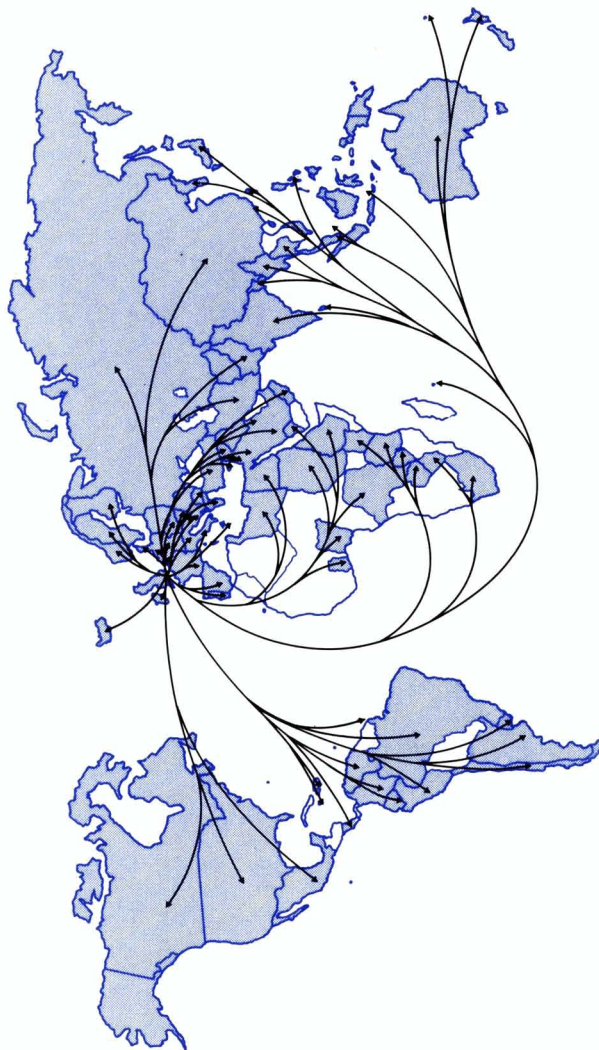




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A. F. Bravery, S. Barry and W. Worley

The use of DTA to study the UV curing of acrylic resins
T. R. Manley and G. Scurr

AC impedance measurements on thick organic coatings on mild steel substrates
S. Narain, N. Bonanos and M. G. Hocking

Flakeglas-filled coatings: past, present and future
N. Sprecher

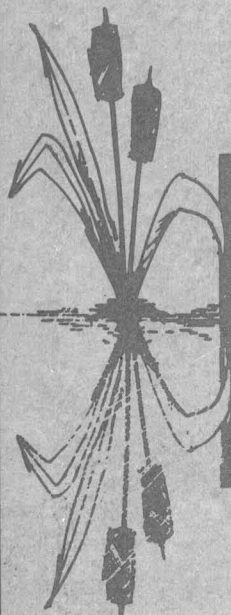
OCCA Conference 1983— "The efficient use of surface coatings", see page 64 for final summary and author's biography. Programmes and registration forms available from address below.

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Paint RESEARCH ASSOCIATION

Technological Advances in the Coatings Industry

London 10 - 12 May 1983

The theme of the 5th International Conference of the Paint Research Association will be major technological advances in the paint industry in the last decade. Although it has been said that what is happening regularly is not news, the programme will concentrate on products and processes in current use, or very near to full commercial exploitation. The papers will present a state-of-the-art review of the subject, indicating how the various obstacles were overcome, the problems still outstanding, and where future development efforts should be concentrated.

All speakers are invited, and chosen from companies prominent in the development of the particular technology. The fact that most of them are from paint companies could suggest that the paint industry itself, and not its suppliers or users, has been responsible for the main advances during the last ten years. The programme will cover the following topics:

- Multipurpose Pigment Dispersions for Solvent-based Paints
- Air- and Polymer-extended Decorative Paints
- Automated Paint Production
- Colour Control
- Cathodic Electrodeposition
- Electrophoretic Powder Coating
- Organic Microgels in Automotive Paints
- Base/Clear Coat Systems
- Self-polishing Antifouling Paints
- Can Coatings
- Wood Preservation and Protection
- High-build Coatings
- Wet Blasting
- High-performance Anticorrosive Paints
- Combined Blasting and Priming

The Conference will cater for scientists and technologists, marketing and managing directors of raw materials, paintmaking and paint using companies.

*Fifth
Paint RA International Conference*

The Conference will be opened at 13:45
by:

Sir Frederick Wood
Chairman
Croda International PLC

Conference Programme

SESSION 1

Tuesday, 10 May 1983
14:00 – 18:00

Chairman: **Edward Groves**
President
Paint RA

Paint Formulation, Manufacture and Control

Paper 1 Multipurpose Pigment Dispersions for Solvent-Based Paints

The theory of stabilisation of colloidal dispersions in non-aqueous media has been the subject of much recent research. Although this has been of great assistance in understanding the difficulties of manufacturing and blending concentrated pigment dispersions, the problem of producing a universal pigment dispersion which can be blended into any solvent-borne paint does not appear to have found a completely satisfactory solution. The author will review current theories of pigment dispersion and the attempts to find a universal dispersant. The results of the extended practical use of multipurpose millbases in paint production will be discussed.

Paper 2 Air- and Polymer-Extended Decorative Paints

Titanium dioxide is responsible for a significant proportion of paint raw material cost. Alternative technologies which can contribute to opacity whilst reducing costs become increasingly relevant. These technologies are described and their relevance to different type products, taking into account specific requirements/factors in different markets, is discussed.

Paper 3 Automation of Paint Production: Premises, Problems, Gains

This paper studies the basic marketing conditions, the marketing mix, and production factors which are essential for gaining profits in the automation of paint production plant. The role of a colour system is discussed and evaluated. The degree of automation, as well as the ways and means to automate the process, are dependent both on the sales mix, and on the types and qualities to be produced and marketed. The pros and cons, gains and problems are discussed against the background of the company's position. Both economic and technical aspects of automation are considered versus conventional plant. The demands on personnel and marketing are also evaluated.

Paper 4 What can a Paint Company Expect from a Colour Control System Today and Tomorrow?

The paper will cover today's spectrophotometers and computer hardware, highlights of quality control and colour matching software, including pigment load calculation, practical correction programs, metallics, computer controlled production dispensing systems, visual colour simulators.

Paper 5 Cathodic Electrodeposition: Present and Future

Cathodic electrocoating is now widely used throughout the world and it has almost completely taken over anodic systems; high performance level and stability are the main advantages whatever technology is used. New developments towards high-build cationic systems are in progress.

Derek Walbridge
Group Research Manager

*Imperial Chemical
Industries PLC*
Paints Division

John Chalmers
Group R & D

Manager,
and
Dick Woodbridge
*Research Manager-
Advanced Projects*

*Berger, Jenson
& Nicholson Ltd.*

Pentti Sipilä
Managing Director

Tikkurilan Värehteaat Oy
Finland

Willi Cornelius
Director

Applied Color Systems Inc
West Germany

Guy Damblant
Manager of
Marketing Studies –
Automotive Dept.

PPG/Corona
France

SESSION 2

Wednesday, 11 May 1983
09:00 – 13:00

Chairman: **Gordon Phillips**
Managing Director
Ault & Wiborg Paints Ltd

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VERTICAL MIXERS & REACTION VESSELS, HEATED	
B215C	7000 gal s/s encl. mixers (2)
R555D	3500 gal glass lined mixer
R555B	1800 gal m/s jktd reactor
R555A	1500 gal Pfaudler gls/ld jktd reactors (2)
R553A	1000 gal s/s jktd reactor 350 psi
R555V	600 gal s/s ½ coiled reactor
S4734	550 gal s/s o/top mixers 5 hp (2)
R555E	500 gal Pfaudler gls/ld jktd reactors (3)
S4408	500 gal s/s Giusti jktd reactor
R5553	350 gal m/s jktd reactor 450 psi
S4581	300 gal Pfaudler gls/ld jktd reactor
S4142	175 gal s/s o/top mixer
N2650	150 gal s/s jktd o/top mixer
S4204	120 gal s/s jktd reactors (2)
N2966	100 gal APV s/s mixer electric jkt
S3877	100 gal s/s jktd mixer
S2731	75 gal s/s jktd reactor
N3257	50 gal Pfaudler gls/ld jktd reactor
S4564	13 gal APV s/s jktd reactor
S4695	10 gal B.C.H. s/s jktd tilting pan with scraped surface agitator
S3414	1 gal s/s jktd mixer
VERTICAL MIXERS, UNHEATED	
N3128	160 gal s/s mixer flp
N3129	100 gal s/s mixer flp
N2964	35 gal s/s stirred vacuum vessel for de-aeration
STIRRERS & AGITATORS	
B118A	Stirrer drive units 1 to 20 hp flp geared, several
S4562	Raise/lower mixer 1½ hp 202 rpm
GN320	Clamp on stirrers, 1 hp, 1440 rpm tefc
GN300	Clamp on stirrers ½ hp 1440 rpm tefc
S4048	Ruba ½ hp v/speed stirrers 20/200 rpm
PASTE MIXERS	
S4586	Morton 80 quart bowl mixer with two s/s bowls 2 hp 3 speed
S4416	Cruickshank bowl mixer 10 quart s/s
S4621	Oakes mixer s/s model 10MPH 10 hp var speed drive
S4437	B-Perkins Hydiperser 12 gal s/s jktd 4 speed 10 hp
R553B	Z-blade mixer m/s 4' x 4' x 3'
S4072	Beken m/s jktd z-blade 25 gal 10 hp
S4071	B-Perkins m/s jktd z-blade mixer 10 gal with vacuum lid
S4465	Beken duplex mixer s/s jktd 4" cube
POWDER MIXERS	
N3186	Nauta type powder mixers 250 cu.ft. s/s unused (2)
N3214	Booth drum blender 6' dia 7' long 10 hp drive
B207F	Double cone blender s/s 200 cu.ft.
B183A	Apex y-cone blender s/s 80 kg. size
S3423	Foster rotocube 2' cube s/s blender
N2960	Y-cone blender s/s 12 cu.ft.
N2755	U-trough mixers, m/s, 5'6" x 2'3" x 2'6"
N3230	Winkworth u-trough s/s 4' x 18" x 22" deep
S4503	Winkworth 2 x 45 gal s/s drum mixer type CT143 flp. var spd. Unused
S3540	Papenmeier mixer THK20, 5 hp s/s jktd
GRINDERS & CRUSHERS, DRY	
B207D	British Rema dry ball mill 6' dia 5' face 75 hp with classifier
T0409	Tube mills 6' dia 30' long 400 hp (2)
T379F	Tube mill 6' dia 19' long 260 hp
N2556	Harrison-Carter fixed beater disintegrator 30" dia 15 hp drive
S3662	Christy Norris s/s hammer mills 18" 12½ hp (2)
S4016	Mikro Atomiser air swept hammer mill type 5MA 7½ hp s/s with cyclone
S4620	Stokes comminuter s/s 5½ hp
S4704	Christy Norris hammer mill 8" dia
B4563	Goodwin granulator 20" x 4"
N2310	Gardner 2-stage spike roll crusher 20" face 15 hp flp
N3249	Sturtevant cone crusher model 00 3 hp

S4529 Mini kek pin mill with feed hopper
1½ hp flp
N3170 Pfleiderer express sifter model 175/120
s/s 1½ hp
R0431A Moritz colloid mill 20 hp flp
S4537 Premier Colloid mill 6 hp
S4694 Sussmeyer super mill model HM 1.5
bead mill 5 hp flp with pump
S4548 Torrance atritor, pilot size 8" dia
B011A Steel ball mills, jktd 6' x 6' (2)
BC112 Torrance porc. lined ball mills
5' x 5' (3)

OVENS & DRIERS

N2447 Dunford & Elliot rotary louvre drier
6' dia 10' long steam heated
N3205 Manesty Petrie fluid bed drier type
60E, flp 60 kilo batch
N3205 Aeromatic fluid bed drier model STFKD
2½ cu.ft. capacity
N3189 Simon twin roll drier 18" dia
rolls 4'6" long with var spd drive
N3122 B-Whitney gas fired ovens 3' cube(2)
B202C Vacuum drier s/s 200 cu.ft. jktd with
agitator
BC181 Pfaudler double cone drier, glass
lined approx 15 cu.ft. capacity
B202A Flaker s/s 2' dia 3' long drum
R553J Drum flaker s/s 4'6" x 4'

EVAPORATORS

N3064 APV triple effect s/s evaporator
with pre-heater and finisher, evap.
rate 5 - 10 tons/hr moisture removal
S4378 APV Junior s/s plate evaporator
with vac pump etc.
S4747 Stratavap scraped film evaporator 2.5
sq.ft. s/s vacuum with condenser etc.

SIEVES & POWDER FILTERS

N3250 Russell 2 deck screens s/s model
R/MU 3'6" x 2'6"
N3197 Hydrasieve s/s screen 30" x 3'

CENTRIFUGES

N3213 Broadbent type 46A 48" dia s/s
ploughing centrifuges (2)
N2681 Broadbent 48" dia r/ld flp (3)
BC161 Sharples super-centrifuge s/s MV4PIJY
R553D Sharples Tornado centrifuge model
4020 40" x 20" s/s manual plough
B207C Sharples model D2700 super-D-hydrator
R553F Westfalia model SAMR 15037 s/s self
cleaning centrifuge
B202B Krauss-Maffei 48" dia s/s centrifuge
type PZ1 40 hp hydraulic drive
R553E Krauss-Maffei model H2S peeler centri-
fuge
R553C Alfa-laval decanter centrifuge 214/31B
R0556 Titan superjector s/s centrifuge 5 hp

PRESSURE & VACUUM FILTERS

BC866 Dorr Oliver s/s rotary vac filter
150 sq.ft.
N2388 Paxman rubber lined rotary vac filter
100 sq.ft.
N3216 Paxman rotary vac filter s/s 6 cu.ft.
S3426 Niagara filter 400 sq.ft. titanium
R5555 Funda pressure filter s/s 1000 litre
R555H APV Bowser s/s pressure filter
R553G Sparkla filter model 18523 s/s 35
sq.ft.
N3229 Stella-meta filter pre-coat
filter type 11238.10
S4222 Meta filter s/s 7" dia 2' long with
mono pump, portable
B207A Edwards & Jones plate & frame filter
press 80 plates 3' x 2'6"
polypropylene
S4226 Johnson s/s filter press 17 plates &
17 frames 23" x 23" x 1½"
N2999 Plate & frame filter press 18
chamber 22" x 22" x 1" (2)
S4744 Stockdale s/s Twistlock filter model
TC300/20

HEAT EXCHANGERS & CONDENSERS

R553H Chemtec scraped film heat exch 22'
long (3)
S4475 Cherry Burrell s/s scraped film heat
exchanger 6" dia 3' long (2)
BC790 Rotopro s/s scraped film heat exch.
1X3R 20" long 3" dia var spd
R383E Chemtec scraped film heat exch.
30 sq.ft. Inconel (2)
B215A APV plate heat exch R55H 850 sq.ft.(4)
B215B APV plate heat exch HMBL 180 sq.ft.
S4992 APV plate heat exch HXU (6) 30 sq.ft.
B215D Heat exch. shell & tube s/s 600 sq.ft
N2571 Heat exch 5 pass 200 sq.ft. titanium
N3301 Heat exch. shell and tube s/s 161
sq.ft. (2)
N2570 Heat exch 4 pass 125 sq.ft. titanium
R5550 Heat exch. graphite 90 wq.ft. (5)
S4701 Heat exch shell & tube s/s 50 sq.ft.
S4751 Heat exch. shell & tube s/s 40 sq.ft.

STILLS AND UNSTIRRED JACKETED VESSELS

R5554 1500 gal Pfaudler gls/ld jktd pan
S4525 450 gal s/s jktd pans (2)
S3269 300 gal s/s o/top jktd vessel
S4143 175 gal s/s o/top jktd pan
S4472 165 gal APV s/s jktd pressure/vac
vessels (2)
S4530 100 gal s/s jktd pressure/vac vessel
S4226 50 gal s/s vessel with cooling jkt
S4592 50 gal Pfaudler jktd pan gls/ld
no outlet
S4471 30 gal s/s jktd tilting pan

AUTOCLOAVE AND STERILISERS

- N3204 Autoclave 4' dia 8' long quick release door 150 psi working
- N2597 Autoclave s/s 2'2" x 2'2" x 2'1" internal, 40 psi quick release door
- N3169 Autoclave s/s 16" dia 42" long
- S4746 Astell steriliser, gas heated 18" dia 3' deep, 30 psi

PRESSURE VESSELS

- RC412 180 gal s/s encl. tanks (20)
- N2762 90 gal s/s vert. tanks 15 psi (B)
- S4568 85 gal s/s pressure vessel 100 psi

SCALES & WEIGHERS

- S2591 Wallace & Tiernan belt weigh feeder up to 2 tons/hr
- S4584 Avery dial scale 500 k with tare
- S4585 Stevens dial scale 250 k with tare
- S4749 Avery dial scale 50 kg

FILLING, PACKING & BAGGING EQUIPMENT

- N2695 Hassia strip pack machines model HV2(3)
- N3282 Reed Medway valve sack filler
- N3211 Driver Southall model DB3 powder fillers 50 gms - 10 kilos (3)
- N2978 Transmatic Fyllan rotary head, powder filler s/s
- R0541 Arenco-Alite model LF6 powder fillers
- N2988 Albro powder filler in-line 3 head automatic
- N2983 Albro twin head powder filler 250 gm automatic
- S3978 Kane Pack mini tape gluing m/c up to 15" wide 18" high

FOOD PROCESSING EQUIPMENT

- R0343 APV plate evaporator triple effect s/s 4 ton/hr evapn
- R0557 Alfa-Laval fruit juice pasteurising plant 2 tons/hour
- R553K Manton Gaulin homogeniser KF6-5BS 25 hp
- BC200 Plate freezer, horizontal for blocks of meat etc. 25 hp motor, unused
- R561A Thermoscrew blenders s/s 12' & 20' long
- BC790 Rotopro s/s scraped film heat exch. 1 x 3R 20" long 3" dia. var spd
- S4537 Premier Colloid mill 6 hp
- N2972 Artofex dough mixer 3' bowl 5 hp
- S4083 Artofex dough mixer s/s 3 hp
- S3057 Benham wet steam oven for canteen use
- N3050 Creamery package s/s 3-ram homogeniser approx 100 gph
- S2894 Weir homogeniser s/s 1 hp drive
- S3326 Ormerod homogenisers 10 gph, 1000 psi ¼ hp
- S2494 Westinghouse s/s mincer 7½ hp
- S3029 Jackson & Church Zenith pulp press for fruit s/s contact parts

- N2406 Thermoscrew s/s 10' long 7" worm
- N2964 35 gal APV s/s stirrer vacuum vessel for de-aeration
- R0235 Coffee roasters 250 & 400 kilo
- R2B3F Drum blenders s/s 5' dia 8' long (2)
- N2410 Wetter meat dicer, hydraulically operated 1" to 0.125"
- R330D Chocolate block shredding machine
- N3198 Dewatering conveyor s/s 3'6" wide 11' long with spray pipes, var spd
- N3197 Hydrasieve s/s screen 30" x 3'
- B096A Scott-Reitz Balmex s/s mixer blender, twin 7½ hp drive 4' x 3' x 2'
- R0431A Moritz colloid mill 20 hp flp
- B073B Schnell type 33547 s/s mixer/chopper vacuum with with pump discharge
- R0447 Hobart vertical cutter mixer VCM80E
- R441A Fat pressure melters 2½ ton batch (3)

COMPRESSORS AND AIR RECEIVERS

- BC232 Broomwade compressors V300 300 cfm 100 psi 75 hp (3)
- S3594 I-Rand receiver mounted compressor 4 hp 15 cfm 100 psi

STORAGE TANKS, CORROSION RESISTANT

- N3290 2750 gal s/s vert cyl tank
- N3272 2600 gal rubber lined horiz tank
- N2687 2000 gal s/s road tanker tank
- N2766 1250 gal s/s road tanker tank
- N3291 1000 gal s/s vert. cyl. tank
- N3238 1000 gal Pfaudler gls/ld storage tank
- N3240 550 gals/s encl tank
- N3232 500 gal fibreglass cyl tanks (3)
- N3000 350 gal high density polythene export containers approx 100 per year
- N3239 300 gal Cannon gls/ld storage tanks(2)
- S4623 175 gal polythene stackable containers
- N3208 100 gal s/s vert cyl tank
- N3051 50 gal s/s o/top tanks (3)

PUMPS, LIQUID CENTRIFUGAL CARBON STEEL

- BC223 W-Simpson type 5DM4 17½ hp
- S3467 W-Simpson 5DM 15 hp 1440 rpm
- N2786 W-Simpson type 3DM8 20 hp (2)
- S4687 W-Simpson type 50WP125 2" conns 2 hp flp
- S3144 W-Simpson pump type 1½DM2 7½ hp two stage
- N2797 W-Simpson type 1½DDM2 7½ hp 2840 rpm
- S3513 Labour pump type 10UL 10 hp
- S3622 Girdlestone type 5L15D conns. 5" 10 hp
- S3686 Pulsometer pump 55 gpm 140' hd 10 hp (2)

PUMPS, LIQUID CENTRIFUGAL CORROSION RESISTANT

- S3481 Deutsche ceramic pump 15 hp
- S3478 Transkem ceramic pump 7½ hp (3)
- S3473 Mitchell ceramic pump 5½ hp (2)
- N3034 W-Simpson 3DC62 s/s 10 hp 2990 rpm

S4725 W-Simpson type 1½ DMC 82/s/s 7½ hp
S4737 SPP s/s jktd pump type HBN-164/135
15 gpm 67' head 3 hp
S4689 SPP s/s jktd pump 40 gpm 38' hd
N2728 Rhodes 20 gpm 75' hd s/s 2½ hp
S4612 Cent. pump s/s 2" conns 5 hp
S4600 Alfa laval s/s pump 1½" conns ¾ hp

