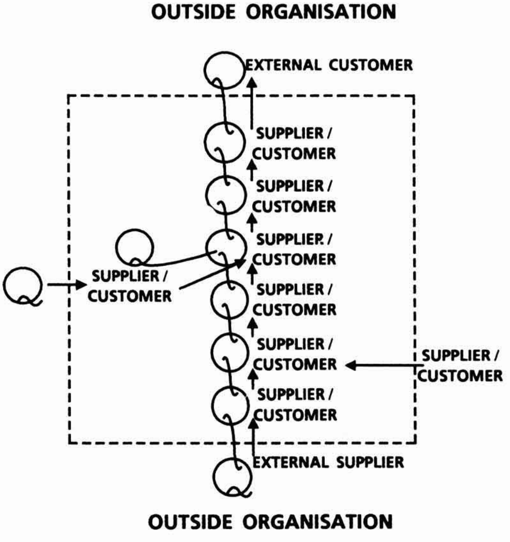
Every day in organisations all over the World, people scrutinise together the results of the examination of work done, and commence the ritual battle over whether the output is suitable for transfer to the 'customer'. They argue and debate the evidence before them, the rights and wrongs of the specification, and each tries to convince the other of the validity of his or her argument. Sometimes they nearly break into fighting.

This ritual is associated with trying to answer the question:

"Have we done the job correctly?"

'correctly' being a flexible word depending on the interpretation given to the specification on that particular day. This is not quality *control*, it is *detection*, post-operational, wasteful detection of bad product or service before it hits the customer. There is a belief in some quarters that to achieve quality we must check, test, inspect or measure – the ritual pouring on of quality at the end of the process. This is nonsense, but it is frequently practiced. In the office one finds staff checking other people's work before it goes out, validating computer input data, checking invoices, typing, etc. There is also quite a lot of looking for things, chasing why things are late, apologising to customers for lateness, and so on, waste, waste, waste.

Figure 1
The quality chains

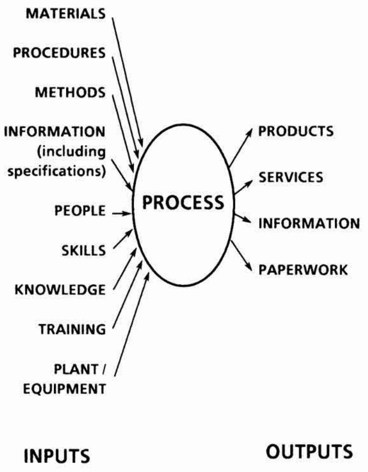


To get away from the natural tendency to rush into the detection mode, it is necessary to ask different questions in the first place. We should not ask whether the job has been done correctly, we should ask first:

"Are we capable of doing the job correctly?"

This has wide implications and TQM is devoted largely to the various activities which are necessary to ensure that the answer is "yes". We should realise straight away, however, that such an answer will only be obtained using satisfactory methods, materials, equipment, skills and instruction, and a 'process' which is capable. A process is the transformation of a set of inputs, which can include actions, methods and operations, into desired outputs, in the form of products, information, services or – generally – results. (Figure 2).

Figure 2
A process



Once we have established that our process is capable of meeting the requirements, we can address the next question,

"Do we continue to do the job correctly?"

which brings a requirement to monitor the process and the controls on it. If we now re-examine the first question: "Have we done the job correctly?" we can see that, if we have been able to answer the other two questions with a "yes", we must have done the job correctly – any other outcome would be illogical. By asking the questions in the right order, we have removed the need to ask the 'inspection' question and replaced a strategy of *detection* with one of *prevention*. This concentrates all the attention on the front end of any process – the inputs – and changes the emphasis to making sure the inputs are capable of meeting the requirements of the process. This is a managerial responsibility.

These ideas apply to every transformation process, which must be subjected to the same scrutiny of the methods, the people, skills, equipment and so on to make sure they are correct for the job. A person giving a lecture, whose slide projector will not focus correctly, or whose material is not appropriate, will soon discover how difficult it is to provide a lecture which meets the requirements of the audience.

The *control* of quality clearly can take place only at the point of operation or production – where the letter is typed or the chemical made. The act of *inspection is not quality control.* When the answer to, "Have we done the job correctly?" is given indirectly by answering the questions on capability and control, then we have *assured* quality and the activity of checking becomes one of *quality assurance* – making sure that the product or service represents the output from an effective *system* to ensure capability and control. It is frequently found that organisational barriers between departmental empires encourage the development of testing and checking of services or product in a vacuum, without interaction with other departments.

Why 'TOTAL' quality?

Some of the most exciting applications of TQM have materialised from departments which could see little relevance when first introduced to the concepts. Following training, many examples from different departments of organisations show the use of the techniques. Sales staff can monitor and increase successful sales calls, office staff have used TQM methods to prevent errors in word-processing and improve inputting to computers, customer service people have monitored and reduced complaints, distribution have controlled lateness and disruption in deliveries, construction sites have reduced waste in time and materials.

It is worthy of mention that the first point of contact for some outside customers is the telephone operator, the security people at the gate, or the person in reception. Equally the paperwork and support services associated with the product, such as invoices and sales literature, must match the needs of the customer. Clearly TQM cannot be restricted to the 'production' or 'operational' areas without losing great opportunities to gain maximum benefit.

The commitment required

Management's commitment to TQM must be real and obsessional, not lip service. It is possible to detect real commitment, it shows on the shop floor, in the offices – at the point of operation. Going into organisations sporting poster campaigning for quality instead of belief, one is quickly able to detect the falseness. The people are told not to worry if quality problems arise, "just do the best you can", "the customer will never notice". The contrast of a company where total quality means something can be seen, heard, felt. Things happen at this operating interface as a result of *real* commitment. Material problems are corrected with suppliers, equipment difficulties are put right by improved maintenance programmes or replacement, people are trained, change takes place.

TQM is concerned with moving the focus of control from outside the individual to within; the objective being to make everyone accountable for their own performance, and to get them committed to attaining quality in a highly motivated fashion. The assumptions a director or manager must make in order to move in this direction are simply that people do not need to be coerced to perform well, and that people want to achieve, accomplish, influence activity, and challenge their abilities.

The role of the quality management function

In many organisations, management systems are viewed in terms of the internal dynamics between marketing, design, production, distribution, accounting, etc. A change is required from this to a larger system which also encompasses and integrates the business interests of customers and suppliers. Management needs to develop an in-depth understanding of these relationships and how they may be used to cement the partnership concept. The quality and marketing functions should be the organisation's focal point in this respect and should be equipped to gauge internal and external customers' expectations and degree of satisfaction. They should also identify quality deficiencies in all business functions and promote improvements.

The role of the quality function is to make quality become an inseparable aspect of every employee's performance and responsibility. The transition in many companies from quality departments with line functions will require careful planning, direction, and monitoring. Quality professionals have developed numerous techniques and skills focused on product or service quality. In many cases, there is a need to adapt these to broader applications. The first objectives for many 'quality managers' will be to gradually disengage themselves from line activities, which will then need to be dispersed throughout the appropriate operating departments. This should allow quality to evolve into a 'staff' department, at a senior level and to be concerned with the following throughout the organisation:

▷encouraging and facilitating quality improvement
▷monitoring and evaluating the progress of quality improvement
▷promoting the 'partnership' in quality, relations with customers and suppliers
▷planning, managing, auditing, and reviewing quality systems
▷planning and providing quality training and counselling or consultancy
▷giving advice to management on the
- ○ establishment of quality systems and process control,
- ○ relevant statutory/legislative requirements with respect to quality,
- ○ quality improvement programmes necessary,
- ○ inclusion of quality elements in all job instructions and procedures.

Quality managers have an initial task, however, to help those who control the means to implement this concept – the managers in industry and commerce – to really believe that quality must become an integral part of all the organisation's operations.

The author has a vision of quality as a strategic business management function that will help organisations to change their cultures. To make this vision a reality, quality professionals must expand the application of quality concepts and techniques to all business processes and functions, and develop new forms of providing assurance of quality at every supplier-customer interface.

The shift in 'philosophy' will require considerable staff training in many organisations. Not only must people in other functions acquire quality related skills, but quality personnel must change old attitudes and acquire new skills. Clearly, the challenge for many quality professionals is not so much making changes in their organisation as recognising the changes which are required in themselves. It is more than an overnight job to change the attitudes of an inspection police force into those of a consultative, team-oriented improvement force. This emphasis on prevention and improvement-based systems elevates the role of quality professionals from a technical one to that of general management. A narrow departmental view of quality is totally out of place in an organisation aspiring to TQM, and the typical quality managers will need to widen their perspective, and increase their knowledge to encompass all facets of the organisation.

To introduce the concepts of operator self-inspection required for TQM, will require not only a determination to implement change but sensitivity and skills in industrial relations. This will depend very much, of course, on the climate within the organisation. Those whose management is truly concerned with co-operation and concern for the people will engage strong employee support for the quality manager or director in his catalytic role in the quality improvement implementation process. Those with aggressive, confrontational management will create for the quality professional impossible difficulties in obtaining support from the 'rank and file'.

Three major components

The organisation which believes that the traditional quality control techniques, and the way they have always been used, will result in total quality is wrong. Employing more inspectors, tightening up standards, developing correction, repair, and rework teams does not promote quality. Traditionally, quality has been regarded as the responsibility of the 'QC' department, and still it has not been recognised in some organisations that many quality problems originate in the service or administration areas.

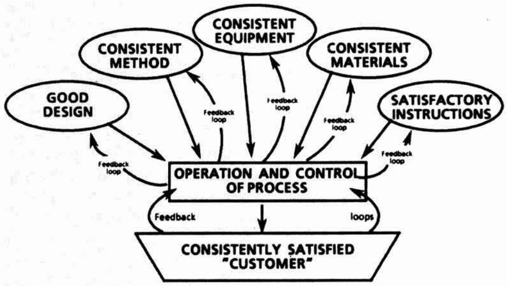
In addition to the management commitment required, there are three major components of TQM:

▷A documented quality management system
▷Statistical Process Control (SPC)
▷Teamwork

The System

To achieve TQM there is a requirement for the development and implementation of a quality management system which enables the objectives set out in the quality policy to be accomplished. Clearly, for maximum effectiveness and to meet individual customer requirements, the quality management system in use must be appropriate to the type of activity and product or service being offered. Consistency can only be achieved if we ensure that, for every product or each time a service is performed, the same materials, the same equipment, the same methods or procedures, are used in exactly the same way, every time. The process will then be 'under control'. This is the aim of a good quality management system – to provide the 'operator' with consistency and satisfaction in terms of methods, materials, and equipment (Figure 3).

Figure 3
The systematic approach to quality management



The International Standards Organisation (ISO) Standard 9000 Series (equivalent to BS 5750, 1987) sets out the methods by which a management system, incorporating all the activities associated with quality, can be implemented in an organisation to ensure that all the specified performance requirements and needs of the customer are fully met. The 'wheel' has been invented but it must be built in a way which meets the specific organisational and product or service requirements. It then requires audit and review to ensure that:

(i) the people involved are operating according to the documented system (a system audit);

(ii) the system still meets the requirements (a system review).

If in the system audits and reviews it is discovered that an even better product or less waste can be achieved by changing the method or one of the materials, then a change may be effected. To maintain consistency, it must be ensured that the appropriate changes are made to the documented system *and* that everyone concerned is issued with the revision and begins to operate accordingly.

Statistical process control

All processes can be monitored and brought 'under control' by gathering and using data. This refers to measurement of the performance of the process and the feedback required for corrective action, where necessary. Statistical Process Control (SPC) methods[1] backed by management commitment and good organisation, provide objective means of controlling quality in any transformation process, whether used in the manufacture of artefacts, the provision of services, or the transfer of information.

SPC is not only a tool kit. It is a strategy for reducing variability, the cause of most quality problems: variation in products, in times of deliveries, in ways of doing things, in materials, in people's attitudes, in equipment and its use, in maintenance practices, in everything. Control by itself is not sufficient. Total quality management requires that the process should be improved continually by reducing its variability. This is brought about by studying all aspects of the process using the basic question:

"Could we do this job more consistently and on target?"

the answer to which drives the search for improvements. This significant feature of SPC means that it is not constrained to measuring conformance, and that it is intended to lead to action on processes which are operating within the 'specification' to minimise variability.

Process control is essential and SPC forms a vital part of the overall TQM strategy. Incapable and inconsistent processes render the best design impotent and make supplier quality assurance irrelevant. Whatever process is being operated, it must be reliable and consistent. SPC can be used to achieve this objective.

In the application of SPC there is often an emphasis on techniques rather than on the implied wider managerial strategies. It is worth repeating that SPC is not only about plotting charts on the walls of a plant or office, it must become part of the company-wide adoption of TQM and act as the focal point of never-ending improvement. Changing an organisation's environment into one in which SPC can operate properly may take several years rather than months. For many companies SPC will bring a new approach, a new 'philosophy', but the importance of the statistical techniques should not be disguised. Simple presentation of data using diagrams, graphs, and charts should become the means of communication concerning the state of control of processes.

A systematic study of a process through answering the questions:

☐ Are we capable of doing the job correctly?
☐ Do we continue to do the job correctly?
☐ Have we done the job correctly?
☐ Could we do the job more consistently and on target?[2]

provides knowledge of the process capability and the sources of non-conforming outputs.

Teamwork

The complexity of most of the processes which are operated in industry, commerce and the services place them beyond the control of any one individual. The only way to tackle problems concerning such processes is through the use of some form of teamwork. The use of the team approach to problem solving has many advantages over allowing individuals to work separately on problems:

▷a greater variety of problems may be tackled, which are beyond the capability of any one individual, or even one department
▷the problem is exposed to a greater diversity of knowledge, skill and experience
▷the approach is more satisfying to team members and boosts morale
▷the problems which cross departmental or functional boundaries can be dealt with more easily
▷the recommendations are more likely to be implemented than individual suggestions.

Most of these rely on the premise that people are most willing to support any effort in which they have taken part or helped to develop.

When properly managed, teams improve the process of problem solving, producing results quickly and economically. Teamwork throughout any organisation is an essential component of the implementation of TQM for it builds up trust, improves communications and develops interdependence. Much of what has been taught previously in management has led to a culture in the West of independence, with little sharing of ideas and information. Teamwork devoted to quality improvement changes the independence to interdependence through improved communications, trust and the free exchange of ideas, knowledge, data and information.

A full discussion of the theory of motivation is outside the scope of this paper and there are many excellent texts on the subject. It is worth pointing out, however, that employees will not be motivated towards continual improvement in the absence of:

▷commitment to TQM from the management
▷the organisational quality 'climate'
▷a team approach to quality problems.

All these are focused essentially at enabling people to feel, accept, and discharge responsibility. More than one organisation has made this part of their quality strategy – to 'empower people to act'. Empowerment to act is very easy to express conceptually, but it requires real effort and commitment on the part of all managers and supervisors to put into practice. Recognition that only partially successful but good ideas or attempts are to be applauded and not criticized is a good way to start. Encouragement of ideas and suggestions from the workforce, particularly through their involvement in team or group activities, requires investment but the rewards are total involvement, both inside the organisation and outside through the supplier and customer chains.

Planning the implementation of TQM

The task of implementing TQM can be daunting and the management team faced with this may draw little comfort from the quality 'gurus'. The first decision is where to begin and this can be so difficult that many organisations never get started. This has been called TQP – total quality paralysis!

Figure 4 offers a series of steps, each of which is described in detail in the book 'Total Quality Management' by the same

[1] see 'Statistical Process Control' by John S Oakland, Heinemann, Oxford, 1986

[2] This system for process capability and control is based on Frank Price's very practical framework for thinking about quality in manufacturing: Can we make it OK? Are we making it OK? Have we made it OK? Could we make it better? which he presents in his excellent book, 'Right First Time'.

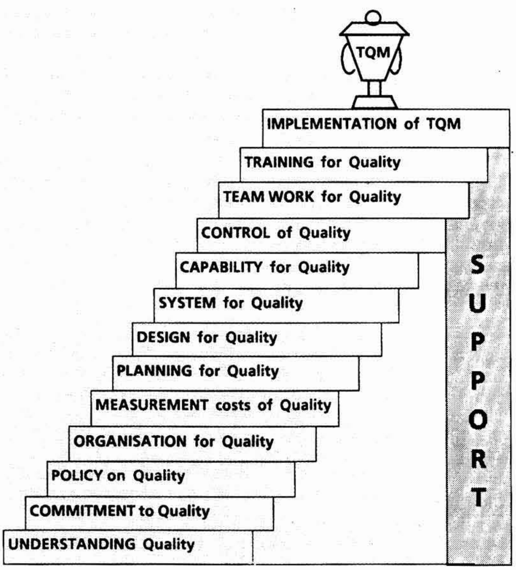
author (published by Heinemann, Oxford, 1989). These should help management to bring total quality into existence. The preliminary stages of understanding and commitment are vital first steps which also form the foundation of the whole TQM structure. Too many organisations skip these phases, believing that they have the right attitude and awareness, when in fact there are some fundamental gaps in their 'quality credibility'. These will soon lead to insurmountable difficulties and collapse of the edifice.

An organisation may, of course, have already taken several steps on the road to TQM. If good understanding of quality and how it should be managed already exists, there is top management commitment, a written quality policy and a satisfactory organisational structure, then the planning stage may begin straightaway. When implementation is contemplated, priorities amongst the various projects must be identified. For example, a quality system which conforms to the requirements of the ISO 9000 or BS 5750 series may already exist and the systems step will not be a major task, but introducing a quality-related costing system may well be. It is important to remember, however, that a review of the current performance in all the areas, even when well established, should be part of normal operations to ensure continuous improvement.

These major steps may be used as an overall planning aid for the introduction of TQM. Major projects should be time-phased to suit individual organisations' requirements, but this may be influenced by outside factors, such as pressure from a customer to introduce statistical process control (SPC) or to operate a quality system which meets the requirements of a standard. The main projects may need to be split into smaller sub-projects, and this is certainly true of quality system work, the introduction of SPC, and quality improvement teams.

An effective co-ordination of these three components will result in quality improvement through increased capability. This should in turn lead to consistently satisfied customers and, where appropriate, increases or preservation of market share.

Figure 4
The steps to TQM

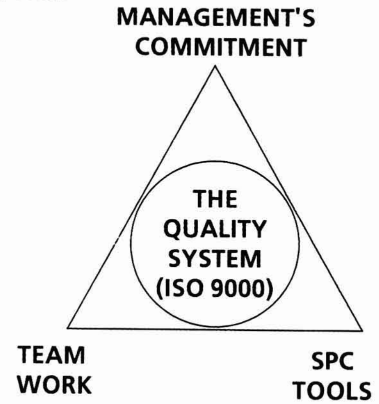


A model for total quality management

The concepts of TQM are basically very simple. Each part of an organisation has customers, whether within or without, and the need to identify what the customer requirements are, and then set about meeting them, forms the core of the total quality approach. This requires several things including a good quality management system, statistical process control (SPC), and teamwork. These are complementary in many ways and they share the same requirement for an uncompromising commitment to quality. This must start with the most senior management and flow down through the organisation. Having said that, either SPC or the quality system or both may be used as a spearhead to drive TQM through an organisation. The attention to many aspects of a company's operations – from purchasing through to distribution, from data recording to control chart plotting – which are required for the successful introduction of a good quality system, or the implementation of SPC, will concentrate everyone's attention on the customer/supplier interface, both inside and outside the organisation.

Much of industry and commerce would benefit from the improvements in quality brought about by the approach represented in Figure 5. This will ensure the implementation of the management commitment represented in the quality policy, and provide the environment and information base on which teamwork thrives.

Figure 5
The TQM Model



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Continued on p.77

Organisational aspects of implementing Just-in-Time

by G. G. Tidman, Tidman Industrial Engineering Services Ltd, Southgate Chambers, Eckington, Sheffield S31 9EH, UK.

Introduction

It was with a certain amount of apprehension that I agreed to prepare this paper. Not least of all because:

□ rarely is an opportunity given for the complete design of an organisation structure in total. Even less the authority for impartially assessing the effectiveness of any particular structure. As a result, experience is scarce and definitive works rare.

□ good organisation structure establishes an environment for performance and yet rarely are upward structures capable of being influenced. This obvious truth giving rise to oceans of organisation politics which cloud key issues.

□ when problems of resource utilisation are considered, organisational effectiveness is rarely a part of strategic planning issues and yet most structures are as a result of evolution, birthright, culture and administrative convenience.

□ the design of formal structures and resulting effectiveness is a complex and most controversial subject with a host of variables and a precious few established criteria despite an immensely complicated body of knowledge.

□ over sixty variables have been listed as influencing organisational effectiveness. See Figure 1. In addition V. A. Graicunas developed the concept in 1930, that the relationships of management multiplied in geometric progression by the number of subordinates. See Table 1.

Table 1
Relationships of management

Subordinates	Relationships
2	6
4	44
6	222
8	1080
10	5210
12	24708
18	2359602

1. Superior dealing with direct subordinates.
2. Superior dealing with other superiors.
3. Superior dealing with different groups under his control.
4. Combinations of 1, 2 and 3.

There can be no more important feature of management than organisational effectiveness which of course is the objective of any structure. To create and maintain an environment in which individuals and groups can accomplish objectives is a key responsibility which is essentially achieved through a framework of responsibilities.

Common problems will be associated with:

□ too many layers of management
□ slow communications, out of touch upper levels
□ departmentalisation of functions, sales rarely talk to production
□ new product planning is difficult
□ accommodating positions of sinecure
□ keeping procedural documentation current
□ catering for change
□ inefficient means of communications
□ ageing team members holding key positions
□ past achievements rewarded by structural position.

Despite the inexactness and, relative to chemistry, the crudity of management theory and science, the development of thought on management dates back to first attempts to accomplish tasks by working in groups. Indeed many records and ideas relating to management date from antiquity belonging to the Egyptions, early Greeks and ancient Romans and of course the administrative practices of the Church and military.

With such early beginnings and always a pressing need for the best possible practice, it seems surprising that most of the development of management theory has been confined to this century and that in real terms, an awakening to this need only since World War 2.

