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REVIEW on page 222 and complete TECHNICAL REPORT on pages 223-234

JOURNAL OF THE OIL & COLOUR CHEMISTS' ASSOCIATION

The Association apologises for the late despatch of this issue, caused by an industrial dispute in the printing industry

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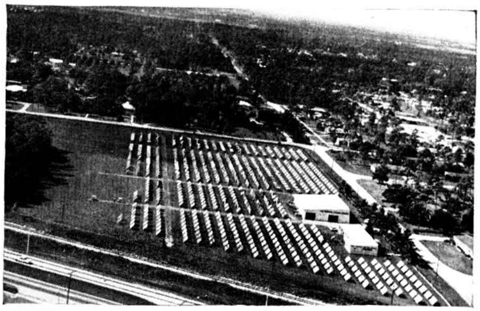

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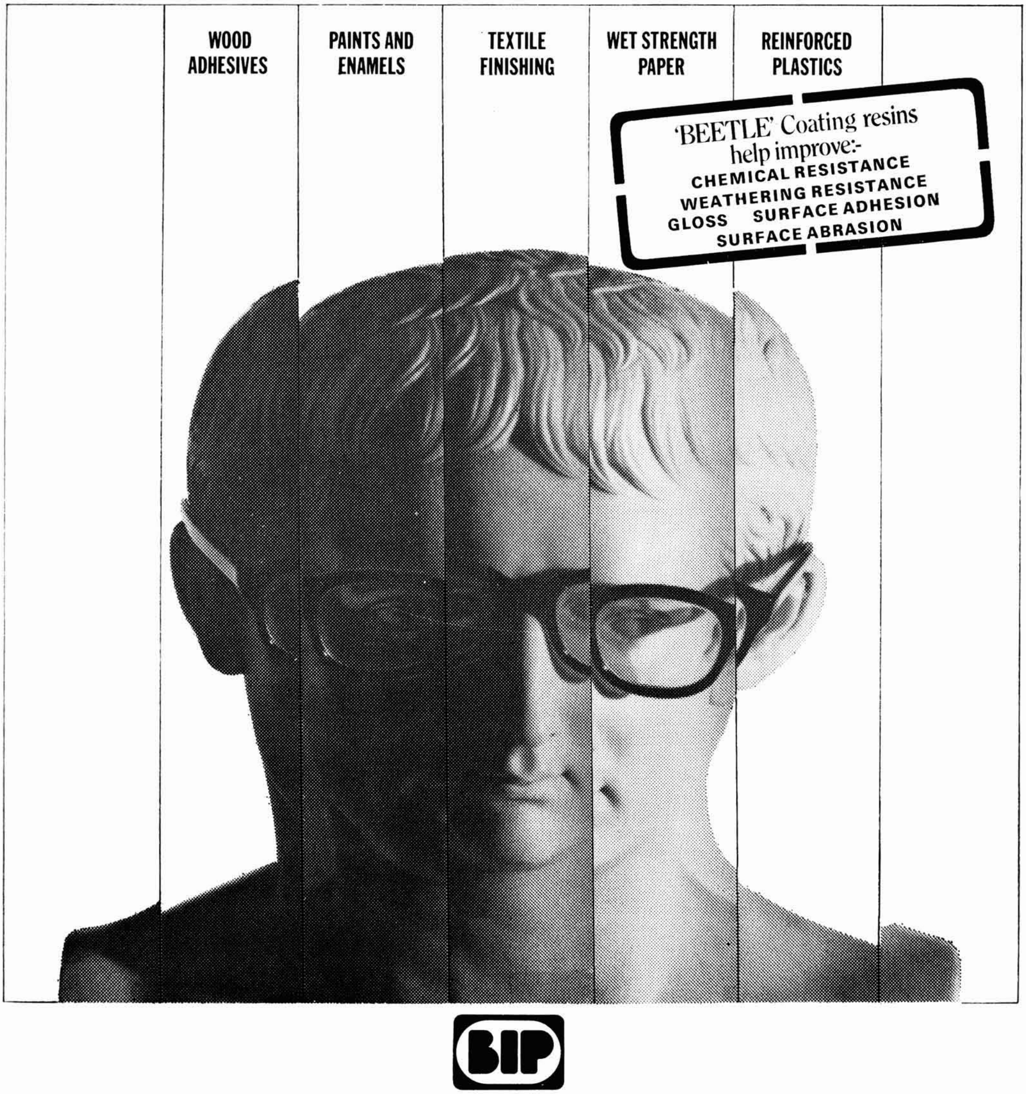
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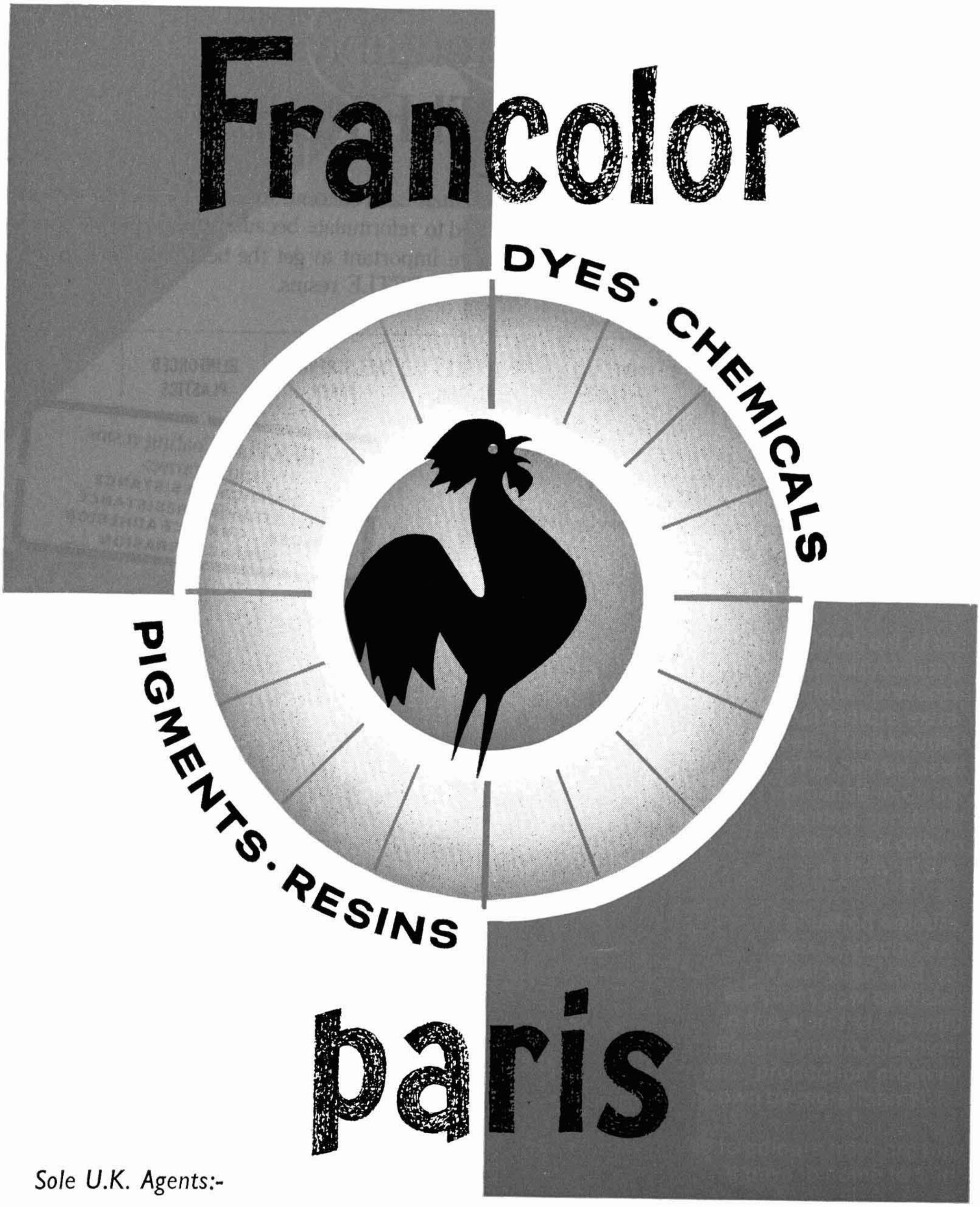

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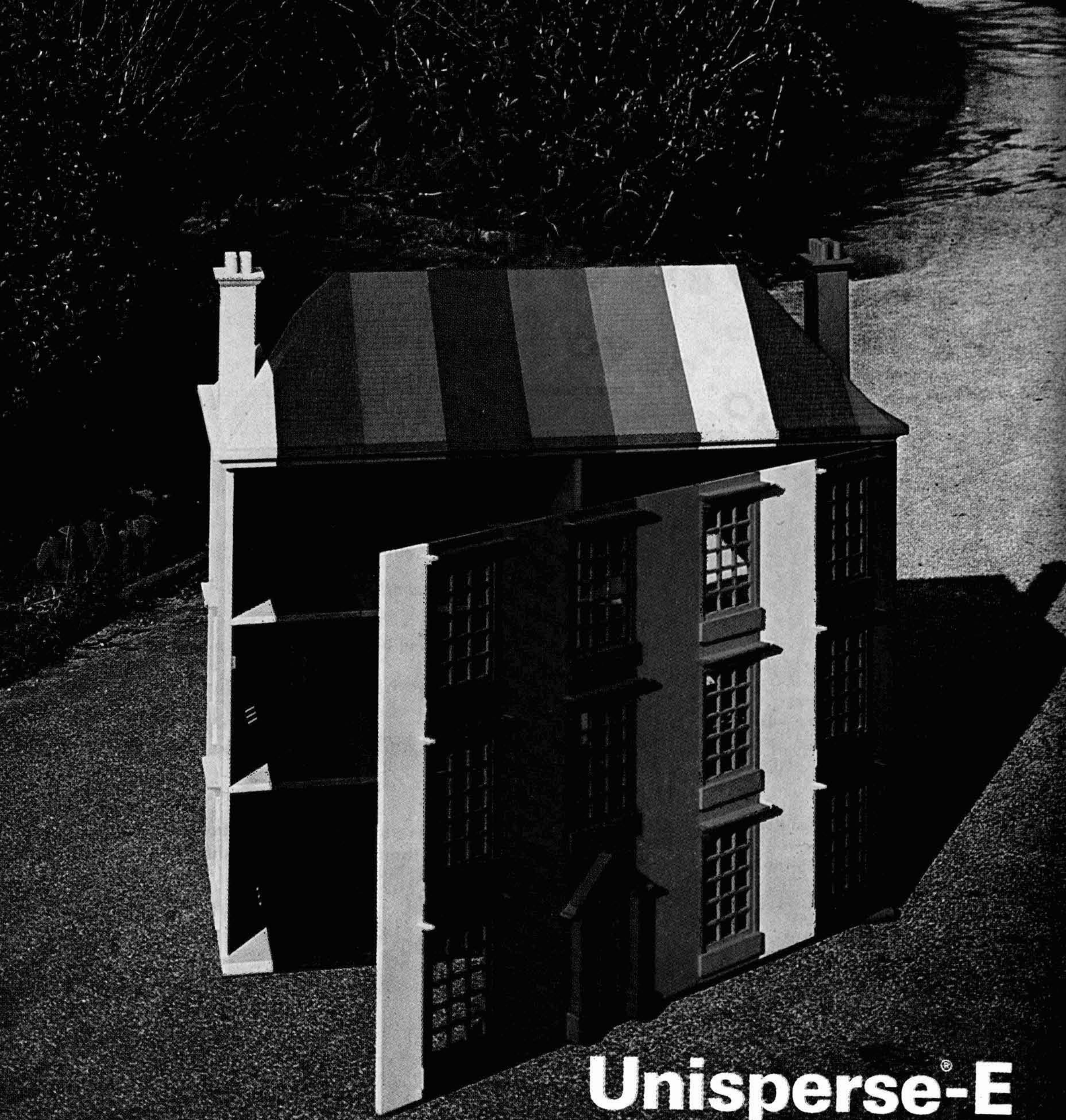

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Transactions and Communications

Some traffic paint compositions.

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Part I: Alkyd based vehicles for traffic paints

Summary

Various short oil-length alkyds, based on the fatty acids of castor oil, coconut oil, stearic or their equivalent combinations, have been prepared and their compatibility with nitrocellulose varnishes has been investigated. An examination has been conducted to establish the suitability of these vehicles for use in conjunction with nitrocellulose in traffic paints.

Keywords

Types and classes of coatings and allied products

traffic marking paint

Raw materials: binders (resins etc)

alkyd resin

nitrocellulose

Quelques compositions pour peintures destinées pour la signalisation routière
Première partie. Véhicules à base des alkydes

Résumé

On a préparé diverses résines alkydes courte en huile, basées sur les acides gras d'huiles de ricin, de coco, l'acide stéarique et leurs combinaisons équivalentes, afin d'étudier leur compatabilité avec des vernis nitrocellulosiques. L'étude a été effectué en vue d'établir l'aptitude de ces véhicules contenant de la nitrocellulose à être utilisés en peintures pour la signalisation routière.

Einige Vorschriften für Strassenmarkierungsfarben
Teil I. Alkydharzbindemittel für Strassenmarkierungsfarben

Zusammenfassung:

Verschiedene kurzölige Alkydharzlacke wurden hergestellt, die mit Fettsäuren des Rizinusöls, Kokosnussöls, Stearins oder mit deren entsprechenden Kombinationen modifiziert worden waren. Ihre Verträglichkeit mit Nitrozelluloselacken wurde untersucht. Ihre Eignung als Nitrozellulose enthaltende Bindemittel für Strassenmarkierungsfarben wurde geprüft.

Introduction

Refs. 1-33

Rapid drying is the most important factor in determining the performance of traffic paints[1, 2]. In general, traffic paints owe their fast drying characteristics to three factors[3,4]:

(i) High pigment volume concentration;

(ii) Use of fast drying vehicles, such as low oil-content resin combinations or oil-free synthetic resins; and

(iii) Low boiling solvents, such as petroleum fractions, with distillation range from 100 to 150°C.

Early types of traffic paints were inexpensive and contained East India, Manila and/or casein resins[5–7]. The use of modified phenolic resin or ester gum in formulating traffic paints improved the durability of the finished coatings over the natural resins[8]. Other types were also used and these included both spirit type paints (blown castor oil, dehydrated castor oil, heavy bodied fish oil, tung oil, etc) and cooked varnish types. These coating systems are greatly improved by using an appropriate plasticiser ratio and blending with suitable synthetic resins[9, 10].

Chlorinated rubber is used efficiently as a binder in formulating traffic paints. In fact, paints with "no pick up" times of 10 to 20 minutes may be formulated by using plasticised chlorinated rubber with or without blending with alkyd or phenolic resins[11]. Traffic paints based on chlorinated rubber show high resistance to water, alkalis and abrasion[12, 13].

Saturated alkyds have also been described as vehicles in formulating traffic paints with or without combination with other non-convertible and convertible resins[14–16]. Recently, the addition of a polyisocyanate/peroxide catalyst to the alkyds, to produce rapid-curing traffic paints with high impact strength, adhesion resistance and good flexibility, has been described[17].

In addition to the above mentioned types of vehicles, the following types of resins have been used as vehicles for traffic paints, as revealed from patents:

(i) Polyester resin containing reactive double bonds and vinylidine monomer and epoxy resin[18, 19],

(ii) Sulfur plasticised with polyethylene tetrasulfide, wood rosin, tertiary butyl polysulfide, chlorinated biphenol, chlorinated naphthalene, natural rubber, butyl rubber, olive oil, dibutyl phthalate, *p*-dichlorobenzene, halo-epoxy alkane and/or alkyd resin[20-26],

(iii) Epoxy resins with a suitable cross-linking agent (hardener)[27-29],

(iv) Cellulosic resins with or without blending with suitable alkyd formulations[30],

(v) Methyl- and ethyl methacrylate resins[31, 32] and α- and β-unsaturated carboxylic acid resins[33].

The objective of the present work is to prepare modified alkyd/nitrocellulose blends and to assess their suitability for use in traffic paints. The local availability of the raw materials is one important aspect which is taken into consideration.

Experimental

Refs. 34-43

Materials

Castor oil Commercial local grade obtained from the castor plant Ricinus Communis by cold pressing.

Coconut oil Commercial grade imported from India.

Glycerol Pure local grade produced by El-Nasr Chemical Company. Periodate analysis showed it to be over 99 per cent pure, and the colour according to the Gardner scale was 1.

Phthalic anhydride Pure grade, VEB Laborchemie, East Germany.

Stearic acid Commercial local grade produced by Nasr Pharmaceutical Co.

Nitrocellulose Paint grade, a local production of Helwan Factory. Average nitrogen content 12 per cent
Viscosity 0.030 200 to 0.045 240N m s^{-2}
Dibutylphthalate content 18 ± 2 per cent
Nitrocellulose content 82 ± 2 per cent

Thinner The thinner used in all instances was of the following composition (per cent by volume):

Butyl acetate	20
Ethyl acetate	20
Butyl alcohol	5
Methyl ethyl ketone	5
Xylene	20
Benzol	15
Ethyl alcohol	15

All other chemicals used were of the purest grade available except where mentioned otherwise.

Alkyd resin preparation

Alkyd resins of short oil length, modified with castor oil, coconut oil, stearic acid and some of their combinations, were prepared under identical conditions. The detailed procedure is given in a later section. The reaction was followed by removing samples after various periods of time using a special device.

Analytical and evaluation techniques

Acid[34], iodine[35], saponification[36] and hydroxyl[37] values and colour[38] and viscosity[39] measurements were conducted according to standard methods. Film properties were also examined; touch dry[40], surface dry[41], water resistance[42] and flexibility[43], using standard methods. The solvent resistance was determined by immersing the coated panels in a mixture of benzene and a petroleum fraction of boiling range 152-204°C (at atmospheric pressure) in the proportions 1:3 by volume, the immersion being for 15 minutes at room temperature. The panels were removed and left to dry vertically for one hour and examined for any film defects.

Results and discussion

Refs. 44, 45

The characteristics of both castor and coconut oils used in the alkyd preparations were determined. The results are given in Table 1.

Table 1

Physico-chemical characteristics of castor and coconut oils

	Castor oil	Coconut oil
Acid value, mg KOH/g	2	2
Saponification value, mg KOH/g	180.4	251.6
Hydroxyl value, mg KOH/g	166.2	000.0
Iodine value, cg I_2/g	87.2	8.1
Viscosity at 25°C, Gardner	U	A
Colour, Gardner scale	2–3	5

Alkyd preparation

Table 2 illustrates the different types of alkyds prepared in this work and their fundamental formulation constants.

Table 2

Types of short oil-length alkyds

Alkyd No.	Main fatty acids present	Oil length (%)	Phthalic anhydride content (%)	Excess hydroxyl (%)	Initial acid value mg KOH/g
I	Castor oil fatty acids	41.8	38.7	39.3	356.2
II	Coconut oil fatty acids	34.3	43.7	39.3	400.0
III	Stearic acid	40.8	39.4	18.1	362.0
IV	Castor/coconut oils fatty acids (1:1 equivalent)	38.0	41.2	39.3	378.1
V	Castor oil fatty acids/stearic acid (1:1 equivalent)	41.3	39.0	28.7	359.1

Alkyds I and II

The calculated amounts of the oil and glycerol were heated in the presence of the glycerolysis catalyst (lead oxide (PbO) 0.04 per cent). The mixture was heated gradually, and a temperature of 240-245°C was reached in 85 minutes (Fig. 1). Heating was continued at this temperature until monoglyceride formation was completed. This usually took 30 to 60 minutes. After completion of monoglycerolysis, the mixture was cooled to 100°C, phthalic anhydride was added and the mixture was heated gradually to 180-185°C according to the programme shown in Fig. 1.

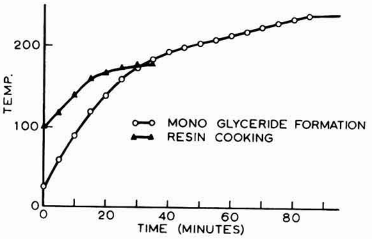

Fig. 1. Time-temperature programme for alkyds I, II, IV and V

Alkyd III

The fatty acid monoglyceride process was followed for this purpose[44]. Stearic acid was first heated with glycerol at 240°C for 90 minutes to form monoglyceride. When the reaction was completed, the reaction mixture was cooled to 100°C, phthalic anhydride was added and the reaction was completed as above. The time-temperature programme is shown in Fig. 2.

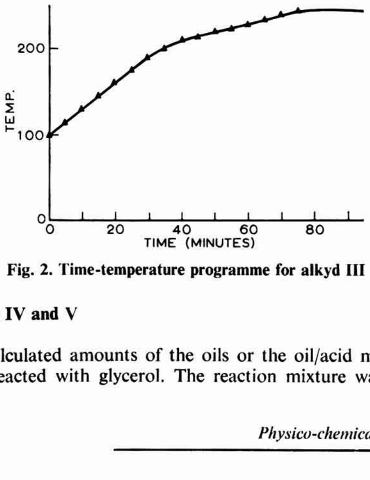

Fig. 2. Time-temperature programme for alkyd III

Alkyds IV and V

The calculated amounts of the oils or the oil/acid mixtures were reacted with glycerol. The reaction mixture was then cooled, phthalic anhydride was added and the reaction was brought to completion as described above (Fig. 1).

The course of the esterification reactions during the alkyd processing for the different types are shown graphically in Fig. 3. It is interesting to note that in all cases, whether following the oil monoglyceride process or the fatty acid monoglyceride process, the rate of decrease in the acid value is almost identical. These findings agree with previous observations[45].

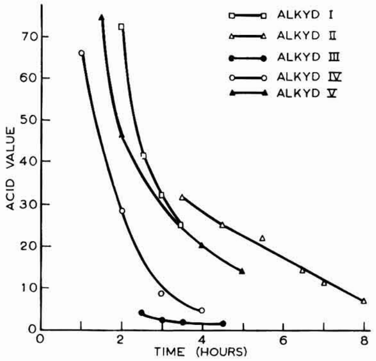

Fig. 3. Variation of acid value with reaction time

Alkyds made from partial fatty acid glycerides (which have been formed either from the fatty acid and glycerol or from an oil and glycerol) are essentially α-substituted, leaving almost identical amounts of α- and β-hydroxyls of glycerol available for esterification with phthalic anhydride. These cause the rate of the process to be identical in all cases.

The characteristics of the different alkyds were determined and the results are given in Table 3.

It can be concluded from the above data that these resins were cooked as thoroughly as possible. In addition, no dehydration of the castor oil took place during the cooking of alkyds based on castor fatty acids. Alkyds composed mainly or partially of castor fatty acids showed higher viscosities when compared with other alkyds.

Compatibility of the prepared alkyds with nitrocellulose

Several 50 per cent resin solutions in xylene were prepared and mixed thoroughly with 25 per cent (by weight) nitrocellulose varnish in butyl acetate/xylene (1:1 by volume), with different proportions of nitrocellulose in the solvent up to a proportion of 30 per cent nitrocellulose. The compatibility of the above combinations was checked. An evaluation of these combina-

Table 3

Physico-chemical characteristics of the different alkyds

	Alkyd number				
Property	I	II	III	IV	V
Acid value, mg KOH/g	25	7.1	1.3	4.4	14.2
Iodine value, cg I_2/g	39	8.0	0.0	18.6	20.3
Hydroxyl value, mg KOH/g	180	0.0	0.0	167.9	161.5
Colour (Gardner)	7—8	11—12	11—12	11—12	11—12
Viscosity, in seconds, of 50% solid content in xylene at 25°C (Ford Cup No. 4)	90	75	55	85	80

tions as vehicles for traffic paints were also conducted, especially with regard to the drying times, resistance against water and organic solvents and flexibility. The results obtained from these studies are presented in Tables 4 to 8 for the different alkyds. The compatibility was checked at room temperature (July, 33°C).

Table 4
The compatibility of alkyd I with nitrocellulose

Blend ratio (%)		Compatibility	Drying time (minutes)			Water and solvent resistance	Flexibility
Alkyd	Nitrocellulose		Surface dry	Tack-free dry	Hard dry		
100	0	—	non-drying	non-drying	non-drying	affected	
95	5	Compatible	„ „	„ „	„ „	affected	
90	10	„	„ „	„ „	„ „	affected	
85	15	„	>30	>60	>60	affected	
80	20	„	15	>60	>60	affected	satisfactory
75	25	„	5	30	60	satisfactory	„
70	30	„	<5	15	40	„	„

Table 5
The compatibility of alkyd II with nitrocellulose

Blend ratio (%)		Compatibility	Drying times (minutes)			Water and solvent resistance	Flexibility
Alkyd	Nitrocellulose		Surface dry	Tack-free dry	Hard dry		
100	0	—	non-drying	non-drying	non-drying	affected	
95	5	compatible	30	>60	>60	„	
90	10	„	15	>60	>60	„	satisfactory
85	15	„	10	>60	>60	„	„
80	20	„	5	30	60	satisfactory	„
75	25	„	5	10	30	„	„
70	30	„	<5	5	30	„	„

Table 6
The compatibility of alkyd III with nitrocellulose

Blend ratio (%)			Drying time (minutes)			Water and solvent resistance	Flexibility
Alkyd	Nitrocellulose		Surface dry	Tack-free dry	Hard dry		
100	0	—	non-drying	non-drying	non-drying	affected	
95	5	compatible	>60	>60	>60	„	satisfactory
90	10	„	30	>60	>60	„	„
85	15	„	15	>60	>60	„	„
80	20	„	12	50	>60	„	„
75	25	„	5	30	50	satisfactory	„
70	30	„	5	5	50	„	„

Table 7
The compatibility of alkyd IV with nitrocellulose

Blend ratio (%)		Compatibility	Drying times (minutes)			Water and solvent resistance	Flexibility
Alkyd	Nitrocellulose		Surface dry	Tack-free dry	Hard dry		
100	0	—	non-drying	non-drying	non-drying	affected	—
95	5	compatible	>60	>60	>60	„	satisfactory
90	10	„	>60	>60	>60	„	„
85	15	„	10	>60	>60	„	„
80	20	„	5	60	60	satisfactory	„
75	25	„	5	30	40	„	„
70	30	„	5	5	30	„	„

Table 8

The compatibility of alkyd V with nitrocellulose

Blend ratio (%) Alkyd	Blend ratio (%) Nitrocellulose	Compatibility	Drying times (minutes) Surface dry	Drying times (minutes) Tack-free dry	Drying times (minutes) Hard dry	Solvent and water resistance	Flexibility
100	0	—	non-drying	non-drying	non-drying	affected	—
95	5	compatible	>60	>60	>60	,,	satisfactory
90	10	,,	>60	>60	>60	,,	,,
85	15	,,	30	>60	>60	,,	,,
80	20	,,	10	>60	>60	,,	,,
75	25	,,	5	60	60	satisfactory	,,
70	30	,,	5	20	30	,,	,,

Conclusions

The conclusions drawn from these studies are as follows :

There are optimum ratios of blends for the different alkyds, as shown in Table 9.