PUMPS, LIQUID GEARED

B088D Ibox s/s gear pump 4" with var spd
S4543 S.S.P. s/s geared pump 300ND
S4477 S.S. Pumps 200ND gear pump
S4090 Ibox M3 s/s gear pump 1 hp 226 rpm

PUMPS, LIQUID POSITIVE DISPLACEMENT

FP88C Mono pump type SH80 with Carter
var spd drive
S4697 Mono pump type SH80
S4459 Mono pump type CLM2
S2480 Mono type CD82A3 15 hp
R083C Mono pumps MT820 wide throat (5)
S4524 Mono type CD80
N2997 Mono type CD72
S4698 Mono pump type SH70
N3241 Mono pump type SH42 (5)
S4673 Mono flexidrive s/s 1½" conns
S4672 Mono flexidrive s/s 2" conns
S4616 Mono type ST421 s/s wide throat
S4319 Mono pumps type ED42 3 hp (2)
S4539 Mono pumps type ED40 rubber-lined (2)
S4536 Mono pump type SJ30 Easiclean
N2981 Delasco peristaltic pump 1½ x 2"
conns 3 hp
S4570 Watson-Marlow peristaltic pump type HRS

PUMPS, LIQUID METERING

S4650 Pulsafeeder diaphragm metering pump
s/s 2" conns trolley mounted
S3372 Wallace & Tiernan s/s metering pump
twin head 965 gph 5½ hp
S4502 Wallace & Tiernan s/s met pump 0 - 3 gph
150 psi
N2784 E.C.D. s/s metering pump G500/V
0-620 gph flp
S3413 E.C.D. metering pump G500 1½ hp
1" conns rubber lined
S3128 APV Milroyal s/s metering pump 915 psi
0 - 34 gph
S4398 Plenty pump s/s geared variable flow
1½" conns 2 hp

VACUUM PUMPS

S4519 Nash Hytor H5 liquid ring pumps (2)
S4691 Nash Hytor vac pump size L4 20 hp
S4538 Nash Hytor vac pump type MT54 4 hp
N3190 Hick type RVA3 vac pumps 80 cfm 15"
S4645 Lacey Hulbert boreas vac pumps 7½ hp(2)
N3276 Edwards vac pumps type EB3A
S4598 Edwards Speedivac type 1SC450B
S4599 Edwards Speedivac type ES150

MECHANICAL HANDLING EQUIPMENT

S3363 Wallace & Tiernan belt weigh feeders

S3363 Wallace & Tiernan belt weigh feeders
N3086 Scissor type barrel lifting clamp
N2488 Barrel lifting & tilting trucks
hydraulic with mains lead 400 kilos

HOPPERS & SILOS

N3011 Hopper 120 cu.ft. m/s with discharge
worm flp
N3010 Hopper 110 cu.ft. m/s with discharge
worm, flp
N3281 100 cu.ft. m/s hopper
S2971 Simon feed hopper twin screw discharge
100 cu.ft. capacity

DUST COLLECTORS

B111B Thorne bag type dust extractor 4 hp
S474B DCE dust collector 2 hp

CONVEYORS AND ELEVATORS

N3187 Entecon s/s conveyor/elevator 3"
dia var lengths (6)
S4646 Entecon conveyor s/s & plastic 3"
dia 9' lift 1.5 hp
N3201 Chain & bucket elevator s/s 10' high
N3149 Screw elevator 10" dia 10'6" lift
with hopper and dust extraction
hood (2)
N3012 Jacketed screw conveyor m/s 12" dia
25' long in 5' sections
S4630 Screw conveyor s/s 6" dia 10' long
N3115 Fourways conveyor 14' long 21" wide
portable, hydraulic lift

GEARBOXES, VARIABLE SPEED

N2226 Electropower var spd unit 40 hp
200-26 rpm vert. down drive
S4227 Carter model 5A 12½ hp flp with
remote control
R148E Carter model 4A with 15:1 redn box
7½ hp flp
S3372 Carter 3A var spd with 5½ hp motor
S4626 Carter var spd type 2A with 12:1
redn box

MISCELLANEOUS

S4750 Powder compactor, Alexanderwert type
WP150
N3269 Elga water de-ionisation plant model
DU01 500/1000 litres/day, new
S4747 Stratavap solvent recovery unit
BC209 Solvent recovery plant 3300 cfm
with carbon adsorber and distillation unit
R520B Sutcliffe Speakman 50 cu.ft. air/min
solvent absorption recovery plant
R474B Pelletisers Fluostatic 6' x 4' horiz
B207E Vacuum sintering furnace approx
2000°C
R0524 Propane tanks & supply system 100tons
BC065 Banbury 3D mixer with 150 hp drive
and twin roll 60" mill
R0450 Banbury rubber mill 1½ kilo size
30 hp var spd

Industrial Paints and Powders

Paper 6

Electrophoretic Powder Coating

Electrophoretic Powder Coating (EPC) is a technology combining cathodic ED and powder coating. It is possible to obtain high-build films (50 μ or more) within one minute automatically, with higher corrosion resistance, with safety and low pollution. The technology is now used in practical automobile body coating and is being further developed for modern coating systems.

Akira Kubo

Leader

EPC Development

Shinto Paint Co Ltd
Japan

Paper 7

Organic Microgels in Automotive Paints

Historically, the control of the application properties of automotive paints has been achieved by the careful choice of solvents with respect to their evaporation rate and solvency. The need to reduce atmospheric pollution has limited this approach. Organic microgels offer a useful alternative method of control of flow. The use of organic microgels in solid colour, metallic, clearcoat and higher solids paints will be discussed, together with some methods of preparation.

Alan Backhouse

Senior Research Chemist-
Automotive Coatings

Imperial Chemical
Industries PLC
Paints Division

Paper 8

Advances in Base/Clear-Coat Systems in Vehicle Finishing and Refinishing

Today base/clear-coat systems are used worldwide for automotive coating. The application, chemical and weathering stability are satisfactory. Influenced by the oil crisis and government regulations, the aim for the future is to increase the solids content of the material. Robot application and electrostatic equipment will be used to get a higher first run non-failure rate and to decrease manpower.

Hermann-Josef Drexler
Group Leader R & D

BASF Farben & Fasern AG
West Germany

Paper 9

Self-Polishing Antifouling Paints

Increased demand for long term freedom from fouling in the late 1960s emphasised only the limitations of conventional media, biocides and mechanisms, particularly the latter. Of a number of radical departures promising drag reduction, diffusion control and reactivation, the synthesis of media based on organo-tin carboxylates gave several outstanding advantages – predictable longevity, fouling control, and control of roughness and build-up of composition on hulls.

William Harpur

Research Director
and

Alex Milne

Research Chemist

Heavy Duty Group
International Paint PLC

Paper 10

Can Coatings for the 1980s

Can making has been revolutionised with the introduction of the two-piece can. This has largely replaced the three-piece can in the beer and beverage market in the UK. New coatings and lacquers have been developed to meet the requirements of high-speed coating of these cans. Future trends indicate more extensive use of water-based lacquers.

Robert Kitchingman

Laboratory Manager

Holden Surface
Coatings Ltd

Paper 11

Wood Protection and Preservation – Why so Important

Structural protection is without doubt a most important matter. Any preservation or treatment is meant as a kind of insurance for keeping the wood in good condition as long as possible. Wood prices

Lissi Jeppessen

Laboratory Manager –
Wood Protection

Sadolin & Holmblad AS
Denmark

Wednesday, 11 May 1983
14:00 – 18:00

Chairman: Tom Graham
Technical Director
Crown Decorative Paints Ltd

Paints for Special Purposes

are increasing, more fresh and quickly growing wood is used in more and more sophisticated constructions, etc. It all means taking better care of the wood.

Paper 12

Contributions to High-Build Coatings

There is a growing need to simplify maintenance painting schedules. A reduction in the number of coats applied is one approach to the problem and attempts have centred upon replacing a system of undercoat and finish by a single coat of finish. Heavier wet film thicknesses implied by the development require increased sag resistance, and this paper describes the balancing of this property against the opposing parameters governing flow.

Keith Smith
Director

T & R Williamson Ltd

SESSION 4

Thursday, 12 May 1983
09:00 -- 13:00

Chairman: **Tore Lundh**
Director, R & D

A/S Jotungruppen
Norway

Application and Pretreatment Methods

Paper 13

Wet-Blasting – the Value

Regardless of all the discussions on control and prevention of corrosion, the problem is still approached on the basis of "who can do the cheapest job?" Work is awarded not by maintenance or corrosion engineers, but by accountants, on the premise that failure, and therefore corrosion, is inevitable. This attitude results in the downward spiral of price and quality and the rapid decline of the very item we set out to protect. If anyone doubts this, let them check the oil tanks, bridges, ships, rigs – indeed any steel structure which was subject to maintenance three years ago. If industry or government really intends to take advantage of such developments as, for instance, the KUE System 918 or the many superb new coatings, then a totally new approach needs to be taken to the method of combating corrosion.

Tom Kelsall
Managing Director

KUE Engineering Ltd

Paper 14

Advances in High-Performance Anticorrosive Paints

Coatings technology has advanced rapidly over the past few years. This has been influenced by the availability of new chemical-resistant polymers, the economic need to reduce maintenance schedules and more stringent health and safety legislation. This paper will discuss how a high-performance coating manufacturer dealt with these problems.

John Bourne
Director

Mebon Paints Ltd

Paper 15

Progress in Combined Blasting and Priming

Steel preparation for coating can be improved by combined blasting and priming. Continued development found shape in grit blasting with simultaneous injection of wet film-forming primer. The novel system and its perspectives are discussed in comparison to conventional practices or pretreatment. Advantages of the new development are independence of humidity and wet conditions, no contamination of the bare metal surface, extended induction time under adverse conditions, and flexible work planning.

Ted Kik
Research Group Leader

Sikkens BV
The Netherlands

Paper 16

Summing Up and the Future

George Anderson
Director

Paint RA

Who's Who

ANDERSON, George (Dr) worked with ICI Dyestuffs Division for 15 years, where he carried out research on photographic chemistry, reactive textile dyes and electrochemical routes to polymer intermediates. As Director of Research with 3M Research Ltd, he was responsible for chemical research of a company with wide-ranging interests. He joined the Paint RA as Director in 1968.

BACKHOUSE, Alan (Dr), was educated at Leeds University and joined ICI Paints Division in 1956. He carried out research into the chemistry of autoxidation and the research and development of resins for anodic electrodeposition. For some years he has been responsible for the research and development of topcoats for the motor industry, an area in which he holds a number of patents.

BOURNE, John, entered the paint industry in 1947, when he joined Thornley & Knight Ltd. Concurrently he studied at Birmingham College of Technology (now Aston University) where he obtained a first class diploma in Paint Technology. From 1953-63 he was Chief Chemist at Camrex Paints Ltd where he was responsible for introducing modern coatings technology in the marine and heavy-duty fields. In 1963 he became one of the founders of Mebon Paints Ltd which is today one of the market leaders in high-performance coatings. He was elected a Fellow of the Technology of Surface Coatings in 1972.

CHALMERS, John, held various positions in coatings research and development with EI du Pont in the USA from 1952-1972. Since then he has been employed in a similar capacity by Berger, Jenson & Nicholson. His present position, as Group R & D Manager, has particular responsibility for liaison and licensing aspects of coatings technology in the Berger Group worldwide.

CORNELIUS, Willi, Director of Applied Color Systems Inc, is responsible for sales and application in Europe. As a young chemical engineer, he introduced colour measurement and colour matching of plastics at Chemische Werke Huels, Germany, in 1965. He joined Macbeth/Kollmorgen in 1968 and, in 1976, moved to Applied Color Systems Inc. Mr Cornelius has been committed to colour for almost 20 years - most of his working life.

DAMBLANT, Guy, worked with the ICI French associate, DUCO, for 5 years, where he participated in the first electrodeposition developments. He joined PPG/CORONA in 1968 and, for 7 years, was in charge of the EDP labs. Electrodeposition Product Manager until 1981, he is now responsible for marketing studies in the Automotive Department.

DREXLER, Hermann-Josef (Dr), worked for six years in an institute of research on fats - Bundesanstalt für Fettforschung. In 1976 he received the H P Kaufmann prize. He started work in the research laboratory of BASF Farben & Fasern AG in Munster in 1977 and moved to Würzburg in 1979. He is responsible for the development of the two-coat metallic system.

GRAHAM, Tom, has spent all his working life with Crown Decorative Products Ltd in paint and resin development and manufacture. He has been Technical Director since 1966. Elected Vice-President of Paint RA in November 1982.

GROVES, Edward (Dr), elected President of Paint RA in November 1982, worked with British Petroleum for ten years, initially in technical development, and subsequently in production management in the oil refining division. He then joined British Resin Products, part of the Distillers (Plastics) Group, and for six years was Technical Manager responsible for the technical and process development of the company's wide product range of resins, moulding powders, PVC and polystyrene compounds. During his subsequent 20 years in the paint industry, he has been Chief Chemist at Sissons Brothers (part of the Reckitt & Colman paint division), and is now a Senior Executive at Manders Paints responsible for paint, resin and process development.

HARPUR, William (Dr), is a graduate of Queen's University, Belfast where he was a student of Professor A R Ubbelohde. He had a Research Fellowship at AERE, Harwell and subsequently joined ICI Alkali Division at Northwich Cheshire, later Mond Division. He has always been concerned with 'Effect Chemicals', for example reinforcing fillers, firefighting chemicals and products for the surface coatings industry. In 1979 he became Research Director of International Paints Heavy Duty Group.

JEPPENSEN, Lissi, a chemical engineer by education, she joined Sadolin & Holmbad in Denmark in 1974 in the central coatings development laboratory for trade sales paints. She is now laboratory manager in the wood preservation and protection field. Lissi Jeppensen joined the European Wood Preservative Manufacturers Group in 1979.

KELSALL, Tom, is Managing Director of KUE Engineering Ltd, a small company who originally developed the low pressure wet blast method known as KUE System 918. The development caused enormous interest, both in the UK and abroad. Subsequently KUE Engineering Ltd have exported machines, and Tom Kelsall has been asked to give talks on wet blasting to various corrosion societies and government departments in USA, Saudi Arabia, the Far East, Spain, Poland, UK, etc.

KIK, Ted. After disrupted technical studies during the war, he started his industrial career in 1945 with production control, to be followed by patent affairs and licensing. In 1961 he joined Sikkens BV, Coating Industries, as Manager of Innovative R & D, where his main activities were on polymers in civil engineering, anticorrosive coating systems, and underwater applied coating systems.

KITCHINGMAN, Robert, has worked with Holden laboratories for 15 years. His researches have included the formulation of coatings, curing by UV and electron beam radiation. He has managed laboratories formulating and servicing paints for caps, closures and three-piece cans. More recently, he has been responsible for the development of paints for architectural oil coating and general industrial markets, and now manages the laboratory formulating paints and lacquers for two-piece beer, beverage and food cans.

KUBO, Akira, graduated in chemistry from the Tokyo Scientific College in 1967, and has worked since then with Shinto Paint Co Ltd on electrodeposition coatings. He has been a leader in the development of electrophoretic powder coating since 1978, and won a technical prize from the Japan Society for Colour Materials in 1982 for this work.

LUNDH, Tore, graduated in chemistry in Sweden and Germany, 1961. He started as a research chemist with A/S Jotunggruppen. After many years as senior officer in the company's international development in North Africa, the Middle East and South East Asia, he became Director of R & D in Jotunggruppen in 1976. Member of Paint RA Council since 1979.

MILNE, Alex, is a graduate of St Andrew's University in Chemistry, and entered the paint industry as an analyst in the Marine Division (Red Hand) of Pinchin Johnson and Associates. An interest in all aspects of the prevention of marine fouling was an almost inevitable consequence, an abiding interest and a continuing challenge. He is the author of several patents and papers in the field, most recently with colleagues in the Ship Performance Group at Newcastle University, where he has just completed an extended sabbatical.

PHILLIPS, Gordon, was educated in the UK and held positions with the UKAEA and Distillers Company prior to joining the Glidden Company in the USA. He subsequently returned to England to join Ault & Wiborg Paints, and is now Managing Director of that company.

SIPILÄ, Pentti, graduated from the Economic University of Helsinki in 1947, worked for 14 years in purchasing and marketing in the paper industry, then went into paint in 1961, followed by 5 years as Managing Director for Finland's leading battery company (1969-1973). He returned to the paint industry as Managing Director of Tikkurilan Varitehtaat Oy, the leading paint company in Finland, and has been Chairman and Vice Chairman of the Finnish Paint Makers Association for several years, a member of the Board of the NIF (Scandinavian Paint and Printing Ink Research Institute), and a member of Paint RA Council since 1978. Tikkurilan Varitehtaat Oy completed the erection of an automated plant in 1975 and has, this winter, completed building and installing another automated plant for industrial coatings.

SMITH, Keith, worked at ICI Paints Division for 15 years, engaged in development projects which included new resins for the electrical industry, roller coatings and non-aqueous polymer dispersions. At Blundell-Polymerglaze he was Technical Manager both in the Industrial and Decorative Divisions. He joined T & R Williamson Ltd in 1975 as Technical Manager, and in 1980 was appointed a Director of the company. Member of Paint RA Council since 1978.

WALBRIDGE, Derek, graduated in chemistry from Oxford in 1952, and joined the Research Department of ICI Paints Division in 1954. After fundamental research on the stability of pigment dispersions in alkyd media, he became a member of the group led by D W J Osmond, which developed novel coatings based on non-aqueous polymer dispersions. His special interest has been the synthesis of polymeric steric stabilisers and pigment dispersants. He is currently a Group Research Manager. Member of Paint RA Council since 1976.

WOOD, Sir Frederick, Chairman and Managing Director of Croda International Ltd, joined Croda Ltd as Trainee Manager in 1947, becoming President of Croda Inc, New York in 1950, Managing Director of Croda International in 1953, and Chairman in 1960. Sir Frederick is also Chairman of the British Technology Group of the National Research Development Corporation and of the National Enterprise Board.

WOODBRIDGE, Dick, joined John Hall & Sons in 1941 and moved with that company into the Berger Group. He has been associated with a number of significant developments in the field of emulsion paint technology. Currently, he is Research Manager - Advanced Projects, with the responsibility for co-ordination of new decorative paint technology within the Berger Group.

Registration Fees

The 2-day Conference (spread over 3 days) will be held in the Paris Suite, London Penta Hotel. It will start at 12.30 (with lunch) on Tuesday May 10, and will end at 13.00 on Thursday May 12.

£160 + VAT per delegate to Paint RA members
£190 + VAT per delegate to others.

Applications should be made on the attached registration form giving full details. Do not send remittance with this form. Invoices will be issued within two weeks after the receipt of the registration form. Fees include Extended Abstracts of Papers, luncheon on 10 & 11 May, tea and coffee. The fees do not include hotel accommodation and Conference Dinner.

Ladies Programme

All delegates' wives and accompanying guests are invited. Provisional programme: afternoon tea and welcome 10 May; on 11 May, one or more of the following: London Museum, Harrods, and shopping, Conference Dinner on 11 May (optional). Trip to Hampton Court on 12 May, morning. Apart from Conference Dinner and hotel accommodation all other items are free of charge. Please indicate your choice on the registration form.

Venue

The Conference will be held at: London Penta Hotel, Cromwell Road, London SW7 4DN. Telephone: 01-370 5757; Telex: 919663.

Situated in the Museum District of London (nearest Underground Station: Gloucester Road), the Hotel features 2 Bars and 3 Restaurants. All rooms are with private bath, colour TV, in-house movies, direct dial telephones, in-room bar and message light system. Limited parking space is available in the NCP car park, located under the Hotel.

Conference Arrangements

Accommodation

The Paint RA has reserved a large number of single and twin-bedded rooms for the nights of 10 & 11 May at the Penta Hotel. A special reduced rate has been negotiated for delegates wishing to book their accommodation through the Paint RA. For further details see the attached Registration Form.

Conference Dinner

The Conference Dinner will be held at 19.30 on Wednesday 11 May at the Penta Hotel. Charge £18 per delegate, £18 per delegate's guest, including VAT & Wine. Dress informal.

Papers & Proceedings

Extended Abstracts of Papers will be issued in advance. Each Paper will be followed by a full discussion and there will be an 'Open Forum' at the end of each Session. Conference Proceedings will be published in the Paint RA Progress Report.

PRA Conference: May 1983

Technological Advances in the Coatings Industry

Registration Form

A Conference & Dinner Please reserve places for the Conference & Dinner for the delegates listed below:

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B Accompanying Guest Please indicate in boxes below which functions you wish to attend

Serial No	Name in Full <i>(Mrs/Miss Christian name Surname)</i>	London Museum	May 11		Conference Dinner	May 12 Hampton Court
			Shopping	Harrods		

Do not send remittance with this form.

Invoices will be issued in due course covering the fee, VAT and Dinner.

