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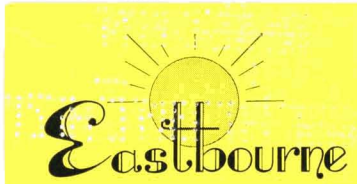

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Transactions and Communications

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Transactions and Communications

The control of settling of some water-soluble paints

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National Research Centre, Dokki, Cairo and *The General Company for Trading and Chemicals, Cairo, Egypt

Summary

In this work, two procedures have been carried out to study what effects the addition of differing amounts of a gelling agent would have on the rate of settling of a wet paint. The first procedure is a centrifugal method of accelerated ageing. The second procedure is based on a slower process, which depends on the measurement of variations in the specific gravity of the paint with time and at a fixed depth in the paint sample.

Keywords

Types and classes of coatings and allied products

stoving finish

Properties, characteristics and conditions primarily associated with materials in general

settling agent

Raw materials for coatings:

binders (resins, etc)

alkyd resin
melamine resin
water soluble resin

prime pigments and dyes

titanium dioxide

surface active and rheological agents

suspension agent

Le contrôle de la formation de dépôt dans certaines peintures à base d'eau

Résumé

Dans cette étude on a utilisé deux techniques pour étudier les effets sur la vitesse de formation d'un dépôt dans une peinture qu'exerce l'addition de diverses quantités d'un agent gellifiant. La première technique entraîne l'emploi d'une méthode centrifuge pour accélérer le processus de déposition. La seconde technique se base sur une méthode plus lente, qui dépend de la mesure des variations, en fonction du temps, de la densité de la peinture à une profondeur précise dans l'echantillon de peinture qui fait l'objet de l'essai.

Kontrolle des Absetzens einiger wasserlöslicher Anstrichmittel

Zusammenfassung:

In dieser Arbeit zum Studium der Wirkung von Geliermittelzusätzen in verschiedenen Prozentsätzen auf die Absetzgeschwindigkeit einer nassen Anstrichfarbe wurden zwei Verfahren durchgeführt. Das erste Verfahren ist eine zentrifugale Methode beschleunigter Alterung. Das zweite Verfahren basiert auf einem langsameren Vorgang, welcher vom Messen der Veränderungen im spezifischen Gewicht der Farbe im Laufe der Zeit und in einer bestimmten Tiefe im Farbmuster abhängig ist.

Introduction

Refs. 1-12

Since paint settling involves the interaction of many complex factors not readily amenable to measurement, it is customary to assess paint settling either qualitatively or by an empirical type of measurement.

In 1951, Standacher[1] studied the sedimentation of certain paints by placing them in test tubes filled to a depth of 14 cm and testing the consistency of the sediment from time to time with a needle ending in a disc-shaped head. He found that polar additives in the correct proportion would inhibit sedimentation, and that these additives were best used to wet the pigments, extenders and fillers before addition of the paint vehicle.

In a Dutch patent[2], settling was prevented by coating the pigments with a derivative of a polysaccharide (for example, carboxymethyl cellulose, cellulose hydrate, or sol-starch derivatives).

A paint system's centre of gravity will shift due to the settling of pigments, and this can be utilised as a test. The paint to be tested is poured into a long glass cylinder set up in a vertical position. When settling has taken place, the system's centre of gravity is no longer in the centre of the liquid column, but has shifted towards the base. Garmsen's settling scales[3], for example, are based on this principle.

A U.S. patent[4] indicated that sedimentation of pigment in lacquers was retarded by the addition of 0.2–1.0 per cent of a long chain fatty acid salt of a basic aliphatic polyamide.

Sukhanova and Novikova[5] studied the effect of lecithin, "Bentone" (NL Industries Inc., USA) and a polyamide resin on the sedimentation of enamels containing barytes and iron oxide. The dispersions were tested in an apparatus which measured the depth of immersion of a cone under variable loads. The authors deduced that the addition of 0.5 per cent lecithin prevented sedimentation and the formation of a dense pigment deposit. Bentone and the polyamide resin also prevented sedimentation, but slightly increased the viscosity of the enamels.

Earlier, Kronstein[6] had studied the effect of addition of 1 per cent lecithin (based on pigment) on the dispersion of various grades of titanium dioxide in latex vehicles. He found that lecithin increased the rate of dispersion and decreased both the rate of settling and the tendency for the paint to become thixotropic.

Patton[7] measured the settling of pigment by a simple pigment settling gauge. The test method consisted essentially of pushing a perforated disc down through the paint using a stepwise procedure, in which weights were periodically added to the probe load at half-minute intervals.

X-ray radiation was employed by Landon[8] to study paint settlement. In 1970, development work on a new X-ray process to measure sedimentation was carried out by Allen[9].

Dreher and Schneider[10] used an amine salt (0.2 to 1.2 per cent by weight) to retard the settling of pigments in lacquers.

A rapid method for predicting the settling properties of various types of pigment in paints, which involved measurement of the specific gravity of the paint at various times, was reported by Mileti[11]. The settling rate was recorded as the difference in specific gravity between the initial reading (after 1 minute) and the final reading (after 48 hours), multiplied by 100.

Recently, Raede[12] has recommended the use of three additives as a means of overcoming discolouration, arising primarily from pigment sedimentation in paint film. Bentone reduced the tendency for sedimentation, soya lecithin acted as a wetting agent and prevented co-flocculation, and a silicone oil influenced the surface structure and eliminated the formation of Bernard cells.

In this work, a gelling agent is used to control sedimentation in aqueous, pigmented resin dispersions. Two methods of testing, an accelerated method and a slow method, are employed.

Experimental

Materials

Titanium dioxide pigment

"Tioxide R-CR" titanium dioxide pigment (BTP Tioxide Ltd, London) was used in this work. It has the following specification:

Specific gravity	4.0
Oil absorption	20
Minimum TiO_2 content	93 per cent

Modifiers: unspecified compounds of Al, Zn, Si.

This rutile grade pigment is specially formulated for maximum chalk resistance and tint retention, combined with excellent milling performance and durability.

Anti-settling agent

"Bentone" is produced by Titan Gesellschaft MBH. It is a gelling agent, which has the property of swelling and gelling in liquid systems. It is a reaction product of an organic ammonium cation with the inorganic mineral, montmorillonite.

Preparation of gel-Bentone

Five parts by weight of "Bentone 34" and five parts by weight of "Bentone 38" were dispersed in 85 parts by weight white spirit. After dispersion to homogeneity, approximately five parts by weight methanol were added and stirred until complete gelation.

Paint formulation

Ball mill base

Titanium dioxide	240 g
Alkyd resin (50 per cent solids)	160 g
Antisettling agent: gel-Bentone (10%)	(as required: between 0 and 1.0 per cent, based on weight of pigment)
Wetting agent: sodium hexa meta-phosphate	(0.2 per cent, based on weight of pigment)
Disperser *N*	(0.2 per cent, based on weight of pigment)
Antifoaming agent: silicone oil (French 470)	(0.05 per cent based on weight of pigment)

These ingredients were dispersed for twelve hours.

Results and discussion

In this work, two procedures were carried out to study the effect on the rate of settling of the addition of different amounts of gel-Bentone. The first procedure was an accelerated ageing technique based on centrifugal force. The second procedure was a slower process, which depended on measuring the variation of specific gravity of the paint at a certain depth as settling took place under the influence of gravity.

The accelerated (centrifugal) process

Samples of paint were formulated as described earlier, using different percentages of gel-Bentone in each formulation (0, 0.25, 0.5, 0.75 and 1.0 per cent).

The paint specification was as follows: solids content 70 per cent; amino resin 30 per cent (based on weight of total resin); pigment-to-binder ratio 1:1.

The paint was formulated with a high solids content to produce an appreciable rate of settling within a short time. The cups of the centrifuge were filled to a depth of 7.7 cm (the cups' internal diameter was 2.02 cm). The speed of the centrifuge was 1380 r.p.m. The depth of the clear varnish was measured at the start of the experiment and after every hour until a more or less stable height was obtained (no further settling). This process needed about 24 hours. The results are shown in Fig. 1. From the Figure it can be seen that the rate of settling is slow in the early stages of centrifuging. After the pigment particles have approached more closely to one another, the tendency for the pigments to flocculate increases and this leads, to some extent, to an increase in the settling rate. Subsequently, the rate of settling is decreased or practically stopped.