Table 9

Optimum blending ratios

Alkyd No.	Composition (by weight) Alkyd	Composition (by weight) Nitrocellulose
I	75	25
II	80	20
III	75	25
IV	80	20
V	75	25

The alkyds prepared can be safely modified physically with nitrocellulose varnishes, especially those with corresponding drying and durability characteristics. As a matter of fact, increasing the nitrocellulose content greatly reduces the drying times of these varnishes.

Blends based entirely on alkyd I (castor alkyd) are not suitable as vehicles for traffic paints since their films are not tack-free.

Binders consisting of equivalent amounts of stearic and castor oil alkyd blended with nitrocellulose in the ratio of 4:1 by weight gave promising results as vehicles for traffic paints.

The importance of these findings are relevant not only to the use of saturated fatty materials, but also to the use of inexpensive saturated fatty materials and their local availability.

[*Received 16 August 1974*

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Part II. Formulation and evaluation of short-oil length non-drying alkyd/nitrocellulose vehicle

Summary

The use of different short-oil length non-drying alkyd/nitrocellulose blends as vehicles for traffic paints have been evaluated. Formulation of a vehicle composed of equivalent amounts of stearic acid and castor oil fatty acids short-oil alkyd/nitrocellulose blend gave promising results, especially with regards to local availability of the raw materials.

Keywords

Types and classes of coatings and allied products

traffic marking paint

Raw materials: binders (resins etc)

alkyd resin

nitrocellulose

Deuxième partie. La mise au point de formules et l'évaluation de véhicules basés sur les mélanges de résines alkydes non séchant, courte en huile, avec les vernis nitrocellulosiques

Résumé

On a évalué les mélanges des vernis nitrocellulosiques avec des résines alkydes, non séchant, courte en huile en tant que véhicules pour peintures pour la signalisation routière. Un véhicule se composant d'un mélange de quantités équivalentes de l'acide stéarique et d'une résine alkyde courte en huile basé sur les acides gras d'huile de ricin avec du vernis nitrocellulosique rend des résultats pleins de promesses, surtout à l'égard des matières premières qui sont à la portée de la main.

Teil II. Vorschriften und Bewertung kurzöliger Alkydharz/Nitrozellulosebindemittel

Zusammenfassung:

Die Verwendbarkeit verschiedener kurzöliger, nichttrocknender Alkydharz/Nitrozellulose-Mischungen als Bindemittel für Strassenmarkierungsfarben wurde geprüft. Vorschriften für gleichwertige Mengen Stearinsäure- und Rizinusölfettsäure enthaltende kurzölige Alkydharz/Nitrozellulose Mischungen ergaben vielversprechende Resultate, besonders mit Rücksicht auf die an Ort und Stelle vorhandene Verfügbarkeit der Rohstoffe.

Introduction

Refs. 1-19

Traffic paints, or road-line or road-striping paints, are among the important and commonly used organic coatings. They are characterised by their fast drying, ease of application, retention of the original colour, durability and resistance to bleeding, frost, varying temperature, moisture and abrasion[1-3]. The type of vehicle employed is the most important factor in determining the durability and performance characteristics of traffic paints[4]. A large number of pigments and extenders is used in formulating traffic paints. Magnesium silicate and micaceous talc are found to be the best of the inert extenders and titanium-barium pigments showed outstanding durability characteristics[5]. Most of traffic paint formulations describe the use of titanium dioxide pigments[6,7], and barium sulfate, calcium carbonate, dolomite, talc, clays and diatomaceous silica as extenders. The use of the last of these extenders greatly improves the adhesion and controls the gloss[8-10].

The selection of a suitable extender is of considerable importance. The type of particle size distribution and the structure of the filler used exert a considerable influence on the durability of traffic paints. The best results have been obtained with crystalline calcium carbonate, with a mean particle diameter of 2.5 μm and particle distribution of 1 to 8 μm.

Glass spheres (glass beads) are frequently used in reflecting marking paints. These may be mixed in to the paint to begin with or dropped on a few minutes after paint application. The "drop on" technique produces an efficient reflector at once, whilst the "mixed in" technique requires some abrasion by traffic to uncover the bead surface[11-18].

Improvement of the reflective power of these beads can be made by using beads partially coated with aluminium, silver or copper by vapour deposition[11] or by using beads made from a mixture of titanium dioxide (35.6-57.0); barium oxide (22.8-40.0); boron oxide (3.5-26.9) and zinc oxide (0.0-20.0)[12] —values in mole per cent.

The use of zinc resinate in traffic paint formulations greatly improves the performance of both oleoresinous and synthetic vehicles[13,19].

This (second) part of the paper deals with the formulation of vehicles made by blending various short-oil length alkyds obtained in Part I with nitrocellulose; the vehicles which satisfactorily passed the tests for compatibility with nitrocellulose, and drying time and durability have been adapted for use as traffic paints.

Materials and techniques

Refs. 20-38

Materials

Several alkyd resin/nitrocellulose blend vehicles[20], with 42 per cent oil-length alkyds, were prepared according to the method described in Part I and blended with nitrocellulose varnish. Table 1 gives the optimum ratio of blend that gives satisfactory results together with the main fatty acids present.

Table 1

Optimum ratio of blend of alkyd vehicles

Formula	Main fatty acids present	Ratio Alkyd	Ratio Nitrocellulose
I	Castor oil fatty acids	75	25
II	Coconut oil fatty acids	80	20
III	Stearic acid	75	25
IV	Castor and coconut fatty acids	80	20
V	Castor and stearic fatty acids	75	25

Pigments. Titanium dioxide, commercial grade, obtained from Chemapol, Czechoslovakia.

Extenders. Calcium carbonate and talc, commercial local grade, products of El-Nasr Phosphate Company.

Additives. Calcium stearate, commercial grade, obtained from Chemapol, Czechoslovakia, and Bentonite, commercial product of Prolab Laboratory Chemicals.

Thinner. The thinner used in all runs was of the composition indicated in the following Table:

Table 2

Composition of the thinner

Solvent	Per cent by volume
Butyl acetate	20
Ethyl acetate	20
Butyl alcohol	5
Methyl ethyl ketone	5
Xylene	20
Benzene	15
Ethyl alcohol	15

Methods and techniques

The preparation of the pigmented varnish[21], uniform film thickness coats[22, 23] and the determination of the viscosity[24], fineness of grind[25], drying times (touch dry[26] and surface dry[27]), film thickness[28], film hardness[29], scratch hardness[30], flexibility (bend)[31], gloss[32], degree of whiteness[33] and the resistance against water[34, 35], alkalis[36], acids[37] and bleeding[38] were carried out according to standard methods. The solvent resistance was determined by the method described in Part I.

In general, a comparison between the immersed portion and that which had remained completely out of the test liquid was made. Failure within approximately 1cm of the edges was disregarded.

Results and discussion

Suitable vehicles for traffic paints were obtained by blending different types of short-oil non-drying alkyds with nitrocellulose varnish. These vehicles are characterised by their fast-drying, flexibility and resistance to solvents and to water; their compositions are given in Table 1. Pigmentation of these vehicles was made according to the formula given in Table 3.

Table 3

Formula for traffic paint composition

Ingredient	Per cent by weight
Titanium dioxide	30
Calcium carbonate	20
Talc	3.5
Calcium stearate	0.25
Bentonite	0.25
Alkyd resin	13.5—14.5
Nitrocellulose resin	3.4—2.6
	remainder (to 100 per cent)

The formulation given in Table 3 was ground until 60μm fineness of grind was reached.

It is noteworthy that these vehicles are miscible in toluene, xylene, acetone, ethyl acetate and butyl acetate and have limited miscibility in ethanol and butanol, but are incompatible with mineral spirit. Moreover, pigmentation of these vehicles causes a decrease in the nitrocellulose content required in order to obtain the optimum conditions. In fact, a 20 to 25 per cent decrease in nitrocellulose content (based on 100 per cent solids) was required upon pigmentation as shown in Table 4. This may be due to the incorporation of the pigment and extender to improve the paint performance, especially with regard to the drying characteristics.

Table 4

Optimum ratio of blend for pigmented varnishes

Formula	Type of alkyd present	Ratio composition Alkyd	Ratio composition Nitrocellulose
1	I	80	20
2	II	85	15
3	III	80	20
4	IV	85	15
5	V	80	20

The relation between the solid content of the pigmented varnish and the viscosity of the finished paint for the different types of vehicles employed is shown in Fig. 1. All these pigmented varnishes show a sharp decrease in viscosity (as measured by Ford Cup No. 4) for solids contents below 60 per cent by weight. Above this value, there is a gradual increase in the viscosity upon increasing the solid content. Below this value, the viscosity became more or less constant.

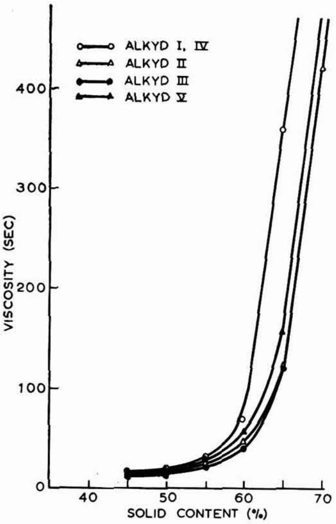

Fig. 1. Effect of solids content on viscosity of the pigmented varnish

Evaluation of the pigmented varnishes was carried out according to standard methods in the following manner:

Hardness. The hardness of the dry pigmented films was measured by the Rocker Hardness Pendulum at 25°C and 65 per cent relative humidity and the results obtained are given in Table 5, in which the film thickness is stated for every reading.

It can be concluded that there is a decrease in film hardness with increasing dry film thickness. Films based on alkyd I and IV showed lower hardnesses when compared with those based on alkyds II, III and V.

Resistance to distilled water, petroleum hydrocarbons, alkalis and acids. The results obtained from these studies are given in Table 6, in which the film hardness after the immersion period, compared with that before immersion, was taken as a criterion for the degree of effectiveness of the coating.

A striking result is the increase in the film hardness after the immersion period. There is no explanation for this phenomenon at the present time.

Scratch resistance. The scratch resistances of the dry films, 72 hours after application, to a load of one kilogram was satisfactory except for those corresponding to formula *3*, which films resisted a load of only 500g.

Flexibility and adhesion bending. Films of the pigmented alkyd/nitrocellulose blends successfully passed the test for flexibility and adhesion when bent over a 6mm diameter rod, except for those films corresponding to formula *3*.

Degree of whiteness and gloss. The data obtained from determinations of degree of whiteness and the gloss of the dry pigmented films of the various vehicles are given in Table 7.

The abrasion test is important for traffic paints. Due to the difficulty in conducting this test, films which passed satisfactorily all the preceding tests were assumed to be satisfactory with regard to abrasion.

Table 5

Hardness measurements of pigmented varnishes films

Film thickness (μm)	Film hardness in seconds Formula 1	Formula 2	Formula 3	Formula 4	Formula 5
0.015	—	43	—	—	—
0.018	—	—	52	—	—
0.020	27	38	51	30	50
0.022	25	36	50	26	49
0.025	23	34	48	24	47
0.028	21	—	—	22	45
0.030	19	32	—	22	42
0.035	—	30	—	21	40

Table 6

Resistance of the coated films against
distilled water, petroleum hydrocarbons, alkalis and acids

Resistance against:	Formula 1		Formula 2		Formula 3		Formula 4		Formula 5	
	Hardness (in seconds)									
	before	after	before	after	before	after	before	after	before	after
Water	22	40	43	53	48	50	26	36	42	47
Solvent	25	30	51	71	50	*	26	38	39	53
Alkalis	19	30	52	65	51	61	26	33	39	46
Acids	22	*	46	56	50	*	30	*	40	*

* affected or partially affected

Table 7

Degree of whiteness and gloss of dry pigmented films

	Formula 1	Formula 2	Formula 3	Formula 4	Formula 5
Degree of whiteness (%)	95	98	95	98	97
Gloss (%)	25	12	10	16	13

The use of stearic acid as the main fatty acid component in the alkyd portion of the vehicle (formula *3*) gave films which showed the greatest hardness and consequently were more affected by the scratch and flexibility tests.

On the other hand, films of the paints based on formula *1* and formula *4*, in which castor oil constituted 100 and 50 per cent of the alkyd portion of the vehicle respectively, showed the lowest values of film hardness. This is attributed to the tackiness of the castor oil, which tends to dampen the pendulum of the Rocker used for measuring film hardness. The use of stearic acid incorporated with the castor oil (formula *5*) overcomes this effect.

Conclusions

Evaluation of the dry pigmented films of various, relatively saturated alkyd/nitrocellulose blends (detailed in part I) as vehicles for traffic paints has been carried out according to standard specifications. The following generalisation can be made:

All films examined were sufficiently hard to resist the scratch test under one kilogram load and also passed successfully the flexibility and adhesion test over a 6mm diameter rod, except those corresponding to formula *3*, based on stearic alkyds.

All the films examined retained their original colour for a period of three months and were "semi-gloss" in appearance.

The studies of resistance to water, solvents, alkalis and acids show the following trends: (a) all films were satisfactorily resistant to water and alkalis; (b) all films were not resistant to acids, except those of formula *2*, based on coconut oil fatty acids; (c) all films were resistant to solvents, except those of formula *3*, based on stearic acid alkyds.

All films tested were resistant to bleeding, which is vital in traffic paint specifications.

In general, a binder consisting of an alkyd resin based on stearic acid and castor oil fatty acids, blended with nitrocellulose varnish in the ratio 80:20 (by weight) gave promising results when formulated as traffic paints with the correct pigments, extender and additives, taking into consideration the availability of the raw materials. The use of highly saturated fatty acid materials in the manufacture of the alkyd resin draws attention to the use of some industrial products and by-products, at present of minor importance.

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Deterioration of paint films by water

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Summary

The long-term action of water as a factor in the degradation of saponifiable paint films has been demonstrated, by measurement of the change in extensibility and breaking load of detached films of alkyd and polyurethane air-drying gloss paints after immersion in water and mildly alkaline solutions.

Keywords

Types and classes of coatings and allied products

alkyd coating
urethane finish

Processes and methods primarily associated with service or utility

film degradation

Properties, characteristics and conditions primarily associated with dried or cured films

elasticity
tensile strength
water resistance

L'altération de feuils de peintures par l'action d'eau

Résumé

L'action prolongée d'eau en tant que facteur à la dégradation des feuils de peintures saponifiables a été demontrée par les mesures des changements de l'extensibilité et de la charge de rupture des feuils détachés de peintures séchant à l'air à base des alkydes ou des polyuréthannes après être immergés en eau ou en solutions légèrement alcalines.

Altern von Anstrichfilmen durch Wasser

Zusammenfassung

Die langdauernde Einwirkung von Wasser wird als einer der Faktoren für die Degradierung verseifbarer Anstrichfilme mit Hilfe folgender Mittel aufgezeigt: Messung der Veränderungen in der Dehnbarkeit und der Zerreissbelastung abgelöster Filme von lufttrocknenden Alkyd- und Polyurethanglanzemaillen nach Eintauchen in Wasser und schwache alkalische Lösungen.

Introduction

Refs. 1-14

The physical effects of water on paint films have been the subject of numerous investigations[1-8]. They are manifest as swelling, blistering, leaching and loss of adhesion. There has also been much study of films as semi-permeable membranes in the transport of water and ions from one side to the other, and of the variations in their resistances to the movement of water.

Even more research has been devoted to the degradation of films by atmospheric agencies, in particular solar radiation[9] and oxygen[10,11]; water may play a part in photo-activated oxidative degradation of polymers[12] and breakdown is believed to be slower in very dry atmospheres[13].

Hydrolytic breakdown of ester type polymer films (especially from drying oils and alkyd resins) under positively alkaline conditions, as for instance by contact with Portland cement and some lime-containing materials, is well known. Most investigations in this field have been concerned with the fairly rapid breakdown of oil media and attack on pigments which are susceptible to alkalis and applied to plaster or concrete backgrounds. Plasters composed solely of lime have been considered not to cause saponification of linseed oil paints (although the pH of saturated lime solutions is about 11), whereas plasters containing lime and traces of alkali-metals (producing higher pH values) were highly active[14]; these results (applicable in the presence of moisture above a certain level) do not take into account possible long-term effects at the lower pH. Cement-based materials when old and carbonated have a pH of about 9.0 and have usually been regarded as neutral in their effects on paint films.

It seems possible that hydrolysis in neutral conditions, over a period of months or years, may be a somewhat overlooked reason for the gradual deterioration of alkyd and other oil-based paints. In particular, it could account for the breakdown of primers, which are not subject to solar radiation, but are often in contact with a moisture-holding substrate, such as wood or masonry. Fully immersed saponifiable paint films may also be subject to slow deterioration in neutral conditions.

The effect of hydrolysis might be indicated by a gradual weakening of the film, so that the mechanical effects of alternate swelling and shrinking, or of movements of the substrate, should become more destructive with time. This possibility appeared worthy of some preliminary investigation, in terms of the change of tensile strength and elongation at break of immersed films.

Experimental

The paints examined were commercial examples of (phthalic) alkyd and one-pack polyurethane alkyd air-drying gloss paints. Films were prepared on tinplate and detached by amalgamation with mercury. Strips of film 75 × 10mm, of measured thickness, were suspended from a frame in glass bottles, either in air or immersed in aqueous solutions maintained at 23°C and at different pH levels, in the absence of light. The aqueous solutions were boiled prior to use to remove air, and the storage bottles sealed by wax with as little air present as possible. Buffered solutions of pH 9.2 and 8.0 were prepared by standard methods, and boiled distilled water was found to produce a pH of 7.0. Although specimens were stored in glass bottles, no change of pH was noted on rechecking at the end of the immersion period. On removal, the strips were washed in neutral distilled water and allowed to dry for seven days in air at 23°C and 45 per cent relative humidity (RH), the same conditions being used for the tensile tests. Some other tensile tests were made at various temperatures, as shown in the Tables 1–6, the rate of extension in all tests being 16.7 per cent per second.

Table 1

Alkyd films, immersed at 23°C

pH	Weeks	No of Samples	Extension (%) Mean	Extension (%) Std deviation	Breaking load (g) Mean	Breaking load (g) Std deviation
—	0	6	67	12	105	30
9.2	2	6	13	1.5	239	75
	3	6	3.3	1.6	250	76
8.0	4	6	24	4.5	580	41
	8	6	5.5	1.8	527	75
7.0	8	6	61	3.5	518	21
	16	3	42	12	108	24
	25	3	37	7.5	400	65
	50	4	18	2.2	198	20

Table 2

Alkyd films, aged in air at 23°C

Weeks	Tensile test temp°C	No of samples	Extension (%) Mean	Extension (%) Std deviation	Breaking load (g) Mean	Breaking load (g) Std deviation
0	23	6	67	12	105	30
	10	6	35	8	285	75
	0	6	11	1.5	346	76
8	23	6	75	13.5	198	44
	10	6	15	6	339	62
	0	6	7	3	295	75
25	23	5	47	5	598	75
	10	3	14	1.3	1311	172
	0	3	2.5	1.3	1375	739

Table 3

Alkyd films, immersed at 23°C

pH	Weeks	Tensile test temp°C	No of samples	Extension (%) Mean	Extension (%) Std deviation	Breaking load (g) Mean	Breaking load (g) Std deviation
8.0	4	23	6	24	4.5	580	141
		10	6	8	4	765	68
		0	6	1.5	0.4	174	73
7.0	25	23	3	37	7	400	65
		10	4	5	4	784	419
		0	6	2	0.4	952	488

Table 4

Polyurethane alkyd films, immersed at 23°C

pH	Weeks	No of samples	Extension (%) Mean	Extension (%) Std deviation	Breaking load (g) Mean	Breaking load (g) Std deviation
—	0	7	31	10	810	80
9.2	2	6	4.0	4	750	130
	4	6	8.5	3	725	148
	8	7	3.0	1.6	1090	151
	12	6	4.0	1.8	183	74
7.0	8	5	10	4.8	697	205
	16	6	6.3	2.5	858	110
	25	6	5.0	2.5	850	115
	50	4	2.6	2.0	1031	156

Table 5

Polyurethane alkyd films, aged in air at 23°C

Weeks	Tensile test temp °C	No of samples	Extension (%) Mean	Extension (%) Std deviation	Breaking load (g) Mean	Breaking load (g) Std deviation
0	35	6	32	7	335	66
	23	7	31	10	810	80
	0	6	3.5	1	884	120
8	35	6	29	7	414	116
	23	6	23	5	559	241
	0	6	3	1.4	1442	75
25	35	6	22.5	6.5	550	118
	23	5	18	8	700	41
	0	6	3	0.7	1250	570

Table 6

Polyurethane alkyd films, immersed at 23°C

pH	Weeks	Tensile test temp °C	No of samples	Extension (%) Mean	Extension (%) Std deviation	Breaking load (g) Mean	Breaking load (g) Std deviation
9.2	8	35	6	3.2	0.8	778	119
		25	6	3.0	1.6	1070	151
		0	6	1.4	0.2	1507	175
7.0	25	35	6	10	5.2	850	51
		25	6	5	2.6	850	115
		0	4	4	0.2	1010	149

Control strips maintained in the dark in air-filled sealed bottles at the same temperature and humidity were also tested after two periods of ageing. Marked curling resulted from the water storage and handling of the weakest specimens proved difficult, so that not all the six replicates of each set could be utilised. Typically erratic results were obtained from replicates, more so for the polyurethane alkyd medium and more for the breaking load than for the extension tests. The graphical results are presented, therefore, to show the best line falling within the standard deviation, indicated by bars.

Results and discussion

Ref. 7

Extensibility (Figs. 1 and 2)

The rapid deterioration in extensibility of the alkyd at pH 8.0 and 9.2 was expected; the life in these conditions would be only a few weeks. Even at pH 7.0, however, the extent of weakening over one year suggests a life of only around two years under fully immersed conditions. This is considered adequate evidence of the part played by water in degrading moist films, which are not fully immersed but at the same time not subject to solar radiation. The situation covers interior paints and also primers and undercoats out of doors, for which solar radiation cannot be the cause of degradation (as it would be for the finishing coat). The cyclic mechanical strain caused by wetting and drying will, in practice, have and increasing effect as the film weakens.

A plot of log (per cent elongation) against time is a straight line for the alkyd paint at each pH, but the rates of change with time are not proportionate to hydroxyl concentration for the three pH values.

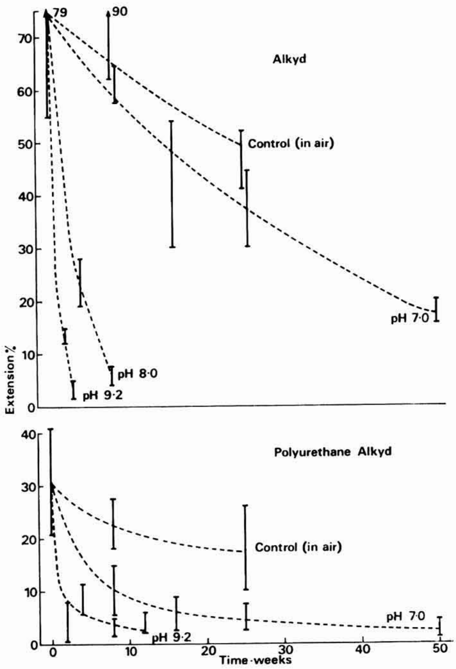

Fig. 1. Extension versus time

The polyurethane alkyd paint, starting with a lower extensibility, was less readily degraded than the alkyd at pH 9.2 as would be expected, although its life was only a few weeks under these conditions. At pH 7.0 it showed a slower, but still large, loss in extensibility, proportionately greater than that of the alkyd. The log (per cent extensibility) versus time plot (Fig. 1) appears to show a change in rate after a certain time, although the number of points is rather small. If confirmed, this change would suggest the possibility of two separate hydrolysis mechanisms, for example, of the ester and urethane linkages. Since the urethane linkage is more readily hydrolysed by acids than the ester link, the experiment could usefully have been extended to a lower pH than 7.0. The results of tests at two other temperatures are shown in Tables 2, 3, 5 and 6, and indicate the ability of the films to cope with strains at various ambient temperatures, before and after weathering and after immersion (Fig. 2). A figure of about 10 per cent extensibility seems (from other work) to be a rough lower limit for serviceable coatings in many uses; this figure was also suggested by Talen[7]. Films of about two per cent extensibility or less are not only unsuitable for unstable substrates, but are likely to fail quickly on weathering.

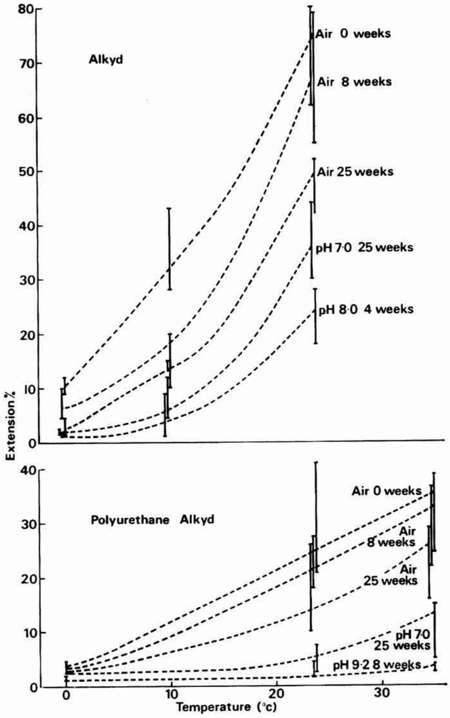

Fig. 2. Extension versus temperature

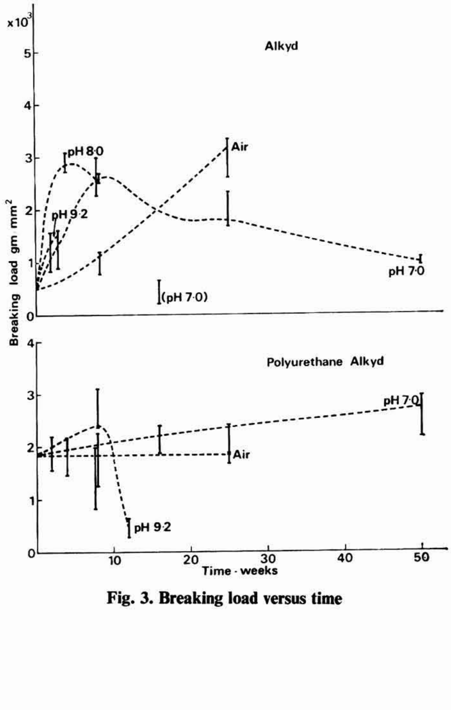

Fig. 3. Breaking load versus time

Breaking load

The breaking load results were more erratic and are considered less illuminating; a rise usually occurs on early ageing followed by a fall as the film degrades. The results are plotted as breaking load per unit cross section, (the mean of film thicknesses measured at several points on each film). A wide spread is obtained because the film breaks at its weakest and probably thinnest point. The results are shown in Fig. 3; one set of results for the alkyd at pH 7.0 falls completely out of line with the rest. The alkyd, whose tensile strength rises for at least six months in air, shows when immersed at all pH values an initial rise and then a fall, whereas the polyurethane alkyd with little change in air shows a slight rise for a year at pH 7.0, but a rise followed by a severe fall within three months at pH 9.2.