The completed form should be sent to:

Dip Dasgupta
 Head of Information Department,
 Paint Research Association,
 Waldegrave Road, Teddington,
 Middlesex TW11 8LD, England.
 Telephone: 01-977 4427 Telex: 928720

C Hotel Accommodation Please reserve accommodation as detailed below:

Delegate's Serial Number	Accommodation needed — for the nights of	Total number of nights	Accommodation (A or B)
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Single room + bath (A) £27			
Twin-bedded room + bath (B) £37 (Double Occupancy)			
Price per day per delegate (inclusive of VAT, Service Charge and Continental Breakfast)			

Name

Position

Company

Full Address

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Date

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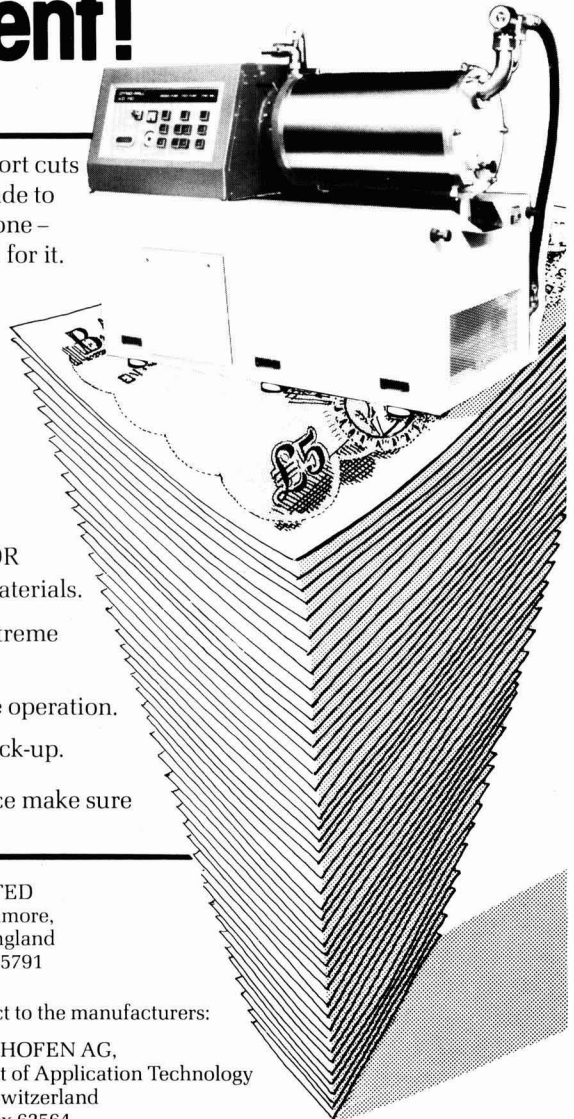
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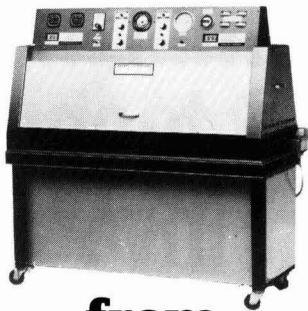
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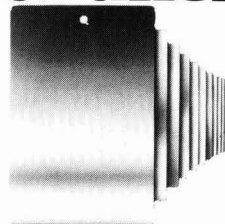


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An alternative method for testing the mould resistance of paint films

A. F. Bravery, S. Barry* and W. Worley

Department of the Environment, Building Research Establishment, Princes Risborough Laboratory, Princes Risborough, Aylesbury, Buckinghamshire HP17 9PX, England

Summary

A method is described for testing the resistance of paint, varnish and lacquer films to mould growth. The method employs flat panels of wood, plaster or other suitable material and has been developed from a previous technique using glass tubes. It has been elaborated after extensive international collaborative work, during which variations in technique have been tested both within and between laboratories.

1. Introduction

This method has been developed as a result of an extensive series of international co-operative experiments conducted under the auspices of the International Biodeterioration Research Group. Earlier work culminated in the publication of a method based on applying paints to glass tubes (Barry, Bravery and Coleman, 1977). Further work has demonstrated that flat panels of wood, plaster, steel or other suitable material can be used as the substrate for the paint film. The particular advantage of the flat-panel technique is that it permits any interactions between the paint film and the substrate that may influence mould resistance to take place and consequently enables a more realistic evaluation of a system of multiple coatings. The method does not supersede that based on glass tubes, which remains a useful technique for screening paints with or without biocides.

Results of the co-operative study shortly to be published (Bravery *et al.*, 1983) have shown that close agreement both between and within the different laboratories can be achieved by experienced microbiologists.

2. Participating organisations

Bayer AG, Krefeld-Uerdingen, West Germany
Bundesanstalt für Materialprüfung, Berlin, West Germany (BAM)

Durham Chemicals Ltd, Birtley, UK
Imperial Chemical Industries Ltd, Organics Division, Manchester, UK (ICI)

Materials Quality Assurance Directorate, London, UK (MQAD)

Paint Research Association, Teddington, UK (PRA)
Princes Risborough Laboratory, Building Research Establishment, Aylesbury, UK (PRL)

Sikkens BV, Sassenheim, Holland
Thor Chemicals Ltd, Ramsgate, UK
US Army, Natick Laboratory, Natick, USA

3. Scope

This method is intended to test the mould resistance of paint films with or without fungicidal additives, either as

part of a multi-coat system or separately. It has also been found suitable for testing the mould resistance of varnishes and lacquers.

4. Principle

Flat panels of wood, plaster, steel or other suitable substrates are painted then conditioned in a suitable environment before being inoculated with test organisms. The panels are then incubated in a test cabinet under specified conditions and inspected at specified intervals for mould growth. The extent of mould growth is recorded in accordance with a numerical code, together with a written description of the nature of the growth and, where possible, photographs.

5. Materials and apparatus

5.1 Flat panels 100 mm (length) × 75 mm (width) and 10 mm thick or the same thickness as the substrate to which the paint is to be applied.

5.2 Suitable apparatus for applying:

5.2.1 A spore suspension (see 6.5.2).

5.2.2 Soiling medium (see 6.5.4).

5.3 A test cabinet (see Appendix A).

5.4 Cultures of appropriate test fungi grown on suitable media (see Appendix B).

5.5 Good research microscopes enabling inspection of the painted surface to be carried out at approximately ×20-30 magnification and a spore count to be carried out at ×200.

A camera attachment suitable for taking photographs at ×20-30 is preferable but not essential.

5.6 A haemocytometer or similar device for determining the concentration of spores in a suspension.

5.7 Appropriate ancillary apparatus and facilities for mycological testing (e.g. incubator, autoclave, inoculating hood).

5.8 Control paint (see Appendix C).

6. Procedure

6.1 Preparation of test panels

6.1.1 Wooden panels: Prepare panels from selected, straight-grained stock, free from knots, stains, excess resin or other defects. Take care to ensure

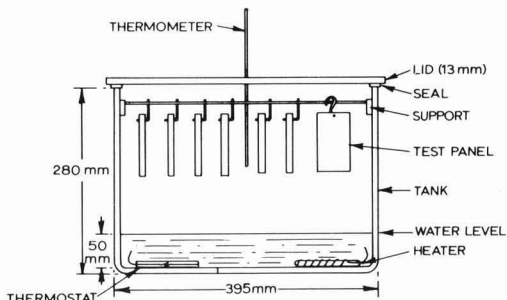


Figure 1. Test cabinet

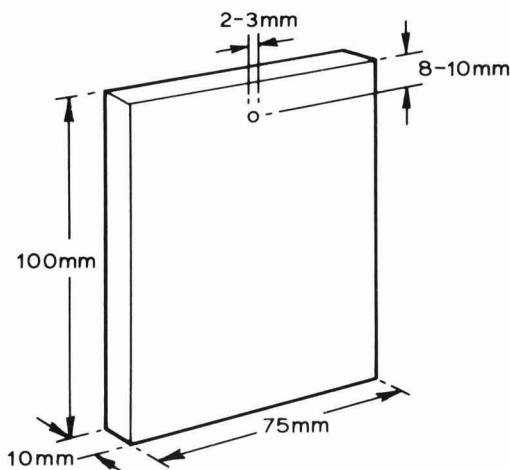


Figure 2. Test panel of wood or plaster

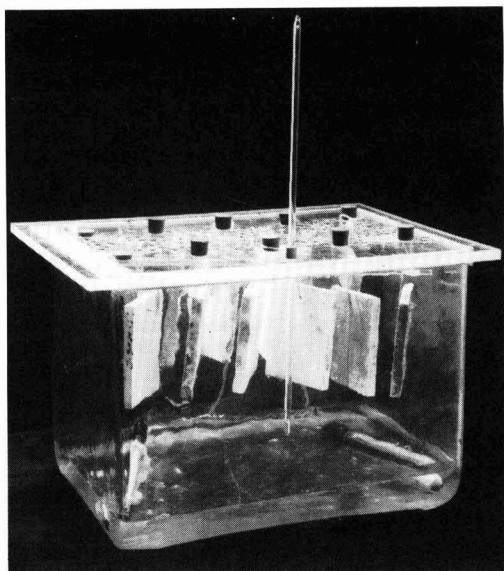


Figure 3. Humidity cabinet for determining the resistance of paint films to mould growth

that the panels do not contain residual chemicals from anti-sap-stain treatments often applied before shipping. Normally, the sapwood of Scots pine (*Pinus sylvestris*) should be used as the standard reference timber. Other species may be used, but this should be stated in any report.

Cut panels 100 mm × 75 mm × 10 mm with the grain in the 100 mm direction. Make a hole of 2-3 mm diameter, 8-10 mm from the mid-point of one of the 75 mm edges (Figure 2). Lightly sand the faces and edges of the panels with a fine-grade sand paper and condition at $23 \pm 2^\circ\text{C}$ or $20 \pm 2^\circ\text{C}$ and a relative humidity of 50 ± 5 per cent or 65 ± 5 per cent for at least seven days.

6.1.2 Plaster panels: Make plaster panels 100 mm × 75 mm × 10 mm (Figure 2) from a 3:2 hemi-hydrate plaster/distilled water mix. Cast into suitable moulds, level to give a smooth finish and leave to set (this takes 16-18 hours). Carefully remove the panels from the moulds and leave for at least seven days at $23 \pm 2^\circ\text{C}$ or $20 \pm 2^\circ\text{C}$ and a relative humidity of 50 ± 5 per cent or 65 ± 5 per cent before applying the paints.

6.1.3 Metal panels: Cut metal panels 100 mm × 75 mm from mild steel or another suitable metal/alloy and lightly roughen with fine-grade sand or carborundum paper. Clean and degrease with 60-80 petroleum ether.

6.2 Preparation of paint sample(s): Thoroughly stir the test paint(s) to produce a homogeneous mix. Before mixing, any skin on the surface of the paint(s) must be removed and the residual paint carefully strained through cloth that is free from dressing (e.g. muslin, nylon).

6.3 Application of test paints: During painting and drying operations, the test laboratory should be kept as free from dust and spores as is practicable. The laboratory temperature should be maintained at $23 \pm 2^\circ\text{C}$ and a relative humidity of 50 ± 5 per cent or $20 \pm 2^\circ\text{C}$ and a relative humidity of 65 ± 5 per cent. At least two specimens for each paint under test should be prepared.

6.3.1 Solvent-based paints: Apply by brushing, dipping or spraying a full even coat of the thoroughly mixed paint sample(s) to the clean and (when appropriate) degreased test specimen(s). Allow the coated specimens to dry for 24 hours and then re-coat in accordance with the manufacturer's or other specified instructions, and at 24-hour intervals using any other coats of paint as required.

6.3.2 Water-based paints: Proceed as in 6.3.1 but it is normally necessary to allow only one hour between coats; frequently it is recommended that the first coat of this type of paint is thinned with water and that only subsequent coats of the paint are applied as received.

6.3.3 Control paint: Allow the coated specimen to dry for 24 hours and then apply a second coat.

6.4 Conditioning of painted specimens

6.4.1 Paints for interior use: Allow the solvent-based painted specimens to condition for 21 days and the emulsion painted tubes to condition for two days under the specified laboratory conditions (6.3).

6.4.2 *Paints for exterior use:* Allow the painted specimens to condition under the specified laboratory conditions for seven days. Then expose them for 250 hours in an artificial weathering machine, e.g. of the type described in BS 3900 Part F3, or any other apparatus giving acceptable standard conditions. At the end of the exposure period remove the specimens and allow them to condition in the laboratory (6.3) for at least 24 hours.

6.4.3 *Paints for special use:* Special pretreatments, other than or as well as that described in 6.4.1 and 6.4.2, may be given and details should be recorded in the test report. An example of some optional procedures is given in Appendix D.

6.5 Microbiological tests:

6.5.1 *Test fungi:* The following species are recommended for general use as a mixed inoculum:

<i>Aspergillus versicolor</i>	IMI 45554
<i>Aureobasidium pullulans</i>	IMI 45533
<i>Cladosporium cladosporioides</i>	IMI 178517
<i>Penicillium purpurogenum</i>	IMI 178519
<i>Phoma violacea</i>	IMI 49948 ii
<i>Stachybotrys chartarum</i>	IMI 82021
<i>Ulocladium atrum</i>	IMI 79906

Species frequently isolated from paint films, and which may be included in alternative tests, are:

Interior situations	Exterior situations
<i>Aspergillus versicolor</i>	<i>Alternaria alternata</i>
<i>Cladosporium cladosporioides</i>	<i>Aspergillus versicolor</i>
<i>Cladosporium herbarum</i>	<i>Aureobasidium pullulans</i>
<i>Cladosporium sphaerospermum</i>	<i>Cladosporium sphaerospermum</i>
<i>Paecilomyces variotii</i>	<i>Cladosporium cladosporioides</i>
<i>Penicillium purpurogenum</i>	<i>Cladosporium herbarum</i>
<i>Phoma violacea</i>	<i>Penicillium purpurogenum</i>
<i>Stachybotrys chartarum</i>	<i>Phoma violacea</i>
<i>Stemphylium dendriticum</i>	<i>Sclerophoma pithyophila</i>

The species used must be recorded in the test report.

NB: These lists are not intended to be comprehensive. Known or suspected pathogens (e.g. *Aspergillus fumigatus*, *A. flavus*) have been omitted. See Appendix E for biological safety precautions.

6.5.2 *Preparation of spore suspension:* Use a well-sporulating culture of each test organism grown on a suitable sloped-medium in a sterile glass tube (see Appendix B).

Prepare each spore suspension separately in 50 cm³ v/v of a suitable wetting agent in sterile distilled water, e.g. 0.01 per cent w/v Tween 80 or Nonidet P40. To dislodge spores use a sterile wire loop and then rotate the tube between the hands. Remove any undispersed lumps or medium by filtration through a sterile muslin filter or any other suitable filter. Check that each filtrate contains not less than 10⁴ spores per cm³. To prepare the test spore suspension mix equal quantities of each checked filtrate.

NB: Some wetting agents (e.g. Tween 80) may effect the viability of spores and should therefore be removed by careful washing with sterilised water.

6.5.3 *Inoculation of test specimens:* After artificial weathering or other pre-conditioning, lay the

painted specimens flat and spray or swab one side with 1 cm³ of the spore suspension. A system for containing the inoculum safely during this operation must be used in order to avoid inhalation by the operator and/or contamination of the laboratory (see Appendix E). Leave the inoculated specimens for 2-4 hours to allow the inoculum to dry.

6.5.4 *Preparation of soiling media:* Either natural or artificial soil may be used and should be prepared according to the methods described in Appendix F.

6.5.5 *Application of soil to paints:* Soiling is applicable to paints for exterior use and to those for certain interior uses where there is a high biological hazard, such as kitchens, breweries and bakeries. Weigh approximately 0.03 g of the specified soil. Apply this quantity using a coarse spray apparatus as evenly as possible over the inoculated area of each specimen whilst the inoculum is still wet.

6.5.6 *Incubation:* Place the test and control specimens randomly in the test cabinet (Appendix A) under the conditions appropriate to the paints under test, i.e. 3 ± 1°C above the ambient for solvent-based paints and 2 ± 0.5°C above the ambient for emulsion paints. Conditions must be carefully monitored and controlled in order to avoid insufficient or excessive condensation on the specimens. Excess condensation causes coalescence of droplets and subsequent washdown of spores and/or soil.

Condensation can be encouraged by fluctuating the temperature in the cabinet. This is best achieved by switching off the heaters for set periods at regular intervals. Particular attention should be paid to the condition of the linseed oil control paint throughout the incubation period, as absence of or limited mould growth on this paint indicates that conditions inside the cabinet are unsatisfactory.

The period of the test is normally 28 days, but may be varied as deemed appropriate. The period of test must be stated in the report.

7. Assessment of results

Remove each specimen in turn and examine it:

7.1 **By normal vision,** reporting on the appearance so far as any loss of decorative appearance attributable to mould is concerned (e.g. scattered discoloured areas, general overall growth).

7.2 **Under a microscope** at a magnification of approximately ×25-30.

7.3 **Scale for assessment:** Assess the growth using the following 0-5 scale:

0 – No growth

1 – Trace of growth

2 – 1-10 per cent coverage of total test area

3 – 10-30 per cent coverage of total test area

4 – 30-70 per cent coverage of total test area

5 – Over 70 per cent coverage of total test area.

A full description of the nature of the growth is important in interpreting the results, e.g. mycelial characteristics, sporulation etc. The presence of dominant or contaminant species should be reported and also the extent to which growth has extended beyond the

inoculated area. Use of the microscope is important in distinguishing incidental dirt contamination and dried shrivelled inoculum.

Photographs of test specimens at magnifications of $\times 1$ and $\times 25-20$ should be provided whenever possible.

8. Acknowledgements

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Appendix A, test cabinet

A.1 Construction

The cabinet consists essentially of a glass or plastics tank fitted with a means of thermostatically controlling the temperature of a layer of water in the base of the tank.

A transparent acrylic lid rests on the top of the tank, seated on a flexible plastics collar effecting an air-tight seal between tank and lid. The lid carries a number of clear plastics dividing partitions forming a number of individual compartments into which specimens are suspended from supports. A thermometer is fitted to record air temperature inside the cabinet.

These compartments, though not essential, partially isolate the individual specimens and so reduce the risk of volatile fungicides affecting neighbouring panels. They also help to reduce the risk of cross-contamination when using different inocula. A typical cabinet is shown in Figure 1.

A.2 Operation

To commence testing, the tank is filled to a depth of approximately 75 mm with water, the painted specimens are suspended in position and the lid is placed securely on top. The temperature regulator is set to maintain the required temperature and the heater switched on. The temperature of the moist air inside the tank should be such that condensation occurs on the painted surfaces of the specimens. The temperature differential employed is normally between 2-5°C depending upon the type of paint being tested.

The cabinet should preferably be housed in a laboratory in which the ambient temperature is maintained at $23 \pm 2^\circ\text{C}$ (or $20 \pm 2^\circ\text{C}$).

The thermostat should be adjusted so that the temperature of the air inside the cabinet is $3 \pm 1^\circ\text{C}$ above the ambient external temperature for solvent-based paints and $2 \pm 0.5^\circ\text{C}$ above for water-based paints.

Condensation may evaporate as the specimens equilibrate to the temperature of the cabinet. If this occurs the temperature should be fluctuated by switching the heaters on and off as required.

Appendix B

B.1 Preparation of cultures

Cultures of the test fungi are normally grown on slopes of Oxoid Czapek Dox Agar (modified) for 14 days at 25°C. However,

fungi selected for the test may be grown on any appropriate media under the appropriate conditions providing that well-sporulating cultures are obtained.

B.2 Maintenance of cultures

Stock cultures may be maintained on appropriate media, e.g. potato carrot agar, for up to six months, providing that they are kept at approximately 4°C. Other methods of retention are by freeze drying or submerging under mineral oil. However; operators must ensure that cultures do not become contaminated by other species and/or mites. A careful check on the morphology and growth characteristics must be made to ensure that no mutation or adaptation has occurred.

Appendix C, linseed oil control paint

A linseed oil control paint is included with paints under test. It is extremely susceptible to mould growth and if little or no growth occurs on this control paint during the test it is an indication that the test conditions are unsatisfactory.

C.1 Composition

Constituents specified on the basis of per cent by weight

Blanc fixe	33	complying with BS 1795/ISO 3262
140 poise stand oil	6.6	complying with BS 4725/ISO/R 276
Raw linseed oil	18.6	complying with BS 242/ISO/R 150
Talc	9	complying with BS 1795/ISO 3262
Titanium dioxide	21	complying with BS 1851/ISO 591
White spirit	11.8	complying with BS 245/ISO 1520

C.2 Preparation

Ball mill until a degree of dispersion corresponding to a reading of 5-6 (30-40 μm) on a Hegman gauge is achieved.

Add 0.21 per cent of cobalt driers (6 per cent Co content).

Ball mill for further 30-45 minutes.

Appendix D, specimen pre-conditioning schedule

Examples of pre-conditioning that might be applied to the painted test specimens before mycological tests, e.g. for paints used in interior situations subjected to heavy condensation.

Allow the specimens painted as in 6.3 to dry under laboratory conditions for seven days.

Expose the specimens under the conditions described in D.1 and D.2 below or as considered appropriate:

D.1 Intermittent condensation conditions

D.1.1 Expose the painted specimens in the apparatus described in BS 3900 Part F2 or other apparatus giving similar conditions for ten days. Remove and allow to condition under laboratory conditions (6.3) for 24 hours.

OR

D.1.2 Expose the painted specimens in a cabinet similar in design to that described in Appendix A, modifying the procedure to produce copious intermittent condensation. This may be achieved by raising the internal cabinet temperature to approximately 40°C for short periods.

D.1.3 Continue the procedure for a period of 14 days, remove the specimens and allow to condition under laboratory conditions for 24 hours.

D.2 Continuous condensation conditions

D.2.1 Immerse the painted specimens in a supply of running water at a temperature of approximately 15°C, the water

being run to waste and not recirculated. A flow rate of approximately 20 litres/hour is appropriate.

D.2.2 Continue the leaching process for 24 hours or such other period as considered appropriate and allow to condition (6.3) for 24 hours.

Appendix E, biological safety precautions

None of the operations involved in the conduct of the method are intrinsically hazardous, nor are the fungi listed recognised as presenting any serious risk of infection to operators or other personnel. However, the concentration of spores in the working environments should be kept to a minimum because some spores can cause allergic responses and because individuals vary in their sensitivity to particulate matter in the air.

The following guidelines are recommended:

- E.1 When departing from the list of suitable test organisms ensure that alternatives are not recognised pathogens.
- E.2 Avoid inhalation of spores at all stages of the work (e.g. inoculate in an appropriate safety cabinet or similar enclosed cabinet, assess specimens inside a plastics fronted cabinet or bag).
- E.3 Dispose of unwanted cultures and test specimens as soon as possible (auto-claving or immersing in a sterilising solution may be appropriate before wrapping for disposal).

Appendix F, preparation of soil

Either natural or artificial soil may be used to aid establishment of the mould growth. This simulates the high biological hazard of natural conditions by providing nutrients and support for the spores.

F.1 Natural soil

Any moderately light, loamy garden soil is suitable. Dry the soil in an oven at 100°C. Grind the dried soil and pass it through a sieve of nominal aperture 200-210 µm. Sterilise the material passing through the sieve by auto-claving for one hour at 120°C on three consecutive days. This material may be stored in a sterile container.