Since Bentone has a "bodying" action, it increases the viscosity of paint. According to Stokes' law, the velocity of the settling particles will decrease with increasing viscosity of the paint. With increasing quantities of Bentone, the paint becomes more thixotropic. From Fig. 1 it can be seen that 0.5 per cent Bentone is sufficient to reduce the rate of settling. This small ratio would not adversely affect the film properties. It is also to be noticed that a smaller percentage of Bentone (0.25 per cent) does not decrease the settling rate; on the contrary, it increases it, and this is thought to be due to the small percentage of Bentone's aiding pigment flocculation, whilst having no appreciable effect on the viscosity of the

paint, so that the bodying effect is insufficient for proper pigment suspension.

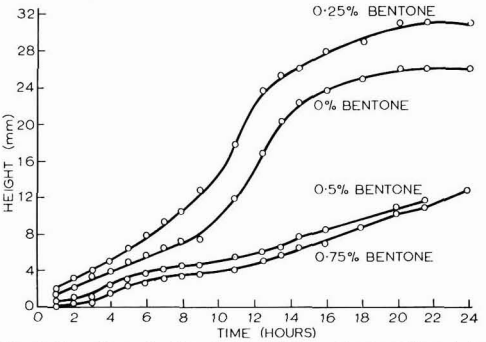

Fig. 1. The effect of gel-Bentone on the centrifugal settling of pigment (centrifugation speed 1380 r.p.m.)

Effect of storage on the rate of settling

Ref. 13

After storage of the paint for five months, the pigment was redispersed thoroughly and the rate of settling was then measured by the centrifuging technique under the same conditions as before. The results are shown in Fig. 2. From these results it can be seen that the settling rate increases after storage. This increase may be due to the occurrence of flocculation during the storage period (the flocculates occurring due to the attractive forces between the pigment particles when contact takes place during the settling period). Although the paint was redispersed thoroughly before the testing procedure and the flocculates formed during storage were broken up, re-flocculation occurred as soon as the external forces causing dispersion ceased; in other words, flocculation is a reversible process[13].

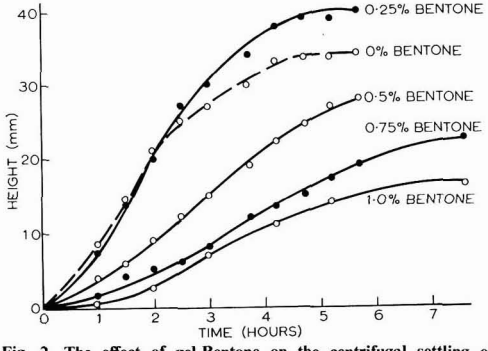

Fig. 2. The effect of gel-Bentone on the centrifugal settling of pigment after 5 months' storage (centrifugation speed 1380 r.p.m.)

Determination of rate of settling from the change in specific gravity of the medium at different levels

According to Archimedes' principle, if a body is wholly or partially immersed in a fluid, the resultant fluid pressure on that body's surface results in an upward force ("upthrust") equal to the weight of the fluid displaced by the body. This force is experienced as a loss in weight, which may be measured by means of a balance.

Paint samples were formulated as described earlier, using different ratios of Bentone (0.0, 0.25, 0.5, 0.75, 1.0 per cent, based on weight of pigment) in each formulation. The paint specifications were as follows: solids content 55 per cent; amino resin content 30 per cent (by weight, based on total resin); pigment-to-binder ratio 1:1.

Five wide-necked bottles of equal volume (25 ml) were filled to the same height with the paints having different percentages of Bentone. A small nickel metal ball (exterior diameter 0.95 cm) was hung by means of a thin thread attached to the beam of a balance and was weighed in air and in water. The water was put in a beaker which stood on a bridge over the pan of the balance. If the weight of the ball in air is W and its weight in water is W_1, then $(W - W_1)$ represents the loss in weight which is equal to the volume of the body (since the specific gravity of the water is very near unity).

This experiment was repeated using paint instead of water, to give the weight of paint having the same volume $(W - W_2)$, where W_2 is the weight of the ball when immersed in the paint. Thus:

$$\text{Specific gravity of the paint} = (W - W_2)/(W - W_1)\ \text{g cm}^{-3}$$

The weight of the ball in the paint (at the same depth in the five bottles) was determined at regular intervals of time for about six months. The results are summarised in Tables 1–5 and shown graphically in Fig. 3. The specific gravity indicated in Tables 1–5 represents the specific gravity of the paint in the region surrounding the ball, this region was approximately 2 cm down from the surface.

Table 1

Variation of specific gravity of paint with time in the absence of Bentone

Solids content: 55%
Pigment-to-binder ratio 1:1
Amino resin: 30% (on weight of total resin)
Weight of ball in air (W) = 3.6900g
Weight of ball in water (W_1) = 3.2350g
$\therefore$ Volume of ball $(W - W_1) = 0.4550\ \text{cm}^3$
W_2 = weight of ball in paint
Depth of ball: 2 cm from surface
Temperature: 25°C

Time (days)	W	W_2	$W - W_2$	Specific gravity
0	3.7025	3.0730	0.6295	1.3835
1	3.7025	3.0670	0.6355	1.3967
2	3.7025	3.0670	0.6355	1.3967
4	3.7022	3.0600	0.6422	1.4114
5	3.7015	3.0565	0.6450	1.4176
6	3.7023	3.0600	0.6423	1.4116
7	3.7000	3.0585	0.6415	1.4099
8	3.7000	3.0570	0.6430	1.4132
10	3.7005	3.0540	0.6465	1.4208
11	3.7005	3.0530	0.6475	1.4231
12	3.7010	3.0560	0.6450	1.4175
13	3.7010	3.0510	0.6500	1.4286
14	3.7001	3.0550	0.6451	1.4178
16	3.7000	3.0510	0.6490	1.4264
17	3.7000	3.0490	0.6510	1.4307
18	3.7000	3.0480	0.6520	1.4329
19	3.7000	3.0470	0.6530	1.4352
20	3.7000	3.0460	0.6440	1.4373
21	3.7000	3.0460	0.6540	1.4373
23	3.7000	3.0460	0.6540	1.4373
24	3.7000	3.0450	0.6550	1.4395
25	3.7012	3.0430	0.6582	1.4466
31	3.7000	3.0410	0.6590	1.4483
38	3.7000	3.0400	0.6600	1.4681
45	3.7020	3.0340	0.6680	1.4681
61	3.7030	3.0330	0.6700	1.4725
85	3.7012	3.0320	0.6692	1.4707
134	3.6900	3.1160	0.5740	1.23153
146	3.6900	3.1210	0.5690	1.2505
157	3.6900	3.1500	0.5400	1.1868
176	3.6900	3.1100	0.5800	1.274
190	3.6900	3.1500	0.5400	1.1868

Table 2

Variation of specific gravity of paint with time in the presence of 0.25% Bentone

Solids content: 55%
Pigment-to-binder ratio 1:1
Bentone: 0.25% (on weight of pigment)
Amino resin: 30% (on weight of resin)
Weight of ball in air (W) = 3.6800 g
Weight of ball in water (W_1) = 3.2350 g
$\therefore$ Volume of ball ($W - W_1$) = 0.4550 cm^3
W_2 = Weight of ball in paint
Depth of ball: 2 cm from surface
Temperature: 25°C.

Time (days)	W	W_2	$W - W_2$	Specific gravity
0	3.7000	3.0680	0.6320	1.389
1	3.7000	3.0650	0.6450	1.4176
2	3.7005	3.0630	0.6375	1.4011
3	3.7015	3.0640	0.6375	1.4011
4	3.7015	3.0610	0.6405	1.4077
5	3.7015	3.0620	0.6395	1.4055
6	3.7000	3.0600	0.6400	1.4066
7	3.7000	3.0590	0.6410	1.4088
9	3.7000	3.0570	0.6430	1.4132
10	3.7000	3.0540	0.6460	1.4197
11	3.7000	3.0520	0.6480	1.4241
12	3.7000	3.0510	0.6490	1.4264
13	3.7000	3.0480	0.6520	1.4300
14	3.7025	3.0460	0.6565	1.4428
16	3.7005	3.0360	0.6645	1.4604
22	3.7030	3.0280	0.6750	1.4835
29	3.7030	3.0110	0.6920	1.5208
45	3.7045	3.0050	0.6995	1.5373
69	3.7020	3.0120	0.6900	1.5165
118	3.6900	3.0040	0.6860	1.5077
130	3.6900	3.0010	0.6890	1.5143
141	3.6900	2.9200	0.7700	1.6923
160	3.6900	2.9200	0.7700	1.6923
174	3.6900	2.9200	0.7700	1.6923

Table 3

Variation of specific gravity of paint with time in the presence of 0.5% Bentone

Solids content: 55%
Pigment-to-binder ratio 1:1
Bentone: 0.5% (on weight of pigment)
Amino resin: 30% (on weight of resin)
Weight of ball in air (W) = 3.6900 g
Weight of ball in water (W_1) = 3.2350 g
$\therefore$ Volume of ball ($W - W_1$) = 0.4550 cm^3
W_2 = weight of ball in paint
Depth of ball: 2 cm from surface
Temperature: 25°C.