However, it is to factors of performance that attention is necessary and the work of F. W. Taylor (1856-1915) is undoubtedly the beginning of a sceintific management school upon which is based most of current thinking. Interestingly the division of labour, supervision, written instructions and control is a description of the work at the Flax Mill, Leeds conducted by Marshall in the 1820's some seventy years before Taylor's work.

The fundamental principle associated with Taylor's scientific approach to management is easily summarised:

□ replace rule of thumb with organised knowledge (science ?)
□ harmony in group action rather than discord
□ work for maximum output rather than restricted output
□ develop individuals to fullest extent for own and company's prosperity

In addition Taylors work on functional management established basic truth on organisation structure concerning unity of command and direction.

Any comparison of organisational effectiveness will return to these fundamentals for assessment of achievement. Indeed it is against similar criteria that managerial performance is assessed and profitability potential realised.

At the risk of over-simplification and reaping the wrath of the academics, our somewhat brief introduction to organisational effectiveness needs to go beyond the foundations of scientific management thinking and seek to identify primary drivers. i.e. those systems and procedure which can be demonstrated to be making a significant contribution to business performance.

Experience lists three such perspectives associated with:

□ individuals and invariably related to reward management
□ organisational and concerned with supervision at differing levels
□ systems and procedures devised as charters

Each of these being heavily influenced by:

□ history
□ ownership
□ size
□ technology
□ goals and objectives
□ environment

of the organisation.

In addition and often a dominating factor is an individuals perception of these influences. For those seeking to gain a better understanding of these issues reference should be made to Handy — "Understanding Organisations" and Hunt — "Managing People at Work".

However viewed organisation design has become of major interest and there is very little practiced advice available. Efforts over the past fifty years having been concentrated on:

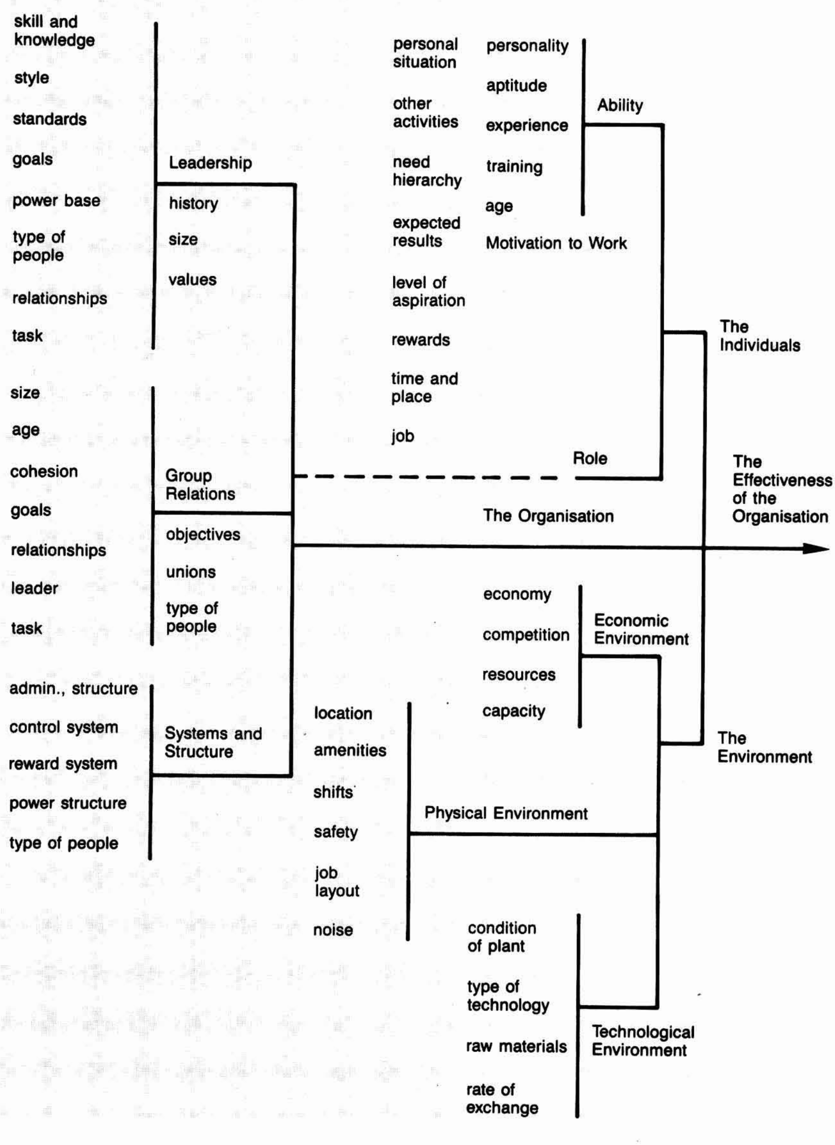
□ specialisation of function and roles
□ standardisation of procedures
□ formalisation of documentation

☐ centralisation of authority
☐ configuration of role structure
☐ use of outside consultants.

No one will argue concerning the need for these procedures or indeed the generally accepted view of 'the more formal the structure — the more formal the procedures'. Procedural systems were found necessary and would form the basis of what Hertzberg referred to as hygiene factors in as much they need to be satisfactory to prevent illness, however in themselves they will not produce good health.

Indeed it could be reasonably argued that procedural documentation is not a condition of effective organisation and Hunt makes the point very well "Structure exists in the mind of the people and refers to those values and beliefs that are shared by the majority of role performers as controlling their behaviour". What is important therefore is the influence that procedural organisation procedures have on the performance of the people during their day to day activities i.e. shared beliefs and values which creates a culture around the 'way of doing things'.

Figure 1
Some factors affecting organisation effectiveness — adapted from C. B. Handy.



Diagnosing organisational health

Rather than attempt to understand the numerous and complex issues involved, when confronted with a sense of urgency for raising productivity, expediency often demands an acceptance of a requirement to ascertain performance. At organisational level there is a coming together of available resources and their combined functioning is reflected in productivity.

Any such performance review is likely to conclude along the lines of a need to:

□ reduce both material and labour costs, which have increased out of proportion in unit costs terms
□ combat the increased pressure on margins being created by the competition
□ examine the ability of managerial resources to achieve and maintain growth consistent with high profitability.

These common failings of business organisations to equal the performance of competitors is invariably the consequence of formal or more likely an informal inter-firm comparison. Confirming the old maxim

"A company has no need to be efficient to be successful, however there is a requirement to be at least as good as the competition".

This somewhat simplistic general truth is possibly the origin of a host of deliberations surrounding 'competitive edge manufacturing'. A phase and theme which has become woven into contemporary thinking on operations and production management.

A number of factors have influenced this focus upon competition performance and although interesting have little relevance to this presentation. However, managerial response to competitive realities has brought about a general acceptance of the need to add performance criteria to various business activities. Certain priorities have gained general acceptance over the past five years and credit is given to Hayes and Wheelwright who as early as 1984 summarised five dimensions:

□ Low cost/price.
□ High performance concerning product features, tolerances and customer service.
□ Dependability with regard to product, delivery and service.
□ Flexibility of product line and response to delivery.
□ Innovativeness in new products and latest technologies.

The acid test of any organisation structure effectiveness is, today, measured in terms of how strategies have been developed to respond to these competitive edge criteria.

In practice however, the results of a well structured inter-firm comparison is rarely the launch pad for a rational performance improvement programme. A more likely stimulant for business performance improvement will be:

□ a change at senior Director level
□ to convince Group administration of managerial performance
□ a change in direction when a Company is stagnating
□ a response to a Trades Union initiative or wage claim
□ short term margin improvement to please the City

Internal pressures are likely to be:

□ inadequate organisational structures
□ lack of confidence and fear of change
□ accustomed to slow change
□ limited managerial competence in managing change
□ lack of experience in new technology
□ low productivity and poor quality
□ ageing plant and maintenance problems
□ low morale, high absenteeism, suspicious employees
□ cash flow problems.

What usually follows is a piecemeal, technique led attack upon ill-defined and rarely measured excess costs.

This rather all too common scenario of events leading to a cost reduction programme invariably produces short term results but rarely leads to sustained improvements in business performance. Unfortunately such short-term improvements gain considerable acclaim and the hunt is on for the next proprietary system to be peddled by the consultancy or accountancy profession.

Such has been the development of managerial progress since Frederick Winslow Taylor (1856-1915) publised "A piece rate system" in 1895 which proved to be the birth of Scientific Management and the beginning of 90 years of technique driven development.

However, there is a major difference in as much that those seeking to apply J.i.T. along the lines of Work Study, Job Evaluation Q.C.' Planned Maintenance, M.B.O., etc will fail to generate the key advantages to be gained.

J.i.T. is not a technique, slogan or even a proprietary system looking for a problem to solve. J.i.T. is a philosophy. A philosophy practiced every minute of every day by any Company committed to J.i.T. whose team members recognise the inappropriateness of hard defined functions within a J.i.T. environment. Continuous incremental improvement as a strategy objective is replacing cost reduction on a fixed goal basis and hard defined functions are being replaced by a much softer 'team' approach.

For those seeking to identify with worthwhile competitive edge manufacturing rather than be content with a policy of 'doing a little bit better than last year' a real opportunity exists. However, beware of a potential upheaval when many functions are exposed to a real need to change away from an environment which has perpetuated a system of just doing sufficient to maintain a position.

Professor Thorsrud of the Work Research Institute, Oslo, states that despite strong pressures for change that have developed during the 1960's and 1970's, old organisations with outmoded structures still abound because traditional forms of organisation:

□ protect the privileges of people with power and status
□ were quite suitable to the mechanisation stage, while mechatronics (combination of electronics and mechanics) requires new forms
□ measure effectiveness in simple economic terms which do not reveal the wastage of human resources and potential
□ include payment systems, planning and administrative routines which need to be adjusted to new forms of organisation. During this adjustment uncertainty may arise about managerial power and control.

Further evidence of a reluctance to change structural thinking comes from an October, 1988 Harvard Business Review where the real impediment is considered to be in managerial infrastructure that has become embedded in most companies of the past 50 years. This particular article includes "the attitudes, policies, systems and habits of mind that are so ingrained and pervasive within companies that they are almost invisible from within them".

Such traditional attitudes and organisation cultures are well identified with such classical features as:

□ top down decision making
□ piecemeal changes
□ bottom line mentality
□ accommodating rather than encouraging initiative and enterprise
□ reactive rather than offering opportunity for proactive personnel
□ departmentalised thinking with differing performance criteria
□ discussions, rewards and punishments flow down, information flows back up
□ performance standards only need to be achieved rather than continuous improvement.

An organisation structure, thus divided, underlies many of the problems confronting manufacturing today and are incompatible with modern requirements concerned with achieving a competitive edge. Capable of operating quite well over the past 40 years following the Second World War such cultures required an environment characterised by:

□ stable comfortable markets
□ centralised decision making
□ basic needs constituted chief motivator
□ task orientated management.

Our informal check list, for establishing to which manufacturing culture any Company belongs, makes no apologies for simplicity and could serve to identify the characteristics which are being associated with a J.i.T. environment.

Characterisation of a competitive edge manufacturing audit.

A. Plant gives an impression of being clean and uncluttered.

B. Performance focus tends to be on a day-to-day basis and related to the dependability and repeatability of the business system. Thus pushing accountability to all levels of the organisation.

C. Process documentation is up-to-date, accurate, detailed and used.

D. Process engineering is emphasised with particular attention to:

□ internal know-how
□ process engineers
□ developing new processes.

E. Throughput time efficiency is monitored, as are relevant factors of production, reported and incorporated into productivity analysis. Feedback of measured results is available at all levels and competitive performance—gain related compensation is made.

F. There is a commitment to long-term continuous improvement on all performance factors and local management are empowered to make participation available to all employees.

G. New technology is introduced consistent with operational needs and related human infrastructure.

H. Training and competence is highlighted throughout the organisation.

I. Information on organisation mission, marketing and manufacturing strategies, plans and policies are available and disseminated widely.

J. All labour is regarded as brainpower, change is accepted as a way of life and learning 'on the run' is the norm.

An audit of the above features of any business will indicate how good the organisation structure is at responding to the competitive edge criteria previously considered which in turn will determine the ability of the business system to offer, within three minute culture terms:

□ Delivery — lead time and reliability
□ Quality — capability and consistency
□ Flexibility — design and volume
□ Price — ?

A brief consideration of how good your organisation structure is at responding to competitive edge criteria could well be appropriate.

Firstly, consider an overview of J.i.T beginning with the definition "a western embodiment of a number of closely related manufacturing practices developed and used by the Japanese" as part of a disciplined programme of productivity improvement and waste reduction. Essentially a combination of managerial practice, techniques and attitudes J.i.T is a simple programme with simple goals, whose objective surrounds

□ stockless production
□ elimination of waste
□ low inventory management
□ enforced problem solving
□ continuous flow manufacturing.

For ease of understanding there are three distinct areas of J.i.T which are likely to influence organisation structure design.

□ in company — the conversion of the business into a J.i.T processing facility and culture change
□ Inter Company — the extension of J.i.T to relationships with customers and suppliers
□ Supporting Techniques — systems and procedures which support the programme. Usually based upon familiar 1960's production engineering and Q.C. methods such as Value Engineering, Statistical Controls, Work Study and Planned Preventive Maintenance.

Most companies will fail to achieve high scores during a performance audit thus implications for organisational review are obvious, as is a need to:

□ get back to basics
□ really get to know customers requirements
□ identify the key competitive edge criteria
□ use whatever is appropriate to design and operate a business system which will deliver the goods consistently, reliably and economically.

This will require:

□ a professional approach to manufacturing
□ a step change in performance over the 'pack'
□ a long term commitment to change and improvement.

This in turn requires an effective organisation structure with a capacity to develop increasing managerial competence. The philosophy, culture and concepts developed by organisational leadership are important determinants of management performance as well as of the type of organisation. 'Organisation climate' is a 1950's phrase which refers to this process which to some extent has been replaced by the now abused term 'culture'. It matters not because what is referred to is "the way we do things around here".

It is not the purpose of this short presentation to examine alternative philosophies or theories of management rather to explore possible changes which may be necessary to withstand some of the demands of increased performance. Performance needs managing otherwise mediocre performance results. Equally little is taken seriously until it is measured or to quote Lord Kelvin

"When you can measure what you are speaking of and express it in numbers you know that on which you are discoursing. But when you cannot (do this) your knowledge is of a very meagre and unsatisfactory kind. Science begins with measurement."

This rather conveniently raises the most important consideration of performance criteria.

Performance criteria

Accountants are renowned for producing strings of indices which when related are supposed to give a vivid picture of business performance. Such a list is certain to include key financial performance ratios with two objectives:

□ to give an indication of quality of management i.e. the influence of organisation structure over business performance
□ liquidity and solvency ratios which together form a view of the financial risk of a business.

Liquidity tends to be short-term and is designed to assess the ability of a company to meet its liabilities as they fall due.

Solvency is a longer-term measure which seeks to assess a company's stability.

Typical, so called performance ratios are likely to include:

A. Return on Capital employed (ROCE)	=	$\frac{\text{Profit before interest and tax (Pbit)}}{\text{Capital Employed}}$
B. Margin on Sales	=	$\frac{\text{Profit before interest and tax}}{\text{Sales}}$
C. Asset Turnover	=	$\frac{\text{Sales}}{\text{Capital Employed}}$
D. Capital Turnover	=	$\frac{\text{Sales}}{\text{Capital Employed}}$
E. Stockholding Period	=	$\frac{\text{Stock} \times 365}{\text{Sales}}$
F. Collection Period	=	$\frac{\text{Trade Debtors} \times 365}{\text{Sales}}$
G. Payment Period	=	$\frac{\text{Trade Creditors} \times 365}{\text{Sales}}$
H. Current Ratio	=	$\frac{\text{Current Assets}}{\text{Current Liabilities}}$
J. Acid Test	=	$\frac{\text{Current Assets — Stock}}{\text{Current Liabilities}}$
K. Debt/Equity (%)	=	$\frac{\text{Total interest bearing borrowing}}{\text{Capital Employed}}$
L. Interest Cover	=	$\frac{\text{Profit before interest and tax}}{\text{Interest payable}}$
M. Turnover per employee	=	$\frac{\text{Sales}}{\text{Number employed}}$
N. Profit per Employee	=	$\frac{\text{Profit before interest and tax}}{\text{Number employed}}$

From a manufacturing viewpoint such statistical returns are interesting, especially if it is indicative of acceptable achievement, however it is generally recognised that:

- ☐ a trend is essential to interpretation
- ☐ a considerable time scale is usually involved
- ☐ rarely fully understood and put to work.

Unfortunately similar comments could be levelled at Value Added criteria which has been demonstrated to be an invaluable measure of business performance and a useful means of assessing where improvements can be made. Typically:

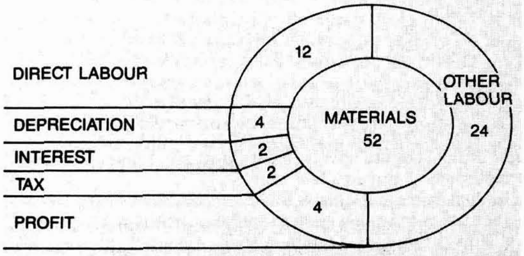
Added Value = Sales − Materials and Services.

In the example shown in Figure 2 a total sales of 100% produces and added value of 48%.

Such an analysis enables the allocation of added value and the use of gearing.

Suppose various procedures and techniques could make possible the same output from 1% less input of materials, energy or bought out services i.e. material utilisation, energy conservation, scrap reclamation.

Figure 2
An outline of value added.



A 1% saving on materials = 8.7% Profit Increase
A 1% extra yield translated into sales = 16.7% Profit

A 1% saving = 8.7% profit increase

Suppose such a yield increase could be translated into extra sales i.e. what is the added value gearing effect of selling rather than scrapping or throwing away resources?

A 1% increase in yield = 16.7% profit increase

The gearing ratio for increased sales from better yield is 16.7 i.e. more than eight times the gearing effect of savings on direct labour.

Is eight times as much attention given to this as an issue?

Do we measure yield or even that we throw away?

Such performance criteria reflects an organisation structure response to business performance and competitive edge analysis.

Take a further sample of those criteria which enable competitive performance to be assessed. Earlier in this presentation four objectives were listed:

- ☐ Delivery — lead times and reliability
- ☐ Quality — capability and consistency
- ☐ Flexibility — design and volume
- ☐ Price — ?

Consider the effect of throughput efficiency on lead time. Does the manufacturing system consider throughput efficiency as a performance criteria?

Lead times are also effected by stock points. What proportion of factory cost is value adding and what is cost adding.

The results of a B.I.M. survey concluded 80% of plants use less than 50% of lead time to add value.

25% use less than 10%!

Is attention paid to simplify and reduce the cost adding activities and improve the added value activities.

Is delivery to due date considered and are actual delivery performances monitored to the extent of on-time, late and early?

How is delivery performance by size of order?

From the previously mentioned survey

25% more deliveries are made late than on time

Box 1

PLANT PERFORMANCE AUDIT

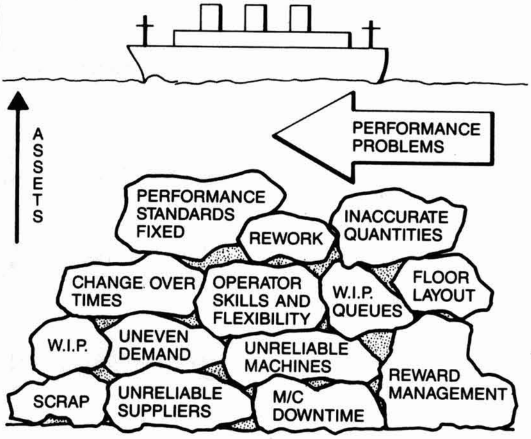
Factor	Is this factor measured in a formal way on a regular basis YES	If answer yes then:
Output Volume	......	Measurement Units..................
Output Standard Hours	......	Number..................
Actual v Planned Lead Time	......	Average % Deviation (+/−)..................%
Delivery Performance Reliability	......	%Delivered on time last Period..............%
Throughput Efficiency	......	Existing TE%..........%
Inventory Record accuracy	......	% Correct..............%
Ex-Stock Availability	......	% Service..............%
Scrap/Yield rate	......	% Loss..................%
Rework	......	% of time spent on rework..................%
Machine Utilisation	......	$\frac{\text{Hours adding Value} \times 100\%}{8736}$......................%
Setting Time/ Changeover	......	$\frac{\text{Setting Hours}}{\text{Available}}$..............%
Labour Utilisation	......	$\frac{\text{Hours adding Value}}{\text{Attendance Hours}}$..................%

Less than 50% of plants achieve 75% on time delivery
Only half of plants have a formal system of monitoring
However plants with a formal delivery performance monitoring system are twice as good as those without.
Statistical process control techniques are used by less than 25% of U.K. manufacturing plants.
Statistical quality control techniques are used by about 30%.
Are current work standards established for all operatives?
No survey details exist but experience would indicate few organisations satisfying the most fundamental good practice with regard to Industrial Engineering procedures.
B.S. 5750 is now regarded as every day terminology. Can the same be said for B.S. 3138?
Without wishing to be guilty of an overkill concerning performance criteria, a brief consideration of a standard plant performance audit (Box 1) will indicate key areas of concern.

Conclusions

Organisational structure is merely a feature of culture or "the way we do things around here".
Organisational structure controls managerial effectiveness which heavily influences company efficiency which determines the overall business systems response to:
Providing DELIVERY concerning lead time and reliability
Giving QUALITY based on capability and consistency
Offering FLEXIBILITY in design and volume
All within PRICE parameters.
It is to these factors of performance that we need to pay attention and analyse how well an organisation satisfied the following criteria:
□ the degree to which self-established objectives are achieved
□ how effectively resources are used in generating output
□ what is achieved compared with that possible
□ how productivity performance is recorded over time.
Such a review taking into account procedures previously considered will truly indicate how ready an organisation structure is to take on the rigours of a new culture. This in 'three minute culture' terms may be expressed as an ability to perform.
Current thinking deploys a nautical analogy of a boat representing adequate performance floating on a sea of assets which give clearance to a bed of obstacles.
The implication is obvious and generally accepted however, the sea of inventory and problems are encountered.
What is required to lower the sea:
□ managerial commitment and an effective organisation structure
What is required to reduce the extent of problems:
□ sound manufacturing management techniques
□ focus, involvement and teamwork
□ reward management related to success
Looking a little deeper at the rock-bed of problems we can deploy the nautical analogy once again as shown in Figure 3.
What are the rewards for reducing inventory levels and tackling some of the problems as they become exposed?
□ reduced assets
□ elimination of waste
□ enforced problem analysis
□ low inventory manufacturing
□ greater throughput efficiency
Is an organisational review a pre-requisite of these achievements?
No, but it takes a responsive disciplined structure to tackle asset reduction and thus expose performance problems. In addition it takes a harmonious, committed management team with a desire to win in order to apply the many techniques which constitute part of any solution.