F.2 Artificial soil

The artificial soil consists of a mixture of mineral salts nutrients with carrier glass beads (ballotini).

F.2.1 Trace element solution

1.46 g ferric chloride	FeCl ₃ 5H ₂ O
1.18 g copper sulphate	CuSO ₄ 5H ₂ O
1.32 g zinc sulphate	ZnSO ₄ 7H ₂ O
0.01 g ammonium molybdate	(NH ₄) ₆ Mo ₇ O ₂₄
0.20 g manganese sulphate	MnSO ₄ 4H ₂ O
Distilled water to make 100 cm ³ of solution	

F.2.2 Mineral salts

0.41 g calcium tetrahydrogen phosphate	CaH ₄ (PO ₄) ₂
0.90 g tri-calcium phosphate	Ca ₃ (PO ₄) ₂
0.20 g calcium carbonate	Ca CO ₃
0.11 g potassium sulphate	K ₂ SO ₄
0.51 g ammonium sulphate	(NH ₄) ₂ SO ₄
1.37 g ammonium nitrate	NH ₄ NO ₃

F.2.3 Potato starch gel

Mix 17.0 g potato starch with 20 cm³ of distilled water to form a thin cream. Pour this mixture into approximately 120 cm³ of boiling distilled water to form a gel.

F.2.4 Ballotini

Thoroughly clean and dry 20 g of grade 15 ballotini.

F.2.5 Procedure

Mix the mineral salts (F.2.2) into 60 cm³ of distilled water. Add this suspension plus 1 cm³ of the trace element solution (F.2.1) to the gelled starch (F.2.3). Beat the mixture thoroughly to ensure a homogeneous mix, then slowly add distilled water, thoroughly stirring during the addition, until the mix weighs 249 g. Add 20 g of the mineral salts/starch paste to 20 g of clean dry grade 15 ballotini (F.2.4). Thoroughly mix and spread very thinly onto sheets of siliconised paper. Dry for three hours at 100± 2°C. Scrape the dried film from the paper, grind gently in a mortar and pass the ground mixture through a sieve of nominal aperture 200-210 µm. The material passing the sieve is used for the test and, if desired, may be stored in a sterile container.

The use of DTA to study the UV curing of acrylic resins

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Summary

An apparatus was constructed to follow the UV curing of acrylic resins by DTA (differential thermal analysis). The induction period and heat of polymerisation were determined for MMA (methyl methacrylate), 1,6-HDDA (1,6-hexanediol-diacylate) and a solution in MMA of Aldural 48368 RCL, using AZDN (azobisisobutyronitrile), Irgacure 651, Trigonal P1 and P15, Sandoray 1,000 and benzophenone/TEA (triethylamine) as initiators.

Three methacrylates and three initiators were studied at 30,

60 and 90°C. No synergism was found. Irgacure 651 was faster than Trigonal P1 or P15, TMPTMA (trimethylolpropane trimethacrylate) was faster than EGDMA (ethylene glycol dimethacrylate), which was faster than THFMA (tetrahydrofurfural methacrylate), i.e. the rate of reaction decreased inversely with functionality.

The apparatus provides a rapid and convenient means of determining induction periods and rates of reaction, but it is less accurate for heats of polymerisation. Absolute kinetic results cannot be obtained with the present apparatus.

Introduction

Coatings that cure when exposed to ultraviolet radiation are economically and ecologically attractive because of the use of monomers that form an integral part of the film and the low energy requirements.

The reactions involved have been the object of considerable study^{1,2}. Conventional photometric techniques³, dilatometry⁴ and infrared spectroscopy⁵, have been used to follow the course of reaction. The polymerisation of acrylic compounds is strongly exothermic, hence thermal analysis methods were investigated.

Based on differential thermal analysis (DTA), a simple technique was developed to provide information on reactions initiated by UV.

Several workers have used differential scanning calorimetry (DSC) to study the thermal polymerisation of methyl methacrylate^{6,7} (MMA), and more recently this has been extended to follow UV initiated polymerisation⁸⁻¹⁰.

In comparison with DSC, DTA is a passive technique. The temperature difference between sample and reference, detected by means of thermocouples, is recorded, unlike DSC where the sample and reference temperatures are kept the same, and the amount of energy required is recorded. Both methods do give information on reactions or changes in heat capacity that arise from transitions as a function of temperature or, in an isothermal mode, as a function of time.

This work describes the modification of the Du Pont 900 (quantitative DTA) and the Stanton Redcroft 673 Thermal Analyser to follow UV initiated polymerisation, and the results obtained from the study of a number of monomers and photo initiators.

Experimental

The Du Pont cell consists of an aluminium heating block above which is a Constantan plate with raised platform for the placement of sample and reference pans. Chromel/Alumel wire thermocouples are attached directly to the centre of the sample platform. The sample and reference pans are shallow aluminium dishes that are in direct contact with the plate, providing good thermal contact.

The plate is thermally insulated from its surroundings and the high heat capacity of the cell provides a heat sink which gives good sensitivity and detection.

Modifications were made to the cell by drilling holes in the lid directly above the sample and reference pans. Through these were placed silica tubes directly beneath a UV source. To prevent loss of monomer, glass tubes were used sealed with a sample pan which, when inverted in the cell, gave good thermal contact with the thermocouple whilst the sample was exposed to radiation which passed through the transparent tube.

The polymerisation of MMA, containing 1.25, 2.25 and 5 per cent azoisobutyronitrile (AZDN), was followed, but the heating effect from the UV source caused an increase in temperature. Maximum exotherms occurred in each case after approximately 50 minutes in a temperature range of 45-50°C.

The tubes were slightly unstable when mounted in the

cell and were sensitive to external vibration that affected thermal contact. Sample leakage caused by variations in the diameter of the tubes necessitated the use of an epoxy adhesive to seal the pans to the tubes.

Because of these difficulties a more reproducible method was sought.

By contrast, the Stanton Redcroft equipment can be readily adopted to follow UV polymerisation. The apparatus consists of a cylindrical alumina cell block approximately 2 inches (50 mm) in diameter and 1 inch (25 mm) high, connected to the detector assembly by means of a stalk 8 inches (200 mm) long, containing the thermocouple leads. Holes in the cell block contain the sample and reference containers which are quartz tubes, approximately 3 inches (75 mm) long, that are shaped to fit over the Pt/Rh thermocouples housed in the base of the cell, so that good thermal contact and detection of temperature difference between sample and reference is obtained.

The apparatus is normally used to investigate thermal stability with heat supplied to the cell block by means of an external furnace. For the purpose of following UV polymerisation, the furnace was removed. A cylindrical ceramic tube was placed over the block and stalk assembly and this was enclosed by a light framework.

Holes were drilled in the lids of the tube and frame assembly so that the quartz sample tubes were supported in a fixed, reproducible position during experiments.

The detector, cell block and framework were placed on an adjustable platform directly beneath a shielded cabinet containing the UV source, an Hanovia 1000 watt discharge tube. An opening in the base of the cabinet allowed transmission of radiation from the lamp. A movable shutter was constructed so that the samples were exposed to light only after the "strike up" of the discharge tube, which was indicated by an external ammeter on the cabinet. In order to eliminate the effects of infrared radiation, a filter consisting of a pyrex glass, water cooled trough was placed in the cabinet directly beneath the lamp.

An asbestos sheathed heating element wrapped around the ceramic tube and a Eurotherm temperature controller provided the temperature required.

The temperature difference between the sample and reference during the experiments was amplified onto an external time base recorder alongside the block temperature, which allowed comparative assessment of induction time and reaction speed to be made.

The apparatus is shown in Figure 1.

A quartz tube with approximately 40 μ l of sample was placed in the cell block via the locating holes in the lids of the frame and the ceramic cylinder. The platform was raised into position and the samples exposed to radiation from the lamp after temperature and base line stabilisation had been achieved on the recorder chart.

The initial experiments were conducted with inhibitor free methyl methacrylate, using AZDN as a photo initiator. The rate of temperature rise can be taken as an indication of reaction speed so that under the same sensitivity and chart speed conditions, the shape of the curve is characteristic of the reaction. A rapid assessment of the polymerisation under different conditions can thus be made by visual comparison of the traces. In addition, the area under the curve is proportional to the heat

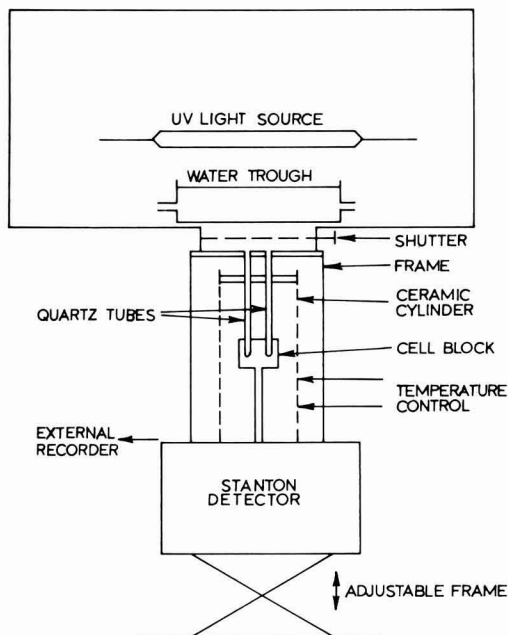


Figure 1. Diagram of apparatus

evolved during the reaction¹¹, which can be determined by the use of thermal standards.

Initial investigations on MMA initiated with AZDN at levels of 0.5, 2.0 and 4.0 per cent were done at 30°C and 60°C.

At both temperatures the reaction proceeded rapidly after a relatively long induction period. Higher temperatures reduced the induction period and increased the rate of reaction.

The traces obtained showed peaks similar to a Gaussian distribution curve, after a relatively long induction period. The peaks from runs at 60°C were narrower than those at 30°C, indicating a faster reaction as may be expected.

Calibration of the apparatus was carried out using a pharmaceutical grade of stearic acid, melting point 64°C, so that the heat of reaction could be calculated from the areas under the peaks using the method of Borchardt and Daniels¹¹.

Table 1 shows the values for time taken to reach peak exotherm (a measure of induction period), molecular weight and ΔH .

The heat of polymerisation of MMA is 132 cal/g. Comparison of the values obtained for ΔH with this would suggest that the degree of conversion obtained during the experiments was only of the order of 20-30 per cent, which was not consistent with the appearance of the samples after the runs. These were solid glasses, although a liquid layer was present on the surface to a varying degree. Determination of residual monomer by GLC indicated much higher degrees of conversion of the order of 80 per cent.

It is possible to obtain kinetic results of reasonable

Table 1

Polymerisation of MMA with varying amounts of AZDN at 30°C and 60°C

	Time to reach peak exotherm (minutes)	Molecular wt $\times 10^5$	ΔH (cals/g)
30°C			
0.5% AZDN	150	2.2	20.7
2.0% AZDN	96	1.3	28.3
4.0% AZDN	85	1.2	24.7
60°C			
0.5% AZDN	72	3.6	35.6
2.0% AZDN	51	2.0	31.0
4.0% AZDN	37	1.7	38.7

Table 2

Polymerisation of MMA using alternative photo initiators in comparison with AZDN at 60°C

	Time to peak exotherm (minutes)	ΔH (cals/g)
Irgacure	39	22.9
Trigonal PI	41	37.6
AZDN	51	31.0
Trigonal 15	63	14.4
Sandoray 1,000	67	32.2
Benzophenone/TEA	94	13.2

standard without complying with all the rigorous conditions¹¹ of Borchardt and Daniels, but in this instance there were clearly too many violations of their conditions leading to erroneous ΔH values.

The molecular weights of the glasses were determined using viscometric techniques on solutions in chloroform. The liquid layer on the surface of the samples may be expected to decrease the overall value, but increased values were evident with reduced initiator concentration and increased temperature.

Comparison of different photo initiators for the polymerisation of methyl methacrylate

Four commercially available initiators and a benzophenone/triethylamine combination were compared on a molar basis equivalent to 2 per cent AZDN at an ambient temperature of 60°C to give a more rapid result.

1. 2,2-dimethoxy-2-phenylacetophenone (Irgacure 651)
2. 1,1-dichloro aceto phenone (Sandoray 1,000)
3. Benzoinbutylether (Trigonal 15)
4. 4t-butyltrichloroacetophenone (Trigonal PI)
5. Benzophenone/triethylamine (1:1 molar)

The traces are shown in Figure 2 and the values of ΔH and time to peak exotherm in Table 2.

A considerable difference in reaction behaviour is apparent under these conditions, although a characteristically long induction period is again evident before appreciable reaction is observed. Only the trichloroacetophenone derivative showed behaviour similar to AZDN.

The difference in reaction behaviour was thought to be

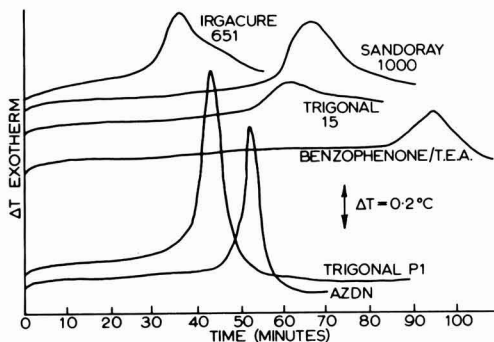


Figure 2. Polymerisation of MMA with different initiators in comparison with AZDN

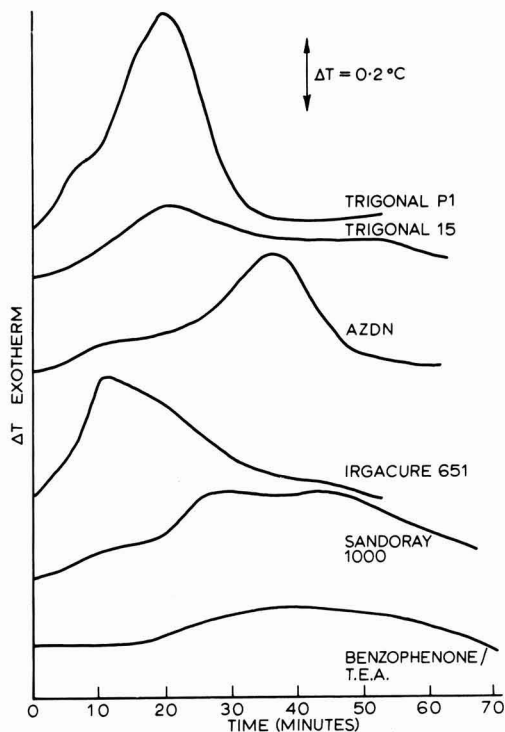


Figure 3. Polymerisation of polyester resin/MMA with different initiators

caused by the combined effects of oxygen and the relative efficiency of the initiators. Exposure to radiation produces free radicals from breakdown of the initiator in an excited state or "exciplex" in the case of the benzophenone/triethylamine combination, which initiates polymerisation of the monomer. Dissolved oxygen in the monomer can inhibit polymerisation by the formation of unreactive peroxy radicals. Initially, the process of inhibition is dominant until the level of oxygen is reduced to a sufficiently low concentration so that polymerisation proceeds. The rate or efficiency of radical production from an initiator when exposed to radiation thus has a significant effect on the overall polymerisation behaviour.

The relative efficiencies of the initiators examined under these conditions can be readily seen from Figure 2. Irigacure 651 has the shortest induction period but the curve is unsymmetrical, indicating competing reactions. It may be in this case that radical production throughout the sample varied, with, initially, a high proportion produced near the surface because of a high extinction coefficient and efficiency. A significant variation in the number of radicals produced throughout the depth of the reactant could lead to a difference in behaviour in the reactant mix. The longer induction periods and more symmetrical shapes shown by the other systems would indicate perhaps a slower, more uniform radical production through the depth of the samples so that the level of oxygen is reduced uniformly to a point at which polymerisation proceeds significantly.

In order to gain further information on the behaviour of the initiators, experiments were conducted on a solution of a polyester resin (Alduro 48368 RCL) in MMA. The level of initiators was the same and the temperature was again 60°C. The traces are shown in Figure 3. Comparison with Figure 2 shows that the peaks are broader, although they do bear a similar relationship with each other. For each initiator there is a significant reduction in the induction period compared with those obtained for MMA alone, i.e. cure rates in a monomer polyester system are faster than for pure monomer.

The addition of a higher molecular weight species to a monomer may contribute to a relatively faster formation of high polymer, but the shorter induction periods do point to a significantly reduced inhibition. The inhibition of free radical polymerisation by oxygen is well-known, and it is generally accepted that this occurs via the formation of unreactive peroxy radicals formed from the reaction of the radical species with oxygen. In addition, it has been suggested that inhibition can arise from the formation of "oxyplexes"¹², leading to quenching of initiator excited states and suppression of polymerisation.

It may be that the addition of the polyester resin to the MMA reduces the dissolved oxygen content, thus reducing the induction time. Alternatively, the high viscosity may have reduced the rate of oxyplex formation, leading to less primary radical deactivation, such as has been suggested to account for the difference in polymerisation rates of TMPTMA and 1,6-HDDA¹³ (1,6-hexanedioldiacrylate).

Comparison of methacrylate monomers

The polymerisation of three commercially available methacrylate monomers was compared with MMA using the equipment.

The monomers chosen were:

Tetrahydrofurfural methacrylate	SR 203 (THFMA)
Ethylene glycol dimethacrylate	SR 206 (EGDMA)
Trimethylolpropane trimethacrylate	SR 350 (TMPTMA)

AZDN was used as an initiator again at a molar ratio equivalent to 2 per cent AZDN/MMA; runs were carried out at 60°C. The commercial materials all showed significantly faster reaction rates compared with MMA, although they do contain some inhibitor. The characteristic long induction period was absent but some difference can be found in the times to reach peak exotherm, Table 3. These are very much shorter than MMA and show a decrease with increasing functionality. (A new discharge tube was fitted to the lamp for these

Table 3

Comparison of the polymerisation of commercial monomers with MMA at 60°C, using AZDN as the photo initiator

	Time to reach peak exotherm (minutes)	ΔH (cals/g)	ΔH (kcal/mole)
Trimethylolpropane trimethacrylate	7	17.6	5.95
Ethylene glycol dimethacrylate	8	30.3	6.01
Tetrahydrofurfural methacrylate	11	40.9	6.95
Methyl methacrylate	39	42.9	4.3

experiments, which explains the difference between the induction time found for MMA and the earlier value.)

In order to investigate further the behaviour of these initiators, a series of runs was performed using the three monomers with three initiators at three temperatures. The time to peak exotherm was taken as a measure of induction period, and the results were satisfactorily analysed by the use of a standard Latin Square¹⁴.

Analysis of the values (Table 4) shows significant differences amongst initiators, monomers and temperatures. The two and three factor interactions are not significant, showing that no synergistic reactions were taking place.

For all combinations, the time taken to reach peak exotherm was reduced with increased functionality, the order observed being TMPTA, EGDMA, THFMA. Also, the values generally reduced with increasing temperature.

Polymerisation of 1,6-HDDA

UV curing systems generally contain acrylate rather than methacrylate monomers in order to gain a faster cure response.

An illustration of the comparative reaction speed was gained from a run using 1,6-HDDA initiated with AZDN at 60°C, again using a molar ratio equivalent to 2 per cent AZDN/MMA. Under these conditions 1,6-HDDA reacted almost 16 times as rapidly as MMA.

The sensitivity and chart speed were adjusted to facilitate measurement, and the polymerisation of HDDA, initiated with the initiators used previously with MMA, was followed at 60°C.

The traces are shown in Figure 4. The shapes of the peaks vary considerably, reflecting the difference in behaviour caused by the different initiators. The most striking is the shape of the peak obtained using AZDN. A long induction period was followed by a vertical temperature response on the trace. In this case it appears that for a period there was virtually total inhibition followed by extremely rapid polymerisation.

The relative ΔH values are:

Benzophenone/TEA (trimethylamine)	54.4 cal/g
Irgacure 651	51.3 cal/g
Trigonal P1	125.0 cal/g
Sandoray 1,000	49.5 cal/g
Trigonal 15	47.6 cal/g
AZDN	93.0 cal/g

Table 4

Polymerisation of commercial monomers with commercial photo initiators at different temperatures - times to peak exotherm (minutes)

	Irgacure 651	Trigonal 15	Trigonal P1
30°C			
THFMA	7.5	10.0	15.0
EDGMA	2.25	7.0	8.5
TMPTMA	2.0	4.0	4.0
60°C			
THFMA	1.5	10.0	8.0
EGDMA	1.0	6.0	3.5
TMPTMA	2.0	2.0	3.0
90°C			
THFMA	3.0	4.0	6.0
EGDMA	2.0	3.0	2.5
TMPTMA	1.0	1.5	2.0

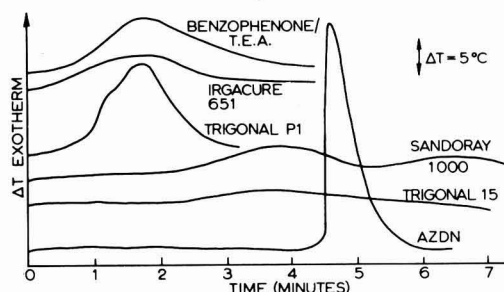


Figure 4. Polymerisation of 1,6-HDDA with different initiators

The benzophenone/TEA system gave the shortest induction time with this monomer, in contrast to results with MMA. Again, the highest value for ΔH was produced by the trichloroacetophenone derivative (Trigonal P1), indicating relatively higher conversions under these conditions.

Attempts were made to exclude oxygen during the experiments. Thin glass tubes were drawn into fine capillaries and bent at right angles. These were placed in both the sample and reference tubes so that the light intensity falling on each was reduced equally. Runs were carried out using MMA with 2 per cent AZDN at 30°C with nitrogen bubbling through the sample, but this aided volatilisation of the monomer.

Some improvement was gained by shortening the capillary so that it was just above the level of the sample, giving a crude nitrogen blanket. This did give a slightly shorter induction time than a control under the same conditions without nitrogen.