Time (days)	W	W_2	$W - W_2$	Specific gravity
0	3.7000	3.0735	0.6265	1.3769
1	3.7000	3.0250	0.6750	1.4835
2	3.7000	3.0010	0.6944	1.5382
3	3.7000	2.9800	0.7200	1.5824
4	3.7025	2.9900	0.7625	1.6758
17	3.7010	2.9015	0.7995	1.7571
22	3.7035	2.9000	0.8035	1.7659
29	3.7030	2.8200	0.8830	1.9406
45	3.7040	2.8100	0.8940	1.9645
69	3.7020	2.8250	0.8770	1.9274
118	3.6900	2.8170	0.8730	1.9187
140	3.6900	2.8130	0.8770	1.9279
151	3.6900	2.8150	0.8750	1.9231
170	3.6900	2.8040	0.8860	1.9472
184	3.6900	2.8170	0.8730	1.9186

Table 4

Variation of specific gravity of paint with time in the presence of 0.75% Bentone

Solids content: 55%
Pigment-to-binder ratio 1:1
Bentone: 0.75% (on weight of pigment)
Amino resin: 30% (on weight of resin)
Weight of ball in air (W) = 3.6900 g
Weight of ball in water (W_1) = 3.2350 g
$\therefore$ Volume of ball ($W - W_1$) = 0.4550 cm^3
W_2 = Weight of ball in paint
Depth of ball: 2 cm from surface
Temperature: 25°C.

Time (days)	W	W_2	$W - W_2$	Specific gravity
0	3.7015	3.0685	0.6330	1.3912
1	3.7005	3.0560	0.6445	1.4165
2	3.7010	3.0535	0.6475	1.4231
3	3.7000	3.0545	0.6455	1.4187
4	3.7000	3.0550	0.6450	1.4176
5	3.7000	3.0500	0.6500	1.4257
7	3.7020	3.0550	0.6470	1.4219
8	3.7020	3.0580	0.6440	1.4154
9	3.7105	3.0575	0.6440	1.4154
10	3.7105	3.0500	0.6515	1.4318
11	3.7000	3.0480	0.6520	1.4324
12	3.7000	3.0480	0.6520	1.4329
14	3.7000	3.0470	0.6530	1.4352
16	3.7000	3.0450	0.6650	1.4395
17	3.7000	3.0430	0.6570	1.4439
18	3.7020	3.0410	0.6610	1.4527
19	3.7000	3.0400	0.6600	1.4505
20	3.7020	3.0400	0.6620	1.4549
21	3.7000	3.0400	0.6600	1.4505
22	3.7020	3.0400	0.6620	1.4549
28	3.7012	3.0030	0.6682	1.4685
34	3.7030	3.0280	0.6750	1.4835
41	3.7030	3.0230	0.6800	1.4945
57	3.7045	3.0110	0.6935	1.5242
81	3.7020	2.9500	0.7520	1.6527
130	3.6900	2.8550	0.8350	1.8352
142	3.6900	2.8280	0.8620	1.8945
151	3.6900	2.8000	0.8900	1.9560
170	3.6900	2.7600	0.9300	2.0439
184	3.6900	2.7000	0.9900	2.1758

Table 5

Variation of specific gravity of paint with time in the presence of 1.0% Bentone

Solids content: 55%
Pigment-to-binder ratio 1:1
Bentone: 1% (on weight of pigment)
Amino resin: 30% (on weight of resin)
Weight of ball in air (W) = 3.6900 g
Weight of ball in water (W_1) = 3.2350 g
$\therefore$ Volume of ball ($W - W_1$) = 0.4550 cm^3
W_2 = Weight of ball in paint
Depth of ball: 2 cm from surface
Temperature: 25°C.

Time (days)	W	W_2	$W - W_2$	Specific gravity
1	3.7005	3.0810	0.6195	1.3615
2	3.7005	3.0615	0.6390	1.4044
3	3.7000	3.0465	0.6535	1.4362
4	3.7000	3.0425	0.6575	1.4450
6	3.7000	3.0390	0.6610	1.4527
7	3.7000	3.0389	0.6620	1.4549
8	3.7000	3.0370	0.6630	1.4571
9	3.7000	3.0360	0.6640	1.4593
10	3.7020	3.0360	0.6660	1.4637
16	3.7015	3.0350	0.6665	1.4648
22	3.7030	3.0350	0.6680	1.4681
29	3.7035	3.0470	0.6565	1.4429
45	3.7040	3.0410	0.6630	1.4571
69	3.7020	3.0220	0.6800	1.4945
105	3.6900	2.8370	0.8530	1.8747
117	3.6900	2.8140	0.8760	1.9252
128	3.6900	2.7000	0.9900	2.1758
147	3.6900	2.6040	1.0860	2.3868
161	3.6900	2.5000	1.1900	2.6154

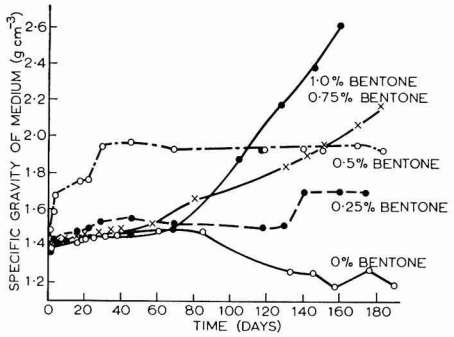

Fig. 3. Variation in specific gravity with time for various concentrations of gelling agent in the medium

From Tables 1–5 and Fig. 3, it can be seen that in absence of Bentone, the specific gravity of the paint increases very little, from 1.3835 to 1.47, during approximately three months and a clear varnish layer of 8.5 mm depth is formed. This slight increase in specific gravity may be due to the increase in concentration of pigment within this region of measurement. After 4.5 months, the specific gravity dropped to 1.26 and more than half the volume of the ball was in the upper clear varnish; after 5.5 months, the specific gravity reached 1.187 and approximately the whole volume of the ball was in the clear varnish layer. This value of specific gravity (1.187) is very close to the specific gravity of the varnish.

Using a small percentage of Bentone (0.25 per cent), the rate of settling is not very different from zero percentage Bentone. After three months, the depth of the varnish layer was 9.5 mm.

In the case of 0.5 per cent Bentone, the specific gravity increases quickly from 1.37 to 1.6758 in a few days, from 1.67 to 1.94 in 25 days and then becomes steady. The depth of the upper clear varnish layer was 6 mm after three months.

Using 0.75 per cent Bentone, the specific gravity increases slowly during the first two months, from 1.39 to 1.53, from 1.53 to 1.78 in the next two months and from 1.78 to 2.17 in the last two months. The depth of the clear varnish was 4.5 mm after three months.

In the case of 1.0 per cent Bentone, the specific gravity increased from 1.36 to 1.47 during the first two months (which is very similar to the previous case), but then increased rapidly from 1.47 to 2.6 during the next four months. The upper clear layer was 3 mm deep after three months. The distribution of pigment after three months is represented diagramatically in Fig. 4.

From these results, it can be concluded that 0.5 per cent Bentone is sufficient to give good dispersion of pigment during the storage period.

Conclusion

In order to study the effect of addition of Bentone gelling agent on the rate of settling by the accelerated process (centrifugal force), paint was formulated with a higher solids content than usual to produce an appreciable rate of settling within a comparatively short time. It is found that 0.5 per cent Bentone is sufficient to reduce effectively the rate of settling; this small ratio would not unduly affect film properties. A smaller amount (0.25 per cent) is insufficient for proper pigment suspension.

After storage of the paint for five months, if the pigment is redispersed thoroughly and the rate of settling is then measured, the settling rate is greatly increased. This may be explained by the occurrence of flocculation during the storage period.