Conclusions

A substantial loss of extensibility of detached films of alkyd and polyurethane alkyd paints, immersed in air-free water at pH 7.0 for 50 weeks, has been demonstrated, with very much faster breakdown in even mildly alkaline solutions (pH 8.0 and 9.2). Breaking loads measured simultaneously tended to increase and then fall for the alkyd, but for the polyurethane alkyd fell only at pH 9.2. Films stored in air also lost appreciable extensibility, but the alkyd gained strength whereas the polyurethane alkyd remained unchanged. The embrittlement is considered sufficient to account for failure in practice, as an additional mechanism to the normal continuing oxidative degradation. It may be an important factor in films protected against solar radiation by succeeding coats.

Whilst this demonstration of mechanical weakening of paint films by water does not specifically indicate the chemical mechanism, hydrolysis is considered the most likely explanation, and the alternative of leaching of plasticising ingredients is unlikely to account for such large and continuing changes. The alternate swelling and shrinkage caused by changes in ambient conditions during normal exposure may also cause a breakdown in films (no conclusive proof of this has been found in the literature), but its effect will be greater on the weakened film and could be the ultimate direct cause of a failure later in the life of a film.

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Optimum use of organic pigments*

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Keywords

Raw materials: prime pigments and dyes
organic pigment

L'utilisation optimale de pigments organiques

Optimaler Einsatz Organischer Pigmente

Introduction

Re 1

The immediate shortage of organic pigments has not really been caused by a shortage of oil, and even in the near future, there are vast resources of oil still available. Only thirty per cent of the oil available is brought to the surface and of this, a mere 5 per cent is used for chemicals. Furthermore, worldwide prospecting for coal will ensure that organic materials are still available from the earth for decades to come. It, therefore, seems unlikely that anyone will stop using oil for chemicals, although it would undoubtedly be sensible to reduce its use as a source of energy.

The reason why organic pigments are in short supply seems to be a question of economics. Prices have risen considerably because of the monopoly position of the Middle East oil countries and, in addition, because of the temporary shortages of some chemicals. The continuing high price of oil will mean a continuing higher cost for chemicals and energy, and this is the reason why it is necessary to use all chemicals as economically as possible. Reclaiming and recycling would seem to be an important activity in order to conserve chemicals, but ecological requirements are probably a greater spur than the eventual shortage of oil.

It would seem that one of the main reasons for shortages at the present time is the lack of plant capacity. This situation has arisen in recent years due to the unfavourable environment for investment. In the chemical industry, only 30 per cent of costs are fixed costs. From 1963 to 1973 wages increased by 140 per cent, and materials and fuel by 65 per cent, whilst during this period, UK selling prices increased by only 32 per cent[1]. Undoubtedly, innovation, increased scale of operations and improved productivity have contributed significantly to keeping down prices, but nevertheless, profit margins were seriously reduced during this period. In 1970/71 there was a "mini-recession", which was the immediate cause of a number of capital investment proposals being cut. Since then, costs of materials and fuel have risen enormously but, more significantly, costs in the construction industries have escalated at over 30 per cent a year. This, in itself, has caused new plant investment to be cut back again, since reduced margins and high investment costs cannot go hand in hand. Thus, reduced margins, reduced capital investment, and concentration of production with a few producers for the so-called "economies of scale", have led to shortages of some key pigment intermediates, in particular, β-naphthol, Tobias acid, β-oxynaphthoic acid and its derivatives. Also dichlorbenzidine, arylamides, *meta*-nitro-*para*-toluidine and phthalic anhydride. This leads to difficulties with 4B toners, Lithol reds, arylamide yellows, diarylide yellows and possibly phthalocyanine blue, and undoubtedly prices will rise to combat higher material and fuel costs, low margins and high cost of investment. The higher priced pigments are, strangely, less affected in terms of shortage at present; they will nevertheless rise in price.

Economic use of pigments

The texture of organic pigments has steadily improved over the years, and the relationship between the energy input during dispersion and the development of colour strength is not a new subject. When pigments and energy were cheaper, there was a degree of dispersion which was considered economically worth-while, and it was often recognised that the time taken to disperse beyond the removal of oversized particles was not justified. With the rising cost of organic pigments and of energy, it is still good common sense to make sure that both are used efficiently. The industry's objectives should, therefore, be fourfold:

1. To obtain more colour strength per kilo or per pound sterling.
2. To use less energy to achieve the result. It is worth observing here that a pigment which has been predispersed by the use of a high energy method, may save the time of the user and, in some cases may give advantageous technical properties, but it does not represent an overall saving of energy. Such methods may, in fact, lead to difficulties if the supply of electricity, for example, were to be restricted.
3. To use pigments to the best colouristic effect as described below.
4. To continue using colour, which is an important feature in the modern world.

The optimum effect

Ref. 2

The optimum usage of pigments must be considered from two points of view. First, the question of economies which, beyond a certain point, make the dispersion operation too expensive in relation to the amount of increased strength

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obtained and, secondly, the optimum development of properties, which is necessary because as dispersion proceeds, some properties improve and others worsen.

Improved dispersion of an organic pigment is usually accompanied by an improvement in (i) colour strength, (ii) brightness, and (iii) gloss (and probably gloss retention), all of which are advantageous properties in surface coatings.

These comments assume that all dispersions are carried out to an extent which removes unacceptedly oversized particles and, therefore, further dispersion which leads to increased colour strength means the formation of smaller particles, which may not be apparent to the casual observer, but will bring changes in physical properties. According to the application, changes in hue and transparency may be advantageous or disadvantageous. Changes which are usually a disadvantage, brought about by better dispersion, are flow properties and lightfastness. Properties affected by gross changes in dispersion include opacity and weathering. The extent of the changes in these properties vary from pigment to pigment. Usually the changes in colour strength are of considerable magnitude. Dispersion may also affect application problems, such as flocculation and flotation.

Pigment dispersion

In the manufacture of organic pigments, variations in the controlling parameters can control the crystal size and also have a considerable effect on the degree of aggregation and the nature of the pigment surface. Nevertheless, pigments are invariably formed as large aggregates which have to be broken down at some stage during dispersion. Fig. 1 shows toluidine red in a typical form before dispersion, and Fig. 2 shows the preferred state after dispersion.

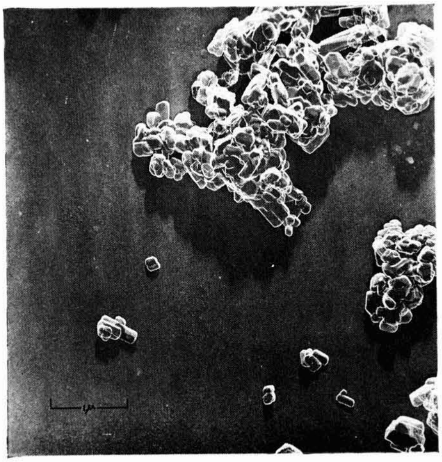

Fig. 1. Electron photomicrograph showing toluidine red before dispersion

In addition to the appropriate crystal form and the degree of dispersion, it is also necessary to relate the degree of dispersion to the application, and to ensure that the dispersion is stable during the use of the paint and its application. The only complete way to approach these optimum conditions is to monitor all batches with very time consuming physical examinations. This is obviously impossible in routine production, but some of the work which has already been carried out for research purposes, can give a good idea of the optimum condition which can be achieved.

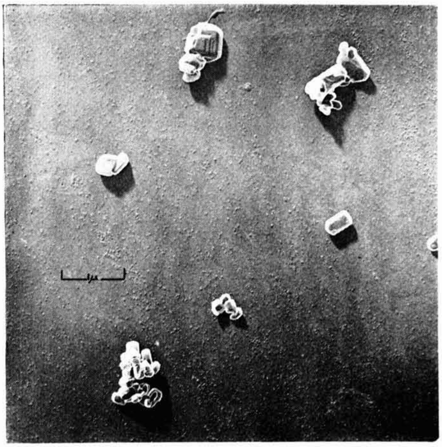

Fig. 2. Electron photomicrograph showing toluidine red after dispersion

The Mie theory as applied to pigment dispersion, and taking into account the optical parameters of the pigment, suggests that with highly transparent pigments of high colour strength, a reduction in particle size leads to a considerable increase in colour strength below about 0.3 μm. The theoretical curve for dioxazine violet (λ = 550 mm) is shown in Fig. 3, together with practical determinations carried out by Carr[2]. Pigment dispersions were prepared by ball milling and sand milling, and average particle sizes determined from a complete analysis using the disc centrifuge; colour strength was measured by colour measurement on reductions with titanium dioxide. From the figure it will be seen that the practical determinations lie extremely close to the theoretical curve and thus confirm that, in many cases, a much higher colour strength should be obtainable by adequate dispersion. It will, however, be observed that it is necessary to decrease the size of the grinding medium in order to obtain finer dispersions, since there seems to be a limit that can be acheived by ball milling. It should also be noted that the times taken to achieve these very fine dispersions would be excessive in terms of cost, for practical purposes, if they were to be carried out by the paint maker.

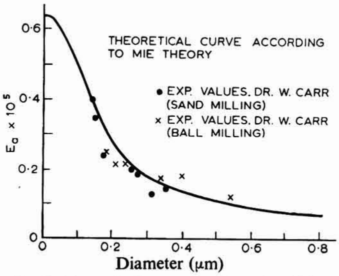

Fig. 3. Theoretical curve for dioxazine violet

In Fig. 4 there is a more detailed study of the same dioxazine violet, where the results are related to the tendency to flocculation. In general, it is observed that the finer the dispersion, particularly below 0.2μm, the lower is the tendency to flocculation.

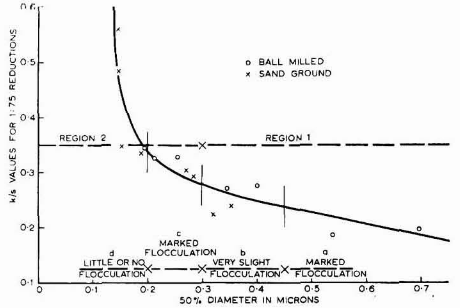

Fig. 4. Dioxazine violet—results related to tendency to flocculation

The Mie theory calculations are based on the optical considerations, refractive index (n) and absorption coefficient (k), and the variations that can be demonstrated are shown in Fig. 5. In Fig. 6 the practical effect can be observed in the comparison between copper phthalocyanine blue, where a steep rise in colour strength is obtained, and pigment green B where there is very little increase in strength with continued reduction in particle size. It is, therefore, important to know with which pigments continued energy input is going to be profitable although, of course, there may be other added advantages relating to transparency or gloss.

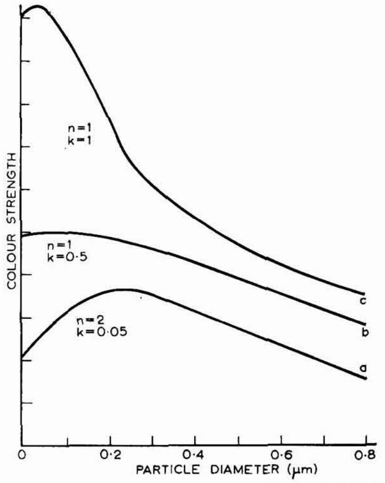

Fig. 5. Colour strength/particle size according to the Mie theory

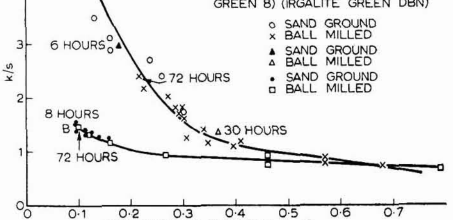

Fig. 6. Particle size of paint stainers/colour strength of titanium dioxide reductions (1 : 12.5)

The results so far described refer to alkyd decorative paint systems, where the dispersion obtained is very stable and measurements of the liquid paint relate to colour strength results obtained in the final paint film. In a paint system where the pigment is not so well stabilised, results obtained do not coincide precisely with the theoretical predictions. This is well demonstrated in Fig. 7, which shows the result with phthalocyanine blue in alkyd/melamine formaldehyde stoving lacquers: the results obtained with sprayed films and poured down films are contrasted with the dotted line curve obtained with an alkyd air drying paint. The conclusion to be drawn from these results is that the average particle size, as determined in the liquid paint, is no longer the same in the final paint film and flocculation must have occurred. In Fig. 4, it will be recalled that the tendency to flocculation is considerably reduced when the particle size of the pigment is below 0.2 μm.

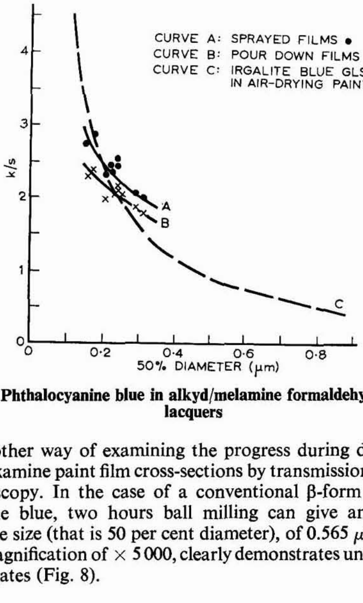

Fig. 7. Phthalocyanine blue in alkyd/melamine formaldehyde stoving lacquers

Another way of examining the progress during dispersion is to examine paint film cross-sections by transmission electron microscopy. In the case of a conventional β-form phthalocyanine blue, two hours ball milling can give an average particle size (that is 50 per cent diameter), of 0.565 μm which, at a magnification of × 5 000, clearly demonstrates undispersed aggregates (Fig. 8).

Seventy-two hours ball milling reduces the average size to 0.215 µm and there is an obvious improvement in dispersion (Fig. 9). Aggregates still remain, however, and their composition can be seen in Fig. 10, where twice the magnification has been used.

The conditions used during Dr Carr's experiments described above, are not very easily applied during practical paint making and it is necessary to consider other ways of achieving these results, which are often provided by pigment manufacturers:

Easily dispersible pigments. These pigments are carefully controlled during manufacture and usually contain a small amount of protective resin which enables the pigment powders to be quickly broken down by high shear dispersion mixing.

Fig. 8. Phthalocyanine blue, two hours ball milling, 50 per cent diameter, 0.565μm (× 5 000 magnification)

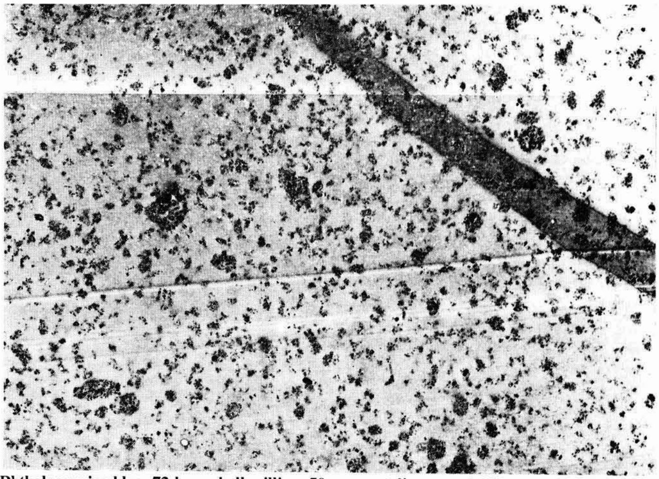

Fig. 9. Phthalocyanine blue, 72 hours ball milling, 50 per cent diameter, 0.215μm (× 5 000 magnification)

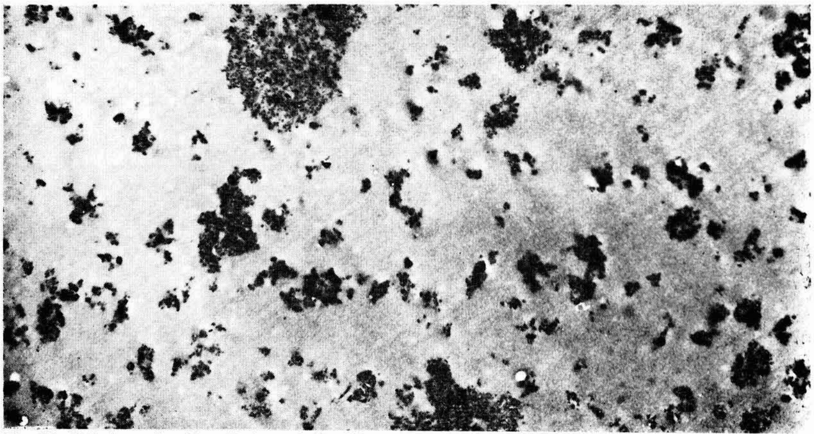

Fig. 10. Phthalocyanine blue, 72 hours ball milling, 50 per cent diameter, 0.215μm (× 10 000 magnification)

Pigment preparations. These are pigments in a very fine state of dispersion in an appropriate carrier, which may represent 50 per cent or more of the total product. They can normally be readily dispersed by stirring in solvent.

Liquid dispersions. In this case, a stabilised dispersion is provided, and the most well known example is the range of products available for emulsion paints.

The liquid dispersion is the closest example to a stable compatible dispersion which carries into the paint, and into the final film, the optimum utilisation of the pigment. It could well be that extensions of these types of products will be made giving optimum value pigments for all types of solvent-based systems and, of course, ultimately for solventless systems.

It may well be said that this paper introduces nothing new; on the other hand, it may have achieved the objective of drawing attention to the ways of obtaining better value from organic pigments, and thereby ultimately making better use of materials and energy.

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An investigation of the discrepancies in the determination of the solids content of stoving enamels crosslinked with nitrogen resins

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Summary

It is known that the experimentally determined solids content of stoving enamels containing nitrogen crosslinking resins can differ from the expected value.

In this paper, the thermal stability of individual nitrogen and plasticising resins, as well as mixtures of these resins, is examined. It is found that the chemical reactions which occur during the solids determination relate to the solids discrepancies. Additionally, it is found that a graphical plot of solids difference against resin composition for nitrogen resin/plasticising resin mixtures can be used to determine the nitrogen resin concentration that gives optimum hardness and flexibility characteristics for the particular resin system.

Keywords

Raw materials: binders (resins etc.)

- alkyd resin
- amino resin
- acrylic resin

Processes and methods primarily associated with drying or curing of coatings

- stoving

Properties, characteristics and conditions primarily associated with:

materials in general

- flexibility
- reactivity

bulk coatings and allied products

- non-volatile content

dried or cured films

- hardness
- impact resistance
- scratch resistance
- stress cracking

Une investigation sur les désaccords au cours de la détermination de la teneur en matière sèche des émaux séchant au four reticulés par les résines azotiques

Résumé

Dans le domaine des émaux séchant au four contenant des résines azotiques de pontage, on sait que les extraits secs déterminés par les expériences peuvent être différents des valeurs prévues.

Dans cet exposé on considère la stabilité thermique de certaines résines soit azotique soit plastifiante, ainsi que les mélanges de ces résines. On trouve que les réactions chimiques se produisant lors de la détermination des extraits secs sont en rapport avec les variations constatées parmi les teneurs en matizre sèche. D'ailleurs, on trouve que la courbe des différences des extraits secs contre la composition des mélanges résine azotique/résine plastifiante peut être utilisée pour déterminer la concentration de résine azotique qui donne les caractéristiques optimales de dureté et de souplesse à l'égard de ce système particulier de résines.

Eine Untersuchung der Unstimmigkeiten bei der Bestimmung des Festgehaltes von Ofentrocknenden Emaillelacken, die mit Aminoharzen Vernetzt sind

Zusammenfassung

Bekanntlich kann der Festgehalt von Stickstoff enthaltenden Vernetzungsharzen bei experimenteller Bestimmung von dem erwarteten Werte abweichen.

In dieser Abhandlung wird sowohl die Wärmestabilität individueller Amino- und weichmachender Harze als auch von Mischungen dieser Harze geprüft. Dabei wird festgestellt, dass die bei der Festgehaltsbestimmung vor sich gehenden Reaktionen mit den Unstimmigkeiten in den Festgehalten zusammenhängen. Ausserdem findet man, dass eine graphische Darstellung des Unterschiedes im Festgehalt gegenüber der Harzzusammensetzung für Stickstoff/Weichmacherharzmischungen dazu benutzt werden kann, um die Konzentration des Stickstoffharzes, welches die optimale Härte- und Biegefähigkeit- Charakteristika des speziellen Harzsystems ergibt, zu bestimmen.

Introduction

The determined weight solids content of stoving enamels containing nitrogen crosslinking resins is frequently found to vary significantly from the "expected" value and, in addition, the stoving schedule used in the solids determination is found to affect the result.

The experimental work reported here was undertaken to investigate these variations in solids contents and to determine whether they could be related to other formulae parameters.

Method of solids determination

Several 65mm diameter tinplate dishes were dried to constant weight at the temperature chosen for the solids determination and the weight measured to the nearest 0.0001g. The sample was weighed on to the tinplate dish to the nearest 0.0005g and was then diluted with about 5ml of filtered xylol. It was found that results obtained from samples varying in size from 0.4 to 1.3g were consistent and the sample size aimed for in the experimental work was 0.75 ± 0.2g. Differing stoving schedules were used in the solids determinations, the schedules being similar to "low bake" and "high bake" schedules that could be used in the commercial utilisation of stoving enamels based on the resins under evaluation.

Solids determination and thermal stability of individual resins

Individual nitrogen and plasticising resins were given repeated stovings at 120°C and 200°C to determine their behaviour. The lower temperature was chosen as it is typical of those used commercially for low bake stoving enamels and 200°C was selected to determine the performance of the resins under extreme conditions. The resins examined were commercial samples of:

1 Hexamethoxy methyl melamine, described by the manufacturer as having 100 per cent solids content.

1a The same resin to which 1 per cent by weight of a 20 per cent solution of *para*toluene sulfonic acid in *n*-butanol had been added.

2 A methylated melamine not requiring the addition of acid catalyst to initiate crosslinking and having a solids content, according to the manufacturer, of 80 per cent.

3 A fast curing *n*-butylated melamine formaldehyde resin with a solids content, according to the manufacturer, of 60 per cent.

4 A hydroxy functional thermosetting acrylic resin with a solids content of 60 per cent. (Referred to in the Figs. and Tables as resin *A*.)

5 A 43 per cent oil length coconut oil alkyd, described by the manufacturer as having 70 per cent solids content.

In the case of stoving at 120°C, the test sample was weighed at 30-minute intervals and, in the case of 200°C, at 5-minute intervals. The results are shown graphically in Fig. 2 and 3.

The results obtained with hexamethoxy methyl melamine (HMMM) with and without the addition of acid catalyst (resins *1* and *1a*) are similar to those obtained by Saxon and Lestienne[1], although it should be noted that these workers used the pure monomeric melamine resin obtained by vacuum distillation of a commercial sample. They were able to demonstrate the rapid initial weight loss of hexamethoxy methyl melamine in the presence of acid catalyst was due to a self-condensation reaction accompanied by the evolution of dimethoxy methane (methylal) and methanol. The weight loss of the uncatalysed resin was attributed to the degree of volatility of the material. Clearly, the relative rates of evaporation and condensation of HMMM will determine the value of weight loss measurements in following its reaction with other resins.

The other nitrogen resins show rapid weight losses initially and then level off to a fairly constant weight. A constant weight after the initial reaction would be expected from the work of Lady, Adams and Kesse[6] who showed from infrared spectra that little degradation of melamine resin films takes place between one and three hours when these are maintained at 140°C. It can be speculated that the initial rapid weight loss is due to self-condensation of the resin with the evolution of water, alcohol and formaldehyde, and is possibly accompanied by the evaporation of low molecular weight polymer species.

The plasticising resins showed relatively little weight loss with the acrylic resin having (as would be expected) excellent heat stability.

Chemistry of the self-condensation and crosslinking processes

It is known that alkylated melamine and urea resins contain the following potentially reactive groups:

Imino	$>NH$
Methylol	$>N—CH_2OH$
Alkoxyl methyl	$>N—CH_2OR$

The presence of NH_2 groups has not been detected[2]. Because the imino group is not reactive with carboxyl or hydroxyl groups, it will not assist in the crosslinking reaction with hydroxy acrylic resins or plasticising alkyds, but will provide a site for self-condensation. The methylol group is able to take part both in self-condensation and crosslinking reactions.

Alkoxymethyl groups react principally by crosslinking, but can also take part in self-condensation reactions. Methoxymethyl groups have been shown[1, 3] to react by crosslinking about 20 times more rapidly than by self-condensation under acidic conditions. The rate of reaction between the alkoxy methyl group on the nitrogen resin and the hydroxyl group on the plasticising resin varies inversely with the chain length of the etherifying alcohol present in the former[4]. Thus, the butoxy methyl groups of a conventional butylated melamine formaldehyde resin take part in crosslinking at a slower rate than the methoxy methyl groups on methylated melamine resins. A slow crosslinking rate permits the competing self-condensation reaction to proceed to a significant extent and, in fact, Koral and Petropoulos[3] state that the rates of crosslinking and self-condensation reactions for conventional butylated amine resins are of the same order of magnitude.

It can be seen from Fig. 1 that during stoving, nitrogen crosslinking resins can undergo a variety of reactions and inspection of the molecular weights of the volatile reaction products does not hold any particular promise that solids determination figures will lead to an insight into the predominant reaction(s) taking place. Accordingly, it was not considered profitable in the present study to determine the solids content of the crosslinking resins at 60°C in a vacuum oven which method, according to Secrest and Heckman[5], gives results close to the true polymer composition because, under these conditions, the polymers can be shown to lose few ether and methylol groups.

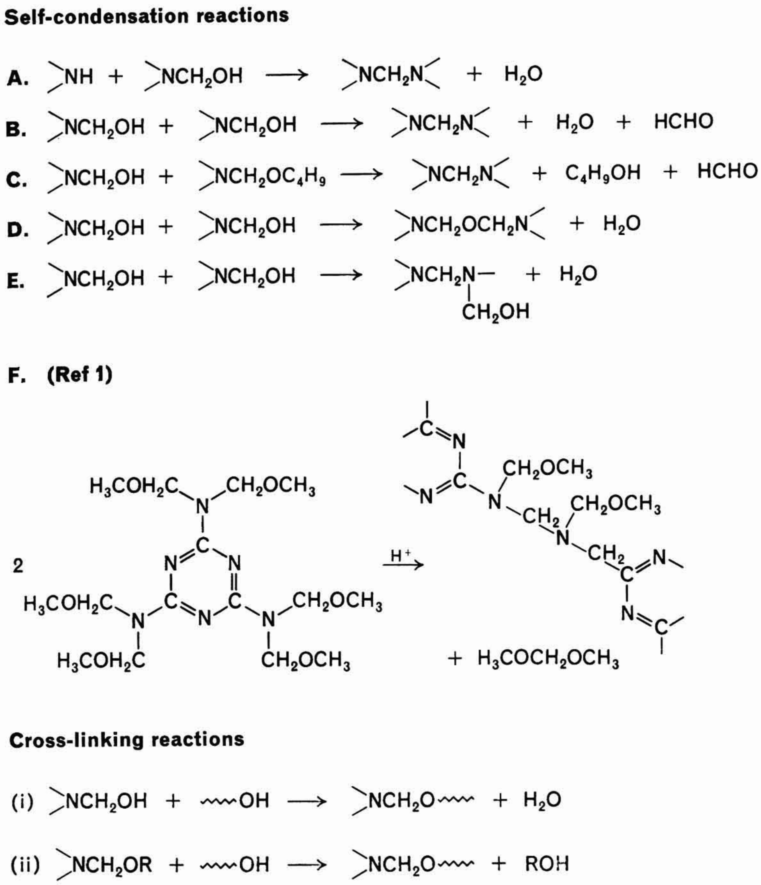

Fig. 1. Possible curing reactions of nitrogen crosslinking resins

Solids determinations on thermosetting acrylic resin-nitrogen crosslinking resin mixtures

Refs. 1-7

The hydroxy functional thermosetting acrylic resin (resin *A*) was chosen for investigation with a wide range of nitrogen crosslinking resins because of its superior heat stability in the initial tests. The amount of crosslinking resin used was varied in each case from about 5 per cent to 40 per cent, based on the solids contents quoted by the manufacturers. A list of the crosslinking resins used is shown in Table 1; all are commercially available products.