The presence of the capillaries in the sample tubes reduced the amount of radiation available to the samples and slower reactions were obtained. Because of this, and the difficulties associated with locating the fine tubes in the sample container, the technique was not pursued.

Conclusion

Thermal analysis can be usefully applied to the study of UV initiated polymerisation of acrylic monomers. The heat evolved during the reaction can be detected using the equipment described and, although strict kinetic treatment is not valid, a comparative indication of speed and conversion can be readily interpreted visually from the shape of the curves. It is possible that the techniques can be extended to investigate other formula variables.

Acknowledgements

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AC impedance measurements on thick organic coatings on mild steel substrates

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Summary

AC impedance measurements were made on phenol-formaldehyde and epoxy varnish coatings, and Corroless "S" paint coatings all on mild steel substrates. The corrodents were aqueous potassium chloride and sodium chloride solutions respectively, and measurements were made over a typical range of 10^{-2} to 10^6 Hz. Impedance plots from these systems show two distinct features: a capacitive semicircle, thought to be due to the varnish/paint film, and an inductive response interpreted as due to interfacial reactions involving intermediate adsorbed species and possibly related to active site formation on the substrate/paint interface.

Introduction

Despite several decades of work, the mechanism by which an organic coating protects a steel substrate is not yet fully understood. In recent years in an attempt to understand the corrosion mechanism and to find out the electrochemical parameters capable of predicting the protective performance of organic coatings, AC impedance measurements over a large range of frequencies have been carried out on immersed painted steel specimens.

This work is confined to a limited number of painted metal systems, viz. chlorinated rubber¹ (55 μm) and coal tar epoxy (60 μm) in 3 per cent NaCl (aerated)², polyurethane (34 μm) and chlorinated rubber-iron oxide³ (40 μm) in 0.5 M NaCl, Epon 1002/versamid⁴ (60 μm) in 3 per cent NaCl, acrylic lacquer (50 μm) in artificial sea water⁵⁻⁷, silicone-modified polyester, vinyl or fluorocarbon (20 μm) top coat over a chromate-inhibited epoxy primer⁸ (5 μm) in 5 per cent NaCl, epoxy (40 μm) in 1N deoxygenated⁹ H₂SO₄. Thus AC impedance measurements on organic coatings thicker than 60 μm have not been reported. Mills and Mayne¹⁰ have shown that

thickening of the paint film reduces the chances of finding low resistance areas which have come to be known as "D" areas. It is also generally considered that the rate of water and oxygen arrival at the substrate/organic coating interface immediately after immersion depends on the thickness of the organic coating¹¹. In view of the important role of thickness in the protective performance of organic coatings, it was considered that AC impedance measurements on thick organic coatings would be of interest. This paper examines the impedance responses of thick (>100 μm) varnish and paint films on steel substrates, immersed in 3.5 M KCl and 0.5 M NaCl solutions.

Materials and specimen preparation

The systems described below were examined.

System A

The coating material consisted of Epikote 1001 (a 50 per cent solution in a 1.27:1 mixture of xylol and butanol), and polyamide Versamid 115 (a 70 per cent solution in xylol). This material was supplied by ICI Ltd. Epikote and Versamid were mixed in a 2:1 ratio by weight and the substrate used was mild steel in the form of a 1.25 cm diameter disc pickled in concentrated hydrochloric acid for 10 minutes and washed in distilled water. A lead was soldered to the back of the disc and this was affixed to a 1 cm diameter glass tube using Araldite. The face of the disc was ground on 600 grade silicon carbide paper and cleaned with acetone. The specimen was stored in a desiccator for one day before coating application. A single coat of phenol-formaldehyde resin was applied by the dip method to the face of the disc specimen. The specimen was dried in air for 48 hours and heated in an oven for another 48 hours at 65°C. The coating thickness was $130 \pm 10 \mu\text{m}$

as measured by micrometer. The specimen was well masked with paraffin wax except for an exposed area of 64 mm². The glass tube was also filled with paraffin wax to prevent accidental contact with the solution. The specimen was again stored in a desiccator for 24 hours and thereafter immersed in a 3.5 M KCl solution at room temperature (22 ± 2°C) open to air but not deliberately aerated.

System B

The coating material was Corroless "S" paint, a commercial product from Lawrence Industries Ltd, Surrey. For this system a 20 × 30 × 1.5 mm rectangular substrate was cut from a mild steel sheet. The specimen was prepared and coated with Corroless in a similar manner to that described for system A. The dry film thickness was 110 ± 10 μm as measured by micrometer. The specimen (exposed area: 240 mm²) was immersed in a 0.5 M NaCl solution at room temperature (22° ± 2°C).

System C

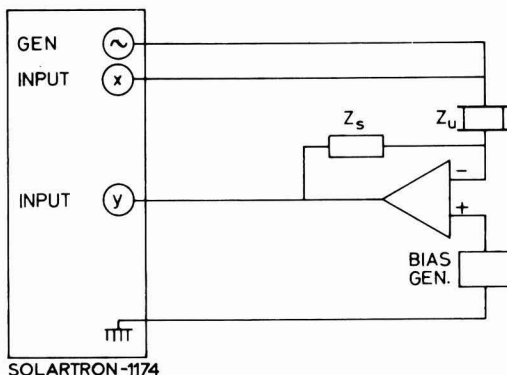
The coating material was phenol-formaldehyde resin, modified by tung oil (74 per cent length) and linseed oil in a 3:1 ratio. The phenol-formaldehyde content was 26 per cent. This material was supplied by ICI Ltd. The substrate and method of coating application was similar to that described in system A. In this case the coating thickness was 140 ± 10 μm and the specimen (exposed area: 64 mm²) was immersed in 3.5 M KCl solution at room temperature (22° ± 2°C).

Testing methods

The measurement system is based on a Solartron 1174 digital frequency response analyser and covers the frequency range 10⁴ to 10⁶ Hz. The system has been developed by the Wolfson Group for Solid State Ionics at Imperial College for the study of solid electrolytes and is described elsewhere¹². A block diagram of the system is given in Figure 1. The Solartron 1174 has two inputs, one of which (designated X) monitors the applied voltage, the other (designated Y) measures the current via a fast current-to-voltage converter. In this configuration $Z_u = -Z_s(V_x/V_y)$, where Z_u is the impedance of the cell and Z_s that of the standard. A DC bias may also be applied if required, along with the AC. A two-electrode configuration and an excitation voltage of 10 mV rms were used throughout these experiments. The platinum counter electrode had a surface area of 40 cm².

Results and discussion

The complex impedance plot given in Figure 2(a) was obtained on epoxy-coated steel (system A), representing an exposure period of 140 hours. Figures 3(a) and (b) give the complex impedance plots obtained on Corroless "S"-coated steel specimens (system B), representing exposure periods of 23 and 240 hours. Figures 4(a)-(d) give the impedance plots of phenol-formaldehyde-coated steel (system C) with an exposure period from 24 to 194 hours. In all these cases the impedance responses consisted of a high frequency semicircle and a low frequency inductive region. The maximum resistive component was obtained graphically from the diameter of the high frequency semicircle of the complex impedance plot. The parallel capacitances were obtained from the corresponding modulus plots, the diameter of which gives the inverse of the parallel capacitance¹³. For example, the corresponding modulus plot of Figure 2(a) is shown in Figure 2(b). The modulus, M , is defined by the expression $j\omega z$, where ω is



SOLARTRON-1174

Figure 1. Block diagram of AC impedance measurement system based on Solartron 1174 digital frequency response analyser. Z_u and Z_s are the impedances of the cell and standard respectively

the angular frequency and z is the complex impedance. These capacitances are in agreement with those obtained from the maximum of the complex impedance plots according to the relation $\omega RC = 1$. The impedance and modulus are expressed in ohm cm² and pF⁻¹ cm² respectively. The values of maximum resistance and capacitance obtained from an analysis of the impedance spectrum in the above systems are given in Table 1.

Table 1
Values of parallel resistances and capacitances of systems A, B and C

System	Exposure period (hours)	Maximum resistance (ohm cm ²)	Parallel capacitance (pF ⁻¹ cm ²)
A (epoxy, 3.5 M KCl)	140	8.60 × 10 ⁵	28.0
B (Corroless "S" 0.5 M NaCl)	23	2.78 × 10 ⁶	11.70
	240	0.175 × 10 ⁵	60.97
C (phenol-formaldehyde, 3.5 M KCl)	24	6.72 × 10 ⁵	35.2
	34	6.76 × 10 ⁵	35.0
	75	6.80 × 10 ⁵	35.0
	194	7.40 × 10 ⁵	33.3

From the above table it can be seen that the capacitance values associated with the high frequency semicircle are much lower than typical double layer capacitances and therefore cannot be due to corrosion reactions at the substrate/coating interface. These values are, however, typical of varnish/paint films¹⁴. On this basis the high frequency semicircle is attributed to the varnish/paint film³. It can be seen from Table 1 that system C exhibits the unusual feature of an increase in maximum resistance and a slight decrease in capacitance with exposure. It is pointed out that there are in the literature some isolated references to similar observations; for example Walter⁸ has observed an increase in the diameter of the high frequency semicircle at intermediate periods of exposure. Standish and Leidheiser⁴ have stated that the capacitance values do not always increase with exposure as might have been expected. No pores, cracks or blisters were noted in the paint film, nor was there any visual evidence of corrosion underneath the paint film. The high observed ionic resistance, of the order of 10⁵ ohms cm², and its persistence throughout the

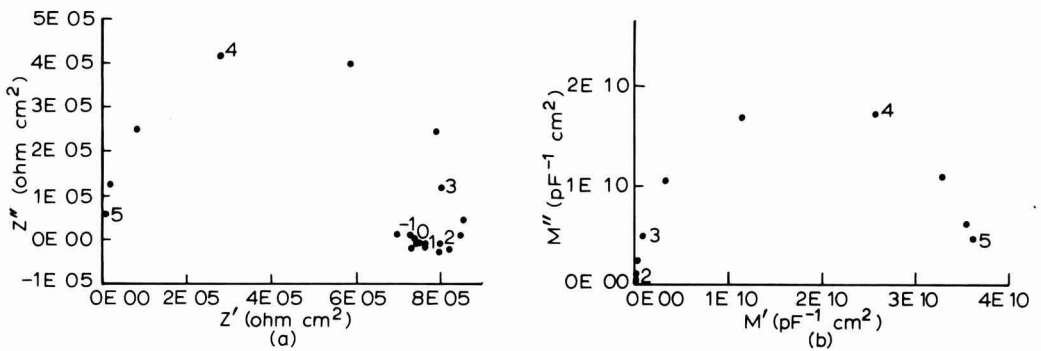


Figure 2. Complex impedance plot (a) and complex modulus plot (b) of system A (mild steel-epoxy, 3.5 M KCl) at 140 hours of exposure. Numbers denote logarithms of frequency: 2E05 means 2×10^5 , 3E05 means 3×10^5 and so on

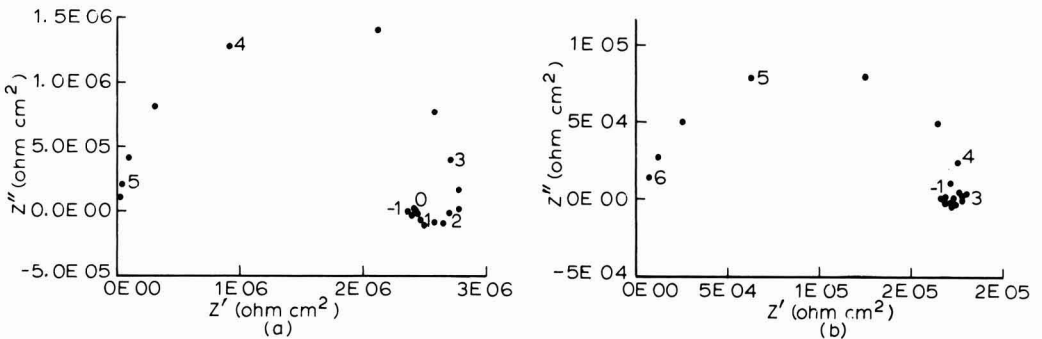


Figure 3. Complex impedance plots for system B (mild steel-Corroless "S", 0.5 M NaCl) at two exposure times: (a) 23 hours and (b) 240 hours. Numbers denote logarithms of frequency

exposure period confirmed that there was no contact between the solution and metal substrate.

In all cases, significantly inductive responses at low frequencies have been observed and the paint films remained intact throughout the exposure period. Epelboin *et al.*^{9,15} have observed inductive loops in the case of epoxy-coated steel (thickness 40 μm) immersed in deoxygenated 1N sulphuric acid and have attributed these inductive loops to relaxation of surface coverages by reaction to adsorbed intermediate species. It seems that intermediate adsorbed species are involved in the interfacial reactions, these reactions are possibly related to the formation of active sites on the substrate under a thick and intact paint film. Our other work¹⁶ also reveals the presence of inductive behaviour in the case of thick, intact films. In the presence of an inductive contribution, the diameter of the high frequency semicircle (i.e. maximum resistance) may not represent the ionic resistance. In order to take into account the interfacial reactions involving adsorbed intermediate species, the circuits shown in Figures 4(a) and (b) are considered. The capacitances of paints and varnishes and reactions involving intermediate adsorbed species are represented by C_p and C_A ; the ionic and interfacial resistances are represented by R_i and R_F respectively. Note the very high value of the inductance L_A (10^3H).

Simulated impedance/frequency responses of these circuits are shown in Figures 6(a) and (b). These illustrate that the maximum resistance as represented by the diameter of the high frequency semicircle does not represent the ionic resistance (R_i) but includes the interfacial resistance (R_F).

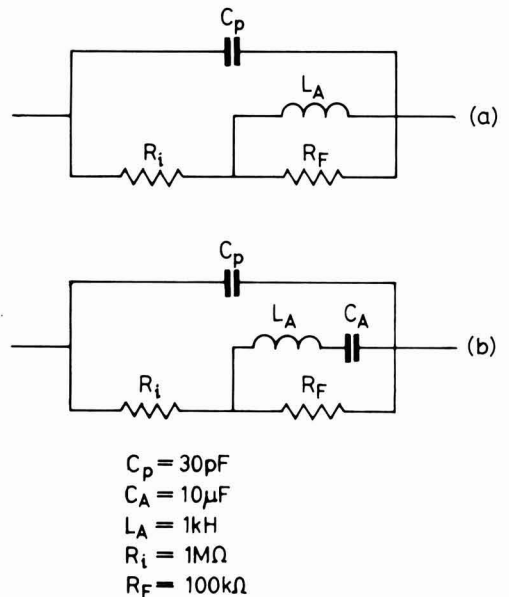


Figure 4. Two circuit equivalents proposed to take into account the observed impedance responses of the systems investigated. C_p represents the capacitance of the paint/varnish film, R_i and R_F represent the ionic and interfacial resistances respectively. L_A and C_A are associated with reactions involving adsorbed species

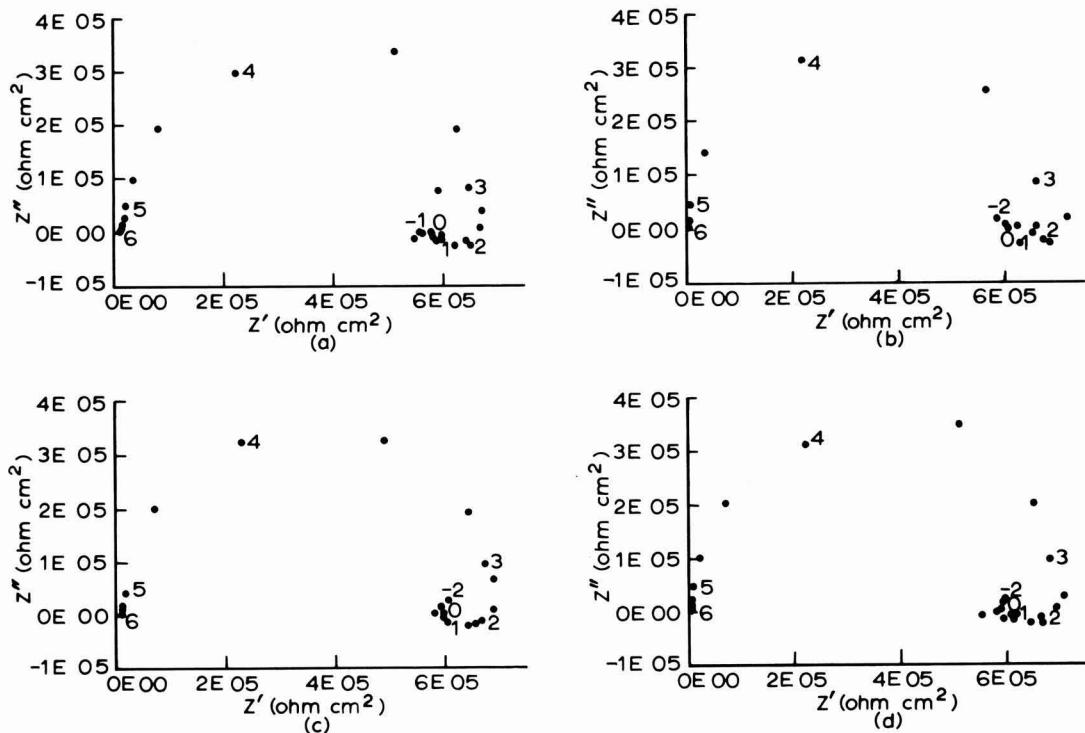


Figure 5. Complex impedance plots for system C (mild steel-phenol-formaldehyde, 3.5 M KCl) at four exposure times: (a) 24 hours (b) 34 hours (c) 75 hours and (d) 194 hours. Numbers denote logarithms of frequency

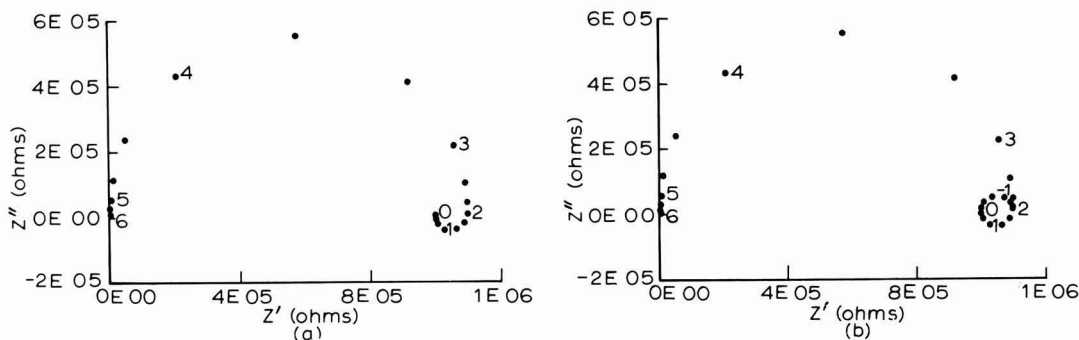


Figure 6. Simulated complex impedance plots for the two circuits shown in Figure 4. Numbers denote logarithms of frequency

An understanding of the exact nature of the adsorbed intermediate species needs to be developed to explain the mechanism of corrosion underneath paint film. Scantlebury and Sussex² have doubted the feasibility of using AC impedance measurements to observe corrosion under an intact film. Our observations, however, indicate that interfacial reactions are indeed reflected in the impedance responses, even under a thick, intact varnish or paint film.

Conclusions

Impedance plots obtained using thick varnish and pigmented paint coatings on mild steel substrates exhibit, in addition to the high frequency semicircle associated with the paint film, an inductive region at lower frequencies.

This indicates that intermediate adsorbed species are involved in the interfacial reactions: these reactions are possibly related to the formation of active sites on the substrate. Impedance measurements on well characterised substrates may give information which can be useful in understanding the mechanism of corrosion reactions.

Acknowledgements

The authors wish to thank Prof B. C. H. Steele for providing frequency response analysis facilities, and ICI Ltd for supplying the varnish samples. One of the authors, S. N., also wishes to thank Imperial College for sponsoring him; without this the work could not have been carried out.

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Flakeglas*-filled coatings: past, present and future

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Corrosion damage is often the main item featured among repair and maintenance costs, which can even exceed the price of the original equipment. Although corrosion is such a devastating problem, it can often be prevented by a thin coating – as long as that coating can provide a tough impermeable barrier between the equipment and the corrosive medium.

Experience in the test laboratory and on-site is currently showing that, among a wide range of corrosion-resistant coatings available, systems based on glass flakes from Owens-Corning Fiberglas are far superior to alternative materials.

Flakeglas material was developed by Owens-Corning Fiberglas in the mid-fifties. Since that time, coatings reinforced* with glass flakes have experienced growing success in an ever widening number of applications.

Glass flakes

Owens-Corning Fiberglas' Flakeglas material consists of thin flakes of glass ranging from 3 to 5 microns in thickness which, once ground, are then sieved and filtered. These flakes are available in diameters ranging from 0.4 to 3.2 mm.

Flakeglas is made out of C-glass, which is highly resistant to chemicals and used largely in the production of corrosion resistant coatings. By incorporating such glass flakes in various types of coatings, low permeability, proven durability and improved adhesion are achieved.

Flakeglas-filled coatings

High quality protective coatings can only be produced from high quality basic materials. Flakeglas-filled coatings, which can be applied at thicknesses ranging from 1 to 3 mm, are made from pulverised glass flakes mixed

with a high performance resin, such as polyester, vinyl ester, bisphenol or epoxy.

Together, these two materials produce a pasty mixture which is applied by trowel or by the spray-up process until the required thickness is reached. Once applied, glass flakes form tightly packed layers (approximately 100 layers in each 1 mm of thickness), which ensure highly effective corrosion resistance and which resist the penetration of aggressive chemicals or gases.

When mixed with high performance resins, glass flakes produce protective materials offering superior performance to alternative coatings based on the same resin/catalyst system but using fillers such as mica, calcium silicate or aluminium silicate.

Chief characteristics and properties of Flakeglas-based coatings

Flakeglas coatings offer many properties which make them well-suited to even the toughest corrosion protection applications. They provide a tough mixture of the qualities of glass with the excellent adhesion and chemical resistance of a thermosetting resin. As glass flakes are only 3 microns thick, they have more flakes per unit thickness of coating than similar alternative materials. This is why Flakeglas coatings have such low water vapour transmission rates.

