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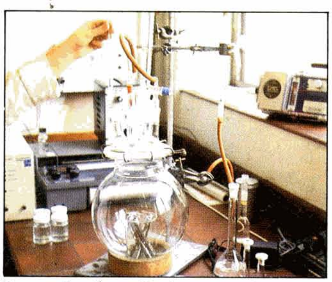
JOURNAL OF THE OIL AND COLOUR CHEMISTS' ASSOCIATION

JOCCA

BSI REGISTERED FIRM



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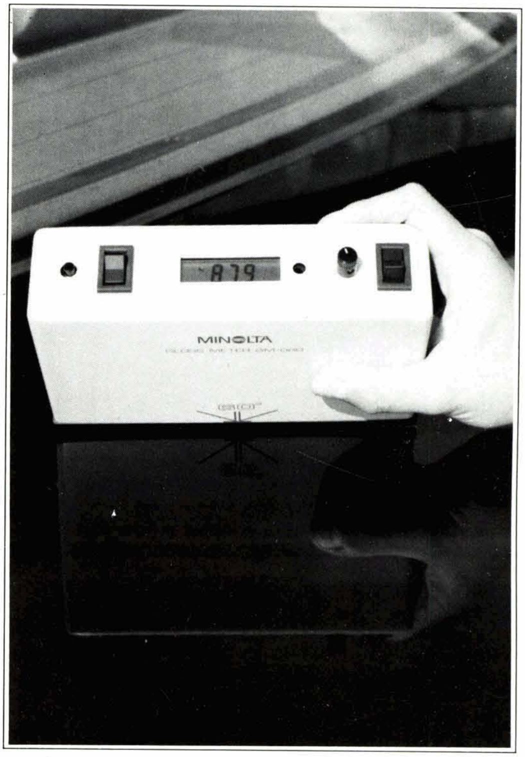

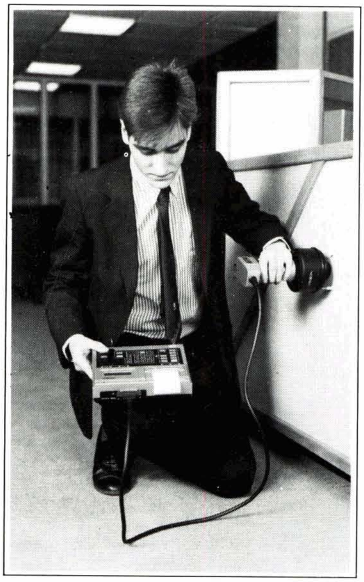

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Tracey Walker

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Buckinghamshire, MK14 5BU"

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JOURNAL OF THE OIL AND COLOUR CHEMISTS' ASSOCIATION

JOCCA

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Contents

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OCCA CONFERENCE 1989

"Profitable Research and Development"

will be held at the

Chester Grosvenor Hotel

on

21 — 24 June 1989

KEYNOTE SPEAKER

Mr. D. Pirret, General Manager, Resins & Materials, Shell UK Ltd.

LECTURERS

Dr. Campus, BP Chemicals
Dr. I. A. Macpherson, Ciba Geigy Pigments plc
Mr. Charity, FIRA
Mr. J. Gent, Fulmer Yarsley Ltd.
Mr. A. J. Hinton, Hinton Safety Consultants
Dr. B. Lane, ICI Chemicals & Polymers
Mr. T. Hughes, Liquid Polymers plc
Mr. Tulley-Turner, Management Consultant
Mr. E. V. Carter and Dr. R. D. Lauden, MPLC Laboratories plc
Mr. T. Kobayshi, Mr. T. Terada and Mr. S. Ikeda, Nippon Paint Co. Ltd., Japan
Mr. L. Banks, PDQ Testing Ltd.
Mr. S. Nordberg, Perstorp AB, Sweden
PIRA
Mr. D. Wallbridge, PRA
Shell Chemicals
Dr. S. Goethe, Wilhelm Beckers, Sweden

Associated with the Conference will be a Mini-Exhibition, for information on this, contact Chris Pacey-Day on 01-908 1086

The Conference Brochure will be available early in 1989

CHESTER CONFERENCE COLUMN

PREAMBLE

We are all agreed, I am sure, that the Chester 89 Conference should be a success and point the way to a revival of this event, thus emulating the recent history of the Exhibition (SURFEX). For this success to be achieved the situation and facilities offered by the venue, the quality of the papers presented, the attraction of the social programme (day and evening) and the efficiency of the administration have to be of a high level not only to attract a satisfactory number of delegates but to reflect well upon OCCA itself.

This, so far as we have proceeded, we feel has been achieved. There remained until recently one outstanding item that could upset all of the above – the cost to the potential delegate. On costing the event in the normal way, with no subsidy and a break-even point around 120 delegates (of varying categories), we came up with £180 for a member and £210 for a non-member. This is about the level of the Eastbourne conference at which there were far too few delegates and plenty of complaints as to the cost (made by those not attending!).

We have therefore taken a bold, positive step in that we have kept the top quality arrangements intact but have reduced the costs to delegates to a level which cannot, in all honesty, attract the same complaints as before. Since one can never get something for nothing this has meant that, with the original 120 token delegates (and 30 partners), we would stand to make a loss of around £4,900. HOWEVER, hopefully this would be the worst outcome.

The position can be alleviated by a number of considerations.

(i) YOU support the conference so that we have at least 200 delegates.
(ii) We advertise well and gain many non-member delegates at top price.
(iii) That we gain a modicum of sponsorship (one multi-national company has already agreed to do this, only the degree of this support has yet to be decided).
(iv) We do not spend all of the built-in £1,000 contingency fund.

This philosophy together with the derived costings has been put formally to the Finance Committee, the Executive Committee and the Council. In each case formal approval has been obtained. The facts in which you are all interested can now be given below.

WHAT WILL IT COST?

Member	£130*	Non-member	£190*
Partner (member)	£10	Partner (non-member)	£12
Day Visitor (member)	£75	Day Visitor (non-member)	£100
Retired Member	£65*	Student Member	£65*
Lecturers	£65 (if staying longer than one day)		

* full registration

N.B. Hotel accommodation is to be paid for by the delegates and can be booked through Priory House up to April 1st, 1989, from the selected hotels which are to be published.

WHAT WILL ONE GET?

1. The full registration fee will include preprints, lunch on both days, coffee and all conference facilities.
2. The Day registration fee will include preprints for the day, lunch, coffee and all conference facilities.
3. Lecturers/Chairmen will be offered free day registration only on the day of their session (but see above), but no accommodation will be paid for unless special circumstances apply.
4. The partner's registration fee will include a guided tour of the City Walls, a trip to Stapely Water Gardens and a tour of the Heritage Centre (lunches at the Grosvenor are extra – £10 each).
5. The Conference dinner and the "Lady Diana" and Welsh Mountains trips will be optional extras for ALL.
6. The Dinner/Dance rate will not include wine.
7. The Golf tournament will be self supporting (Jim Jackson is to advise on costs).

N.B. ALL PRICES EXCLUSIVE OF VAT

WHAT NOW?

If you support the Chester Conference you will benefit personally, save OCCA a loss and ensure the continuance of this biennial tradition in the future.

If you do not support the event it would seem reasonable to deduce that you are not interested in such a function and we should cancel Cambridge 1991. Alternatively it could be that you desire a really cut-price job only, achieved by it being so heavily sponsored commercially that it could hardly be called an OCCA conference anymore.

I feel sure that you will not let OCCA down!

A. C. JOLLY (Hon. Conference Officer)

ICI Resins – a new world force

ICI PLC, the fourth largest chemical company in the world, has announced that its world-wide resins and surface coatings business will operate as ICI Resins to strengthen the focus of the business group on customer needs.

ICI Resins combines the technical service, research and marketing expertise of ICI with the highly innovative product development capability of the Polyvinyl Companies, acquired by ICI in 1985 with its Beatrice Chemical take-over. Headquartered in Runcorn, Cheshire, ICI Resins is part of ICI Chemical & Polymers Ltd, a subsidiary of ICI PLC. While the main marketing and research centres for the new organisation are in Cheshire, important parts of the group are located in Waalwijk (Holland), Wilmington, Massachusetts (USA), and Barcelona (Spain). Manufacturing is also carried out in Singapore, Mexico, Venezuela and Brazil and sales are made to over 150 countries world-wide.

As part of the reorganisation, Polyvinyl Chemicals US became ICI Resins US in April this year, and Polyvinyl Chemie bv announced its new name, ICI Resins bv, in September. Although organisational changes have taken place in both these companies, and in the UK, the three main sites will continue to operate under the same successful management teams.

Adrian Bromley, General Manager of ICI Resins, announcing the move, said, "Using the ICI Resins name completes the unification of the international business and will improve the image of the group to our customers and the world at large. We have set demanding growth targets, but with out first-class team we intend to meet those targets and be a major force in our business areas."

Akzo's Perchem UK plant now on stream

The chemical division of Akzo has announced that its Perchem brand organoclay plant is now fully operational at its Littleborough facility in England. The reactors and plant were transferred from the company Duedingen, Switzerland, site in order to effectively coordinate research and production and to improve transfer know how on Akzo's own raw materials into the Perchem products. Akzo's main lab for quarternary ammonium compounds will also be situated at Littleborough.

ICI Paints receives Queen's Award

In recognition of the development of Aquabase, the revolutionary waterborne basecoat for vehicles, ICI Paints was recently presented with the Queen's Award for Technological Achievement. Principal executive officer Herman Scopes received the award from the Lord Lieutenant of Berkshire, Col The Hon G. W. N. Palmer OBE TD JP at a ceremony held at the ICI Paints research centre, Slough.

New PU latex plant

Following increased demand from European customers a new 2,000 tpa polyurethane water based dispersion plant has been built for Baxenden at Droitwich, UK.

New Carless blending service

Carless Refining & Marketing has recently invested over £0.2 m on special chemical blending facilities for both its main distribution depots: Longport, Stoke-on-Trent; and Bow, East London. This new equipment enables Carless to supply customers with chemical products already blended to the exact formulation required.

Commenting on this important customer service, Bob Preston, Distribution Manager of the Company's Longport depot, said: "Chemical blending of our types of products is on the increase. What we now offer is a very convenient and cost effective service which not only saves the customer time and space but also gives them the reassurance that the formulation they require is precise."

Exxon acquires Noroxo

Exxon Chemical has acquired from Orkem (previously known as CdF Chimie) the shares of the latter's affiliate, Noroxo, which produces a wide range of alcohols and organic acids at its 115,000 tonnes/year plant at Harnes in Northern France. The alcohols made at Harnes are used at Exxon Chemical's Rotterdam plant to make the company's range of Jayflex plasticisers for PVC. They are also sold on the merchant market for various other end uses such as defoamers, detergents, surfactants and additives.

E & E acquires Midkem

Ellis & Everard plc, the UK's leading independent Chemical Distributor, have acquired the entire issued share capital of Midkem Group plc for an initial cash consideration of £1,600,000 Midkem Group PLC is Midland based and formulates and supplies performance chemicals.

ICI Paints N American market realignment

C-I-L Paints, a business unit of C-I-L Inc, both of Toronto, is to commit its entire management, research, production and marketing resources to the automotive finishes market in North America, while its industrial coatings business will be assumed by The Glidden Company of Canada Limited. Both companies are wholly-owned subsidiaries of ICI UK and members of the ICI Paints World Group.

Jacob Shapiro, General Manager, says that C-I-L Paints has developed a considerable technological base for finishes used by automotive companies on new cars and trucks and for the Refinish aftermarket. "We now will be committing all of our energies and resources to these markets, while Glidden, also part of the ICI Paints world group, will serve the industrial market". C-I-L Paints will spend $2 million in 1989 to enhance its York Works manufacturing facility in Toronto.

HARCROS – a new global chemicals group

The chemicals to plantations group Harrisons and Crosfield has announced a major reorganisation of its chemical interests worldwide under a new single name Harcros.

Chemicals are now the major contributor to the group's profits as a result of significant investment in recent years. Activities are concentrated in UK and North America with a growing presence in Europe and Australasia. All the chemical companies, with a combined turnover in excess of £500m, will now operate under the name of the Harcros Chemical Group.

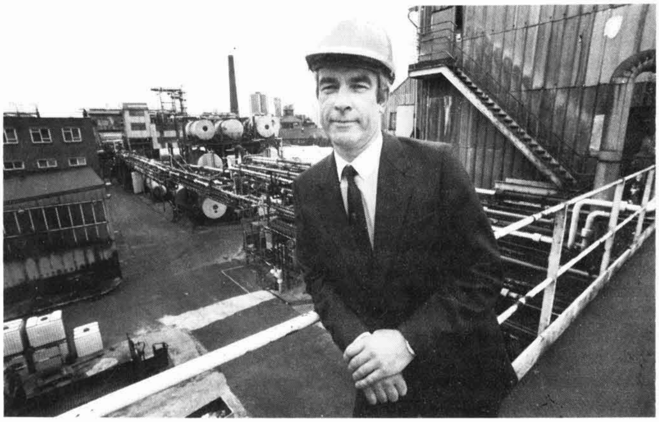
The chemical division is involved in both manufacture and distribution of organic and inorganic chemicals. British Chrome and Chemicals, American Chrome & Chemicals, Deanox, Wayne Chemicals as well as Durham Chemicals manufacture inorganic chemicals. Lankro, Haagen, Limox, Tinstab and Durham Chemicals are the Harrisons and Crossfield names known in the organic chemicals polyurethanes. This business, when

Thompson-Hayward, New England Chemical, Long Island Chemical, Northland Chemical and Harrisons and Crosfield Pacific in the USA as well as Harrisons and Crosfield Canada and Harcros Chemicals (Australia) specialise in distribution.

On the manufacturing side the following companies are raw material suppliers to the paint industry:

British Chrome and American Chrome are world leaders in manufacturing chromium chemicals. These are used in a range of products supplied to diverse industries for wood preservation, leather tanning, refractory bricks, anti-corrosion paints and special pigments.

Durham Chemicals is the UK's major producer of zinc oxide and related products for the rubber and paint industries. It has the only plant in the UK manufacturing anhydrous aluminium chloride, an important catalyst in the petrochemical industry which is also used in the preparation of dyes.



Peter Savage, the new Managing Director of Harcros, during a recent site visit to Lankro Chemicals.

Deanshanger Oxides is the sole manufacturer of synthetic iron oxides in the UK, producing a wide range of non-toxic pigments that are sold throughout the world, largely to building material manufacturers. Growth in the use of pigments has led to an extensive expansion and development programme which has improved the range and scope of the pigments that are manufactured. Deanshanger also produces high quality lead oxide for use in the glass and pigment industries.

Lankro Chemicals – a recent acquisition with headquarters in Manchester – produces speciality chemicals such as polymer additives, radiation curing chemicals, surfactants and polyurethanes. This business, when combined with Durham Chemicals, Tinstab and the Haagen group, will create a major force in the polymer additives market both in Europe and internationally.

Peter Savage, the Managing Director of the Harcros Chemical Group, stressed that under the new group identity each of the individual companies will retain their operation autonomy but will be able to draw on the advantages of operating on a larger scale as a more cohesive group.

As part of these changes the board is committing substantial capital resources to technological expansion and improvements. Furthermore all the companies will benefit from a rejuvenated concentration on research and by a New Ventures division which will be set up as a result of the reorganisation. This division will work right across the Harcros Chemical Group and will concentrate on the opportunities for new business in the 1990s.

Harcros has also made the following new appointments: Dennis Stocks, former Managing Director of Lankro, becomes New Ventures Director; Bernard MacAlhone, Marketing Director at Lankro, becomes Polymer Additives Business Director, and Roy Clancey, of Lankro, becomes Speciality Business Director.

The reorganisation is part of a plan to obtain substantial growth over the next 5-10 years and double sales to over £900m by 1992. About half the growth should come from companies already in the group and half from acquisitions related to existing operations.

BMT leads Marine Painting Forum

British Maritime Technology Ltd, the independent UK maritime research and technology organisation, has launched a Marine Painting Forum. The 13 member forum has agreed a number of objectives and elected David Allison (Procurement

Executive, Ministry of Defence) as its Chairman. The objectives are:

- ○ To develop a national strategy to improve the economics and quality of painting in the UK marine and fabrication industries.
- ○ To identify and consider new techniques and developments which benefit the UK marine and fabrication industries and the forum's members.
- ○ To sponsor or manage projects of mutual interest.
- ○ To seek representation on the standards committees for offshore and land based marine structures.
- ○ To arrange for presentations and demonstrations of new developments relevant to the marine painting industry.
- ○ To assess the impact of proposed or impending Health and Safety regulations in the industry and define the appropriate measures that need to be undertaken.

Other members of the Marine Painting Forum currently include:

Appledore Ferguson Shipbuilders Ltd, Camrex Ltd, Devonport Royal Dockyard, Hempels Marine Coatings, International Paint plc, Jotun-Henry Clark Ltd, Ministry of Defence Procurement Executive, North East Shipbuilders Ltd, Rosyth Royal Dockyard, Swan Hunter Shipbuilders Ltd, Vosper Thornycroft (UK) Ltd and W. & J. Leigh & Co.

For further information contact BMT on 01-943 5544

HSC sets control limit for acrylamide

A Control Limit for Acrylamide has been adopted by the Health and Safety Commission (HSC), acting on the advice of the Advisory Committee on Toxic Substances. With effect from 1 July 1989, occupational exposure to Acrylamide must be controlled so as not to exceed 0.3 milligrams per cubic metre (mg/m^3) in air expressed as an 8-hour time weighted average (TWA). The new Control Limit replaces the current Recommended Limits which were set at 0.3 mg/m^3 for the 8-hour TWA. Acrylamide is used to form polymers and co-polymers particularly in flocculants and surface coatings.

PPG terminates Grow merger agreement

PPG Industries has announced today that it has exercised its right to terminate the merger agreement (*JOCCA*, p 297 October) which it had entered into on 19 August with the Grow Group Inc.

Hoechst wax distributor

Hoechst UK Chemicals Division has recently announced the appointment of a small order distributor for their range of waxes, Ceridust, Hordamer and Licomer grades. The "under 1-tonne" business will be handled by Whitfields Chemicals Ltd of Newcastle for the paint/ink sector.

CHI takeover boosts own-brand growth

CH Industrials PLC Group are increasing their presence in the household products market with the acquisition of Windeck, one of the UK's leading suppliers of 'own-brand' paints, for £2.1 m.

Windeck, who have current annual sales of over £8 million, manufacture and supply a wide range of paint and coatings sold under own-brand labels by leading DIY retail stores and trade outlets. As an own brand specialist, Windeck perfectly complement CHI's other paint and building chemicals company, Cementone-Beaver.

"The two paint companies will develop independently," said CHI Executive Chairman, Tim Hearley. "The acquisition of Windeck moves us into a new market niche within paint and household products. We see plenty of opportunity for further growth within this area and will be giving Windeck every encouragement to develop there business further. I must stress that Windeck will remain a quite separate operation to Cementone with their own production plant, products and customers. Naturally there may be some cross fertilisation of ideas and product knowledge, but independent growth is our intension."

Windeck are based in Bingley where they have a workforce of about 100 people. The company has a long and well established name within the own-brand paints field and has its own paint production and canning plants. The current management team will continue to be led by Managing Director Pauline Stocks.

PA on-fax

The Paintmakers' Association Fax number is 01-735 0616.

Change of address

Perfectos Printing Inks Co Ltd, manufacturers of printing inks for fabric label printing, have moved their head office to Perfectos Mills, Normanton Lane, Bottesford, Nottingham NG13 0EL, UK.

Fullbrook Systems Ltd, specialists in viscosity control, have moved to Unit 21D, Bourne End Mills, Hemel Hempstead, Herts HP1 2RN, UK.

Shamrock Technologies SA new offices are at Rue des Vernes 18, CH-2013 COLOMBIER (NE), Switzerland.

Products

New road marking resin system

A newly-developed profile road marking system has been developed by Degussa. One new feature is that its profiles are spaced at between 10 to 20 cm and project above the otherwise smooth marking surface by between 2 and 10 mm. These profiles rise above the film of water on the road surface, resulting in considerably better headlight reflection, particularly in critical conditions in the twilight and in the dark, and indicating the line of the road more effectively to the driver. Furthermore, the surface noise generated when the wheels run on these profiles draw the driver's attention to the fact that he or she may have inadvertently crossed the centre line. The material on which these profile markings are based is

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The voice of

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the Degaroute two-component cold plastic marking resin. The road marking compounds produced on this basis are suitable for mechanical or manual application. They harden rapidly, allowing traffic to drive over them only 20 to 30 minutes after application. The finished markings, between 1.5 mm and 3.0 mm thick, are weather resistant.

High-profile road marking

For further information Enter K101

New PU thickener

SER-AD FX 1100 is a PU thickener in powder form from Servo Delden BV (represented by Hüls in the UK). This is solvent-free and dispersed in water or aqueous coatings shows equally excellent flow and levelling properties as obtained with liquid, organic solvent-thinned PU-thickeners. Odourless, solvent-free dispersion paints made with FX 1100 show an alkyd-like rheology. FX 1100 may also be used in powdered but water dispersible coatings and adhesives.

For further information Enter K102

New non-formaldehyde insolubilizer

The Paper Industry Speciality Chemicals unit of PPG Industries has introduced an environmentally safe non-formaldehyde based insolubilizer resin for paper coatings. The new Curesan 199 resin is equally effective for high solids pigmented coatings and size press applications. It improves printability in most coated paper applications, particularly those grades containing high synthetic binder content.

For further information Enter K103

Durable floor coating

Steritile, manufactured by Liquid Plastics under BS 5750, is an exceptionally tough water based poly(amino)amide cured epoxy coating which forms a hardwearing, impact resistant and durable surface. It is applied by airless spray or roller and owing to its self priming characteristics can be applied directly even to damp substrates. Steritile is free from toxic solvents and heavy odour, and is without fire risk. The product forms a tightly adherent seamless coating which, because of its high resistance to wear, is the ideal coating for industrial and commercial floors, especially those subjected to wheeled traffic.