The second procedure was based on a slow process, which depended on measuring the variation of specific gravity of paint at a selected depth: this parameter is a function of the solids content at that depth. When this method was applied to media of high solids content (70 per cent), the results in Table 6 were obtained.

Table 6

Specific gravity measurements by the suspended ball method for media of high solids content

Time (days)	Specific gravity at different Bentone concentrations				
	No Bentone	0.25% Bentone	0.5% Bentone	0.75% Bentone	1.0% Bentone
0	1.74	1.74	1.96	2.22	2.84
10	1.97	2.2	3.1	3.71	6.25
30	2.59	2.6	4.9	5.4	

From Table 6 it can be seen that the values of specific gravity are unrealistic, particularly at a Bentone content above 0.25 per cent. This may be due to the influence of secondary forces leading to a thixotropic gel structure, enhanced by the

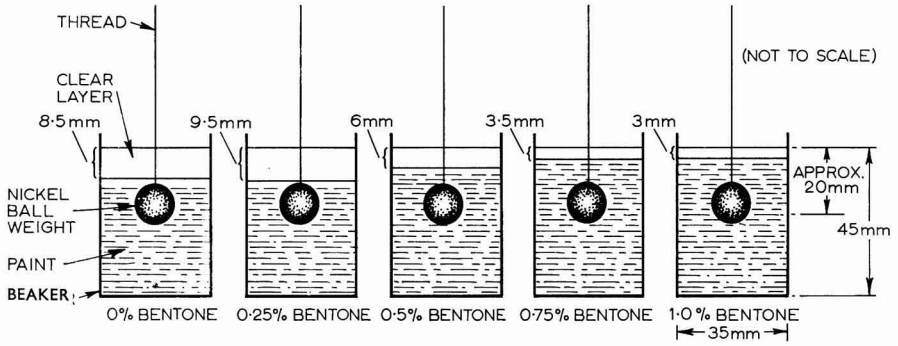

Fig. 4. The distribution of pigment after three months in the presence of various amounts of Bentone

high solids content in the presence of the higher percentage of Bentone. There are, therefore, limitations in using the suspended ball method for the determination of the rate settling of pigment in water-soluble resin media.

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The influence of plasticiser content on the mechanical properties and durability of chlorinated rubber paint films*

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Summary

The paper studies the effect of binder composition on the mechanical properties of unsupported films of chlorinated rubber and relates these to checking, a defect frequently encountered in climates which have a high level of solar radiation and large diurnal temperature changes.

The work has shown that, in general, binders with high tensile strength give improved resistance to checking. The best results were obtained with chlorinated rubber/ethylene vinyl acetate at a ratio of 70/30. Good results were also obtained with chlorinated rubber/acrylic blends at ratios of 3/1 to 6/1 and with chlorinated rubber/chlorparaffin 70/chlorparaffin 42 at a ratio of 55/35/10, all on a weight basis. Chemical resistance is largely unaffected by the modifications.

Keywords

Raw materials:

binders (resins, etc.)
chlorinated rubber

plasticisers
plasticiser

Processes and methods primarily associated with manufacturing or synthesis
plasticisation

Properties, characteristics and conditions primarily associated with:

raw materials for coatings and allied products
binder ratio

dried or cured films
checking
durability
mechanical property

L'influence qu'exerce la teneur en plastifiant sur les caractéristiques mécaniques et sur lar durabllité des films de peintures à caoutchouc chloré

Résumé

Dans cet exposé les auteurs décrivent une étude de l'influence exercée par la composition du liant sur les caractéristiques mécaniques des films sans support de peintures à caoutchouc chloré et ils les mettent en rapport avec le faiençage, défectuosité qui arrive très souvent dans les climats qui comprennent un niveau élevé de radiation solaire et les importantes variations diurnes de température.

L'étude a démontré qu'en général, les liants de haute résistance à la traction donnent une meilleure résistance à faiençage. Les résultats les meilleurs ont été obtenus avec un mélange de caoutchouc chloré et d'éthylene vinyle acétate dont le rapport est de 70/30. De bons résultats ont été obtenus également dans le cas des mélanges de caoutchouc chloré et des résines acryliques ou le rapport se varie entre 3/1 et 6/1, et dans le cas d'un mélange de caoutchouc chloré, de chloroparaffine 70 et de chloroparaffine 42 dont le rapport est de 55/35/10. Tous les rapports cités sont pondéraux. La résistance aux agents chimiques se montre largement indépendante de ces modifications.

Der Einfloss des Weichmachergehaltes auf mechanische Eigenschaften und Dauerhaftigkeit von Chlorkautschuklackfilmen

Zusammenfassung:

In dieser Abhandlung wird die Auswirkung der Bindemittelzusammensetzung auf die mechanischen Eigenschaften freier Filme von Chlorkautschuk hinsichtlich Haarrissbildung untersucht, einem in Klimata mit starker Sonnenbestrahlung und während des Tages grossem Temperaturwechsel häufig beobachteter Schaden.

Die Arbeiten haben gezeigt, dass im allgemeinen Bindemittel mit hoher Zugfestigkeit der Haarrissbildung besser widerstehen. Die besten Ergebnisse wurden mit Chlorkautschuk/Äthylenvinylazetat im Verhältnis 70/30 erhalten. Ebenso wurden gute Resultate mit Chlorkautschuk/Akrylverschnitten im Verhältnis 3/1 bis 6/1 und mit Chlorkautschuk/Chlorparaffin 70/Chlorparaffin 42 im Verhältnis 55/35/10, alles gewichtsmässig, erhalten. Durch die Modifizierungen wird die Beständigkeit gegen Chemikalien kaum beeinflusst.

Introduction

Controlled chlorination of natural or synthetic rubber to a 65 per cent Cl content transforms the rubber from its tough elastic state into an inert resin with good film forming properties. The films, however, are brittle and to satisfy the mechanical properties required of a paint, external plasticisation is necessary.

For paints with high chemical resistance, inert plasticisers, such as the chlorinated paraffins, are the usual choice. There are, of course, many other types of product which are compatible with chlorinated rubber and could function as plasticisers or co-resins. These include ester plasticisers, many alkyds, some hydrocarbon resins, polymeric plasticisers, vinyl resins, and acrylic based resins.

In this paper, it is proposed to discuss briefly the effect which some of these plasticisers have on the mechanical properties and exterior durability of chlorinated rubber paints. In order to obtain durability data under more demanding conditions than normally exist in the United Kingdom,

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much of ICI Mond Division's testing is now duplicated at overseas test sites, such as Johannesburg, South Africa, which enjoy a high level of solar radiation and large diurnal variations in temperature. Under these conditions, physical defects such as yellowing and checking are, generally, more pronounced.

The British Standard 2015: 1965 "Glossary of Paint Terms" defines checking as "fine cracks which do not penetrate the top coat and are distributed over the surface giving the semblance of small pattern". Yellowing is defined as "the development of a yellow colour on ageing: most noticeable in the dried films of white paints or clear varnishes". These definitions infer, and ICI Mond Division's experience confirms that although aesthetically unattractive, neither of these defects has any significant effect on the long term durability of chlorinated rubber paints. "Crazing" or "crocodiling", which are extreme forms of checking, may give rise to premature failure.

It is known that under adverse atmospheric conditions, such as those encountered in South Africa and South America, chlorinated rubber finish paints may check or yellow: the same paints exposed under UK conditions are less likely to exhibit these effects. Most of the paint formulations published by ICI Mond Division are intended for use under the climatic conditions normally encountered in Western Europe and modifications are frequently required where the paints are to be used under conditions of high ambient temperature.

In formulating paints, ICI Mond Division combines conventional paint testing with physical measurements of the mechanical properties of unpigmented films. These measurements give some indications of the likely performance of the paint, in particular, its resistance to checking and embrittlement. Normally, the tests are carried out using an "Instron" tensile testing machine.

The Instron is a sophisticated instrument used to produce stress/strain curves for a variety of materials. When the material is stretched on the Instron, the force is recorded on the ordinate, the elongation on the abscissa. The force is divided by the cross-sectional area of the specimen to obtain stress, and elongation, by gauge length (the length of sample which is stretched) to obtain strain. From these stress-strain curves it is possible to gain information about the mechanical properties of a particular material, for example tensile strength, elongation, yield stress, and toughness (see Fig. 1). These mechanical properties, in turn, may be related to empirical paint testing or information concerning plasticisation. Typical stress/strain curves for plasticised "Alloprene" (ICI Mond Division) chlorinated rubber films are shown in Fig. 2.