The solids content of the resin mixtures and of each resin seperately was determined by the method described previously at two stoving schedules: 120°C for 30 minutes and 160°C for 10 minutes. The result of the solids determination on each separate resin was taken to be the "actual" solids of the resin at the stoving schedule involved. From these results, the expected solids of each resin blend could be calculated and the values so calculated were referred to as the "theoretical" solids of the resin solution mixtures.

The actual solids of each resin solution mixture was determined, and compared with the theoretical solids value. The difference Δ between the theoretical and actual solids values appeared to be very random and no pattern was immediately evident.

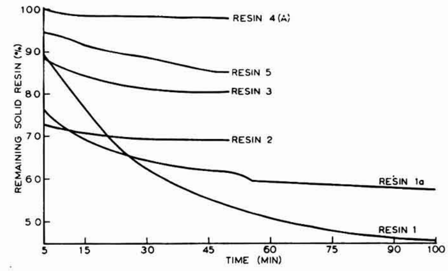

Fig. 2. Thermal degradation at 200°C

Table 1

Nitrogen crosslinking resins used in the study

Reference	Description	Solids content quoted by manufacturer (%)
S	Hexamethoxy methyl melamine ..	100
T	Hexamethoxy methyl melamine + 1% PTSA* (20% solution) ..	100
U	Modified methylated melamine ..	80
V	*n*-Butylated benzoguanamine formaldehyde resin	60
W	*n*-Butylated urea formaldehyde resin	50
X	*n*-Butylated melamine formaldehyde resin; "slow" curing	64
Y	*n*-Butylated melamine formaldehyde resin; "fast" curing	58
Z	*n*-Butylated melamine formaldehyde resin; "fast" curing	60

*PTSA is *para*toluene sulfonic acid.

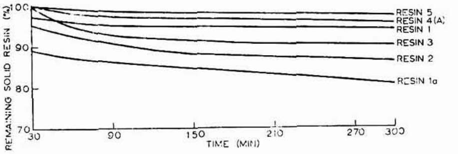

Fig. 3. Thermal degradation at 120°C

Graphs were plotted of Δ against the concentration of nitrogen crosslinking resin in the resin mixture. The graphs (Figs. 4 to 11) show some similarities, with the exception of catalysed HMMM and the modified methylated melamine, that is, resins *T* and *U*.

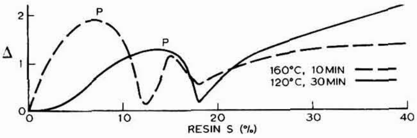

Fig. 4. Resin A—resin S

A point of similarity, that will be shown to have some significance, is the occurrence of an initial peak (P). In some cases the peak is sharply defined, in others it is much flatter. The graph (Fig. 5) for resin *T* (HMMM in the presence of acid catalyst) has a curve inverse with respect to the other graphs and shows minima (M) instead of the peaks (P). The shape also indicates a higher actual resin solids content than the theoretical value. Saxon and Lestienne[1] have found that HMMM is slightly volatile at 100°C, and significantly more volatile when heated by itself at 150°C. In the determination of the actual solids of resin *T* alone, a degree of self-condensation, with the resultant evolution of methylal (molecular weight 76) will occur, as well as some evaporation of the resin. When resin *T* is crosslinked with the acrylic resin, the crosslinking reaction predominates and methanol (molecular weight 32) is evolved. It is also believed[1] that when HMMM is involved in a crosslinking reaction, weight loss due to HMMM volatility is markedly lowered. Thus the significant difference between catalysed and uncatalysed HMMM—crosslinking reactions reported by earlier workers can be seen to be well reflected in the differences between Figs. 4 and 5.

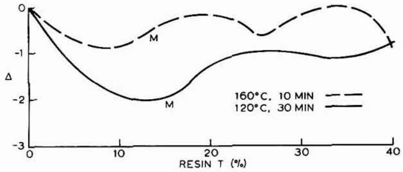

Fig. 5. Resin A—resin T

It should be noted that the graph of solids difference for catalysed HMMM (Fig. 5) shows minima (M) that are at the same acrylic-to-melamine ratios as the peaks (P) shown in the graph for the uncatalysed HMMM.

The graphs for resin *U* (Fig. 6) show points of inflexion (*I*) and it will be shown that these points have the same significance for resin *U* as do the peaks (P) for the other nitrogen resins.

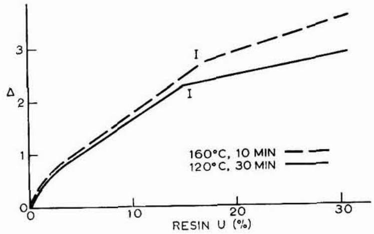

Fig. 6. Resin A—resin U

It is a commonly accepted formulating guide when a plasticising resin is crosslinked with *n*-butylated melamine resins that about 30 per cent by weight crosslinking resin solids content is necessary, based on plasticising resin solids. It has been shown[7] that HMMM in the presence of acid catalyst will react with a plasticising alkyd to produce a film of equivalent hardness to an *n*-butylated melamine resin when used at about half the solids level of the latter. When the graph of catalysed HMMM with acrylic resin is compared to the graph of the fast curing butylated melamine resin (resin *Z*) (Figs. 5 and 11), a significant result appears. The minimum (M) on the graph of catalysed HMMM (Fig. 5) appears at approximately half the crosslinking resin concentration at the peak (P) of the fast curing melamine resin (Fig. 11). It may also be significant that the initial peak in Fig. 11 appears at approximately the crosslinking resin level that is regarded as being the normal formulation starting point for this type of system.

When these two facts are considered, it appears that the shape of the graphs obtained is related to the reactivity of the system for a given set of conditions. The position of the initial peak observed is, generally, different for each crosslinking resin, and may vary significantly as the stoving conditions are changed. The initial peak (P) on the curve may provide an indication of some significant ratio of plasticising resin to crosslinking resin for a given stoving schedule, since the peaks appear at ratios similar to those normally used for the resins in question. In order to investigate this hypothesis, physical checks were carried out on films cast from the resin mixtures.

The criteria taken to measure degree of cure were hardness and flexibility. Other film properties, such as solvent resistance and stain resistance, were found to change too slowly with nitrogen resin content to be useful. Hardness was measured on a Sheen Scratch Tester, using a ball ended needle. Results were quoted as being the greatest load the film would stand without rupture; increments of 50 grams were used, as this is the limit of accuracy with this instrument. This method complies with DEF 1053 Method 14 and BS 3900 part E2.

The flexibility was determined by the Wedgebend method. This method employs a panel, bent over on itself through an angle of 180° with 3.2mm radius, the film under test being on the outside of the panel. The bent panel is laid on a tapered block, and struck along its length by a weight of 2.25kg falling from a height of 0.6m. The resultant panel is thus tapered from 3.2mm radius to being quite flat. The panels are examined for cracking, the length of panel edge showing cracks measured from the zero radius end. The panels used in this test are 115mm long.

The film for these physical tests was cast as 12µm dry film thickness on scuffed electrolytic tinplate, stoved as specified.

The results of the physical tests are shown in Tables 2 to 5 for several nitrogen resins in combination with the thermosetting acrylic resin. It is evident that the composition for the optimum hardness-flexibility characteristics of the films agrees closely with that of the initial peaks (P) or inflexion points (I) on the graphs shown in Figs. 4-11, except for the catalysed HMMM resin, where the optimum point coincides with the initial minimum (M).

Table 2†

Resin A with resin T. Physical properties at 120°C, 30 min, and 160°C, 10 min

Resin *T* (%)	Stoving schedule	Scratch resistance (g)	Wedgebend (mm)	Graph peak
5	160°C, 10 min	300	6.0	9
12	160°C, 10 min	400	9.5	9
18	160°C, 10 min	350	9.5	9
5	120°C, 30 min	300	9.5	12
12	120°C, 30 min	450	12.5	12
18	120°C, 30 min	400	12.5	12

†Note: In all the following Tables in this paper, Wedge bend is measured in mm of cracking and scratch resistance is the maximum weight (in grammes) which the film will withstand before rupture. The Tables show only a typical collection of determinations of physical properties carried out on these and other resin solution mixtures. A full list of all test results is available from the authors on request.

Table 3

Resin A with resin U. Physical properties at 120°C, 30 min, and 160°C, 10 min

Resin *U* (%)	Stoving schedule	Scratch resistance (g)	Wedgebend (mm)	Graph peak
10	160°C, 10 min	300	63.5	15.5
17	160°C, 10 min	400	12.5	15.5
25	160°C, 10 min	450	19.0	15.5
12	120°C, 30 min	300	3.0	17.0
18	120°C, 30 min	450	6.0	17.0
25	120°C, 30 min	350	6.0	17.0

Table 4

Resin A with resin W. Physical properties at 120°C, 30 min, and 160°C, 10 min

Resin *W* (%)	Stoving schedule	Scratch resistance (g)	Wedgebend (mm)	Graph peak
12	160°C, 10 min	300	9.5	15
18	160°C, 10 min	350	0	15
25	160°C, 10 min	200	0	15
5	120°C, 30 min	250	19.0	12.5
12	120°C, 30 min	400	3.0	12.5
18	120°C, 30 min	300	6.0	12.5

Table 5

Resin A with resin Z

Resin *Z* (%)	Stoving schedule	Scratch resistance (g)	Wedgebend (mm)	Graph peak
12	160°C, 10 min	350	6.0	22
18	160°C, 10 min	400	6.0	22
25	160°C, 10 min	200	12.5	22
25	120°C, 30 min	350	12.5	35
33	120°C, 30 min	400	19.0	35
40	120°C, 30 min	300	16.0	35

Other conclusions which can be made from the comparison of the results of the physical properties with the shape of the graphs are:

(a) where the graph is a straight or nearly straight line (e.g. Fig. 6 and the 160°C curve on Fig. 7), the physical properties show little change with changing acrylic to nitrogen resin ratio;

(b) where a sharp initial peak occurs in the graph, there is a correspondingly sharp rate of change in physical properties with changing acrylic to nitrogen resin ratio at the peak;

(c) where a straight line results, the flexibility decreases as hardness increases, although within a given range only small changes are observed.

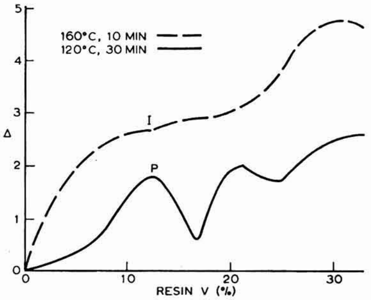

Fig. 7. Resin A—resin V

Effect of acid catalyst

It is known that acid catalysts accelerate the rate of many of the reactions shown in Table 1 so it was considered useful to repeat the previous study on some of the resin systems

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Orange 2640	Orange 2640	Orange 2640		
Orange 3040		Orange 3040	Orange 3040	
			Red 3730	Red 3730
Yellow 1870	Yellow 1870	Yellow 1870		
			Violet 5890	
			Red 4790	
			Violet 5100	
			Red 3910	
			Maroon 4780	
	Yellow 1520			
	Yellow 1560			
			Maroon 3920	Maroon 3920
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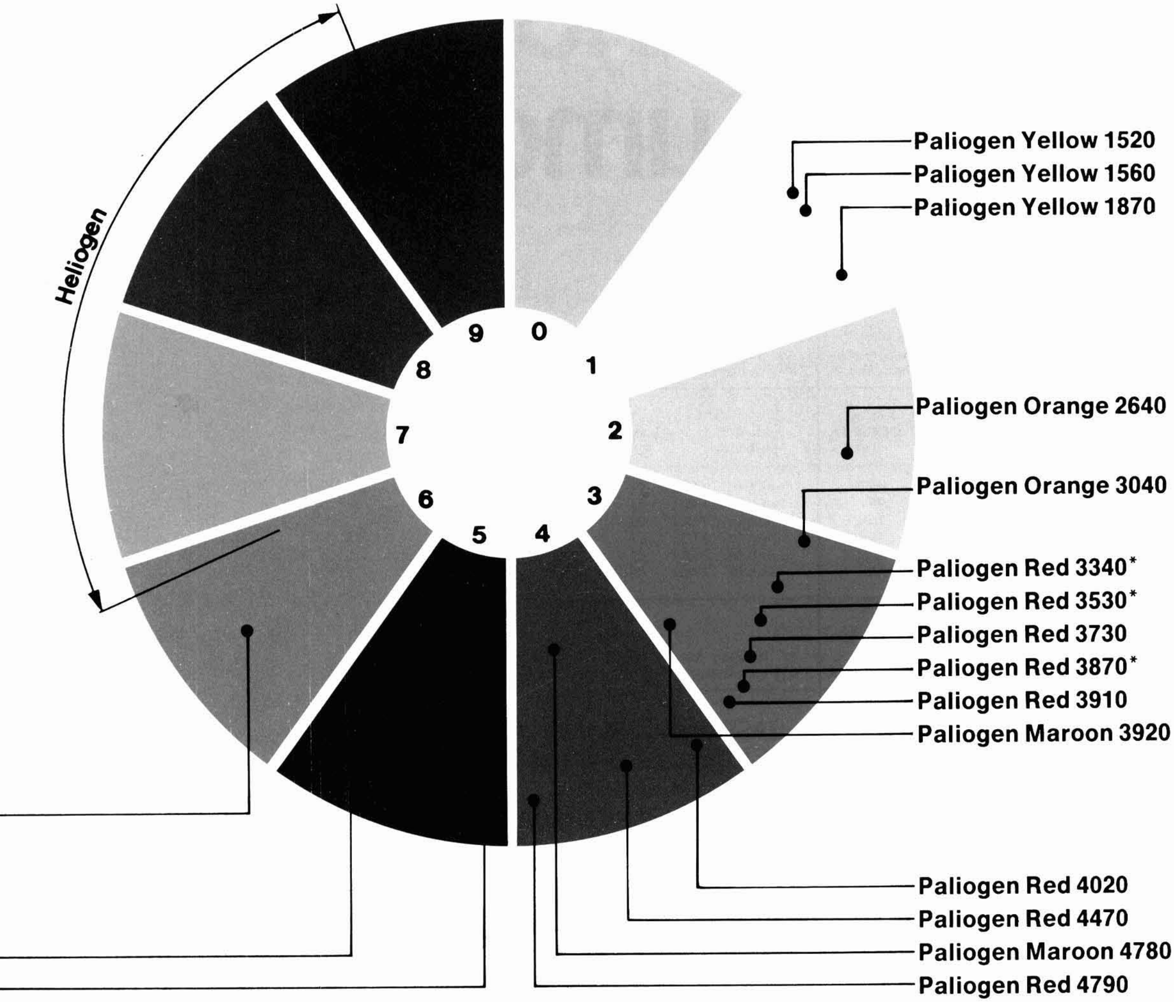

with the addition of 1 per cent by weight of a 20 per cent solution of p-toluene sulfonic acid in n-butanol.

Figs. 12 to 15 and Tables 6 to 8 show the results obtained for the catalysed systems.

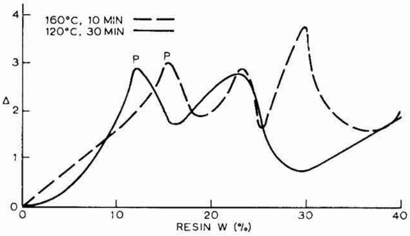

Fig. 8. Resin A—resin W

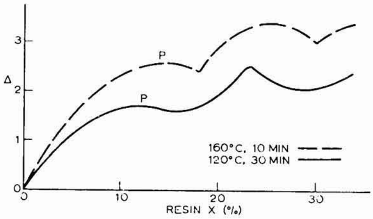

Fig. 9. Resin A—resin X

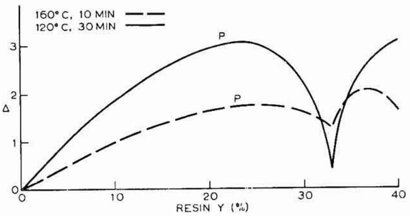

Fig. 10. Resin A—resin Y

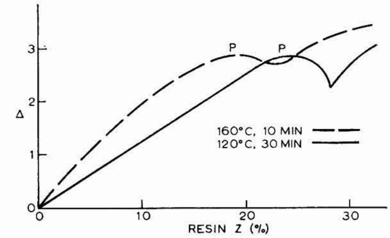

Fig. 11. Resin A—resin Z

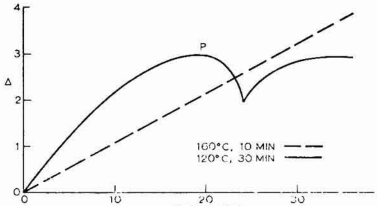

Fig. 12. Resin A—resin U—catalysed

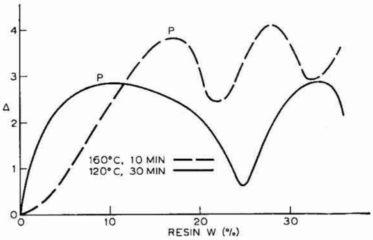

Fig. 13. Resin A—resin W—catalysed

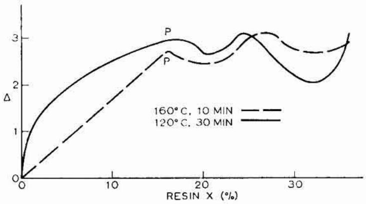

Fig. 14. Resin A—resin X—catalysed

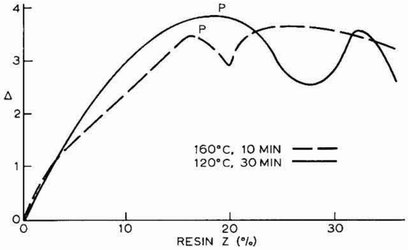

Fig. 15. Resin A—resin Z—catalysed

Table 6

Resin A with resin U in the presence of acid catalyst. Physical properties at 120°C, 30 min, and 160°C, 10 min

Resin U (%)	Stoving schedule	Scratch resistance (g)	Wedgebend (mm)	Graph peak
12	160°C, 10 min	450	12.5	nil
16	160°C, 10 min	500	19.0	nil
20	160°C, 10 min	500	19.0	nil
12	120°C, 30 min	500	9.5	18.5
16	120°C, 30 min	550	6.0	18.5
20	120°C, 30 min	700	12.5	18.5

Table 7

Resin A with resin W in the presence of acid catalyst. Physical properties at 120°C, 30 min, and 160°C, 10 min

Resin N (%)	Stoving schedule	Scratch resistance (g)	Wedgebend (mm)	Graph peak
12	160°C, 10 min	450	16.0	17
16	160°C, 10 min	500	22.0	17
20	160°C, 10 min	400	44.5	17
12	120°C, 30 min	450	16.0	10–15
16	120°C, 30 min	500	16.0	10–15
20	120°C, 30 min	400	19.0	10–15

Table 8

Resin A with resin Z in the presence of acid catalyst. Physical properties at 120°C, 30 min, and 160°C, 10 min

Resin *Z* (%)	Stoving schedule	Scratch resistance (g)	Wedgebend (mm)	Graph peak
12	160°C, 10 min	500	25.0	16
16	160°C, 10 min	450	12.5	16
20	160°C, 10 min	500	50.5	16
8	120°C, 30 min	450	16.0	10
12	120°C, 30 min	550	16.0	10
16	120°C, 30 min	500	16.0	10

It is evident that acid catalysis has a pronounced effect and the greatest changes are, as would be expected, found at the lower bake schedule, 30 minutes at 120°C. Stoichiometrically, urea reacts with less formaldehyde than would melamine, and hence urea resins, as a class, contain high levels of imino groups. In addition, Van Zuylen[2] has shown that highly reactive melamine resins contain higher levels of imino groups than do the slow curing melamine resins. It is, therefore, interesting that the urea and fast curing melamine resins show the largest change between catalysed and uncatalysed solids difference value Δ. These differences being particularly evident at low nitrogen resin concentrations.

The physical properties of the catalysed systems again show an optimum in hardness-flexibility performance coincident with the initial peak (P) on the graphs.

Investigation of different plasticising resins

Other plasticising resins were examined with a number of crosslinking resins. These plasticising resins included:

Resin *B*, a short oil coconut alkyd—non-volatile content 60 per cent (non-drying)

Resin *C*, a short tall oil alkyd—non-volatile content 50 per cent (semi-drying)

Resin *D*, a short oil dehydrated castor oil epoxy ester—non-volatile content 50 per cent (semi-drying)

The solids content of samples of these resins, blended with crosslinking resins at various ratios were determined and the results compared with theoretical values. The discrepancy Δ between the actual and expected solids values was determined, and graphs plotted as before. Resin *B* gave graphs of the basic shape previously observed (Figs. 16 and 17), but resins *C* and *D* gave almost straight line graphs. However, when the actual solids content of the samples (instead of the difference between actual and theoretical solids content) using resins *C* and *D* were plotted against the alkyd nitrogen resin ratio, a curve showing one or more minima resulted. These graphs are shown in Figs. 18 to 21.

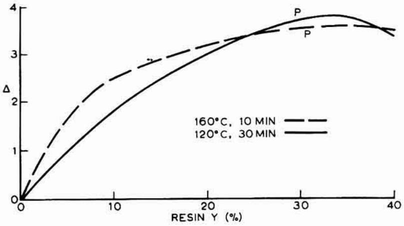

Fig. 16. Resin B—resin Y

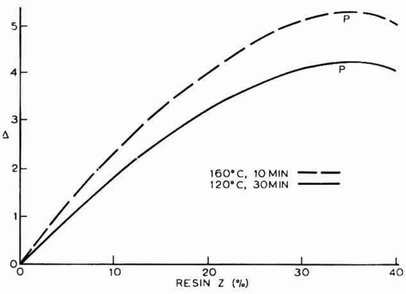

Fig. 17. Resin B—resin Z

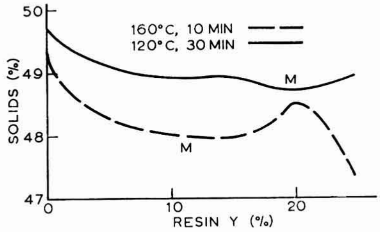

Fig. 18. Resin C—resin Y

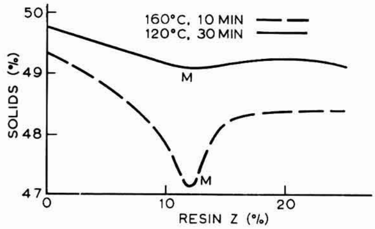

Fig. 19. Resin C—resin Z

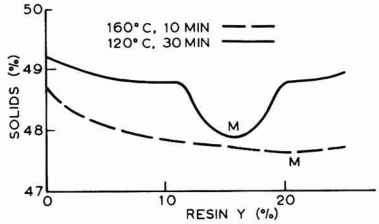

Fig. 20. Resin D—resin Y

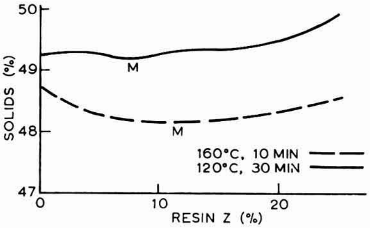

Fig. 21. Resin D—resin Z

Physical checks on films cast from the samples showed that an optimum in properties occurred at the initial minimum on the graph. The results are shown in Tables 9-11.

Table 9

Resin B with resin Y. Physical properties at 120°C, 30 min, and 160°C, 10 min

Resin *Y* (%)	Stoving schedule	Scratch resistance (g)	Wedgebend (mm)	Graphical optimum
25	160°C, 10 min	400	12.5	34
33	160°C, 10 min	550	19.0	34
40	160°C, 10 min	550	22.0	34
25	120°C, 30 min	1 000	31.0	33
33	120°C, 30 min	1 000	25.0	33
40	120°C, 30 min	1 000	47.0	33

Table 10

Resin C with resin Y. Physical properties at 120°C, 30 min, and 160°C, 10 min

Resin *Y* (%)	Stoving schedule	Scratch resistance (g)	Wedgebend (mm)	Graphical optimum
8	160°C, 10 min	Soft	50	14
12	160°C, 10 min	Soft	50	14
16	160°C, 10 min	900	12.5	14
16	120°C, 30 min	550	12.5	20
20	120°C, 30 min	550	12.5	20
25	120°C, 30 min	400	19.0	20

Table 11

Resin D with resin Y. Physical properties at 120°C, 30 min, and 160°C, 10 min

Resin *Y* (%)	Stoving schedule	Scratch resistance (g)	Wedgebend (mm)	Graphical optimum
16	160°C, 10 min	800	6.0	20
20	160°C, 10 min	900	3.0	20
25	160°C, 10 min	800	8.0	20
12	120°C, 30 min	450	0	16
16	120°C, 30 min	500	0	16
20	120°C, 30 min	400	6.0	16

It is, therefore, suggested that the results with systems containing semi-drying resins should be plotted in this way to allow for the oxidation of the plasticising resin during the determination of its solids content.

Other plasticising resins, both drying and non-drying, have been examined by the authors using this method, and give results, which agree with those reported here. Batch to batch variations of commercial resins have been examined and found not to affect significantly the position of the initial peaks (P) or minima (M).

Conclusion

The difference between "actual" and "theoretical" weight solids content for plasticising resins crosslinked with nitrogen resins is related to the crosslinking reactions that occur during the solids determination. A graphical plot of the solids difference against resin composition may be used to determine the nitrogen resin concentration which gives optimum hardness-flexibility performance.

[*Received 12 November 1974*

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Next month's issue

The Honorary Editor has accepted the following papers for publication, and they are expected to appear in the July issue of the *Journal*.