A Flakeglas coating has a coefficient of linear expansion close to that of carbon steel and can thus withstand thermal shock without loss of adhesion or cracking. In fact, Flakeglas coatings have shown excellent performance when submitted to 10,000 hours of cyclic testing between -30°C and 50°C during Owens-Corning thermal shock tests.

Given the superior resistance of glass flakes to highly

*Flakeglas is a trademark of Owens-Corning Fiberglas Corporation

aggressive environments, coatings based on them have little to fear either from atmospheric conditions or temperature-humidity cycling and accelerated weathering tests; such coatings have demonstrated high resistance to salt spray exposure.

The excellent coating integrity of this material and the use of multiple layers of overlapping flake reinforcement also give coatings high resistance to mechanical abuse and abrasion, increasing their abrasion resistance by a factor of two compared to a non-filled system. Flakeglas coatings offer superior adhesion to metal substrates even when subjected to severe and reverse impact, and have a particularly high degree of bond integrity when applied to steel.

Thus, with their high resistance to corrosion and physical abuse, Flakeglas coatings offer a long maintenance-free life. Field installations re-visited after over five years have shown that these materials continue to offer maximum protection long after alternative coatings and lining systems have failed.

Flakeglas coatings can be cost-competitive with other materials currently used in this field, such as rubber-lined steel. Also, other features of this material – fast application times using spray-up, long life and easy repair – help to increase its economic advantages.

Flakeglas production process

Flakeglas owes its superior performance characteristics to the current manufacturing process developed by Owens-Corning Fiberglas. Glass is melted in a paramelter and fed to the Flakeglas bushing which is heated to more than 1000°C. Therefore, the glass forms a continuous cone-shaped film which is pulled by a pair of pinch rollers. The bubble wall is broken by these rollers and the broken films are then transported to a hammer mill by means of a pneumatic system. The milled Flakeglas drops onto a screener which retains the oversized flakes, returning them to the separator for re-grinding in the hammer mill. The properly sized Flakeglas enters the collection bin from where it is packed and shipped. It should be noted that these flakes are not coated with any form of binder.

Development history of flakeglas

The first commercial use of glass flakes by Owens-Corning Fiberglas was in the late 1950s. At the time, the handling characteristic of the flake was investigated to improve production operations and product quality. This effort led directly to the techniques now utilised to provide flake separation in the resin matrix and improvement in anticorrosion coatings.

In mid 1956 trials were initiated in which compounds of glass flake and epoxy resins were investigated for possible use in protection against the environment and anticorrosion applications. In June 1957, 30 per cent glass flake-filled epoxy resin was successfully applied to a concrete substrate. Also at that time, techniques were investigated to apply flake-filled thermoplastic materials to a pipe lining.

During the period 1958 to 1962, work on coating equipment, resins, compounding and field trials on a wide variety of surfaces and applications continued. As a result of these investigations, application was improved by the use of a modified Binks Model 18 spray gun used in conjunction with an externally mixed catalyst.

Flakeglas coating compound M-100 (a modified bisphenol-A-polyester) was introduced in late 1961. After initial test marketing, Owens-Corning returned to supplying the flake only. The original technology generated was provided to potential customers. Since then, glass flake-filled coatings have been used successfully in a wide variety of applications, from the petroleum, chemical and marine areas to transportation, energy and water treatment sectors of industry.

Flakeglas coatings first arrived in Europe when some United States compounders and applicators started to sell these coating compounds through their affiliates or licensees.

Once the market developed, processors eventually switched to local production and current European applications are generally the same as those in the United States.

Recent developments: thin film coatings

The techniques used to apply thick coatings, the time required for surface preparation, and installation costs have generally limited their usage to large structures with severe corrosion protection needs. Therefore, in the early 1970s, additional research and development work was initiated by several firms and individuals with the aim of developing thin film corrosion resistant paints and coatings with a glass flake filler. The objective was to offer higher performance, glass flake-filled corrosion resistant coatings for medium to moderately severe corrosion service applications.

Various techniques were investigated to improve the coating. These included post milling to reduce the flake to a size suitable for spraying with conventional air or airless equipment. Also, techniques of treating the flake were developed to allow them to assume a more or less parallel orientation without rolling.

Glass Shield Coatings Ltd conducted liquid and vapour permeation trials on a glass flake-filled alkyd coating in thin (50-88 microns) films containing five layers of flake. Results indicated that treated glass flakes of 3 mm nominal size had substantially less liquid and vapour transmission than the smaller 25 microns flake.

The leafing treatment technique was also applied to several non-glass flake materials for use in an epoxy matrix. Exposure in hours, blistering, rusting, undercoating, overall appearance, general appearance of film, and general appearance of substrate were rated. The glass flake proved to be superior to the other flake materials, except in the salt spray where it was beaten by aluminium and equal to iron oxide and stainless steel.

Additional tests on abrasion resistance, chemical resistance and track resistance were also conducted. In these tests, the glass flake-filled coatings proved superior to the unfilled controls.

Following this work a series of coatings utilising the improved leafing were tested and from this work a proprietary line of coatings has been developed. Corresponding studies have been undertaken in the United States and Europe by the US Paint Division of Grow Chemical Company. These materials are being tested in a variety of vehicles: urethane, epoxies and polyesters. Again, the thrust of their programme is thin film coatings, which lend themselves to ease of deposition by conventional spray equipment.

The future of Flakeglas coatings

The performance and advantages of Flakeglas-based coatings have been clearly demonstrated over the last 20 years in the continual battle against corrosion, and improvements are still being made.

The application area for these coatings will continue to be expanded both through producing new materials based on larger, thinner glass flakes and by modifying the methods of applying the material and thereby reducing labour costs. Also, the use of more sophisticated spraying equipment will help reduce the effect of solvents currently used, allowing new Flakeglas coatings to meet tightening environmental standards.

The availability of such new systems as thin film coatings will offer further opportunities to improve the cost/performance ratio of Flakeglas coatings. For example, thinner coatings may permit electrostatic application. This produces uniformity of application and reduces overspray, thereby allowing the use of more costly, higher performance coatings.

In short, it is now possible to specify and use glass flake-filled coatings in a wider range of thicknesses and applications than ever before, and this situation will continue to improve in the foreseeable future.

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next month's issue

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

Micaceous iron oxide paints by *D. M. Bishop and F. G. R. Zobel*

Electrochemical impedance in coated metal electrodes. Part 5: film thickness by *L. M. Callow and J. D. Scantlebury*

Structural changes in polymer films. Part 2: the effect of the pigment zinc oxide on the electrolytic resistance and transition temperature; some comparisons with the pigments iron oxide and red lead by *D. J. Mills and J. E. O. Mayne*

Copolymerisation of polyunsaturated fatty vinyl monomers with styrene by *B. S. Sitaramam, P. C. Chatterjee and M. A. Sivasamban*

occa meetings

London

Marketing opportunities with new high performance acrylic technology

The first technical meeting of the 1982-83 session was held on 23 September 1982 at The Princess Alice, Romford Road, Forest Gate, London E7. Section Chairman, Brian Gilliam, welcomed the members and guests to the Section's new home and thanked Rohm & Haas for providing the buffet.

Guest speaker was Mr D. J. Kerrison of Rohm & Haas, European Operations who presented a paper entitled "Marketing opportunities with new high performance acrylic technology".

The paper was an overview of the newer technologies and the market segment in which they are starting to gain acceptance.

In the sphere of decorative paints, the last bastions of solvent systems are high gloss paints and wood varnishes and stains. New high T_g systems with resistance properties are now available which marry the previously proven acrylic durability with application characteristics and aesthetics acceptable to the end-user. This has been achieved with not only the correct binder but suitable rheology modifiers, which allow the paint chemist to tailor-make a formulation for specific market needs.

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

With wood systems, the acrylic emulsion capability of allowing wood to breathe and reduce water content, coupled with durability and specific adhesion has allowed penetration of the opaque stain market. Clear films, while transparent to UV, lead to degradation of the wood itself. A new acrylic has inherent UV absorbing characteristics which operate without film degradation.

With the rising cost of TiO₂, a novel approach has been made in gaining opacity while maintaining economic formulation costs. Termed opaque polymer, it is an emulsion-based product which on drying develops air voids not only assisting opacity by light scattering but also acting as spacers for TiO₂.

In the industrial coatings market the curcure coating segment is still dominated by NC or two-pack systems. Cost, solids, fire and health hazards all point to an alternative approach. Aqueous systems have now satisfied most technical needs, however, the aesthetics leave much to be desired.

A new, unique development from Rohm & Haas overcomes the "greyness" effect of water-based systems and gives the warmth or "rechauffage" of the traditional systems.

Water-based printing inks have been known for many years, particularly in the flexo market. Higher performance speciality inks have always remained solvent-based due to technical inadequacies in existing aqueous systems.

Recent technical breakthroughs have resulted in acrylic aqueous: (a) Clear overprint varnishes (COPV), with both high gloss and excellent heat seal resistance and (b) Inks for polyethylene film with printability and adhesion to corona discharge treated film.

With the development of new building standards and the need to insulate, a new generation of acrylic emulsions has been developed with excellent durability, water resistance (early), reflectivity and adhesion to PU and polystyrene. These new roof coatings are a rapidly developing segment in the building industry.

The last major area is high performance chemical resistant flooring. These have traditionally been epoxies, with problems related to toxicity and low temperature cure, and MMA based syrups with fire and volatility constraints.

A new 100 per cent solids system with low volatility, toxicity and odour has been developed termed Polymer Concrete. Trials in France, Sweden and Germany have proven the efficiency of the system.

After question time, Mr E. Farrow proposed a vote of thanks to which the audience responded in the usual manner.

B. A. Canterford

Auckland

Technical awards

The September meeting of OCCA Auckland began with the presentation of awards to OCCA members who had qualified for these during their participation in the Surface Coatings Technical Course, which had been conducted at the Auckland Technical Institute. Successful candidates Miss S. Patel, Mrs S. Warrington, Mr D. McDonald and Mr M. Wheeler received the "New Zealand Diploma of Surface Coating Technology".

Dr Ron Maylor was not able to attend and will receive his certificate and prize for best overall student at a later date. Mrs Warrington received the prize for best student paper.

Twelve students taking the two year course joined 62 members to hear the award winning paper, which was the first technical paper given by a lady to Auckland OCCA.

Mrs Susan Warrington's paper was on a topic unrelated to her area of technical involvement in the industry, it was entitled "Investigation into antifouling".

The aim of this investigation was to expose a range of antifouling, involving different toxins and binder types, comparing their performance over a nine month period. The trends in toxin types from the 1500s to the present day were investigated. Most emphasis was on the three main toxins used in modern antifouling, i.e. cuprous oxide, organotin and organic toxins.

The five antifouling types were also described, i.e. soluble and insoluble matrix, scrubable and self polishing matrix, and hydrophilic top coats. These types were compared particularly for rates of leaching. It was found that the rate of leaching from the antifouling must be above a minimum level to be effective in preventing growth and attachment of fouling organisms and algae in particular. As a film ages its toxin leaching rate falls to below the critical value. At this stage the film fails and no longer prevents fouling.

The economic efficiency of shipping is reduced by hull

The logo for OCCA meetings is enclosed in a rounded rectangular border. The word "OCCA" is in a bold, sans-serif font, and "meetings" is in a larger, bold, sans-serif font with a stylized, slightly italicized appearance.

roughness, whether by uneven surface coating or fouling. Roughness has the effect of increasing drag and turbulence. Turbulence increases the rate of leaching by disturbing the laminar layer at the paint/water interface.

In conclusion antifouling compositions based on insoluble matrices are physically more serviceable than traditional water-soluble matrices. The use of organic toxins or combinations containing polymeric tin and organic toxins can have synergistic effects.

A. Macdonald

West Riding

The pigmentation of thixotropic alkyd gloss paints

A lecture meeting of the West Riding Section was held on Tuesday 2 November 1982 at the Mansion Hotel, Leeds.

Mr J. E. Hall of BTP Tioxide Ltd gave a talk on the above topic. The main theme of his paper was flocculation and the measurement of flocculation gradients.

Mr Hall suggested that problems are often encountered when manufacturing thixotropic alkyd paints and that pigment utilisation was often unsatisfactory. The nature of flocculation in these paints was discussed and a mechanism for its occurrence proposed. The main parameter for assessing flocculation was said to be the measurement of flocculation gradient. The method of determination was described and several graphical examples given.

The speaker illustrated the effect of loss of opacity due to flocculation. He suggested that up to 25 per cent increase in opacity could be achieved by reducing flocculation. The effects of flocculation on durability, colour and gloss of the finished paint were also described. Mr Hall introduced a new low cost instrument for measuring flocculation gradients. This instrument was said to have been developed by BTP and was being marketed by Sheen. A list of flocculation gradients of the top 20 thixotropic alkyd paints was produced. The gradients were shown to vary from 0.4 (good) to 0.92 (poor), i.e. suggesting a large quality difference.

Mr Hall went on to examine the effect of different resin types. The resins included long oil liquid alkyds, structured alkyds and thixotropic alkyds. It was shown that resin type had a very marked effect on pigment performance. The parameters discussed included acid values, saponification values, gel strength and molecular size distribution.

Mr Hall introduced the concept of using absorption isotherms for measuring the quantity of resin and solvent on the pigment surface. The results produced indicate that a highly flocculated system has a large quantity of resin on its surface but little solvent.

The speaker then discussed various techniques for

reducing flocculation in thixotropic alkyd paints. He considered different resins, different organic treatments on TiO_2 and also mill base temperature. Finally, Mr Hall highlighted the influences of varying the method of paint manufacture on flocculation.

After a very enthusiastic and lively discussion period, the vote of thanks was given by Mr Eric Bishop.

D. V. Maltman

Midlands

Synthetic resins

The annual student lecture of the Midlands Section was held on Thursday, 18 November 1982 at the Clarendon Suite, Stirling Road, Edgbaston, Birmingham.

Members, guests and students heard Mr J. S. Bridle of Cray Valley Products Limited give a talk entitled "Synthetic resins".

Mr Bridle commenced his talk with a brief description of a resin plant saying that the average batch size was between 3 and 20 tonnes of solid resin. When the reaction is completed the resin is dropped into thinners in the blending tank and from there it is pumped into a holding tank, barrels or road tanker. There are four main processes for alkyd resin production:

1. Alcoholysis
2. Fatty acid process
3. Direct esterification
4. Acidolysis

Of these the first two are the ones most commonly used.

The speaker then went on to discuss acrylic resins saying that the choice of raw materials was limited but the composition was very variable. Acrylics can be classified into thermoplastic or thermosetting depending on their chemical structure and curing mechanism. Of the two, thermosetting are more widely used and these can be divided into three categories:

1. Hydroxy – acrylics – these are crosslinked with amino-resins and stoved at 120-140°C or can be coupled with isocyanate such as Desmodur N and cured at ambient temperature.
2. Acrylamide acrylics – when crosslinked with an epoxy resin and cured at 150-170°C these exhibit good chemical resistance.
3. Carboxy acrylics – these are also coupled with epoxy resin and cured at 170°C.

Mr Bridle continued his talk by describing alkyd resins. With these resins there is a wider choice of raw materials.

Alkyds are vulnerable to hydrolysis by alkalis because of the ester linkages in the polymer chain, while acrylics, on the other hand, which have carbon to carbon links show good alkali resistance. The speaker discussed the various processes used to prepare alkyds commercially with the relative advantages and disadvantages of each process. The composition of an alkyd can be greatly varied by changing the type of oil and the oil length to give resins ranging from types suitable for brushing decorative paints to spraying stoving enamels.

Finally Mr Bridle spoke of some of the modifications of alkyd resins, briefly outlining their composition and uses, these can be summarised as follows:

1. Vinylated: Styrene – This gives resins that touch dry rapidly but have limited tolerance to white spirits and usually have difficult recoating periods.

Vinyltoluene – These are slower drying than the styrenated types but are soluble in aliphatic solvents.

Acrylated – Fast drying

2. Silicone: Improved chalk and chemical resistance. High modification levels required, tend to be expensive.

3. Urethane: Chemically strong, tough, good alkali resistance, colour retention not very good. If toluene diisocyanate is replaced by isophorone diisocyanate then colour retention is improved.

4. Thixotropic: These are usually polyamide modified.

5. Two-pack urethane: These are saturated short oil alkyds coupled with isocyanate and cured at ambient temperature.

6. Water-dilutable: The future of these is questionable.

7. High solids: These are a new development and with the advent of aluminium complex driers, form useful coatings.

A lively question time followed, reflecting the interest shown in the talk. The meeting closed with a vote of thanks proposed by Mr H. J. Clarke and endorsed by the audience in the usual manner.

B. E. Myatt

Trent Valley

Trent Valley goes back to school

After an absence of six years the Trent Valley Branch has returned to the British Railways School of Engineering on London Road, Derby for its technical meetings.

The Trent Valley Branch was founded in 1963 as an off-shoot of the Midlands Section to cover the counties of the East Midlands and held all its meetings in the then British Railways School of Transport until 1975.



British Railways School of Engineering, London Road, Derby, the current venue for Trent Valley branch technical meetings

The lecture theatre at the British Railways School of Engineering offers first class facilities for both the speaker and audience, being equipped with a range of projection equipment, tiered soft seating and retractable desks.

Trent Valley also provide a splendid buffet mid-way through the evening and are hopeful that they can attract members from further afield to swell their own small but enthusiastic membership.

A further boost to the promotion of OCCA in the Trent Valley was achieved when the November speaker, Mrs Doreen Cornelius of Cray Valley Products, was invited to be interviewed on BBC Radio Derby and spoke for a few minutes on the packaging and labelling of dangerous substances (see below) during which the meeting and venue were well publicised.

Has the Trent Valley branch achieved a first in radio for OCCA?

Packaging and labelling

The second technical meeting of the Trent Valley Branch took place on 25 November at the British Railways School of Engineering, Derby, when Mrs Doreen Cornelius of Cray Valley Products presented a paper with slide illustrations entitled "Packaging and labelling – how to stick with it".

The subject matter of the paper centred around the Health and Safety Commission consultative document "Proposals for Classification, Packaging and Labelling of Dangerous Substances Regulations 1988".

The document is based on UN classifications and its intention is to make hazardous materials recognisable by an appropriate label which must conform to the guide lines in the proposals.

The object of the label is to inform, advise or instruct, attract and warn and will consolidate all the information necessary to the user.

The current UK labelling requirements embody the Poisons Act, Petroleum Consolidation Act, Highly Flammable Liquids and LPG Regulations, Transport Regulations, 1974 Health and Safety at Work Act, and the EEC current and projected legislation.

The labelling information must include the name of the substance or preparation, name and address of the manufacturer together with an emergency telephone number, hazard indication symbol and nature of risk, a

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risk phrase and safety phrase, preventative advice, and effects of hazard. Transport labels are in the form of a red diamond with the appropriate hazard symbol, name and address and telephone number to contact in emergencies. The hazard symbols used are those to denote explosive, oxidising, highly flammable, toxic, corrosive, irritant, and harmful. If the product is to be exported the label must be in the language of the manufacturer as well as that of the country for which it is destined.

The information given on the label should be supported by a supplementary information sheet giving full Health and Safety Data including disposal of spillages and containers.

Finally, Mrs Cornelius summarised the ECOIN and EINECS legislation. The main criteria requirements for reporting for inclusion in EINECS are that the item must be a substance, element or compound, polymers should not be reported but substances used in their manufacture should be, the product should have been on sale between 1 January 1971 and 18 September 1981, and must be reported on one of the official forms before 31 December 1982.

After a very lively discussion which highlighted some of the problems envisaged by members, a vote of thanks was proposed by Mr S. Watson and was heartily endorsed by all present.

J. C. Ellis

Manchester

Short communications from the 1982 "Discourse in surface coatings" Friday 24 September

Morning session – "Equipment and dispersion"

The chairman of the morning session, Leslie Silver, OBE, opened by referring to the concern he felt with the economic climate and the effect on future confidence. In a difficult economic climate a *flood of imports* (no reference to the attendance of G. T. Flood from Scotland intended) in the shape of the increasing volume of paint imported into the UK was a disturbing trend. At this juncture Leslie declared his company's interests, i.e. SPL's tie-up with a European manufacturer, though the effects, if any, on the importation of paints are not known.

Bill Black of ICI described his many years in pigment dispersion and posed the following points:

1. Why dispersion?
2. Cause of dispersion
3. Practical dispersion
4. Contributions from pigment manufacturers
5. Potential problems for the future

Howard Sullivan of DH Industries gave a very detailed answer to the question of dispersion. He commenced by

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noting that 1982 was the "silver" (25 years) jubilee of the original sand mill (Du Pont). Historical development over this period included a progression thus:

Ball mills – high speed disperser + sand mill – importance of premixing – the philosophy of diameters, i.e. 1D → 3D, 4D – no dead spots.

Concurrent to the morning session on "Equipment and dispersion" was a session on "Resins and vehicles" chaired by Professor John Bevington of the University of Lancaster and assisted by W. G. Topham of Goodlass Wall and W. P. I. Baily of Vinyl Products Ltd.

After a professorial introduction contributions were received on subjects related to the session's title, e.g.:

Economic aspects – no sense of urgency – 20 years of oil remaining. Vegetable oil fatty acids – competition from food consumption.

Resistance to new products unless they exhibit improved performance at a lower cost.

Today it's petroleum shortages – will it be titania ores tomorrow?

Does paint suffer from built in obsolescence?

The Forth Railway Bridge – red lead in oil – satisfactory?

The Forth Road Bridge – "modern system" – unsatisfactory?

Discussion of polymers, oligomers, molecular weights and the inter-relationship affecting film properties and degree of crosslinking brought the morning session to a thought provoking close.