Figure 3
A sea of problems.



Associated with production industrial and manufacturing engineering practices developed during the 50's, deployed during the 60's and abused during the 70's these techniques include:

□ line of balance	□ linear programming
□ simulation	□ decision trees
□ critical path analysis	□ break even analysis
□ PERT	□ management by objectives
□ MRP	□ job evaluation
□ work measurement	□ method study
□ planned maintenance	□ SWOT analysis
□ Q.C. techniques	□ value engineering
□ statistical method	□ P.B.R.

In conclusion therefore it becomes apparent that a company's success will depend upon:
□ knowing the customer
□ recognising the real competitive edge criteria
□ operating systems which deliver consistently, reliably and economically
□ a professional approach to manufacturing
□ a step change in performance over the 'pack'
□ a long term commitment to continuous change and improvement.
Equally apparent is that the above will require organisational abilities capable of building and motivating a competitive team, determined to win. New measures of performance criteria and progressive incremental improvement in manufacturing engineering will be the ultimate measure of competitive performance within a team who will push at these margins of experience trying on all front to be better than before.
i.e. dynamic, well structured and suitably led learning organisations.
Remember however "Copying today's best practice will in many cases only help in making you part of tomorrows history".
Finally and very worthy of note is the fact that long implementation time scales exist in programmes of improvement and culture change. No room for a 'quick fix' or 'three minute culture' involvement. Most programmes look at a time frame of three to five years.
Gradual incremental change and improvement with greater flexibility requiring new work procedures, manning levels and new skills is required. Optimum span of control, number of levels, best way of describing jobs, appraising people, reward

Continued on p.77

SURFEX 90 PREVIEW

16-17 May 1990

Harrogate International Centre, North Yorkshire, England.

Fred Morpeth, Honorary Exhibition Officer, writes:

I am very pleased to introduce this preview to SURFEX 90, the third in the new concept, biennial exhibitions established in 1986. Formulated after careful market study, SURFEX 86 was a cost-effective combination of the best features of theatre style and hotel bedroom shows. For the exhibitor it combined the open approachability of the one with the simplicity of the other offering a complete package of a ready-made stand inclusive of all services. For the visitor it offered a welcome return to readily accessible technical and commercial information in comfortable surroundings conducive to the renewal of old acquaintances.
The new formula has proved highly successful, each exhibition being quickly sold out to the foremost suppliers of pigments, resins, equipment and services to the surface coatings industries. SURFEX is equally popular with visitors, over 40% of whom are in senior decision making positions. The show is also an excellent opportunity for junior staff to see the breadth and diversity of the trade they have joined and to learn from contacts they would not ordinarily make.
SURFEX 90 is larger again than ever with more exhibitors and stands throughout the conference Centre and in the adjoining International Hotel. For anyone involved in development or the selection or purchase of materials, equipment and services for surface coatings I urge you not to miss the premier exhibition for your industry.

Ich freue mich, Ihnen einen Einblick in SURFEX 90 geben zu können, die dritte der neuen, zwei-jährlichen Messen, die im Jahre 1986 begannen. Formuliert nach den Ergebnissen sorgfältiger Marktforschung, wurde SURFEX 86 eine preiswerke Kombination mit den besten Eigenschaften von Theater-Stil und Hotelzimmer-Ausstellung. Für den Aussteller kombiniert die Messe die offene Anpassungsfähigkeit des einen mit der Einfachheit des anderen, und bietet somit ein abgerundetes Angebot für einen Stand, der alle Dienste enthält. Für den Besucher bedeutet sie eine willkommene Rückkehr zu leicht erreichbarer technischer und geschäftlicher Information, in einer Ambienz, die es ermöglicht, alte Bekammtschaften zu erneuern.
SURFEX 90 ist auch diesmal wieder grösser als je zuvor, mit mehr Ausstellern und Ständen im Konferenzzentrum und im auschliessenden International Hotel. Für alle, die mit Entwicklung und Wahl oder Kauf von Materialien, Ausrüstungen und Dienstleistungen für Oberflächenbehandlung zu tun haben, kann ich empfehlen, diese erstklassige Industriemesse nicht zu verpassen.

J'ai le plaisir de vous présenter cette avant-première à l'exposition SURFEX 90, qui sera la troisième des blennales nouvelle formule créers en 1986. Fruit d'une étude de marché très poussée, l'exposition SURFEX 86 a su tirer le meilleur parti de deux formules d'exposition: en hall ou en pièces individuelles. L'exposant pouvait ainsi bénéficier dé la facilité d'approche de l'une et de la simplicité de l'autre, et d' une enveloppe globale comprenant stand et services asociés. Quant au visiteur, il pouvait facilement y avoir accès á toutes les informations techniques et commerciales dans un décor agréable facilitant les reprises de contact.
L'exposition SURFEX 90 sera plus étendue que jamais, regroupant davantage d'exposants et de stands dans le Centre de Conférence et dans l'Hòtel International voisin. A tous ceux qui s'occupent du développement, de la selection ou de l'achat de matériel, équipements et services se rapportant à l'industrie des revêtements, je recommande de ne manquer à aucun prix cette exposition d'importance primordiale pour leur profession.

Me complace mucho presentar esta vista de antemano de SURFEX 90, la tercera de las novedosas exposiciones bianuales establecidas en 1986. Puesta en marcha a raíz de un cuidado estudio del mercado, SURFEX 86 resultó una combinación con efectividad de coste de lo mejor de los espectáculos teatrales y de las habitaciones de un hotel. Combinaba para el expositor el enfoque abierto de unos con la sencillez de los otros y ofrecía un stand ya completo con todos los servicios. A los visitantes les ofrecía un acceso asequible a la información técnica y comercial en un ambiente cómodo, propicio para encontrarse de nuevo con conocidos de otras ocasiones.
SURFEX 90 es otra vez mayor que nunca, con más expositores y stands en todo el Centro de Conferencias, así como en el vecino Hotel Internacional. Insto a todo el que se relacione con el desarrollo, selección o adquisición de manteriales, equipo y servicios para revestimientos de superficies a que no se pierda la exposición más importante para este tipo de industria.

This Preview highlights the products and equipment which will be on show, together with details of how to get there, where to stay and an invitation card. The Preview is being published in advance of the Official Guide which will be part of April JOCCA. ▷ ▷ ▷

WHAT'S ON SHOW

Akzo Chemicals Ltd will feature their full range of products for the Coatings Industry including Epilink epoxy curing agents, Siccatol paint driers, Perchem rheological additives and other ancillary products.

Allied Colloids will highlight their additives for emulsion paints; water based resins for inks, adhesives, industrial paints and lacquers.

ARCO Chemical Europe Inc. will be promoting Arcosolv, Arconate and propylene glycols product ranges as well as the Arcocomp solvents formulation computer programme.

BASF Plc will feature: A. Pigments: 1. Heliogen Blue L6980F – A new phthalocyanine blue especially for metallic finishes. 2. Sicopal Yellow L1110/Paliogen Orange L3180HD – lead free shades in the yellow/orange area. B. Resins: 1. Laroflex LR8229 – new low viscosity grade for higher solids coatings. 2. Laropal A81 – aldehyde resin for the production of pigment pastes with universal compatibility in solvent based systems. 3. Luhydran A841S – resin for water based wood finishes with high chemical/solvent resistance.

Bayer UK Ltd – Bayers Inorganic and Pigments groups will provide information and graphics displays on Baysilone's high quality resins, paint additives, impregnating agents, Bayertitan titanium dioxide, Baylith dessicants and moisture absorbers and Bayferrox range of pigments.

BIP Chemicals is one of the leading European manufacturers of high quality melamine and urea resins used by major paint manufacturers throughout the world for the production of industrial surface coatings where quality and performance are of paramount importance. The "Beetle" range of amino resins has been developed for technically demanding applications.

Blythe Colours will display the Blythe "Kera Collection" featuring especially KERATRANS – Transparent Iron Oxides KERAFAST – Mixed Metal Oxides KERAFLECT – Camouflage Pigments and KERASPERSE – Pigment Dispersions.

Bohlin Reologi UK will be launching the expanded capabilities of the VISCO88 hand held viscometer using new measuring systems and software. This will enhance the application areas for both QA and Product Development. Also on show will be the Bohlin Controlled Stress Rheometer which is able to simulate manufacture and end use conditions in the Coatings Industry.

BYK Chemie GmbH will be showing new defoamers for water-based coatings which are 022, 023 and 045; and will introduce the newest developments in levelling aids.

C & W Specialist Equipment will display a selection of test cabinets from our range which includes Hot Salt Spray Cabinets to ASTM B117, Composite Corrosion Cabinets, Mebon Prohesion Cabinets, Humidity Cabinets. These units are available in the following sizes: 200; 450; 1000 amd 2000 litres. New products in our range include Water Soak Cabinets, Controlled Temperature/Controlled Humidity Cabinets, Environmental Cabinets and Deep Freeze Cabinets.

Carri-med will be exhibiting the computer controlled CSC Rheometer: an instrument which is ideal for characterizing the rheological properties of paints and coatings. Yield points can be measured directly and properties such as sagging can be readily simulated.

Colourgen Ltd will feature the Entire Range of the Company's Colour Management Match Prediction Systems based around the CS-1100 Spectrophotometer and IBM compatible computers and software. New products will include a Colour Visualiser and the latest ink and paint software.

Concept to Commissioning will be exhibiting: 1. Solids/liquids mixing and dispersion from UCE Developments Ltd. 2. Small Media Bead Mills from Knight Process Engineering Ltd. 3. Vessel Washing/Solvent Recovery from Gateway Technology Ltd. 4. Process Control from DataStor Ltd. 5. Systems Project Engineering from AI Process Systems Ltd.

Cookson Laminox Ltd will feature their synthetic micaceous iron oxide. Two grades of pigment for protective coatings. LAMINOX S for weathering coats. LAMINOX F for anticorrosive primers. The pigment has an optimised lamellar particle structure which provides outstanding performance.

Craynor SNC will feature EPOXY ACRYLATE, URETHANE ACRYLATE, WATER REDUCIBLE and other oligomers to meet the demands of the radiation curing industry. With the Sartomer acrylic multi functional monomers, Craynor SNC can offer the widest range of radiation curing products in the world.

Cray Valley Products will be showing the latest developments in THIXOTROPICS and TWO-PACK finishes for high performance INDUSTRIAL COATINGS. The CVP range in WOOD FINISHING will be featured, and POWDER COATINGS will also be shown. Additionally, recent advances in THIXOTROPY for DECORATIVE paints will be displayed.

Croda Colours Ltd will be showing SCOLOR amd FORTHBRITE pigments for inks, FORTHFAST pigments for inks, paints and plastics.

Croxton + Garry Ltd will feature BRITOMYA and SNOWCAL Chalk Whitings; OMYA Calcites; MIOX Micaceous Iron Oxide; CELLOSIZE; HEC COATEX Associative Thickeners and Dispersants; ESACURE Photoinitiators; PROMINDSA Red Iron Oxides; PERGOPAK Matting Agents; TRIHYDE Flame Retardants; COLOROL and FORBEST Dispersing Agents and Slip Additives.

Durham Chemicals will be exhibiting the complete range of products supplied to the Surface Coatings Industry, including Zinc Oxide, Zinc Dust, Paint Driers, Paint Additives, Biocides, and Talc.

ECC International is a major supplier of white minerals for the paint and allied industries. The HyPerformers range of products includes: Polestar calcined clays. Supreme and Speswhite fine china clays, Claytone organo-bentonites, as well as a comprehensive range of china clays and calcium carbonate extenders and other minerals.

Eiger Torrance will feature their range of Horizontal Bead Mills; Motormills (mini, laboratory, and production machines), high speed dispersers (laboratory and production machines), Batch Bead Mills and Batch Attrition Mills.

Ellis + Everard Specialities Ltd **An established technical marketing company to the paint, plastic and ink industries, will be exhibiting their full range of Organic and Inorganic Pigments from ICI Colours & Fine Chemicals, Proxel & Densil Biocides from ICI Speciality Chemicals, Additives and Anti-Foam Agents from Bevaloid, a full range of Nitrocellulose damped in IPA, Meths, and Plasticizers.**

Floridienne (UK) Ltd will exhibit a range of 1) Pigments: MICROFAST organics, PFIZER iron oxides, HITOX buff titanium dioxide, HABICH chromates, MICROTINT Aqueous stainers, MICRODISPERSE alkyd stainers. 2) Polymers; REPOLEM emulsions, FLORPLAST polyester. 3) Additives: MICROPOWDERS micronised waxes, MICROCIDE biocides, FLORSTAB UV stabilisers plus UV additives.

FMJ International Publications Ltd will highlight: Polymers Paint Colour Journal, Paint & Ink International, European Adhesives & Sealants, The Resins & Pigments Exhibition.

Foscolor Ltd will feature a full range of Chip and Liquid Dispersions for the Printing Ink and Surface Coating Industries. Particular emphasis will be placed on our range of Dispersions for Water Based Systems.

John Godrich will exhibit: A selection from Liebisch Salt Spray Cabinets – Combines Corrosion and SO_2 Cabinets. Credit Humidity – Refrigeration – Environmental Cabinets. Credit Hegman Guages – Cross Hatch Cutters – Coater-Applicators-Impact-Abrasion Testers. Mixers Energy/Time Saving Rotostats – Credit HSD – Chemical Rotor/Stator. Laboratory to Production.

Grace UK will present a wide range of speciality chemicals for the Surface Coatings Industry. Their Technical Service Group will review latest developments on new and existing products within the Davison Product Line. SYLOID: Super efficient ED range of matting agents. SHIELDEX: New high performance non toxic anti corrosion pigment used in maintenance and general industrial primer systems working by the principal of ion exchange. SYLODEX BENTONITES and SYLOSIV: Moisture scavengers.

The Haeffner Group of Companies Personnel from The Haeffner Group will have details of their full range of raw materials for the surface coating, printing ink and plastics industries. Fillers, extenders, natural and synthetic iron oxides, mineral and cellulose fibres, organic pigments, machinery, pigment chips and dispersions.

The Heubach Group will feature a wide range of pigments including: Heucotron, Heucotron "LD", Heucodur, Heucosin, Heucoplast, Heucoflow, Krolor, Heucorox, Zinc Phosphate ZPIO, Heucophog ZPA/ZMP/ZPO, Heucofex, Zinc Dust, Zinc Flakes, Zinc White Harzsiegel, Heucomin 5, Lead Oxide and Lead Salts, Decor Products.

Huls Aktiengesellschaft will exhibit a wide range of binders, resins and additives including DYNAPOL® coating polyesters, LIPATON® aqueous dispersions, DYNASYLAN® and DYNASIL®, DYNAPOL® copolyesters, VESTAMELT® copolyamides, DYNACOLL® 7000 copolyesters and DYNACOLL® special purpose polyesters.

K & K Greeff Ltd will be introducing products for High Solids/Low VOC Compliance which will include a new range of Polyols and Silica Gels from the USA. For high performance Coatings and Inks, Teflon PTFE and Dowanol Butylated Glycol Ethers will be featured. Full information will be available on the New Lead Free Drier combination from Van Locke and the Hilton Davis Range of Transparant Iron Oxides.

K & K Polymerics will be featuring Cellulose Ethers, Epoxy Resins, Latices, Surfactants, Paint Additives, Acid Catalysts and Polyester and Polyurethane Polyols.

Kemira Oy will present its pearlescent pigment line of Flonac® lustre colours. Colours of gold, silver, copper and interference shades will produce brilliance and texture demanded in the finest finishes. Flonac® pearlescent pigments are highly recommended for incorporation into both water based and solvent based paint systems.

Kirklees Chemicals Ltd will feature state of the art Viking Products for the Paint, Adhesives and Textile Industries.

KRONOS Ltd: Kronos TiO_2 Pigments featuring the Groups considerable resources and the measures taken to fully conform with environmental requirements worldwide. A number of TiO_2 Grades will be demonstrated in particular the High Quality Chloride Pigments KRONOS 2160 and KRONOS 2310.

Lakeland Laboratories Ltd will feature Wax Emulsions, Imidazolines, Amphoterics, Phosphate Esters – Speciality Surfactants.

Lawrence Industries will be exhibiting the full range of HALOX non-toxic Anticorrosive Pigments, and Tanning Stain Inhibitors along with Englehard ATTAGEL Thickeners, SATINTONE Calcined Clays, ASP Hydrous Clays. A new range of coloured pigments including METEOR PLUS for coatings, Cellulose fibres and Silicas.

Meta Scientific Ltd will show their Colour Measurement, Gloss, Coating Thickness and Microscopes. Software for Colour Library and Search Facilities will be on display.

3M United Kingdom Plc exhibit will include: Fluorad Fluorochemical surfactants for high performance applications in aqueous and non-aqueous systems. Fluorad Fluorochemical intermediates and Scotchlite Glass Bubbles.

Netzsch Mastermix Ltd will feature: LME 20-Agitator Mill for ultra fine grinding of dispersions. PMD VC Fixed Vessel Dispersor for liquid and paste systems.

Norwegian Talc UK Ltd exhibit will include: 1. MIKRODOL/MIKRODOL H Grades – Pure White Dolomite, ultrafine powders to coarse granules. 2. MICROTALC AT/IT EXTRA – Ground and Micronised Talcs. 3. MICROMICA – Micronised Mica. 4. SILCELL Low Density Mineral Additives. 5. MICHEMLUBE Wax Emulsions.

Pearson Panke will exhibit: the latest Erichsen Glossmaster with statistical facilities and new cost effective viscometer equipment for testing gelation time of powder coatings; adhesive testing equipment dry film thickness gauges for any substrate.

The Q-Panel Company: The QUV Accelerated Weathering Tester will form the centre piece of the Q-Panel Company display. The QUV is a laboratory simulation of the damaging forces of the weather – exposing samples to alternating periods of ultra violet light of defined spectoral energy and to periods of wetness.

Resinous Chemicals will be featuring resins from their UK manufactured range namely thixotropic and general industrial products. From Hoechst AG product offer will be highlighted resins for powder coatings, SCA modified binders for stoving applications, and low free formaldehyde amino resins for automotive/industrial coatings.

RHEOX Inc., the newly formed company, a part of N L Industries Inc., is the world's largest producer of rheological additives for solvent-borne coatings systems. The exhibit will provide an overview of the new company organisation and its BENTONE, MPA, THIXATROL, RHEOLATE and other rheological additives, which are sold within the UK by their respective agents, Steetley Minerals Ltd and KRONOS Ltd.

Schering Industrial Chemicals will be featuring: EUREPOX epoxy resins for Paints, Coatings, Resin Mortars, 2 Component Adhesives. EUREDUR Curing Agents for Epoxy Resins. EURELON polyamide resins for Printing Inks, thixotropic alkyds. EURMELT polyamides for Hot Melt Adhesives. EURETEK Adhesion Promoters. EURECRYL cyanoacrylate super glues. Organotin components for wood preservatives and marine antifouling coatings.

Scientific & Medical Products Ltd will be exhibiting: Brookfield Viscometers including the following models – Rheoset DVII, DVI and DVII Cone and Plate. Also Cahn Instruments Dynamic Contact Angle Analyser for surface "Wettability" analysis.

SCM Chemicals, the world's second largest producer of titanium dioxide by the environmentally preferred chloride process, will be featuring information on the comprehensive range of TiONA pigments, in particular: RCL-628 a specialist grade of TiO_2 for high performance coatings, where outstanding durability, high opacity and exceptional gloss are demanded. RCL-535 a unique multipurpose grade of TiO_2 designed to meet the requirements of the plastic industry. SCM Chemicals will also be displaying information on its commitment to Total Quality Control.

Shell Chemicals: A £10m investment in Shell UK's Epoxy manufacturing facilities which, using improved purity feedstocks, will produce consistent quality customer-tailored Epikote resins.

Silberline Ltd manufacturers of non-leafing Alu-Pigments for automotive finishes will be exhibiting its full range of

the highly successful classical SPARKLE SILVER™ ALU-PIGMENTS™ as well as HYDROPASTES™ and AQUAPASTES™ for waterborne systems. Also on display will be a range of granulated, solvent-free Masterbatches in various binders for printing inks, powder coatings and plastics.

Steetley Minerals Ltd will feature the BENTONE Range of Rheological Additives from RHEOX INC. LIGHTWEIGHT and PERLITE Fillers from Grefco Inc. Lo-Vel Flatting Agents from PPG Industries Inc. The Steetley Ranges of Dolomite and Talc Extenders.

Sun Chemical Pigments Ltd will concentrate on three product areas: I) A presentation of High Performance Pigments for Automotive Coatings in multiple physical forms. These include Sun Chemical's unique standardised High Solids Press Cakes and SUNSPERSE® dispersions. Flushed versions of these pigments will also be shown. 2) A New Perylene Red I79 which has created extensive interest in the US and Japan. 3) FLEXIVERSE® and SUNSPERSE® aqueous dispersions for aqueous printing inks.

Tego Chemie Service range of paint additives and silicone based binders will be featured. Several new developments are presented in the field of defoamers, flow and levelling agents and mar and slip resistance additives. As one of the leading silicone producers in Europe, Th. Goldschmidt AG., the parent company continues to direct a major part of its research and development through its specialist companies such as Tego Chemie Service. New products are featured in the extension of the established Tego print range of additives for the printing ink producer.

Charles Tennant (London) will exhibit amino crosslinking resins for Surface Coatings (Dynn Cyanamid), speciality alkyds polyester for paint industry (Dyno Industrier), Elveron functional resins, Elvacit Bead aqueous dispersions and water soluble resins and AB Dispersants (Du Pont) and Phenolic, Maloic and Esterified Resin Esters for the adhesives and coating industries (Propinave).