For further information Enter K104

Equipment

New FTIR spectrometers

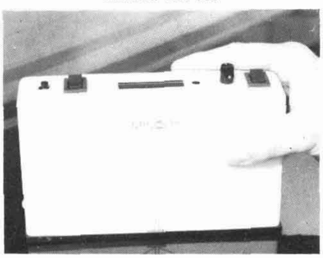
Perkin-Elmer has introduced two new versions of the 1700X Series FT-IR spectrometers. The near-infrared version covers the range 15800-27000 cm^{-1}. The far-infrared version covers the range 720-30 cm^{-1} without the need to change optical components.

For further information Enter K105

Minolta launch portable glossmeter

Minolta, more familiar for Chroma Meters measuring Colour, has introduced the Gloss Meter GM-060. The GM-060 is compact,

Minolta GM-060



lightweight and portable (only 965 grammes). The unit is based on 60°/60° geometry based on ASTM D523. The effective measuring area is 7 mm x 14 mm. The range of display is 0 to 199.9 gloss units with an accuracy of ±1% Primary standard plate – Black calibration plate, Secondary standard plate – White ceramic calibration plate. The unit is powered by Ni-Cd batteries.

The light beam strikes the surface to be measured at an angle of 60° in order to ascertain the gloss of the flat surface and hence the GM-060 is suitable for measuring a whole variety of non-metal surfaces such as plastics, enamels, paints, rubbers, ceramics, polished stones, etc.

For further information Enter K106

Heraeus new materials tester

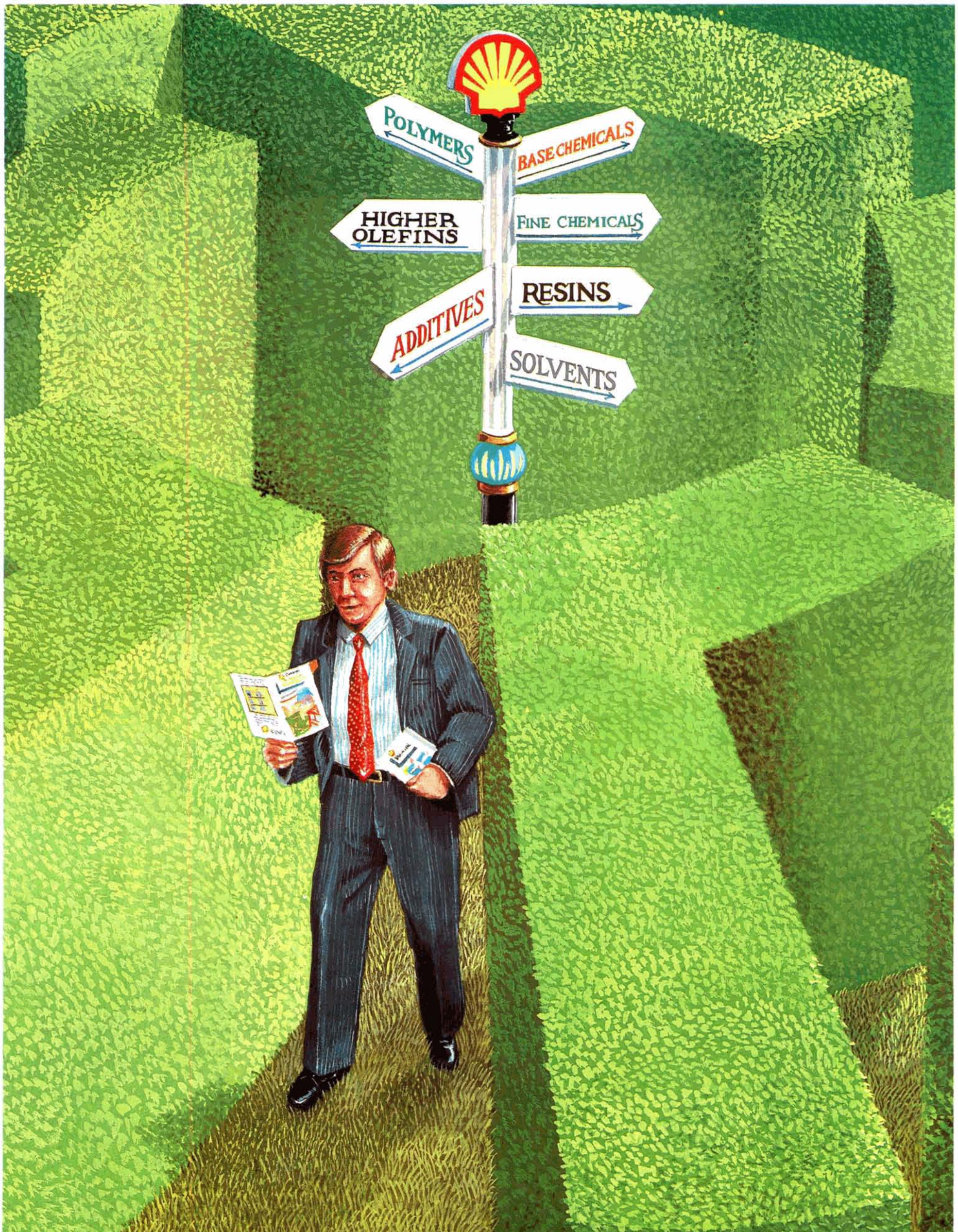
The Suntest CPS

Heraeus Equipment Ltd has introduced a new light and weather fastness tester, the Suntest CPS – and is offering a free two-week evaluation of the machine. "We will also provide assistance and advice in applying it to specific projects," said Trevor Dixon, Heraeus Equipment's managing director. Another feature introduced in the Suntest CPS is a complementary capability in the optional flooding system, for cycling wetting of samples to simulate weathering. Time cycles can now be electronically adjusted from 1 up to 999 minutes. Pump power has also been made variable in order, again, to add refinement to reproducibility of results.

For further information Enter K107

New fire safety cabinet

A new safety cabinet, which has been developed by R E Pickstone

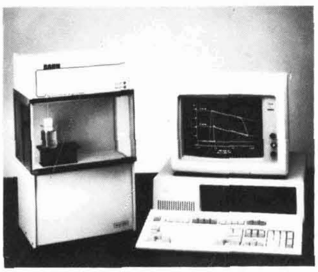

POLYMERS
BASE CHEMICALS
HIGHER OLEFINS
FINE CHEMICALS
RESINS
ADDITIVES
SOLVENTS

Ltd for the storage of flammable materials, hazardous chemicals, computer disks and other products, shuts out heat and seals in toxic fumes for approximately one hour. The cabinet provides safe storage of highly flammable liquids in glass containers, as outlined in the Highly Flammable Liquids and Petroleum Gas Regulations 1972.

For further information Enter K108

Surface wettability

The new DCA Series 300 Dynamic Contact Angle Analysers from Cahn allows you to pre-programme to scan the entire surface of a material and provide accurate, useful surface wetting data . . . automatically. The simple "hands-off" operation of the DCA and its interface with a personal computer eliminates the eye strain and tedious work associated with optical methods. The DCA extends its operation to include the surface tension of scanning liquids as well and the measurement of the interfacial tension of a multi-liquid system is simplified.

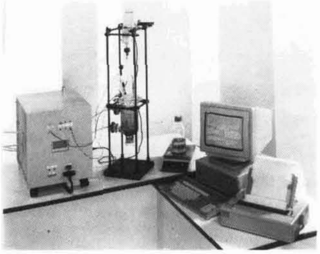


Cahn Dynamic Contact Analyser

For further information Enter K109

New computer controlled reactor

New on the market from Spectrum Computer Services Plc is the updated computer-controlled and automated reactor PC-Lab, designed to make expensive and time-consuming laboratory processing tasks both more reliable and less labour-intensive. The system facilitates the running of most common laboratory processes, including addition of reactants, temperature control for heating, cooling or isothermal conditions,



Automated reaction with PC-Lab

reflux and distillation for vacuum to ambient pressure. Controlled addition of reactants can be determined by time, temperature or pH levels.

PC-Lab has been carefully designed using readily available components, considerably reducing both initial purchase and replacement costs. Glassware, valves, temperature and pH probes are all available off-the-shelf to achieve maximum flexibility. The system comprises a reactor assembly unit, an Olivetti PC, control valves and balance, plus temperature and pH probes. Control equipment and monitoring probes are linked to the PC and all reaction results are fed into and stored by the system, enabling tests to be re-run, evaluated or adapted at the touch of a button.

For further information Enter K110

Hysolve mobile solvent disposal

Hyman plc announce a new service which cuts the huge costs of disposing of solvents, and eliminates the hazards of transporting these materials on busy roads. Hysolve is a new mobile

Hysolve distillation trailer

distillation service which recycles dirty solvents on site. Completely self contained in its own compact trailer, the unit can be fully operational within two hours of arrival. Hyman, who are offering the equipment on a day by day leasing basis, say that the unit is both easy to operate and intrinsically safe from fire hazards. The Hysolve process is ideally suited to operations producing between 1,000 and 5,000 litres of dirty solvent per month, and the machine is capable of recovering up to 1,500 litres per day, depending on the materials involved. "Hysolve requires no capital investment by the user, and is very safe because it works under a completely closed system," says John Baker of Hyman. "There is no chance of stray contaminants being introduced, because the only solvents you get out are those you put in."

For further information Enter K111

Literature

Bayer tapestry

Bayer UK is to launch a novel corporate communications campaign which centres on a unique name association with the renowned Bayeux Tapestry. The Bayeux Tapestry was made in 1082 to commemorate events leading up to one of the most famous landmarks in English history – the invasion of William the Conqueror in 1066. The "Bayer Tapestry" in 1988 marks the chemical Company's 125th anniversary, and exactly 100 years of pharmaceutical research. The Bayer Tapestry therefore features 80 key events and dates in the company's history. Numerous mentions on the tapestry concern chemicals, Bayer's largest manufacturing Sector.

For further information Enter K112

Low cost ink jet printer

A new A4 full colour leaflet from Keith Wood Co Ltd details their Compact 100 low cost, single line, large character Ink Jet Printer.

For further information Enter K113

Literature Miscellaneous

ACS data sheet on Spectra-Sensor II. Ultra small area view options ACS brochure on production dispensing system.

For further information Enter K114

New Perkin-Elmer Chromatography supplies catalogue.

For further information Enter K115

Ullmann's Encyclopaedia of Industrial Chemistry (28 volumes). Vol. A1 to A10 is £149 each. VCH Ltd (1988).

For further information Enter K116

Crystallization and Polymorphism of Fats and Fatty Acids. Ed. N. Gartia and S. Kiyotoka. Marcel Dekker (1988).

For further information Enter K117

New. Waxes Booklet – W48 is launched, Hoechst UK 88.

For further information Enter K118

Basic Optics and Pearlescent Pigments. Mearl 88.

For further information Enter K119

COSHH regulations presented to Parliament

New regulations to protect the health of people exposed to substances hazardous to their health from work activities were laid in Parliament on the 19 October by Norman Fowler, the Secretary of State for Employment.

The Control of Substances Hazardous to Health Regulations 1988 are the most far-reaching health and safety legislation since 1974. They will replace a range of inflexible and out-dated existing legislation, applying only to certain sectors of industry, with a comprehensive and systematic approach to the control of exposure to virtually all substances hazardous to health in all types of work and workplace.

Dr John Cullen, Chairman of the Health and Safety Commission, which proposed the regulations and submitted them to the Secretary of State, said today: "We are delighted at this most welcome conclusion to several years' hard work by the Commission and Executive in discussion, formulation, negotiation and drafting of these important regulations, their accompany Codes of Practice, and other guidance materials."

"We regard COSHH as a major development in the protection of people's health at work. Here is a flexible approach which concentrates on the real risks in the workplace, which should make employers think more carefully about the health problems caused by their work activities and lead to a much needed improvement in health at work."

A key factor in the new approach of the regulations is a requirement for employers to assess the health risks which arise from hazardous substances in their work activities, and to have in place the controls that this assessment concludes will be most effective to protect people's health. The controls are to be properly used and maintained in effective working order, appropriate training and information provided for those who may be affected by the hazardous substances, and, where appropriate, routine monitoring of exposure and health surveillance will be required.

The regulations will come into force on 1 October 1989, with an additional period, until 1 January 1990, for assessment to be completed.

"Control of Substances Hazardous to Health Regulations" SI 1988 No. 1657 price £3.30 is available from HMSO or booksellers.

Codes of Practice as follows have been approved by the Health and Safety Commission with the consent of the Secretary of State for Employment to give practical guidance on compliance with the Regulations:

Control of Substances Hazardous to Health Regulations 1988, Approved Code of Practice "Control of Substances Hazardous to Health" and Approved Code of Practice "Control of Carcinogenic Substances", HMSO, ISBN 0 11 885468 2.

For employers engaged in work with vinyl chloride: Approved Code of Practice "Control of Vinyl Chloride at Work", available from HSE Salespoint.

Meetings

Spectroscopy and Chromatography

The Royal Society of Chemistry are carrying out an open learning (self study) course from January to March 1989 on "Spectroscopy and Chromatography" followed by a three-day workshop at Thames Polytechnic 21-23 March 1989. The tuition fee for the course is £410.00 (non-member fee), £170.00 (student fee). For further information contact Ms L. A. Hart, Royal Society of Chemistry, 30 Russell Square, London WC1B 5DT.

OCCANZ – Call for Papers

OCCA New Zealand will be holding its 1989 Convention at Rotorua from 27-30 July on "OCCA and the Environment". Due to the diverse nature of our involvement within the supply or manufacturing industries, we have the resources to protect our environment, and the intention of the 1989 convention is to highlight the efforts of OCCA membership and associated organisations, in their current and planned programmes, to protect the environment not only for present but for future generations. If you wish to present a paper contact Heather Smith at Bayer NZ Ltd, phone (09) 889159, or Mike Rowlands on (09) 883009, replies required by 7 December 1988, or write to: 1989 Convention Programmes Organising Committee, OCCA New Zealand, PO Box 5192, Auckland, New Zealand.

OCCA CHESTER CONFERENCE
See Page 346

People in the News

PA's new Senior Vice-President

Geoffrey Watson has been appointed Senior Vice-President of the Paintmakers' Association and is Chairman-designate of the Packaging Committee. Mr Watson has for over 30 years worked in the surface coatings industry starting his career with Fishburns and is currently in charge of BASF's UK surface coatings operations.

Geoffrey Watson

New Head of FRS

David Woolley, BSc, PhD, FIFireE, CChem, FRSC, has been appointed Head of the Fire Research Station based at Borehamwood, Hertfordshire, in succession to Mr K. N. Palmer, who retired in June.

President-Elect of FSCT

John C. Ballard, Vice-President, Research, Kurfees Coatings Inc, Louisville, KY, has been nominated for the position of President-Elect of the Federation of Societies for Coatings Technology.

W. Hawley & Sons Ltd

As part of current expansion plans, W. Hawley & Sons Ltd has announced a number of senior staff appointments. Dr **T. L. Lloyd** has joined the company from RTZ Chemicals as Managing Director and succeeds Mr **Sefton Hawley** who remains as Chairman. Mr **M. R. Hall** of Selective Financial Services, Derby, has joined the Board as Commercial Director and Mr **D. L. Dryhurst** has been appointed Marketing Manager to succeed Mr **Norman Hunt** who retires in November. Mr Dryhurst has many years' experience in the construction and allied industries and has recently returned from a three-year secondment in the Middle East.

BASF Industrial Coatings

Jim Mahoney of BASF Coatings & Inks has been appointed to the position of Director and General Manager for its Industrial Coatings Division following the retirement of Peter French. Jim Mahony joined BASF Coatings & Inks in 1984 as Sales Services Manager of the Container Coatings Division of Inmont Ltd, which was acquired by BASF in 1985. Shortly after BASF's acquisition of Inmont, he was appointed Director and General Manager of the Container Coatings Division.

Jim Mahoney

BASF Liquid Inks

Robert Kinkead has been appointed Liquid Inks Sales Director of the Printing Inks Division of BASF Coatings & Inks Ltd. Mr Kinkead will be joining a team further strengthened by the recent appointment of Dr **Eric Cawkill** as Liquid Inks Technical Director.

New PDC Manager at Graco

Graco UK have appointed **Ken Dale** as their new Product Sales Manager of the Painting, Decorating and Contracting Division. Mr Dale has considerable experience in sales and engineering. The Graco PDC range includes powered rollers, electrical and petrol driven spray equipment and line striping equipment.

Reed Plastics

John Walker has been appointed Sales Development Manager of Reed Plastic Containers. Previously its Marketing Manager, he joined the company in January 1980. Mr Walker has an engineering background, and his initial appointment was as Systems Sales Engineer. Subsequently, in 1982, he was promoted to the position of Packline Sales Manager, assuming responsibility for the automated packaging systems marketed by the company.

John Walker

BS 5750

I was delighted to respond to an invitation by the Hon. Editor to provide the editorial for this special feature on quality assurance. Particularly so because the paint industry has shown itself to be one of the leaders in recognizing the benefits which accrue from the adoption of BS 5750 and participation in third party registration to demonstrate this fact.

There are currently 35 companies in the two Registered Firm schemes operated by BSI QA. The schemes are recognized by most of the major purchasers of paints, both special purpose and general application. Indeed, a clear indication of the commitment of the industry to quality.

BS 5750 was published in 1979 and rapidly became the national Standard for Quality Systems. It provided a base for the Registered Firm schemes which BSI QA had introduced a year or two earlier and in 1982, was the main plank of the Government's Quality Campaign aimed at improving the competitiveness of British industry, both at home and abroad.

The success of this campaign and the wide adoption of BS 5750 by industry, coupled with third party registration, is history. The current picture is one of continuing demand for third party registration and BSI QA now has nearly 6,000 registrations and licensees.

A great deal has happened since 1982 however. Apart from this continuing adoption of BS 5750, the Standard itself has become international. In 1987 the ISO 9000 series of standards were published, ISO 9000, 9001, 9002 and 9003 being substantially the same as the 1979 editions of BS 5750 : Parts 1, 2 and 3. As a result, BS 5750 was updated and the 1987 edition is identical to ISO 9000. Similarly, in 1988 CEN/CENELEC adopted ISO 9000 as the European Standard and published them as the EN 29000 series. As a result, an exercise has been carried out in the UK to update the quality systems of all Registered Firm and Kitemark licensees to the new Standard. Thus, British industry is in a position where their lead in adopting BS 5750 : 1987 and third party registration should give them a marketing advantage.

Will this be the case? If we look at Europe we see the use of EN 29000 being considered quite positively by the EEC Commission to determine its role in the regulatory area of Directives. We see Certification Bodies in European countries starting to establish quality system assessment and registration activities. We see, as part of the 1992 initiative, the move towards reciprocal recognition so as to reduce or remove barriers to trade resulting from differing certification procedures. We see, at least in the UK but also from other European countries, a growing tendency for purchasers to demand evidence of a supplier's control over his design and production by means of demonstrably effective quality systems to these international standards.

With this background, we can consider the question posed. 1992 is intended to provide one single market. It opens the way to increase sales across this wide market. It also opens the door to other European manufacturers and suppliers. Opprtunity and competitition will go hand in hand. Every manufacturer will seek a competitive edge and I would suggest that the Registered Firm, ie demonstrably having an effective quality system to international standards, have in their hands a tool to help them achieve that competitive edge. It is no good waiting for 1992 however. As I mentioned at the beginning, we already have manufacturers with registration. Why not use that now, to establish a presence in the European marketplace, using registration as a major marketing feature to European customers, to gain market share. All the indications are that registered firms have a two or three year lead on other European manufacturers but that this will be rapidly eroded, probably by 1992 as it is recognized and adopted in Europe. BSI QA already has a number of European companies Registered. Not many, but they represent companies who are seeing the opportunities and are coming to us in the absence of a similar facility in their own countries at the present time. The message is surely clear.

If we extend our view to the world in general, it should not be surprising that many countries are adopting ISO 9000. Perhaps one indicator of the interest in quality is that the ISO 9000 standards have become the best seller of all international standards. Similarly, it should be of interest that ISO/CASCO, the ISO Council Committee for Conformity Assessment, has 43 participating countries and 22 countries who have observer status. The annual meeting of CASCO for the last two years has attracted 70+ delegates representing around 40 countries and international organizations such as EEC, EFTA, GATT, etc.

Apart from the use of BS 5750/ISO 9000 as a marketing tool, its adoption does of course bring clear benefits to a company. Most companies see a substantial reduction in costs. Most companies recover setting up costs and Registration costs within a year or two and enjoy improved performance. It shows on the bottom line! To quote the MD of a BSI QA Registered Firm: "The case for quality is proved."

John E. Ware
Director
BSI Quality Assurance

For further information on BS 5750 contact: Mike Lukey, BSI Quality Assurance, PO Box 375, Milton Keynes MK14 6LL. Tel: (0908) 220908. Fax: (0908) 220671.

Route to BS 5750/ISO 9000 registration

by R. Easy, Yarsley Quality Assured Firms Ltd, Trowers Way, Redhill, Surrey RH1 2JN, UK

Introduction

The objective of any profitable manufacturing business is to supply, on time, products of a Quality Standard which satisfy the customer in both performance and price, thus ensuring short and long term sales.

To achieve this a company must operate in a cost effective controlled manner. Paint, resin, adhesive and specialist chemical manufacturers are not an exception to this rule – to remain profitable we must all ensure that all products are manufactured under the right conditions and to the correct Specifications. The Specification used as a basis for achieving this objective is BS 5750/ISO 9000 'Quality Systems'.

The Government White Paper "Standards Quality and International Competitiveness" published in July 1982 established the framework for the National Quality Campaign. Financial assistance was made available to help companies establish Quality Assurance Systems. The Government helped in establishing certification bodies such as Yarsley Quality Assured Firms Ltd (YQAF Ltd) and set up the National Accreditation Council for Certification Bodies. Yarsley Quality Assured Firms Ltd is the only certification body assessed by the NACCB and accredited by the Secretary of State for Trade and Industry for a scope that includes the research and development, manufacture and supply of synthetic resins, adhesives and sealants, putties, paints, industrial waxes, polymer based products and specialist chemicals. The resources therefore have been made available for companies to develop and have their Quality Systems assessed by an accredited body. Unfortunately there is a misunderstanding regarding quality assurance, certification and its implications.