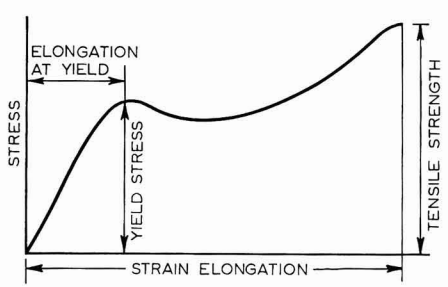


Fig. 1. A typical stress/strain curve

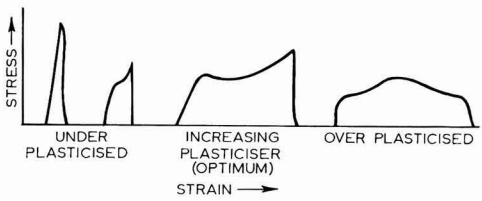


Fig. 2. Typical stress/strain curves for chlorinated rubber/plasticiser blends showing the effect of increasing the plasticiser content

Experimental

The unsupported films are prepared by casting a 50 per cent solution of the binder, generally in toluene, on to glass panels precoated with a polyvinyl alcohol parting agent. Two coats are usually applied using a 350μm applicator with a 24 hour interval between coats.

After six days' ageing at 23°C and 60 per cent relative humidity, the films are cut into the required dumb-bell shape. The parting agent is removed one day later and the test pieces pulled at an initial strain rate of 100 per cent per minute.

The results obtained are typical of polymer/plasticiser systems in that the tensile strength moves to a maximum then decreases. Toughness, an arbitrary measurement combining the effects of tensile strength and elongation, can be used to optimise the binder composition.

For chlorinated paraffins and ester plasticisers in two-component binders, the optimum toughness occurs at approximately 70 parts chlorinated rubber with 30 parts of plasticiser (see Table 1 and Fig. 3).

Table 1

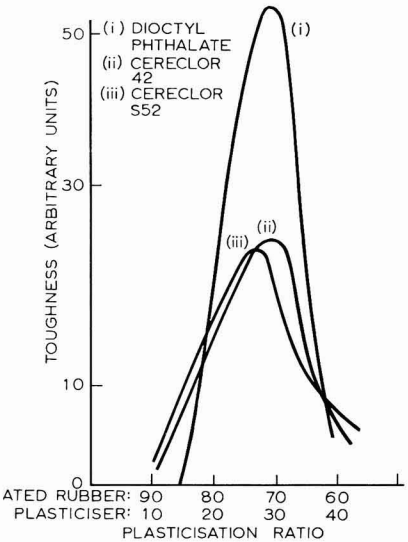
Effect of plasticiser on mechanical properties of chlorinated rubber/chlorinated paraffin binary systems

Plasticiser				
Alloprene R20*	Cereclor 42*	Tensile strength (kg cm^{-2})	Elongation (%)	Toughness (Arbitrary units)
90	10	80	4	<1
80	20	65	60	21
70	30	25	190	25
65	35	11	280	14
60	40	<1	550	6

*Alloprene and Cereclor are registered trade names of ICI Ltd.

When a pigment composed of spherically shaped particles is used, however, it is generally accepted that some additional plasticiser will be required and a ratio of chlorinated rubber to plasticiser of 65/35 is normally adopted. Extensive durability tests have confirmed that this binder composition is suitable for all but the most extreme climatic conditions. When laminar shaped pigments are used, for example micaceous iron oxide, the pigment particles themselves impart a degree of flexibility and a ratio of 70/30 is often preferred. Overplasticisation can lead to checking and excessive dirt pick-up.

A similar pattern emerges with ternary binders, although in this case the inclusion of the third resin offers greater freedom of binder composition (see Table 2).



. 3. Optimum plasticisation of chlorinated rubber

ment of toluene by a higher boiling solvent blend, ene and 2-ethoxy-ethyl acetate, results in an increase on but has little effect on tensile strength.

f weathering properties

Division is currently engaged in a project designed se formulations recommended for use in the ıvironments referred to earlier. A series of low- ı paints (15 per cent PVC) were exposed as 2 × films on clean abraded steel pre-primed with a ing (25 μm dry film thickness) of an epoxy zinc he main parameters studied were pigmentation /hite) and binder composition. Standard binary and ternary binders were compared with Alloprene/acrylic blends, with blends of Alloprene/"Evatane 40-50" (an ethylene vinyl acetate co-polymer) and with blends of Alloprene/Cereclor 70/Cereclor 42 selected from the Instron work.

A series of high-build paints was also exposed. Again, the main parameter investigated was binder composition, although two pigmentations were included—micaceous iron oxide (MIO) at 30 per cent PVC, and secondly a black pigmentation, 30 per cent total PVC, comprising 1 per cent (by volume) Degussa Special Black 4 and 29 per cent (volume) Barytes RS. These paints were exposed as two coats (each of 100 μm dry film thickness) brush applied on to abraded steel panels preprimed with one coat of a 25 μm thick zinc rich epoxy primer.

Instron measurements (see Tables 2 and 3) confirm that the mechanical properties of a conventional chlorinated rubber finish paint (low or high build) can be improved either by increasing the Alloprene-to-plasticiser ratio or by replacing the chlorinated paraffin plasticiser by an ethylene/vinyl acetate co-polymer. These modifications produce tougher films, generally with higher tensile strengths and low elongation at break.

Similar results, not reported in this paper, confirm that toughness can also be increased by replacing the Cereclor 70 by acrylic resins, such as Neocryl B725 or Paraloid F10.

Results of natural weathering trials both in the United Kingdom and South Africa (Tables 4 and 5) confirm that checking in chlorinated rubber paints can be greatly reduced by careful formulation. For high-build paints, best results were obtained with systems containing Evatane 40-50 as plasticiser. Resistance to checking was noticeably better at the higher chlorinated rubber-to-plasticiser ratio, but flaking failures noted in the MIO series exposed in the UK indicate that the optimum ratio may be nearer to 65:35. Of the chlorinated rubber/chlorinated paraffin blends, best results were achieved with Cereclor S52 at an Alloprene-to-plasticiser ratio of 70:30, whilst the tougher 55/35/10 blend of Alloprene/Cereclor 70/Cereclor 42 exhibited better resistance to checking than either the standard 50/33/17 or the 40/35/25 blends.

Table 2

Effect of plasticiser on the mechanical properties of standard ternary binders

Alloprene R10	Cereclor 70	Cereclor 42	Tensile strength (kg cm^{-2})	Elongation (%)	Toughness (Arbitrary units)
60	35	5		Too Brittle	
60	20	20	40	80	17
55	35	10	18	74	7.5
50	35	15	10	230	11
40	35	25	3	580	7

Table 3

Mechanical properties of modified chlorinated rubber binders

Binder system	Composition (% w/w)	Tensile strength (kg cm^{-2})	Elongation (%)	Toughness (Arbitrary units)
Alloprene R10/Cereclor 70/ Cereclor 42	50/33/17	4	425	10
Alloprene R10/Evatane 40-50	70/30	85	180	85
	60/40	87	260	80
Alloprene R10/Evatane 40-50/ Cereclor S52	70/23.3/6.7	39	335	50

Inclusion of Alloprene R125 also resulted in a noticeable improvement in the performance of the standard ternary binder.

Replacement of Cereclor 70 by acrylic resins is another way of reducing the tendency to checking. Of those resins examined, excellent results were obtained with Neocryl B725, a thermoplastic acrylic, and Paraloid F10, a butyl methacrylate copolymer. After two years' exposure, none of the gloss paints was showing any serious failures.

An interesting feature of this programme is the apparent correlation between laboratory measurements of mechanical properties of unpigmented films and the resistance to checking of applied paint films containing the ethylene vinyl acetate plasticiser, Evatane 40-50. Further work is planned to confirm this relationship in the chlorinated rubber/acrylic blends.

Effect on accelerated weathering and chemical resistance

The chemical resistance, accelerated weathering and resistance to salt water immersion of these modified chlorinated rubber finish paints has also been investigated.

Paint films applied directly on to steel panels were placed in continuous contact with a range of 20 per cent aqueous reagents for a period of five days.

Paints containing the acrylics, Paraloid F10 and Neocryl B725, together with those plasticised with Evatane 40-50, were all resistant to hydrochloric acid, sulfuric acid and caustic soda at the concentration used. In addition, the paint containing Neocryl B725 was also resistant to 20 per cent nitric acid.