Afternoon session

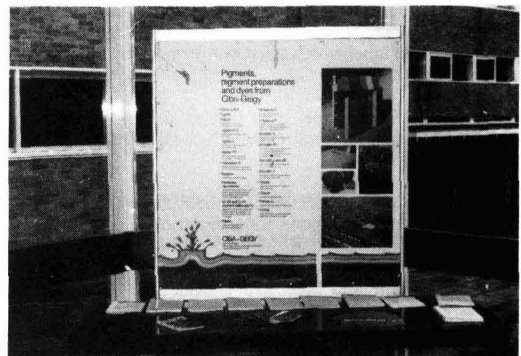
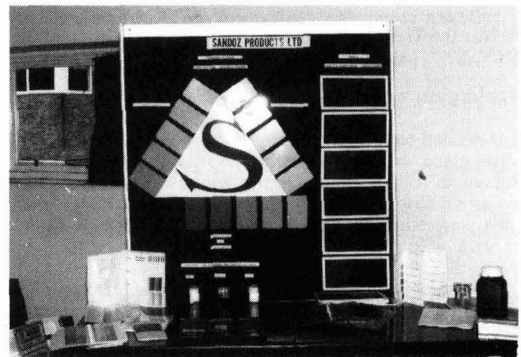
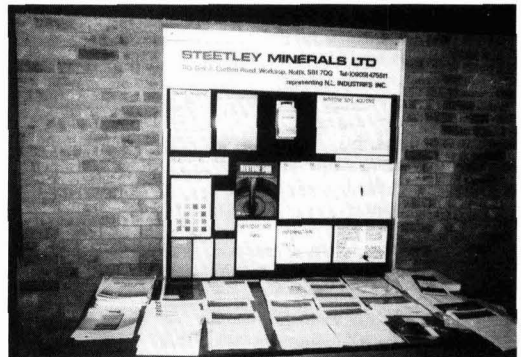
Under the chairmanship of Jack Mitchell of Crown Decorative Products and supported by discourse leaders Geoff Flood, Ciba-Geigy Pigments, Paisley, and John Rackham, BTP Tioxide Ltd, the subject of pigments and additives was discussed.

Geoff Flood, who has 13 years experience in the pigment using surface coatings industry and the last seven years in the Plastics Technical Services Laboratory as manager, made his contribution based on the following format:

The pigmentation of different types of paint was discussed highlighting the need for different approaches to be made when pigmenting them.

Emulsion paints

Normally these are coloured via paste dispersions. It is difficult to disperse most coloured pigments into aqueous



Some of the 13 stands, which were manned all day, at Manchester Section's "Discourse in surface coatings"

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systems via high speed mixers hence the need for pastes. As most emulsion paints are used internally they do not have very high lightfastness requirements.

Oil-based decorative paints

Inorganic pigments are mostly used in the colouration of decorative paints, which are frequently shaded with organic pigments to brighten and intensify the shades. Chrome pigments were extensively used to produce yellows and reds with opacity at a given shade usually being achieved by adding titanium dioxide.

Industrial finishes

"Horses for courses" is very much the watchword with industrial finishes. Pigment selection will depend to a very large extent on factors such as solvent combination, curing schedule, catalysts and the environment where the finish will be used. Very often high value pigments are the only possibility, having the right blend of colour with acceptable resistance properties.

Other additives

Brief mention was made of additives such as wetting aids, anti-settling aids etc.

John Rackham with 30 years experience is technical service manager with BTP Tiioxide. John's contribution had both a provocative and rhetorical theme which was presented under a number of headings including:

The biggest individual raw material bill is often for TiO_2 .

Do you get value for money?

Are there alternative forms of white opacity?

Many additives work by promoting flocculation – are they necessary?

Additives are used far too frequently as substitutes for poor formulation – true or false?

In the Colloquium Room Michael Leveté of the Paintmakers Association was assisted by David Clayton of Crown Decorative Products and D. J. Reynolds of Berger Jensen & Nicholson in discoursing the subject of "Environmental constraints".

The opening remarks involved reference to:

It is becoming more difficult to run a factory.

The vagaries of labelling were fully discussed, including comparison between EEC and Third World requirements.

An alternative to following legislation is to move the factory to a country not subject to the legislation.

Product liability – is it coming? In order to claim damages it is necessary to prove a fault in the product.



Discourse leader Geoff Flood of Ciba Geigy Pigments Division is seated on the left with session chairman Jack Mitchell of Crown Decorative Products on the right



Eric Hurst, one of the organisers of "DISC"



John Rackham of BTP Tiioxide gave a presentation on pigments and additives that had both a "provocative and rhetorical theme"



Seen above is George Topham of Goodlass Wall who assisted W. P. I. Baily of Vinyl Products Ltd and Professor J. Bevington (session chairman) with the session on "Resin and vehicles"

The PA offers insurance for its members – no takers – do they have very few claims or good insurance already?

Lead in paints – should lead driers be included in legislation? Present opinion is that the level is very low, but lead is an emotive issue.

Frank Redman, in his closing remarks to the delegates that had attended this successful OCCA discourse, paid special tribute to the organisers, led by Eric Hurst, John Ebdon of Lancaster University and last, but not least, the chairmen of and from industry, accompanied by Lancaster University's John Bevington.

The preservation of paint systems

The All Saints lecture theatre, Manchester Polytechnic was the venue for this presentation on Monday 8 November 1982 given by Dr Frank Hauxwell, recently technical service manager of ICI – Biocides Division and now customs synthesis business manager, ICI Organics Division, Speciality Chemicals. The lecturer commenced by discussing the historical background of ICI followed by reference to the effects of health and safety legislation and the need for the supplier to build a close relationship with the customer in the interests of problem solving.

It was stated that the preservation of paint had an alliterative aspect by reference to problems, products, pros and cons and protocols. Recent enquiries had shown a demand not only for the protection of dry films from fungus but also for protection against algae. A further important point made was that the market contained a wide spectrum of products for preserving paint films but as there were no new products a "log jam" effect had occurred.

The effects of the European Core Inventory new regulations were discussed as well as the resultant commercial risks of introducing new products.

Ray Stott proposed the vote of thanks which was received with unanimous accord.

F. B. Windsor

Pigments for inkmakers

Following his lecture on a similar topic to the student branch in early 1981, Dr J. D. Sanders of the Pigments Division of Ciba-Geigy Plastics and Additives Company addressed the Manchester Section on Friday 8 October on "Pigments for inkmakers" at the Crest Motel, Bolton.

The lecturer referred to the traditional suspicion of inkmakers for the unknown additives they assume are used by their suppliers. He said that his talk was intended to dispel some of this mistrust by explaining in elementary terms the approach used by pigment chemists to obtain the pigment properties which inkmakers require.

Pigments are defined as colouring matters which are insoluble in the medium in which they are applied. In printing inks the pigmentation is often relatively high and as a result a combination of high print strength together with good flow, transparency and gloss is needed. Unfortunately the techniques used by the pigment chemist to get high strength, good gloss and transparency have the effect of reducing the flow of the ink. The lecturer described the ways in which particle interaction can be controlled to obtain an acceptable compromise.

The chemical modification of hue is a complex subject but it usually applies that simple azo compounds of low molecular weight are yellow and the shade can be progressively "deepened" through orange and red to maroon and even blue as the complexity increases. There are a number of exceptions but in general the introduction of nitro, methoxy and ethyl groups accentuate this effect whereas chlorine causes a hue shift in the contrary direction.

The lecturer went to some lengths to show that pigment properties can often be predicted from a knowledge of their chemistry. Obviously toner pigments (insoluble salts of water soluble dyes) are converted to a soluble form in the presence of soap and alkali; on the other hand it is predictable from their chemistry that they will have good resistance to organic solvents. Similarly azo pigmentary colours of low molecular weight could be expected to be soluble to a significant degree in organic solvents but, with increasing molecular weight and the correct choice of substituent groups, this can be controlled. For example, the diarylide yellow pigments have twice the molecular size of their mono-azo analogues and their solvent resistance becomes much more acceptable for printing ink applications.

Easily dispersible pigments have created particular suspicion on the part of inkmakers that they contain exotic and unwelcome additives, but often this is not the case. The technique of keeping particles separate during drying, so that large forces are not required to separate them during dispersion, is usually more a matter of pigment manufacturing technique than the use of unusual additives.

The lecture concluded with a brief discussion of pigment toxicity, which is a subject of perennial concern since consumer organisations and employers' organisations are sometimes tempted to overreact. Salts of toxic metals (lead, chromium, barium) are obviously to be avoided in foodstuffs packaging. Similarly, substances known to be carcinogenic in humans are not nowadays used, but materials of similar chemical type are naturally viewed with suspicion and must be handled with due care. This is largely a matter for the pigment manufacturer rather than the inkmaker. The lecturer advised the latter to eliminate hazards wherever practicable, e.g. by encouraging sensible package design, to keep a sense of proportion about the degree of hazard involved and never to quote figures which might then be adopted as toxic limits.

The lecture provoked questions on a variety of topics including the effect of different metal ions on hue, resistance to flocculation and an intriguing but little known blue azo pigment, CI Pigment Blue 25.

Mr Norman Piper proposed a vote of thanks. The meeting was attended by 36 members and guests.

J. D. Sanders

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

Berger saves thousands using NS software

Berger Paints has completed the introduction of NOR-SAL2, the real-time database sales ledger package, developed by Northern Software, which is reportedly helping the company to save hundreds of thousands of pounds.

The significance of a real-time system is that the files of information stored on the computer are instantly updated at the moment each transaction is made through a terminal. NOR-SAL2 enables routine debt chasing, cash allocations and the maintenance of the sales ledger to be fully automated.

The important result and major reason behind the implementation of the package is that credit control staff now have the means of identifying quickly those customers in need of personal attention and have more time for chasing outstanding balances. Berger Paints issues 20,000 invoices a month to 8,000 customers and the reduction of the outstanding debt by just a few days has resulted in a saving of several hundreds of thousands of pounds.

Northern Software won the order only after a very thorough investigation and search of the world's software market by Berger to find a suitable real-time database package.

Reader Enquiry Service No. 31

Baxenden purchase Witco

The Baxenden Chemical Co. Ltd has acquired Witco Chemical Ltd's Droitwich factory and the businesses which were carried out on the site.

The manufacturing activities and services remain unchanged, and production of polyester resins, surfactants and speciality coatings will continue at the Droitwich factory.

Baxenden is said to be one of the UK's leading manufacturers of urethane chemicals, speciality acrylates and speciality organic chemicals.

Reader Enquiry Service No. 32

Slate powder filler

H. Haeffner and Co. Ltd has been appointed agent and distributor for the Delafila range of slate powders and granules produced by Delabole Slate Ltd.

According to Haeffner, slate powder is an excellent mineral filler for use in all types of industrial coatings, roofing felts and tiles, bituminous mixes and as a low-cost filler in plastics.

Haeffners will stock and distribute all grades of Delafila.

Reader Enquiry Service No. 33

Autochem and Synthite combine resources

Autochem Ltd and Synthite Ltd have agreed to combine their resources to market a range of specialised automotive refinishing chemicals throughout the British market during 1983.

Synthite products will be distributed by Autochem to over 1,000 automotive trade outlets throughout the UK.

Autochem distributes a wide range of thinners and solvents to the automotive refinishing market. These include a full range of virgin and reclaimed cellulose thinners, turpentine substitute, white spirit and associated products.

Synthite already manufactures paint strippers and other surface preparation chemicals, and a full range of maintenance and cleaning chemicals which are widely used throughout industry.

Reader Enquiry Service No. 34

Harshaw representative

Westlairs Ltd has been appointed exclusive representative within the UK and Eire for the sale of the corrosion test cabinets (salt-fog and SO₂) manufactured by the Harshaw Chemical Company of Cleveland, Ohio, USA.

Reader Enquiry Service No. 35

new products

New TiO₂ pigment

Tioxide R-TC60 is a new chloride pigment produced by the Tioxide Group (which claims to be the world's second largest manufacturer of titanium dioxide pigments) and has been designed for use in applications that demand the highest level of durability.

According to Tioxide the new pigment is specially designed to give superb gloss retention and chalk resistance in all durable polymers. The organic treatment on the pigment is said to ensure excellent dispersion such that it can be readily dispersed in most polymers using a high speed impeller mill. Tioxide R-TC60 is claimed to be flocculation resistant and to give coatings of the highest gloss and opacity.

Whiteness, brightness and resistance to colour change are described as outstanding, while it is also claimed that the pigment produces exceptionally clean tints.

Reader Enquiry Service No. 36

news



Mindon's Superstatic, suitable for hand-held or automatic operations

Re-designed Mindon Superstatic

Mindon Engineering (Nottm) Ltd has recently completed a new substantially re-designed version of the successful Superstatic powder paint coating system.

Reader Enquiry Service No. 37

Thermotitrator

The rapid, routine quality control analysis by titration of slurries, pastes, semi-solids, creams, oils and fats may now be achieved with the new Howe thermotitrator. Changes in temperature during a reaction are measured using a thermistor and electrical bridge system, thus allowing titration to be performed on many semi-solids and viscous materials which cannot be titrated by traditional methods. The equipment is based on research work conducted by Professor L. S. Bark of Salford University. Thermotitration can be applied to almost any reaction provided the substrates can be stirred and the reaction is chemically tailored to be specific for the active group being analysed.

Reader Enquiry Service No. 38

New range of scales from Sauter

Sauter has produced a new range of scales to cover the whole spectrum of industrial weighing applications from 15-6,000 Kg. The new range, known as the Sauter Multirange, is said to have a very high degree of accuracy and to be totally water and dustproof.

Reader Enquiry Service No. 39

Dilute suspension particle analysis

The size of rigid particles in colloidal suspensions such as paints can be measured very accurately and rapidly using electro/optical birefringence effects, according to a Data Laboratories Ltd release published recently. The Data Lab release goes on to say that the data resulting from these tests can be stored and processed very simply using a waveform recorder, such as Data Lab's DL1080. Other applications include dipole moment determination of all particles and rapid analysis of particle aggregations.

Optical birefringence is a property that electrically polarised materials exhibit. If a large DC electric field is pulsed near a colloidal suspension the polarisation axis of all the particles in the suspension will tend to align with the field direction. The relaxation time of the particles is proportional to the particle mass and inversely proportional to its moment of polarisation.

In a practical set-up, a beam of collimated light, from an industrial laser, is directed into the colloid perpendicular to the plane of the electric field. The beam will be split, due to particle alignment, into the normal refracted beam and a birefringent beam. This second beam is sensed by a photodetector and its intensity is proportional to the degree of alignment of the colloid particles with the electric field.

The system can be fully automated for industrial applications to give fast calculations and hard copy of particle size and distribution. The system has to work in real-time to give the rate of particle relaxation and therefore the particle size. In practice, the output from the light sensor is connected to a Data Lab DL1080 waveform recorder controlled by a microcomputer such as the CBM-PET. Data Lab now supplies a data transfer software package for this application together with a software control package. Firmware is also available for the DL1080 for hard copy output to a digital plotter.

This arrangement, it is said, can be used to evaluate the size and electrical characteristics of macromolecules and macroparticles in a dilute solution or suspension very quickly. The DL1080 stores the data from the photodetector and being fully bus controllable, can perform a series of data manipulative sequences to give the required output fully automatically to the computer or plotter. The DL1080 contains as standard the "intelligence" to calculate

gradient, maximum points and area under the curve, which saves time and software overhead in such applications. The system can be used for particles of the order of 1 part in 10^5 . This is claimed to give a larger range of sizes than many other methods of measurement, at a relatively low cost.

Reader Enquiry Service No. 40

New approach to effluent treatment

System CP is a new approach to effluent treatment which, it is claimed, can cut disposal costs throughout the paint and surface coatings industries. Launched by Polymericol Ltd, the new system is designed to deal completely with the waste water disposal problems encountered by small to medium sized companies. System CP can also be used to supplement existing plant through the segregation and individual treatment of particularly troublesome elements of the mainstream effluent.

Tankering away raw effluent or discharging direct into a sewer has become increasingly expensive, whilst the capital investment required for a traditional treatment plant is impractical for many firms. Based on a series of unique reactants and an innovative plant design, System CP offers, according to Polymericol, a straightforward and low-cost means of removing solids, colour, heavy metals, solvents and other contaminants from waste water, and is particularly useful for oily effluents where the stability of certain emulsions negates the use of many conventional treatments.

Full sludge de-watering facilities are included in the plant to reduce volume and therefore minimise the cost of removing solids from the effluent. Additionally, the inherent chemical encapsulation of many toxic substances by the system's reactants can eliminate the need to tip the concentrated sludge on approved sites. In some situations, the high quality of the final discharge may allow for water re-circulation, cutting both fresh water extraction and effluent volume disposal charges levied by the water authorities.

Reader Enquiry Service No. 41

New GC series from Siemens

Siemens has adopted what is described as a new approach to gas chromatography with the Sichromat series of single and double channel instruments. The new system features what is said to be a unique oven with optimal accessibility to the column system from three sides. A single or double oven is available, all ovens being completely independently thermostatically controlled, with motor driven adjustable mantles which enable quicker, safer cooling down of the oven.

A wide range of modular detectors and injectors offer great variability by using standardised fittings, permitting quick

and simple change-over. Each module is self-sufficient in that it has a temperature sensor, heating system, thermal insulation and is coupled directly to the columns.

Another unique feature of the Sichromat is described as the "valveless column switching for live chromatography". This means that the standard chromatographic column switching technique, such as back flush and heart cut are performed without any switching valves in the sample path. Thus there is a high degree of operational reliability, small dead volume and higher separation performance, thus much shorter analytical times.

In the double oven system two different metal or glass columns can be connected but operated under different chromatographic conditions, e.g. packed linked to capillary columns, capillary to capillary columns, or packed to packed columns all in vertical or horizontal configurations.

Reader Enquiry Service No. 42

Level switch for solids or liquids

Flowline Systems Ltd is manufacturing a new level switch system for liquids or solids.

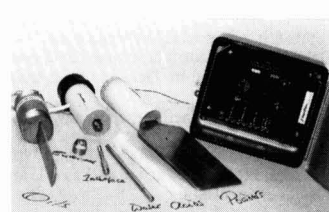
The system comprises a probe, a sensor head and support electronics, and the principle of operation is based on a radio oscillator transmitting a weak signal from the probe. A disturbance in the area of the probe by media covering it will cause oscillations to cease and a relay to be actuated.

The probe differs for different applications, allowing the unit to operate on both liquids and solids. Liquids may be conducting or non-conducting and Flowline says hot oil, tar, paste, slurry, sewage and waste of all kinds have been satisfactorily switched.

The probe can tolerate any amount of build-up without effect on the switching point. A major feature of the probe is its ability to be mounted remotely from the sensor, and, as it consists only of an insulated metal rod, it is capable of withstanding very high temperatures.

The probe may be designed to operate externally through a glass or plastic tube or from outside a plastic container.

Reader Enquiry Service No. 43



Flowline's level switch shown with four probes for various media, from left to right: for oils, water, acids and powder

New refrigerated centrifuge

Baird & Tatlock has launched a refrigerated version of the MKIV autobench centrifuge. The new machine includes the full complement of safety features of its ambient cousin, but also possesses a working temperature range of +2°C to ambient.

Reader Enquiry Service No. 44

Rectangular dust collectors

Dustcheck Ltd has introduced a range of rectangular dust collection filters. Six sizes of housing are available, offering filtration areas from 10 up to 60 m² in size.

These supplement an existing range of circular units, but are claimed to show cost savings of up to 10 per cent for the larger sizes. The new collectors utilise the well established Purolator large area micronic filter cartridges and are compatible with all general industrial dust control requirements, with venting varieties also available for silo applications. These new Dustcheck rectangular filters are claimed to utilise considerably less floor area than other competitive units and are supplied complete with integral fan, collection hopper and an automatic mechanical shake cleaning system. Optional extras include acoustic hoods and explosion relief panels, together with weathercowl and shaker controls for the silo varieties.

Reader Enquiry Service No. 45

literature

Australian raw materials index

OCCA Australia has published the fifth edition of its "Raw materials index".

The comprehensive index covers the following topics: pigments, resins, solvent, oils and intermediates, additives, laboratory equipment, and specialised services with indexes on products, suppliers, and agencies.

The publication is A4 size and is available at a cost of A\$50.00 including postage (surface air lifted) from: Mr R. E. Walton, Laporte Group Australia, 20-22 McPherson Street, Banksmeadow, NSW 2019, Australia.

Reader Enquiry Service No. 46

Size reductions

A new booklet is available from Fritsch GMBH entitled "Size reduction in the laboratory" which contains some useful guidance for people setting up or developing sample preparation facilities. In particular, some of the application technology which is supplied with the text in the form of tables could be very useful.

Reader Enquiry Service No. 47

Epoxy resins study

"Epoxy resins" is the subject of a new techno-economic multi-client study to be undertaken by Skeist Laboratories, Inc., consultants to the polymer industries.

According to Skeist Laboratories, epoxy resin is the polymer for all seasons. High in performance yet moderate in cost, it fits into a wide variety of industrial applications and thus is more resistant than other materials to the vagaries of the business cycle. US production exceeds 300 million pounds, with a value approaching 400 million dollars.

Epoxyes are one of the leading coating vehicles found in OEM product coatings and special purpose coatings because they excel in adhesion, heat resistance, hardness and corrosion resistance. They are the preferred primer coat for metal coatings and are very much in the forefront of the newer technology systems. About half of the epoxy resin destined for coatings is high solids, water-borne or powder. As the coatings industry continues to replace traditional coatings with less polluting and environmentally safer systems, epoxy resin should benefit immensely.

Epoxyes were the first engineering/structural adhesive to be commercialised. For over three decades, consumption of the "miracle glue" has kept on increasing, in spite of competitive forces such as cyanoacrylate. Epoxy film adhesives have become indispensable components in the building of aeroplanes. Conductive epoxy adhesives, filled with silver powder or flakes, enter a variety of electronic applications.

The total subscription fee for early subscribers (before 1 March 1983) is US\$5,000. A free brochure, with a tentative table of contents, is available by completing the Reader Enquiry Service form at the back of the *Journal*.