The need for quality assurance

Client demand

Many customers are requesting that their suppliers have a Quality System that meets the requirements of BS 5750. This pressure is forcing companies to obtain registration which means that, unfortunately, few of them actually reap the real benefits of Quality Assurance, mainly because they see it as another requirement to be met in order to secure a contract.

Marketing tool

Companies often see Quality Assurance and registration as a marketing tool and therefore develop Systems purely to gain registration and the privilege of using the associated registration logo. This can often be an expensive marketing tool as there is little or no commitment within the company and the procedures have been written only to satisfy the Standard to gain registration and not for internal company requirements.

Improved competitiveness

Very few companies consider the benefits of Quality Assurance in terms of profitability and it will, therefore, surprise many that this is the main objective and why the Government is placing so much emphasis on it. If a company considers the formal controls required to operate cost effectively in terms of BS 5750, then the client's requirements will be automatically addressed and the company will be competitive.

Approach

Most companies have a system of operations. Unfortunately, these systems are informal and rely on local knowledge, i.e. an individual or group of individuals knowing what to do. What happens when these people leave or are absent from work? The system falls apart and other spend unnecessary time and effort in retrieving the situation.

The first step is to review current operations by carrying out a survey, e.g. How are enquiries dealt with? Where do we purchase our supplies? How do we plan production, storage and despatch, or control record and development etc. However, before anything can be even attempted, there must be a commitment from the Chief Executive to support the adoption of Quality Assurance principles and practices and the implementation of new and amended systems as a result of the survey finding.

To carry out the survey, follow the route an enquiry or order takes through the company. This can be undertaken by using internal resources or by employing a Consultant (assistance is available under the DTI Enterprise Initiative). On completion of the survey, record the findings under functional headings, noting all documentation used, e.g. formulations, receipts, process records and test requirements, etc., and cross-reference them with the requirements of BS 5750. The results usually fall into four categories.

1. System in operation is effective and meets BS 5750 requirements but needs documenting.
2. System in operation is ineffective and needs improving.
3. System in operation is documented and meets BS 5750 requirements.
4. No system in operation.

During this survey all documentation should be brought together to see whether any can be combined, or whether the information called for needs reviewing itself, or whether a brand new document is required. Authorities and responsibilities must be clearly identified and formalised.

It is important that individuals performing the functions have an input into the development of the system, so that once the survey has been completed an action plan can be drawn up assigning responsibility and timescale for the development of a particular procedure (e.g. purchasing to be undertaken by Purchasing Officer in conjunction with Quality Assurance Co-ordinator) and cross referenced to BS 5750 requirements.

It is essential that procedures are written in terms of a company's operations and not in line with BS 5750 Clause numbers (one procedure may cover several BS 5750 requirements). Procedures must be written from the point of view of their usage within the company and not for the benefit of Assessors.

As written procedures and documentation are established they should be tried and tested by implementing them and obtaining feedback as to their usefulness. Any difficulties experienced in use and any requests for change must be recorded. Where one document is used in several departments it is important that

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Grades
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comments from all areas are obtained so that the best overall document is established, rather than one that meets all the requirements of one function and none in the others.

By adopting this approach a company can build on its existing system and meet the requirements of BS 5750 in a cost effective manner, incorporating the pure Quality requirements such as internal audit, management review and corrective action which, once established, enable the system to be continually improved and updated in a controlled manner.

In establishing a Quality Management System it is essential that BS 5750 is made to fit the company's operations and not the company made to fit the requirements of BS 5750. BS 5750 is a general standard and needs to be carefully interpreted in terms of Industrial Sectors.

YQAF assessment route

Once a company has established its formal Quality Management Systems and has a Quality Manual and supporting procedures, the company is in a position to apply for BS 5750 registration with Yarsley Quality Assured Firms Ltd.

Application

Initially a Questionnaire is required to be completed and returned, in order that a detailed Proposal can be prepared and submitted, without obligation.

The Proposal/Quotation will detail the scope of the assessment, costs, timescale and optional payments method, i.e. paying fees when due (Option 1) or spreading the assessment and surveillance costs over the three year certification period (Option 2) and will be submitted to the applicant together with a copy of the YQAF Ltd Codes of Practice.

Desk study

On receipt of the application form, relevant fees and Quality System documentation, a desk study will be carried out, to ensure that all the requirements of the relevant part of BS 5750 have been met. If there are any areas of doubt the Assessor will contact the applicant and seek further clarification.

Once the Assessor is satisfied that the requirements have been met he will contact the applicant to arrange a date for the on-site assessment. At this stage the applicant will be aware that all the requirements have been met in terms of the supplied documentation.

On-site assessment

A few days before the on-site assessment a detailed itinerary will be sent to the applicant, outlining the assessment programme.

On arrival, the Lead Assessor will convene a meeting to discuss the programme and to reassure personnel that the assessment is a Systems assessment and not a personal one.

As the documentation has already been approved the Assessor will be assessing the degree of implementation of the System, therefore individuals need only know how they carry out their work and not the details of BS 5750.

The on-site assessment is to assess the degree of implementation of the procedures previously assessed during the desk study.

During the assessment individuals at all levels will be asked how they perform their particular functions and, as appropriate, what paperwork (records) they produce as evidence of the actions being carried out.

On completion of the assessment the Lead Assessor will convene a closed meeting and report the assessment results.

Should any deficiencies be noted during the assessment these will be discussed at the closed meeting.

It is important to realise that the assessment is not a pass/fail situation. Although any deficiencies recorded may prevent registration being immediate, a re-assessment will not be necessary.

Should any deficiencies be noted the Lead Assessor will require corrective actions to be taken. Arrangements will be made for an Assessor to return at a later date to assess the implementation and effectiveness of such actions.

The company, on meeting the requirements, is formally notified in writing. A Certificate of Registration is then issued, which permits the company to display the YQAF/NACCB logo, and six monthly surveillance visits are carried out to ensure adequate controls are maintained. These visits are not made unannounced as this causes unnecessary disruption to the company concerned.

Based on Paper presented to the PRA Symposium "Quality Control & Quality Assurance in Paint and Allied Industries", London, 17-18 May 1988.

BS 5750 The reality

by K. R. Smith, Cray Valley Products Ltd, Waterloo Works, Machen, Newport, Gwent NP1 8YN, UK

When the Paintmakers' Association in 1984 yielded to pressure from some of its members to look into BS 5750 registration, they started a ball rolling which is likely to transform not only the Paint Industry but all supplier industries to the paint trade too. A large number of paint companies is now either registered or working towards registration under the ubiquitous standard, and they necessarily place pressure on their various suppliers to register too. Hence, manufacturers of resins, pigments, oils and solvents, to name but a few, are all now being harangued by the paint makers to upgrade their systems.

One could argue that the BSI have launched the perfect marketing campaign, where every customer gained inevitably leads to other conquests, and it seems certain that in the not so distant future the majority of companies of any size in the UK will be registered.

In a situation where the Quality business is so buoyant, it is inevitable that a number of sources of advice has emerged, and many companies are taking the consultancy route to registering, on the grounds that success is thereby guaranteed. No statistics are available to demonstrate the truth or otherwise of this notion. However, contacts with others in the paint and allied industries lead the writer to believe that consultants are tending to overspecify the requirements of BS 5750 and the ISO 9000 series of equivalent international standards.

The differing interpretations of the standard amongst paintmakers has been noticeable in the communications reaching Cray Valley Products in the latter's capacity as one of the largest resin producers in Europe. Such approaches have varied from the brief, extremely vague, and even casual, to the highly specific, detailed and extensive.

BS 5750/ISO 9000

For the uninitiated, if there are any left, it should perhaps be explained that BS 5750 is a British Standard on Quality Systems. It provides required procedures for quality assurance in all aspects of a company's operations, and registration under the standard proclaims to all that the company is operating under conditions which provide products which are consistently "fit for purpose".

BS 5750 comes in three versions, somewhat oddly referred to as Parts 1, 2 and 3, although these do not in fact represent three separate parts of the whole. In fact, Part 1 is the most all-encompassing, since it includes the development and service functions, as well as the production and installation covered by Part 2. Part 3 is the most limited, confining itself to quality assurance in final inspection and test only.

The 1987 versions of BS 5750 also bear ISO standard numbers, so giving the documents international status and recognition. BS 5750 Parts 1, 2 and 3 are in fact synonymous with ISO 9001, ISO 9002 and ISO 9003. Part 1 is only really necessary where there is a strong involvement with customers at the product development stage.

Most resin manufacturers, under advice from the BSI via the British Resin Manufacturers' Association, are opting for Part 2, while Part 3 is restricted essentially to agents who simply check out products before supply.

Economics of BS 5750

Before looking at the various aspects of the standard itself, it is perhaps worth commenting on the real value of registration. Most companies will find it necessary to spend money to achieve it, albeit mainly in terms of time spent, which may be obscurable if a suitable existing employee can be found to organise the system! Hence, they will also like to be able to see some financial reward resulting from all their efforts. The original main selling point for BS 5750 seemed to be that it would give a company a commercial advantage over its competitors, but this cannot be so where a whole industry is registered, as when trade associations like the Paintmakers' or British Resin Manufacturers' Associations recommend that all their members should register.

Furthermore, there are distinct signs that BS 5750, in the guise of ISO 9001-9003, is set to take off equally in Continental Europe, so any advantage over European competition is likely to be shortlived too. Beyond Europe, some advantage may remain for longer, although there are similar standards in existence elsewhere, for example in South Africa and Japan. What is certain, is that the general adoption of BS 5750 in the UK will ensure an increased ability to compete with Far Eastern rivals. On the more direct level, monetary advantage will be obtained from improved productivity – resulting from, in turn, decreased re-work and spoiled work, rather than from any ability to increase prices. This is expected from the familiar principles of Quality costs, as illustrated in BS 4891 (see Figure 1), and it is up to individual companies to ensure that their expenditure on Quality Systems is carefully planned to be as cost effective as possible. Any extravagant demands for so-called Quality functions which seem to offer little in terms of real product quality/reproducibility should be treated with caution and suspicion.

The truth is that there will be a severe disadvantage to any company which fails to register, and as registration becomes more and more widespread, it will become very difficult for non-registered sources to find customers.

Implementation of BS 5750

Thus, having demonstrated that it is really inevitable that most companies will register, it remains to look at the standard itself and suggest cost-effective ways of implementing its various parts. It is not the intention here to rewrite the standard, nor the guidelines thereto offered by the BSI in BS 5750:Part 5, or by the CIA in their "BS 5750:Guidelines for use by the Chemical Industry."

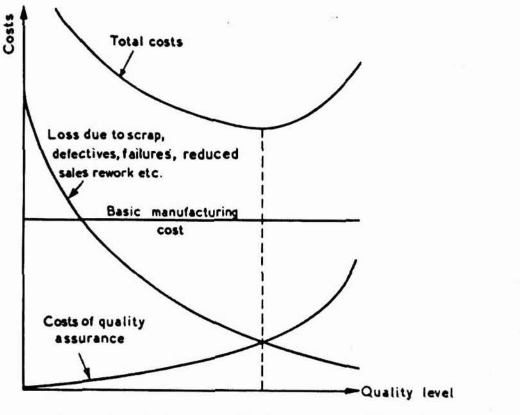
It is only intended to provide comments on interpretation of these documents where there is indeed room for manoeuvre, and where some perspective based on observations to date may be useful.

1. Quality policy

BS 5750 calls for a quality policy statement, and this should be a very straightforward, concise statement of the company's policy signed by as senior a member of management as possible,

Figure 1

Economics of Quality Assurance (reproduced by courtesy of the British Standards Institute).



preferably the MD. This essentially demonstrates that the contents of the Quality Assurance Manual, of which this is usually an introductory part, has the full backing of the most senior management. If it is very long, nobody will read it, and its effect will be lost.

The signature, incidentally, does not have to be an original on every copy of the Quality Policy statement – photocopies are perfectly acceptable.

2. Organisation

A clearly defined Quality organisation is needed, with a nominated Quality Manager, who must be independent of the Production function. He or she should carry sufficient authority and backing to be able to implement and enforce the necessary Quality systems, and must also have a nominated deputy. These needs are stressed in the 1987 version of BS 5750, and can represent serious problems for very small companies. While the Quality Manager need not necessarily devise the system initially, it is probably preferable that he, or at least some employee of the company, should set down the Quality system and implement it, rather than leave this to an outside consultant – even if a consultant is used for general guidance. The Quality Manager does not, fortunately, have to be employed solely for this function.

3. Quality system

As defined by BS 5750, this comprises essentially the sum total of the paperwork associated with the system viz. the Quality Assurance Manual, Quality Plans and supporting secondary manuals, information and forms.

4. Quality assurance manual

This is the heart of the Quality System, as it must describe the entire system, making clear precisely how the various parts interlink, and indicating unequivocally who is responsible for what. Responsibilities are best described in terms of job titles rather than individual names, to avoid repeated revision of the contents with staff changes. A list of job holders may be included as an appendix, which is simple to update as necessary.

The Manual should be constructed in a way which makes most sense for the particular operation – not in the order given in the standard.

A decimal classification system with supporting 'Contents' and without page numbers, is ideal, as this allows for subsequent modifications or additions with the minimum of fuss.

Each page must carry an issue number, copy number and date, but does not need to be individually signed provided a clear 'amendments' appendix is included which lists historical changes made to the manual. Some companies have adopted double or even triple signatories for each page, but this is quite unnecessary. A single signature on the title page (bearing an Issue No.) and perhaps on the amendments appendix is all that is needed – and this may be photocopied for copies of the Manual.

The copy number relates to individuals or individual 'titles' who are to receive copies of the manual.

Various views may be heard as to the optimum length of the Quality Assurance Manual, from "not more than 30 pages or you have overdone it" to "nothing less than 100 pages could possibly be sufficient." In truth, the length will be dependent on the type of operation, but all statements should be kept as succinct and unequivocal as possible, so that the manual is quick and easy to use by the recipients. The Quality Assurance Manual must be regarded very much as a working document, and should be presented in a suitably durable binder to ensure that it remains so. An envelope-type presentation binder is ideal for the purpose.

It should concentrate on organisational factors only – thus it will normally include copies of any forms to be used, probably as appendices, but will not include any technical data, test methods, process methods, specifications and the like.

Phrases such as "when appropriate" or "as necessary" or "if required" should be avoided.

Because the QAM is a working document, it is not necessarily ideal for dissemination to customers, and requests for "extra" copies should be treated with caution because of the subsequent difficulty in controlling and updating such copies. If copies additional to the 'official' circulation are given for any reason, they should be marked as "non-controlled" copies.

Finally, it should be remembered that the QAM must describe what is actually being done when the system is audited. If when the Manual is drawn up it is felt that changes must be made, these must be put into effect in good time to be established practice by the time of the audit. Regardless of what BS 5750 says, the system will be audited against what is stated in the Manual.

5. Quality plans

The standard calls for a clear statement of formulation, method of manufacture and test procedures for each product, but it is not necessary to physically bring together all of these parts, in detail. Usually, systems will exist already for dealing with all of this, and major rewriting can almost always be avoided by use of a suitable cross-reference system. Thus, the detailed processing instruction sheet may be separated from the Formulation card for product, and Test Methods may be elsewhere again.

Having said this, it is nevertheless essential that the 'current' data are clearly identified, and a synopsis of recipe, brief process and specification may usefully be brought together as a kind of shorthand Quality Plan from which to work.

6. Contract review

This somewhat misleading title really refers to the way a company ensures that is supplies what the customer wants, i.e. any sale is regarded as a 'contract' in this sense, and it is necessary to show that any special requirements for a particular customer, which become part of that contract, are actually fulfilled. A clear system needs to be in place for receiving special instructions from a customer, agreeing these technically and including them in formal product specifications/despatch instructions as necessary. This would, of course, be part of the normal order processing system, but may need formalising to meet the needs of BS 5750.

7. Document and change control

It is a requirement of the standard that all documentation is 'controlled', which means that it is properly authenticated when issued, and in any subsequent amended versions. Outdated versions must be withdrawn from the system, and use of 'extra' copies pinned on walls etc. for reference purposes must be avoided (unless these are included in the formal 'controlled' circulation). When changes are needed, these may be written in by hand, provided the amendments are signed and dated.

Most copies of obsolete documents should be destroyed, but at least one copy should be retained for historical reference purposes, clearly stamped as 'Obsolete' or 'Superseded'.

For most types of document, an Issue Number is desirable, although date of issue may sometimes suffice.

8. Purchasing

Materials bought in must be covered by specifications agreed between the supplier and the company, and some assurance is needed that the purchases do indeed conform to these specifications. This may be achieved by provision of Certificates of Conformity, but equally may be by assessment of the supplier's ability to meet the spec. This, in turn, may be by (a) questionnaire, (b) historical evidence or (c) audit of their quality systems – or a combination of these.

Registration of the supplier under BS 5750 represents the ideal way of meeting (c), as it includes built in continual reviews, but this can also be by independent audit visit. If these are difficult for any reason, then evidence that a particular supplier has been providing satisfactory material for some time is satisfactory too.

The Vendor Assessment Questionnaire seems to represent a quck, easy way of obtaining a basic view of a supplier's Quality System, where he is trusted to fill in a questionnaire to provide appropriate information. However, in practice it can be difficult to obtain satisfactory replies, and CVP's own questionnaire had received only about a 60% return within 2 months. Also, from the numbers of questionnaires being received by CVP from their customers, it is apparent that the majority of paint manufacturers have not relied on full questionnaire assessments at all. Since the numbers of assessment visits have also been very small, it must be assumed that most companies are relying on a combination of historical acceptability and supplier registration.

9. Material/product specifications

As above stated, all incoming materials must be to agreed specifications, but it is not necessary to indulge in lengthy exchanges of stamped and signed documents in normal circumstances. Wherever possible, it is desirable to accept the supplier's spec. – as long as he can be persuaded to actually supply a specification, with pass/fail criteria on all properties, rather than "typicals". It is always difficult for suppliers to make to different specifications and, more especially, to different test methods, for a number of customers, and agreement on these is invariably a time-consuming procedure. Having obtained the specification, the supplier should be simply told that he is expected to supply to that spec. A reference to the specification should be made on purchasing documentation, although if the material has an in-house code which is to be used on the paperwork, it is useful to adopt this same code as the basis for the specification reference.

Where several suppliers are involved, with slightly differing specs. it is usually possible to draw up an in-house spec. which embraces all of these. There is no need to draw up a separate spec. for each supplier.

If a material is offered which is out of spec. or is found to be off-spec. on testing, this may still be used if it is considered acceptable, providing it is formally accepted on a concessionary basis, and signed for to this effect.

Similarly, if a product is made which is off-spec, it may be offered to the customer on a Concessionary Release basis, and supplied to that customer with his approval, provided a record is kept detailing the nature of the fault, and the contact resulting in acceptance.

10. Certificates of conformity

Great emphasis has been placed on provision of Certificates of Conformity with product, the idea being that this guarantees conformance with agreed specs. Oddly enough, these are not actually called for by BS 5750, but have become accepted as a normal part of "Quality Assessment Schedules" (QAS). These are essentially particular embodiments of the standard drawn up for individual industries – usually by the appropriate Trade Association in consulation with customers' associations. When a Company's Quality System is audited, it is expected to comply with the particular QAS to which it relates, so certificates are "built-in" to the system.

However, customers do not have to demand certificates of conformity, although these are an added assurance of conformance. The ironic fact is that when it becomes registered, and hence committed to providing certificates, a company is inherently more reliable as a supplier, even without these certificates.

A useful compromise has been found acceptable in many cases, which is the 'blanket' certificate. This provides assurance that a specified list of products will be supplied in-spec. for an indefinite period.

A distinction should be drawn between Certificates of Conformity, which simply state that a product meets the agreed spec. and Certificates of Analysis, which provide additional information on the "finals" of the batch of product in question. When a supplier is registered, or otherwise highly rated, certificates of analysis should not be needed, unless the information is to be used as part of a Statistical Process Control (SPC) function.

11. Product process control

Needs under the standard are fairly predictable here, with the requirement for proper identification of product and intermediates at all stages, including batch numbers except for continuously produced products, and of course fully documented processing/control instructions. Traceability of batches of product through the plant and to the customer is needed, together with a general traceability of raw material deliveries into products.

12. Inspection/testing

Product must be fully tested and shown to meet specifications before supply. Incoming material need not be fully tested if purchased from an

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Approved Supplier, although it should be at least inspected on delivery. A percentage of deliveries would usually be tested, notwithstanding the reliability of the supplier, although this is not strictly necessary under BS 5750.

CVP checks products a second time in a "Quarantine" or Quality Laboratory, prior to despatch, although this again is not strictly needed under the standard.

Samples of product must be kept for a year unless stability is known to be less than this. Raw material samples once again need not be kept, although the established practice in CVP of retaining such samples also for about a year will be continued, as this has proven invaluable in the past.

13. Inspection/test status

It is a requirement that all materials and product at the company shall be of known status with respect to quality i.e. whether they are good, no good or of some intermediate state! Batch numbering of product combined with an effective reference system may be sufficient in some circumstances, but usually some form of labelling and/or segregation is needed on both materials and product. A "traffic-light" system has been adopted by CVP, comprising red, green and yellow discs.

Red predictably indicates sub-standard status, green indicates acceptable standard, while yellow is used for anything else, such as "restricted use" or "under test."

However, it may also be possible to avoid some of this by adopting a 'default' status for non-status-labelled stock. CVP have done this, using a different approach for materials and product. In the former, all materials must be green-labelled when approved, red-labelled when rejected, but left unlabelled when under test. For product, where a powerful computer system records status by batch number, no label indicates satisfactory product provided the computer system also says so! Yellow and red labels are used for other states as described, as an additional safeguard against accidential despatch.

Segregation is difficult to use in a resin plant because of the bulky nature of the product, but products in small containers may be better controlled by this means – physically moving the material from 'quarantine' to 'rejected' or 'accepted' areas after test.