Table 4

Natural weathering of chlorinated rubber high-build finishes—assessment of checking after two years' exposure

Binder system	Composition (% w/w)	United Kingdom		South Africa	
		MIO	Black	MIO	Black
Alloprene R10/Cereclor 42	70/30	—	7	—	9
Alloprene R10/Cereclor S52	70/30	7	7	10	8
Alloprene R10/Cereclor 70/Cereclor 42	55/35/10	9	4	10	5
	50/33/17	7	3	7	3
	40/35/25	—	2	—	1
Alloprene R10/Alloprene R125 Cereclor 70/Cereclor 42	38/12/33/17	8	5	10	3
Alloprene R10/Evatane 40–50	60/40	6	7	9	8
	70/30	10	8	10	10
Alloprene R10/Evatane 40–50/Cereclor S52	70/23.3/6.7	7	—	9	—
	70/17.5/12.5	7	—	9	—
	70/12.5/12.5	6	—	10	—
Alloprene R10/Neocryl B725/ Cereclor S52	57/19/24	7	8	10	9
	60/15/25	6	7	10	7
	66/11/23	7	8	10	9
Alloprene R10/Paraloid F10/Cereclor S52	60/20/20	7	—	10	—
	68/17/15	8	—	10	—
	66/11/23	4	—	7	—
	73/12/15	7	—	10	—

Table 5

Natural weathering of chlorinated rubber gloss finishes—assessment of checking after two years' exposure

Binder system	Composition (% w/w)	United Kingdom		South Africa	
		White	Black	White	Black
Alloprene R10/Cereclor 42	70/30	8	10	10	6
Alloprene R10/Cereclor S52	70/30	10	7	10	6
Alloprene R10/Cereclor 70/Cereclor 42	55/35/10	9	9	9	6
	50/33/17	8	10	8	7
Alloprene R10/Alloprene R125/Cereclor 70/ Cereclor 42	38/12/33/17	8	—	10	—
Alloprene R10/Evatane 40–50	60/40	10	10	10	9
	65/35	10	—	10	—
	70/30	10	—	10	—
Alloprene R10/Evatane 40–50/Cereclor S52	70/23.3/6.7	10	8	10	8
	70/17.5/12.5	10	—	10	—
	75/12.5/12.5	10	—	10	—
Alloprene R10/Neocryl B725/Cereclor S52	57/19/24	10	—	10	—
	60/15/25	10	9	10	8
	66/11/23	10	—	10	—
Alloprene R10/Paraloid F10/Cereclor S52	60/20/20	10	10	10	9
	73/12/15	10	—	10	—

Accelerated testing to BS 3900 Parts F2, 3 and 4 was also carried out. After 1000 hours' exposure to salt spray, paints based on the Alloprene/Evatane binders showed slight blistering from a scribed cross-cut on the test panel, but all others were perfect. None of the low-build finish paints exhibited any failures after 1000 hours' accelerated weathering of 1000 hours' immersion in salt water. Some of the black high-build paints, however, showed a degree of blistering from the cross-cut after 1000 hours' salt spray. Full results are given in Tables 6 and 7.

Conclusion

The work has confirmed that improved film integrity can be achieved, whilst still maintaining adequate chemical resistance, by modifying standard chlorinated rubber paints by the inclusion of acrylic resins or ethylene/vinyl acetate co-polymers. There are indications, however, that the performance of these paints under water, particularly at higher PVCs, is not entirely satisfactory.

[*Received 8 September 1976*

Table 6

Modified chlorinated rubber finish paints—accelerated weathering, chemical resistance

Binder system	Composition (% w/w)	Accelerated weathering* (BS 3900)	Salt water soak	Salt spray	Chemical resistance† (7 days contact)			
					20% HCl	20% H_2SO_4	20% HNO_3	20% NaOH
Alloprene R10/Cereclor 42	70/30	10	10	10	R	R	R	R
Alloprene R10/Cereclor 70/Cereclor 42	50/33/17	10	10	10	R	R	R	R
Alloprene R10/CMW Q269/Cereclor S52	58.3/19.4/22.2	10	10	10	LR	LR	R	R
Alloprene R10/Paraloid F10/Cereclor S52	62.2/15.6/22.2	10	10	10	NT	NT	NT	NT
	60/20/20	10	10	10	R	R	NR	R
	72.8/12.2/2/15	10	10	10	R	R	NR	R
Alloprene R10/Neocryl B725/Cereclor S52	56.3/18.7/25	10	10	10	R	R	R	R
Alloprene R10/Evatane 40–50	60/40	10	10	8D 0.5 inch from X	R	R	NR	R
	70/30	10	10	6M 0.5 inch from X	R	R	NR	R
Alloprene R10/Evatane 40–50/Cereclor S52	70/17.5/12.5	10	10	10	R	R	NR	R

*All tests were carried out to BS 3900, Parts F2, 3, 4. Unless otherwise stated, all ratings refer to blistering and are assessed by ASTM Method D-714-56. Checking was assessed on a 0–10 scale where 10 = no failure.

†R = Resistant. LR = Limited resistance: film stained, but substrate undamaged. NR = Not resistant. NT = Not tested.

Table 7

Modified chlorinated rubber high-build paints—accelerated weathering, chemical resistance

Binder System	Composition (% w/w)	Micaceous iron oxide (30% PVC)			Carbon black/Barytes (30% (total) PVC)			Titanium dioxide/Barytes (30% PVC)			
		Accelerated weathering* (BS 3900)	Salt water soak	Salt spray	Accelerated weathering*	Salt water soak	Salt spray	Chemical resistance† (7 days contact)			
								20% HCl	20% H_2SO_4	20% HNO_3	20% NaOH
Alloprene R10/Cereclor 42	70/30	10	10	10	8F	10	10	R	R	NR	R
Alloprene R10/Cereclor 70/Cereclor 42	50/33/17	*Checking* 4	10	10	NT	NT	NT	R	R	NR	R
Alloprene R10/CMW Q 269/Cereclor S 52	58.3/19.4/22.2	10	10	10	10	8MD on 10%	6F, 0·25 inch from X	R	R	NR	R
Alloprene R10/Paraloid F10/Cereclor S 52	62.2/15.6/22.2	NT	NT	NT	10	10	6D, 0·25 inch from X	NT	NT	NT	NT
	60/20/20	10	10	8F	NT	NT	NT	NT	NT	NT	NT
	72.8/12.2/15	10	10	10	NT	NT	NT	NR	R	NR	R
Alloprene R10/Neocryl B725/Cereclor S 52	56.3/18.7/25	*Checking* 8	10	10	10	10	8MD, 0·5 inch from X	NT	NT	NT	NT
Alloprene R10/Evatane 40–50	60/40	10	10	10	10	6M, 0·25 inch from X	8D, 0·5 inch from X	NT	NT	NT	NT
	70/30	10	10	10	10	6M, 0·25 inch from X	8D, 0·5 inch from X	R	R	NR	R
Alloprene R10/Evatane 40–50/Cereclor S52	70/17.5/12.5	10	10	10	NT	NT	NT	NT	NT	NT	NT

*See footnote 1 to Table 6. †See footnote 2 to Table 6.

Appendix

Chlorinated rubber finish paints

Ingredient	High-build micaceous iron oxide (11G379*) (% w/w)	High-build black (11G528*) (% w/w)	Finish coat white gloss (15D476*) (% w/w)
Alloprene R10 (ICI Ltd)	21.2	14.8	14.2
Cereclor 42 (ICI Ltd)	9.1	—	—
Evatane 40-50 (ICI Ltd)	—	6.7	7.6
Thixatrol GST (Kronos Titan GmbH)	1.0	1.8	—
Bentone 34 (10% gel) (NL Industries Inc)	—	—	2.3
Tioxide RCR 2 (BTP Tioxide Ltd)	—	—	11.4
Micaceous iron oxide	35.2	—	—
Special Black 4 (Degussa)	—	0.4	—
Barytes	—	29.7	—
Soya lecithin	—	0.3	—
Xylene	16.8	23.1	—
Solvesso 100 (Esso)	16.8	23.2	64.5

*ICI Mond Division reference number.