Tennant-KVK will exhibit on behalf of its principal a number of new products and ranges, applications which include Industrial Paint Tionting Systems, Classical Organic and Fanal Pigments for Liquid Inks and Hyperdispersant Inks.

Troy Chemical Company BV will pay special attention to anti-cratering agents for both solvent and water dilutable systems, the wetting and dispersion agent Troysol 98C and the rheology agent Troythix 42BA – a liquid viscosity modifier for non-aqueous systems. Regarding Biocides, focus will be on the in-can preservative Troysan I74 and on Polyphase PIOO – the fungicide recently granted regulatory approval by the HSE authorities.

Union Camp Chemicals (UK) Ltd will feature resins for adhesives, giving good tack and stability in hot melts and pressure sensitives. Polyamides for flexographic printing, curing agents, and adhesives. Polymeric plasticisers for PVC and octyl dimerates for lubricants.

Vinamul's advanced polymer emulsions for paints will be on show and will feature Vinamul 3480, a novel binder offering outstanding cost-performance benefits in high PVC matt paints and the Vinamul 3600 series of soft multipolymer emulsions including the latest binder designed specifically for solvent free paints.

Wengain Ltd will highlight pigments and resins for printing inks, paints, plastics and adhesives. MAGRUDER COLOR – New pigments for newsinks and aqueous systems, WAARDAL – Non toxic pigments for speciality coatings, LEAD CHROME COLOURS – New products for plastics, CAFFARO – Chlorinated rubbers and paraffins. LEON FRENKEL – Hard resins for all applications.

Yorkshire Colour Systems Ltd – YCS the UK and Eire agents for Datacolor AG of Switzerland will be showing: "Pigmenta" the paint and plastics colour control match prediction system, also on show will be the Datacolor MMK metallics control system, this sytem is used by many European car manufacturers.

Also exhibiting at SURFEX 90 will be the following companies:

☐ Samuel Banner & Co Ltd ☐ BDH Ltd ☐ Boud Marketing Ltd ☐ Bromhead & Denison Ltd ☐ Buckman Laboratories Ltd ☐ Capricorn Chemicals Ltd ☐ Cera Chemie BV ☐ Chemapol (UK) Ltd ☐ Ciba-Geigy Plastics ☐ Cornelius Chemical Co Ltd ☐ Dominion Colour Company ☐ DSM Resins ☐ Elcometer Instruments Ltd ☐ Elem Chemicals ☐ Ellis Jones & Co (Stockport) Ltd ☐ Henkel-Nopco Ltd ☐ Harlow Chemical Co ☐ Hoechst UK — Chemicals Division ☐ Hoechst UK — Pigments Division ☐ ICI Colours & Fine Chemicals ☐ Industrial Dispersions Ltd ☐ Magnesium Elektron ☐ NL Chemicals (UK) Ltd ☐ OBS Machines Ltd ☐ PA ☐ PRA ☐ Production Chemicals Ltd ☐ Rhone Poulenc ☐ Sandoz Products Ltd ☐ Sawell Publications ☐ Scott Bader Co Ltd ☐ The Shear Co Ltd ☐ Sheen Instruments Ltd ☐ Stort Chemicals Ltd ☐ Sud-Chemie AG ☐ Thomas Swan & Co Ltd ☐ Thor Chemicals (UK) Ltd

HARROGATE CENTRE

Note To Exhibitors

The SURFEX 90 OFFICIAL GUIDE will be published with the April 90 issue of JOCCA and all companies should return their Official Guide Entry Forms to Peter Fyne at Priory House by Monday, 26 February

HOW TO GET TO HARROGATE

Harrogate is well placed for access by road, rail, air and sea.

By Road

Harrogate is centrally situated within the UK. London is 200 miles to the south and Edinburgh is 200 miles to the north. The schematic map adjacent shows the major road routes to Harrogate. The West Yorkshire Road Car Company (part of the National Bus Company) provides bus and coach services to and from the Harrogate area. For coach information call (0423) 66061.

By Rail

Harrogate is served by British Rail (Eastern Region) and trains include high speed services from Kings Cross –London to York or Leeds with local connections to Harrogate. Depending upon the connection, the journey time normally takes 2½ – 3 hours. For further information call Harrogate Station (0532) 448133.

By Air

Leeds/Bradford Airport is situated 12 miles south of Harrogate with taxi and bus links from the airport to Harrogate. There are daily services from Amsterdam, Birmingham, Gatwick, Heathrow, Dublin and Paris to Leeds Airport.For flight information call Leeds Airport (0532) 509696.

The following air carriers operate domestic and international scheduled services:

Aer Lingus operate flights from Dublin. Enquiries (0532) 508194, Reservations (0532) 434466.

Air UK operate flights from Amsterdam, Belfast, Edinburgh, Stanstead and Paris (CDG). Enquiries (0532) 503251, Reservations (0532) 457468.

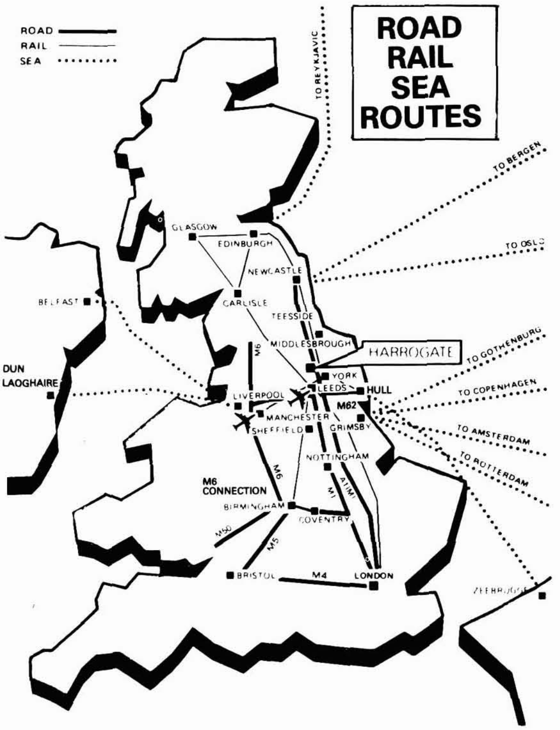
The following telephone numbers may be used when making reservations for Air UK from within Europe: France – Air France, Paris (1) 45356161, Netherlands -KLM, Amsterdam (020) 747747, Norway – SAS, Bergen (05)310950, SAS, Stavanger (04) 521566, Belgium – KLM, Brussels (02) 7207150, KLM, Antwerp (03) 2327860, West Germany – KLM, Frankfurt (069) 290401, Denmark – Cimber Air, Sondeborg (04) 422277.

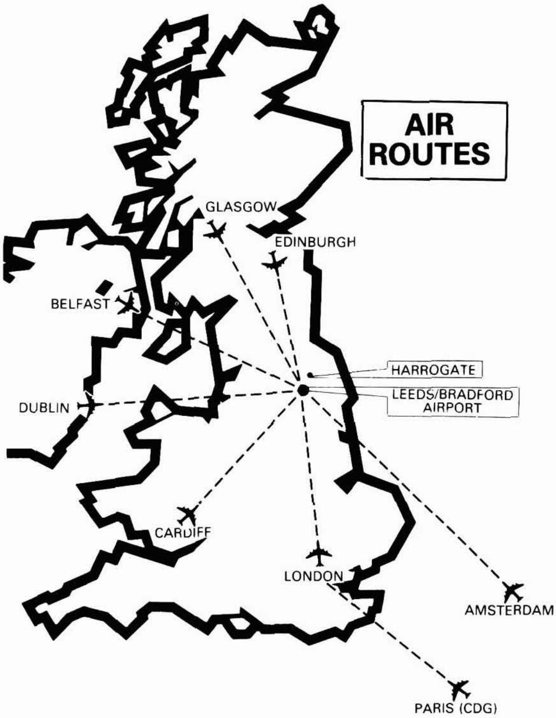
British Midland Airways operate flights from Heathrow. Enquiries (0532) 508194, Reservations (0532) 451991.

Capital operates flights from Cardiff and Glasgow. Enquiries (0532) 505650, Reservations (0532) 504992.

By Sea

Hull is the nearest seaport to Harrogate. North Sea Ferries operate from Rotterdam (Europort) or Zeebrugge to Hull. Hull has excellent road links to Harrogate. For further information call (0482) 795141.





The Reception Area

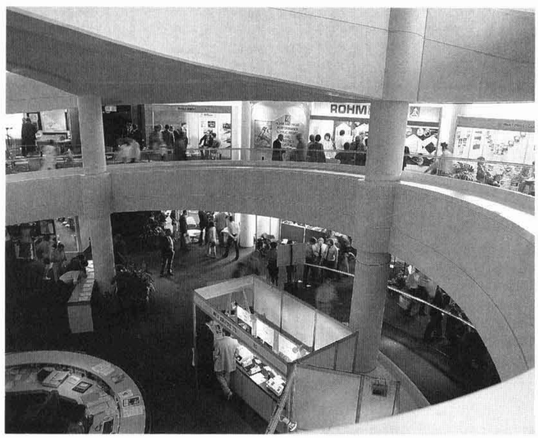
THE VENUE

The Harrogate International Centre is now established as one of Europe's finest exhibition venues, a fact which is verified constantly as major international and national organisations and companies select it for their events and then return year after year. The SURFEX organisers had no hesitation in returning to the Harrogate International Centre for the third in the new style exhibitions.

The exhibition stands will be positioned throughout the Centre in **Hall D, the Reception area, Gallery** and Auditorium and for the first time additional stands will be located in the Ripley Suite at the adjoining International Hotel with direct access from the Gallery level at the International Centre.

Exhibitors hospitality suites will again be located in the Centre and International Hotel.

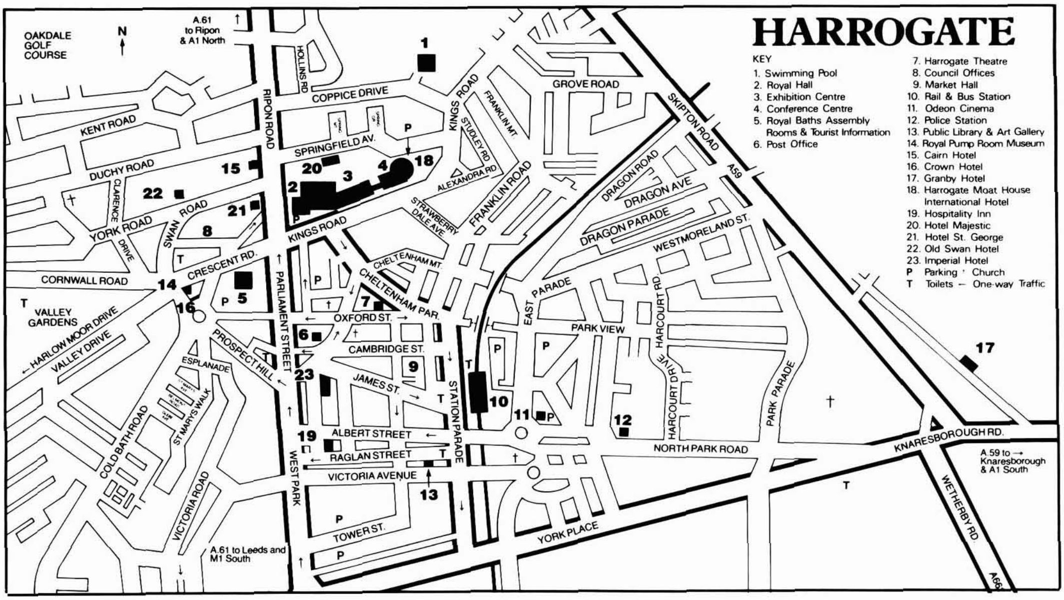
An additional attraction will be a daily free prize draw open to all registered visitors. Tickets for the draw will be issued on registration.



The Gallery

The Auditorium

Hall D



ACCOMMODATION IN HARROGATE

The following is a selection of the major hotels in Harrogate. All prices, which have been negotiated in conjunction with SURFEX, are per room per night and include full English breakfast, VAT and service. Bookings should be made direct with the hotel quoting the SURFEX concessionary rate.

Hotel	Tel (0423)	Dbl/Twin	Single
International	500000	75.00	54.00
Imperial	565071	65.00	55.00
Majestic	568972	70.00	50.00
Hospitality Inn	564601	70.00	60.00
Crown	567755	80.00	65.00
Old Swan	504051	82.00	65.00
Granby	566151	80.00	60.00
Fern	523866	70.00	40.00
Gibsons	522246	52.00	27.50

For smaller hotels contact the Bureau (0423) 565912.

A comprehensive colour guide (50p plus p & p) to the Harrogate District, including many advertisements offering hotel accommodation, is available from the Harrogate Tourist Centre on (0423) 525666.

SURFEX DINNER

The highly successful SURFEX dinner will again feature as a major function of the Exhibition. The dinner will be held at the Majestic Hotel on Wednesday 16 May. Professor John Oakland, Bradford University will be the guest speaker. For ticket enquiries contact Peter Stanton on (0274) 308052, Fax (0274) 737058.

HARROGATE CENTRE

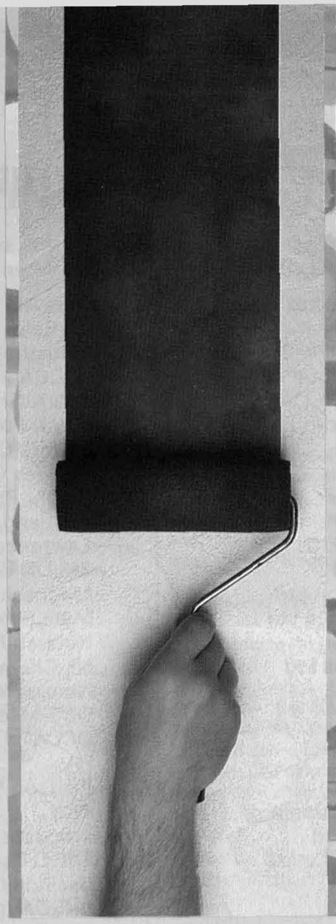
PRE REGISTRATION

You will find enclosed an invitation card inviting you to pre-register for SURFEX. Registration cards will appear with the March and April issues of JOCCA and the special Official Guide and Route Planner will also appear with the April issue.

If you have not already booked advertising space in the Official Guide, or require additional invitation cards, please contact the SURFEX organisers at Priory House on (01) 908 1086, Fax (01) 908 1219.

PRA SYMPOSIUM

The Paint Research Association will be holding a symposium in conjunction with the Exhibition at the International Hotel on Monday and Tuesday 14 – 15 May.The title of the symposium is "Coatings for Difficult Substrates". Further information may be obtained from Dip Dasgupta, PRA on (01) 977 5527, Fax (01) 943 4705. Registration form for the symposium will be carried in the April issue of JOCCA and a report on the symposium and a selection of the papers will be published in the Journal.



SURFEX 90 LIST OF EXHIBITORS at 1/2/90

A I Process Systems Ltd
Akzo Chemicals Ltd
Allied Colloids
ARCO Chemical Europe Inc
Samuel Banner & Co Ltd
BASF United Kingdom Ltd
Bayer UK Ltd
BDH Ltd
BIP Chemicals Ltd
Blythe Colours
Bohlin Reologi UK Ltd
Boud Marketing Ltd
Bromhead & Denison Ltd
Buckman Laboratories Ltd
BYK-Chemie GmbH
Capricorn Chemicals Ltd
Carri-med Ltd
Cera Chemie BV
Chemapol (UK) Ltd
Ciba-Geigy Plastics
Colourgen Ltd
Concept to Commissioning
Cookson Laminox Ltd
Cornelius Chemical Co Ltd
Craynor SNC
Cray Valley Products
C & W Specialist Equipment
Croda Colours
Croxton + Garry
Datastor Ltd
Dominion Colour Corporation
DSM Resins
Durham Chemicals
ECC International Ltd
EFKA Chemicals
Eiger Group of Companies
Elcometer Instruments Ltd
Elem Chemicals
Ellis + Everard Specialities
Ellis Jones Ltd
Floridienne (UK) Ltd
FMJ International Publications Ltd
Foscolor Ltd
Gateway Technology
John Godrich
W R Grace Ltd
H Haeffner & Co Ltd
Henkel-Nopco Ltd
Heubach
Harlow Chemical Co
Hoechst UK – Chemicals Division
Hoechst UK – Pigments Division
Hüls AG
ICI Colours & Fine Chemicals
Industrial Dispersions Ltd
JOCCA
K & K Greeff Chemicals Ltd
K & K Polymerics
Kemira Oy
Kirklees Chemicals
Knight Process Engineering Ltd
Lakeland Laboratories Ltd
Lawrence Industries Plc
3M UK Plc
Magnesium Elektron
Meta Scientific Ltd
Netzsch Mastermix Ltd
NL Chemicals (UK) Ltd
Norwegian Talc (UK) Ltd
OBS Machines Ltd
OCCA
PA
Pearson Panke Equipment Ltd
PRA
Production Chemicals Ltd
The Q-Panel Company
Resinous Chemicals Ltd
RHEOX Inc
Rhône Poulenc
Sandoz Products Ltd
Sawell Publications
Schering Industrial Chemicals
Scientific & Medical Products Ltd
SCM Chemicals Ltd
Scott Bader Co Ltd
The Shear Co Ltd
Sheen Instruments Ltd
Shell Chemicals UK Ltd
Silberline Ltd
Steetley Minerals Ltd
Stort Chemicals Ltd
Süd–Chemie AG
Sun Chemical Pigments Ltd
Thomas Swan & Co Ltd
Tego Chemie Service
The Tennant Group of Companies
Thor Chemicals (UK) Ltd
Troy Chemical Company BV
UCE Developments Ltd
Union Camp Chemicals (UK) Ltd
Vinamul Ltd
Wengain Ltd
Yorkshire Colour Systems

Additional companies wishing to exhibit should contact Fred Morpeth on 0942 865438.

An introduction to Just-In-Time philosophy

By R. R. Trick, Senior Lecturer in the School of Business at the Polytechnic of Huddersfield, Queensgate, Huddersfield HD1 3DH, UK

Introduction

Most managers in UK manufacturing industry who are aware of Just-In-Time (JIT) would agree that it is a "good thing". These managers are also served by a large industrial consultancy sector which promotes the many and varied principles of JIT and helps to plan its implementation. In other words the WHAT, HOW, WHEN, WHERE and WHO of JIT can be answered by (relatively) routine analysis of the business operation, problem identification and appropriate re-organisation. However the question remains – WHY? What is the real *purpose* of JIT? This is the fundamental question which this paper seeks to address.

Technology and market forces

In the current industrial and commercial climate the factors of changing technology and market demands have a combined impact upon companies' growth (or survival). These factors have *forced* quite radical changes in product design, production methods and organisation structure.

Technological innovations in products go hand in hand with advances in the processes to manufacture them. This is especially well illustrated in the chemical industry. For example a series of interactive analyses of the product at various stages of the production process will require sophisticated systems to maintain product quality. It may also be the case that the materials used in the product have a restricted supply and that productive use of them is essential in order to compete in the market.

It can, of course, be said that the various factors identified above are nothing new in the world of manufacturing industry. However it is recognised that the modern scenario is characterised by an unprecedented speed of response to market demands and to the use of technology to meet these demands.

An interesting philosophical question arises here – does technological innovation create market demand or vice versa? Taking a very broad view this is a "chicken and egg" situation. For example the widespread use of micro electronic controls in consumer products satisfies a demand for compactness and functional reliability; it also benefits productivity for the manufacturer by reducing component count and easing the automation of assembly processes and quality control, thereby lowering the price of complex products and (in turn) stimulating market demand.

However, rather than pursue this question to some debatable conclusion, industrial managers will gain more tangible benefit from recognising that they are MANAGING CHANGE. This means change in respect of:

- □ Markets
- □ Product Technology
- □ Process Technology
- □ Monetary & Fiscal Policies
- □ Environmental & Legal Constraints

It also means, because of the rapid progress globally in information and communications technology, that the industrial manager has to deal with change more frequently and over shorter timescales.

The role of JIT in managing change

Relating to the previously identified areas of change, JIT is particularly aimed at process technology. Analysing this further we can say that it is specifically concerned with the operational logistics of the business (from vendor to internal processing to distribution) and minimising the lead-time between and during the various stages of the process.

It must be emphasized that JIT may also have connections with other change factors, eg. changes in product design, but the prime focus is upon MATERIAL FLOW, as in Figure 1.

In order to put Figure 1 into a JIT perspective, we need to understand that:

(a) The "material flow" poses problems relating to "industrial logistics".

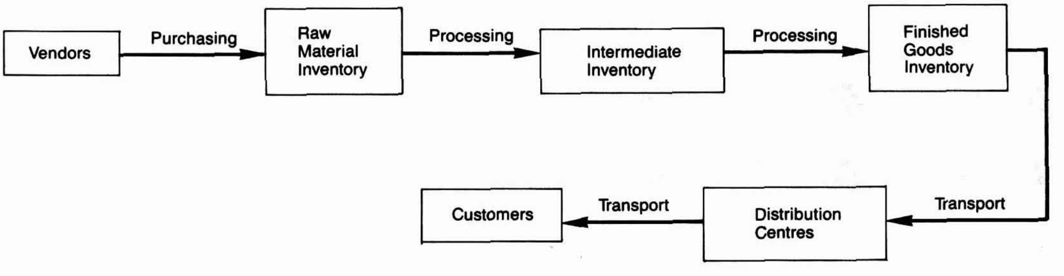
(b) The problems in (a) are normally identified when managers attempt to balance a combination of conflicting demands (eg. delivery promises, economic purchasing and inventory policies and maintaining a "level capacity" strategy to keep the plant running at all costs).

(c) The solutions to the logistics problems in (b), which require an *analytical* approach, may be constrained by the *summarised* nature of financial targets and budgets.

(d) A compromise between the respective requirements of logistics managers and financial managers is achieved by complex administrative procedures, which are designed to provide a company-wide management information system.