14. Non-conforming product

This is really not so much of a problem as may be supposed, and it is perfectly permissible to blend off non conforming products provided this is well justified and documented. This probably means getting another form printed, and records must be kept to show where non-conforming product has been disposed of, and conversely to show what has been blended into any particular batch of product. It is useful to tie this in with Technical Complaints and Substandard Generation systems, as these lead inevitably to non-standard product!

If it is considered that a non-spec. batch is good enough to offer to a customer, this must be done, as mentioned before, using a formal, recorded "Concessionary Release" system. Written confirmation from the customer is not needed, however.

15. Equipment calibration

This is an area to which it is easy to over-react, and where it is essential to make rational judgements as to required accuracies at the outset. The standard says, in effect, that whatever accuracy the producer claims is necessary for any instrument must be maintained. Thus, if it is judged that a temperature variation ±5°C in a process stage will be of no consequence, then this degree of accuracy should be specified in the calibration system. The temptation to adopt accuracies which are the best that the instrument department can offer should be resisted, and it should be remembered that when the instrument is re-calibrated, it should never be found to be outside this specified range. If it is, then calibration frequency needs to be increased.

All calibrations need to be traceable to national standards, but there is no need to use very expensive pre-calibrated instruments if, for example, these can be checked internally against one standard. For example, thermometers for use in water-baths at 25°C need only be 'calibrated' at this one temperature against an NPL standard, and labelled accordingly. Some maintenance companies are offering special 'BS 5750' services for such items as weighscales and balances, but the extensive calibrations then carried out may not be necessary. It is necessary only to calibrate to a standard which ensures that measurements made are to the stated accuracy requirements.

16. Quality records

As might be expected, good methods are needed for making and keeping quality records for all parts of the system, and adequate storage facilities are needed to keep older records in useable, retrievable condition.

17. Handling, storage, packaging and delivery

All of these aspects of the business need to be adequately controlled to ensure protection of the product after manufacture. Remember that containers must be clearly specified to suit each product, and matters such as product handling, truck loading methods and transport must all be subject to clear codes of practice.

18. Training

This is an area which has caused great concern among would-be registrees, because the implications of needing to have records of adequate training for all personnel relating to the Quality System are far reaching. Indeed, proper records to show that such training is used and is effective are needed, but it is not expected that long-serving, experienced people will have gone through newly introduced training schemes, and even memos issued which describe training programmes set up for new intake can constitue "records". Having said this, it is necessary to have current training schemes which ensure that all persons affecting product quality are able to do their jobs in a way which ensures that the system is protected. This should include appropriate assessment of effectiveness of training undergone.

19. Quality audits

All parts of the Quality System must be regularly reviewed and audited in order to determine the effectiveness of methods used. Furthermore, there must be systems for detecting weaknesses and faults in all parts of the system and for correcting these. There must also be included a Management Review of the entire system, which is a kind of audit of audits. All of these are best conducted using standard audit questionnaires, which ensure that a consistent approach is taken for each audit, and that performance is quantified wherever possible.

Conclusions

It would seem inevitable that most companies will ultimately be more or less obliged to upgrade their Quality Systems to BS 5750/ISO 9000 standards. That being so, then the earlier they do so the better, as there will clearly be some commercial benefit at first in being a 'preferred' supplier.

The cost of registering will obviously depend on how good a Company's existing systems are, but well-run firms

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Experiences on the road to BS5750 accreditation and beyond

by S Brooks, Intermediates Division, Exxon Chemical Limited, Arundel Towers, Portland Terrace, Southampton SO9 2GW, UK

This article describes the steps that were needed to obtain BS5750 accreditation for the marketing distribution of all of Exxon Chemical's solvents, performance fluids, plasticisers and oxo-alcohols and the approach that was used by the Company. This is the first such accreditation obtained by a petrochemical company.

In recent years industry has been increasingly pressed to improve the quality of its products. In part this has been to meet pressure of foreign competition, especially from Japan, and in part as a result of the public expecting higher standards. As a company Exxon Chemical is committed to a programme of Total Quality Management based on continuous improvement, and we have always recognised that the first step in any programmes that our customers might undertake would be to ensure that their incoming feedstock and other raw materials would be of a consistent and assured quality. Indeed, even before the introduction of the British Standard scheme some customers had already begun asking for reassurance that the quality of delivered product met their particular needs. The form of these requests ranged from six page "quality" questionnaires, through certificates of analysis and conformity, to requests for visits in order to audit our on-site facilities.

When BS5750 was announced it became clear that full accreditation under the scheme would satisfy all these needs. Indeed the benefits of the scheme to customers were so obvious and the incentives for requiring suppliers to conform to it were so marked that one could easily imagine that in a few years full accreditation would be a basic requirement for any supplier.

But what exactly is BS5750?

It is a nationally accepted standard for quality systems which is used by all major organisations and co-operative assessment schemes. It is designed to cut down on the need for individual firms to carry out separate audits on their suppliers, and thus reduce the multiplicity of assessment schemes that could otherwise result. BS5750 sets out very clearly the methods by which a quality system, incorporating all the activities associated with quality control, can be implemented in an organisation in order to ensure that all the performance requirements and needs of the customer are fully met. It is identical to the ISO9000 standard which is recognised as governing quality assurance standards internationally. The achievement of certification to BS5750 therefore carries with it an automatic certification of conformance with the ISO9000 international standard.

The overall scheme permits certification on several different bases, each contained in a different "part" of the scheme. The nature of the business of the Company concerned dictates which part of the BS5750 is relevant for its particular application. So far as the chemical industry is concerned the most appropriate ones are:

Part One. This concerns the "design, manufacture and distribution of products". For the chemical industry this applies to a company which is manufacturing chemicals to be sold against a customer's specification, such as product formulated for the requirements of an individual customer.

Part Two which relates to companies manufacturing and distributing chemicals to be sold against own specifications.

In our case the operation for which we were seeking certification was the marketing distribution of all Exxon Chemical solvents, performance fluids, plasticisers and oxo-alcohols. It is not a manufacturing activity. The products are manufactured at a number of locations both inside and outside the UK and the operation involves distributing them, via tank storage locations, to customers throughout the UK. Thus the control of the quality of the materials received/accepted into the tankage is as crucial to the quality assurance as the handling of them from there onwards. These materials are all sold against our own specifications and therefore the Part Two certification was the relevant one.

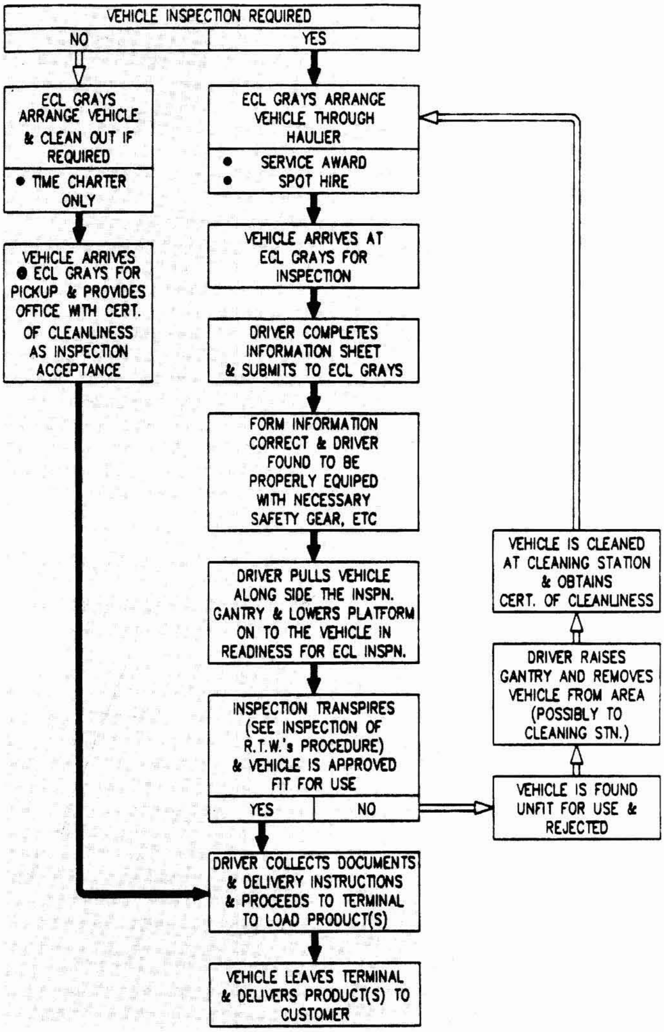
The first step on the route to certification involves developing a Quality Manual and sending this to the BSI for formal inspection.

Though we thought our operational procudures were good and we gave our customers a quality service anyway (and therefore obtaining certification should not be too difficult), we had no formal quality assurance policy or systematic manual defining responsibilities etc. Our first problem in producing a Quality Manual was that we had no-one in-house who had done this kind of thing before and, as no company had so far tried to become accredited in this area, there were no consultants who had obtained experience in preparing manuals on the marketing distribution of liquid chemicals. In the event we used the same consultant who had already been hired to work on the accreditation of our Intermediates manufacturing operation at Fawley.

The actual development of the Quality Manual is a complex process that is both time consuming and laborious. The first stage is to develop a Quality Policy, against which all of the detailed procedures in the manual can be measured.

Figure 1

Flowcharts are an almost indispensable aid in analysing both the operations and quality systems and in ensuring that there are no omissions or inconsistencies in the procedures.



Next comes the breaking down into their separate parts of all the operations involved in actually controlling or confirming the quality of the product and service provided. All of these procedures can be documented in the form of flow diagrams (see Figure 1).

The procedures documented in this way included those to ensure that all certificates of conformity for purchased product or received product are logged and retained (Purchasing Document Control); that all product is fully checked by the independent inspectors; that the equipment used by the inspectors is properly calibrated; that any 'off-spec' product (Non-conforming Material) is effectively controlled; that any customer complaints are correctly logged on the appropriate forms and that these are filed and acted upon; that there is provision for necessary training of all those involved in the process (Exxon Chemical employees and contractors personnel); that there is an internal system for auditing compliance with the procedures; and that any changes to the quality procedures are fully controlled, approved and fully documented. The flow diagrams of the quality procedures are then used to weed out any inconsistencies between the procedures, to identify and develop any new procedures that are needed, and to assign responsibilities for each of the activities within each procedure. They can also be used on a longer term basis to streamline and improve the procedures.

When this was completed it was necessary to prepare a second manual, the Operations Manual, to set out each of the steps and responsibilities in respect of the normal physical operations, such as receiving an order from a customer, preparing the paperwork, giving instructions for checking, and loading a vehicle and then actually delivering the product. In each case it is necessary to document all the steps with special reference to such aspects as product quality, reationalising any anomalies within the operational procedures, developing new procedures for such aspects as the audit of operations performed by external contractors, ensuring that interface problems do not occur when working with contractors and, above all, ensuring that all procedures are implemented 100% of the time.

Finally, after some 12 months of concentrated and detailed work, we were ready for the next step, the submission of our Manual to BSI. The formal procedure of the scheme lays down that if the submitted manual meets the BSI standards there will be a formal visit to the sites involved in the application. During this visit we had to demonstrate to the assessing Inspectors from the BSI that, for the products covered by the Quality Manual, all the procedures laid down were in place and operational and that we were carrying out our operations as specified in the Quality Manual. Happily we were able to do this but the Inspectors very properly reminded us that, even after this assessment the BSI

During a visit to the Exxon Chemical Grays order office customers were given a detailed explanation of the Quality Assurance procedures and they were able to see the on-site facilities for the whole distribution process.

will, with 48 hours notice, carry out periodic review visits to ensure that the Quality Assurance Standards have not slipped.

Looking back over the work involved we can see that we have gained many benefits in addition to being able to offer our customers an assured level of quality and service. These have arisen partly through the process involved in preparing the manuals and partly as a result of having our operations so fully documented in such detail. On the operational side itself we find that, because of their close involvement in the process, we now have a much improved working relationship with contractors, with a greater recognition that success depends on us working together. Procedures needed to be examined before we could fully document them and this highlighted weak or non-cost effective areas and helped us to improve them. also the new procedures that were instituted as part of the process now ensure that we have a tighter control of any "off-spec" material. The new procedures also ensure that salesmen have quicker and more accurate and reliable data available to respond to customer's queries whilst new customers have an independent yardstick to judge us by. We believe that, as a result of the quality programme, we can now offer a better overall level of service to our customers (see picture).

Another spin-off benefit has been the development of a wider commitment to customer service by our employees through experience of Quality Assurance principles. This is something that we consciously tried to foster throughout the programme. One of the tools we used was a video that we made to explain Quality Assurance and BS5750 to employees, contractors and customers, and which included an introduction from our Managing Director. Top management commitment throughout was vital to ensure Q.A. did not become a 24 hour wonder but something that was here to stay, and this was also evidenced by the dedication of considerable resources to the programme. The preparation and implementation required a continuing effort amounting to 1.5 person years (plus the efforts of the outside consultants) on the coordination aspects alone.

This management commitment is also a vital factor in maintaining this accreditation on a long-term basis in the future, and extending it within Exxon Chemical in order to obtain manufacturing and marketing distribution approval for the whole of our European operations in line with the ISO9000 standard. Actions are already in hand to achieve this.

But for the present we are confident in Exxon Chemical Intermediates manufacturing and marketing distribution that, as a result of our accreditation and continuous commitment to quality, we can prove that we are taking all steps required to assure our customers that they will receive what they expect to receive ■

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will have most of the elements of a BS 5750 system already – they will simply need some re-organising and formalising (probably with the issuing of some new forms!). Care should be taken not to over-complicate the organisation, and to build on existing systems wherever possible. This helps the acceptance of any new routines which are agreed between the Quality Manager and the relevant departmental managers. It also helps to keep the costs down.

Once again, it should be emphasised that the Quality System is intended to improve and maintain quality. If a particular 'requirement' does not seem to contribute to this in any way, then it is probably not a requirement at all!

Based on Paper presented to the PRA Symposium "Quality Control & Quality Assurance in Paint and Allied Industries", London, 17-18 May 1988. ■

BROOKS 3

An adhesive manufacturer's viewpoint

by R. Sandland, Borden (UK) Ltd, North Baddesley, Southampton SO52 9ZB, UK

Abstract

This paper will indicate the scope of work carried out at a site of Borden (UK) Ltd and the considerations leading to the decision to obtain approval to BS5750. It will then study the problems encountered before reaching the standard and future plans will be indicated. The paper will be completed by a mention of costs and benefits.

Borden owns six sites in the UK with resins and adhesives being manufactured at three of them. The site under consideration is at Southampton producing the widest range of adhesives, about four hundred grades drawn from some ten families of resins. Production is mostly by batch process in reaction vessels ranging in size from one to twenty tonnes, the only continuous process is formaldehyde manufacture. In addition to the resins both stretch and shrink wrapping film is made on the site. The Company has held Ministry of Defence approval of certain resin systems for well over forty years and continues to be approved to defence standard 05-24; in earlier years it has been approved by the British Standards Institution for UF foam insulation and by Lloyds Register of Shipping for marine adhesives.

Changes always take time and although the Department of Trade and Industry began its quality campaign many years ago and the first edition of BS5750 is dated 1979/ Bordens commenced their review in 1983. At this time the Company began to be aware of the value of a nationally recognised quality approval scheme which could embrace most of its products rather than a chosen few. At first, application was made to the National Testing Laboratory for accreditation under the NATLAS scheme but this proved to be unsuitable due to it being tailored to approve the laboratory rather than the company. The NTL was most helpful and advised application to the Production Engineering Research Association to be considered for the Quality Assurance Advisory Service (QAAS). This service was offered by the DTI to encourage companies to satisfy the requirements of BS5750; it consisted of an introductory visit by a ministry official to ensure that the Company understood the offer and was a suitable recipient, followed by the services of a quality specialist who would allocate fifteen working days to a full assessment and a detailed, written report.

In 1984 the Yarsley Technical Centre reviewed the Company under the QAAS scheme and for a number of departments this was their first experience of BS5750 in practice.

To a chemist the specification reads as though it was written with an engineering company in mind and it was most interesting to see how the consultants translated the requirements to suit a chemical company. In due course a forty-page report arrived detailing both the conformances and the non-conformances to the quality standard. In order to satisfy BS5750 all non-conformances needed to be corrected and, following a careful study of the report, it became clear that some changes were quite minor and could be implemented immediately but that five of the requirements would need a substantial input of time and expertise. These major non-conformances were as follows:

1. Responsibilities not sufficiently well defined within the organisation.

2. Documentation of Company procedures to be more formal.

3. Quality audits not planned within defined procedures, no audits of sub-contractors.

4. No formal quality control of suppliers, no preferred list of suppliers, no formal system for approval of new suppliers.

5. Only limited traceability of raw materials through manufacture to finished products.

Whilst on-site expertise was available to tackle this job staff shortages meant that, in order to proceed and complete within a reasonable time span, it would be necessary to employ consultants.

During the following months a number of detailed meetings occurred to weigh the pros and cons of the case and to ensure that all senior management were fully informed before being asked for their opinions about proceeding. In fact these meetings fulfilled their purpose because unanimous decisions were reached: by the film division not to proceed and by the resin division to invite Yarsley to assist in obtaining approval.

For the next twelve months all those involved in quality worked very closely with the consultants:

(a) By preparing a Quality Manual which outlined the whole quality programme of the Company from issue of documents, auditing and correction of procedures, acceptance of orders, development of new products, purchase of raw materials to manufacture, test, storage and despatch of finished products.

(b) By preparing formal Company Procedures detailing activities effecting product quality; each procedure defines what is controlled, who is responsible, how it is controlled and when it is controlled. Some of the procedures in use satisfied the standard and only needed to be written up in the correct format but others required

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The role of an instrument maker in meeting quality control demand

A Routs, Sheen Instruments Ltd, 8 Waldegrave Road, Teddington, Middlesex TW11 8LD, UK

Introduction

The obvious role of an instrument maker is to supply good quality products conforming to required standards at a reasonable price and in the delivery time required by the customer. Most q.c. testing is covered by test methods in BS/ASTM/ISO etc. so we have to ensure conformity where applicable. There are many questions that need answering and which certainly cannot be answered by instrument manufacturers on their own.

The instrument makers role

Since 1980, when Sheen was acquired from its founder owners family, the company has prominently included at the front of its catalogue the naive statement. "Your own suggestions regarding new testing equipment are welcome".

Since 1980 the company has in fact been approached only *twice*, both occasions during the past 18 months in connection with:

1. Wet Abrasion/Scrubbability Testing.
2. Drying Time Measurement.

Currently Sheen is collaborating with a BSI committee in wet abrasion testing and on a PRA study group which is partly concerned with accurate and easily determined drying time measurement. It is worth pointing out that there are no approved BS standard methods of test or BS approved instruments for carrying out either of these vary important tests and the subject of BS and other standards will be returned to later. It may not be coincidental that the need for these two standard approved instruments has been identified during the past 18 months, during this time one heard daily the mention of BS 5750 and its general requirements from our UK customers.

We are unable to comment on behalf of our friends and competitors at home and particularly abroad, although we would be interested to know what those companies representing foreign instrument manufacturers say when (or if?) asked to certify their instruments for reasons connected with end-users BS 5750 requirements.

BS 5750 — Milestone or Millstone?

Since early 1987 however we have been asked several times a day to calibrate and issue certificates of conformity for all kinds of instruments, many of them not our own and a number of which should have gone to the scrapyard long before BS 5750 was ever heard of:

- Grind gauges with precious little if any channelling left.
- Applicators with chipped or serrated edges.
- Viscometers encrusted with dried paint on their bearings or rotor arms.
- Antique glossmeters, 60° versions with optics twisted and giving readings at anything between 40° - 80°!!
- Reflectometers with blackened bulbs.
- Flow cups with obvious signs of having their orifices scraped with screwdrivers, files, scouring pads or emery boards.

We do what we can (for a modest fee) but the point is that these instruments had presumably been in use prior to being returned to the instrument maker even though they were hopelessly and dangerously inaccurate.

There is obviously a drastic increase in customers awareness of the need for regular re-calibration and it is to be hoped that frequent inspection by q.c. or laboratory staff and if necessary much more regular return of instruments for re-calibration or even (who knows?) replacement by the manufacturer or supplier will become established practice.

One can only hope that financial directors will become more aware of the importance of accurate, current test equipment and that typical replacement costs are small compared to the latest computerised accounts systems they are looking at!

Instrument prices

One surely must agree that the prices the customer perceives to pay for most things are too high and he is convinced that prices asked for by *some* instrument suppliers are *far* too high! I can only speak on behalf of Sheen but the customer should bear in mind that most of the test instruments used in our industry are very low in annual sales volume and are therefore made in very small batch quantities, some as little as 3 - 5 at a time or even "one-offs" as the order is received. Annual world sales of some familiar instruments (such as pendulum hardness testers, automatic panel sprayers, special types of film applicators) amount to less than 50 of each product. Bear in mind that there are several of us making these products and various different International Standard versions are required by the customer.

Not so long ago Sheen was asked by quite a small firm for a fineness of grind gauge, standard double channel, 0-100 microns. The company expressed outrage when told the price and the owner commented that he had a friend with an engineering workshop who could make one for less than half the price. Three weeks later the same customer returned to Sheen and brought the gauge made by the friend with him. On checking Sheen found it not to be flat, not straight and the channelling was indeed zero at one end and 100 microns deep at the other. The channel depth at the various points between was all over the place, in some places 30% out compared to the BS Spec which allows plus or minus two microns!. The customer then admitted that his friend had told him that it had taken 4 days to make and they had to scrap 5 gauges which were even worse than the one he had shown us. Following inspection of Sheen's gauges the customer bought it on the spot.

It is also worth mentioning at this stage that development costs of new instruments are very high nowadays and have to be charged for. The good old days of the instrument company owner/designer knocking up a prototype on his kitchen table on Sunday afternoon and having 2 or 3 production models made by Friday are finished.

Q.C. as a production function

Until recently q.c. work, batch sampling, comparing production batches with customer specifications etc. was done in most companies (including the largest) by the "gentlemen in the white coats". They usually belonged to R & D or product development departments and were generally well qualified people, usually chemists, and very capable of explaining why the batch had insufficient gloss, had too low viscosity etc.