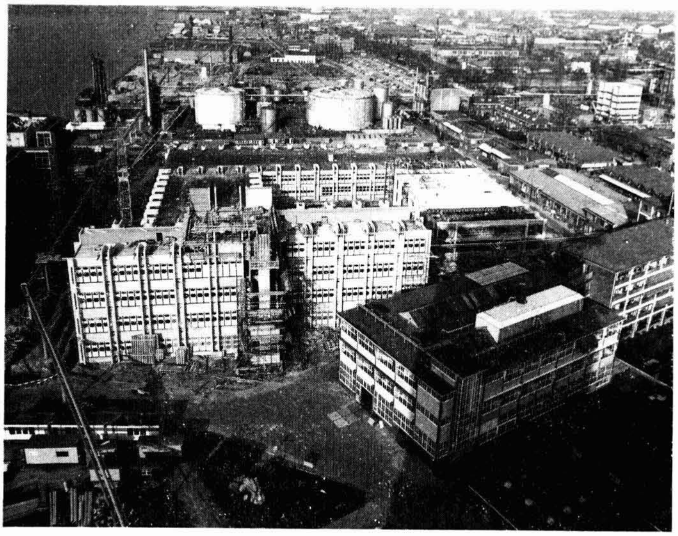
Coating immersed concrete for swimming pools and sewage installations, *by P. J. Gay*

Particle size measurement of carbon black in surface coatings, *by W. Carr and G. A. Lombard*

Some advances in melamine resin technology, *by J. E. Sreeves*

Fatty acid design for alkyd resin manufacture, *by A. L. Stubbs*

Information Received



The new Polymer Centre building at the Amsterdam Laboratories of Shell Research BV under construction. The Royal Dutch/Shell group's polymer research and development activity is being consolidated in Amsterdam, where the new Polymer Centre is due for completion this year. Research work and technical service with the group's wide range of polymers, intermediates and ancillary chemicals, previously carried out at Delft in The Netherlands, and at Carrington near Manchester and Egham in Surrey, will by then have been transferred to Amsterdam.

Queen's Awards to Industry 1975

Allied Colloids Manufacturing Company Limited has won a second award for export achievements. The company won its first award in 1972. Allied Colloids manufactures speciality chemicals for use in the production of textiles, paper, plastics, ceramics, paint and rubber, and also chemical products for water and effluent treatment and use in the mining and mineral processing industries. Current exports total approximately £6·5 million.

ICI's Agricultural, Organics and Pharmaceutical Divisions have each received an award for export achievement. The Organics Division, ICI's top exporting division with products exported during 1974 worth a record total of over £100 million, has won an award for the fourth time. The award for the Agricultural Division goes to its methanol group, now the dominant exporter in this division, accounting for about one-third of international methanol trade.

Scott Bader Company Limited, Wollaston, Wellingborough, Northants has received an award for achievement in technological innovation. Since the company was founded in 1920, its technical developments have included the introduction of the first low viscosity nitrocellulose for the lacquer industry in 1922, the first British naphthenate driers in 1936, and the first cold-setting polyester resins for reinforced plastics in 1947. The company receives its award this year for a system for the production of high gloss water-based paints.

Expansion by Shell Chemicals at Stanlow

A major expansion of plants for the production of epoxy resins and related products is underway at the Stanlow, Cheshire, site of Shell Chemicals UK Limited. Total cost will be around £12 million.

When this is completed during 1977, capacity for both liquid and solid "Epikote" epoxy resins will have been increased to more than double the present figure. Additional storage and warehouse facilities for epoxy resins are also to be built. Design and engineering construction will be handled by Shell Chemicals UK at Stanlow, with technical advice from Shell Internationale Chemie Maatschappij, The Hague. The additional material will meet increasing market demand both in the UK and overseas. Shell companies are the world's leading producers of epoxy resins, with production in nine countries.

A number of other units at Stanlow which provide feedstock for epoxy resin production are also being expanded. Capacity for diphenylol propane (DPP) is being increased from 15 000 to 22 000 tonnes per year. The phenol/acetone plant, which came on stream towards the end of 1972, is to be modified to increase its output by more than 20 per cent by the end of 1976. It will then be capable of producing around 120 000 tonnes per year of phenol and 72 000 tonnes of acetone.

The outlets of both of these materials include their use as feedstocks for DPP production at Stanlow, and some phenol will also be exported to Shell Nederland Chemie's Pernis plant, where a new 60 000 tonnes per year DPP plant is scheduled to come on stream in 1976. Cumene feedstock for the Stanlow phenol plant is largely imported from the Pauillac plant of Shell Chimie in France, which uses benzene supplied from the 450 000 tonnes per year plant in Stanlow completed in 1974.

Safety in hydrocarbon oxidation

A hydrocarbon oxidation study group is to be established by the Institution of Chemical Engineers where companies which operate hydrocarbon oxidation processes can meet to discuss and exchange information on the technical aspects of safety.

UK distributor for Santocel

Monsanto Limited has announced the appointment of Durham Raw Materials Limited, 3/4 Great Tower Street, London EC3 as UK distributor for "Santocel", the company's silica aerogel flatting agent for surface coatings.

Cabot Carbon: impending closure

Cabot Carbon Limited, Stanlow, has announced the impending shutting-down of one production unit at its Stanlow carbon black plant and the initiation of a redundancy programme. These moves result from substantially reduced carbon black demand, coupled with continuing cost inflation at very high levels.

Rise in UK paint exports

The Paintmakers' Association has announced that paint exports from the UK showed a 21 per cent growth by volume last year, according to official statistics. In value terms, the increase was about 54 per cent compared with 1973, paint exports now exceeding £40 million per annum.

An analysis of the figures shows that EEC countries took 31 per cent by value in 1974, compared with 33 per cent in 1973 and 23 per cent in 1972. EFTA countries took 10.5 per cent in 1974, against 11 per cent in 1973 and 15 per cent in 1972.

New products

New inorganic pigment from Bayer

Bayer has announced a new inorganic pigment—Light Yellow 6R—suitable for use in surface coatings, printing inks, plastics and building materials.

Light Yellow 6R is a development of 3R; its higher saturation level extends the range of applications of this pigment class and offers many intermediate shades by blending with the 3R or 8G pigments. Shades can be formulated within the range from "golden yellow" to orange.

Pyrolytic boron nitride

Pyrolytic boron nitride, available from Fulmer Components Limited, is an extremely inert material which is particularly suited to high temperature applications. It is made by deposition from the vapour phase on to graphite moulds at temperatures above 1 700°C. A layer approximately one millimetre thick may be built up which, on release from the mould, gives a free-standing shape. Crucibles, dishes, tubes and other components may be formed by this means. It has a matt white surface, and its significant flexibility makes it more robust than many other ceramics.

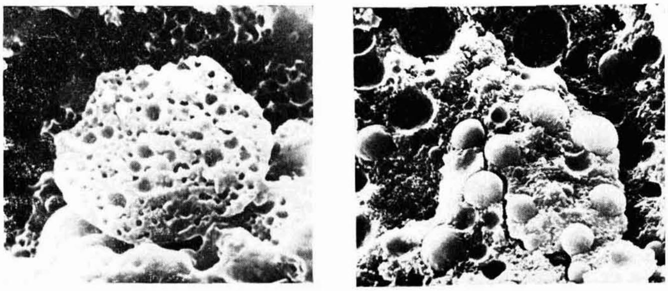
(Fulmer Components Limited is a subsidiary of Fulmer Research Institute Limited, which is owned by the Institute of Physics.)

Sprindrift

Tioxide International has announced the introduction of "Sprindrift" in to Europe. This is a novel material offering the opportunity of significant technical advance in a wide range of water-borne products.

It is claimed that formulators, particularly in the paint industry, will find a new freedom when producing compositions of high opacity. Sprindrift offers for the first time the advantage of dry-hiding combined with the film integrity associated with a fully bound system. Good application will no longer have to be compromised by the need to incorporate extenders or matting agents. The new product will be supplied as an aqueous slurry, and the formulator will be able to simplify production and increase throughput by using it.

Sprindrift was developed by Dulux Australia, and an agreement has been reached whereby market development in Europe will be carried out by Tioxide International Limited.



The basis for "Spindrift" is a system of spherical polymer beads of fairly uniform size having a maximum diameter in the range 3 to 50μm. The above photograph shows a polymer bead about 13μm in diameter partly embedded in a coalesced film of acrylic latex. The outer section of the bead has been removed and a scanning electron microscope reveals vesicles up to 1.2μm in diameter. The photograph on the right has been taken using a scanning electron microscope at ×2 000 magnification and shows a fresh acrylic latex paint film that has been torn to reveal the internal structure. Polymer beads up to 8μm in diameter can be seen in a coherent matrix of partially coalesced latex.

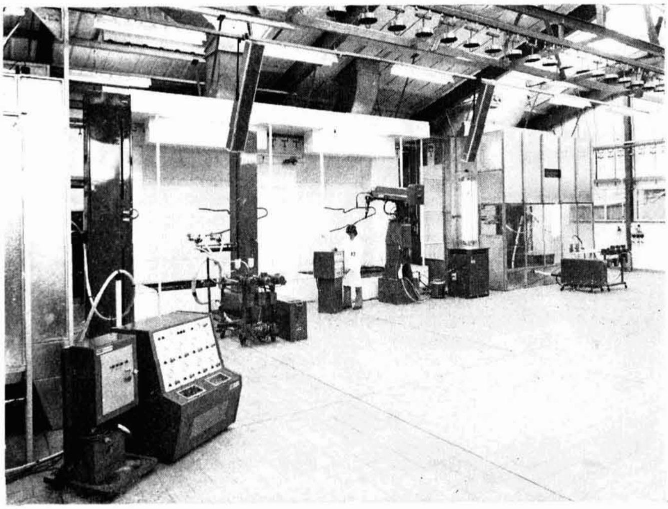
Treatment of concrete reinforcements

Jenolite Division of Duckhams Oils has introduced a new system of treating concrete reinforcements prior to embedding. The system consists of treated rusted reinforcements with Jenolite rust remover-preventor and subsequent sealing using "Jenoseel 3". This treatment is claimed to prevent spalling and subsequent rust staining through the cracks.

Literature

Gasil micronised silica gels

Technical publications No. 43 from Joseph Crosfield & Sons Limited gives detailed information on the company's "Gasil" brand micronised silica gels for matting surface coatings.



A general view of the new customer demonstration laboratory built by Binks-Bullows Limited for the analysis and solution of automated product finishing problems for UK and overseas customers. In the left foreground is the electrostatic powder coating booth and powder supply equipment. Next to that is a booth for air-assisted electrostatic painting. In the centre is the laboratory's main feature, the electronically-controlled robot spraying machine, RAMP 4088. On the far right is the glass-walled booth in which pure electrostatic painting is carried out. The laboratory is part of a £0.25 million factory extension recently completed by Binks-Bullows—one of the leading spray painting equipment manufacturers in this country.

Modaflow

Monsanto's Technical Bulletin IC/PL-338 gives specifications, application characteristics, commercial formulations and other information concerning the company's "Modaflow" resin modifier for non-aqueous coatings.

Rubber technology

The 1975 edition of Progress of Rubber Technology is now available from the Plastics and Rubber Institute, 11 Hobart Place, London, price £5.25.

Solubility parameters

A 24-page booklet, Technical Bulletin ICS (X)/75/1, has been published by Shell Chemicals explaining the application of solubility parameters and the development of solubility parameter systems.

Synthetic polymers from Allied Colloids

A range of six synthetic copolymers for use in the manufacture of inks, lacquers, polishes and other sealing and coating materials is introduced in a new technical booklet describing the "Alcolec" carboxylated polymers from Allied Colloids Limited of Bedford, England.

The booklet includes charts showing solution viscosities, solubility with 35 typical solvents, compatibility with 50 commercially available resins and plasticisers, flexibility and heat seal properties and water and steam resistance, etc.

Courses, Symposia, etc.

Plastics and rubber technology

Various short courses in plastics and rubber technology are being run between July and September this year by the Manchester Polytechnic. These are of approximately one week's duration and the fee for each course is £30.00. Further details are available from R. W. Little, Department of Polymer Technology, John Dalton Faculty of Technology, Chester Street, Manchester.

Hull

Cosmetics

The sixth meeting of the 1974/75 session was held at the George Hotel, Land of Green Ginger, Hull on Monday 17 March 1975. This was a meeting especially arranged for the ladies, and 36 members and guests attended. Mr E. Armstrong, the section chairman, introduced Mr D. S. Morris of the Helena Rubenstein laboratories who gave a lecture entitled "Cosmetics".

Mr Morris began by giving a history of make-up from the times of Tutankhamun, through the Elizabethan and Victorian eras to the present time. Modern cosmetics had been founded by Elizabeth Arden and Helena Rubenstein at the beginning of this century.

Mr Morris gave a brief account of skin preparations (cleansers, toners and moisturisers) and discussed make-up in some detail. There were different types of make-up, namely foundations, powders, blushes, eye make-ups, mascara, eye-liners and lipsticks. Indications were given of the types of raw materials used in the formulation of make-ups. Mascara, used by 51 per cent of women, was alcohol based and comprised pigmented waxes. Eye-liners were based on PVAc copolymers. Lipsticks, used by 82 per cent of women, were composed of low melting silicone waxes with a low pigment content to give a moderately high gloss.

Allergy was one of the main problems in the cosmetics industry and all too often the use of potentially good raw materials or additives was prohibited mainly due to bad publicity. An example of such an additive no longer used in cosmetics was hexachlorophene; this compound was claimed to have caused cancer in rats when used in grossly excessive quantities and has been subsequently banned due to adverse publicity.

A practical demonstration of the art of cosmetics was given to two volunteers from the audience by two experienced beauticians. Mr Morris's lecture was exceedingly well received and he spent some considerable time answering countless questions put to him by his audience.

A vote of thanks was proposed by Mr T. W. Wilkinson who complimented the speaker of his attractive presentation and drew some humorous comparisons between paints and cosmetics. He also expressed how gratifying it was to see so many at the meeting to hear such an able speaker. The audience responded to Mr Wilkinson's vote of thanks with a rapturous round of applause.

D.M.W.

Irish

Science in crime detection

A meeting was held at the Clarence Hotel, Dublin on Wednesday 19 March.

Mr R. Simon of the Institute for Research & Standards, and an Ordinary Member of the Section, accompanied by Detective Superintendent Murphy of the Garda Siochana Technical Bureau, gave a joint lecture on scientific methods used in the detection of serious crime.

Mr Simon explained that at the moment the Garda has no forensic laboratory, although the Government has now made the necessary funds available for such an establishment. In the meantime, forensic investigation was carried out on behalf of the Garda by the Institute for Research & Standards and by the state laboratory.

Much of the work involved examination of paint films or smears, often in connection with "hit and run" or "smash and grab" cases, and for this type of work the Institute was fortunate in possessing a scanning electron microscope. This instrument was fitted with a probe analyser attachment and was capable of presenting an analysis of the solid components of a paint film in a manner that would be acceptable as evidence in court.

Mr Simon felt that methods of analysing the medium contained in a paint film were difficult to achieve.

Detective Superintendent Murphy explained that the Garda Technical Bureau consisted of five sections, namely, Fingerprint, Ballistics, Photographic, Mapping and General Investigation. Each section was controlled by a detective sergeant, with the necessary complement of detective constables. In addition, access to the work of the state pathologist was available.

With the exception of those attached to the Mapping Division, two years' training was given at Scotland Yard—training of the Mapping Division was undertaken by the Ordnance Survey Department, which had its headquarters in Phoenix Park.

Supt. Murphy said that no member of the Bureau was permitted to give evidence in court until five years' training had been received, and he emphasised the need, in crime detection, for maintaining a completely open mind. The audience was assured that scientific evidence in a case was only one facet of a case, and would require additional support in order to obtain a conviction.

The chance of duplicate fingerprints occurring was so remote as to be discountable, but one of the problems when investigating a crime was to obtain perfect prints which enabled them to be identified rapidly and with certainty.

It was explained that the Ballistics Section was able to identify the weapon from which a missile was fired with certainty by virtue of the marks caused by the rifling on the barrel. A cartridge case could also be identified with a specific weapon by the marks caused by the firing pin. Both of these could be photographed and produced as evidence in court. The Ballistics Section also investigated the obliteration of car engine and chassis numbers by car thieves and had methods of reproducing the original numbers.

The Photographic Division obviously had a very wide function and worked in close liaison with all other sections of the Bureau. It was also responsible for the Photofit method of producing facial likeness for crime investigation. This method is considered to be superior to the Identikit method, and in using it the operator has access to a wide range of photographs of features which make up the human face.

Among the various duties of the Mapping Section was the production of models of, for example, road accidents, which are acceptable as evidence in court.

The evening was most successful and well attended, and the topic was clearly of great interest, as shown by the number of questions which were put to the speaker.

R.C.S.

London

Interfacial phenomena of inks

The Section held a technical meeting at the Polytechnic of the South Bank on 11 March 1975, under the chairmanship of Mr R. H. E. Munn. The speaker was Mr H. Hansen of the Scandinavian Institute for Paint and Printing Inks, who presented a paper entitled "Interfacial phenomena of inks".

The paper dealt with the formulation of printing inks. The biggest problem within the printing ink industry was to formulate inks which make the printing possible, taking into consideration the different interfacial phenomena during the printing process and still leading to a print with the required qualities. Of the four different processes available, the lithographic process provided further problems because of the presence of a rubber blanket and a damping unit introducing thin layers of water into the system. Mr Hansen went on to talk about interfacial phenomena in lithographic printing inks. The most common problems were related to unwanted mixtures of water and ink and to the acceptance of ink in non-image areas leading to printing faults.

A vote of thanks was made to Mr Hansen by Mr R. H. E. Munn.

B.A.C.

Manchester

Student Group

The prevention of bacterial corrosion of mild steel with paint films

Mr A. V. Robinson of Camrex (Holdings) Limited, discussed the prevention of bacterial corrosion on mild steel at a meeting of the Student Group on 26 February at the Manchester Literary and Philosophical Society.

Mr Robinson illustrated the severity of corrosion that could be caused by bacteria, especially on ships lying in muddy conditions, with slides of ships only 18 months old, in which the corrosion had almost penetrated through steel plates nearly 1.5cm thick. It was shown that most of this corrosion was due to sulfate-reducing bacteria (*Desulfovibrio Desulfuricians*) which were fairly widespread. A range of inhibitors had been added to the paint systems used in laboratory trials, and these were discussed in some detail.

About 20 students were present, and after a short question period, the vote of thanks was given by Mr R. Scott.

A.McW.

Reviews

Surface Coatings

A complete handbook of paint technology.

Prepared by the Oil and Colour Chemists' Association Australia in conjunction with the Australian Paint Manufacturers' Federation New South Wales: University Press 1974. Pp. xv + 486. Price Aust. $16.00; OCCA Members $14.00.

The preparation of a new course in surface coatings technology is a formidable but challenging task requiring the co-operation of specialists in the practical as well as the theoretical aspects of the subject. The field to be covered is very wide and in consequence of the modern trend in specialisation it is inevitable that a considerable number of participants becomes involved.

The present work represents the first fruits of such a venture. It consists of some 54 chapters (some of which, however, are very short) which are the collated lectures delivered at various centres and directed towards the building of an integrated course covering the field of surface coatings. An enormous amount of work has obviously been expended in preparing the lectures and producing the book which, to quote one of the Forewords, "will serve as a valuable guide and reference document for future students". The value of the book to students would be increased considerably if a conventional index were included; the existing "Index" is a list of contents. As a guide for future lecturers and teachers, however, the book will be exceedingly useful.

The book commences with some interesting statistics on the Australian paint industry and then devotes two chapters to the basic organic chemistry of surface coatings and elementary polymer science. In many of the succeeding chapters, discussion of the relevant basic chemistry precedes that of the technology; this is good practice. Proceeding through the book, the various topics are presented in a lucid and logical manner but fuller treatment is merited by some subjects, for example, Pigments (other than extenders), Colour Matching and Industrial Maintenance Coatings. Among the very excellent chapters are those on Extender Pigments, Printing Ink Technology and Industrial Paint Application and Formulation.

The book is well produced and very few errors were spotted. It is an excellent example of co-operative effort and deserves to be successful.

W. M. MORGANS

Gas Chromatography of Coating Materials

By J. K. Haken

New York: Marcel Dekker Inc 1974. Pp xv+334. Price $29.75.

The literature on applications of analytical techniques to particular industries is becoming increasingly dispersed. An article on the use of chromatography in the paint industry may be found in the general analytical journals, the specialist chromatographic journals, the general chemical literature or the technical paint literature. For this reason alone, this book on the gas chromatography of coating materials is particularly welcome. The author, J. K. Haken, is the well-known gas chromatographer from Australia, who has been particularly concerned with problems of paint analysis and contributed several articles to *JOCCA*. The book gives an informal, not too critical, account of the subject, with full original references and adequate indexes. It is merely necessary to list the items covered to indicate the scope of the book. These include general techniques; analysis of solvents and plasticisers; determination of residual monomer and monomer purity; analysis of resisns, oils and additives; polymer pyrolysis and examination of films. Without doubt, it is an essential requirement for any paint laboratory possessing a gas chromatograph.

L. A. O'NEILL

EXHIBITION REVIEW

OCCA—XXVII a great success

The Twenty-Seventh Annual Technical Exhibition (OCCA-XXVII) of the Oil and Colour Chemists' Association was held at the Empire Hall, Olympia, London from 22-25 April 1975 and was one of the most successful in attracting overseas exhibitors and visitors.

Represented as direct exhibitors were organisations from 15 countries:

Australia, Belgium, Finland, France, Germany, Holland, Hungary, Italy, Norway, Poland, Rumania, Sweden, Switzerland, the United Kingdom and the United States. Many other overseas organisations showing with British associates were included among more than 150 names mentioned in the "Official Guide" to the Exhibition.

Interpreters were in attendance to help both exhibitors and visitors and their services were in constant demand; for the second time, a stand was made available to the Wayfarers Travel Agency, which also proved of benefit to many of those visiting the Exhibition.

An industrial dispute affected the taking down of the Exhibition which was held prior to OCCA-XXVII and this continued throughout the preparation time. Nevertheless, it had been hoped throughout the weekend that OCCA-XXVII would still open on time, and it was only in the late afternoon of Monday 21 April that a change in the situation meant that the Exhibition was forced to open three hours late on the first day. The Exhibition Committee was conscious of the fact that everyone concerned appreciated that the circumstances were beyond the control of the Association and it expresses its thanks to both exhibitors and visitors for their forebearance and co-operation in making OCCA-XXVII such a resounding success.

Many exhibitors commented once again on the very high proportion of overseas visitors, and on the percentage of high level management represented amongst the visitors; it was also apparent that the decision of the Committee to make a small charge for admission, which included a copy of the "Official Guide", undoubtedly prevented casual visitors who might otherwise be attracted to exhibitions for which no admission charge was made and who gathered quantities of technical literature from the stands. This innovation has been welcomed by many exhibitors and it in no way acted as a deterrent to serious visitors to this unique Exhibition. Amongst those countries represented were:

Austria, Australia, Argentina, Belgium, Brazil, Canada, Colombia, Czechoslovakia, Denmark, Finland, France, Germany, Greece, Holland, Hungary, Iran, Italy, Iceland, Ireland, Israel, Japan, Jordan, Kenya, Malta, Malaysia, Morocco, New Zealand, Norway, Nigeria, Poland, Pakistan, Portugal, Rumania, Rhodesia, Sudan, Spain, South Africa, Switzerland, Sweden, Tanzania, Trinidad, Turkey, USA, Uruguay, Venezuela and Yugoslavia.

The Association's Information Centre featured details of the Association's Conference to be held at Scarborough from 17 to 21 June under the title "The performance of surface coatings—does the reality match the theory?", and details of membership, the Association's Professional Grade and its publications. The Centre was the focal point not only for those enquiring about Association activities but also for visitors wishing to meet their friends at the attractive seating area directly in front of the Centre.

The theme of the Technical Education Stand this year was "Radiation curing" and the stand attracted a number of enquiries. An informative leaflet was prepared by Mr S. R. Finn (Hon. Editor) for distribution. The Association also expresses its thanks to the following, who provided material for the stand:

Bayer, Cray Valley Products Limited, and "Paint and Varnish Production" (now "Modern Paint and Coatings").

Staff from various Technical Colleges in the London area, as well as representatives from the Paintmakers' Association, manned the stand and were able to advise on courses and careers.

A view of the first floor of the Exhibition Hall during opening hours. On the left, visitors are crowding around the Association's Information Centre (see page 224) where enquiries were constantly received on Association activities and details of membership, and on the Association's Professional Grade and its publications. In the foreground is the pleasant seating area where visitors were able to meet friends and consult literature.

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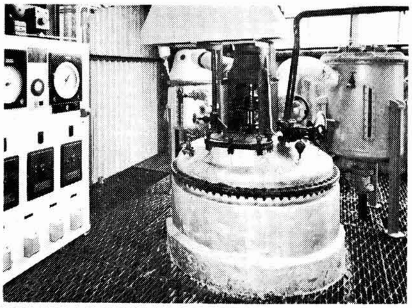
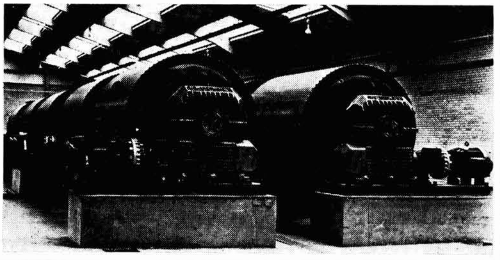
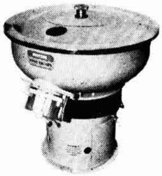




A recent installation of Ball Mills.

Air Suspended Strainer



Vibratory Coating and Blending Machine.

Exhibition Report 1975

Technical journals and services • Extenders, fillers and matting agents • Pigments • Additives, driers, surfactants and hardening agents • Chemical intermediates • Oils and fatty acids • Solvents and plasticisers • Manufacturing equipment and drums • Laboratory apparatus and testing equipment • Resins—acrylic, alkyd, amino, emulsion and water based, epoxy, miscellaneous, polyamide, polyester, polyurethane and silicone • Miscellaneous items

Technical journals and services

CIBA-GEIGY (UK) LIMITED has recently published a booklet entitled "Safety in laboratories". It was shown at the Exhibition and is available from the Corporate Public Relations Department, CIBA-GEIGY (UK) LIMITED, Simonsway, Manchester M22 5LB.

CIECH exhibited the products of the Union of Paints and Lacquer Industry, "POLYFARB", of Gliwice, which cover a wide range of marine and decorative materials, anti-corrosive and chemically resistant paints, furniture and wood lacquers. The "Oliva" range of marine paints for new ship construction and those undergoing repair was also shown.

POLYMERS, PAINT & COLOUR JOURNAL has, in recent issues, provided articles on current commercial and technical problems associated with raw materials, cash flow and similar problems. The organisation of symposia on topics of current interest is an increasing activity of the journal and details of those planned for 1975 were available on the stand.

TIN RESEARCH INSTITUTE demonstrated the use of tin compounds in the paint and allied industries as biocides, and for wood preservation. Samples of the latest anti-fouling marine paints were shown, which covered the latest developments in this field.

WAYFARERS TRAVEL AGENCY again provided hotel accommodation, theatre tickets and information required by visitors to the Exhibition and gave information on the other extensive facilities provided.