(e) The management information system grows in terms of both scope and sophistication (eg. increased use of model techniques for forecasting, planning and business analysis), which turn requires the creation and maintenance of more transaction data.

Figure 1
Material flow



However the effective management of change in manufacturing industry must ultimately be judged upon success in the market place. This is not primarily achieved by administration but by:

▷ Delivering Products at the Right Quality

▷ Lowering Unit Production Cost.

In other words we are concerned with manufacturing productivity – at the level of the product and on the shop floor.

Of course the aforementioned administration systems serve to provide the measures of productivity but care must be taken to ensure that such measures send the right messages to managers at the corporate level.

Example: Subsequent to major capital investment a company produces information to demonstrate that profit per employee is rising. This information may disguise the fact that Added Value (the difference between Sales Value and Material Cost) has not increased. This may be due to a combination of factors including sub-optimum material yield from the new processes and excessive levels of inventory. On the assumption that materials form the major portion of direct cost, indicators relating to labour productivity may be misleading.

As the above example shows, the management of productivity must focus primarily upon the manufacturing process and its surrounding logistical operations, such as material procurement and transmission.

These are the areas where JIT philosophy is turned into practice and, indeed, may challenge some of the basit tenets of industrial management and organisation.

Manufacturing industry is well versed in the methods and techniques of productivity improvement, such as Work Study (labour), Value Analysis (material), and Operational Research (inventory and distribution). However, the value of these tools may be constrained by basic principles which are reflected in company policy. For example, a manufacturing policy which includes maximum utilisation of plant capacity and the procurement of materials in economic batch quantities may conflict with the need to achieve "true" productivity in terms of quality, delivery and low unit cost. If these latter conditions are to be achieved, a more radical approach towards productivity improvement will be required. It will mean that established rules and procedures are challenged and that skills in the management of change have to be applied in earnest. It is from this viewpoint, rather than as another productivity technique, that the purpose of JIT should be understood.

JIT – A short historical perspective

Almost all the literature on JIT relates to practice in fabrication industries. The particular emphasis is often split between two major categories of JIT application, "Japanese" and "Western". Japanese JIT refers to manufacturing and assembly processes in the automobile and consumer durable industries. The companies are organised into "focused factories", ie. a networked system of relatively small manufacturing units, delivering one to the other in stages all the way to final assembly. The system is based upon the use of very short term production schedules (right down to one-day quotas or less), matched closely to market demand. Capital investment is maintained at very high levels to allow for maximum automation and rapid changeovers to accommodate maximum product flexibility. Although capital cost is high, day-to-day administration cost is minimised by working to short-term production programmes with minimal transaction data needing to be processed. Shop floor scheduling and control is devolved to the operational level, inventory levels held at the precise levels required for a shift (in effect, "zero inventory") and, in the event of any malfunction in the system, the entire process may be halted for immediate remedial action.

Western JIT, in many respects, should not need to be differentiated from the Japanese approach. Indeed there are many examples of Western companies who have adopted similar methods to their Japanese counterparts. One of the best-known cases is that of Hewlett Packard, who have adopted a variation of Toyota's "Kanban" (ie. a pull card) system in their assembly plants in order to minimize intermediate stocks and improve control of shift quotas. Another example from the same industry can be seen with IBM's assembly operations for personal computers which rely upon "just-in-time" deliveries of components, several times a day, from a network of certificated, quality-approved suppliers.

However, there are certain underlying differences between the respective economic, geographical, political and social conditions appertaining to Japan and the Western industrial block. Japan is a small, heavily-populated area with a large home market in which to test its products. Industrial companies dominate its political life, its population is educated and trained to meet industry's needs and its products are protected from foreign competition. Manufacturers concentrate upon high volume, high-tech products and they are supported by low rates of interest to finance investment in automation. To over-generalise, it is as though the nation is set up like a network of continuous processes and production lines.

Most Western nations, such as the UK, share few of the conditions which apply to Japan, and it is notable that the manufacturers whose operations most closely resemble their oriental counterparts are those who are in fierce competition with them, eg. Hewlett Packard, IBM and Ford. However the bedrock of Western industry comprises companies whose manufacturing systems are based on the concept of the "batch". Batch production systems have a natural tendency to generate the kind of manufacturing policies which were cited earlier, ie. maximum utilisation of plant capacity and the procurement of materials in economic batch quantities. The results of such policies are often seen as:

(a) Inflexibility to meet short term customer demands by committing plant to over-production on economic grounds.

(b) Reluctance to invest in excess (ie. flexible) capacity.

(c) Inward-looking "cost-cutting" mentality, which improves efficiency but restricts growth. This point has much to do with the UK's industrial under-capacity problems, which in turn lead to imports being sucked in.

(d) Use of complex systems for the recording of transaction data. These data are essential components of computerised administration systems such as MRP (Materials Requirements Planning). The function of MRP systems over the last two decades is to provide control information which helps to minimize the harmful effects of the level capacity and batch inventory policies highlighted above.

The evolution of JIT in Western economies has been largely based upon the application of JIT principles into industrial operations based upon the "Batch/MRP" concept. Put another way "Western JIT" aims to introduce investment and work practices at the operational level (ie. process, transport and storage) which bring more continuity throughout the system depicted in Figure 1, which are flexible to meet short term demands and which (very importantly) maintain product quality at the required levels.

JIT in chemical processing

In the previous section the underlying theme was that JIT practice aligns itself most readily with continuous, mass production industries, ie. it is essentially "anti-batch". However certain industries are *so* continuous and repetitive (eg. food processing) that JIT principles are built into their very existence. At the opposite extreme there are "project" industries (eg. shipbuilding) where one-off situations predominate. Chemical processing resides at some point in between, as illustrated in Figure 2.

Chemical Processing, in common with Engineering industry, operates in a batch mode. Other shared characteristics include:

(a) A product structure composed of various ingredients.

(b) Intermediate products which can be further processed into a number of alternative finished products.

(c) An MRP system of planning and control, in concept if not by name.

The MRP concept is based upon a Master Production Schedule, which determines:

- ☐ What to Order
- ☐ How Much to Order
- ☐ When to Order
- ☐ When to Schedule Delivery

This is a front-end planning activity which generates information for maintaining priorities for:

- ☐ Inventory Planning & Control
- ☐ Capacity Requirements Planning
- ☐ Shop Floor Control (ie. managing the detailed flow of materials inside the plant)

The "nuts and bolts" of the entire system for manufacturing planning and control are contained within the company database, ie:

- ☐ Raw Material Purchase Orders
- ☐ Inventory Records
- ☐ Product Structures (Ingredients)
- ☐ Process Routings
- ☐ Process Controls
- ☐ Customer (or Forecast) Orders
- ☐ Planned Shipments

The planning and control administration system will, however, face a number of difficult management problems, for example, poor vendor performance, inaccurate (or out of date) inventory records, too little (or too much) capacity and inflexibility to meet changed order requirements and delivery dates. Very often the solution is sought by investing in bigger and more expensive plant but this will in turn induce pressure to achieve a financial return – which means maximum utilisation at all costs! The original management problems are therefore magnified rather than reduced.

JIT offers the means of breaking out of this vicious cirle. It does this by setting aside the questions of capacity utilisation and return on capital investment. It focuses initially upon material velocity through the manufacturing system, as depicted in Figure 1, by reducing lead times, both within processes and between processes. Lead time reductions are partly achieved by technical improvements (eg. reduced set-up times) and also by scheduling work orders in quantities which adhere as closely as possible to planned shipments. Requirements are determined by working back through the system, all the way to the vendor, who is expected to make just-in-time deliveries to meet the manufacturer's production schedule in the quantities required.

Objectives of JIT

(a) To achieve flexibility in manufacturing systems to meet market demands and to improve competitiveness.

(b) To improve productivity by eliminating the waste inherent in batch production.

Costs of JIT

For any company JIT should be seen primarily as an investment in ideas, with capital investment as a secondary element.

A JIT Programme is likely to incorporate some or all of the following:

(a) Technical improvements in manufacturing processes, especially in reduced set-up times and interactive process control.

(b) A Quality Improvement Programme which involves all employees and which is aimed at continual improvement.

(c) Vendor certification and monitoring, based on a Zero Defects policy and with rewards and penalties for delivery performance.

(d) Employee training in the management of change.

(e) Increased use of information technology by individual employees and quantitative planning and control techniques at all levels.

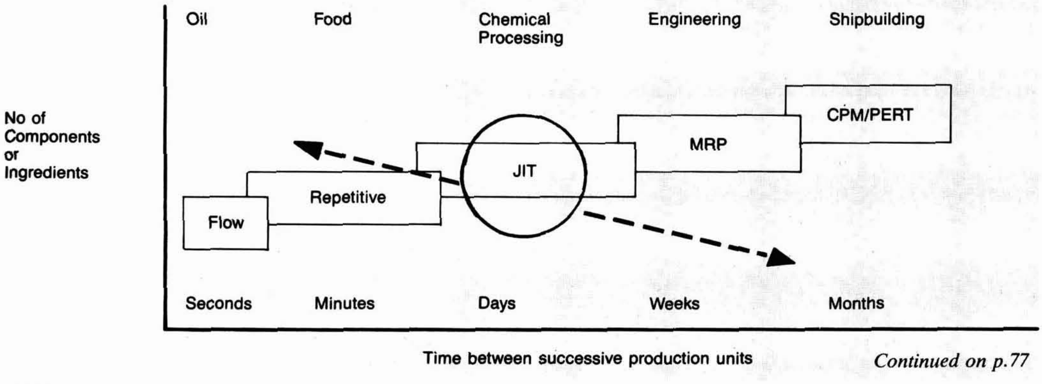
(f) Re-appraisal of performance measures, incorporating allowance for sub-optimum capacity utilisation.

Benefits of JIT

(a) Customer-led order quantities with shorter production lead times.

Figure 2

JIT relative to other industries (based on "Manufacturing Planning & Control Systems" by Vollmann, Barry & Whybark-Irwin, 1988)



Continued on p.77

Analysis of black deposits on road markings using solvent extraction – thermogravimetric and pyrolysis – gas chromatographic techniques

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Abstract

Black deposits have been observed to cover rapidly the road markings in Riyadh, Saudi Arabia. Previous work has shown that deterioration of the asphalt road surface was not a cause[1,2]. This study reports the use of further techniques to identify the black deposits. Pyrolysis — gas chromatography shows that they contain natural, butadiene and styrene-butadiene rubber. Solvent extraction and thermogravimetric analysis have been used to split the deposits into four fractions (i) extractable organic compounds, (ii) organic polymer, (iii) carbon black and (iv) an inorganic residue. The ratios of (i), (ii) and (iii) are shown to be very similar to the corresponding ratios for typical tyre tread rubbers. The sulphur content values for both black deposits and tyre debris are similar while that of bitumen is higher. Thus the black deposit is shown to be tyre debris mixed with road dust.

Introduction

In certain hot, dry, dusty environments with heavily used roads, the useful service life of road markings (lane dividers etc.) is severely curtailed by a black deposit building up on the surface of the paint and obscuring it. Riyadh is among the places where this problem is particularly acute, and the Saudi Arabian Standards Organization (SASO) has been investigating it.

The results of a literature search indicated that amongst the work on road marking paint, there had been little discussion of the current problem of blackening. As long ago as 1952, Keese and Benson[3] noted severe discolouration could be caused by road dust and tyre film. Two decades later Rumer and Ost[4] found that the dirt collected from some Swedish roads consisted of "dirt" from the road surface (stone grains and asphalt) and a minor part from car tyres. Another article by Green[5] dealt with black deposit observed in the autumn of 1972 on heavily trafficked roads in the United Kingdom after a long dry period of weather. The deposits were a mixture of oil, tyre-rubber compound, mineral matter and water. The origin of the oil was almost certainly the automatic chassis lubrication system of heavy vehicles. The oil and tyre compounds were estimated by acetone extraction followed by pyrolysis-gas chromatography.

In the absence then of directly relevant published work, various authorities favoured quite different mechanisms for blackening of the road markings before SASO undertook its investigation. The three causes most frequently suggested were (i) deterioration of the bitumen road surface, (ii) wear debris from tyres and (iii) the use of unsuitable road marking paints.

The first of these possibilities has been addressed in earlier papers in this series. A study of the bitumen of roads in Riyadh showed it to be of "satisfactory/superior" quality which have good ability to withstand environmental attack[1]. Moreover infra-red analysis of the black material recovered from the road paint showed oxidation products of bitumen (asphaltenes) to be essentially absent[2]. Pyrolysis of the black material followed by infra-red spectroscopy implied that it contained at least some rubber[2] Thus the blackening is not the result of deterioration of the bitumen road surface, but may be associated with tyre debris. Investigation of this latter point is the principal topic of this paper.

Samples of the black material were obtained by washing the blackened road markings and their composition was compared with that of rubber removed from tyre treads by abrasion. Three techniques were used: (a) pyrolysis-gas chromatography, (b) solvent extraction followed by thermogravimetric analysis and (c) comparison of sulphur content.

Experimental methods

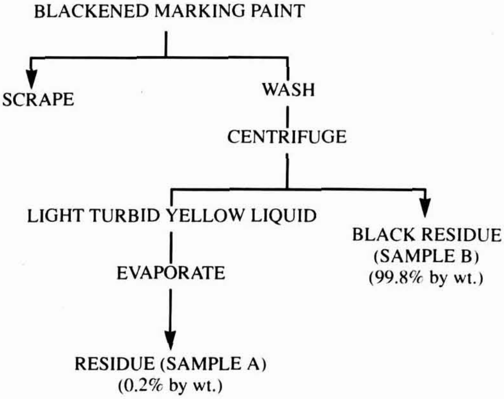
1. Preparation of Samples:

(a) Twenty samples of black deposits were sponged with distilled water from different types of road markings laid on new and old pavement surfaces. The washings were highly centrifuged four times at 45,000 rpm and the residues were dried at 100°C (Sample "B"). The liquid was evaporated to dryness to give a residue, sample "A" (Figure 1).

(b) Twelve samples of rubber were prepared by abrasion of three kinds of new tyres T1, T2 and T3.

Figure 1

Sampling of black material from discoloured road markings.



2. Pyrolysis-gas chromatography

Samples of black residues and of tyre treads were pyrolysed in a stream of nitrogen in the entry port of a gas chromatograph using a Curie point pyrolyser. The gas chromatography conditions were as follows:

Pye PU 4500 with Curie — Point pyrolyser (610°C)
Packing 10% squalane

Column 1.6 meter × 4mm ID glass column

Oven Temperature, °C	90
Injection temperature, °C	125
Detector temperature (FID), °C	150
Carrier gas (nitrogen) flow, ml/min	50
Attenuation	1600

3. Solvent extraction and thermogravimetric analysis:

The solvent used in the oil extraction was carbon disulphide which is a highly polar solvent used to dissolve bitumen and derivatives produced by oxidation and cracking. The samples were subjected to carbon disulphide CS_2 extraction in a Soxhlet. Weighed amounts of the extract residues were then heated in a nitrogen stream up to 400°C to determine the organic material insoluble in carbon disulphide: any such material would be polymeric in nature. The last stage was heating the new weighed residues in an oxygen stream up to 525°C to determine the carbon content of elemental carbon[6].

4. Sulphur determination

The sulphur was estimated using the oxidation method described in ASTM D-129.

Results and discussion

Pyrolysis — gas chromatography

The pyrographs for the black material (samples A and B) in Figures 2 and 3 should be compared with those obtained from various tyre rubbers (Figure 4). It is clear that the black material contains rubber. Sample 1 consists chiefly of natural rubber (NR) and styrene — butadiene rubber (S.B.R.) (Natural rubber is a constituent of truck tyre treads). Sample 2 consists of SBR and butadiene rubber (BR) in proportions similar to those in the tread of the T2 and T3 car tyres.

Thermogravimetric analysis

The solvent extraction and two stage thermal analysis splits the samples into their constituent parts. The carbon disulphide extracts the non-polymeric organic compounds. the polymer component is removed by heating to constant weight at 400°C in nitrogen. Carbon black is stable under these conditions. The elemental carbon is then removed by heating in oxygen at 525°C leaving an inorganic residue.

Figure 2

Pyrographs of black deposits obtained from road paint by method indicated in figure 1-sample 1. The presence of different types of rubber is indicated.

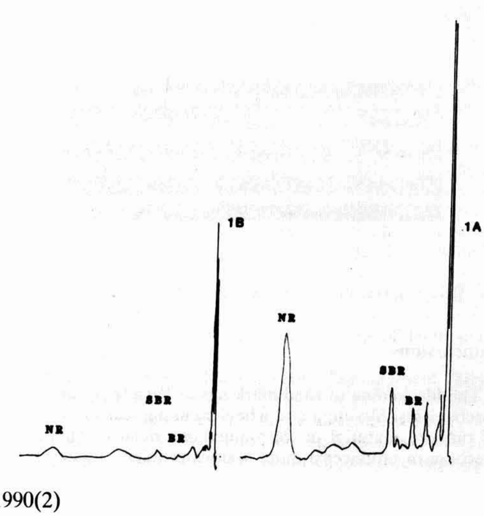


Figure 3

Pyrographs of black deposits obtained from road paint by method indicated in figure 1-sample 2. The presence of different types of rubber is indicated.

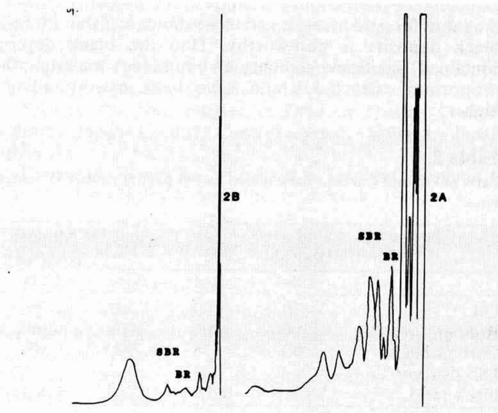


Figure 4

Pyrographs of rubber from the tread of locally obtained tyres, T1, T2 & T3.

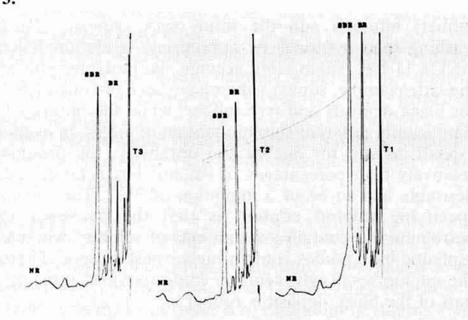


Table 1 shows the results of the solvent extraction-thermogravimetic analysis applied to (i) tyre treads, (ii) bitumen, (iii) the black deposit (sample B) from road markings and (iv) a similar sample obtained from washing the asphalt road surface itself. The results have been expressed as parts by weight associated with 100 parts of polymeric material, except for bitumen in which there is no insoluble polymeric content.

It is clear that the bitumen, being completely soluble in carbon disulphide, behaves quite differently from the black

Table 1

Oil extraction — thermogravimetric comparative analysis of rubber-tyres, bitumen and black deposits, parts to 100 part rubber in tyre.

Stage	Rubber tyres T1	Rubber tyres T2 & T3	(Bitumen)	Black deposits on surface of Road Markings	Black deposits on surface of Asphalt Pavement
Oil extracted by CS2	61.7	65.7	(100%)	64±1.0	64±1.0
Polymeric Material insoluble in CS2	100	100	(0.0%)	100	100
Carbon black	75	83.1	(0.0%)	83±1.5	83±1.5
Inorganic residue	—	—	(0.0%)	552±5	552±5
Oil: Carbon black Ratio	0.8:1	0.8:1	—	0.8:1	0.8:1

deposits. Comparing the black deposits with the tyre rubber shows a very similar composition except that the black deposits contain a substantial amount of inorganic material.

Table 2 gives some literature values for oil, rubber and carbon black content of vehicle tyres. The similarity between the ratios for modern tyres and those shown in Table 1 for the black deposits is noteworthy. Had the black deposit contained significant amounts of bituminous materials the proportion extracted would have been correspondingly higher.

Table 2

Parts of Oil and Carbon black added to 100 part of rubber in vehicle tyres[7]

	Before 1960	1960	1964	Modern Passenger Cars
Oil	10	40	50	75
Rubber	100	100	100	100
Carbon black	50	75	90	95
Oil: Carbon black ratio	0.2:1	0.52:1	0.55:1	0.8:1

Sulphur Estimation

Comparison has been made of the sulphur content of tyre-rubber, bitumen and the solid black deposits (B) from washing road markings by appropriate oxidation following ASTM D-129. Taking into account the inorganic content of the latter sample, similar values have been obtained 1.8-2.0% for black deposits and tyre rubber, while the bitumen has a significantly different sulphur content of 5.3%. In evaluating asphalt cement for quality and durability, the presence of relatively high percentages of sulphur has been considered desirable and to be of a minimum of 3%[8]. The theory for specifying sulphur content is that the paraffinic crude petroleum oils contain low amounts of sulphur, whereas the asphaltic base crudes contain higher percentages. Therefore the sulphur results gives further confirmation that the organic part of the black deposit is rubber.

Mechanism of Blackening

By combining observations in the field with the results of laboratory investigations the following account can be given of the blackening of road markings.

The discoloration of fresh markings is clearly worst in areas of rapid braking approaching traffic lights, inclinations and intersections: some of the blackening is obviously associated with skid marks. In addition to this, a gradual greying with time occurs throughout the road system and even in parking lots with concrete surfaces. Eventually the road markings are obscured.

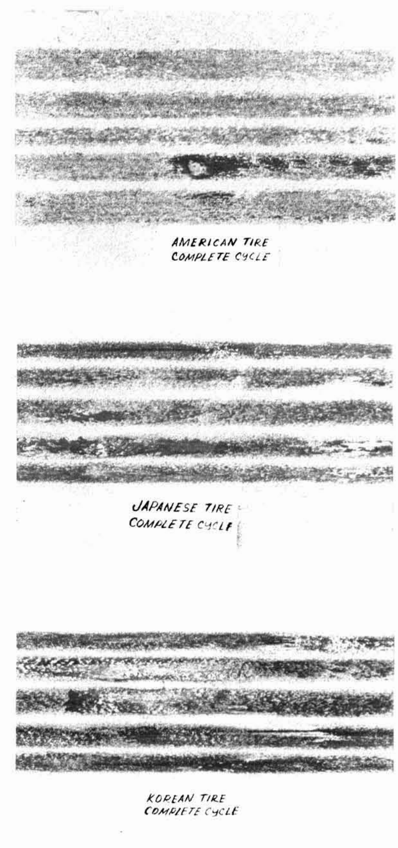
The deposition of rubber after skidding was demonstratred by washing the tyre of a light "pick-up," spinning it on a concrete surface and driving onto a steel sheet painted with road marking paint. The black lines shown in Figure 5 were produced by a single transverse. They were clearly caused by rubber deposited following the frictional heating and abrasion.