The problem was that it often took them rather a long time to come to these conclusions and in the meantime the batch of product had been shipped to the customer. The resulting problem when the product arrived at *their* customers factory had to be sorted out by the technical service department.

One still sees in factories at home and abroad, samples being taken from the production line, and finally ending up hours or even days later in a nice, clean, temperature controlled laboratory which is equipped with all kinds of expensive high precision test equipment. The problem then arises if the only person who knows how to really operate the £15,000 viscometer or the £25,000 (plus) colour matching system is on holiday, off sick or out helping a harrassed tech. service manager who has been threatened with having 1000 litres of unacceptable product poured all over his new Sierra!

Many of these problems can be detected much earlier if the *production* departments are equipped with simple, easy to use instruments. It only requires a small area on the production floor, suitable screened off, where batch sampling can easily be done by comparatively unskilled operators. Gloss, viscosity, opacity and other tests can be quickly checked using modern, portable instruments.

Product examples and BS (or other) standards

Following a study of the BS3900 and ASTM standards the author has come to the overwhelming conclusion that many of the standards are now out-of-date, most of them have been around since long before the micro-chip, fibre optics and many modern coatings were dreamed of!

Now a few points concerning a number of products and standards in current use:

Gloss

Most International gloss standards appear to have been written in the 1930's and really have not progressed since.

All standards continue to refer to 20° angle of incidence for high gloss finishes, 60° angle for mid-gloss (whatever that means) and 85° angle of reflection for very low gloss surfaces.

It is well-known that most product specifications indicate the use of a 60° gloss measuring angle, some (mainly automotive but not many) indicate 20° gloss angle for high gloss but few people, Sheen included, give much credibility for the indication of the accuracy of gloss measuring at 85° mainly because it involves the use of reflecting mirrors and a large sampling area. Sheen sells very few 85° glossmeters, a few 20° instruments but the vast majority have 60° measuring heads. Linearity on modern instruments plus the use of the microprocessor in making compensating adjustments makes anything other than 60° measurement unnecessary in our opinion.

Gloss standards

It may come as a surprise to many to know that there is no **British** source of traceable gloss standards and the master gloss standards are traceable only to US or German standards.

Viscosity

The simplest and widely used method of determining viscosity, the flow-time method using a flowcup is a veritable minefield! One is regularly asked for 'Ford Cups'. (Table 1) and one can imagine the confusion caused if a junior buyer tries to order one. Regularly we receive orders for BS Ford 4's and we have to check to make sure what is required.

Particularly confusing and serious is the continuing use of *both* types of BS flowcup! at least *one* major paint manufacturer still uses the old specifications flowcups because the expense involved in establishing revised flow-times using the currently specified cup would be prohibitive!!

ICI Rotothinner

Simple, easy to use, ideal Q.C. instrument, made by Sheen for years, nearly 2000 in use around the world. This very popular instrument is not covered by ANY BS or International specification!!

Drying time

The BK drying time recorder,

Table 1
So you want to buy a Ford Cup!

Sheen Ref.		
401	BS Flowcup	BS 3900-A6 - 1983
403	ASTM Flowcup	ASTM D 1200 - 1958
404	DIN Flowcup	DIN 53211
406	ASTM Flowcup	ASTM D1200 - 1982
417	BS/ISO Flowcup	BS 3900-A6 - 1986 ISO 2431 - 1984 DIN 53224
419	AFNOR (French) Flowcup	NFT - 30-014

hundreds of them in use worldwide, again no BS or International Standard. As mentioned earlier there is a PRA study group investigating drying time measurement.

Wet abrasion scrubbability testing

A major method of testing durability of surfaces, covered by ASTM and SABS (South African Bureau of Standards) but not BS or ISO Standards. A BS committee is currently considering its inclusion in BS 3900 but after nearly 18 months there are still decisions to be made concerning the precise specification required for the instrument.

Hiding power/opacity charts

Many are in laboratory use. Occasionally customers return them because they are either not white or not black enough We would like to know how white and how black they should be! There is, as they say, no answer to that; there is no standard set.

What's new

Sheen has produced a number of new instruments during the past 2 to 3 years, all of them aimed at improving the quality control function, three of these are briefly mentioned here:

Autovisc

An inexpensive instrument to enable accurate, repeatable, mess-free flow-times to be determined using flow-cups. This instrument removes operator error involved in the traditional method using finger and stopwatch.

Test panel sprayer

There must be hundreds of hand-sprayed test panels produced daily on all types of substrates. One cannot believe repeatability or reproducibility is possible and any batch of hand sprayed panels will vary in coating thickness and build-up.

These panels are then being subjected to corrosion testing, colour matching etc. using very expensive equipment. Varying results will obviously be produced if there is no consistency in the test panel. An automatic panel sprayer ensures consistency.

Statistical, portable glossmeter

One of the most compact, versatile glossmeters available at the moment, full SPC capability if required, very easy to use on the production line or in the QC department.

Conclusions

So what is the role of an instrument maker?

To make what *you* need but to be kept informed of what the industry needs. One hopes that there will be a place for us (not only Sheen!) on BS 3900 and other committees studying test methods in the future.

Based on Paper presented to the PRA Symposium "Quality Control & Quality Assurance in Paint and Allied Industries", London, 17-18 May 1988. ■

OCCA CHESTER CONFERENCE See page 346

Corrigenda: Burkill et al, *JOCCA*, 1988, p285, amended last two paragraphs.

In the presence of oxygen the zinc sulphite will be oxidized and will pass into solution as zinc sulphate and the ferrous phosphate will be converted to ferric phosphate, which was observed as a precipitate in the solution and as a loose yellowish-white deposit on the specimens.

It is concluded from this investigation that the inhibitive properties of tribasic zinc phosphate are limited to those areas where atmospheric pollution is high and the rain water has a pH of at least 4. Earlier it was thought that it might act through soap formation and degredation[5], but there is very little evidence that it functions in this way.

Fundamentals in quality assurance

by D. M. Wallace, The De La Rue Company plc, Group Research Centre, 68 Lower Cookham Rd, Maidenhead SL6 8LA, UK

The hard lesson that some industries have learnt and others are just beginning to do so is that for the continued survival of any industry, whether it provides a product or a service, CONSTANT ATTENTION must be paid to the subject of QUALITY. Whilst industries on the whole, may survive, individual companies and organisations rise and fall by the quality of their products or services and those paying the greatest attention to quality will almost certainly survive the longest.

Everyone is fully aware of the inroads made by Far Eastern Countries into what they were once regarded as our home markets.

Britain once produced the world's best automobiles, bicycles, TVs, radios and textile goods. They were without equal.

Whilst Britain still retains a percentage share of the world market in some of these areas, the major reputation for quality, reliability and performance is firmly rooted with Japan.

Look around the home and see what names pervade into our daily lives: SONY, PANASONIC, TECHNICS, TOSHIBA and MITSUBISHI. Nissan are now even established in our own North East of England producing automobiles and place great emphasis upon quality.

Let us first of all ask ourselves some questions:

What is Quality?

How do we recognise it?

And having done so, can we not measure it?

Can we control it?

Definitions of quality abound

1. Quality is the response to the customers perception of excellence.
2. Quality is what the customer says he needs, not what tests indicate as satisfactory.
3. Quality = Degree of Reliability.
4. Quality is practical, but it is moral and aesthetic, it is perceptual and subjective.
5. Quality should be recognised as a virtue – not just a profitable strategy.

Reliability means that the product or service has a defined lifetime, which one therefore measures.

It has performance parameters built into its production, which one can also measure, define, agree upon, and products or services outside these parameters mean that they could and sometimes are regarded as unreliable and outside or beyond quality standards.

Quality could be the perceived excellence of the product or service.

It is an emotional attachment.

This emotional attachment, viewed in the eyes of a beholder can be seen from different standpoints.

In terms of supplying a product or a service to a customer it can be viewed from both the suppliers and producers aspect.

Therefore it can be both objective and subjective, and thus can prove difficult to measure, control or assure; furthermore these measurements, controls and assurances can similarly be interpreted objectively and subjectively.

Some would argue that

QUALITY = PROFITS

Were you to prove your point, this would be sufficient justification for most companies to implement a quality programme.

Others would argue otherwise and say that

QUALITY COSTS PROFITS

The intention is to show you that,

QUALITY = PROFITS

and the evidence that customers place great value on quality surrounds us all the time.

It could be argued and probably widely agreed that HIGH PERCENTAGE MARKET SHARE brings PROFITS. However to sustain or maintain that high percentage market share and hence sustain profits, it is essential that an organisation must maintain or be continuously upgrading the quality of its products or services.

Companies must be continually aware of the changing quality of its market competitors and must maintain its quality awareness.

No product or service has a quality lead, new companies are continually entering the market place and are constantly redefining the quality of products, mainly for the benefit of the customer. In 1985, a Gallup Survey for the American Society of Quality Control indicated that most consumers were willing to pay to get quality in a product they desire.

The conclusion that could be perhaps drawn is:

Those companies that provide quality goods and services will survive.

QUALITY = SURVIVAL

SURVIVAL = PROFITS

Q.E.D.

QUALITY = PROFITS

There are some that argue that

QUALITY COSTS PROFITS

and in his book QUALITY CONTROL. Theory and Applications, Bertrand L. Hansen, devotes one full chapter to the economics of quality control and several chapters to statistical control.

He details, prevention costs, appraisal costs, failure costs and even covers the subject of rate of return on quality control investment.

The author would suggest that there is only one real rate of return on quality control/or quality assurance; investment and that is:

CONTINUING SURVIVAL IN THE MARKET PLACE

Having hopefully justified in some way the need to implement a quality programme, there must be a basis upon which the programme can be built.

Quality Assurance and Quality Control programmes can be of several types, and in the main they are specific to the organisational structure, and product of service produced.

But there are essentially FOUR basic types:

1. There is no formal Q.C. or inspection organisation, the operator performs quality checks and a supervisor has the final authority.
2. There is a definite organisation with a hierarchy for inspection.

In this type of system, the production management has the final authority for approval, not to mention the input from sales, marketing and finance.

How many times have we heard the justifications for product approval in terms such as

A) The house/refrigerator/ship/lorry is at the factory door and the product must be released now.

or

B) If we do not approve today and deliver tomorrow we will not get paid for the next 90 days and miss the company's defined objective of 60 days.

3. There is a definitive QC organisation.

In this type, the QC manager does all the quality planning and acts as the Devils Advocate representing the interests of the customer. In this system, In-process Quality Control is usually the responsibility of production management.

4. There is a definitive QC organisation which is autonomous of all other

functions in terms of quality. Usually it reports to a director of quality. Sometimes this is the Technical Director.

Generally speaking, the responsibility for QC is fairly well defined but unfortunately the reporting procedures are usually fairly nebulous.

Taking a broad look at the quality assurance programmes of some of the most successful organisations one can illustrate some of the factors which are common to them all.

In almost all cases, there is a total pre-occupation with quality at every level of company management. Some recent management literature has referred to it as almost an obsession. An article in the Sunday Times on recent improvements at Austin Rover referred to it also as an obsession.

Obsession is an emotion and quality as we explained earlier begins with emotional attachment.

In a symposium organised by the PRA in January 1984, Maurice Alston said that "Quality Circles" originating in Japan in the early 1960s, were based partly on behavioural science that quality circles would tackle and solve problems such as improvements in attitudes to work and improving relationships with management.

These are two areas, not traditionally associated with quality control or quality assurance. Both of these, as you are aware, involve emotional relationships.

Quality must be first on the agenda of every meeting at every level. It does not matter whether your organisation has 15 or 1,500 employees, whether you are the QC manager or an accounts clerk, a poorly written set of QC standards or a badly addressed invoice will have destroyed your quality credibility.

Take a close look at your Quality assurance programme and decide whether you have a guiding system or ideology. If you do not, you do not have a programme. You may have even invented your own ideology but as long as it exists then you are on the way.

It really does not matter which system you adopt as long as you follow it through rigorously. The cost of quality has in the past been measured in terms of appraisal, prevention and failure costs but the system, which ever one you choose must take these into consideration as a part of the total system.

Measurement of quality in whatever terms, has to be seen to be carried out and must be done at the onset of the programme.

Targets must be defined and improved upon, and most important of all, they must be totally visible to everyone.

Figures such as Success Rates, Production Figures, Rejections, visibly displayed on a factory floor, are good examples of this.

Measurement of such parameters must be done by active participation and active participants. It should never be carried out by independent audits. Quality improvements must be seen to be rewarded, and at the same time Quality targets that are set and achieved must also, in some way be rewarded. An example of this could be a monthly production bonus based on production figures, for all employees.

It is essential for the implementation of a successful quality programme that everyone be trained so that they are capable of assessing quality or quality improvements. Revolutionary changes in possible management attitudes dictate that everyone from the company chairman down be trained in problem, cause and effect analysis, rudimentary statistical process control and group problem solving.

Brainstorming could also be used to identify solutions to work problem areas.

The Japanese axiom is that Quality Control starts with training and ends in training. They use voluntary quality circles and the general experience is that most quality improvement opportunities lie outside the natural work group and indeed, they insist that the key to success is not the natural work group, instead cross-functional management is the major organisational tool in realising improvement goals.

For success, there must be a major change in managerial philosophy. The norm of empire building by middle management should and must be a thing of the past. There is no such thing as an insignificant improvement, there is no such thing as a large or small problem; only quality improvement opportunities. The most successful quality programmes also show that there is a need for stimulation.

In the 1930s Western Electric carried out a sociological experiment involving production staff. It was an attempt to improve production by improving the lighting conditions and it worked. Lighting conditions were improved and productivity improved. However, contrary to expectations, when the lighting conditions were deliberately deteriorated, productivity again improved although the stimulation was both positive and negative, productivity actually improved.

Absolutely everyone must be involved in the quality programme. It is essential to involve suppliers of materials and raw materials, as well as customers in the quality programme.

When a company such as a paint manufacturer depends upon so many outside organisations for the components of the finished product, cooperation for Quality is absolutely essential.

There is, from some quarter, the argument that when the quality of the product goes up, then the costs will actually go down. Poor quality has a cost which has been documented. These essentially are, prevention, appraisal and failure costs.

Prevention costs are those expended in an effort to prevent poor quality. Appraisal costs are those expended on the measurement of quality characteristics to assure conformance to quality requirements, and failure costs are those costs generated by the defective product not meeting quality requirements.

Cost reduction campaigns do not often lead to improved quality and redundancies apart, they usually do not result in long term lower costs. On the other hand, the most effective quality programmes yield not only improved quality but lasting cost reductions as well.

Quality and quality improvement is a never ending programme. All quality is relative, quality never stands still. Are you aware of your competitors in your field, or those that might be in your field in a couple of years time?

Do you systematically review the performance of competitors' products? Who are your competitors? Where will they come from in the future? Is it Europe? Far East? America?

Looking at the surface coating industry, over the past couple of years, it would appear that Europe, in terms of surface coatings companies is shrinking. The market size may be expanding but the number of companies servicing it are reducing. With the exceptions of ICI and a couple of others, the UK paint industry appears to be in danger of becoming a subsidiary of the European Continental paint industry.

Like others in other fields, are you perhaps looking to Japan.

On the face of it, the Japanese have made remarkably little inroads into the European paint industry, yet perhaps 1992 may change that.

Does the Japanese commitment to quality actually pay dividends? No one would argue that the Japanese have a total commitment to quality.

A simple comparison of the European and US paint industry with the Japanese may shed some light upon the matter. As an aid to comparison, the author has used two single criteria: a) the contribution per employee to turnover (sales) and b) contribution to production in tonnes/employees. Compare the results of European, American and Japanese paint industries, and see how Europe and the

UK compare. (See Tables 1 to 5).

The criteria for comparison may not in some people's eyes be a fair one but it certainly gives us a useful comparison. Having outlined what many analysts consider are the important basic factors present in the most successful quality programmes, now take a look at BS 5750 and see how it compares.

The author proposes to use BS 5750 as it appears to himself, to be the baseline from which most of the chemical industry judges its performance in terms of quality programmes. First of all, as said earlier, company management must have an obsession with quality.

BS 5750. Says that For guidance only. Quality is the responsibility of management. It also says that the management representative responsible for quality, shall be independent.

In the successful quality programmes quality is the responsibility of everyone not just "quality management". How many times have you heard the statement, "quality, that's not my problem – see the quality manager".

How many quality control managers have felt at some stage in their career that they appear to be the general whipping boy for someone or everyone else's mistakes.

Is your QC department the unwanted hiccough in production? Can you also truthfully say that your quality function is independent?

If you can, you may undoubtedly conform to BS 5750 in its requirements, but you may well be far short of having a successful quality orientated organisation. The whole company should be quality orientated, not just one independent part of it.

It could be argued that in the form that one knows it BS 5750 is an acceptable quality ideology, and as said earlier, there is a need for an overall acceptable ideology, but perhaps, a modified BS 5750 in terms of total management/employee commitment may be a more powerful ideology. BS 5750 however does offer a strong basis for suitable modification.

It honestly does not really matter however which system you use, as long as you follow it rigorously. Remember as well, approval to BS 5750 does not necessarily mean that you are supplying quality materials, services or products.

Whatever quality of material you manufacture, good or bad, if you manufacture within the approval of BS 5750, it will still not give the purchaser an indication of the quality of your product. All it does tell him is that you are making it consistently within the defined guidelines.

The guiding quality philosophy must come from the TOP, it must be seen to come from the TOP and maintained at all times. It is a total company commitment.

As referred to previously quality must not only be measured but it must also be seen to be measured.

The quality programme is subject to regular audits, sometimes independent not only for the benefit of the product or service but for the maintenance of the status quo. "If we do not do it, we may lose our registration" is the cry often heard. The quality momentum must be maintained and quality audits must not and indeed in the best programmes cannot be carried but as independent acts.

Quality measurements must be seen to be carried out and simple displays of such criteria as:

1. Successful batches this week compared to last week, will allow people to decide how they and the system are performing.

Quality measurement can be either subjective or objective. If it is subjective because of organisational commitment, it cannot be independent. It is an essential part of any successful quality programme that quality improvements

Table 1

Employees: European/USA/Japan Paint Industry

	1985	1987
USA	55000	56000
UK	13500	14000
West Germany	23800	24500
Japan	19000	19000*
France	15750	14800
Italy	16000	13250
Spain	6000	7800
Netherlands	5600	5800
Portugal	3470	3500
Belgium	2100	2100
Sweden	2930	2890
Austria	2550	2441
Switzerland	2600	3000
Denmark	2100	2100
Norway	1700	2000
Finland	1700	1531

* Estimated

European figures by Information Research Ltd.

Table 2

National production (tonnes x 10^3)

Country	1985	1987
USA	4054	4637
UK	775	862*
West Germany	1318	1350
Japan	1848	1890
France	826.8	653
Italy	620.6	675
Spain	285	307
Netherlands	258.3	229
Portugal	92.3	103
Belgium	135.8	141
Sweden	185.5	196
Austria	124.2	114
Switzerland	92.5	116
Denmark	138.2	151
Norway	74.9	80
Finland	82.2	92

* UK figures based on "Business Monitor"

Table 3

Contribution per employee to production (tonnes)

Country	1985	1987
USA	73.7	82.8
UK	57.4	61.51*
West Germany	55.38	55.1
Japan	97.26	99.47
France	52.49	44.1
Italy	38.78	50.9
Spain	47.5	39.4
Netherlands	46.12	39.5
Portugal	26.59	29.4
Belgium	64.66	67.14
Sweden	62.88	67.8
Austria	48.70	46.7
Switzerland	35.57	38.6
Denmark	65.80	71.9
Norway	44.05	40.0
Finland	48.35	60.1

1987 Figures based on "Business Monitor".

Table 4

Contribution per employee to turnover

Country	Turnover £ Sterling x 10^3/Employee	
	1985	1987
USA	129.9	179.6
UK	94.9	100.0
West Germany	60.74	64.56
Japan	112.55	99.7
France	59.57	64.11
Italy	47.69	58.19
Spain	45.79	35.35
Netherlands	52.88	56.88
Portugal	21.75	22.46
Belgium	85.13	60.51
Sweden	78.13	63.97
Austria	53.56	52.57
Switzerland	53.52	53.70
Denmark	73.07	99.90
Norway	68.04	51.35
Finland	66.05	70.62

must be seen to be rewarded. In some people's eyes the concept of reward is often seen in financial terms but it could possibly also take the form of a guarantee of continuous employment for a percentage share of the work force.

This particular concept, i.e. reward, essential to any successful quality programme is obviously limited to an individual company or organisation and financial and/or employment conditions or considerations are beyond the area of operations of BS 5750. Training is also an essential part of any foreward looking organisation and everyone should be trained so that they are capable of assessing quality.

BS 5750 says that "The supplier shall establish a system for identifying training needs and certification requirements for all contracting, design, manufacturing, installation and quality assurance functions that would be adversely affected by such a lack of training". Here BS 5750 goes some of the way towards a total commitment to total training but in my opinion, not far enough. Since quality considerations should be total then identifying training needs should also be a total company consideration from the chairman and board of directors downwards, and not just in terms of defined quality linked functions.

All functions should be quality linked. Total training should be the company motto.

In terms of assessing, defining and measuring quality, it is accepted that multiple function teams should be used. BS 5750 emphasises that QC/QA systems are supposed to be independent.

BS 5750 says:
The supplier shall appoint a management representative, preferably independent of other functions.

It is accepted fact that most quality improvement opportunities outside the natural work group and therefore cross-functional management is absolutely essential. There is an overwhelming need for a MAJOR CHANGE in management philosophy. Empire building by middle management must almost certainly be relegated to dinosaur status.

It has been argued that the quality audit acts as a constant stimulus to the well being of the quality programme and BS 5750 clearly states that, "in order to assure that the system remains effective – management should periodically and systematically conduct review" and on the further assumption that there is no such thing as an insignificant improvement "quality system reviews should indicate possible improvements".

No item in the improvement process is too small to use in generating and sustaining momentum. Everyone must be involved in the quality programme: suppliers, distributors, customers, sales and marketing, personnel, accounts, and to reinforce this the author concludes with the definitions of quality, and make no apologies for repeating them.