Reader Enquiry Service No. 48

Zinc

The Zinc Development Association has published a new edition of one of its basic leaflets on zinc. "Zinc production, properties and uses" is in effect an up-to-date encyclopaedia article on zinc. After a brief outline of where zinc is mined, produced and consumed, there is an account of the ores and their preparation followed by a description of thermal and electrolytic zinc production. The main uses are then covered under the headings Zinc coatings, Die castings, Brass, Other alloys, Superplastic zinc, Rolled zinc, Anodes for cathodic protection, Zinc oxide, Zinc dust and Lithopone. Summaries are given of the main physical and mechanical properties of pure zinc, a zinc die casting alloy, the gravity casting alloy ZA12 and a typical rolled zinc copper titanium alloy.

The leaflet, available free on request from ZDA or by completing the Reader

news

Enquiry Service form at the back of the *Journal*, is meant primarily for teachers and/or students of metallurgy, materials science or engineering.

Reader Enquiry Service No. 49

Specs and standards service

London Information, the Ascot-based specifications, standards and technical documentation "supermarket", has just produced a leaflet on its latest services, which include a free advisory service.

Reader Enquiry Service No. 50

meetings, etc.

Polyurethane coatings in industry

A one-day symposium is being held in Nottingham on Thursday 17 March 1983 by the Institution of Corrosion Science and Technology entitled "Polyurethane coatings in industry".

Emphasis will be placed on recent developments in the protective coating of a wide variety of substrates such as metal, wood, foam, concrete etc.

For further details contact the organising chairman, Dr R. W. Saville, Nicklin & Co., Nicklin House, Pleasley Road, Whiston, Rotherham. Tel: 0709-60675

Call for papers

The 9th International Conference in Organic Coatings Science and Technology is to be held in Athens, Greece from 11-15 July 1983. A scientific programme has been arranged and papers for contribution are sought, anyone interested should write to the address below with a view to submitting a summary (of no more than one page) no later than 1 April 1983. For further information contact: Prof. A. V. Patsis, conference director, Materials Research Laboratory, CSB 209, State University of New York, New Paltz, New York 12561, USA.

Industrial rheology

The Massachusetts Institute of Technology is holding a one week special summer programme from 1-5 August 1983 on "Rheology: principles and practice". The programme is to be held at the Institute the address of which is shown below. Further details are

news

available from: Prof. ChoKyun Rha, Biomaterials Science and Engineering, Room 56-137, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA.

OCCA news

York Conference 1983

"Paint finishing in the car industry" by H. L. Quick will be presented in Session IV of the Conference. The summary of the lecture and biography of the author are shown below. All other summaries and biographies were published in the January 1983 issue, pages 28-36.

Paint finishing in the car industry

H. L. Quick

Summary

The paper outlines the basic procedures currently used worldwide for the painting and protection of motor bodies and examines the evolutionary changes which have occurred in the last decade or so.

It examines the prospects for future body materials, and the finishing considerations which may arise as a result of the quite significant changes in materials of construction held by some to be imminent.



H. L. Quick

Biography

A metallurgist by profession, H. L. Quick, FIM, FIMF joined the old

people

Following its separation from Berger Paints, Resinous Chemicals Ltd now becomes a trading company in its own right and remains a wholly owned subsidiary of Berger, Jenson & Nicholson Ltd.

Mr W. M. Collins, a director of BJN, is appointed chairman and Mr C. H. Morris becomes managing director. Colin Morris

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

Humber Motor Co. Ltd in 1948 as a materials engineer to inaugurate a materials development activity. In the early days of this appointment he became closely associated with all aspects of the development of body finishing processes and materials, which has remained a personal interest over the intervening years.

In 1969 he was appointed chief materials engineer for the Rootes Group, subsequently retaining that position when the company was taken over by Chrysler Corporation. The later take-over of the Chrysler interests in the UK and Europe by Peugeot saw H. L. Quick appointed executive engineer, UK Engineering Services, in which appointment he deputises in the UK for the French director of engineering.

Mr Quick has presented many papers over the years on the subject of autobody protective systems as well as papers on the wide ranging subject of materials in automobile engineering.

News of members

A. C. Jolly, resin consultant

A. C. (Tony) Jolly is currently active as a resin consultant in technical, marketing and public relations matters connected therewith. He recently gave a paper in Edinburgh to the IRM '82 Conference for and on behalf of Crown Protective Coatings, a division of Crown Decorative Products Ltd; the title of the paper was "Moisture-curing polyurethane paints". He has also been retained by Scott Bader in a technical consultative capacity to their Polyester Division.

Auckland Section

Perfumery

OCCA Auckland's November meeting was on a topic of general interest for members and their spouses. It attracted 52 in all to hear Mr Merv Cunningham, marketing manager for Christian Dior

is at present a member of OCCA's Exhibition Committee and has had extensive experience in other posts on OCCA's Council, as well as being a past Newcastle Section Chairman. Mr F. N. Norris, formerly operations director, succeeds Colin Morris as commercial director and Mr J. W. Mason is appointed company secretary.

Following the completion of new office accommodation in December, the administration offices have been transferred from Portland Road, Newcastle, to the Dunston site.

(cosmetics) in New Zealand, talk on perfumery in New Zealand.

A modern perfumer may use up to 3,000 raw materials which are natural products from plants, isolates or distillates from natural oils, and aroma chemicals. Perfume has freshness for a sensation of wellbeing, diffusion to enhance the aura the user projects, tenacity for a life of up to six hours, and harmony for a gradual evolution of the perfume.

Perfumes can be visualised as top, middle or base notes but they are interwoven. The floral middle notes of jasmine, rose etc. play a part in the development of the top and base notes. Top notes are citrus, fruity, green or aroma chemicals, and base notes are wood, oriental, animal, amber, mosses and spice. Jasmine is the most important middle note, and five million petals are picked with the morning dew on them to give one kilogramme of essential oil!

In the early 1800s perfumes were created for individuals and by 1920 were still a luxury product. Traditional perfumery houses then became less dominant and by 1950 there was a greater proliferation of products and with the increase in cost of launching a perfume a larger middle market developed. The French domination until 1970 was eroded by the American producers for the mass market. A few well-known names have been long established, Chanel No. 5, 1921; My Sin, 1925; Shocking, 1935; and the oldest male fragrance, Imperial EDC, on the market since 1860.

A. Macdonald

Scottish Section

Golf tournament

The annual Scottish Section golf outing was held at Aberdour, Fife, on 7 May 1982 in glorious sunshine despite the fact that the course had been covered with two inches of snow the previous day.

Members and guests enjoyed a good lunch before launching into the tricky and

treacherous course in this picturesque seaside town.

Once again Mr Hugh Munro won the Whittaker Trophy with an outstanding eight under par round, as well as the major share of the sweep. (He still maintains it is luck!) Mr Tom Kirkwood not only won the Morris Ashby Quaiich for the best scratch score with a gross 71 but also the BTP Tioxide Tankard for the most improved player with a four stroke improvement over last year's score. Runners up on the members side were Mr Brian Donaldson and Mr Nigel Baird.

The Visitors' Shield was won by Mr Bill Jack, and the runner ups were Mr Willie Milne and Mr Fred McIntosh.

The prizes were presented by Mr John Toovey, the Chairman, who fortunately just managed to avoid collecting the booby prize. We would like to record our thanks to the following companies who supplied prizes: Ciba-Geigy, Shell Chemicals, A. G. Paterson, Samuel Banner, Federated Paints, TR Chemicals, BTP Tioxide, Strathclyde Chemicals, C-Cure Coatings.

Ladies' evening

A social evening was held in the Albany Hotel, Glasgow, on 30 April 1982. Mr Alec Hearne, MBE gave a talk on hypnotism coupled with an amazing and hilarious demonstration of his skills on members of the audience. Not only did Mr Hearne try to help smokers give up the terrible weed but also foretold of the Chairman's future which came to fruition some two months later.

Forty-six members and guests enjoyed a buffet afterwards.

J. Toovey

Jordan Award

The Jordan Award Committee now invites applications for the eighth award of £100. The rules of the Award are:

1. The Award will be 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.

2. The final date for submission of applications will on this occasion be 31 December 1984 and it is hoped to present the award at the Association's Conference in the following year.

3. The selection of the recipient of the Award will be made by the Jordan Award Committee under the chairmanship of the Association's Hon. Research and Development Officer.

4. There will be two methods of application. First, by the submission of a paper describing original work by the candidate which is offered for publication in the *Journal* or has been so published during application. The alternative method will be by recommendation by 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 candidate's own contribution will be required if a paper is offered under joint authorship.

5. Applications should be addressed to the Director & Secretary at the Association's offices.

The publications listed below and their prices are obtainable from: BSI Sales Counter, 195 Pentonville Road, London N1 9ND (personal callers), BSI Sales Department, 101 Pentonville Road, London N1 9ND (orders by post). Telephone: 01-837 8801. Telex 23218.

British Standards

684: Section 1.10: 1982 Determination of moisture and other volatile matter 4 page A4 size Gr 2

Describes determination of loss in mass by drying using a sand bath, hot plate or drying oven. A third method uses nitrogen to remove volatile matter. Supersedes BS 684: Section 1.10: 1976 =ISO 662. (ISBN 0 580 13052 5)

3483: PVC/1 Methods of testing pigments for paints 3483: Part B3: 1982 Determination of residue on sieve (water method, manual procedure) =ISO 787/7| 4 page A4 size Gr 2

Specifies a manual method for determining the residue on a sieve of a pigment or extender dispersed in water. (See also Part B4). Supersedes BS 3483: Part B3: 1974. (ISBN 0 580 12935 7)

3483: Part B6: 1982 Determination of matter volatile at 105°C = ISO 787/2| 4 page A4 size Gr 2

Specifies a general method for determining the mass of matter volatile at 105°C in a pigment or extender. Supersedes BS 3483: Part B6: 1974. (ISBN 0 580 12936 5)

3483: Part B7: 1982 Determination of oil absorption value =ISO 787/5| 4 page A4 size Gr 2

Specifies a general method for determining the oil absorption value of a pigment or extender. Supersedes BS 3483: Part B7: 1974. (ISBN 0 580 12937 3)

3483: Part B8: 1982 Determination of density (Pyknometer method) =ISO 787/10| 6 page A4 size Gr 3

Specifies two methods for determining the density of a pigment or extender by using a pyknometer. (See also Part B9). Supersedes BS 3483: Part B8: 1974. (ISBN 0 580 12938 1)

3483: Part B10: 1982 Determination of tamped volume and apparent density after tamping = ISO 787/11| 6 page A4 size Gr 3

Specifies a general method for determining the tamped volume and the apparent

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new members

The section to which each new member is attached is shown below in italics.

Ordinary members

Bennett, G. H. (*Thames Valley*)
Braidwood, C. (*Scottish*)
Christensen, G., MSc (*General Overseas - Denmark*)
Edmondson, D. L., MSc (*Auckland*)
Henwood, M. B., BSc (*Auckland*)
Jenkins, C. H., LRSC (*Manchester*)
Lambert, W. G. E. (*Thames Valley*)
Mace, P. J., LRSC (*London*)
MacGregor I. D., BE (Civil) (*Wellington*)
Nisbet, P. S., BSc (*Scottish - Eastern Branch*)
Ojunga-Andrew, M., BSc (*General Overseas - USA*)
Orton, S. P., BSc (*Thames Valley*)
Patel, S., BSc (*London*)
Shepherdson, W. D. (*Manchester*)
Smith, L. H., Grad RSC (*Scottish*)
Souter, J. G. (*Cape*)
Thankachan, C., PhD (*Ontario*)
Vermeer, J., BSc (*Ontario*)

Associate Members

Bos, W. Y. M. (*Auckland*)
Bradley, J. J. (*Auckland*)
Hancock, T. R. (*Auckland*)
Hudson, J. T. (*Auckland*)
Leonard, M. (*Manchester*)
Tomlinson, P. A. (*Midlands*)

Registered Student

Radin, G. J. (*Scottish - Eastern Branch*)

**bsi
news**

density after tamping of a pigment or extender. Supersedes BS 483: Part B10: 1974. (ISBN 0 580 12939 X)

3483: Part C3: 1982 Determination of acidity or alkalinity of the aqueous extract =ISO 787/4| 4 page A4 size Gr 2

Specifies a general method for determining the acidity or alkalinity of an aqueous extract of a pigment or extender. Supersedes BS 3483: Part C3: 1974. (ISBN 0 580 12940 3)

3483: Part C4: 1982 Determination of pH value of an aqueous suspension =ISO 787/9| 4 page A4 size Gr 2

Specifies a general method for determining the pH value of an aqueous suspension of a pigment or extender. Supersedes BS 3483: Part C4: 1974. (ISBN 0 580 12941 1)

3900: PVC/10
Methods of test for paints
3900: Part C7: 1982 Pressure test for
stack 3900: Part C9: 1982 Methods for
evaluation of the compatibility of a
product with a surface to be painted |
=ISO 46271 6 page A4 size Gr 3

Specifies procedures for assessing com-
patibility of a paint system with the sub-
strate. No current standard is superseded.
(ISBN 0 580 13031 2)
3900: Part D6: 1982 Determination of
contrast ratio (opacity) of light-coloured
paints using polyester film | =ISO
3906 + Amd 1| 6 page A4 size Gr 3
Specifies a method for determining
opacity of white or light-coloured paint
films. No current standard is superseded.
(ISBN 0 580 13032 0)
3900: Part F9: 1982 Determination of
resistance to humidity (continuous con-
densation) | =ISO 62701 6 page A4 size
Gr 3
Specifies a method for determining
resistance to high humidity under con-
tinuous condensation conditions. (See
also Part F2). No current standard is
superseded. (ISBN 0 580 13045 2)

3900: PVC/10
Methods of test for paints
3900: Part C3: 1971 Hard-drying time
Amendment No. 2 Gr 0 AMD 4119

Reprints

General series
2523: 1966
Lead-based priming paints
Incorporates AMD 3941

Amendments

3900:
Methods of test for paints
3900: Part F2: 1973 Determination of
resistance to humidity under condensa-
tion conditions
Amendment No. 1 Gr 0 AMD 4083

British Standards reviewed and confirmed

2523: 1966
Lead-based priming paints
Confirmed as amended by AMD 3941

3900:
Methods of test for paints
3900: Part B4: 1965 Determination of
lead in low-lead paints and similar
materials
Confirmed as amended by AMD 4044
3900: Part C3: 1971 Hard-drying time
Confirmed as amended by AMD 4119
3900: Part E6: 1974 Cross-cut test
Confirmed as amended by AMD 3893

3900: Part F2: 1973 Determination of
resistance to humidity under cyclic con-
densation conditions
Confirmed as amended by AMD 4082

New work started

Methods of analysis of fats and fatty oils.
Section 2.10 Determination of acid value
and of acidity.
Will describe titrimetric and
potentiometric methods, and will imple-
ment the revision of ISO/R660 FAC/18

Pavement marking paints
Will amend the test procedures to assist
independent assessment of paints claim-
ing compliance with the requirements of
BS 6044: 1981. PVC/26

Powder cement paints
Will revise BS 4764 to allow textural
finishes and to include improved
pigments.

Draft standards for public comment

82/55556 DC Methods of test for paints
(BS 3900). New part. Determination of
the "soluble" mercury content of the solid
matter in paints and of the liquid portion
of water-dilutable paints (ISO/DIS
3856/7)

82/55557 DC Methods of test for paints
(BS 3900). New part. Determination of
natural spreading rate by brush applica-
tion (ISO/DIS 7254).

82/55558 DC Methods of test for paints
(BS 3900). New part. Brush application
of coatings to test panels at a specified
spreading rate (ISO/DIS 7877)

82/55585 DC Methods of test for paints
(BS 3900). New part. Determination of
resistance to cathodic disbonding

82/55734 DC Methods of test for paints
(BS 3900). New part. Sampling of
powder coatings (plastics coating
powders)

82/55735 DC Methods of test for paints
(BS 3900). New part. Determination of
particle size distribution of powder coat-
ings (plastics coating powders) by
vacuum sieving

82/55736 DC Methods of test for paints
(BS 3900). New part. Determination of
the gelation time of powder coatings
(plastics coating powders)

82/55737 DC Methods of test for paints
(BS 3900). New part. Determination of
the storage stability of powder coatings
(plastic coating powders)

82/55738 DC Methods of test for paints
(BS 3900). New part. Determination of
the loss of mass on heating of powder
coatings (plastic coating powders)

82/55755 DC Methods of test for paints
(BS 3900). New part. Temperatures and
humidities for conditioning and testing

(ISO/DIS 3270) (Revision of Appendices
to BS 3900: Part C8 and Part D1)

82/55844 DC Amendment No. 1 to BS
2015: 1965
Glossary of paint terms.

*82/55423 DC Method for the deter-
mination of distillation characteristics
(Revision of BS 4591: 1971) (ISO/DIS
918)

*82/55435 DC Methods of test for
phenol, cresols, cresylic acid and xylene-
ols for industrial use. Part 11 Determination
of crystallizing point of O-, M- and P-
cresol (DIS 1897/11). Part 12 Deter-
mination of distillation range of cresylic
acid and xylene-ols (DIS 1897/12). Part 13
Determination of residue on distillation of
cresylic acid and xylene-ols (DIS 1897/13)
CIC/41

*82/55581 DC General methods of test
for alkyd resins for paints and varnishes
(ISO/DIS 6744). PVC/3
This draft standard is being made avail-
able but, because of its limited interest in
the UK, it is unlikely to be implemented
as a British Standard)

*82/56105 DC Methods of test for paints
(BS 3900). New part. Determination of
colour and colour difference: Principles
(ISO/DIS 7724/1)

*82/56106 DC Methods of test for paints
(BS 3900). New part. Determination of
colour and colour difference: Measure-
ments (ISO/DIS 7724/2)

*82/56107 DC Methods of test for paints
(BS 3900). New part. Determination of
colour and colour difference: Calculation
(ISO/DIS 7724/3)

*82/56117 DC Specification for prussian
blues for paints (Revision of BS 283:
1965) (ISO/DIS 2495)

New ISO Standards

ISO 1247:
Aluminium pigments for paints
ISO 1247: Amendment 1: 1982 1 page B
≠ BS 388

ISO 5916: 1982
Methyl chloride for industrial use -
Determination of impurities - Gas
chromatographic methods 6 page D

ISO 5918: 1982
Chlorofluorohydrocarbons for industrial
use - Determination of inert gas content -
Gas chromatographic method -
General principles 4 page C

ISO 5921: 1982
Chlorofluorohydrocarbons for industrial
use - Analysis by gas chromatography -
General principles 7 page E

ISO 6227: 1982
Chemical products for industrial use -
General method for determination of
chloride ions - Potentiometric method 8
page E

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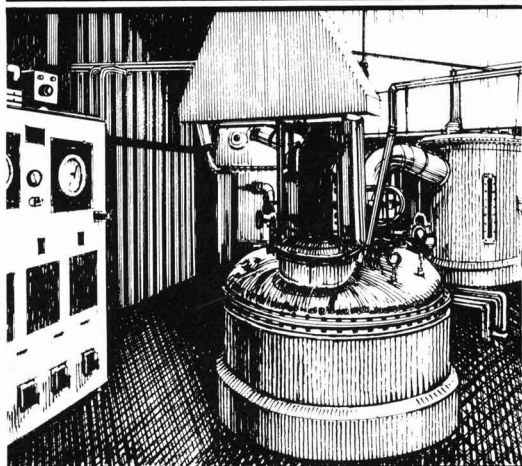


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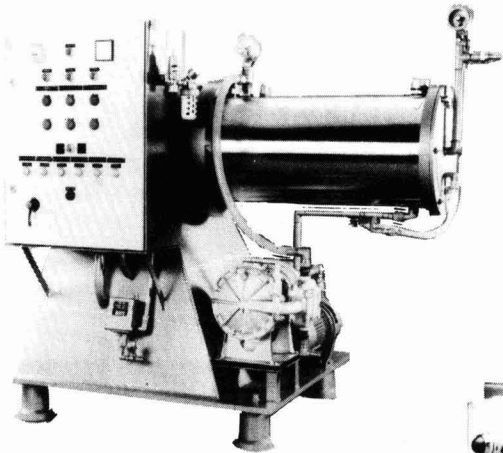
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Reader Enquiry Service No. 213



EIGER ENGINEERING LIMITED

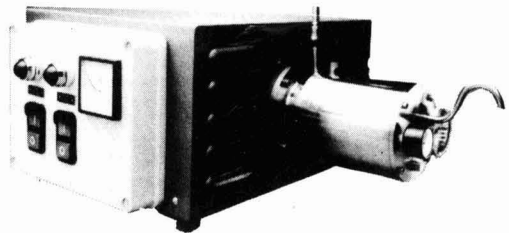
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75 L Automated Motormill

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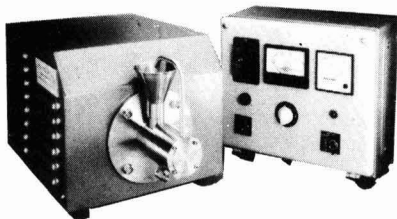
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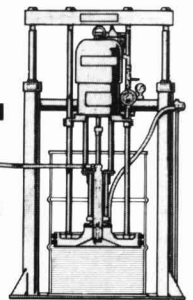
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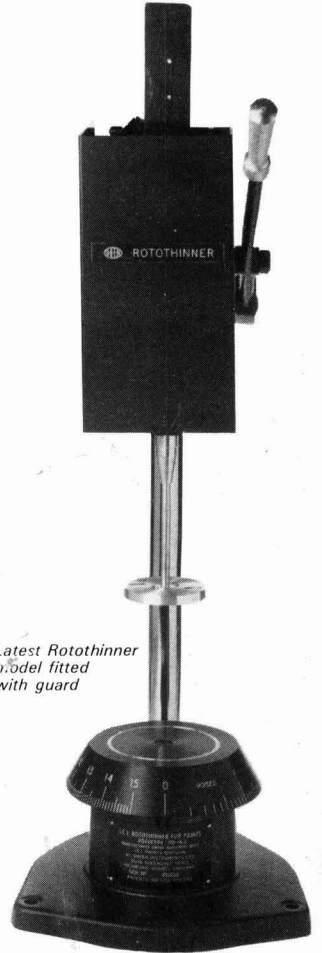
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