Thus the black deposits are of two different types. One is unambiguously tyre black associated with skidding and wheel spinning (Figure 5) and occurs mostly in areas of rapid braking. This deposit cannot be easily washed from the surface.

The second type builds up more slowly, but produces a much more serious problem as it is ubiquitous, and after an initial greying obscures the markings. This deposit is largely removed by washing with water, and is the material which has been subjected to laboratory examination. It has been shown to be a mixture of tyre debris and dust, originating no doubt in the surrounding desert, open areas, building sites etc[9]. Any tyres of poor quality will wear more rapidly and aggravate the problem. This mixture of tyre debris and dust is picked up by vehicle tyres and deposited on the marking paint. This deposition occurs on all types of paint. SASO has conducted field trials of a large number of marking paints. Some were hot applied thermoplastic, some solvent-based thermosetting; some were commercial materials some experimental formulations developed in the laboratory. Although the blackening did not occur at identical rates with all paints, all paints were adversely affected, and eventually became obscured. Thus while the nature of the paint does have an effect on the rate of blackening, it is a relatively minor one. The blackening is not a consequence of a fundamental inadequacy in the paint employed.

Figure 5

Tyre black associated with skidding and wheel spinning.



Conclusions

The blackening of road markings in Riyadh occurs by two mechanisms. Skidding and wheel spinning leads to a deposit of rubbery material in the immediate vicinity. The second mechanism produces a more serious problem. General wear debris from tyre treads mixed with road dust is picked up by vehicle tyres and deposited on the road markings whenever they are crossed. Degradation of the bitumen plays no part in this mechanism which occurs on all types of marking paint.

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Paper presented at the OCCA West Riding Symposium — "The Implications of JiT", University of Leeds, September 1989.

R. R. Trick, Continued from p.73.

(b) Lower average levels of inventory.

(c) Simplified planning and control of manufacturing based on customer priorities.

(d) Less transaction data in the administration system, giving reduced overhead cost.

(e) Quality and delivery problems become visible more quickly and clearly, allowing for immediate corrective action to be taken.

(f) Authority and responsibility for manufacturing planning and control may be decentralised, reducing the bureaucracy of a central administration.

(g) Employees increasingly become "knowledge workers" who understand the entire manufacturing system, allowing for "flatter" organisation structures and improved communication.

(h) New performance measures are introduced, related to customer service rather than to the utilisation of direct labour or capital equipment.

Why JIT?

We return to the original question. This paper is not intended to be a catalogue of JIT techniques nor how to implement them. Its purpose is to raise doubts: doubts about the major (global) issues facing manufacturing industry; doubts about the meaning of productivity; doubts about how success can be measured. It is only when these doubts have been seriously raised that managers can come to realise that JIT is worthy of serious investigation. ■

Paper presented at the OCCA West Riding Symposium "The Implications of J-i-T" University of Leeds, September 1989.

G. G. Tidman, Continued from p.70

management, controlling, budgeting, forecasting and planning will all need to be reviewed.

It is unlikely that a 'programme for improving productivity and reducing waste' will be strong enough to influence major structural changes. Equally it is unlikely that most organisation structures will stand the acid test of such cultural changes.

Therefore, which comes first — THE CHICKEN OR THE EGG? ■

Paper presented at the OCCA West Riding Symposium — "The Implications of JiT", University of Leeds, September 1989.

The effect of pigments in formulating solar reflecting and infrared emitting coatings for military applications

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Summary

The near infrared (NIR) reflectance of paint schemes may be increased by replacing dark pigments which are highly absorptive in the visible and infrared regions, by visually similar pigments with low NIR absorption. On exposure to sunlight, these low NIR absorbing pigments reduce heat build-up and thermal infrared (TIR) signature. Examples are cited in which reduced temperatures were achieved using these replacement pigments on items of defence equipment.

1. Introduction

Temperature reduction is widely achieved in civilian operations by minimising the spectral absorbance of solar radiation with light coloured reflective paints. However, some operations, such as use of coatings for camouflaging defence equipment, preclude the use of light coloured paints and demand that dark coatings be used.

This report describes the results of replacing highly absorbing NIR pigments in paints systems used on (i) pilots' helmets, (ii) fibreglass vehicle bodies and (iii) ships' hulls con structed with foam sandwich/glass reinforced plastic laminates. In these examples, excessive temperature increases causing operational problems or structural failures were overcome by the use of low NIR absorbing coatings. The principles involved in formulating coatings to reduce solar heat build-up and thermal signature are discussed and various approaches used by different countries are also covered.

2. Background

The infrared band of concern for solar and infrared absorbing (emitting) coatings occurs within the wavelength range 0.7-14.9μm. The infrared spectrum is generally divided into the **near infrared (NIR)** region between 0.7-2.5 μm and the **thermal infrared (TIR)** region between 3-14 μm. The visible region of the electromagnetic spectrum lies in the wavelength range between 0.4-0.72 μm (400-720 nm) while the ultra-violet region relevant to solar radiation is considered to be the region between 0.2-0.4 μm (200-400 nm).

The wavelength range (and intensity) of radiation emitted by an object varies with temperature, resulting in the peak radiation moving to shorter wavelengths at higher temperatures. Sunlight at sea level has an intensity of approximately 0.1 W/cm^2 with peak intensity (sun surface temperature 6000 K[1]) in the visible region around 0.5 μm. The energy in the solar spectrum under clear conditions consists roughly of 5% ultra-violet radiation, 45% visible radiation and 50% infrared radiation. Ninety-six per cent of total solar radiation falls within the wavelength range 0.2-2.5 μm (200-2500 nm), approximately 1.7% within the 3-5 μm range and 0.1% in the band between 8-14 μm[1].

Objects on the earth's surface having temperatures around 30°C are strong sources of TIR radiation even though they may not be hot enough to emit visible radiation. These objects emit approximately 98% in the wavelength range 3-30 μm[2]. In general, the overlap between reflected solar radiation and self emitted radiation is confined to the 3-5 μm region, e.g. 'at room temperature, the power emitted at 5 μm by an efficient radiator is as great as the power from sunlight falling on the same area'[3]. In the 8-14 μm region, the reflection of solar radiation is much less important than in the 3-5 μm region, e.g. energy self-emitted by a black body at 100°C in the 8-14 μm band is approximately 4 x 10^{-2}W/m^2 whereas the intensity of sunlight in this region is of the order of 1 x 10^{-4}W/m^2.

Coating requirements to control radiation emissions from an object fall into two categories:

(i) coatings which act by controlling absorbance or reflectance of **incident solar radiation.** These coatings operate predominantly in the visible and NIR regions.

(ii) coatings which control emissions resulting from a combination of **incident solar radiation** and **thermal self emitted radiation.** These coatings operate in the visible, NIR, and the TIR regions.

This paper examines the manner in which paint formulation influences the absorption and reflection of visible and infrared radiation thereby controlling solar heat build-up and radiation emission in certain spectral regions.

2.1 Visible and NIR radiation of coatings

Light in the visible and NIR regions falling upon a coating, either enters the paint film or is specularly reflected at the surface. The light entering the film is either diffusely reflected by the pigment particles, absorbed by the pigment and resin or transmitted through the film to reach the substrate or an underlying paint coating. Light reaching the substrate is absorbed or reflected back through the film. Radiation not reflected either by diffuse or specular processes is converted to heat or chemical energy.

Light-scattering in the visible (and NIR) is at a maximum when large differences exist between the refractive indices of the pigment and medium and when pigment particle size (which may include voids), relative to the wavelength of the non-absorbed component is such as to offer maximum resistance to the passage of light at that wavelength[4] in accordance with Rayleigh scattering principles. Hughes[5] showed that the higher the ratio of refractive indices of pigment to vehicle, the higher the scattering power of the paint. For a selected value of this ratio, m, Jaenicke[6] concluded that the maximum scattering power for a wavelength λ, occurs at a particle diameter, d, given by:

$$d = \frac{0.90\lambda\,(m^2 + 2)}{n\pi\,(m^2 - 1)}$$

where n = refractive index of the vehicle in the paint coating. Tomkins and Tomkins[7] have suggested that the Mie scattering theory shows to a good approximation that the same relationship may be used for different wavelengths with correspondingly different optimum particle sizes. As such, they suggest that while commercial white pigment preparations are unsuitable for infrared reflection, reflectivities of 98% are possible with larger particle size preparations of these pigments.

It is possible to measure scattering and hiding power in the NIR region in a similar manner to that for the visible region by measuring the reflectance values of paint films at NIR wavelengths when applied over a highly reflecting white (RW) and a highly absorbing black (RB) surface. Large differences[4] in the values of RW and RB indicate poor NIR hiding power (i.e. high infrared transmission) whereas reflectance values of similar order indicate good hiding power. Furthermore, where the reflectance values are similar but low, absorption is the major factor involved, whereas similar but high values indicate that hiding power is largerly achieved by diffuse reflectance. Using this procedure, one group of pigments is found to be strongly reflecting, another is transparent and a third which is strongly absorbing, e.g. the red, orange and yellow chromes are found to be strongly reflecting in the NIR, the blue and green chromes strongly absorbing, while many yellow and red organic pigments are seen to be relatively transparent to NIR radiation.

NIR absorbers are found to have a profoundly depressing effect on reflectance values in the NIR[4].

2.2 Formulating coatings for visible and NIR radiation

In view of their relevance to defence operations, requirements for coatings to provide visual camouflage and/or temperature reduction of an object exposed to sunlight were adopted in military specifications.

In early times, it was possible to conceal an object simply by the application of a paint coating exhibiting colours similar to those of natural materials in the vicinity. Camouflage paints are generally black, earth coloured or dull green flat coatings. Black roughly represents shadow, the earth colours represent sand and rocks and dull green represents vegetation. Flat paints are used to avoid specular reflections and to avoid the problem that gloss causes a loss in the surface colour definition at certain angles thus destroying the advantage of camouflage[8].

However, dark coloured low gloss paints are liable to excessive heating when exposed to light. If dark colours are used, it is not possible to reflect the visible part (45%) of the solar radiation. However, if the highly absorbing pigments used in the paints, e.g. carbon black, are replaced by pigments which do not absorb in the NIR then the colour will be retained but the NIR absorption will be reduced.

By the fifties and early sixties, NIR camouflage was required against photographic detection of the object. NIR photography detects radiation up to 0.95 μm, this radiation consisting of the infrared component of daylight reflected from the object. (Up to 1970, paint literature on infrared radiation properties have almost exclusively referred to NIR radiation). By the seventies, camouflage against TIR surveillance up to 14 μm was receiving attention[3]. At these longer wavelengths, thermal self-emission contributes increasingly to the total emission. Although detectors operating in this region are extremely sensitive, the practical situation in a terrestrial environment involves the detection of target temperatures in a background having natural fluctuations of several degrees. The permissible target temperature variation is suggested[3] to be 4°C from ambient.

Cohen and McLeskey[9] found that large particle size titania and magnesium silicate significantly increased NIR reflectance at 1.2 μm in agreement with Tomkins and Tomkins[7] predictions on size dependent NIR reflection. Preparations of this pigment and filler were used to develop[9] white and grey solar heat reflecting paints for defence equipment that provided comparable reflective properties to specification paints at 66% reduction in dry film thickness.

The principle of using inorganic pigments of large particle size to improve the NIR reflection properties of camouflage paints is employed in a number of U.S. MIL Specifications, e.g MIL-E-46061 and MIL-E-46096B where particle sizes of 1.25-1.55 μm are required. MIL-C-46127 for a solar reflecting undercoat requires 75% of the titania particle size to be 10-20 μm.

2.3 NIR reflective paint schemes: different approaches

Fundamentally different approaches have been adopted[10] to improve the NIR reflectivity of paint schemes. The approach adopted in the U.K. (e.g. by Radar Research Establishment[11]), is to replace highly absorptive pigments in the paint film by alternatives which are transparent in the NIR but absorptive in the visible. The colour is retained but the infrared radiation will pass through to the undercoat. If then a good reflective undercoat is used beneath the infrared transparent finish, the NIR radiation will be reflected by the paint scheme as a whole. The study then becomes one of examining pigments in terms of their absorption and transmittance in the visible and infrared range. This system has two limitations. Firstly, the film thickness of the topcoat must be minimal since however efficient the material, there is always some absorption, and secondly, maintenance requires that an undercoat be applied when the topcoat is being recoated, otherwise the reflective undercoat becomes covered with an increasingly thick (and increasingly absorbing) topcoat.

The U.S. Army Coatings Laboratories[9] have concentrated their research on pigments which strongly reflect infrared radiation rather than transmit it to the undercoat. However, the U.S. materials apparently were to some degree transparent in the NIR range since 'the undercoat directly beneath the solar reflecting topcoat was a critical factor[10]'. The U.S. also found that the metal substrate under the coating also played a rôle in NIR reflection.

In the investigation described herein, the NIR reflectance of paints has been increased, as in the U.S. approach, but by replacing the absorptive pigments rather than the transparent pigments.

3. Experimental

3.1 Paint systems

(i) A NIR reflecting grey paint system was formulated for pilots' helmets to replace the existing white paint which produced a reflection on the interior surface of the aircraft canopy (Gagliardi *et al*[12]). The use of standard grey paints caused elevated temperatures so that a synthetic black infrared reflecting pigment[13] was incorporated into the test formulation.

(ii) A NIR reflecting deep bronze green paint was prepared (Grey *et al*[14]) following a request to overcome high surface temperatures, cracking and heat distortion of cabins of fibreglass vehicle bodies. The green paint was formulated using a grade of chrome oxide and a synthetic infrared reflecting black pigment[13].

(iii) Two NIR reflecting grey paints were developed with different synthetic black tinters[13,15] following a request for suitable paints for ships' hulls which were of foam sandwich/glass reinforced plastic (GRP) construction. This plastic laminate structure was subject to excessive temperature build-up which could potentially lead to: (i)distortion, delamination and cracking of the composite (Gagliardi[16]), (ii) loss of the integrity and strength of the adhesive bonding between the GRP and the foam and (iii) reduction in the shear strength of the foam core[17,18].

3.2 Infrared reflectance

The reflectance properties of the coatings were measured at 800 nm using a modified EEL reflectometer. Reflectance measurements at 750 nm and 850 nm were carried out using a Cary infrared reflectance spectrophotometer.

3.3 Heat reflective properties

The effect of the paints on heat absorption was assessed by different methods depending on the requirement.

In trial (i), painted panels were placed on a piece of hardboard inclined at an angle of approximately 45° to the horizontal and exposed in a perspex box to midsummer sunlight. The temperature reached by the panels was recorded by a 'Comark' electronic thermometer connected to Kaptan covered '30B and S' copper versus constantin thermocouple wires set in a groove on the front surface of the panel sealed in place with polyester resin.

In trial (ii), glass reinforced polyester panels, 150 x 300 mm were painted and placed at a distance of 460 mm from a Philips 250 volt infrared lamp facing the lamp normally. These lamps have an intensity of 0.12 W/cm^2 with peak intensity in the NIR at around 1.0 μm (c.f. sunlight at 0.5 μm). The panel was left in front of the lamp until the panel surface temperature stabilised. The temperatures were recorded as in trial (i).

Temperature measurements were not conducted in trial (iii).

4. Results

From the results shown in the Tables, it is apparent that significant increases in NIR reflectance can be achieved by replacing strongly NIR absorbing pigments.

It is also evident from Tables 1 and 2a that significant reductions in temperature were achieved corresponding to increases in NIR reflection by the replacement materials.

5. Discussion

5.1 NIR radiation

The requirement for reduced NIR absorption in the three instances in the Tables arose from Service requests to lower the thermal load arising from either a desire to prolong equipment life or improve operational conditions. It is apparent that replacing NIR absorbing pigments with reflective materials has a profound effect on substrate temperatures.

The increased NIR reflectivity of these camouflage paint schemes has raised questions on the effect of these changes on detection levels. There is a belief that the increased NIR reflectivities will lead to a decrease in the range of detection. The question involves weighing the likelihood of increased detectability in NIR regions for laser guided munitions when using these paint schemes against the increased detectability by thermal infrared devices when not.

5.2 TIR radiation

The requirement for reducing thermal loads has, in recent times, been extended to matching equipment thermal infrared (TIR) signatures with environmental levels[8]. Formulation of paints to give low absorbances (and emittances) in the TIR region is rendered difficult by the

Table 1

Temperature of paint systems for pilots helmets[12]

Paint System (Undercoat/topcoat)	% Infrared Reflection	Temperature °C
1. White/light grey (NIRR)*	62	48
2. White/dark grey (NIRR)	45	58
3. Light grey (NIRR)	65	55
4. Dark grey (NIRR)	48	62
5. Light grey	18	63
6. Dark grey	5	73
7. White lacquer	90	38
8. Black lacquer	3	76

* near infrared reflecting

Table 2a

Temperature of paints for army fibre glass cabins for bomb disposal vehicles[14]

Paint System	Maximum Temp°C*
1. NIL	93.5
2. 2 coats grey primer	79
3. 2 coats white primer	57.6
4. 2 coats grey primer + 2 coats green	108
5. 2 coats white primer + 2 coats white	63.5
6. 2 coats white primer + 2 coats green	104
7. 2 coats white primer + 2 coats NIRR green	75.8

* Distance between lamp and panel is 460 mm. Ambient temperature is 18-19°C.

Table 2b

Infrared reflectance of paints for fibre glass cabins of army bomb disposal vehicles[14]

Coating	% Reflection at 800 nm
Grey primer	19
White primer	91
Green finish	10
White epoxy	80
Green NIRR finish	45

Table 3

Infrared reflectance of paints for minehunter-inshore vessel[16]

Coating	% Reflection at 750nm	800nm	850nm
Admiralty Grey	22	20	19
Grey (Paliogen black)	78	78	77
Grey (Helio black)	58	72	75

large number of chemical structures in organic resins which absorb in this region. To eliminate absorption in the TIR, bonds between light elements, e.g. carbon-hydrogen bonds (3.0-3.7 μm), oxygen-hydrogen, nitrogen-hydrogen (2.7-3.3 μm), must be absent. One method aimed at decreasing these absorptions has been to use chlorinated resins, e.g. PVC film adhesively bonded in patches on camouflage netting[19]. The vinylidene chloride copolymers, e.g. vinylidene chloride-acrylonitrile also show very weak absorption in the 3-5 μm area[19].

The infrared absorption bands of inorganic materials tend to be broad and fewer in number than organic materials. A number of the metal oxide fillers or pigments e.g. zinc oxide, are relatively weak absorbers in the TIR region[20]. Their relatively weak emissions in the TIR make them suitable for camouflage in this region.

Low emissive paints (LEP), which are claimed to reduce by as much as 50% the loss of energy in radiative form, are now commercially available [21]. It is recommended by the suppliers that these LEP should be applied to ships, tanks and vehicles that are subject to solar heating during the day, but require reduction of the heat loss at night. LEP coatings with reflectance of about 50% in the 8-14 μm region are used externally and can be generally made in any colour.

6. Conclusions

In this report, the development of paint formulations with similar visible characteristics but with significantly lower temperature and hence thermal signature is described. These coatings may be made at marginal cost increases over those in service. Considerations should be given to the replacement of coatings on items of defence equipment, where service life of TIR signature are important. If the major component of TIR detection can be assigned to an excessive temperature increase as a result of solar radiation absorption, coatings which increase NIR reflection should be considered.

Passive countermeasures such as infrared and visible camouflage paint are cheap and effective for long periods providing an attractive technique for operational requirements[22]. It is said[3] that 'one cannot make a target impossible to see, one can only make it more difficult to see, delay its detection and increase the likelihood of overlooking it or misidentifying it'. Correctly used, camouflage can spell the difference between a successful campaign and defeat. The use of newer detection and target techniques requires that the present camouflage paint schemes be progressively extended into longer wavelength regions to reduce temperature and infrared emission.

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Terms

$$\text{emissivity (e)} = \frac{\text{radiant power emitted/area}}{\text{radiant power emitted by a blackbody/area}}$$

The absorbing properties of the surface are characterised by the absorbance defined as

$$\text{absorbance (\&)} = \frac{\text{radiant power absorbed}}{\text{radiant power incident on surface}}$$

At thermal equilibrium, e = & (Kirchoff's Law), i.e. good aborbers are good emitters. ■

Computer modelling of solvent blends

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Abstract

The accurate prediction of the evaporation behaviour of solvent mixtures is the key to cost effective solvent formulation in the coatings industry. The development of an accurate computer model for predicting the evaporation of solvents is described. The application of the model to common surface coatings problems is discussed.

BP Chemicals manufactures a wide range of chemicals and plastics, and is a major supplier of raw materials to the coatings industry. The products supplied to manufacturers of surface coatings include monomers, plasticisers and solvents.

The BP Chemicals solvent range includes alcohols, esters, ketones, glycols, glycol ethers, glycol ether esters and hydrocarbons. In order to provide an effective service to solvent customers in the coatings industry an extensive knowledge of solvent applications has been built up by the BP Chemicals Solvents Technical Service Group, based in Hull. By working closely with solvent users an appreciation of the problems that face them has been developed.

There are many pressures facing the coatings industry today, including new environmental legislation, the requirement for coatings with higher performance, and the need to reduce costs. In these and in many other areas BP Chemicals, as a supplier to the industry, is often called upon to offer advice and assistance.

This article describes the development of a computer model for predicting the evaporation behaviour of solvents in coating systems. This model was developed in response to many technical enquiries in this complex area from coatings manufacturers. The model has evolved into BP SOLVE, the BP Chemicals evaporation prediction and reformulation program, which is now available free of charge to solvent users in the coatings industry.