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Estimation of the solubility parameters of low molecular weight compounds by a chemical group contribution technique

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Summary

The principle of additivity which applies to the molar attraction constants of any chemical groups present in a molecule has been used in the determination of solubility parameters for several esters, ethers and other compounds. Solubility parameters calculated using this group contribution technique have been reported by a number of workers and the values compare favourably. For isomers of organic compounds, the solubility parameter varies in the order *normal*> *iso* >*tertiary* due to an increased packing around the central carbon atom. The presence of bulky substituted groups in a molecule increases that compound's value of solubility parameter. In the case of an aromatic ether, its solubility parameter will increase in the order *meta*- <*ortho*- <*para*- because of an increasing specific gravity.

Keywords

Properties, characteristics and conditions primarily associated with materials in general

solubility parameter

Miscellaneous terms

internal cohesive energy

Le dosage des paramètres de solubilité de composés à faible poids moléculaire, au moyen d'une technique qui tient compte de la contribution individuelle de chaque groupement chimique

Résumé

Le principe d'additivité qui s'applique aux constants d'attraction molaire des groupements chimiques qui figurent dans la molécule a été utilisé au cours du dosage des paramètres de solubilité de divers esters, éthers et d'autres composés. Des paramètres de solubilité calculés au moyen de cette technique ont été mentionnés par plusieurs auteurs et les valeurs sont très comparables l'une à l'autre. Dans le cas des composés organiques, le paramètre de solubilité des isomèrs se dispose dans l'ordre suivant: *normal*> *iso*> *tertiaire* du à une augmentation progressive de l'entassement autour de l'atome central de carbone. La présence des substituants volumineux dans la molécule augmente la valeur du paramètre de solubilité de ce composé. Dans le cas d'un éther aromatique, le paramètre s'augmente selon la série *meta*< *ortho*< *para* à cause de l'augmentation progressive de densité.

Bewertung des Löslichkeitsparameters von Verbindungen niedrigen Molekulargewichts mittels einer chemischen Gruppenkontributionstechnik

Zusammenfassung:

In einer Bestimmung der Löslichkeitsparameter von verschiedenen Estern, Äthern und anderen Verbindungen wurde das Prinzip der Anlagerung benutzt, welches auf die molare Anziehungskonstaten irgendwelcher in einem Molekül vorhandenen chemischen Gruppen anwendbar ist. Unter Benutzung dieser Gruppenkontributionstechnik berechnete Löslichkeitsparameter wurden von einer Anzahl von Arbeitern berichtet, und diese Werte sind gut vergleichbar. Als Folge stärkerer Packung um das zentrale Kohlenstoffatom variiert der Löslichkeitsparameter für die Isomeren organischer Verbindungen in der Reihenfolge *normal* > *iso* > *tertiär*. Die Anwesenheit substituierter Gruppen von grossem Umfange in einem Molekül erhöht den Wert des Löslichkeitsparameters für diese Verbindung. Wegen ansteigenden spezifischen Gewichts vergrössert sich der Löslichkeitsparameter bei einem aromatischen Äther in der Reihenfolge *meta*—<*ortho*—<*para*—

Introduction

Refs. 1-25

The solubility parameter is one of the fundamental properties of a material. An earlier comprehensive article[1] on the solubility parameters of film formers focused the attention of many research workers on the application of this property in the field of organic surface coatings[2-14].

Small[15] introduced the concept of group contributions based on Scatchard's findings[16] for the calculation of solubility parameter. He showed that a parallel linear relationship can be established among several homologous series by expressing the square root of the product of the cohesive energy E and molar volume V as a function of chain length. Thus the quantity $(EV)^{0.5}$, or the total molar attraction F is constant and equal to the sum of the contributions due to each group. Therefore, the solubility parameter δ can be estimated by the following relationship:

$$\delta = \frac{F}{V} = \frac{(EV)^{0.5}}{V} = \left(\frac{E}{V}\right)^{0.5} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

where δ is expressed in $(\text{cal/cc})^{0.5}$, E is the molar internal energy (cal/mole), V is in (cc) and F in $(\text{cal cc})^{0.5}$.

The values of E, V and F for a given substance are found to be the sum of individual contributions of chemical groups present in the molecule:

$$E = \Sigma E_i \quad \ldots\ldots\ldots\ldots\ldots (2)$$

$$V = \Sigma V_i \quad \ldots\ldots\ldots\ldots\ldots (3)$$

$$F = \Sigma F_i \quad \ldots\ldots\ldots\ldots\ldots (4)$$

where the suffix i denotes the corresponding values of each individual group. The values of group contributions, E_i, V_i and F_i, are constants and are mostly available in the literature[11,15,17–25].

In a homologous series (paraffins and olefins), the values of E and V increase with increasing number of additional groups, whereas in the case of substituted alkanes, it is found that the value of E is the net total of attractive and repulsive energies exerted by various groups in the molecule. The term V which represents the actual volume occupied by one molecule at a specified temperature is a function of size, steric configuration, degrees of freedom and the intermolecular forces. However, for the sake of convenience most workers have simply used the molar volume in calculations.

Since very little work has been published since Small[15] put forward the group contribution concept, it was felt worthwhile to use the technique based on the summation of contributions due to groups, individual atoms and bonds reported by various workers for the calculation of solubility parameters of a number of esters, ethers and various other compounds and discuss the results.

Experimental

Materials

Two series of compounds, that is esters and ethers, along with a few others (none being strongly hydrogen bonded) were selected for the determination of solubility parameter by the principles of additivity. Physical constants, such as molecular weight, density and structural formula, were obtained by referring to handbooks of chemistry and physics.

Procedure

Refs. 15, 11, 24, 23

The reported values of F_i and E_i for the individual groups were used for the calculation of total molar attraction constant F and cohesive energy E. The molar volume V was obtained by dividing the molecular weight of the compound by its density. The following three examples illustrate the procedure for the estimation of F, E and δ.

Example 1: n-Propyl acetate

The group contributions to the molar attraction constant F, reported by Small[15], Hoy[11], Hoftyzer and Krevelen[24], and the cohesive energy are given below.

Groups	F			Cohesive energy (E)
	Small's value	Hoy's value	Hoftyzer & Krevelen's value	
$2(CH_3—)$	2×214.0	2×148.3	2×205.5	2×2300.0
$2(—CH_2—)$	2×133.0	2×131.5	2×137.0	2×1000.0
$(—COO—)$	1×310.0	1×326.6	1×250.0	1×3200.0
Total	1004.0	886.2	935.0	9800.0

The gramme molecular weight of the compound is 102.13g and density is 0.8874g/cc at 20°C; therefore, the molar volume is 115.14cc. Hence the solubility parameter of the compound is: 8.719 (Small); 7.696 (Hoy); 8.120 (Hoftyzer & Krevelen); 9.225 (Cohesive energy).

The value of δ for n-propyl acetate can also be determined[23] by adding up the individual contributions F_i due to atoms and bonds:

Atoms		Krevelen's value of F_i
5(C)		5×0.0
10(H)		10×68.5
2(O)		2×125.0
	$F=\Sigma F_i=$	935.0
	$\delta=(F/V)=$	$935.0/115.14=8.120$

Example 2: Ethyl iso-butyl ether

Groups	F			Cohesive energy (E)
	Small's value	Hoy's value	Hoftyzer & Krevelen's value	
$3(CH_3—)$	3×214.0	3×148.3	3×205.5	3×2300.0
$2(—CH_2—)$	2×133.0	2×131.5	2×137.0	2×1000.0
$(—CH—)$	1×28.0	1×86.0	1×68.5	1×100.0
$(—O—)$	1×70.0	1×115.0	1×125.0	1×1500.0
Total:	1006.0	908.9	1084.0	9500.0

The gramme molecular weight of ethyl iso-butyl ether is 102.17 and its density is 0.75g/cc at 20°C; hence, the molar volume is 136.045cc. Therefore, δ equals 7.394 (Small), 6.680 (Hoy); 7.967 (Hoftyzer & Krevelen); 8.356 (Cohesive energy).

In terms of contributions F_i due to atoms and bonds, δ for ethyl iso-butyl ether is:

Atoms		Krevelen's value of F_i
6(C)		6×0.0
14(H)		14×68.5
(O)		1×125.0
	$F=\Sigma F_i=$	1084.0
	$\delta=F/V=$	$1084.0/136.045=7.967$

Example 3: n-Amyl chloride

Groups	F			Cohesive energy (E)
	Small's value	Hoy's value	Hoftyzer & Krevelen's value	
$(CH_3—)$	1×214.0	1×148.3	1×205.5	1×2300.0
$4(—CH_2—)$	4×133.0	4×131.5	4×137.0	4×1000.0
$(Cl—)$	1×270.0	1×205.1	1×230.0	1×3100.0
Total	1016.0	879.4	983.5	9400.0

The compound's molar volume is $106.60/0.883=120.724$cc at 20°C Therefore, δ equals 8.415 (Small); 7.284 (Hoy); 8.146 (Hoftyzer & Krevelen); 8.824 (Cohesive energy).