WHEATLAND JOURNALS LIMITED showed examples of the journals it publishes in this field: "Paint Manufacture", "Industrial Finishing and Surface Coatings" and "Electroplating and Metal Finishing Journal". Copies of the 1975 "International Finishing Industries Manual" were available at the stand; the purchase price of this manual includes a year's subscription to "Industrial Finishing and Surface Coating".

Extenders, fillers and matting agents

JOSEPH CROSSFIELD & SONS LIMITED concentrated its exhibit on the areas in which the coatings industry is moving away from solvent based systems; the use of Gasil WP in emulsion systems was demonstrated. The use of the Gasil range of micronised silicas as matting agents for a wide range of coatings was shown, as well as the new, ultrafine silica, SM111, introduced for matting solution vinyl coatings and as a suspending agent. The use of Microcal ET in emulsion systems to reduce coats without reduction of quality was demonstrated.

DURHAM RAW MATERIALS LIMITED exhibited the Monsanto range of Santocel silica aerogels.

JACOBSON VAN DEN BERG COMPANY (UK) LIMITED exhibited micronised grades of barytes and gypsum from CARGAS BLANCAS INORGANICAS and the ARMOFORM LIMITED light weight glass micro-balloons from 10 to 250 µm diameter for use as fillers.

NL INDUSTRIES INCORPORATED, Industrial Division, showed a range of Bentones of various types which are listed under "Additives" below.

A/S NORWEGIAN TALC displayed its wide range of fillers, which includes the Microdol range based upon chemically pure dolomite. It is available in a wide spectrum of particle sizes and has good wetting and dispersion properties. Micro-Talc consists of magnesite containing talc, AT is suitable for primers, undercoats and interior emulsion paints; IT is one of the whitest grades of talc available; FWXO is a coarse grade recommended for bituminous systems and polyester putties. Micro-Mica W and Mica Micronor are laminar muscovite micas suitable for primers and emulsion paints, proving resistance to chemicals, heat and UV light.

SACHTLEBEN CHEMIE GMBH showed its range of blanc fixe and white barytes extenders.

Pigments

BASF FARBEN + FASERN AG BEREICH SIEGLE exhibited a wide range of organic and inorganic pigments. Sico Yellow 2GT and Sico Orange GST are new mono azo pigments for printing inks having very high transparency. New transparent iron oxides Yellow 222, Red 444 and Red 444/4 have improved dispersion qualities. Semi-transparent oxides Yellow 088 VN BV and Red 288 VN BV are also easily dispersed. For automotive finishes Chrome Yellows 70 CS and 72 GS are particularly lightfast and resistant to sulfur dioxide as are the Molybdates 5 GS and 5 GGS. New anti corrosive Sicorin RZ and RZP are metal salts of organo nitro complexes which behave in a way similar to chromates of low solubility; panels were exhibited to demonstrate corrosion protection comparable to that of zinc chromate and the improved results that can be obtained by including a small amount of Sicorin in zinc phosphate formulations. The Sicolux new range of fluorescent daylight pigments with improved resistance to solvents and heat was shown and for coil coating systems Chrome Titanium 4 FG and Nickel Titanium Yellows AFG and AMFG provide improved hiding power and gloss.

BASF UNITED KINGDOM LIMITED showed the recently developed pigments Paliotol Orange 2330 (Ni complex), Paliotol Red 3670 (perylene), Paliogen Red (pyranthrone) and Paliogen Red (perylene). The Heliogen range of phthalocyanine pigments now includes two flocculation resistant blues and a special green shade for paints. New metal complex dyes shown were Neozapon Brown BE and Neozapon Brown 6R. Laconyl Orange 304 (pyranthrone) and Laconyl Red 387 (perylene) are new grades suitable for emulsion paints outdoors. The Basoflex range of pigment dispersions for use in aqueous flexographic inks has been increased by the addition of further yellow and orange shades. New basic Nigrosine black dyes with improved solubility have been introduced. Paliogen and paliotol reds for use with plastics were exhibited, as well as the Euthylen and Lufilen ranges of pigment dispersions for polyolefins have been increased by further colours.

BAYER AG showed its inorganic pigments ranging from white to black. The Dyestuffs Division showed its latest Helio and Helio Fast pigments, pigment preparations and Irisol Fast dyestuffs.

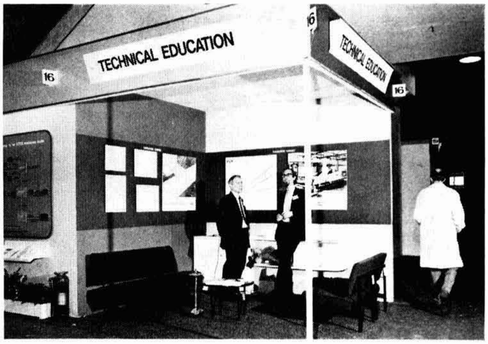
CABOT CARBON LIMITED demonstrated its new furnace blacks intended to replace its channel blacks. The new Monach and Black Pearls include the 1300 for the highest quality systems, 1100 and 900 for maximum jetness, particularly in plastics, the 880 for high tinting strength and excellent dispersibility and the 700 range with high oil absorption and easy dispersion characteristics.

CIBA-GEIGY (UK) LIMITED displayed a number of newly developed products suitable for use in the paint, printing ink and plastics industries, and focussed attention on new additions to the Unisperse E range of aqueous paste dispersions for interior and exterior emulsion paints. Also featured were pigment preparations and dyes for wood stains. Easily dispersed pigments for letterpress and lithographic multi-colour printing and pigment preparations for vinyl inks were also shown. Irgazin Yellow 5 GT and Blue 3 GT for automotive finishes, solid colours and metallics were demonstrated. Selected high grade pigment powders from the Cromophtal and Irgazin range for special printing applications were displayed.

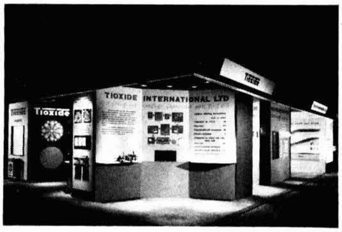
CORNELIUS CHEMICAL COMPANY LIMITED showed the HILTON-DAVIS CHEMICAL COMPANY'S range of flushed colours, Transoxide (transparent iron oxide), and the KEMIRA OY range of titanium dioxide pigments. Also on view were the latest developments in the series of Pearl pigments from the MEARL CORPORATION.

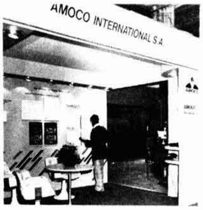
DEGUSSA introduced Black 1618 for multi-use film-solvent carbon papers with good jetness, blue undertone, excellent dispersion and limited bleeding. Development black 2/0 is a specially developed product for UV-curing printing inks having extremely short drying times. The Printex blacks 400 and 200 have long given good results in high quality inks, 200 improves both flow qualities and the economics. Development Black 3 has been introduced for news inks. The newly developed Carbon Black Chips, Efweco NC 18/2, has been introduced for top quality nitrocellulose lacquers, NC combination lacquers and all systems compatible with ester soluble cellulose derivatives. A new class of pigment black based on a

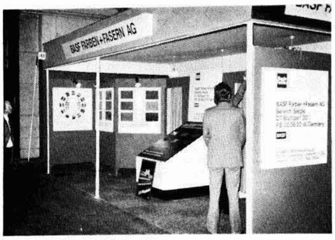
The Association's Information Centre and the adjacent Interpreters' stand were in constant use throughout the period of the Exhibition. Many enquiries were received concerning the Professional Grade for Ordinary Members of the Association and this year's Conference, to be held in Scarborough, as well as the many other activities of the Association and its publications.

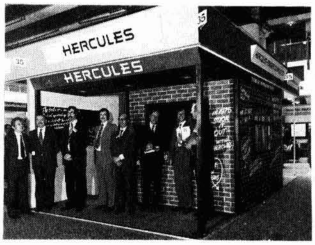


The theme of the Technical Education Stand was "Radiation Curing" and the stand attracted a number of enquiries. A leaflet had been prepared by the Association's Hon. Editor and copies were freely available. Staff from various Technical Colleges in the London area as well as representatives from the Paintmakers' Association manned the stand and were able to advise on courses and careers.









furnace process was shown; it provides high jetness and is intended for plastic materials and coatings of high solids content.

DURHAN RAW MATERIALS LIMITED exhibited its zinc dust 962, which has been developed for use with silicate based paints and has met with considerable success.

HERCULES POWDER COMPANY LIMITED featured the use of Radglo pigments in printing inks and plastics. New pigments from TEN HORN show technical advantages with emphasis on lower costs, and the Imperial pigments are principally for use in cosmetics.

HILTON-DAVIS CHEMICAL COMPANY showed, in addition to those products shown by the CORNELIUS CHEMICAL COMPANY, examples of flushed colours 24-A and 42-A, the Ultrakrome lines and Transoxides. A new system of pigment colours known as Sup-R-Conc was also exhibited.

HOECHST AKTIENGESELLSCHAFT exhibited a wide range of improved pigments for the paint and printing ink industries. Special attention was given to the "70" series of pigments of good hiding power for lead-free industrial coatings, Hostatints multi-purpose tinting pastes, Flexonyl products for aqueous flexographic inks and Reflexblues for inks.

IMECO exhibited its range of organic pigments and concentrates for printing inks.

IMPERIAL CHEMICAL INDUSTRIES LIMITED showed the latest additions to its range of organic and inorganic pigments for paints and printing inks, including special modifications to improve the performance and usefulness of existing products.

JACOBSON VAN DEN BERG & COMPANY (UK) LIMITED displayed a range of flushed and predispersed pigments manufactured by PODELL INDUSTRIES INC (USA) and high quality bronze and aluminium powders and pastes from ESTS A. VAN LERBERGHE of Belgium.

KEMIRA OY showed its titanium dioxide pigments with the latest improvements, and illustrated their use in some novel fields of application. Special emphasis was laid on the inadequacies of chalking and gloss reduction alone as the main indicators of the durability of coatings. Other factors, such as cracking, rusting and fading, must be critically assessed to determine the effect of titanium dioxide on the durability and protective value of coatings.

LAPORTE INDUSTRIES LIMITED provided information on its latest developments in titanium dioxide pigments. The effects of the degree of dispersion and the stability of mill bases and paints in relation to weathering behaviour was featured, with particular reference to gloss, film shrinkage and the temperature during exposure. A new high gloss, easily dispersible, sulfate route pigment, RH52, was introduced.

MONTEDISON GROUP featured its ranges of rutile and anatase types of titanium dioxide, including special grades for a wide number of applications. The company also produces a series of inorganic pigments.

NL INDUSTRIES INCORPORATED, Industrial Chemicals Division, demonstrated the use of its SC-1 and CR-42 and the Oncor range of lead-free anti-corrosive pigments for maintenance paints, aqueous industrial and electrodeposited paints.

PHILLIPS PETROLEUM COMPANY exhibited samples of their carbon blacks.

PRODUITS CHIMIQUE UGINE KUHLMANN showed new pigments, which included Lutetia cyanines EN1 and 12NS and Lutetia Red 7B, Lutetia Ruby 2B and 4B toners. A new series of Catulia dyes for transfer printing was exhibited, as well as pigments and dyes from the ALLIANCE DYE AND CHEMICAL COMPANY LIMITED.

SACHTLEBEN CHEMIE GMBH exhibited for the first time a range of chloride process titanium dioxide pigments; Hombitan R-C1 22 is a multi-purpose rutile pigment for interior and exterior use giving excellent colour, hiding power and gloss, and because of its rheological and optical properties it is also recommended for inks. Hombitan R-C1 66 has been developed for the highest quality exterior coatings.

SANDOZ PRODUCTS LIMITED presented new organic pigments and solvent soluble dyestuffs. Sandorin Blue BNFR is a stabilised α phthalocyanine giving good resistance to flocculation and Savinyl Red BLSN is a solvent soluble dye with high stability to bleeding and lightfastness in transparent and metallised coatings. Also exhibited were pigments in the Sandorin and Graphtol ranges and pastes in the Pintasol and Artilene ranges suitable for a number of new techniques, including water based systems, high solid content paints and powder coatings, UV curable printing inks and pigment pastes for solventless and water based coatings.

SCC COLOURS LIMITED has introduced three new ranges of dispersed colours, new Yellow Chrome, new Brillfast and copper ferrocyanide pigments, diarylide yellow and an improved β phthalocyanine blue, pyrazolone orange, 2B toner and rubine 4B.

SUN CHEMICAL CORPORATION featured its range of organic pigments and pigment dispersions. New products giving ease of dispersion in both oil and liquid inks include AAA yellow, AAOT yellow, AAMX yellow, lithol rubine and carbazole violet. The Fossilsets and Blitzsets ranges of flushed colours and a range of Presscake high solids colours were also shown. New developments are SUN Carbazole and Quinacridone pigments introduced for automotive paints and a new series of flushed colours for colouring polyolefins. A range of the SHEAR COLOUR LIMITED pigment dispersions were shown, which include transparent red and yellow oxide pastes for thermosetting and thermoplastic type coatings.

TENNECO CHEMICALS EUROPE LIMITED displayed the Colourtrend Exceptional Colour system of 1350 colours which are lightfast, lead-free and alkali resistant.

TIOXIDE INTERNATIONAL LIMITED showed its R-HD2 pigment for aqueous gloss paints, which is also suitable for glossy liquid inks, giving outstanding opacity and gloss. The sulfate process Tioxide R-CR2 has been supplemented by a chloride process grade R-TC4. A wide range of pigments for plastics of any type is available, which includes the long established R-TC2 and R-FC5 grades. The importance of good dispersion was stressed, and methods of determining and recording the degree of dispersion were demonstrated, including contact X-ray microradiography and the "Chefs hat" test for plastics. Old and new methods of metal finishing were shown by practical demonstration, the first by a practical demonstration of copper enamelling and the latter by UV curing of a printing ink for metal decoration. Also exhibited was the newly developed Spindrift pigment, which also fulfils the function of an extender, and consists of spherical polymer beads containing sealed air pores and pigment, which provide extremely high opacity. It is anticipated that this product will result in a reduction of both raw material and manufacturing costs and will give exceptionally easy brush application.

Additives, driers, surfactants and hardening agents

AKZO showed a number of additives which included accelerators, antifouling agents, Armid HT, a non-scratch agent for offset printing inks, Armogel, a thixotropic additive, and Siccatol, lead free driers, including zirconium. Also shown were Ketjenflex 9, Duomeen TDO for pigment dispersion, as an anti-settling agent promoting adhesion and reducing flotation and grinding agents. Information was provided on the Trigonal photo-initiators.

ANCHOR CHEMICAL COMPANY LIMITED exhibited its amine hardening agents in the Ancamine range, which include MCA, a highly reactive modified amine for low temperature and under water curing, AD for the fast curing of thin films, LO and LOS with low dermatitic hazard, TL and TLS for tank lining operations and AC for rapid curing at room temperature. Epodil L, a low viscosity liquid hydrocarbon resin for use as an epoxy diluent, was also shown.

ARCO CHEMICAL COMPANY showed the Ultrawet range of anionic biodegradable linear alkylate sulfonates.

BAYER AG included in its exhibition of resins the Crelan range of cross-linking agents for acrylic powder coatings and also the Preventol range of preservatives for the coating industry.

BEROL KEMI AG exhibited a number of cellulose ethers and surfactants, in addition to its display of resins.

BYK-MALLINCKRODT CHEMISCHE PRODUKTE GMBH showed som new additives—BYK VP352P, a powder, and VP Powder Flow No. 3, a high viscosity liquid—which are levelling agents for powder coatings—as well as a range of wetting, dispersing, anti-floating and anti-flooding agents, defoamers etc, for water reducible coatings.

CABOT CARBON LIMITED displayed Cab-O-Sil fumed silica, which provides precise viscosity control in inks, coatings, resins and many plastic and rubber systems. Its use in powder coatings, where it improves edge coverage, improves adhesion and prevents caking, was also shown.

CHEMISCHE FABRICK SERVO BV, exhibiting on the CHEMISCHE WERKE HÜLS stand, showed a range of additives for the surface coatings industry. Serdar GFN is an antifoaming agent applicable to almost all latex systems and also suitable for use in water soluble alkyd resins; it is free from silicones and does not cause cratering when used in small amounts. Ser-Ad FX-504 is a low foaming pigment dispersant to prevent pigment flocculation in aqueous systems. Ser-Ad FA-601 is an effective wetting and dispersing agent for solvent based systems. Ser-Ad 321 can be used to reduce the electrical resistance of paints to be sprayed electrostatically.

CdF CHIMIE exhibited Norsolyde AE11, for improving dispersion in water based systems.

CHEMOLIMPEX showed, in addition to resins, single and mixed versatate driers and a number of organic peroxides.

DEGUSSA exhibited the matting agent TK 100, which has a particularly great matting effect and very good transparency and is easy to stir into mixtures. It is mainly suitable for finishing lacquers for artificial leathers, air drying alkyd resin lacquers and polyurethane resin textile coatings. Also shown were aluminium silicate P820 and Aerosil fumed hydrophobic silica for anti-corrosive paints.

DURHAM RAW MATERIALS LIMITED showed the Nuodex range of high metal content driers based upon synthetic acids and the Cyclodex driers for use in water based systems. Developments to replace the lead based Nuact paste were described and a new product NOPB was introduced. Also exhibited were the latest Nuodex biocides, wetting and dispersing agents and the Modaflow flow control agents, including Nuosperse HOH, a new product for aqueous systems.

DYNAMIT NOBEL AG displayed a number of organic titanates for the manufacture of electrical insulating lacquers, for hardening silicones and as esterification catalysts for dicarboxylic acids.

EASTMAN CHEMICAL INTERNATIONAL AG provided new information on the use of cellulose acetate butyrate in stoving enamels, high solids coatings, non-aqueous dispersions and powder coatings, and also on the use of cellulose acetate propionate in flexogravure and screen inks. Texanol, a coalescing agent for latex paints and Kodaflex TX1B for plastisols and vinyl articles were shown, as well as the Epoline waxes to improve the coating appearance and durability and CP-343-1 to improve adhesion of coatings to untreated polypropylene.

HENKEL & CIE GMBH showed a wide range of additives for various purposes, which included anti-settling agents, anti-floating agents, pigment wetting and dispersing aids, anti-foamers defoamers, thickening and thixotropic agents, anti-skinning agents, release agents, additives for electrostatic spraying and emulsifiers for polymerisation.

HERCULES POWDER COMPANY LIMITED drew attention to new Natrosol products, some grades of which have applications in highly alkiline systems.

HOECHSTAKTIENGESELLISCHAFT exhibited wetting and dispersing agents for inorganic pigments and for stabilising emulsion paints.

IMPERIAL CHEMICAL INDUSTRIES LIMITED showed a number of additives, which included Proxel CRL, a product with low toxicity and chemical stability for the preservation of emulsion paints.

JACOBSON VAN DEN RERG & COMPANY (UK) LIMITED displayed the Surfynol range of non-foaming surfactants and dispersants, a range of polyethylene wax emulsions for matting and to increase rub and scratch resistance of printing inks. The Sedapol and Sedaplast anti-settling agents and paint additives were also shown.

LAPORTE INDUSTRIES LIMITED included in its display a range of additives for various purposes. Laponite RD, a rapid dispersant designed for use where limitations in dispersion equipment exist, was demonstrated.

MANCHEM LIMITED featured its Alusec driers, which present a new concept in paint drying, and are derivatives of aluminium alkoxides whose latent co-ordinating power provides through drying by co-ordination with the polar groups in the medium, without the use of lead driers. Due to the need to reduce volatile matter in high solids coatings, a range of high metal content driers have been introduced.

MONTEDISON GROUP showed cumene hydroperoxide, Peroximon KI.

NL INDUSTRIES INCORPORATED showed a series of rheological control additives for solvent- and water-based systems, including Bentones, Thixcins and Thixatrols. Rheotone SA-30 is a self-activating Bentone-type rheological additive, Thixseal 1084 a non-toxic rheological additive for caulks and mastics and EA-1075 is a pigment suspension agent for aqueous industrial coatings.

RHONE-POULENC exhibited the range of Rhodosil silicones as additives for anti-fouling, anti-cratering and anti-discoloration, to provide resistance to sea fog and to scratching, to provide slip and to produce a hammer effect. Rhodopas AXCM 3, maleic acetochloride, is suitable for the protection of metals.

SCHERING AG showed a range of organotin biocides for various purposes and the Euredur, modified polyamide, amine and polyamino imide azolines, hardening agents for epoxy resins. New developments included a special hardener for epoxy powder coatings and a novel anti-fouling paint system.

SHELL CHEMICALS UK LIMITED showed a full range of curing agents for powder coatings.

TENNECO CHEMICALS EUROPE LIMITED included in it exhibit a range of defoamers and coalescing agents for latex paints and flame retardants.

TITANIUM INTERMEDIATES LIMITED displayed a comprehensive range of titanium alkoxides and titanium chelates. Tilcom AT is an additive for non-drip emulsion paints. The use of titanium organics for improving inks based upon cellulose nitrate was described, as well as their application as esterification catalysts, in wire enamelling and in heat resistant paints, and as protective colloids in emulsion polymerisation.

UNION CARBIDE EUROPE SA showed its Cellosize brand of hydroxyethyl cellulose, which is available in a number of grades and offers a wide range of choice in formulating emulsion paints.

VEBA-CHEMIE AG exhibited a number of epoxy resin hardeners, which included isophorone diamine (IPD) and trimethyl hexamethylene diamine (TMD) and also the diamine-based curing agents V 214 and V 215. Recent technical advances in the use of VEBA waxes for printing inks, lacquers and paints was described (see also under Resins, polyurethane). PMDA, TMPA, HHPA and MHHPA anhydrides and a number of isocyanates are available.

WACKER-CHEMIE GMBH included in its exhibit a number of silicones and silicic esters as coating and impregnating agents for textiles, paper, masonry repellants and for the preservation of ancient monuments. Chloracetaldehyde-sodium bisulfite was shown as a fungicide/bactericide for rubber latex paints.

Chemical intermediates

AKZO showed a series of organic acids for the production of driers and non-drying alkyd resins, in addition to fatty acids obtained from naturally occurring oils. Vinyl acetate and vinyl chloride monomers and diphenylol propane and Ketjon-Dianot multi-valent alcohols based on bisphenol A are also available.

AMOCO CHEMICALS EUROPE demonstrated the use of isophthalic acid (IPA 99), terephthalic acid (TA) and trimellitic acid (TMA) in the manufacture of resins, as well as exhibiting a number of resins based upon them.

ANCHOR CHEMICAL COMPANY LIMITED showed ethylene glycol and 1-3 butanediol methyacrylates and trimethylol propane trimethyacrylate, as well as low viscosity diacrylates and higher viscosity/activity tri- and tetra-acrylates. The Sartomer range of polyfunctional acrylic monomers for radiation curing were also shown.

LAPORTE INDUSTRIES LIMITED offered phthalic anhydride.

MONTEDISON GROUP showed a number of glycols, formaldehyde, formurea 80 and hexamine, maleic and acetic anhydrides, acetonitrile, terephthalic acid, dimethyl terephthalate and tetrapropylene.

SHELL CHEMICALS UK LIMITED showed its Cardura and Veova-based systems for use in a variety of water-based solventless systems and powder coatings.

UNION CARBIDE EUROPE SA showed its Niax polycaprolactone polyols for use in high performance polyurethane coatings, permitting the formulation of moisture curing coatings; their low viscosity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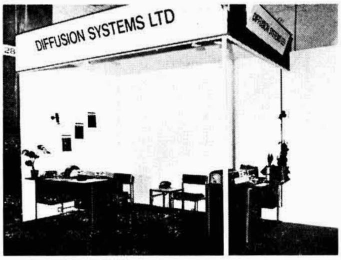
SCC


DIFFUSION SYSTEMS LTD


NEUMO LIMITED
AN AFFILIATE OF PAXALL INC


KINHURST ENGINEERING LIMITED


ANCHOR CHEMICAL COMPANY LIMITED
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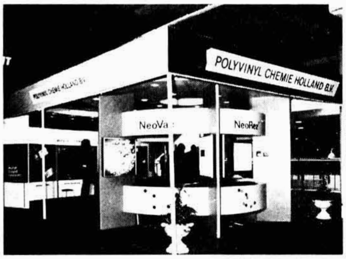
CHEMICAL CORPORATION
PIGMENTS DIVISION
W.A. MITCHELL & SMITH LTD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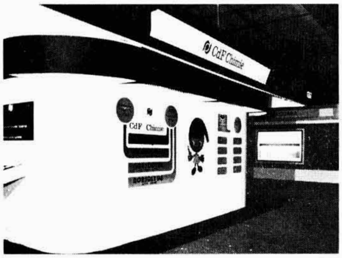
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Special Gases


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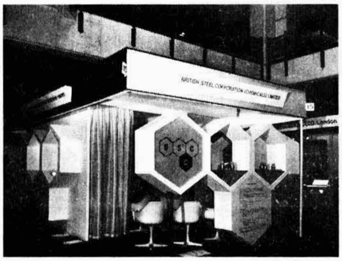
BRITISH STEEL CORPORATION (CHEMICALS) LIMITED


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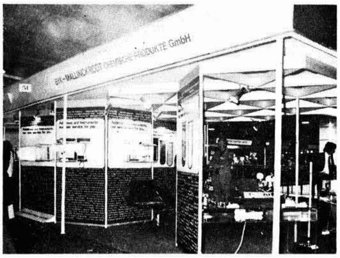
Croda Resins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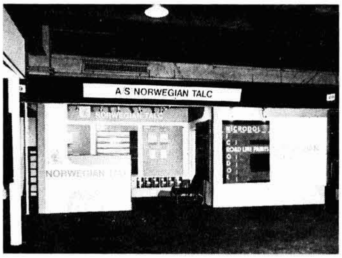
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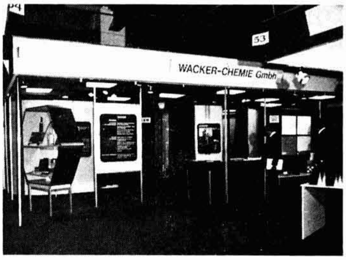
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WACKER-CHEMIE GmbH


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MARCHANT BROS. LTD.
VEB KOMBINAT NAGEMA
MARCHANT BROS. LTD. London


DURHAM RAW MATERIALS LTD
DURHAM CHEMICAL GROUP


JACOBSON VAN DEN BERG & CO (UK) LTD.