In order to develop any model for predicting the behaviour of solvents which will be of practical use to the coatings industry it is necessary to understand the reasons why solvents are used in the way that they are, and to understand how solvent formulations are developed. Solvent power and evaporation behaviour greatly influence the performance of the finished coating. Coating manufacturers use solvent mixtures to achieve the required solvent power and evaporation characteristics at the lowest cost. When developing a solvent formulation the coating chemist builds a model in his mind of how the solvent mixture will behave when the coating is applied. This model is constructed by the chemist using experience and information from published literature, such as evaporation rate data for individual solvents and solubility parameters. A coatings chemist can then use this model to suggest formulations that can be evaluated in the laboratory. This method of developing solvent formulations works, however it is usually a very time consuming and costly process involving the evaluation of many trial formulations.

In constructing such a model the coatings chemist relies on evaporation rate data for pure solvents obtained either from the literature, the solvents suppliers, or from his own experimental work. However, there is considerable disagreement in the literature on the evaporation rates for pure solvents. This is mainly due to the fact that in many cases the cooling of the solvent on evaporation has not been properly taken into account. Another factor which complicates the prediction is the rate at which a solvent evaporates from a mixture. It is not the same as the rate at which it evaporates when pure. To illustrate this consider a mixture of toluene and isopropanol.

	%wt.	Relative Evaporation Rate for Pure Solvent (isothermal, 21.5 deg C)
Toluene	50	2.6
Isopropanol	50	2.6

(All evaporation rates are quoted relative to n-butyl acetate = 1.0)

Applying a simple model based on isothermal evaporation rates to the above system would result in an evaporation prediction where the toluene and the isopropanol evaporate at a constant rate with the relative proportions of the two solvents staying the same throughout the evaporation. This is not what happens in practice. Figure 1 shows the actual evaporation profile for this mixture, under isothermal conditions. The initial overall relative evaporation rate is ca. 4 not 2.6, and the evaporation rate of the isopropanol increases as its concentration falls. This effect is due to the interactions that occur between the two solvents.

Coating chemists clearly have a requirement for an accurate predictive model for solvent evaporation. This requirement was recognised by BP Chemicals and a program of work was undertaken to develop such a model.

An extensive study of solvent evaporation was carried out in co-operation with several large paint manufacturers. The key requirements for the model were identified. The model must be able to account for solvent-solvent interactions, it must be able to calculate the heat requirements of the evaporation, and it must be able to predict solvent loss on spray application. The development of the model to take account of each of these requirements will now be described in more detail.

A study of the factors affecting the evaporation of pure solvents, which included measurement of solvent evaporation under tightly controlled conditions, established the validity of an evaporation mechanism. This mechanism assumes that the rate determining step for solvent evaporation from a coating is the diffusion of the solvent molecules through the still air boundary layer between the surface of the solvent and the bulk air. This process can be expressed mathematically:

$$\text{Evaporation Rate (pure solvent)} = \frac{M.D.V}{d(p-V/2)}$$

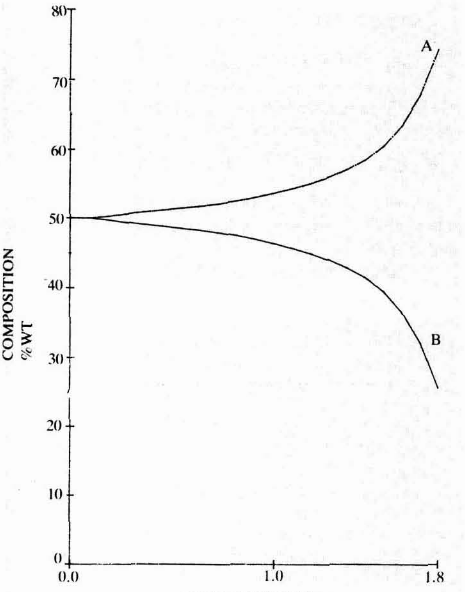
where

M = Molecular Weight
D = Diffusion Coefficient
V = Vapour Pressure
d = Thickness Of Boundary Layer
p = Atmospheric Pressure

The influence of solvents on each other can be quantified if the activity coefficients for the individual components of a mixture are know or can be calculated. The evaporation rate for an individual component of a solvent mixture can be expressed as:

$$ER_i = \frac{\gamma_i.m_i.M_i.D_i.V_i}{d(p-V_m/2)}$$

Figure 1



A = Toluene

B = Isopropanol

where

ER_i = Evaporation Rate
γ_i = Activity Coefficient
m_i = Mole Fraction
M_i = Molecular Weight
D_i = Molar Diffusion Coefficient
V_i = Vapour Pressure
p = Atmospheric Pressure
V_m = Total Solvent Vapour Pressure
d = Thickness Of Boundary Layer

This expression forms the basis for the evaporation prediction model used by BP SOLVE.

Activity coefficients are composition dependent variables, and need to be calculated at each stage in the evaporation. The first step in the development of the computer model was to devise a reliable method of calculating activity coefficients for individual components of solvent mixtures. The method which gave the most accurate results when compared to laboratory measurements was based on an extended form of the Fredenslund UNIFAC group contribution method[1]. This method, widely used by chemical engineers for distillation design, considers a liquid as a solution of functional groups, e.g. CH3,CH2,CO,OH etc. Activity coefficients can then be calculated for each component by the interaction of these functional groups. The BP SOLVE model uses this method to calculate the activity coefficients of each solvent at each stage of the evaporation.

In practice solvents cool during evaporation until a steady temperature is reached at which the heat required to supply the latent heat of evaporation exactly equals the heat supplied by the surroundings. To model this phenomenon BP SOLVE employs a heat balance calculation. The latent heat of evaporation and the heat supplied from the surroundings are used to calculate the temperature at which the evaporation takes place, and hence the relative evaporation rate under conditions of free cooling. This calculation also takes into account the heat capacity of the substrate that the coating is being applied to. Predicted and experimental values for evaporation temperatures and relative evaporation rates were found to be in good agreement.

Table 1
Paint thinner formulation

Solvent	%Wt
Acetone	10
MEK	15
MIBK	5
n-Butyl Acetate	5
Ethoxy Propanol	5
Toluene	35
Xylene	10
Isobutanol	5
SBP 3	10

The accurate prediction of the temperature of evaporation also shows if blushing is likely to be a problem. Blushing, a coating film defect, is caused by excessive absorption of water into the drying film. It is likely to occur if the temperature of the drying film falls below the dew point. The BP SOLVE model can be used during the formulation process to identify solvent systems that would cool to below the dew point on evaporation, and hence be likely to cause blushing. Such systems can then be reformulated using BP SOLVE so that the evaporation temperature remains above the dew point.

The way in which a coating is applied to a substrate has a major effect on the evaporation of the solvents. In particular, when coatings are sprayed a large proportion of the solvent can be lost before the coating reaches the substrate. Before attempting to model this, the solvent loss during spraying was measured in the laboratory for a large number of systems. This work established that solvent evaporation during spraying is not controlled by a diffusion process, as is the case for evaporation from a film, but rather can be best thought of as a flash evaporation. BP SOLVE models solvent loss during spraying using a flash evaporation calculation, where the evaporation rate is dependent on the partial vapour pressures of the individual solvent components.

To illustrate how the BP SOLVE model works in practice the evaporation of a typical paint thinner will be discussed. The composition of the thinner is shown in Table 1. The evaporation prediction generated by BP SOLVE is shown in Tables 2 and 3. Table 2 shows the overall relative evaporation rate, the evaporation temperature, and the composition of the evaporating mixture in weight percent. Table 3 shows the grouped solvents[2], the three dimensional solubility parameters, and the log of the viscosity.

The evaporation prediction is in two parts. Firstly the program calculates the solvent loss during spraying. Then, the subsequent solvent loss from the surface of the substrate is calculated. The first row of Tables 2 and 3 shows the initial composition and solvency of the formulation. The second row shows the solvent loss and temperature drop on spraying. The third row shows the situation immediately after spray application, with the paint now on the substrate. Subsequent rows show the prediction for solvent loss from the drying paint film. The evaporation prediction ends when 90% of the solvent has evaporated. The information given in the tables is also displayed graphically. Figure 2, which shows the evaporation profile for the grouped solvents[2], gives an indication of how well balanced the formulation is.

There are several features of this evaporation prediction which should be noted. The relative concentrations of

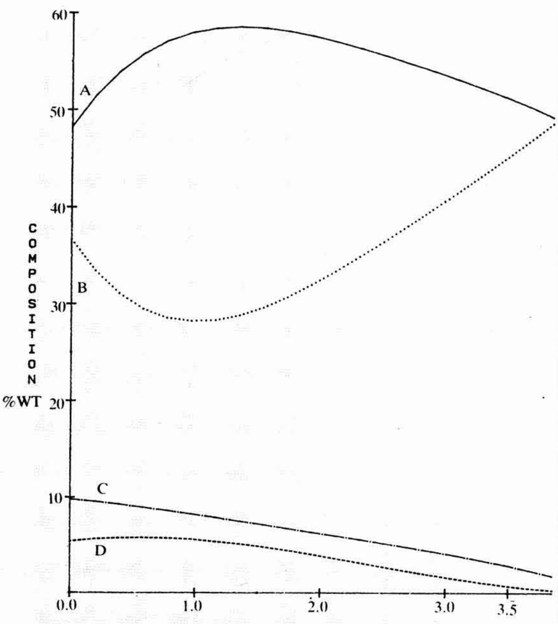
Table 2

Time Minutes	Temp °C	Rate	n-butyl acetate	isobutanol	Acetone	MEK	MIBK	Toluene	Xylene	Ethoxy Propanol	SBP 3
0.00	20.0	5.65	5.0	5.0	10.0	15.0	5.0	35.0	10.0	5.0	10.0
0.00	11.5	5.65	5.9	5.5	5.1	12.3	5.7	37.9	11.9	6.0	9.7
0.00	19.5	4.11	5.9	5.5	5.1	12.3	5.7	37.9	11.9	6.0	9.7
0.50	17.5	2.28	7.4	5.8	0.6	7.4	6.7	40.8	14.8	7.5	9.1
1.00	16.8	1.72	8.6	5.5	0.0	3.7	7.3	40.4	17.5	8.9	8.2
1.50	16.6	1.44	10.0	4.8	0.0	1.5	7.8	38.0	20.3	10.4	7.2
2.00	16.6	1.26	11.5	3.9	0.0	0.5	8.2	34.0	23.6	12.2	6.2
2.50	16.7	1.11	13.3	2.7	0.0	0.1	8.4	28.3	27.6	14.4	5.2
3.00	16.9	0.97	15.3	1.6	0.0	0.0	8.2	21.1	32.4	17.2	4.1
3.50	17.1	0.82	17.4	0.7	0.0	0.0	7.5	13.1	37.8	20.7	2.8
3.85	17.3	0.72	18.6	0.3	0.0	0.0	6.5	7.7	41.7	23.4	1.8

Table 3

Time	Aliphatic Hydrocarbons	Aromatic Hydrocarbons	True Solvents	Latent Solvents	Solubility Parameters	Fractional Polarity	Hydrogen Bonding Index	Log Viscosity
0.00	10.0	45.0	40.0	5.0	9.1	0.18	4.8	1.392
0.00	9.7	49.8	35.0	5.5	9.0	0.14	4.1	1.685
0.00	9.7	49.8	35.0	5.5	9.0	0.14	4.1	1.685
0.50	9.1	55.6	29.5	5.8	9.0	0.09	3.4	2.098
1.00	8.2	57.8	28.5	5.5	9.0	0.07	3.3	2.433
1.50	7.2	58.3	29.7	4.8	9.0	0.06	3.4	2.773
2.00	6.2	57.6	32.3	3.9	9.0	0.06	3.6	3.143
2.50	5.2	55.9	36.2	2.7	9.1	0.06	3.9	3.562
3.00	4.1	53.5	40.8	1.6	9.1	0.06	4.1	4.043
3.50	2.8	51.0	45.6	0.7	9.1	0.06	4.3	4.580
3.85	1.8	49.4	48.5	0.3	9.2	0.06	4.4	4.980

Figure 2



A = Aromatic Hydrocarbons
B = True Solvents
C = Aliphatic Hydrocarbons
D = Latent Solvents

aromatic and true solvents, shown in Figure 2 are roughly the same at the beginning and at the end of the evaporation. However, the concentration of true solvents falls during the first part of the evaporation, giving rise to a fall in solvency. The fall in solvency may cause precipitation of part of the resin. Another feature that should be noted is the large temperature drop on spraying. This may cause blushing if the paint is applied in an atmosphere of high humidity. If either blushing or resin precipitation were found to be occurring in this case, an improved formulation could be developed with the aid of BP SOLVE.

The BP SOLVE evaporation model has aided the development of several new BP Chemicals solvents for use in the coatings industry. The new solvents offer benefits to the customer, whilst generating new business for BP Chemicals. Hundreds of solvent formulations have been studied and reformulated with the aid of this model. Many of the improved formulations are being used by coatings manufacturers today. In 1988 BP SOLVE was made available to the coatings industry, and it is now in use in coatings laboratories around the world.

The development of the BP SOLVE evaporation model and its application to solvent problems has been profitable for both BP Chemicals and its customers in the coatings industry. The continuing development of the model to meet the demands of new coatings technology should prove to be equally profitable.

Acknowledgements

Dr B. Hudson and Mr A. D. Sheen of BP Chemicals were responsible for the original ideas and experimental work which resulted in the development of the BP SOLVE evaporation model.

References

1. Fredenslund, A., et al *A.I.Chem, E. Journal,* 1975, **21,** 1086.
2. Solvents are classified by BP SOLVE as true (esters, ketones, glycol ethers and glycol ether esters), latent (alcohols), aromatic (toluene, xylene etc) and SBP (aliphatic hydrocarbons).

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Printing Inks for the 90's

The technical programme for the OCCA/SBPIM joint Symposium on 22 March 1990 in Birmingham has now been finalised. Seven papers and a general review of the Symposium will be presented and ample opportunity has been provided within the programme for comment and discussion.

The full programme and biographical details of the speakers follows.

Paper 1 – The impact of ecology on the development of flexo/gravure inks
Dr C. W. Patterson, BASF Coatings + Inks

Environmental concerns and issues as voiced by the 'green lobby' are now high on the political agenda. The recent formation of Her Majesty's Inspectorate of Pollution is the prelude to impending legislation limiting atmospheric emissions of both volatile and noxious substances. This legislation will have a profound effect on both the ink manufacturer and converter. New flexo/gravure inks are being developed to meet these changes. The paper will concentrate on water borne inks and their developments

Dr Christopher Patterson read chemistry at Essex University and obtained his PhD doctorate from the University of Nottingham. He is currently employed as a Development Chemist by BASF Coatings + Inks.

Paper 2 – The challenge of newspaper printing to ink makers
Mr G. Burdall, Usher-Walker

The paper will begin with a very brief history of the production of newspapers, leading to a description of the current newspaper titles with circulation figures and trends.

The unique demands that the production of newspapers places on the ink maker will be detailed. The main printing process used to produce newspapers will be discussed at length, together with the differences in ink formulation that each process requires. The implication of the introduction of Low Rub inks will be assessed and the paper will conclude with a review of future developments.

Gerry Burdall is Technical Director of Usher-Walker and has over 30 years experience in the printing ink industry. He was Managing Director of a small ink producer until taking up his present position five years ago. He is author of a chapter in the 4th Edition of the Printing Ink Manual which has been published recently by the SBPIM.

Paper 3 – Radiation curing – Where does it fit in?
Mr G Webster, BASF Coatings + Inks

The market for radiation curable inks and varnishes developed, and continues to grow, because these products offer real technical and commercial advantages for the converter. The principal features deemed responsible for this growth are introduced in the paper.

Specific amongst the ideas considered, are the relevance of radiation curable products to the "just in time" concept and to providing print for the packaging industry with acceptable levels of odour and taint. An overview of the main areas of application is given.

The potential sources of curing radiation, together with the raw materials available for product formulation are examined, with particular attention being paid to environmental issues arising from their use. A critical review of the current state of the art is used as a basis from which projections for possible future advances are proposed.

Glen Webster graduated from Liverpool University in 1980 with a degree in Chemistry, after undertaking an Honours year project studying aspects of the Conductivity of Polymers. After leaving University he worked for a number of years on various research and development projects in the non-ferrous metals industry. He has recently joined the Inks Division of BASF Coatings + Inks and is now a member of the team engaged in research and development for radiation curable printing products.

Paper 4 – Will lithographic inks continue to meet the demands of high speed publication and packaging printing?
Mr P. Gray, Coates Lorilleux

The paper will discuss how the printing ink industry will successfully accommodate the advances in press design and higher productivity speeds. The main emphasis will be towards packaging printing, but publication printing will also be included. The presentation will be shared with Mrs Margaret Barraclough, proprietor of Print Advisory Services, who will review the requirements for lithographic printing inks from the viewpoint of a printer.

Pat Gray is the National Technical Manager, Packaging Inks with Coates Lorilleux LtdHe has a background of 37 years in the printing ink industry where he has been involved in product development, manufacture and technical service to the lithographic industry.

Paper 5 – Pigment developments for the printing inks for the 90's
Mr C. Bridge, Ciba-Geigy

The factors which are likely to influence pigment developments for printing inks in the 90's will be reviewed from a global, rather than UK only basis.

There are several general factors affecting all ink sectors, such as the continuing need to reduce costs and particularly energy consumption in the ink making processes which can be seen at least in part as the preserve of the pigment maker, but there are also several specific factors which are likely to become important in particular end use areas, eg the problems with printing at ever increasing speeds on web offset heatset processes, to which the pigment maker may make an effective contribution.

The problems which are seen particularly as the preserve of the pigment maker will be revised by the main ink sectors, and an indication of the possibility, and sometimes of the cost, of solutions given.

Christopher Bridge read Chemistry at UMIST. He joined Geigy Pigments in November 1969 in the R & D Department. He is currently the Ink Applications Manager for the Classical Organic Pigment business of Ciba-Geigy and responsible for world-wide technical service for that business and for the evaluation of R & D products intended for the ink industry.

Paper 6 – Resin developments for tomorrow's inks
Mr R. H. E. Munn, Cray Valley Products

The development of resins specifically for use in printing inks has often been neglected and as a consequence resins have been adapted and modified to meet the unique requirements of the industry and the exacting needs of the various printing processes.

The surface coating industries, including printing inks, now have to face common problems which are dictating the future trends in new resin developments. Emphasis is being placed on protection of workers and the environment, higher performance at faster speeds, improved adhesion to newer substrates and cost effectiveness. The resin industry is and will continue to come up with the answers. The real question is whether the newer sophisticated polymers will be tolerant enough to meet the specific needs of the ink maker.

Ray Munn read Chemistry at London University, entered the resin industry in 1946 and, following a three year period as Technical Director with a paint manufacturer, joined Cray Valley Products in 1965. He has worked in a variety of technical and management roles including a two year period in France and is now International Business Development Director.

Paper 7 – **Developments in water-based screen printing inks**
Mr M. J. Barker, Dane & Company

Environmental issues and Health and Safety considerations will continue to create new challenges to the screen printing industry during the 90's. Water based or water reducible inks are of significance in addressing these important issues.

The paper will explore the potential effect of water based ink technology in screen printing with particular reference to practical experience in the USA.

Michael Barker joined the Dane Group of Companies in 1970 following 10 years previous experience of Research and Development on lithographic ink formulation. He was appointed Technical Director in 1982, previous to which he held various positions within the Dane Group including R & D, Technical Sales Support, Sales/Marketing, both in the UK and the Export Division.

The final presentation at the Symposium will be an Open Discussion which will be led by Geoffrey Hutchinson, a leading consultant to the printing ink industry.

Registration forms for the Symposium were included with the January 1990 issue of JOCCA and a further form is included with this issue. Further details on the Symposium are available from the General Secretary at Priory House. ■

Book Reviews

Surface Coatings — 1

Edited by Alan D. Wilson (Laboratory of the Government Chemist, Department of Trade and Industry, London, UK). John W Nicholson (Laboratory of the Government Chemist, Department of Trade and Industry, London, UK) and Havard J. Prosser (Warren Spring Laboratory, Department of Trade and Industry, Stevenage, UK).
Elsevier Applied Science Publishers Ltd. 1987
273pp Price (hardback) £40

This is the first volume in a new series reviewing recent developments in the field of surface coatings.

Chapter 1. The Widening World of Surface Coatings, by the three editors, is a general introduction to the series. It points out the wide range of conditions to which modern surface coatings are subjected — protection from atmospheric, immersed and buried corrosion, chemical corrosion, biological attack, and high temperature attack in addition to the traditional uses for decorative effect.

Chapter 2: Organotin-Based Antifouling Systems is by Stephen J. Blunden and Robin Hill of the International Tin Research Institute, Uxbridge, UK. The fouling of ships' bottoms and other immersed structures by the attachment and growth of marine plants and animals is described, and its prevention by application of antifouling coating systems containing biocides outlined. Most attention is devoted to the organotin compounds which came into use during the 1960's, the most widely used being triorganotin compounds, chiefly tributyltin oxide (TBTO) and tributyltin fluoride (TBTF). Such compounds may be used to supplement or replace older biocides such as cuprous oxide in conventional antifoulings, but have a particular advantage in that they may be copolymerised with film-forming polymers to form binders with biocidal properties e.g. tributylitin acrylate or methacrylate copolymerised with methyl methacrylate. Depending on the choice of polymer suitable binders containing 40 or 50% triorganotin may be formulated and have proved both technically and commercially successful. One disadvantage has, however, come to light in recent years — extremely low concentrations of organotins have adverse effects on the reproduction and growth of oysters and other commercially important shellfish, and in consequence the use of such antifoulings on small boats has been banned, although at present they are still permitted on larger ocean-going vessels. There are 250 literature references to this chapter.

Chapter 3. High Solids Coatings, is by Robson F. Storey, of the Department of Polymer Science, University of Southern Mississippi, USA. Interest in this field arose particularly from restrictions on the amount and type of organic solvents released into the atmosphere; in 1966 the famous Rule 66 was introduced with a view to reducing the notorious "smog" in the vicinity of Los Angeles, and similar clean air regulations are now almost universal. They have had a considerable effect on the formulation of industrial coatings, the use of high solids materials being an important method. The basic requirements of low molecular weight polymers (oligomers) to enable high solids coatings to be prepared are described, and the need for a narrow molecular weight distribution emphasised. Alkyds and polyesters, epoxy, polyurethane and acrylic coatings are covered. There are 60 literature references to this chapter.