- Quality is what the customer says he needs. NOT what tests indicate is satisfactory.
- Quality should be recognised as a virtue. NOT just a profitable strategy.
- Quality is practical, but it is moral and aesthetic, it is perceptual and subjective.
- Quality is what we are all about or should be.

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Table 5

National ratings

Tonnes/Employee		Contribution/Employee to Turnover £ Sterling × 10^3	
1985	1987	1985	1987
Japan	Japan	USA	USA
USA	USA	Japan	UK
Denmark	Denmark	UK	Denmark
Belgium	Sweden	Belgium	Japan
Sweden	Belgium	Sweden	Finland
UK	UK	Denmark	West Germany
West Germany	Finland	Norway	France
France	West Germany	Finland	Sweden
Austria	Italy	West Germany	Belgium
Finland	Austria	France	Italy
Spain	France	Austria	Netherlands
Netherlands	Norway	Switzerland	Switzerland
Norway	Netherlands	Netherlands	Austria
Italy	Spain	Italy	Norway
Switzerland	Switzerland	Spain	Spain
Portugal	Portugal	Portugal	Portugal

Paper presented to the PRA Symposium "Quality Control & Quality Assurance in Paint and Allied Industries", London, 17-18 May 1988. ■

Continued from p.369

substantial modification. It seemed that in the latter case always two or more departments were involved and frequently there were conflicting interests to be reconciled before the final wording could be agreed by all parties.

The whole year proved to be a most interesting period of intensive training and learning but it was with considerable relief, and, not a little satisfaction, that we obtained approval to BS5750 Part 1 in January 1986.

By March 1986 a team of six quality auditors had been chosen and trained and had carried out their first audit of the site. The auditors were drawn from different departments to avoid too great a strain on any one department. Their findings showed that the Company still had quite a lot to learn about the standard but the system was proving itself and the formal documentation was already showing its value. For the last two years understanding of the system has grown and by now there is a real appreciation of its value across the whole site.

Each of the other sites involved in resin production obtained their approval to BS5750 within the following twelve months. These sites made good use of the earlier experiences at Southampton and once again, for similar reasons, Yarsley acted as consultants with both exercises proving to be entirely successful.

Looking ahead, the Company sees the attainment and maintenance of approval to BS5750 as one step in an on-going commitment to quality. At this moment the Managing Director is leading a task force in the study of Total Quality Management with a view to adoption within the next year. Recently the European Community raised its own quality standard, ISO9000, which is largely based on BS5750, this specification requires a consideration of statistical techniques where applicable and so the Quality Manager is developing a Statistical Quality Control approach to a number of grades.

When asked to give the cost of an exercise like this, one way is to tot up the invoices which ignores the hidden expenses and gains of the Company personnel. The manhours expended can prove to be very high but the experience gained can prove to be even more valuable and this would seem to be the case with Borden. So to return to the invoices, in round figures the consultation fee was £7,000, the registration and approval fee was £2,000 and annual fees about £1,000.

Measurement of the costs may not be easy but measurement of the benefits is even less easy. The formal auditing, regular reviewing and full documentation of systems save time, improve efficiency and instil discipline across the site. Measurement attempts of these advantages have commenced but no clear trends are visible at present. Customers are increasingly requiring proof of capability to supply and maintain high quality products and service so production of a certificate of approval re-enforces customer confidence. Approval to ISO9000 will extend one's quality standing into the whole of Europe and this will prove to be of particular advantage in the single market situation of 1992 and onwards. Additionally quality certification puts one in good standing in relation to the Consumer Protection Act 1987. The benefits should be summarised in the words – approval to BS5750 keeps a company in business. ■

Paper presented to the PRA Symposium "Quality Control & Quality Assurance in Paint and Allied Industries", London, 17-18 May 1988.

Developments in fire protective coatings for military equipment: A review

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Summary

A continued increase in the use of fire retardant coatings by allied Defence Forces is expected in view of the higher levels of composite and other lightweight materials being employed in modern military equipment. However, the increased smoke production reportedly associated with some fire retardant coatings has led to differences of opinion on the relative benefits associated with their use. This aspect combined with the growing awareness on health and safety factors associated with fire has, in part, resulted in a variety of coatings and testing methods being adopted by allied Service organizations. This review examines the field and discusses the mechanisms of action and relative performance of fire retardant coatings in relation to the above.

1. Introduction

Fire retardant coatings delay ignition of the substrate by slowing the spread of flames and/or hindering the passage of heat to the substrate. There are a number of different types of coatings which protect the underlying substrate from combustion. Some authors have used the term fire retardant to describe inert coatings which have a high degree of resistance to ignition or decomposition[1], whereas others have suggested that fire retardant coatings are reactively involved in protecting the substrate by forming thermal decomposition products which insulate or protect against the fire[2]. Vandersall[3] used the terms nonflammable and insulative to distinguish between these two coating types. Commonly, materials reactively protecting the substrate are further differientiated into intumescent and flame retardant coatings. Intumescent coatings swell to produce a protective insulating barrier between the flame and the substrate while flame retardant coatings react by producing gaseous species on heating which interfere with the flame propagating reactions[4,5].

It has been suggested[6] that there have been few major developments in flame retardant paints in recent years because of their limited effectiveness. However, the adoption of paints based on chlorinated resins by the US Navy suggests that the flame retardant resins combine good maintenance properties with adequate fire and flame retardancy (see Section 6.4.3). Since the development of intumescent coatings in the late forties and early fifties[7,8] most attention has been directed towards these materials because of their high insulation efficiency from a limited film thickness. Intumescents are characterised by the ability to rapidly expand to form a stable, inorganic or carbonaceous char when subjected to heat. This is achieved by the production of non-flammable gases which are trapped by the softened film, forming a thick insulating layer which solidifies and protects the substrate. The protective capacity of intumescents, relative to unretarded coatings, was reported by the US atomic weapons test programme[9] as follows: thermal radiation of 12 calories per square centimetre second (cal/cm^2 sec) ignited unpainted wooden structures while those coated with white paint survived 25 cal/cm^2 sec with a blackened wooden surface. Commercial intumescent paints bubbled and expanded at about 12-25 cal/cm^2 sec, and then withstood several hundred cal/cm^2 sec. Since endothermic reactions (sublimation, ablation) can only remove a few cal/cm^2 sec, the ability of the refractory char to resist heat transfer is crucially important.

In recent times, considerable attention has also been directed towards high temperature insulating materials[10-12] which slowly erode or ablate with heat. Progress in this area has been greatly assisted by NASA efforts to meet the requirements of higher strength-to weight composites for aerospace. A large number of composite materials have been formulated including the carbon composites used on the wing leading edges and nose of the orbiters[13] which experience temperatures up to 1,700°C.

The objective in fire retardant coating research for general military use is for a highly serviceable paint which could be used under sealed conditions, as for example in ship bulkheads and submarines. Such applications demand that the paint evolve no toxic vapors during and after painting. Following extensive investigation, Naval Research Laboratories (NRL) in Washington[14] concluded that the evolution of toxic gases in cases of extreme heat or fire is unavoidable with the present state-of-the-art fire retardant materials. Furthermore, in many instances the fire retardant additives adversely affected working properties such as appearance, durability, gloss, organic content and flexibility of the paints under investigation.

In severe fire conditions, fire retardant paints would be of little or no significance in preventing the conflagration. Only under conditions where combustion may start from an isolated source, an electrical short circuit or similar circumstance can fire retardant paints play an important role[15]. Different coating schemes have therefore been employed with the aim of providing an effective coating against corrosion, while affording the level of fire protection required.

2. Combustion and fire retardation

The burning behaviour of materials, i.e. flammability, flame propagation, heat production and decomposition products, is not only dependent on the chemical composition but also on physical parameters such as volume, surface area and shape as well as characteristics of the ignition source.

When considering the combustion of common materials, it is normal to consider the process as a heterogeneous reaction with atmospheric oxygen taking place on the surface of the material. Depending on whether the oxygen supply is higher than the rate of reaction of oxygen with the material, the reaction is either activation- or diffusion-controlled. However, as polymers frequently decompose into gaseous products which react with oxygen in a homogeneous reaction, they are often divided into two groups. The first group of polymers thermally degrades with heat such that bonds in the main chain are broken resulting in the formation of low molecular weight gases and liquids, for example poly(methyl methacrylate). At high temperatures, polymers of this group leave very small amounts of nonvolatile residues. The second group of polymers shows a tendency for intramolecular rearrangements, cyclization and recombination which ultimately yield carbonised products, for example poly(vinyl chloride). The pyrolysis of these compounds results in the conversion of linear to cross-linked and aromatic nonvolatile products. The thermal stability and yield of carbonised products increases with aromatic content. A simple empirical equation has been proposed relating the yield of these non-volatile products and the limiting oxygen index (LOI)[16]. Hence, higher yields of carbonaceous products are a measure of improved flame retardancy.

Investigations aimed at retarding the combustion of materials are essentially directed at either reducing the rate of heat release or increasing the rate of heat loss from the combustion reaction. The mechanism of this action may be related to chemical influences (characterised by rate constants of reactions) or physical ones (heat and mass transfer parameters).

A number of speculative modes of action have been proposed for fire retardation including:

- retardation of reactions occurring on the condensed phase interface
- retardation of gas-phase reactions with gaseous combustion inhibitors which interfere with gaseous flaming reactions
- retardation of combustion by endothermic decomposition of retardant or endothermic gaseous reactions
- generation of noncombustible gaseous products which dilute the gaseous reaction species
- barrier formation retarding heat supply to the material and/or transport of reactants to the flame zone

The mode of action of most fire retardants currently used has not been established unambiguously. Therefore the division of retardants according to mechanistic principles can only be tentative and is often based on very general concepts about the role of the flame retardant on the combustion process which has frequently been related to both condensed-phase and gas-phase processes[17].

3. History of fire retardant coatings

By the 19th century, Gay-Lussac[18] had found that a number of borates and the ammonium salts of sulphuric, phosphoric and hydrochloric acid were effective as fire retardant compounds. The first reference to the use of fire retardants in paint coatings was in a patent[19] to Louis Paimboeuf in 1837 by the addition of lime, potash, alum and common salts to water or oil based paints. The product, it was claimed, would produce a fire retardant paint suitable for protecting buildings against fire.

Antimony compounds[20], first mentioned as fire retardants in 1884, were not combined with halogenated hydrocarbons until 1936[21], a mixture still widely used today. Borates[22] were proposed for use in fire retardant paints in 1898 and silicates[23] in 1933. All of these materials are generally used in fire retardant paints known as non-intumescents.

In 1948, a patent [24] was issued to the Albi Chemical Corporation for an intumescent paint which expanded on heating to form a fire retardant protection barrier. The original paints contained water soluble inorganic salts and binders unsuitable for exterior exposure. In recent times, higher molecular weight reactants have been incorporated as the carbon source (tripentaerythritol), intumescent (ammonium polyphosphate) and blowing agent (melamine) to minimise water sensitivity. However, some of the more common additives used in intumescent paints still exhibit a degree of water sensitivity.

Reviews on aspects of the development of fire retardant coatings have been published by Ware and Westgate[25], Vandersall[3], Lyons[26] and Hindersinn & Witschard[27].

4. Fire protection/destruction of military equipment

The development of fire retardant coatings for Defence use has been greatly influenced by incidents involving the fire destruction of military equipment. A number of these events, including those outlined below, have illustrated the limitations of the coating practice in use at the time and provided an impetus for the development of improved fire retardant materials.

4.1 Coating developments arising from World War II fire destruction

The use of fire retardant coatings on military equipment arose largely from destruction of ships by fire during World War II[28]. Prior to the war, the presence of thin coats of paint was not regarded as a fire hazard. However, the US Navy found that steel ships were no guarantee against fire loss due to the practice of repeatedly painting ships' compartments until heavy layers of paint were built up. The accumulated paint was sufficiently flammable to spread fire from one sealed compartment to another by heat transmitted through the bulkhead. Burning sheets of paint also fell from overhead restricting those trying to control the fires.

As a result of the Pearl Harbour attack, a specification covering fire retardant paints for coating bulkheads and over-heads in US Navy surface ships was developed[29]. The alkyd paint which was adopted was fire retardant by virtue of high pigment volume and by incorporation of antimony oxide. The requirement for this paint was that when heat was applied to the rear of the panel, blistering and ignition were retarded. The paint was intended to prevent fire spreading from a sealed compartment to those adjoining it.

4.2 Coating development arising from US aircraft carrier fires

Over the past 20 years, the US Navy suffered a number of disastrous fires aboard the aircraft carriers USS Forrestal (1967), USS Enterprise (1969) and USS Nimitz (1981). Fires caused by aviation fuel spilt on the flight deck spread rapidly enveloping weapons lying on the deck or hung under the wings of nearby aircraft. Within 3 minutes weapons began to detonate or launch propulsively. The catastrophic fire aboard USS Forrestal resulted in the deaths of 133 men[30] while the cook-off on USS Nimitz resulted in the immediate deaths of 14 men and resulted in 60 million dollars of damage[31].

These carrier fires gave rise to a requirement for use of a fire retardant coating to protect bombs, rockets and other ordnance. A programme was established to delay the temperature rise and hence the ordnance reaction for a period of 5 minutes and the extent of the reaction to a deflagration (case rupture and burning of the explosive). This was achieved by the use of intumescent coatings based on an epoxy polysulphide coating incorporating borate salts as the intumescent agent[32].

4.3 Coating review arising from fire destruction in the Falklands conflict

The fire destruction of equipment in the Falklands conflict caused considerable disquiet because of the apparent vulner-ability of equipment to combustion, e.g. 'the loss of HMS

Sheffield followed by the losses of the frigates Ardent and Antelope and the destroyer Coventry raised an immediate outcry because of the speed with which they caught fire' and 'the problem of fire-protection does need urgent action'[33].

The types of materials used in many British ships gave cause for concern. It has since been suggested that PVC coatings must be eliminated[34] as should the use of foam rubber. Ventilation systems and cable runs are two suspect areas for future review. Problems which arose from the use of aluminium in superstructures had become apparant at an earlier date following incidents involving USS Worden off Vietnam and USS Belknap in the Mediterranean[33].

4.4 Fire retardant coatings: Different Services – Different approaches

Difficulties in selecting a fire retardant coating and suitable testing procedures for military equipment might be expected in view of the range of substrate materials, the differing performance requirements involved and the assorted nature of equipment employed throughout the armed forces. However, at the present time, little agreement or interaction exists between countries, between Services, or testing organizations on the most appropriate coating for protecting a specific item of equipment or a particular substrate against fire. In many ways, the situation is well illustrated by the fire retardant coatings presently adopted for use on the interior of allied naval vessels.

4.4.1 Fire retardant coatings for allied naval ships

The Navies of Britain, US, Australia and New Zealand have, to a large degree, adopted different approaches to the choice and testing of fire retardant coatings used on the interior of vessels. As presently understood, the situation is as follows:

(a) The US Navy has adopted two fire retardant paints for use on the interior of its vessels, one formulated from a water-based vinylidene chloride resin and the other from a solvent-based chlorendic anhydride resin. This selection is presumed to be based on the extremely high limiting oxygen indices (LOI, i.e. the minimum percentage oxygen level that will support combustion), for these resins compared with possible alternative materials such as acrylics. An atmosphere containing 60% oxygen is required for combustion of vinylidene chloride resin compared to 17.3% oxygen for acrylic resin (see Section 8).

(b) Personnel involved with fire retardant coatings for the Royal Navy are firmly opposed to the use of materials based on chlorine compounds[35]. Their view is that the toxic and corrosive gases produced by coatings containing chlorine derivatives are of far more concern than the flammability of the coatings themselves. The acid products are understood to have subsequently caused electronic failure on a UK naval vessel which sustained fire damage. The description[33] of the deaths of the cooks and control room personnel on HMS Sheffield by toxic gas inhalation from vinyl chloride combustion graphically illustrates the problem of smoke generating materials such as PVC coatings (LOI 46).

(c) New Zealand Naval personnel involved with ship coatings have stated[36] that they intend to replace the 'ABR 19'[37] fire retardant coating where possible with commercially available gloss latex paints as these were found to have superior fire retardant properties to the previously used solvent based paint. They are also considering an alternative system of the gloss latex paints with added alumina trihydrate for improved fire retardant properties.

(d) The Royal Australian Navy (RAN) uses the ABR 19 approved alkyd paint as fire retardant for its general ship-board use. The flammability and smoke generation of a large number of organic materials used in RAN ships including adhesives, cellular polymers and laminated materials has been investigated by Brown and Dunn[38].

(e) Discussion of naval paint schemes

The objection to chlorine containing materials by Royal Navy personnel based on in-service experience, viz 'a balance must be found but . . . smoke generating materials such as foam rubber and PVC must be eliminated'[33] is understandable. However, judged on the ability of a material to burn, the chlorine based resins used by the US Navy are the coatings of choice. US Naval personnel[39] have suggested that smoke generation from ship-board fires is unavoidable and given the greatly improved fire retardant performance of the chlorine based coatings, they opt for these resins. For example, the test results showed that brief ignition occurred for 5-6 seconds with the chlorine based fire retardant while the unretarded paint system flashed into a violent ball of flames which extended to the roof of the test chamber[40].

The use of gloss latex paints by the New Zealand Navy eliminates the necessity of carrying flammable solvents on board ship. NZ has reported decreased flammability of this unretarded commercial latex paint compared with ABR 19 alkyd fire retardant paint.

5. Fire retardant coatings

5.1 Types of fire retardant coatings

Coatings resistant to combustion have been grouped into a number of categories, the major ones being (i) flame retardants (ii) ablatives (iii) glass-like melts and (iv) intumescents.

5.1.1 Flame retardant coatings

As discussed above, flame retardant coatings produce gaseous species which inhibit reactions in the flaming process. It is generally agreed that flame retardant paints, although having excellent brush application and flow properties, give far inferior fire protection than intumescent paints. Funt & Magill[41] have shown that fire retardants operating by flame inhibition can be defeated by even moderately elevated temperatures. Consequently, decreasing attention has been directed towards coatings whose action is confined to inhibiting flame propagating reactions.

5.1.2 Ablative coatings

Ablative coatings provide excellent fire exposure protection for structural steels. Their function is based on gradual erosion of the coating by energy absorption from a fire. To change the virgin solid coating into a gaseous composite requires heat input that would otherwise be absorbed by the structure being protected. The temperature rise of the protected structure is retarded in direct proportion to the ablative coating thickness and its thermal properties. With the assistance of NASA support in recent years, high temperature oxidation-resistant polymers such as phenolics, polybenzimidazoles, polyimides, polythiazoles, polyphenozazines and expoxies[42-45] have been proposed and/or employed in these coatings. Phenolics, for instance, do not burn under ordinary conditions particularly in composite form. Phenolics filled with mica, fibres and minerals have obtained the most recent Underwriters Laboratory classification of SE-0 rating[46].

5.1.3 Inorganic coatings which form glass-like melts

Paints made with alkali silicates or borax form glass-like melts during a fire which form a barrier between the air and the flammable substrate. Steel panels painted with this type of finish can be heated to 900°C. The major problem with these coatings has been that alkali silicates tend to be brittle and water sensitive. Consequently, these earlier forms have been of decreasing importance.

Currell[47] has suggested that the brittleness of the silicates is the result of 0.17 network bonds per unit volume. Silicones (polydimethylsiloxanes) on the other hand have 0.03 bonds per unit volume which gives them excellent flexibility but inferior mechanical and thermal properties. Ray[48,49] also drew attention to the importance of network connectivity in these glassy materials pointing out, for example, that those with 3-connected building units have a lower T_g (e.g. 270°C) than those with 4-connected building units (e.g. 1,200°C). By appropriate selection of inorganics, a suitable coating may be achieved.

In recent times, attention has been directed at overcoming the shortcomings of the inorganic coatings. One of the methods used to improve the mechanical properties of inorganic compositions has been by the incorporation of fibres into the matrix frequently referred to as bridging agents. Recent work has resulted in the complete replacement of the inorganic matrix with inorganic fibres, producing thermally resistant materials that can be heated to 1,500°C and dropped into liquid nitrogen without damage[50].

State-of-the-art inorganic coatings include systems filled with intumescent compounds such as hydrated salts, minerals and organic agents. Some of the alkali metal silicates are also reported to be intumescent film forming materials and are used with and without fillers[51]. An inorganic intumescent is also available in sheet or paste form[52]. Inorganic coatings represent the most obvious way for achieving smokeless fire retardant coatings.

5.1.4 Intumescent coatings

An intumescent paint is required to expand to form a cellular foam which has good insulating properties and resistance to combustion. A well-known example of the phenomenon of intumescence is the popular classroom demonstration of the action of acids on carbohydrates. In this instance, the dehydrating action of concentrated acid on sugar produces a voluminous low-density carbonaceous solid.

It has been suggested that for an intumescent coating to function successfully, the following properties are required[53]:
(1) The binder polymer should soften or decompose below the activation temperature of the intumescent agent.
(2) The binder should be expanded by the intumescent agent.
(3) The binder residue should contribute to the stability of the intumesced foam produced by the agent.
(4) The binder system should be nonburning or self extinguishing when exposed to a flame and preferably endothermic upon anaerobic thermal decomposition.

Intumescent paints have generally been formulated with a carbon source (e.g. a polyol), a blowing agent (e.g. chlorinated paraffins or melamine) and a dehydrating agent (generally an acid precursor such as ammonium polyphosphate). Satisfactory operation of intumescent paints requires that these three chemicals operate at the right time and in the required sequence. For example, decomposition of the blowing agent at too low a temperature will result in the gases escaping before the char can be formed, while decomposition at too high a temperature will destroy the char.

It has been suggested[54] that some variation in activation temperatures of the components of intumescent coatings might be desirable for different requirements. Commercial systems are reported to be available from a NASA supplier which are suggested to operate between 180°C and 600°C. Little published information is available on these coatings.

In recent times, self-intumescent compounds have been developed[55] such as with nitroaniline sulphate and the sulphanilimides[9]. The nitroaniline-sulphate compounds unfortunately intumesce exothermically[9,56] and while the sulphanilimides are free of this defeat, their foams were found to have poorer insulating and fire resistant properties than foams formed from the traditional phosphate fire retardant compounds.