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UGINE KUHLMANN
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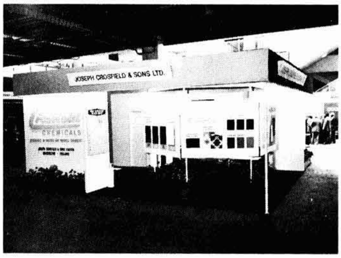
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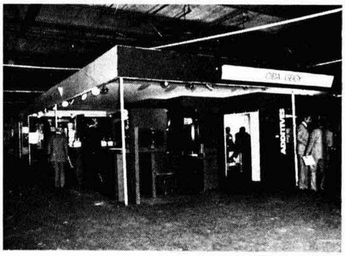
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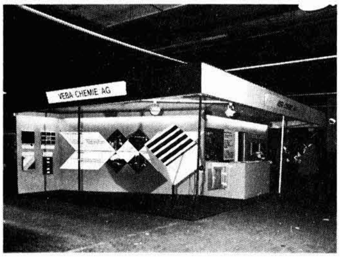
VEBA-CHEMIE AG


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CHEMISCHE INDUSTRIE SYNRES BV

makes them attractive for use in high solids formulations.

VEBA-CHEMIE AG featured it PMDA anhydride, which provides exceptional crosslinking density and which can be used in weather resistant, non-chalking polyester powders, a number of hydrogenated phthalic anhydrides and also isophorone diisocyanate for the production of light stable polyurethanes.

Oils and fatty acids

AKZO showed its C_8–C_{10} synthetic fatty acids for drier manufacture and the high specification, 1098, C_8–C_{10} acids for the manufacture of non-drying alkyds, conjugated fatty acids and distilled vegetable oil fatty acids, synthetic fatty acids and tall oil fatty acids. Wood oil, products from castor, safflower, soya bean and distilled tall oil were also displayed.

CHEMISCHE WERKE HULS AG displayed Polyoil 110 for use in water soluble air drying primers without any solvent and Polyoil 130 for air drying primers with a solvent content of benzene below 5 per cent.

CORNELIUS CHEMICAL COMPANY LIMITED provided current data on the Oulu tall oil derivatives.

JACOBSON VAN DEN BERG & COMPANY (UK) LIMITED showed the conjugated oil 122-G for alkyd resin manufacture and the emulsified oil PVO 44-0 for use as a latex paint modifier.

Solvents and plasticisers

AKZO showed a number of acetyl and chlorinated solvents.

BAYER AG exhibited its product Ue 6090 which is a fast-to-light polyisocyanate mainly used as a reactive thinner in car repair finishing.

BEROL KEMI AB showed its range of plasticisers and solvents.

BRITISH STEEL CORPORATION (CHEMICALS) LIMITED gave information on its research and experience on solvents. The company can provide benzene, toluene, xylene and naphthas.

HENKEL & CIE GMBH exhibited solvents and epoxy plasticisers.

LAPORTE INDUSTRIES LIMITED offered a range of esters and alcohols.

MONTEDISON GROUP Petrochemicals Division have a range of alcohols, cyclohexanol, tetrapropylene, toluene, xylene, acetone, cyclohexanone and alkyl acetates. The major exhibit on the stand of PHILLIPS PETROLEUM COMPANY was devoted to the naphtha reforming facilities operated at a rate of 2.1 million tonnes per year. Solvents available are benzene, cyclohexane, toluene, mixed xylenes, *o*- and *p*-xylene and paraffinic raffinate naphtha.

SHELL CHEMICALS UK LIMITED whose main exhibit concerned resins, also provided information on its range of aromatic and aliphatic hydrocarbons, as well as of alcohols, ketones and Oxitols. The exhibits were based on the principle that a fundamental understanding of solvent behaviour can help to solve practical solvent problems. Information was available in a technical bulletin on solubility parameters which approaches the subject in a practical way to explain their application in predicting solubility and selecting or replacing solvents.

TENNECO CHEMICALS EUROPE LIMITED offered a number of products for the paint and allied industries which include trialkyl phosphates, such as trioctyl phosphate, and a wide range of narrow and wide cut aliphatics, low and high boiling aromatics, and oxygenated and speciality solvents.

WACKER-CHEMIE GMBH showed its GB ester, a high boiling solvent.

Manufacturing equipment, drums etc

Since the Dyno-Mills were first introduced into the UK two years ago by WILLY A. BACHOFEN, they have become well established for the rapid and uniform grinding and dispersion of a wide range of products. Although no new models have been introduced this year, additional information on their use was available.

BAKER PERKINS CHEMICAL MACHINERY LIMITED provided information on its wide range of mixing machinery for the chemical industry, but concentrated its exhibit on diagrams of machinery for the production of powder coatings. Information was also available on equipment from the Stoke Division, formerly Steele and Cowlishaw Limited.

WILLIAM BOULTON LIMITED showed its Vibro-Energy machine for the mixing and blending of powders, which is also suitable for spray coating powders with semi-viscous liquids. A vibratory machine for colour coating powders, a vibratory grinding machine, a Podmore/Boulton Vibro-Energy mill for fine grinding, Vibro-Energy strainers and separators and an oil/water separation system which can reduce pollution to 2 ppm were also shown.

G. J. ERLICH LIMITED exhibited the O'TOOLE quick operating filter with a porosity of 5 to 100μm and a modular grinder, sand type mill having ten times the output of traditional grinders and especially designed for difficult products. Planetary mixers, high speed mixer/dispersers, Microsfera grinding machines operating with glass or steel balls, triple roll machines and high speed mixers, are all available from MOLTENI. Information was also provided on the GEHALIN filling presses, the PREVIERO granulator for chips and the KARCHER vessel cleaning equipment.

GAF (GREAT BRITAIN) LIMITED showed for the first time in the UK a new dual-density Extenda-Life filter bag designed to reduce costs by increasing bag life. The bag may be used with the Gadflo pressure vessels and thus increases the flexibility of the GAF Snap-Ring filter bags. A range of sillings for the bags in nylon, polypropylene, viscose and wood, covering a range of particle size from 1 to 800μm are available. A new low cost cartridge was also shown.

JOHN GODRICH showed the Chemcol series of mixers MS0, MS1 and MS3, with the MS2 model in operation. The unique advantage of these mixers is the absence of any bearings in the immersed portion; various rotors and stators are available to vary the flow pattern of the charge. The new Rotostat mixer-emulsifier was also exhibited.

JENAG EQUIPMENT LIMITED exhibited improvements to its range of Jenag liquid strainers. The 1200 unit, to a new design first shown last year at the *OCCA* Exhibition, has become well established. Further information was provided on all the five models available, covering flow rates of 0 to 12.25m^3 per hour and capable of dealing with liquids of up to 200 poise viscosity.

KINHURST ENGINEERING LIMITED's main exhibit was the No. 4 Monomill bead type dispersing machine for paints and printing inks having a mill base capacity of 220-240 litres and producing high grade dispersions in 60 to 90 minutes.

MARCHANT BROTHERS LIMITED showed its 152 × 304mm and 152 × 406mm triple roll machines, available with cleaning systems and the VEB KOMBINAT NAGEMA range of horizontal type triple-roll mills with two-speed drive and available with pan lift, four point hydraulic roll pressure control and automatic water cooling control.

NEUMO LIMITED demonstrated fully automatic and semi-automatic filling machines and its latest transfer pumps. The fully automatic machines are continuous running single track, with twin filling heads and equipped with a lid placer, roller presses and container coder. The machine will handle all free flowing, viscous and thixotropic, water- and solvent-based paints. Neumo pumps and air motors are designed for continuous operation and are safe in flameproof areas.

NORPRINT LIMITED exhibited its new fully automatic paint can labeller, which incorporates a conveyor and photo-sensitising unit, applies self-adhesive labels in precisely the required position on the can. The machine can be adjusted in 10 seconds to work on a different size can of any of a range of five sizes; the production rate is between 40 and 85 per minute according to can size. The equipment can be arranged to overprint in one or two colours on a preprinted colour-matched label which can be matched to the required colour.

PORTER LANCASTRIAN LIMITED introduced the Portatank, a completely new type of tank for the bulk storage of liquids under air-free conditions. Cleaning is unnecessary as the tank is equipped with a polyethylene disposable lining which is changed at each filling; new liners are sealed to prevent contamination and rolled for easy insertion.

A. STRAZDINS PTY. LIMITED showed its series of improved design Blendorama colourant dispensers and the new 50ml single pump machine for small and medium quantities, the double 150ml capacity unit and the large 600ml unit for factory use.

TENNECO CHEMICALS EUROPE LIMITED showed the GRACO Colorant

Equipment Division's dispensing equipment.

TORRANCE & SONS LIMITED demonstrated a working production unit featuring the TORRANCE PMA hydraulic mixer, enhanced by the paste mill attachment, which consists of a rotating table driven by a motor and reduction gear unit to suit a specified container and fitted with adjustable side and bottom scrapers to ensure full surface scraping. Information was available on the new Q attritor system.

WINTER OSAKEYHITO again exhibited the WINTERMIX tinting system in which a hole is punched in the lid of a tin of base paint, the correct amount of colourant introduced through it, a plastic stopper is inserted to close the hole and the contents thoroughly mixed. A new mixer for the system was shown which effects complete mixing in 30 seconds. Mixing capacity ranges from 0.33 to 10 litres.

Laboratory apparatus and testing equipment

WILLY A. BACHOFEN showed the 0.6 litre model KDL of its Dyno-Mill described under "Manufacturing equipment."

BYK-MALLINCKRODT CHEMISCHE PRODUKTE GMBH exhibited its range of glossmeters, which includes single and multi-units using fibre optics, a dynometer for surface tension measurement, tendency to sedimentation and sediment characteristics; the Persoz and Koenig pendulum testers; a Cupping tested and the Bycolour tristimulus colourmeter giving electronically calculated values of x, y, Z, and E.

DIFFUSION SYSTEMS LIMITED demonstrated its range of surface measuring instruments which included fixed angle gloss heads to BS 3900 and ASTM D 523 20°, 60° and 85° methods and gloss heads variable from 10° to 85°. A simple spectrophotometer for colour and brightness measurements was shown, which provides simple spectral analysis when used in conjunction with a nine narrow band filter set and tristimulus values with a XYZ filter wheel. The PRS reflectometer for simple comparison of visual brightness, which is available in portable form, the Model 57 Spherical hazemeter with its own integral display for the measurement of total and diffuse luminous transmittance and the Model 6 and 7 densitometer for the printing and lithographic industries, were also displayed.

G. J. ERLICH LIMITED showed examples of a full range of laboratory and pilot plant scale machines.

JOHN GODRICH provided information on the Xenotest 1200 light- and weather-fastness tester, salt spray and SO_2 exposure cabinets and other laboratory equipment including the BERNROX laboratory heat transfer press, which enables samples to be produced quickly and accurately. It incorporates sophisticated controls—the pressure on the plattens is maintained hydraulically and is automatically released after a predetermined time and incorporates sensitive temperature control. Details were available of the WERNER MATHIS laboratory jet dryer.

JENAG EQUIPMENT LIMITED exhibited small scale versions of the strainers described under "Manufacturing equipment."

MARCHANT BROTHERS LIMITED included in its exhibit the small 76 × 152mm model of the triple roll mill described under "Manufacturing equipment."

RUDOLPH MEYER'S INCORPORATED exhibited a number of instruments which included the A1C2 Universal Printability Tester featuring an interval switch allowing printing at intervals of up to six seconds and an extended speed range up to seven metres per second. A new drying time recorder was shown which allows examination at 12 different times with an interval of up to 24 hours between examinations and a new development of the Tack-o-Scope having a new DC motor drive and the oscillation of the distribution system; the new construction allows a maximum speed of 450 metres per second.

MISCROSCAL LIMITED showed its FMC 11 and FMC 2V Flow microcalorimeters which facilitate the measurement of the heat of adsorption. Wide angle photoseditometers for particle size analysis in the range 75 to 2μm and the MICROSCAL Ladal X-Ray sedimentometer, which has centrifugal and gravitational settling to cover the 5 to 0.1 and 75 to 1μm size ranges, were shown. Also on view were the 1 and 40-litre spinning rifflers; the latter is now available with bulk sample collection facilities for powders and granular solids. MICROSCAL is promoting the sale of the VIANOVA ETL and CONDUCTOMETER range of instruments in the UK. A new apparatus to produce accurate samples of powders in liquid suspension was also shown.

RESEARCH EQUIPMENT (LONDON) LIMITED exhibited the latest models of its range of instruments, which included the ICI cone and plate viscometer, drying time apparatus, micro-indentation apparatus and pressure weight per gallon cup and the REL range of scratch, impact, abrasion testers, flow cups, salt spray cabinets, adjustable film spreaders and fineness of grind guages.

RK CHEMICAL COMPANY LIMITED demonstrated its K Gravure Proofer, K Flexo Proofer and K Gravure/Offset Proofer. The Gravure Proofer may be adapted as a laminator or film applicator. An enlarged version of the Printing Proofer has been introduced with facilities to print three or four colours with a fine registration. The full range of K Hand Coaters was also shown, which include an automatic version with variable speed and pressure.

SHEEN INSTRUMENTS (SALES) LIMITED has a wide range of instruments and testing equipment and exhibited the 45° precision gloss and mattness meter covering a range from matt to full gloss; an ×5 multiplication scale enables greater differentiation with materials having a gloss of 20 per cent or less. Also shown were specular glossmeters, the STORMER-KREBS viscometer, the ICI SHEEN rotathinners, the DIN hardness rocker and the SWARD bubble typerocker.

Resins

ANCHOR CHEMICAL COMPANY LIMITED showed Epodil L, a liquid hydrocarbon resin of low viscosity, intended for use as a diluent for epoxy resins. It is chemically inert and compatible with most epoxy resins and curing agents.

ARCO CHEMICAL COMPANY featured the new Poly P-D family of resins. The liquid resins are low molecular weight hydroxy terminated homopolymers of butadiene, the molecular structure of which resembles that of polybutadiene. Cure is effected by reaction with di- or poly-isocyanates via the urethane reaction. The range of SMA styrene/maleic anhydride resins was shown and these have a wide area of application in surface coatings and printing inks.

BASF UNITED KINGDOM LIMITED exhibited Acronal 81D/Plastilit DS 3060 combinations and Elastostic E 1020 for use in sealants.

BEROL CHEMIE AB included cellulose ethers in its display.

BRITISH STEEL CORPORATION (CHEMICALS) LIMITED showed a number of products for use in surface coatings, which included pitches for pitch/epoxy and pitch/polyurethanes and which are now found suitable in pitch/vinyl and pitch/chlorinated rubber systems. Information on the latest work on the use of water based paints containing pitch and resin, special pitches and liquid coumarone and indene resins was available.

CdF CHIMIE showed its Norsolene SP polyindenic resins, which are completely soluble in white spirit and some grades are available with improved compatibility with alkyds or with EVA resins.

CHEMISCHE INDUSTRIE SYNRES BV exhibited Alsynol KZ 70, a modified hydrocarbon resin, for toluene based printing inks. Alsynol RL 42, a phenolic resin of higher viscosity than RL41, is widely used in heat-set web-fed offset printing.

CHEMISCHE WERKE HÜLS AG showed the range of Vilit soluble vinyl chloride polymers. Vilit MC 34 and BL 242 are new terpolymers with free carboxyl groups. Information was given on the further uses of these resins in anti-corrosion lacquers, in high build coatings, road marking paints and zinc dust primers. Other resins for lacquers shown were SK for alcohol soluble paper lacquers and AP for nitrocellulose lacquers.

CHEMOLIMPEX showed a number of colophony based resins, rosin esters, maleic esters and colophony modified phenolic resins.

CORNELIUS CHEMICAL COMPANY LIMITED exhibited the ARCO CHEMICAL COMPANY'S styrene/maleic anhydride and polybutadiene resins.

CRODA RESINS LIMITED displayed the Kelrez, Kelsol, Kelset and Kelvar media for printing inks, adhesives and the flooring industries.

DYNAMIT NOBEL AG showed a new product, Dyflor C 2180, a polyvinylidene fluoride resin for use in powder coatings having excellent resistance to chemicals and weather, good thermal resistance, high elasticity and impact strength. Also included were the Dynasil types for zinc rich paints for use at temperatures up to 400°C; Dynasylan BSM 40 may be used as an impregnating material for building materials. Dyfor L is for roll coating and Dyflor 2000 ES and 2000 WS are for powder coatings.

EASTMAN CHEMICAL INTERNATIONAL AG provided new information on the use of cellulose acetate butyrate in baking enamels, high solids content coatings, non-aqueous dispersions and powder coatings. The latest work with cellulose acetate propionate in the flexogravure and screen inks was described.

ESSO CHEMICAL LIMITED exhibited the range of Escorez hydrocarbon resins; 1302 is a development of the 1000 series having improved compatibility. 5000 is a water white hydrogenated resin, 8000 a reactive hydrocarbon intermediate and Escopol a low cost liquid hydrocarbon resin.

HERCULES POWDER COMPANY LIMITED provided information on their new phenolic resin Pentalyn 5303, which is of special interest because of its controlled solubility in low-aromatic content solvents, and Pentalyn 683 a partially hydrocarbon based resin for improving cost effectiveness. Afax amorphous polypropylene is a new product which offers the possibility of cost reduction by modification of polymer systems and as a constituent of hot melt adhesives.

HOECHST AKTIENGESELLSCHAFT showed its nitrocellulose compatible hydrocarbon resin for wood coating and other lacquers and other grades with good solvent release for gravure inks.

IMPERIAL CHEMICAL INDUSTRIES LIMITED illustrated further developments in the use of Alloprene based paints for use on steel with lamellar pigments and traffic marking paints and in printing ink media.

JACOBSON VAN DEN BERG & COMPANY (UK) LIMITED showed the COLORADO CHEMICAL SPECIALITIES INC range of high vinyl polybutadiene resins, which cure to hard solids with excellent adhesion, chemical resistance and electrical properties, and also the CHEMPLAST phenolic resin dispersions.

LAPORTE INDUSTRIES LIMITED exhibited its ketone resins.

MONTEDISON GROUP showed butadiene-acrylonitrile copolymer emulsions and polyvinyl acetate solid homo- and co-polymers.

PHILLIPS PETROLEUM COMPANY gave information on the high density polyethylene resins and solution polymerisation rubbers.

RHONE-POULENC provided information on Rhovinal B polyvinyl butyral for wash primers, and the Rhodopas AX 85.15 and AX 90.10 vinyl copolymers for strippable varnishes, anti-fouling paints and anti-corrosive marine paints. Rhodopas AXCM 3 is maleic acetochloride for the protection of metals and for coating asbestos cement and as a varnish for aluminium. Rhovinal F is a polyvinyl formal for insulating varnishes.

TENNECO CHEMICALS EUROPE LIMITED showed the Avorez resinates and Pentec pentamaleic and glycerol maleic esters for printing inks, plastics, paint and adhesive industries.

UNION CARBIDE EUROPE SA exhibited its solvent vinyl resins for marine and maintenance coatings and illustrated the "Hi-Vi" high build approach employing single-coat application of 200μm thick films on vertical surfaces. Niax polycaprolactone polyols were also described.

VEBA-CHEMIE AG illustrated the use of Veba-Waxes, which are mainly polyethylene waxes, in printing inks, lacquers and paints.

WACKER-CHEMIE AG showed its PVCL copolymers in the Vinnol range, H15/50 and H15/45M for lacquering aluminium foils, E15/45 and E15/45M for silk screen inks. VE15/40A is a new reactive copolymer with free hydroxyl groups and compatible with alkyd resins. Homopolymers for plastisols and organosols are Vinnol P 70 and the finely granulated P 70F. Polyvinyl butyrals for wash primers were also shown.

WORSDALL CHEMICAL COMPANY LIMITED illustrated the latest developments in the use of the Surcoprene resins, which are of interest because products based upon them do not need strong solvents.

Acrylic resins

BASF UNITED KINGDOM LIMITED showed its Luhydran LR 8417 and 8434 acrylic dispersions for water based stoving systems and its acrylic resins for powder coatings, Luprinal P LR 8414 (acrylic) and Lumitol P LR 8447 (hydroxyl containing acrylic).

CHEMISCHE INDUSTRIE SYNRES BV explained that the hydroxy acrylic resin Synedol 2513 was now available in solvents, which allow its use on solvent sensitive plastics. The new resin has the coding TP 142 DL, whilst the same resin coded TP 158 DL is for enamels providing rapid stackability. (See also emulsion and water soluble resins.)

DEGUSSA has available an autocrosslinking methacrylate resin VP 3949, which contains hydroxyl groups and a blocked polyisocyanate for the production of powder coatings.

DYNO INDUSTRIER AS in addition to the Dynolex A-081 acrylic dispersion, a new resin Dynolex A-555 has been introduced to give a harder film.

HOECHST AKTIENGESELLSCHAFT provided information on its acrylic resin for high solids stoving enamels and the acrylic resin for air-drying two-component finishes for car refinishing with properties usually obtained only with stoving enamels. Pure acrylic emulsions for paints and resin-bound plasters and vinyl acetate-ethylene-vinyl chloride copolymer emulsion for the same purposes were shown.

MONTEDISON GROUP exhibited its Crilat, Resiacril and Resiapat acrylic resins.

POLYCHROME LIMITED showed energy curable acrylic ester resins for inks, overprint varnishes, wood finishes, metal coatings, printing plates and the manufacture of strapping tape.

POLYVINYL CHEMIE HOLLAND BV showed its Neocryl solid thermoplastic acrylic resins and Neocryl acrylic solution polymers and a range of acrylic emulsions.

RHONE-POULENC exhibited its Rhodopas ACVX hydroxylated acrylic copolymers for varnishing wood, metals and plastics and for high build anticorrosion paints.

ROEHM GMBH introduced a new pure acrylic emulsion, Plextol D 498 which is further mentioned under "Emulsion and water soluble resins", and a new alcohol soluble acrylic resin Plex 8628 F for printing inks and plastics. Starting formulations were available for a wide range of products.

ROHM AND HAAS (UK) LIMITED showed acrylic emulsions.

Alkyd resins

BAYER AG exhibited its range of Alkydols for automotive and appliance finishes, urethane modified types with soya bean oil and an alkyd for full gloss or matt parquet sealing and boat finishes.

BEROL KEMI AB showed the latest additions to its Soalkyd range and, in particular, water reducible alkyds and a specially modified fast drying alkyd.

CdF CHIMIE is now operating a new alkyd resin plant and exhibited a number of new alkyds now available, particularly for the decorative field.

CHEMISCHE INDUSTRIE SYNRES BV demonstrated the use of Alsynol RL 42, a modified phenolic resin and its alkyd resin Alsynol PN in web offset printing inks. Additional grades of Alsynol PN are available for rapid drying high gloss varnishes for sheet-fed offset and heat-set web-fed printing.

CHEMOLIMPEX exhibited more than 30 types of alkyd resin.

DYNO INDUSTRIER AS showed a new version of its Dynotal T-36X, coded T-36E, containing 75 per cent solids in a less objectionable solvent for acid curing and force dried paints. For water based stoving enamels, the company has developed Dynotal T-26W 80 per cent, based on tall oil, and Dynotal O-10W 80 per cent, an oil free alkyd.

HOECHST AKTIENGESELLSCHAFT showed alkyds for high solids stoving enamels.

IMECO can offer a range of alkyd resins for paints and varnishes.

WORSDALL CHEMICAL COMPANY LIMITED explained that owing to the shortage of isophthalic acid, a new range of Estokyds, based upon other acids and showing equal or improved properties, has been introduced.

Amino resins

BASF UNITED KINGDOM LIMITED showed its range of Luwipal LR water-thinnable melamine resins for water based stoving systems.

BEROL KEMI AB exhibited the latest additions to its Soamine and water reducible ranges of amino resins.

The major feature of the BRITISH INDUSTRIAL PLASTICS LIMITED stand was comprehensive information on the relative performances of the Beetle isobutylated amino resins; this information was available also as a technical publication.

CHEMOLIMPEX has available a range of amino resins.

CRODA RESINS LIMITED exhibited its new high solids content, heat curing polyester/amino resins systems.

DYNO INDUSTRIER AS has previously shown its Dynomin MM9 and MM100 melamine/formaldehyde resins, and to these has now added a water soluble, 100 per cent solids resin, Dynomin UM 13, which can be used in high solids water- or solvent-based systems.

MONTEDISON GROUP showed its Lamelite series of melamine resins and the Gabbrocel, Xilocolla and Resins UF ranges of urea resins.

SCHERING AG showed modified amines for hardening epoxy resins.

Emulsion and water based resins

AKZO showed a vinyl acetate/ethylene, which is a new development product.

AMOCO CHEMICALS EUROPE has developed the TMA 116A Resin WS 3823 which is a water soluble alkyd with better hydrolytic stability and is based upon IPA 99 and TMA. The replacement of tall oil in the formulation by pelargonic acid improves the initial colour and colour retention. A new concept in curing has been developed for IPA/TMA based water soluble resins, such as WS-549, to improve colour retention on drying, storage stability and better mechanical properties. Modification of a latex trim paint with an IPA/TMA water soluble polyester resin improves gloss, flow and adhesion to chalked surfaces.

BASF UNITED KINGDOM LIMITED showed stoving systems based upon acrylic dispersions and water soluble melamine resins and the Acronal DS 3095 acrylic dispersion for pressure sensitive adhesives.

BRITISH INDUSTRIAL PLASTICS LIMITED indicated the latest developments in water based coatings, with particular emphasis on the amino component.

CdF CHIMIE reviewed the versatility of the Norsolyde alkyd resins and, in particular, Norsolyde AE 11, a self-emulsifying alkyd which can be added to emulsion paints to improve properties. The development work of this project has led to a better understanding of film formation.

CHEMISCHE INDUSTRIE SYNRES BV exhibited the hydroxy acrylic dispersion, Synresyl TP 141 DF, which can be applied by flow coating to give a high gloss finish. Acrylic dispersions, Synresyl TP 173 DF and TP 174 DF, for high gloss decorative enamels and Synresyl TP 123 DF as a binder for decorative stone plastics were shown. A water soluble acrylic resin, Synsilate TP 164 DE, has been developed for roller coating and a water soluble alkyd resin, TP 143 DE for stoving enamels for household appliances.

CHEMISCHE WERKE HULS AG showed the Litex copolymer and terpolymer latices. Litex A.10 is a lightfast binder of high pigment binding capacity for exterior paints and synthetic plasters. A.20 is for coatingc oncrete and othertiles to prevent efflorescence. Litex 6301 is an additive for cement mortar and for application on expanded thermoplastic wall tiles.

CORNELIUS CHEMICAL COMPANY LIMITED showed the ROEHM GMBH range of acrylic resin emulsions and solutions.

DYNAMIT NOBEL AG exhibited emulsion type polyesters for water based paints without amines.

DYNO INDUSTRIER AS showed water soluble alkyd and amino resins and these are mentioned under earlier headings. Acrylic dispersions for high quality emulsion paints have been exhibited previously, but a new dispersion, Dynolex A-554, having excellent wet adhesion and suitable for bathrooms and kitchens, has been developed.

EASTMAN CHEMICAL INTERNATIONAL AG has developed new resins based upon EASTMAN TMPD and CHDM glycols to demonstrate their use in high solids and water based coatings.

HOECHST AKTIENGESELLSCHAFT exhibited its pure acrylic emulsions for wall paints, gloss paints and resin bound plasters and a vinyl acetate/ethylene/vinyl chloride emulsion for emulsion paints and resin bound plasters.

JACOBSON VAN DEN BERG & COMPANY (UK) LIMITED showed the AIR PRODUCTS AND CHEMICALS INC. Airflex vinyl-ethylene emulsion.