Chapter 4. Recent Developments in the Artificial Weathering of Coatings using Plasma Erosion, is by N. A. R. Falla, of the Paint Research Association Teddington, UK. Assessment of the durability of paint coatings exposed to the atmosphere by site testing and in various accelerated weathering machines is described. Different machines accelerate degradation to differing degrees according to their design and method of operation, and usually require up to 12 weeks to produce effects equivalent to several years of outside exposure. For long life coatings the periods were even longer and the PRA investigated the possibility of substantial reductions by exposure to oxygen plasmas. The radio-frequency generation of oxygen plasmas, with a mixture of oxygen ions, electrons and atomic oxygen in a near vacuum (c.1 mm.Hg) is described, also their effects in eroding paint films. Comparisons with natural weathering were fairly good, closer in fact than a standard carbon arc weatherometer, and could almost certainly be improved by varying the operating conditions of the plasma generator. Bearing in mind that the plasma erosion process takes only 10 or 15 minutes, the equipment costs only about one-third the price of a typical weatherometer and is much cheaper to operate, the results warrant further investiations. There are 56 literature references to this chapter.

Chapter 5. The Use of X-Ray Photoelectron Spectroscopy for the analysis of Organic Coating Systems, is by J. F. Watts, of the Department of Materials Science and Engineering, University of Surrey, UK. The technique described (XPS) is a method of surface analysis that does not degrade the surface. The theory of XPS is covered, and the instruments and procedures described. Samples are examined under ultra high vacuum (10^{-9}-10^{-11} mbar) and results refer to a surface layer of only about 2-6 nm. Comparison of results from freshly applied films with those exposed to natural or artificial weathering enable deterioration to be detected after short periods, before it is visually apparent. Coatings failures can be analysed and the effects of surface pretreatment, interfacial breakdown, cathodic delamination and metal/polymer interaction distinguished. The technique is valuable in investigations of the fundamentals of surface degradation of organic coatings. There are 105 literature references to this chapter.

Chapter 6. Adhesion Promoters, is by Peter Walker of the Atomic Weapons Research Establishment, Aldermaston, UK. Adhesion of protective and decorative coatings to the substrate is a primary requirement if the coatings are to perform well; equally important is retention of adhesion under service conditions, high humidity or water immersion being particularly damaging. Proper surface preparation is required to achieve maximum adhesion and adhesion promoters or coupling agents are often effective to improve it. Considerable research has been devoted to the development of silanes as adhesion promoters, suitable types containing polar silanol groups and organo-functional groups capable of reaction with polymeric binders. Different types of silane are described, methods of use discussed and their effectiveness assessed; they are particularly effective in ensuring good adhesion retention after exposure to high humidity and water immersion. Organic titanates have also been developed for similar uses, polar groups again being involved.

More recently zirconates have also been offered, one advantage being that they do not form coloured complexes with phenolic materials. These three classes of compounds are the major adhesion promoters, although a range of others has been investigated, some having specific applications. There are references to Patent literature (important in this field), a bibliography and 93 literature references to this chapter.

Chapter 7. Molecular Relaxation Processes During Film formation, is by Carl J. Knauss of the Chemistry Department, Kent State University, Ohio, USA. As a coating changes from a liquid to a solid it is viscoelastic in nature, and when studying the change it is helpful to know something about the elastic properties of the material as well as the viscosity at various stages of the drying processes. The author describes five instruments used for laboratory study of viscoelastic properties. The author's laboratory has worked especially with impedometry, a technique whereby the modules of rigidity and the drying rates of films applied to a fused quartz rod may be measured. Measuring viscoelastic properties in addition to viscosity and drying times using conventional recorders enables much more information to be obtained regarding molecular relaxations occurring during drying and film formation. There are 54 literature references to this chapter.

Summing up, this volume reviews some specialised fields of interest to investigators working on surface coatings. The general approach is academic, as indicated by the large number of references to scientific literature, so it will be of greater use to scientists working on fundamental research than to those concerned with product development.

T. A. Banfield ■

Colloidal Hydrodynamics

by Theo G. M. Van de Ven
Academic Press Ltd. London 1989
582pp Price (hardback) £43.00

This book is the fourth in the Colloid Science series of monographs. The preceding volumes have dealt with Dispersion Forces, Zeta Potential and Polymeric Stabilization and each has become a definitive text in its field. This new volume maintains the high standard and is likely to become an essential reference book for coatings scientists dealing with pigment dispersions and polymer colloids.

The author graduated from Utrecht and subsequently studied at McGill University under S. G. Mason whose ability to present rheological phenomena in the form of easily understood physical models he has inherited. The second half of the book was written while the author was on sabbatical leave at the Colloid School at Bristol University.

The first chapter of the book provides a useful summary of the basic concepts of fluid dynamics and colloidal forces with adequate references to more detailed texts. This is followed by a very readable account of the Brownian motion of non-interacting particles, ending with a review of experimental techniques. A later chapter deals with the Brownian motion of interacting pairs of particles. Two extensive chapters discuss the behaviour of non-interacting and interacting colloidal particles subjected to shear, gravitational, electric and magnetic fields. Once again a review of the various rheological and optical experimental techniques ensures that the practical aspects of the subject are not overlooked. These chapters cover all aspects of the flow and sedimentation behaviour of spherical and non-spherical particles and form a monograph in their own right. Particle-wall interactions are then discussed and finally the properties of more concentrated dispersions are described in chapters dealing with multiparticle interactions and flow behaviour.

The overall treatment of the subject is so comprehensive that any criticism is necessarily minor in nature. However, two topics of particular relevance to coatings, viscoelasticity and the rheology of flocculated dispersions, could perhaps have been discussed in more detail.

The presentation is excellent with many diagrams and illustrations. As a result the book can be read with interest and profit by the non-specialist and is likely to become a standard reference book for those already working in the field, but it will be of greatest benefit to mathematically inclined students of colloids and hydrodynamics to whom it can be most strongly recommended as a basic textbook.

D. J. Walbridge
Paint Research Association ■

Role of Honour

The General Secretary's column in the January issue of JOCCA has generated considerable interest, correspondence, telephone calls and some embarrassment! Association staff have been happy to supply addresses and thus enable members to renew old acquaintances with former colleagues and friends and we are now receiving interesting comments and reminiscences from some of the most senior and long serving members and I hope that a selection of these reminiscences can feature in future issues of JOCCA.

It is inevitable that the data from which we extracted the information for the January listing contains errors and omissions. By virtue of their long service, the membership records of those members listed go back for many years and in some cases information was not available to transfer to the computer database. A considerable tidying up of the list has now been possible and the latest listing indicates that 432 members of the Association have twenty-five or more years service.

Three names are to be added to the list of members with thirty-nine or more years of service, which should include Past President C. W. A. Mundy, G. L. E. Wild, Honorary Secretary L. J. Brooke, J. H. W. Turner, P. F. M. Coverdale, E. F. Parker and H. Lomas. Our apologies to these long serving members. A revised list of long serving members will be published in a future issue of JOCCA.

SURCON 91

This issue of JOCCA heralds the first official announcement of SURCON 91, the name chosen by the Association for the relaunch of its biennial technical convention. Subtitled "Developments in the Science of Surface Coatings", the meetings will review major technical developments relevant to the surface coating industries and comprise a mixture of invited and submitted papers with the criteria for selection being strong technical papers at the forefront of new technologies.

The preliminary announcement and Call for Papers can be found on the inside front cover, facing the Contents page. Already, firm offers of papers have been received from major companies and Simon Lawrence, who is responsible for the technical programme, is confident that other high quality papers will be forthcoming. Companies and individuals wishing to submit papers for consideration should contact Simon Lawrence without delay.

The relaunch of the Association's major technical meeting has been the culmination of extensive discussions and consultations with Sections, Council and Committees and companies. The Conference Management Committee, under the leadership of Tony Jolly, is to be congratulated on its imaginative concept, the last of the Association's major institutions to be reformed. SURCON 91 is worthy of your support.

SURFEX 90

The build up to SURFEX 90 is now well under way and the first preview to the Exhibition is included with this issue. A further preview will appear with the March issue and the full Official Guide and Route Planner will appear in April. You will also find in the Journal an Invitation Card to pre-register for the Exhibition. If you are unable to attend, pass the invitation to the colleague and do all you can to publicize SURFEX 90, the principal surface coating exhibition within the UK.

Associated with the Exhibition will be a major conference organised by the Paint Research Association, which this year will be held as an integral part of the Exhibition at the Harrogate International Hotel; adjacent and adjoining the Exhibition Hall. SURFEX will also feature the third, highly successful, SURFEX Exhibition Dinner when the principal speaker will be Professor John Oakland, the UK Guru of Total Quality Management and an excellent and entertaining after dinner speaker. SURFEX 90 promises to be the biggest, most interesting and best supported Exhibition in the series and is an event not to be missed.

Spring Symposia

Registrations are already being received for the Association's two major spring symposia. Printing Inks for the 90's, the joint symposium with the SBPIM, will take place on 22 March in Birmingham and a registration form is enclosed with JOCCA. Considerable interest has been shown in this symposium, which brings together raw material suppliers, ink producers and end users and will discuss the many challenges facing the printing and packaging ink industries in the 90's and in particular the influence of environmental concern on its products and how the industry will face the challenge of the environment. A limit of 100 registrations has been set for this symposium and early registration is essential.

The third in the successful series of Newcastle Section Student Symposia will be held on 24 April. The subject matter will again be paint production and the Section have deliberately set registration fees at a very modest level in order to secure the maximum participation and in particular by new entrants to the industry.

The Association has decided to increase the profile and frequency of its technical meetings and to market and promote Section meetings on a national basis. This new policy has now been in operation for almost a year and already has resulted in higher and more broadly based registrations to the benefit of delegates and the Association and is a further sign of the professional attitude taken by the Association in the organisation of its activities.

London Section

Collaboration

*T*he London Section's first technical meeting of the 1989-90 programme was held on Thursday 21 September 1989 at the Naval Club, Hill Street, Mayfair. Mr John Bernie, Managing Director of the Paint Research Association presented a paper entitled "Collaboration — A Route to Successful Research".

The lecturer commenced by reviewing the paint industry worldwide. The industry has production totalling 12,000 million litres per year and sales of £20 billion per annum. The restructuring that has occurred in recent years was outlined. This has occurred mainly through acquisition and divestment amongst the major paint companies. As a result there has been globalisation of demand and the introduction of standardised products on a worldwide basis. Consequently, the gap between the major paint companies and the other companies has widened dramatically and this is clearly seen in R&D expenditure and market share.

The challenges facing the paint industry were discussed and these include demographic, economic, social, political and environmental factors. These challenges are being met through the use of cheap, plentiful and environmentally friendly raw materials by the big multinational companies. The other companies are following suit but they must adopt alternative strategies if they are to survive. These include the penetration of niche markets, establishing strong technical service, and through collaboration with other parties. Collaboration is occurring in R&D, joint venture companies and licencing agreements.

The role of the Paint Research Association, in particular its structure and the services it offers were discussed in some detail. The benefits offered by the PRA to both small and large companies alike, in terms of collaborative projects was outlined. Funding of these projects can be achieved in many ways, and the various sources available include member companies, Government departments and the EEC. Mr Bernie emphasised that all projects needed to be industry led. A number of current projects undertaken by the PRA were discussed as case studies along with proposed future projects.

The presentation was followed by a lengthy question time which indicated the interest the audience had in the lecture. The vote of thanks was proposed by Graham Steven.

G. J. Steven ■

Manchester Section

Family lecture

*S*ixty members, wives and children attended Manchester Sections family lecture, held at Salford University, on Friday, 8 December 1989, with Dr Tom Patterson presenting his talk and demonstration, entitled, "Having Fun with Chemistry".

Dr Patterson started his talk by delving into history, and demonstrating the simple chemical reactions which were used by magicians, and followed this by a demonstration of flammable gases, using inflated balloons. The lecturer continued with an illustration of the production of foams, such as urethane foams, and followed this by describing and illustrating the effects of heat on reaction rates. The theory behind the energy of reactions was outlined, and the effects catalysts and the input of energy explained. The talk continued with a demonstration of Chemiluminescence, and its practical use, both in nature and the commercial field, outlined. Dr Patterson concluded his lecture by describing and demonstrating different types of explosive, and the various conditions, materials which would not normally be considered dangerous, can explode.

The whole lecture was designed, with a series of bright colours, mountains of foam, flashes, bangs, and clouds of smoke, to demonstrate chemistry, in a way which is not now possible in a class room, because of safety factors.

The vote of thanks was proposed by the section chairman, Norman Seymour, and this was followed by a substantial buffet, subsidised by the section.

M. G. Langdon ■

Midland Section

Nappar fluids

*T*he October meeting of the Midland Section was held at the Clarendon Suite, Stirling Road, Edgbaston, Birmingham.

Miss S Brooks and Mr J Hauge of Exxon Chemicals presented a lecture entitled "Nappar Fluids for Paints and Printing Inks".

The speakers first discussed the Nappar Fluids, describing them as naphthenic hydrocarbon solvents obtained by hydrogenating parent aromatic compounds. The resulting "Nappar" solvents are reported to possess greater solvency power than the more conventional aliphatic hydrocarbon solvent, coupled with a higher level of purity and lower odour.

Isoper Fluids were then discussed after being introduced as aliphatic solvents of high purity. The tighter composition specification had endowed the solvents with very low odour and higher than average OEL values compared with aromatic containing white spirit.

The final range of solvents discussed were the Exx-Print range. By varying the solvent composition within strict limits Exxon boasted a family of printing ink solvents in which solvency power could be varied for a given distillation range.

This well illustrated talk was brought to a close following a brief discussion of some environmental aspects associated with using organic solvents.

M. J. Round ■

Newcastle Section

Pigment concentrates

*F*ifty members and guests attended the third meeting of the 1989/90 Session on 7 December 1989 at St Mary's College, University of Durham. The speaker on this occasion was Mr Peter Quednau of EFKA Chemicals who delivered a lecture on "Polymer Dispersions for the Production of Pigment Concentrates".

He began by observing that modern paint companies are committed to fast service of coatings, with performance tailored to customer needs, of consistently high quality, in any required colour at competitive prices. Paint production, therefore, needs to be rationalised, as far as possible, on a simple colour mixing basis and many companies have been trying to do this with pigment pastes. Consideration shows that, for a reasonably wide range of coating types, a manufacturer would need anything up to twenty different pigments each dispersed in ten-to-fifteen different binders, which would present a severe stocking problem. To avoid this, concentrated pigment dispersions with fluidity and high compatibility are needed and this is only feasible with suitable dispersants and little added binder. Ideally, a pigment slurry in solvent only would seem to be the answer, but experience shows bad slurry/tinted product stability without some form of stabilizing resin in the pigment dispersion. At the moment no universally-compatible resin exists and with those currently used there is always the danger of product quality being affected if addition of pigment concentrates adds significant quantities of "foreign" stabilizing resin at the same time.

Mr Quednau then introduced the concept of a new type of polymeric dispersant. This would stabilize pigment dispersions by steric hindrance, would give low viscosity for easier mixing and be effective at low concentrations to allow good compatibility with a range of resin systems. Striking the right balance of molecular mass and structure to give good steric hindrance without too adverse an effect on solubility and compatibility is critical. Optimum dispersion results when there is strongly oriented interfaced structure between polymeric dispersant and pigment. Two EFKA types illustrate these points; one, a long chain molecule containing regular polymeric isocyanate segments and pendant reaction groups for locking closely with pigment surfaces, and the other, a similar concept with polyacrylate segments replacing isocyanate regions. The isocyanate-type produces low viscosity dispersions but these are insoluble in white spirit: conversely the polyacrylate-type gives white spirit solubility but higher viscosity dispersions. Both polymeric dispersants contain tertiary amine and are basic. Molecular masses are in the range $10^4-2.5\times10^4$ to promote steric hindrance and neither interferes with coating film formation or performance.

Mr Quednau gave examples of how dispersant requirements are calculated for different pigment types: using oil absorption values for inorganics, DBP absorption values for carbon blacks and BET adsorption values for organics. In each series of pigment types, a fixed percentage of dispersant solids, based on the appropriate factor, was said to work effectively: exceptions appear to be some organic violets which require lower amounts, perhaps due to surface treatments. For all pigments additional stabilizing resin at 2-4 times the solid dispersant is recommended. Typical resins are EFKA Polymer 101, Laropal A81, Paraloid DM55 and various short-oil alkyds, choice depending on requirements e.g. with stoving — or isocyanate-cured systems use short-oil alkyds with high hydroxyl values. He then showed a series of slides demonstrating that, with suitable formulation, the total solid dispersant and resin should never be more than 2.5% of the final paint. Pigment examples included titanium dioxide, micronised yellow and red oxides, molybdate scarlet. Pigment Red 170 and quinacridone violet. The necessity for resin as well as dispersant was shown by the dramatic viscosity reduction when present.

Turning to typical flooding and flotation defects, he suggested that this is due to the disparity of physico-chemistry properties between pigments, and that using the sort of pigment concentrates previously outlined eliminated such defects: best results are obtained when the molecular weight of the resin is 2-3 times that of the dispersant. He illustrated the benefits with an excellent series of coloured slides showing acrylic/isocyanate resin-based colours obtained with pigment concentrates with, and without, dispersant/resin blends at 1-1.5% levels — phthalo blue with titanium dioxide, yellow oxide or organic red with titanium dioxide. Heavy flocculation with the phthalo blue and severe flooding with the yellow oxide and organic red were shown to be eliminated by the use of dispersant/resin. High magnification photomicrographs of the coating films with transmitted light showed the massive flocculation of phthalo blue and organic red when no dispersant was used.

Mr Quednau concluded that the development of special polymeric dispersants has made possible the development of universal pigment concentrates which have low viscosity, free flow and high pigment level. With a suitable stabilizing resin at low concentration no defects such as flocculation, flooding or incompatibility result when used in solvent-thinned coatings. He showed transparencies of a West German company which successfully manufactures Maintenance Coatings, General Industrial Stoving and Two-Pack Coatings, based on fifteen different binders or binder combinations, using a computer dosing system. Details of the method of operation were shown, the whole giving the impression of a very clean and sophisitcated production operation.

The vote of thanks was given by Newcastle Section Chairman, Mr David Neal.

Question time afterwards revealed a good deal of interest aroused within the audience which was eventually cut short by the news that the buffet and wine sponsored by EFKA were ready for serving.

J Bravey ■

Ontario Section

Water-based press coatings

At the well-attended November 15 Technical Meeting, Mr Kenneth Sugamori of Sinclair & Valentine discussed the development, uses and benefits of acrylic water-based coatings as applied in-line over lithography.

Mr Sugamori began with a brief history of these coatings. He then described their general composition, and detailed their mode of drying through evaporation coalescence and post-cure, making the point that dry air movement is more important to setting and drying than is heat alone. He stated that acrylic-coated work can usually be full-piled without spray powder, but cautioned against allowing excessive heat build-up in the pile, which can soften these coatings and lead to blocking.

The speaker described the many types of in-line application systems and drying systems that are currently available, and pointed out their respective advantages and disadvantages. He stated that almost all new litho presses are now being installed with in-line coaters that can be used for either aqueous or ultraviolet-cured topcoats.

In conclusion, Mr Sugamori enumerated the benefits of aqueous coatings in comparison with oleoresinous varnishes and UV coatings.

Section Chairman Douglas Pratt thanked the speaker for his most interesting talk and, to a round of appreciative applause, presented the framed speaker's certificate.

Mr Pratt reminded members that the next Technical Meeting will be held on January 17, 1990, and closed the meeting with a wish for all to have a happy and safe holiday.

J. F. Ambury ■

Transvaal Section

Calcigloss

On 11 October 1989 the Transvaal Section was addressed by Mr Anthony Page of Plüss — Staufer A G on the subject of Calcigloss.

Calcigloss is a calcium carbonate with a mean particle size of 0,9μm in the range 5μm to 0,2μm and a density of 2,7 g/ml. It may be used in both aqueous and non aqueous systems such as alkyd paints using a dissolver without causing hazing or loss of gloss. It acts as a spacing extender increasing the efficacy of pigments such as titanium dioxide. It may be used in silk gloss, brushing enamels and industrial finishes.

With the replacement of 12,5% of the titanium dioxide on a volume basis there was only a slight effect on the hiding power and a saving of about 10% on raw materials costs could be achieved.

After an active question and answer session the vote of thanks proposed by Mr L Saunders was heartily endorsed by the audience.

The Chairman thanked Messrs Lewis and Everitt for their sponsorship of the evening whereafter the members enjoyed the snacks and refreshments provided.

R. E. Cromarty ■

Midland Section

Ladies' Night

The Midland Section Ladies' Night was held at the Penns Hall Hotel on 27 October 1989. As in previous years the evening was theme, this being Spanish.

Approximately one hundred members and guests—including the Association's President, Mr A G North, and its General Secretary, Mr C Pacey-Day — attended the dinner which was followed by entertainment from a lively magician. Flamenco and other styles of dance were performed by the Grosvenor Girls providing the mood for dancing to the excellent six-piece band, Take Five.

M. J. Round ■

Spanish theme at the Midlands Section Ladies Night — Top table guests

Memorium

S. N. Hawley (1924-89)

Further to the Memorium which appeared on p505 of December 89 JOCCA, Mr J. N. Hawley has notified us that Donald Hawley was in fact the cousin of the late Sefton Hawley and not his brother as mentioned.

New Members

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

Ordinary members

Chamberlin, D. T., BEng. *(Manchester)*

Cleary, T. *(Midlands-Trent Valley)*

Dayaram, M. *(Natal)*

Francis, E. *(Natal)*

Gore, G. I. *(Bristol)*

Testa, C. A. BSc *(Manchester)*

Associate members

Bisset, W. E. *(Natal)*

Clark, I. *(Cape)*

Gates, C. J. *(Midlands)*

Godfrey, W. M. *(Cape)*

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