5.2 Properties of fire retardant paints

One of the most difficult tasks of the formulator is to achieve the desired level of fire inhibition while retaining the functional properties of the coating. Coating thickness requires a balance between fire retardant performance desired and the weight penalty resulting from the thicker coating. As good fire resistance commonly requires high levels (10-20%) of fire retardant, these coatings frequently suffer from poor mechanical properties. Related properties which may also be affected by these high filler levels include: application properties, abrasion resistance, flexibility, cleaning properties, solvent resistance, hardness, scrub resistance, gloss levels, shelf life, exterior durability and water sensitivity.

Intumescent coatings which achieve their action by chemical incorporation of the active agent directly into the binder are presumed to have better coating properties, e.g. gloss levels than coatings with intumescent fillers.

Certain pigments are known to greatly improve the performance of fire retardant coatings[9] whereas others are believed to be detrimental. Vandersall[3] has suggested that finely divided solids such as pigments may improve the intumescence of fire retardant coatings by assisting nucleation of the blowing agent. In contrast, Ryles[5] has suggested that 'most of the pigments commonly used to tint paints seem to have a deleterious effect on intumescence. The worst are the organic pigments; if possible, only metal oxides should be used'.

6. Fire retardant coatings for defence use

Protection of equipment generally involves the use of a paint coating applied to a steel, aluminium, polymer or composite substrate. In recent years, high performance coatings have been increasingly adopted for military equipment and have included the thermosetting epoxies and urethanes. A typical high performance scheme for steel or aluminium involves an inhibited epoxy polyamide priming paint and a polyurethane topcoat while organic polymer substrates are commonly painted with polyurethanes. The alkyd paints and nitrocellulose lacquers prevalent in former times are of decreasing importance. The fire retardation of these coatings is discussed in Section 6.1-6.4 below and summarised in Table 1.

Fire ratings on structural steel are given in terms of the length of time a coating will maintain the temperature of the steel below approximately 540°C (1,000°F)[2]. In the case of aluminium, protection below 177°C (350°F)[2] is required and for many plastics, below 100°C.

6.1 Epoxies

Epoxy resins formulated with amides, amines and polyesters are widely used for the protection of allied Defence equipment, particularly as priming paints. US Navy also uses a fire retardant epoxy-polysulphide to protect explosives, the so-called 'NASA fire retardant' coating scheme.

Table 1

Coating Resin	Characteristics	Remarks
Polyurethane	Moderately flammable LOI 19.0	Easily flame retarded. Toxic gases a problem. Flame retarded with phosphates, halogens.
Epoxy polyamide	Moderately flammable LOI 19.8	Flame retarded with halogens phosphates, borates, alumina trihydrate.
Acrylics	Flammable LOI 17.3	Flame retarded with phosphates, halogens, alumina trihydrate.
Alkyd	Flammable	Flame retarded with phosphates, halogens (chlorendic anhydride).
Vinylidene chloride	Nonflammable LOI 60.0	Used by US Navy.

Epoxy resins are flammable materials, a property that can be reduced by using fillers particularly those evolving water vapour, e.g. epoxies[26] filled with 60% hydrated alumina have an LOI of 40.8 (cf. 19.8 for a nonretardant system).

Fire retardant epoxy resins may be prepared either by simple addition of fire retardant compounds or by modification of the resins to chemically incorporate these elements. It has been suggested that 5-6% phosphorus is required to attain significant fire retardation[26], although one reference suggests that 2% phosphorus is sufficent if ammonium polyphosphate is employed[57]. As with other types of coatings, formulation with both phosphorus and chlorine elements is reported to produce self extinguishing epoxy resins at lower phosphorus levels than by phosphorus alone[58].

A wide variety of phosphorus and halogen-containing compounds have been employed to retard epoxy resins, both by addition and by chemical modification of the resins. Phosphorus-containing compounds used as additives include ammonium phosphates, organophosphorus compounds and phosphorus-halogen mixtures. Phosphorus trianilide[59] has been proposed as an intumescent agent with even better water washability than ammonium polyphosphate. A clear intumescent epoxy coating[60] has been prepared by reacting triphenyl phosphite, which had been known to be a reactive diluent[61] with an epoxy resin. The coating is apparently devoid of the storage instabilities of conventional intumescent systems but is reported not to intumesce when pigmented[62]. Chlorine on an aliphatic portion of the resin is preferred to that on an aromatic nucleus for fire retardant activity[63].

Addition of boron compounds including boric oxide[64], borates[65] and organoborate esters [66] are all reported to produce self extinguishing epoxy resin systems (an LOI of 28 is considered self extinguishing). About 20% boric oxide renders an epoxy resin self-extinguishing. Organic esters of boron acids such as trimethoxyboroxine, a borolane or a borinane[67,68] have been used which dissolve in the resin. General Electric[69] found that triphenylantimony was an effective flame retardant in an epoxy resin and that addition of a halogenated compound did not further affect flammability.

Reports on chars of intumescent epoxy coatings[6,51] suggest that they tend to be more durable than those formed from a number of other coatings, e.g. neoprene. Selection of the intumescent was found to be critical to adhesion of neoprene chars but not to those from epoxy resin systems.

6.2 Polyurethanes

Polyurethane coatings are widely used in Defence applications because of their excellent long term performance, outdoor durability and chemical resistance. Their use is mainly confined to two-package systems comprising isocyanate prepolymers and polyols.

It has been suggested[70] that a survey of the literature does not give much detail of the exact nature of polyurethane flammability. The combustion of the polyurethanes is believed to occur mainly from pyrolytic decomposition of the resin to low molecular weight volatile species which undergo luminous reactions in the flame[71,72]. The soft polymer segment is particularly amenable to this process. Direct oxidation of carbon in the polymer phase, sometimes known as 'punking' or 'afterglow' is not regarded as a great problem with urethanes. Degradation is complex and is obviously dependent on the starting materials. Unzipping to starting materials may occur at lower temperatures. Loss of carbon dioxide results in the formation of olefins and primary amines and may be followed by formation of secondary amines[73].

The fire retardant requirements of the polyurethanes are lower than other condensation polymers[4] presumably because they contain a high percentage of nitrogen. It is known that the structure of the polyurethane has a significant effect on flammability. Einhorn *et al*[74,75] have studied char formation and smoke generation in a series of polyurethanes with and without fire retardants. For the polyisocyanates, toluene diisocyanate (TDI) gave the poorest flame ratings, the poorest chars—often none—and produced the least smoke. Conversely, the least combustible sample, polymethylene polyarylisocyanates produced the best char and the greatest smoke.

Only a few reports have been directed at the thermal stability of the soft segments connecting the carbamate units in polyurethanes. These are normally polyalkylene ether units or polyesters. Polyester linkages are reported to give better flame ratings than polyethers[76]. Of the polyethers, the low molecular weight polyethers give better flame retardation than the high molecular weight polyethers[77] presumably as the former require more polyisocyanate for curing.

Trimerisation of isocyanates produced ringed isocyanurate structures with burnthrough times increased by a factor of 10 or more over isocyanates[78]. Ring structures in the polyol component were also found to improve fire resistance. The use of trimellitic anhydride with polyetherpolyols decreased the weight loss after fire testing to 16% compared to 85% for other polyols[79]. The incorporation of epoxy groups into urethanes was also found to improve the fire retardancy of the systems. This was suggested to occur because of the formation of cyclic polyoxazolidones[80].

6.2.1 Non-reactive additives

Most fire retardants have been developed for urethane foam systems. Durability of the treatment for coatings intended for outdoor use is important as is coating performance. In view of the great potential importance of polyurethanes, methods for lowering the flammability are receiving increasing attention. The literature on fire retardant polyurethane coatings has been reviewed by Papa[71], Wen-Hsuan Chang[4], Frisch and Reegan[70] and Lyons[26].

As with a number of other coatings, decreased flammability of polyurethanes can be obtained by incorporating fire retardant additives such as polyhalogenated compounds, antimony oxide and phosphorus compounds into the coating. A wide variety of additives, both nonreactive and reactive, have been proposed, however only a small number have shown commercial importance[81].

Lyons[26] suggested that flame retarded polyurethanes (generally foams) often have a tendency to generate excessive smoke, a problem which he believes requires further research. Frisch and Reegan[70] have likewise reported that the addition of phosphorus and/or halogen containing compounds, either in the form of an additive or a reactive component, results in relatively high smoke evolution, limited heat resistance and, in many cases, reduced hydrolytic stability.

It has been noted[82] that the incorporation of some fire retardants in polyurethanes, notably phosphorus, tends to render the polymers less thermally stable. In the cases studied, the initial decomposition temperature was lowered, but the char yield was increased at higher temperatures[83,84].

Of the additive fire retardants, antimony oxide is the most often reported, generally in association with chlorinated organic compounds[85].

Phosphates perform very well in urethane systems at relatively low concentration (ca 1.5%), however many of them are water soluble and do not dissolve in the the urethane components. Materials containing ammonium polyphosphate which is less water soluble than the inorganic monophosphates, show excellent retention of fire retardancy after short immersion periods[86]. They are reportedly effective[87] at a 4% level (1% P) in passing ASTM 1692 fire resistance. Melamine phosphate has been used[88] instead of the inorganic phosphates to overcome the settling problems which result from the insolubility of the latter in these high performance resins.

Comparatively, it has been reported[89] that the type of phosphorus-containing fire retardant matters little as long as it can decompose to acids on heating. However, Lyons[26] examined phosphates, phosphonates and phosphites and concluded that phosphate was the most effective form of phosphorus as a fire retardant in urethanes. Analysis of residues has revealed no appreciable loss of phosphorus content up to 700°C[79,82].

Most of the phosphorus-halogen compositions are additive materials rather than reactive compounds. The benefits of halogens in urethanes seem only marginal for while 1.5% phosphorus is needed to retard polyurethanes in the absence of halogens, the level is lowered to 1% in the presence of 10-15% chlorine[26].

It was noted that polyurethanes were found to have a lowered flammability with halogenated phosphate esters if formulated with certain silicone surfactants, an effect presumed to be physical[90]. Another report[91] suggests that ferrocene is both a flame retardant and smoke suppressant. Alumina trihydrate, widely used to reduce flame retardancy of organic materials, was found to be relatively ineffective in polyurethanes by itself, although effective in combination with halogenated compounds[92].

Myers *et al*[93] found that ammonium pentaborate mixtures gave much better results in a thermoplastic polyurethane than did ammonium polyphosphate.

6.2.2 Reactive flame additives

The chemical incorporation of reactive fire retardants into polyurethane resins is considered important where urethanes are employed as topcoats exposed to the weather. Chemical bonding prevents the retardant leaching from the resin during long-term exposure. Some researchers have also reported that chemical incorporation into the resin gave better fire retardancy than simply blending of nonreactive additives, at least for phosphorus[86].

A large number of the reactive compounds are comonomers broadly classified into three basic types: phosphorus-containing polyols, phosphorus- and halogen-containing polyols and highly aromatic polyols. They are incorporated into the polyol component by virtue of the fact that synthesis of the polyisocyanates requires complicated technology involving the reaction of phosgene with polyamines.

Phosphate polyols represent the least expensive solution as fire retardants but they exhibit moisture sensitivity. Consequently, they are of limited value in producing durable flame retardant polyurethane coatings. To improve the hydrolytic stability as well as flame retardancy, polymers have been prepared containing the phosphorus directly bonded to carbon. They have been prepared by condensing phosphorus containing diamines with bischloroformates. These polymers were found to have comparable stability to non-phosphorus containing urethanes against alkaline hydrolysis. A film produced from one of these polymers exhibited self-extinguishing properties. A number of such compounds have been incorporated into polyurethane polymers[94,95] but their usefulness in polyurethane coatings has not been established.

In summary, it is difficult to evaluate the overall performance of the various fire retardant systems because of the large number of variety of polyurethane formulations. Information on them comes from patents and product bulletins. Several patents on materials for use in fire retarding polyurethane coatings have appeared[95-105].

6.3 Acrylics

Acrylic polymers are extensively used in coating systems on military equipment, buildings and fixed installations. The two forms of acrylic coating in common use are acrylic latex paints and solvent-based acrylic lacquers. The acrylic latex paints are widely used as interior/exterior decorative paints on constructions and more recently considered for use on the interior areas of Naval ships from the United States and New Zealand. The acrylic lacquers are used as durable topcoats on certain items of military equipment, e.g. Australian F-111C aircraft.

Acrylics are considered to be highly combustible. Plastic sheets are roughly comparable to wood in flammability and ignition characteristics[106]. Latex paints with fillers and pigments are apparently much less flammable and in an examination of a large number of materials by the ASTM E-84 25 ft tunnel test, latex paints were reported to have the lowest flame spread of all materials tested[107]. The thermal degradation of acrylics is dependent on the substitution of the carbon atoms of the backbone. With no substitution, little monomer is recovered; with substitution, the polymer unzips such that the product is almost entirely monomer[108]. Addition of an acid-forming fire retardant alters the decomposition products of poly(methyl methacrylate) to produce large amounts of carbonised deposit in a manner similar to the retardation of cellulose decomposition[109].

The acrylates are fire retarded principally with phosphorus compounds ranging from phosphates to phosphonium compounds. Self-extinguishing poly(methyl methacrylates) have been produced by adding about 8% phosphoric acid to the monomer and then polymerising to give a polymer containing about 2.5% P[110]. Poor flame retardancy was obtained with trimethylphosphine oxide, a volatile species, whereas maximum oxygen index elevation was achieved with phosphoric acid[111].

Fire retardants effective for acrylate polymers include reactive monomeric additives with polymerisable double bonds for copolymerising into the polymer and additive materials which are either soluble or insoluble in the polymer network. Phosphorus-containing methacrylate and acrylate esters are easily prepared and many compounds have been synthesised. Likewise examples of halogen-containing esters and halogen/phosphorus containing methacrylate and acrylate esters are also numerous. Phosphorus in these polymerisable forms is mainly in the form of phosphonates with the exception of a hydrophosphite.

Of the additives, the phosphorus-halogen compositions have found favour commercially on a cost effective basis. Many of these compounds serve as plasticisers. The effect of chlorine is to reduce the phosphorus requirement from about 5% to about 2%. This reduces the amount of retardant required from about 40% to around 15% so that gloss levels and other properties will be less affected. Cass & Raether[112] found that improved results were obtained from a halogen-containing polyphosphonate when compared against three halophosphate esters which they partly attributed to the higher molecular weight of the phosphonate making the compound less of a plasticiser.

6.4 Miscellaneous

6.4.1 Silicones

Silicone coatings may be considered to be heat resistant rather than fire retardant coatings and offer good protection up to 350°C. The addition of heat resistant pigments such as aluminium can raise this to 550°C. They are therefore widely used in high temperature environments such as on aircraft engine and gear components.

6.4.2 Phenolics

The British Navy Ships Materials Committee has reported[113] that 'emphasis is now being placed on the possible use of phenolic resin as fire retardants in structural applications. Although polyester resins are acceptable at present, the potential advantage of phenolics in fire are such that they cannot be ignored.

6.4.3 Coatings containing chlorine based resins

(a) Vinylidene chloride/vinyl chloride resins

The US Navy have recently adopted a water based vinylidene chloride fire retardant coating for use on the interior of Naval vessels. This paint (formulated to F-25A) has proven to be superior to the traditional fire retardant paint system[40].

(b) Chlorendic anhydride based resins

Chlorinated alkyds based on chlorendic anhydride have been employed in US Naval vessels for a number of years as the interior fire retardant paint coating. The material was formulated to a given specification (F-124) and tested to Military Specification DOD-E-24607. This paint has until recently been the interior workhorse for USN vessels and shows good fire retardant properties.

7. Char properties of intumescent paints

The theory of char effectiveness[3,9,51] is based on the char yield and its insulation efficiency depending on the cell structure and its reflectance. The rate of heat transfer through the char determines how long the substrate can be protected. Parker and Winkler[114] have shown that the primary thermo-chemical anaerobic char yields as measured from a thermo-gravimetric analysis bears a direct relationship to the number of multiply bonded aromatic rings present in the initial polymer. Since the thermal conductivity of gases is approximately an order of magnitude lower than solids, conductivity is best reduced by reducing the density of the foam.

The structure of the char depends on the staging of the blowing agent relative to the formation of a critical viscosity in the semi-molten layers formed by the active filler and the binder system. If the blowing action occurs too early, the intumescent action is reduced because the molten material is too viscous. If the action occurs too late, solidification of the char inhibits intumescence. If the molten material becomes too fluid, i.e. the viscosity becomes very low, large cells are formed during the blowing process and gel in the char. These large cells are relatively ineffective and the char can become quite frangible. However, providing that the char is composed of small tough, closed cell structures, char integrity should be favoured.

The radiative heat transfer through a fire protective coating is controllable either by the reduction of emissivity or by the increase in the reflectance of the coating (char). Systems with low emissivity at a given wavelength have a high reflectance, i.e. $s + e = 1$ (where s and e are reflectance and emissivity[9]). It was found that the oxides which provided the highest reflectance, titanium dioxide, zirconium dioxide, and phosphate and antimonate glasses consequently have very low emissivity. As such, these pigments greatly assist in reducing the radiative heat transfer through a char layer.

The properties of char toughness and durability are of critical importance to the performance of the intumescent. A program[5] in which the individual constituents of an intumescent system were systematically varied revealed adhesion problems with many of the intumescent formulations and unexplained variability in others. The study also showed that intumescent compounds which operated satisfactorily in one binder did not necessarily work in another and that careful selection of the system was necessary.

AWRE in the late 1950s developed an epoxy based system with a very high content of foaming agent. This gave enormous char/virgin expansion ratios of 50:1 or even 100:1 and correspondingly high performance figures under ideal conditions. However, the resulting light, fluffy char was easily blown away in light winds or convection currents. Since that time the commercial suppliers of this type of product have adopted more conservative ratios of between 4:1 and 8:1 by using less foaming agent[54].

8. Evaluation of fire retardant paints

A coating must be exposed to a fire or heat source of known intensity in order to establish its fire resistance rating which is determined by the length of time that it successfully performs during exposure. A large number of different tests have appeared over the years to rate the fire retardancy of materials. Recently, the trend has been to adopt the methods which best simulate the end use of the coating.

Many fire tests begin with exposure to a fire source until ignition is achieved. The fire source is then withdrawn and observations continued. This method has been the most common single-point test. However, many materials which show good fire retardant properties at one heat flux may perform poorly at higher values so that tests on isolated materials should cover a range of conditions. Fire retardants operate by increasing the threshold of ignition of materials. The effect of raising the heat flux causes fire retardant polymers to burn when the flux is high enough and for many polymers the retardant effect is removed at high fluxes. It has been suggested that tests for assessing fire retardants vary in effectiveness according to which of three stages of a fire the measurement is associated. These stages are (i) ignition, (ii) flame spread, or (iii) extend of conflagration.

A brief description of the more commonly used fire testing procedures for coatings are given below:

ASTM E 84-70 (25 ft Tunnell)[115].
Monsanto 2-ft Tunnel[116].
ASTM D 1360-70 (Cabinet Flame Test).
British Standard BS 476 (Flame Propagation).
ASTM D 2863-74 (Oxygen Index).
ASTM E 162-67 (Radiant Panel)[117].

ASTM E 136 (Noncombustibility of Elementary Materials)[117].

US Navy's 'Resistance to Ignition Test'[117].

Lockheed 37-676 (Coating Heat and Fire Resistance Test)[118].

ASTM E 84-70 tunnel test[115] was developed by the Underwriters Laboratories of the USA. The test determines flame spread, fuel contribution and smoke development. The test consists of a 25-ft long horizontal flue with the sample to be tested forming part of the tunnel. The sample size is 25-ft x 20-inch. The chamber is sealed and a controlled gas-fed flame impinges on one end of the sample and ignites combustibles present. The flame is applied for 10 minutes and the advance flame front is recorded during the test. The term 'flame spread' is an arbitrary rating based on asbestos-cement board – rating 0 and red oak – rating 100. A flame spread of 25 or less is often required for critical areas. (Some consider that the most important factor in saving lives and minimising property loss in a fire is the flame spread which led to the development of this test.)

The Monsanto 2-ft tunnel test[116] was found by Monsanto to correlate with the expensive 25-ft tunnel test. The 2-ft tunnel consists of 24 x 4-inch angle iron inclined 28° from the horizontal. A window in the side of the tunnel permits flame spread to be determined. The coated substrate, 23⅞ x 3⅞ inch, is placed coated side down over the burner. The coated panel is burned for 5 minutes and the maximum flame spread measured. Insulation value, degree of intumescence, char volume and afterglow can be measured. This test is reported to be an excellent method for evaluating coatings.

ASTM D 1360-70 cabinet flame test is one of the oldest tests for evaluating the flammability of coatings. Height of intumescence, weight loss, char area and volume can be measured but not flame spread. The 8 x 12 inch panels are placed at 45° coating side down in the cabinet over a flame fuelled by 5 ml of absolute ethanol.

ASTM D 2863-74 determines the limiting oxygen index of the film. In this test, a film of the coating is suspended in a vertical position in the chamber. The oxygen level in the chamber is adjusted to permit ignition and then reduced at a specified rate until the flame extinguishes.

The British Standard 476, pt 7 (1971) 'Surface Spread of Flame, Test of Materials' is designed to assess the ability of various paints to influence the spread of flame across their surfaces. This test requires a vertically mounted radiation panel, 900 mm square with a concrete refractory surround. On one side of the radiant panel, a specimen holder is hinged to the surround so that when placed in position, it is flush with the inner face of the surround. A vertical gas flame is applied to one end of the radiant panel for one minute as the specimen is exposed to the radiant panel. The time of flame spread is recorded at 1.5 and ten minutes by measuring distances from the bottom edge of the specimen.