MONTEDISON GROUP offer polyvinyl acetate homopolymer and copolymer dispersions and dispersions of butadiene-acrylonitrile.

POLYVINYL CHEMIE HOLLAND BV showed the Neocryl A 600 series of water based concrete sealers, flooring sealers and for coatings metal and plastic. Also shown were the Neocryl NL-10-D and NL-10-E self-crosslinking acrylic emulsions for paint and wood, metal and paper board coatings. Neocryl BT-8 and BT-20 are intended for water based stoving enamels in conjunction with methylolated melamine resins.

RHONE-POULENC gave information on new applications of paints based upon Rhodopas emulsions. Emulsions have been developed which are suitable for the coating of prefabricated sections in factories.

ROEHM GMBH introduced a new pure acrylic emulsion, Plextol D 498, for the preparation of masonry, decorative and indoor paints, primers, impregnating paints and paints for porous concrete.

ROHM AND HAAS (UK) LIMITED had available further information on the use of the Primal series of emulsions for non-yellowing, high gloss, good flow and superior wet adhesions, coupled with excellent outdoor durability. The second generation of these materials showing improved solvent and flash rust resistance, coupled with ease of application, speed of drying and lack of hazards to health and of fire risk. It is now possible to formulate spray paints with up to 70 per cent solids content. A new flexographic and gravure ink vehicle was introduced, Primal I-94, which has excellent pH/viscosity stability and gives a high gloss, sharp impression, good transfer and excellent wet rub resistance.

WACKER-CHEMIE GMBH showed the new EVA grades of its Vinnopas emulsions, including CEF 10 with excellent pigment binding properties and weather resistance. Also available are EP 1 and EP 11 emulsions for use as adhesives for PVCl foils.

Epoxy resins

CdF CHIMIE exhibited its Lopox 1000 epoxy resin for powder coating.

CHEMOLIMPEX showed examples of its epoxy resins.

CIBA-GEIGY (UK) LIMITED, Plastics Division, provided a new polyepoxide formulation for weather resistant powder coatings and gave information on its range of Araldite resins.

HOECHST AKTIENGESELLSCHAFT showed an epoxy resin ester for water thinnable primers and top coats.

JACOBSON VAN DEN BERG & COMPANY (UK) LIMITED featured the epoxy ester CEE-5 as a modifier for latex paints.

SCHERING AG commenced production of epoxy resins in 1971 and exhibited a range of Eurepox resins and Euredur hardeners.

SHELL CHEMICALS UK LIMITED featured its Epikote resins for powder coatings, clear lacquers and drum linings, as well as for air drying and stoving water thinnable paints. A full range of curing agents was also shown.

Polyamide resins

CRODA RESINS LIMITED exhibited its Plastamid polyamide resins.

JACOBSON VAN DEN BERG & COMPANY (UK) LIMITED showed the CHEM-PLAST (of Italy) liquid and solid polyamide resins for a wide range of applications, including flexographic inks and as reactants with epoxy resins.

SCHERING AG exhibited its thermoplastic and reactive polyamide resins, the former intended for printing inks and hot melt adhesives and the latter for use in conjunction with epoxy resins. The thermoplastic types are now marketed under the names Versamid and Eureton and the reactive resins as Versamid and Euredor.


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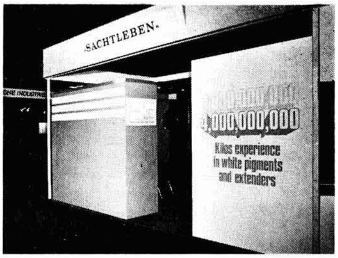
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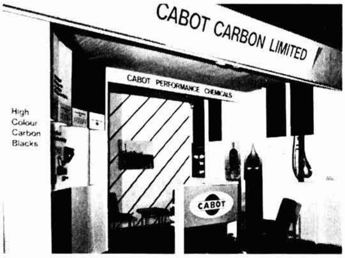
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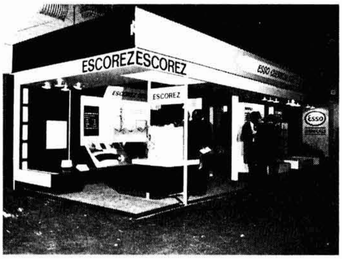
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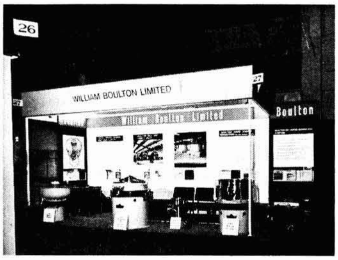
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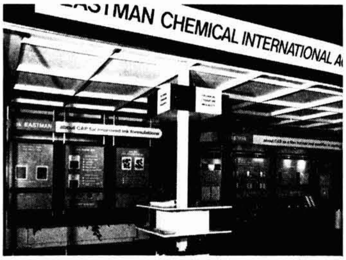
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Polyester resins

The AMOCO CHEMICALS EUROPE polyester resin DT-2 C-resin PC-600 based upon terephthalic acid and suggested for a saturated powder coating medium has been made more stable on storage and is recommended for use where outstanding physical and chemical performance is required. AXE Resin PU-73/11 is an aliphatic isocyanate cured polyester based upon IPA and TMA giving excellent outdoor resistance, colour retention and very fast drying times.

BASF UNITED KINGDOM LIMITED showed its unsaturated polyester resins Ludopal LR 8394 (for ultraviolet curing) and Ludopal LR 8436.

BAYER AG exhibited Alkynol 1363W, an oil free saturated polyester for water reducible stoving finishes.

BEROL KEMI AB showed water reducible polyester systems.

BRITISH INDUSTRIAL PLASTICS LIMITED gave information regarding the latest developments in its polyester resins for powder coatings, water based and high solids coatings.

CdF CHIMIE exhibited Norsolyne 943 polyester resin for powder coatings, which is curable with blocked isocyanates or melamime resins.

CHEMISCHE WERKE HÜLS AG showed the Vesturit polyester resins, which included the new 906 for coil coating and industrial paints, BL 12211 and BL 1203 for high solids coatings whilst BL 950, BL 951 and BL 952 (high molecular weight linear polymers) provide highly flexible coatings.

CRODA RESINS LIMITED provided information on the formulation of high non-volatile heat curing polyester/amino resin systems.

DYNAMIT NOBEL AG showed its Dynapol L series of high molecular weight linear saturated polyesters to give flexibility, adhesion and outdoor durability. They are suitable for can coatings; the Dynapol H types are branched chain thermosetting resins; Dynapol P is a saturated polyester containing terephthalic acid for the production of powder coatings. The polyester resins TE and TI for wire enamels are methacrylate resins, the latter being a polyester imide based on terephthalic acid.

EASTMAN CHEMICAL INTERNATIONAL AG described promising new resins based upon TMPD and CHDM glycols, which have been developed for high solids and water borne coatings.

HOECHST AKTIENGESELLSCHAFT showed unsaturated polyester resins for flexible fillers and putties with good sanding properties after short curing times.

IMECO are able to offer polyester resins.

MONTEDISON GROUP showed the Gabrite polyesters produced by its Petrochemicals Division.

Polyurethane resins

AMOCO CHEMICALS EUROPE demonstrated the outstanding performance offered by Amoco IPA 99/TMA polyurethane coatings.

BAYER AG exhibited a range of new products in its Desmodur/Desmophen series. The Desmodurs include light-stable isocyanates and those for very fast drying. Desmocap 11 is a blocked polyurethane polymer for use with epoxy resins and Desmolac is a drying polyurethane resin for coating flexible substrates. A number of Desmophens for special purposes are available.

BEROL KEMI AB showed examples of two-component isocyanate systems.

CdF CHIMIE illustrated improvements in its Norsodune NS 943 polyester/caprolactam masked diisocyanate system.

CRODA RESINS LIMITED provided information on its non-yellowing moisture curing isocyanates in aliphatic solutions.

HOECHST AKTIENGESELLSCHAFT exhibited its blocked polyisocyanate for use with acrylic resins in stoving enamels.

POLYVINYL CHEMIE HOLLAND BV showed the NeoRez blocked polyurethanes and moisture curing polyurethanes.

VEBA-CHEMIE AG presented its isophorone diisocyanate as a component of light-fast polyurethanes and two urea adducts for compounding with low viscosity hydroxy esters. A development product is T 1890, an isocyanurate adduct for cold curing. U 900 and U 556 are solvent based polymers for moisture- or cold-curing to give light-stable coatings for wood, plastics, concrete etc. UB 1256 is a polyurethane resin which allows later curing due to built-in caprolactam blocked NCO groups; it cures at between 180 and 350°C to give high flexibility and is specially developed for coil coating.

Silicone resins

CRODA RESINS LIMITED showed the Heydolac range of silicone copolymers.

DYNAMIT NOBEL AG exhibited the Dynasil types, which are ideal for corrosion protection, and suitable for binders for zinc rich primers on iron and steel and for temperatures up to 400°C. Dynasylan BSM 40 may be used as an impregnating agent for mineral building materials.

RHONE-POULENC featured its Rhodorsil silicones as binders and additives for the paint industry with excellent resistance to high temperatures, oxidation, water and chemicals and showing good electrical resistance.

WACKER-CHEMIE GMBH displayed silicone resins and silicic esters for the formulation of paints with outstanding temperature resistance, dielectrical performance, water repellancy and resistance to oxidation and bacteria. Also shown were silicone resins combined with polyesters, alkyds and acrylics.

Miscellaneous items

BOC SPECIAL GASES DIVISION are able to supply over 130 speciality gaseous chemicals in cylinders ranging from a few grammes to over one tonne capacity, and mixtures of them can be blended to exact requirements. The BOC gas alarm recently developed to give warning of potentially dangerous gases and the BOC oxygen monitor were displayed. Comprehensive gas analysis facilities are now available on a consultancy basis.

BRITISH STEEL CORPORATION (CHEMICALS) LIMITED is developing an improved process for the production of a wide range of high purity aromatic nitriles by means of fluid bed, vapour phase aminoxidation.

TENNECO CHEMICALS EUROPE LIMITED showed the Colwell Colour Cards which are able to produce albums, fan decks and colour cards.

Acknowledgment

The Exhibition Committee is indebted to the Honorary Editor, Mr S. R. Finn, for his work in the compilation of this report.

OCCA—28

The motif for the Association's 1976 Exhibition shown above was designed by Robert Hamblin to continue the theme of the last two Exhibitions—in which attention was drawn to the welcome extended to exhibitors and visitors from overseas—by showing the target for 1976 as London, where all the previous Association's Exhibitions have been held.

OCCA-28 will take place from 23-26 March 1976 at Alexandra Palace, London N22, and the plans of the Exhibition Committee are well advanced, so that it is hoped to despatch the Invitation to Exhibit to those organisations who have previously exhibited and also to those who have requested details, at the end of June.

The review of OCCA-XXVII, which appears above, shows that the Exhibition attracted direct exhibitors from 15 countries with 150 organisations represented and with visitors from almost 50 overseas countries. Any organisation which has not previously requested a copy of the Invitation to Exhibit but wishes to receive one, should write (or telex) immediately to the Director and Secretary at the Association's offices, since the closing date for this unique international forum for display and discussion in the surface coatings industries will be **1 October 1975.**

Obituary

Leslie Oliver Kekwick

Members of the Association, in particular those of the London Section, will have been saddened by the news of the death of Leslie Kekwick after a painful illness borne with his usual fortitude. The Association, and indeed the industry, have lost a great figure; a man of stature unfortunately rarely met with. Those who knew him well will undoubtedly have a feeling of great personal loss. He was a friendly and approachable man and never failed to help a friend in need—he was indeed a tower of strength to all who knew him and will be greatly missed.

He was Hon Treasurer of the London Section shortly after the war until he became Chairman in 1949. His impact on the London Section, and indeed on the whole Association, was to be profound and significant for the future. It was he who conceived the London Section Technical Trade Exhibition, the first show being held at what was then the Borough Polytechnic in 1949. His two years as Chairman were distinguished by the rapid growth, not only of the Exhibition but of other events and functions held by the Section.

In 1951 the Council, in its wisdom, nominated him President and at the AGM held in Scarborough that year he was duly elected. On the closure of the Conference on the Saturday he travelled to Paris to represent the Association at the FATIPEC Congress held there.

At this time the Association had decided to have its own offices and Robert Hamblin had been engaged as General Secretary. The first task Leslie Kekwick had as President was to find a home for the Association and he arranged for offices at the Memorial Hall Farringdon Street, where the Association remained for a number of years before moving to the Wax Chandlers' Hall.

He was a most active President and during his period of office it was fortunate that he had to travel around the world for his company, Amalgamated Oxides Limited. This enabled both him and his wife to visit the Sections in New Zealand, Australia and South Africa at a time when the Association's finances would not have allowed a visit of this kind. He returned via the United States where he stayed with Bob and Betty Matlack.

He retired from his position as Chairman of Amalgamated Oxides Limited some four or five years ago but still retained an interest in the Association, his last attendance being at the Past President's Dinner last Autumn.

Leslie Kekwick was a man of many parts and his Committee activities included the chairmanship of the N. W. Kent Hospital Board for a number of years.

Herbert Worsdall

Report of Council Meeting

A meeting of the Council took place on 2 April 1975 at the Great Northern Hotel, King's Cross, London N1 9AN. In the absence of the President (Mr L. H. Silver), the Chair was taken by the Honorary Treasurer (Mr F. Cooper). There were 21 other members of Council present.

Before the formal business of the meeting was taken, the Council stood in silence in tribute to the memory of three distinguished past members of the Council whose deaths had been reported since the previous Council meeting—Mr L. O. Kekwick (President 1951-53 and an Honorary Member 1968), Mr G. N. Hill (Honorary Editor 1937-47 and an Honorary Member 1962) and Mr E. A. Bullions (a past Chairman of both the Scottish Section and its Eastern Branch).

It was reported that Mr I. Ford had accepted an invitation to be the Association's representative on the BSI Committee LGE/19—Artificial Daylight for Colour Matching and also on the Colour Group. Reports were received on the Scarborough Conference, scheduled to take place from 17 to 21 June and the Reunion Dinner for past and present members of Council in the autumn. The annual accounts which had been accepted by the Finance Committee were approved by the Council for inclusion in the Annual Report, which will be circulated to members before the Annual General Meeting to be held on the 20 June 1975. Estimates for 1975 were also adopted by the Council.

The Council considered in detail a report from the Finance Committee on the number of circulars which were sent each session to members of the Association in respect of section activities. Recommendations were made to correlate the activities of sections at section level before the circulars were sent to the Association's headquarters for dispatch to the members and it was hoped that this would effect a saving in time, stationery and postage. A schedule showing the number of members whose subscriptions for the current year had not been received was laid before the Council and a resolution was passed, in accordance with Article 15, to remove from the Register at the 30 June the names of any members whose 1975 subscription had still not been received by that date.

It was reported that requests had been received for a paper to be presented at the forthcoming convention of the Federation of Societies for Coatings Technology which would take place at Los Angeles 29-31 October 1975 and also for the convention of the Scandinavian Federation of Paint and Varnish Technicians which would take place at Helsinki 29 September to 1 October 1976. **Any members of the Association who are willing to present a paper at either of these functions should contact the Director and Secretary immediately.**

The arrangements concerning section symposia in 1976 were discussed and it was agreed to hold the 1976 Association Annual General Meeting at the same time as the West Riding Section's symposium at Harrogate, 25 and 26 June 1976. The report was received on the future organisation of the overseas sections in South Africa and New Zealand. Section Chairmen reported on the activities of their Sections and, in particular, Council noted with pleasure that both the Thames Valley Section's Symposium in March had been successful and that the Newcastle's Symposium which would take place later in the month had already attracted so many registrations that the Section could not accept any further bookings.

Mr Cooper, on behalf of the President, stated that it had been his wish to record a vote of thanks to all those members retiring from Council and to thank them for their support during his term of office. In response, Mr D. E. Hopper, Chairman of the Midlands Section, expressed the thanks of the Council to the President for his unfailing interest in the Association and this was carried with acclamation.

There being no further business the Chairman declared the meeting closed at 4.06 p.m.

Notice to Members

West Riding Section

Golf tournament

The annual competition for the OCCA Golf Trophy (open to all Members) and the West Riding Chairman's Trophy (open only to West Riding Members) will be held at Pannal Golf Club, Harrogate, Yorkshire on Thursday 4 September 1975. Guests of members will be allowed to compete for a visitors' prize.

Members intending to participate in this event are invited to confirm their interest, with name, address and telephone number, to the Section's Hon. Social Secretary, N. Cochrane, as soon as possible. Mr Cochrane's address is 19 Rutland Road, Harrogate, Yorkshire HG1 2PY.

Various prizes have already been promised to provide more incentive to competitors, but the Section would welcome any further offers, from either companies or individuals, in order to complete the prize list.

Midlands Section

Trent Valley Branch

Annual General Meeting

Approximately 50 members and guests of the Trent Valley Branch attended its Annual General Meeting held at the Cross Keys' Inn, Turnditch, on the evening of Friday 11 April.

Mr J. Burns welcomed the President, Mr Silver, and his charming wife, and Mr C. White presented Mrs Silver with a beautiful example of Crown Derby pottery as a token of appreciation. Mr D. Hopper, Midlands Section Chairman and his wife and several Council members were also present. The Committee was returned to office for the 1975/76 session. Mr S. Hawley was elected Chairman designate and Mr S. Watson also joined the Committee. This business completed, a festive spirit took over and a splendid buffet supper was consumed.

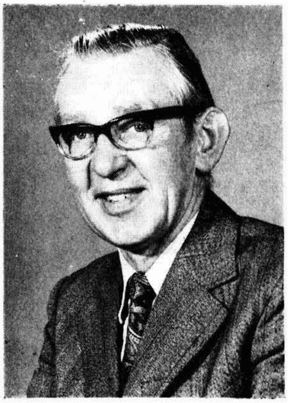
News of Members

Mr D. H. Clement, an Ordinary Member attached to the Midlands Section and an Associate in the Professional Grade, is serving on the Applied Chemistry Committee of the Technician Education Council, which is hoping to approve technician courses starting in September 1976. Mr Clement is currently with Arthur Holden & Sons Limited.

Mr A. Glen, an Ordinary Member attached to the Eastern Branch of the Scottish Section, is serving on a corresponding body in Scotland, the Applied Chemistry Committee of the Scottish Technical Education Council. Mr Glen works with Isaac Spencer and Co. (Aberdeen) Limited.

Mr D. J. G. Kerrison, an Ordinary Member attached to the London Section, has recently been appointed Sales Director by Rohm and Haas (UK) Limited. He will be responsible for the continuing promotion of solvent free paints, coatings, printing ink and floor polish emulsions marketed by the company.

Mr J. M. Maughan, an Ordinary Member attached to the Hull Section, has retired recently as Works Director of Humbrol Limited, Hull. Mr Maughan first became involved in the paint trade in 1931 with Smith and Waltons, and became a member of the Association in 1946. He was appointed Works Director of Humbrol in 1961 and is currently being retained by the company in a consultative capacity.



J. M. Maughan

Professional Grade

At the meeting of the Professional Grade held on 15 May 1975, the Committee authorised the following admissions:

To Fellowship

Harry Smith (*General Overseas Section—Tanzania*).

Leslie Valentine (*London Section*).

Herbert Charles Worsdall (*London Section*).

Transferred from Associateship to Fellowship:

Andre Jaime Beere (*Thames Valley Section*).

To Associateship

Alexander Hamilton (*Scottish Section*).

Henry Langford (*London Section*).

Francis Edward Stone (*Midlands Section*).

Full details for admission to the optional Professional Grade for Ordinary Members last appeared in full in the March 1975 issue of the *Journal*. Copies are also available from the Association's offices.

Register of Members

The following elections to membership have been approved by Council. The Section to which new members are attached is given in italics.

Ordinary Members

Barrett, Paul Leslie, PO Box 1084, Auckland, New Zealand. (*Auckland*)

Billson, Noel Edwin, 4 Walworth Avenue, Pakuranga, New Zealand. (*Auckland*)

Bowman, Lester James, BSc, Rohm & Haas (UK) Ltd, Lennig House, 2 Masons Avenue, Croydon, Surrey CR9 3NB. (*London*)

Daffern, David, BSc, 59 Bower Road, Hextable, Nr. Swanley, Kent BR8 7SF. (*London*)

Davison, John William, LRIC, 21 Baderwood Drive, Frimley, Surrey Heath, Surrey. (*London*)

De Jong, Jan Lauwrens, PO Box 164, Alberton 1450, South Africa. (*South African*)

Dempsey, Basil John, 18 Picton Street, Papatoetoe, Auckland, New Zealand. (*Auckland*)

Devine, James, Plascon Evans, PO Box 10, Luipaardsvlei 1743, Transvaal. (*South African*)

Ellis, Kenneth William, BSc, Malaysian Carbon Sdn. Bhd, PO Box 30, Port Dickson, Negri Sembilan, Malaysia. (*General Overseas*)

Flint, Peter Gregson, 6239 Fischbach/TS, Gundelhardt Strasse Nr. 1, West Germany. (*London*)

Groves, Thomas Edward, BSc, PhD, Dalen, Forest Drive, Kinver, Nr. Stourbridge, Worcs. (*Midlands*)

Hancock, Sekeeta, 18 Aberdour Road, Goodmayes, Ilford, Essex. (*London*)

Harding, John Valentine, 19 Nailsea Court, Sully, Nr. Penarth, South Wales. (*Newcastle*)

Hathaway, Eric Hugh, 57 Hillfield Road, Hemel Hempstead, Herts. (*London*)

Millar, Donald McLean, Hird Hastie Paints, 73 Milnpark Street, Glasgow. (*Scottish*)

McConnell, David Jenner, LRIC, Bowater Technical Services Ltd, Callybank House, Gravesend, Kent DA11 9AQ. (*London*)

McCort, John Graham, Industrial Paints Limited, Box 142, Tauranga, New Zealand. (*Auckland*)

McLean, James, BSc, 74 Moorside Road, Tottington, Nr. Bury, Lancs. (*Manchester*)

O'Sullivan, Michael John, 1st Ave Extention, PO Box 142, Tauranga, New Zealand. (*Auckland*)

Peel, John David, ARIC, 15 Fairview Gardens, Meopham, Kent. (*London*)

Shaw, Martin John, BA, PhD, ARIC, Ciba-Geigy (UK) Ltd, Pigments Division, Roundthorn Industrial Estate, Wythenshawe, Manchester. (*Manchester*)

Sykes, Brian Richard, BSc, 37 Beech Court, Ponteland, Newcastle upon Tyne, NE20 9NE. (*Newcastle*)

Waller, Alan John, Nacanco Ltd, Salhoose Road, Norwich. (*London*)

Wicks, Zeno W., AB, PhD, Dept. of Polymers & Coatings, North Dakota State University, Fargo, North Dakota 58102, USA. (*General Overseas*)

Winkeler, Mam, Sigma Coatings BV, Amsterdamseweg 14, Uithoorn, Holland. (*General Overseas*)

Associate Members

George, Anthony Derek, PO Box 39001, Auckland West, New Zealand. (*Auckland*)

Hart, Wayne Ronald, Allied Chemical (NZ) Ltd, PO Box 39-189, Auckland West, New Zealand. (*Auckland*)

Morgan, Murray D, 44 Ripon Crescent, Meadowbank, Auckland 5, New Zealand. (*Auckland*)

Ripley, Daniel Lawrence, T & C Chemicals (Pty) Ltd, PO Box 1366, Johannesburg 2000, Transvaal. (*South African*)

Sellars, Ian Carrington, Yew Tree Farm, Moss Lane, Mobberley, Cheshire. (*Manchester*)

Thompson, Geoffrey Alan, Hunter Douglas Ltd, PO Box 12046, Penrose, Auckland, New Zealand. (*Auckland*)

Registered Students

Fernley, Gordon, 36 Wentworth Crescent, Hayes, Middlesex UB3 1NN. (*Thames Valley*)

Lowrie, Janice Elizabeth, 42 Penyston Road, Maidenhead, Berks. (*Thames Valley*)

Virgin, Karen, Ciba-Geigy (UK) Ltd, Pigments Division, Roundthorn Industrial Estate, Wythenshawe, Manchester. (*Manchester*)

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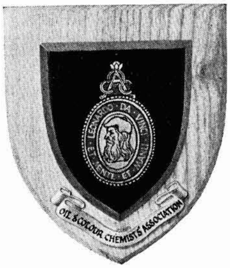

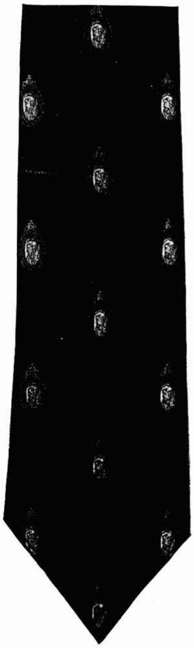

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The tie is blue terylene, with the Association's insignia woven in red and gold silk.

The blazer badge has the insignia embroidered in silver and gold wire on a red and blue ground.

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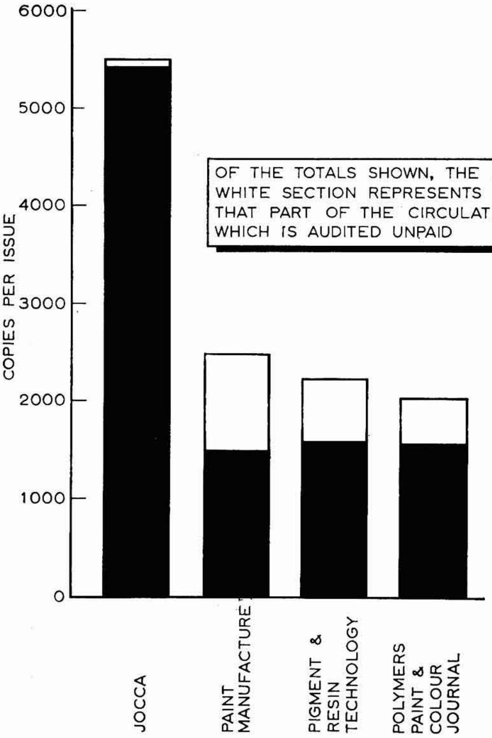
Scarborough
17-21 JUNE 1975

Papers given at the Association's Conference 17-21 June under the title "The performance of surface coatings—does the reality match the theory?" will be published with discussions in the *Journal* later this year, starting in September.

There are, however, a few spare copies of the bound preprints now available, and these may be purchased by those not able to attend the Conference at £10.00 per copy (*Prepayment only* to Oil and Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF England).

Comparison of circulations of U.K. publications to the paint, printing ink and allied industries



(Reference Audit Bureau of Circulations Reviews, Jan-Dec 1973)

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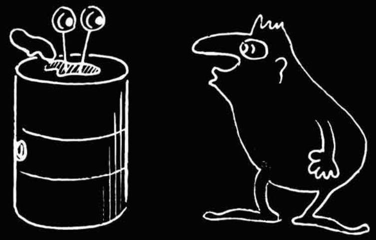

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