US Navy[40,117] uses the *ASTM E 162-67* 'Surface Flammability of Materials using a Radiant Heat Energy Source' for evaluating nonflaming coatings. The radiant heat source is a 12 x 18-inch panel in front of which is an inclined 6 x 18-inch specimen, the upper edge of which is closer to the source. A pilot burner, capable of being swung out of position when not in use, is mounted horizontally to provide a 2-3 inch flame of gas. The position of the burner tip is such that the flame will be in contact with the top centre area of the sample. Ignition occurs near the upper edge and the flame front progresses downward. A factor derived from the rate of progress of the flame front (ignition properties) and another relating to the rate of heat liberation by the material are combined to provide a flame spread index. Provision is also made for measurement of the smoke evolved during tests.

US Navy[117] is also considering the use of the *ASTM E 136* 'Noncombustibility of Elementary Materials' for evaluating nonflaming, fire-protective coating compounds. This method is designed to identify the noncombustibility of materials to indicate those which do not aid combustion or add appreciable heat to an ambient fire. In this apparatus, two concentric refractory tubes are arranged with heating coils outside the larger. A controlled flow of air is passed down the outer tube and then up the inner tube. The 1.5 x 1.5 x 2-inch sample is placed in the inner tube with thermocouples. The temperature is maintained at 750°C. The thermocouples are monitored and materials are reported as noncombustible if the recorded temperatures do not rise 30°C above the furnace air temperature and if there is no flaming of the specimen after the first 30 seconds.

The only widely recognised method used for determining the fire retardancy of coatings for the Australian Navy has been the Australian Standard *K179-1969* 'Semi-Gloss Enamel – Low Fire Hazard for Noncombustible Surfaces (Primarily for Service Use)' which is based on the UK MOD Defence Specification Method Def-1114, 'Paint Finishing, Fire Retardant, White and Tinted White'. The Australian Standard differs from its British prototype by requiring the application of two coats of the fire retardant coating without primer, whereas the British Defence Standard requires a zinc chromate primer (the absence of primer in the Australian Standard raises questions about the relevance of the scheme to the system actually used by the Navy). Both methods require examination of the coating to see if flaming, and blistering occur following the application of a flame to the reverse side of the panel. As such, both are unsuitable for intumescent paint evaluation.

The US Navy[40,117] has developed a more severe test than *AS K179-1969* to determine whether a paint will ignite into flames when the sole ignition source is the heated metallic substrate to which the paint adheres. The test is occasionally referred to as the "Resistance to Ignition Test' and is modified from one described by Birnbaum & Markowitz[119]. The apparatus consists of a high amperage direct current generator and ancilliary equipment to shunt the current directly through the test specimen to cause rapid heating. It is calibrated to give a temperature rise from within the test specimen of 1,000°C within 60 seconds. Good fire retardant paints show little or no ignition whereas unretarded flammable paints frequently showed violent ignition characteristics followed by continued flaming.

In 1954 Lasch and Jukkola[2] surveyed the US Specifications for fire retardant coatings suitable for aircraft and considered them inadequate for coatings on metal surfaces. These workers therefore developed a procedure judged by backface temperature. Since that time, a number of specifications have appeared for determining backface temperatures as a measure of heat and fire resistance of coatings. The Royal Australian Air Force (RAAF) favours one of these procedures, the *Lockheed Aircraft Corporation Specification No 37-676* 'Coating Fire and Heat Resistant[118].' In this test, 12-15 mil thick coatings are required to maintain the backside of an 8 inch square coated aluminium panel below 550°F above ambient for 15 minutes when the coating is exposed to a 1,000°F heat source. The coating must also not burn or blister when exposed to a 2,000°F flame for 15 minutes. The flame must be generated using a natural gas-oxygen mixture suitably adjusted to cover a 5-inch diameter area. The panel must not be burned or blistered, but partial annealing is permissible.

Other tests for fire retardant paints include the *ASTM D 1361* (stick and wick), the *NASA T-3 JP-4 fuel-fired furnace test*[51] and *the quarter-scale compartment test*[120]. The first test is relatively old and not generally employed for intumescent or high performance coatings while the two latter tests have been restricted to specialist establishments. Individual researchers have designed a number of simple tests for fire retardant coatings including a *propane torch method*[91] which, it is claimed, creates a large thermal shock and determines if stable char formation can occur. Other workers[9] have discarded the propane torch claiming that the temperature (1,200°C) was too high and that more characteristic results were obtained from flat flame burners which gave a range of reproducible flame temperatures.

9. Smoke generation and toxicity

In the absence of a nonflammable, non-smoke producing, fire retardant coating, a variety of coatings have been developed. The limitations of combustible organic materials have given rise to a widespread attitude that while fire retardant coatings may be very effective in protecting substrates against combustion, these coatings increase smoke propagation thereby creating a problem greater than that of substrate combustibility. Very little is known about the factors controlling smoke generation during a fire. However, the addition of heavy metals has been found to be effective in suppressing smoke from PVC[121,122].

Todd[34] reported that conventional chlorosulphonated polyethylene sheathings are flame retardant and have high oxygen index values but that in a fire they emit large volumes of smoke and high levels of hydrochloric acid gas. He found that the introduction of alumina trihydrate filler resulted in major reductions in smoke emission and the acid gas was restricted to less than 5% (a 50% reduction) at 800°C. American reports suggest that a paint coating has been developed for this cabling which meets US military requirements[123].

ICI Chemicals & Polymers Division[124] report an 80% reduction in smoke generation from coated polyurethane foam by the introduction of either an alkyl phenyl phosphate or calcium zinc molybdate in a vinyl chloride/vinylidene chloride resin.

Toxicity evaluation is a field for which standard ISO methods have not been agreed. This remains an extremely important area for future progress in the field of fire retardancy.

10. Conclusions

This report reviews the various kinds of fire retardant coatings that have been used by the Services as well as those that have been reported in the literature and discusses theories on their mechanisms of action.

The field of fire retardant coatings is a complex one, complicating factors including different substrates, different requirements and different tests. At this time, no ideal coating is available which provides long term surface protection with excellent fire retardancy, negligible smoke and toxic vapor production for use on all substrates. Consequently, different fire retardant coatings are utilised depending on the application. However, the use of different coatings for similar applications is apparent among allied Services. This is believed to reflect the limited interaction between relevant personnel in the coatings field.

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From the General Secretary

SBPIM Annual Conference

The Bull Hotel at Gerrards Cross was the venue for the Third Annual Conference of the Society of British Printing Ink Manufacturers (SBPIM) with whom the OCCA is pleased to be associated as one of the nine founder Affiliate Members. One-hundred-and-seven delegates and partners from sixteen member companies, Affiliates and Society staff attended the Conference.

The Society, representing 27 companies, used the occasion of the Conference to report on its activities including participation in the European Committee of Paint, Printing Ink and Artists' Colours Manufacturers' Association (CEPE) and to debate the important topic of image and presentation.

The guest speaker was James Moorhouse, MEP for London South and Surrey East, who spoke on the topical subject of The Single European Market in 1992. Emphasising that 1992 was a reality, not a dream, he argued that only by Europe standing together could competition from the Far East and in particular from Japan be resisted. On the question of Sovereignty, he assured the meeting that although Britain would lose their individual veto, a coalition with only one or two allies would be sufficient to secure the safeguard of national interests. A question and answer session following his presentation highlighted the concern of member companies that UK standards for safe chemicals used in the printing ink and paint industries would not be adopted by other European countries. The Society was advised to lobby MEPs and Brussels to try to secure the adoption of its UK Exclusion List on a pan European basis.

The afternoon session included contributions on The Forecast Demand for Print Consumption for the next two years, the role of the Society in CEPE and a thought-provoking presentation by Vice-President Christopher Dane on the Society's image, ending with the display of a new poster emphasising the Society's commitment to safe chemicals, coupled with an image designed to appeal to the workplace.

The final session was devoted to presentations by Chairmen of the Society's standing committees on their work programme for 1989. Technical Committee Chairman, Ray Pierce, drew attention to the concern of his Committee with implications of the "Safety of Toys" Directive which will become effective on 1 January 1990. The Committee felt that the Directive would have very important implications for member companies, including customers requesting and paying for testing of surface coatings prior to purchase. The meeting was also asked to consider whether the Society should have a policy on ecology, but here it was felt that the question should be addressed on an industry-wide basis rather than by the printing ink manufacturers alone.

Representing the Technical Training Board, Richard Sharpe reported on the successful development of a distance learning programme in printing ink technology in conjunction with Watford College, which would lead to the award of a BTEC National Certificate. The distance learning programme, although not so ambitious as the Paintmakers' Association's Open Tech, was nevertheless felt to fill an important gap in the industry and already many member companies had expressed an interest in enrolling their employees.

Other committee presentations were made by Peter Hepworth on the Works Management Committee and finally by Robert Simpson on the Finance Committee in which he opinioned that the pressure of Health & Safety legislation and additional training requirements were not sustainable by an industry which reported a level of return on assets of only 6% in 1987.

Society Chairman, Tony Welton, concluded the Conference with an Open Forum in which members were able to comment on the presentations by Committee Chairmen and in particular discuss the promotion of the Society's image. Members felt that the use of the Society's logo with its strong links to the use by member companies of safe chemicals should be emphasized in all publications and that the promotion of the Exclusion List in particular its acceptance by other European countries should be the most important task for the Society in the years up to 1992.

Jordan Award

The Jordan Award Committee is seeking nominations for the eleventh Award to be made at the Association's AGM in 1989 at the Chester Conference. The Award, which comprises a Certificate and £100, is made for the best contribution to the science or technology of surface coatings by a member of the Association of any nationality working in either the academic or industrial fields who is under the age of 35 at the date of application. The final date for submission of applications will on this occasion be 31 January 1989. The selection of the recipient of the Award will be made by the Jordan Award Committee under the Chairmanship of Dr Simon Lawrence, the Association's Honorary Research & Development Officer.

There will be two methods of application, first by submission of a paper describing original work by the candidate which is offered for publication in the Journal or has been so published during the two years prior to the closing date for application. The alternative method will be by recommendation of a superior for work which for reasons of commercial secrecy cannot be published; in this case, the candidate will be expected to submit a dissertation on a topic relating to his work and demonstrating his superior knowledge of the principles thereof. The Award is for individual merit and clear evidence of the candidates's own contribution will be required if a paper is offered under joint authorship.

Members will find a copy of the official application form and regulations enclosed with this issue of the Journal.

■

Letters

Barium Metaborate

Dear Sir,

I refer to an article which appeared in the February 1988 edition, Vol. 71, No. 2 of your Journal. This article was entitled "Some Anti-corrosive Primers Free of Lead and Chromate" by A. Z. Gomaa and H. A. Gad.

As one of our products, barium metaborate, was included in the study, we were most interested to see the article appear in *JOCCA* but would like to offer the following comment.

On page 53, the authors conclude from Tables 6 to 8 that amongst other things, "increasing the percentage of barium metaborate resulted in lower gloss values". When looking at the tables for formulations, I note that no account was taken, with the exception of the formulations based on red lead, to change the drier component. We have noticed, in our work with barium metaborate, which has of course been going on for some 30 years, that it is necessary to reduce the amount of surface drier component in the drier mix when barium metaborate is present in an alkyd film. Unless this is done, the barium from the barium metaborate appears to form a complex that acts as a surface drier. This increased rate of surface drying forms microhazing at the surface of the film. This results in lower gloss being developed as the film drys. It also incidentally allows the film to touch dry fairly quickly. Our recommendation when barium metaborate is incorporated in an alkyd film is that the surface drier - —usually cobalt – be reduced to approximately one quarter of what it normally is in a comparable formulation without barium metaborate. Experience shows that this works very successfully, and if gloss is an important feature, allows full gloss alkyd paints to be formulated containing barium metaborate either for corrosion resistance or fungal resistance.

Buckman Laboratories Pty Ltd,
PO Box 161,
Granville,
New South Wales 2142,
Australia.

Yours faithfully,
D. E. Morgan

19 Sept 1988

OCCA Meetings

London Section

1993

*T*he first Technical meeting of the London Section for the 1988/89 session was held on Thursday 15 September 1988 at the Naval Club, Hill Street, Mayfair. Mr Michael Levete, Director of the Paintmakers' Association, gave a presentation entitled "A Qualitative Assessment of Recent Upheavals in the Paint Industry – where will we all be in 1993".

Mr Levete outlined the overall implications of the 1986 Single European Act, which comes into effect in 1992 without specifically referring to the Paint Industry. He foresaw the major changes being technical, fiscal and physical (the removal of frontiers) in nature.

The main effects the Act will have upon the Paint Industry were then dealt with in some detail.

The preparation of new product standards is an area in which it is envisaged that problems may be encountered when this is transferred into European terms. Different countries will each have their own national interests, and this may pose problems when a standards committee is formed from these nations.

Health and Safety is another important area. At present six directives have been issued but others of some importance have been omitted. The control on toxic substances is likely to be tightened with increased suspicion falling upon raw materials. This may lead a movement towards waterbased systems.

The evidence of national approaches is being eroded in both vehicle refinishing and wallcoverings. These have recently become more international in nature. The emphasis is now upon retaining advantages, compared with obtaining advantages. Few national paint companies exist in Europe as opposed to America, and the impact of lowering trade barriers is more likely to be seen in specialised coatings manufactures with further acquisitions abroad likely.

In closing, Mr Levete referred to the recent acquisitions, mergers, joint-ventures, and takeovers that have occurred within the industry over the last decade. Ownership of the market leaders in the different segments was discussed, and potential changes in the market post 1992 were speculated upon. Further changes in the decorative segment were envisaged while niche marketing in the industrial segment may take place. The importance of the Paintmakers' Association as a body representing the industry was emphasised and the requirement for more raw material suppliers and paint manufactuers to become members was commented upon.

The vote of thanks was given by

Dr P. Thukral after a lively question period had occurred.

G. J. Steven ■

Manchester Section

Wood science

The first lecture of the 1988/9 session was held at the new venue of the Mechanics' Institute, Manchester, on Monday 3 October 1988. A paper entitled "Basic Wood Science and Decay Control with Surface Coatings" was presented to the 38 members and guests present by Mr J. A. Rigby, Senior Technical Representative, of Buckman Laboratories Ltd.

The lecturer first outlined the basic differences between the two type of wood with regard to cell structure.

Soft Woods – Coniferous
Hard Woods – Deciduous

Wood from both types can be split into two sections, heartwood and sapwood, the proportions of each type varying widely from variety to variety of tree, and the differences in cell structure between the two were illustrated.

Mr Rigby continued his lecture by illustrating the different types of fungi which attack wood. These can be classified into three groups:

Moulds
Sap Stains
Decaying Fungus

Their major food sources were outlined and the characteristics of each type of fungus described.

Fungi require oxygen, reasonably warm temperature, a food source and moisture to survive. Moulds and stains only attack sapwood greatly increasing its porosity and leaving it more open to attack by decaying fungi. There are four types of decaying fungi which attach heartwood as well as sapwood, these are:

White Rot
Brown Rot
Soft Rot
Dry Rot

and the way each type attacks timber was outlined.

Wood can last for centuries if properly protected:

i.e. Properly seasoned,
Dry area,
Avoid soil contact,
Use pressure preservation.

Samples of wood under attack were illustrated, and the different methods of testing the different treatments for wood were outlined. Wood from the moment of felling the tree and from the saw mill onward must be protected.

Currently the toxicity of products used for wood preservation is causing concern. The relative safety of Buckman's products compared with conventional preservations was outlined, and the legislation covering the use of pesticides and the toxicity data required by the Health & Safety Executive outlined.

The lecture was followed by a lively question and answer session, and a vote of thanks was proposed by Mr Ray Stott.

On completion of the formal proceedings, those present were able to participate of a buffet courtesy of Buckman Laboratories Ltd.

M. G. Langdon ■

Natal Section

Some aspects of corrosion in the Durban harbour

The two exposure stations in Durban, at the old whaling station and at the Bayhead, are the most heavily affected areas for corrosion in Southern Africa. Next in severity is the exposure station at Walvis Bay on the western coast of Southern Africa.

This was stated by Mr John Carrick, the Durban Harbour Engineer, at a lecture to OCCA Natal at the Durban Jewish Club on 18 July 1988.

Corrosion control in the Durban Harbour forms a most important factor in maintenance. The Port life is governed by corrosion and not wear and tear. Wharf and container cranes, railway lines and crossings, sheet-piled wharfs, floating cranes, roof sheeting, aluminium and galvanised iron materials are included in ferrous and non-ferrous metals totalling over 75,000 tonne.

Experimental work covers mild and stainless steel, zinc, copper and aluminium. Stainless steel shows promise but the type is most important: 316 is the best so far. However, the cost performance factor is very important.

Cranes are protected by paint on a three-year cycle and 27,800 litres annually are used.

Mr Carrick concluded with comments that his work covers four areas:

1. Seeking to use materials without coatings.
2. Use coatings in a cost-effective manner.
3. Designing out potential corrosion problems.
4. Continually striving for better understanding of corrosion to be able to reduce losses due to corrosion.

Mr Carrick answered many interesting questions from the floor.

The meeting closed with a vote of thanks to the speaker by Mr Rocky Moodley.

One-day symposium

A record number of 48 people attended a successful and stimulating one-day symposium on "The technician's role in quality assurance. An aspect of modern paint technology" being held on 24 August 1988 at the Westville Hotel.

The topics covered were:

Do it right – SABS 0157 by Mr W. Taylor of the South African Bureau of Standards.

Start out right "Management by Mr P. McKay of Plascon Evans.

What is right – Marketing by Mr A. Mackenzie of Cookson Chemicals.

OCCA Meetings

Get it right – Product development by Mr R. Aitken of AECI Paints.

Keep it right – Manufacture by Mr R. Philbrick of Dekro Paints.

Keep it right – Technical service by Mr T. Naidoo of AECI Paints.

The symposium took the form of a workshop with discussions following each paper and a general discussion at the end of the symposium.

A vote of thanks was accorded to Mr Les Fisher and Mr Ian Knight for their hard work in preparing the symposium.

E. Puterman ■

OCCA News

Manchester Section

Quiz night

The third Manchester Section Quiz Night was held at the Silver Birch, Birchwood Centre, Warrington, on the evening of Monday 19 September 1988. This increasingly popular event was attended by 78 members and guests with sixteen teams taking part.

The quiz was excellently conducted by questionmaster John Bennett with subjects ranging from the Human Body, Geography, Sport, Music, Politics, etc.

After a close and exciting battle, the winners were H. Marcel Guest, with Coates "B" Team second, and Process Inks third, with McPhersons Paints taking the Booby Prize.

The section would like to thank BASF, Ciba-Geigy and Tioxide for donating prizes and helping to make this a most successful event.

MANCHESTER SECTION QUIZ NIGHT

FULL RESULTS

		Pts
1st	H. Marcel Guest	166
2nd	Coates "B" Team	163
3rd	Process Inks	160
4th	Crown Paints	159
5th	Q. C. Colours	155
6th	BASF	154
7th	ICI Solsperse "B"	149
8th	Tioxide & Others	148
9th	Ciba-Geigy	140
10th	ICI Solsperse "A"	137
11th	Foscolour	133
12th	Johnstones Paints	130
13th	Coates "A" Team	126
14th	Swale Winnett	122
15th	Lorilleux International	118
16th	McPhearsons Paints	112

M. G. Langdon ■

Obituary

Harry Gosling

Mr R. H. Hamblin writes:

With the death of Harry Gosling, the Association has lost a distinguished member, who contributed greatly to its growth in earlier years and maintained his interest in the Association throughout his life.

When one recalls Harry Gosling, it seems natural to associate him with the Manchester Section and when I first met him he was the Silver Jubilee Chairman (1950-52) of that Section. But his long service to the Association spanned the years from the time just before the War when he was Honorary Secretary of the London Section (in succession to Cecil Mundy, its first Honorary Secretary, who had been appointed Honorary Secretary of the Association) to his attendance at recent Council Reunion Dinners, when his Association reminiscences were much appreciated by the company.

At the same time as his Chairmanship of the Manchester Section, he also served as an Association Vice-President, an office which he again held from 1959 to 1961. He was elected President for 1953-55, two years after the establishment of the Association's first permanent secretariat.

Forthright in his views and both vigorous and eloquent in expressing them, he endeared himself both to members of the Council and the secretariat by his uncomprising desire to ensure that the Association and the Sections played their full part in the industries. Perhaps the highlight of his Presidency was the Llandudno Conference of 1955, held against a background of a railway strike, which necessitated organising coaches by road for many delegates. Nevertheless, so great was his enthusiasm at promoting this venture that, on the final evening, it was necessary, to accommodate all those attending, to hold two dinners simultaneously in different hotels, the speeches being relayed by cable laid along the seafront.

Strongly supportive of the Manchester Section, he understood the importance of the world-wide involvement of the Association. During his Presidency, the international commitments of the Association were developing rapidly, not only with the overseas Sections of the Association but also with the international alliance which was then in its infancy. He was most concerned to nuture these links and took considerable pride in the growing recognition of the Association's *Journal*, whose circulation was increasing considerably and in the Exhibition, which he opened in 1954, being the first to be held in an Exhibition Hall.

He will be missed by members of the Association, many of whom will remember his acts of kindness and generosity.

Mr F. B. Redman writes:

Bob Hamblin has already itemised Harry's distinguished record of service to the Association, a record spanning a solid half century.

My memories of Harry are comparatively recent, and are focussed on a past Chairman's dinner for Manchester Section at the Last Drop Hotel, Bolton. On that occasion Harry was in the Bronze Medal position of seniority behind George Campbell and Victor Jolly. However, when it came to anecdotes and other less than true amusing stories, Harry was quite surely in the running for Gold.

His humour was heavily flavoured with slices of Lancashire life in the early decades of this century, and one had the feeling that much of the humour stemmed from personal experiences.

If Harry were to adapt a quotation from Shakespeare and claim it as his own, he would truly believe – to mine own self be true, I cannot then be false to any man.

I cannot think the ghost of Shakespeare will take offence at this misquotation in this context. ■

INDEX TO ADVERTISERS

MEETINGS

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DEADLINES

Extended abstract, 31st January, 1989, final date for registration, 28th February, 1989, full paper, camera ready, 11th April, 1989.

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David Scantlebury, The Corrosion and Protection Centre, UMIST, P.O. Box 88, Manchester, UK. Telephone 061 236 3311 ext. 2604. Telex 666094.

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For further information and registration forms, contact David Scantlebury at UMIST.

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