The value of δ for n-amyl chloride due to the contributions of the atoms and bonds is:

Atoms		Krevelen's value of F_i
5(C)		5×0
11(H)		11×68.5
(Cl)		1×230.0
	$F = \Sigma F_i =$	983.5
	$\delta = F/V =$	$983.5/120.724 = 8.146$

Results

Solubility parameters determined by the group contributions suggested by (i) Small (ii) Hoftyzer and Krevelen (iii) Hoy, and by (iv) cohesive energy and (v) atom and bond contribution methods are listed under the symbols δ_S, δ_{HK}, δ_H, δ_{COH} and δ_K in turn (Tables 1–4). The reported values of solubility parameter for some compounds are listed in column 6 of Table 4 for the sake of comparison.

Table 1

Solubility parameter of esters $(cal/cc)^{0.5}$

Compound	δ (S)	δ (H, K)	δ (H)	δ (Coh)	δ (K)
	1	2	3	4	5
1. Ethyl acetate	8.907	8.161	7.718	9.486	8.161
2. n-Hexyl acetate	8.658	8.306	7.903	8.887	8.306
3. n-Heptyl acetate	8.483	8.191	7.799	8.730	8.191
4. iso-Amyl acetate	8.317	8.070	7.479	9.024	8.070
5. iso-Butyl acetate	8.343	8.038	7.415	9.164	8.038
6. iso-Propyl acetate	8.415	8.028	7.359	9.358	8.028
7. Methylene diacetate	10.155	9.011	9.329	10.158	9.011
8. Methyl acetate	9.235	8.271	7.798	9.879	8.271
9. n-Propyl acetate	8.719	8.120	7.696	9.225	8.120
10. Benzoyl acetic ester (ethyl)	10.507	10.542	9.832	10.590	10.542
11. Benzoyl acetic ester (methyl)	10.833	10.846	10.092	10.850	10.846
12. Ethyl bromoacetate	10.243	9.314	9.027	10.076	9.314
13. Butyl 2-chloroacetate	9.711	9.033	8.832	9.606	9.033
14. Ethyl chloroacetate	10.091	9.055	8.918	10.012	9.055
15. Methyl chloroacetate	10.480	9.298	9.178	10.417	9.298
16. Methyl cyanoacetate	12.093	12.155	10.891	12.277	12.155
17. Ethyl cyanoacetate	10.290	10.723	9.839	11.221	10.723
18. Ethyl dibromoacetate	10.562	9.758	9.349	10.408	9.758
19. Ethyl dichloroacetate	10.002	9.153	9.003	10.223	9.153
20. Ethyl thioacetate	9.911	8.385	8.411	—	8.385
21. Ethyl acetoacetate	10.073	10.002	9.051	10.170	10.002
22. Methyl acetoacetate	10.630	10.509	10.439	10.610	10.509
23. Ethyl n-chloro-3-oxo-butanoate	10.488	10.228	9.559	9.972	10.228
24. Ethyl 2,2-diethyl-3-oxobutanoate	9.026	9.371	8.292	—	9.371
25. Benzyl acrylate	9.763	9.307	9.149	—	9.307
26. n-Butyl acrylate	8.660	8.071	7.827	—	8.071
27. Cyclohexyl acrylate	8.853	8.529	8.185	—	8.529
28. Ethyl acrylate	8.876	8.103	7.884	—	8.103
29. Methyl acrylate	9.133	8.202	8.002	—	8.202
30. Butyl adipate	8.882	8.520	8.459	8.856	8.520
31. Ethyl adipate	9.209	8.645	8.674	9.209	8.645
32. Ethyl anisate (Ethyl p-methoxy benzoate)	9.778	9.760	9.629	9.968	9.760

Table 1—Continued

Solubility parameter of esters $(cal/cc)^{0.5}$

Compound	δ (S)	δ (H, K)	δ (H)	δ (Coh)	δ (K)
	1	2	3	4	5
33. Methyl anisate	10.470	10.420	10.070	10.450	10.420
34. Allyl benzoate	9.648	9.224	9.066	—	9.224
35. Benzyl benzoate	10.041	9.815	9.579	9.660	9.815
36. Butyl benzoate	9.303	9.022	8.708	9.265	9.022
37. Ethyl benzoate	9.732	9.328	9.019	9.273	9.328
38. Pentyl benzoate	9.241	9.004	8.738	9.170	9.004
39. iso-Butyl benzoate	9.187	9.040	8.569	9.395	9.040
40. Methyl benzoate	10.107	9.610	9.300	9.937	9.610
41. Methylene dibenzoate	11.400	10.870	11.040	10.380	10.870
42. Phenyl benzoate	11.090	10.797	10.552	10.231	10.797
43. n-Propyl benzoate	9.538	9.200	8.890	9.457	9.200
44. Ethyl decanoate	8.355	8.178	7.801	8.517	8.178
45. Methyl decanoate	8.296	8.706	8.301	8.848	8.706
46. Pentyl hexanoate	8.296	8.706	8.301	8.848	8.706
47. Ethyl hexanoate	8.473	8.129	7.731	8.792	8.129
48. Butyl hexanoate	8.564	8.313	7.921	8.714	8.313
49. Amyl butyrate	8.457	8.166	7.776	8.716	8.166
50. Benzyl butyrate	9.452	9.167	8.853	9.339	9.167
51. Butyl butyrate	8.485	8.140	7.745	8.798	8.140
52. Ethyl butyrate	8.604	8.112	7.701	9.040	8.112
53. iso-Butyl butyrate	8.229	8.033	7.472	8.875	8.033
54. Methyl n-butyrate	8.828	8.221	7.792	9.282	8.221
55. n-Propyl butyrate	8.575	8.163	7.760	8.926	8.163
56. Amyl caproate	8.930	8.706	8.301	8.848	8.706
57. Butyl caproate	8.565	8.316	7.925	8.716	8.316
58. Ethyl caproate	8.474	8.130	7.735	8.792	8.130
59. Methyl caproate	8.817	8.394	7.979	9.051	8.394
60. Ethyl caprylate	8.391	8.144	7.761	8.625	8.144
61. iso-Amyl caprylate	8.811	8.654	8.258	8.624	8.654
62. Methyl caprylate	8.610	8.313	7.916	8.795	8.313
63. Allyl cinnamate	9.507	9.116	9.127	—	9.116
64. Methyl cinnamate	9.964	9.513	9.430	10.631	9.513
65. n-Decyl acetate	8.866	8.678	8.278	8.774	8.678
66. Ethyl heptanoate	8.430	8.140	7.751	8.703	8.140
67. n-Heptyl n-heptylate	8.337	8.212	7.839	8.439	8.212
68. Methyl heptanoate	8.571	8.223	7.820	8.842	8.223
69. Glycol monomethyl ether acetate	9.141	9.022	8.521	9.806	9.022
70. Ethylene benzoate	11.145	10.676	10.800	10.201	10.676
71. Ethylene butyrate	9.346	8.774	8.804	9.278	8.774
72. Ethylene laurate	8.702	8.594	8.414	8.500	8.594
73. Ethylene myristate	8.624	8.561	8.361	8.415	8.561
74. Ethylene palmitate	8.835	8.009	7.806	8.086	8.009
75. Ethylene propionate	9.564	8.002	8.933	9.529	8.002
76. Ethylene stearate	8.833	8.033	7.818	8.056	8.033
77. Ethylene benzene propanoate	9.443	9.158	8.844	9.335	9.158
78. Ethyl iso-butyrate	8.329	7.633	7.401	9.155	7.633
79. n-Propyl iso-butyrate	8.461	8.209	7.609	9.102	8.209
80. Ethyl iso-valerate	8.286	8.040	7.451	9.102	8.040
81. iso-Amyl iso-valerate	8.197	8.073	7.549	8.703	8.073
82. iso-Butyl iso-valerate	8.031	8.004	7.263	8.877	8.004
83. n-Propyl iso-valerate	8.252	8.055	7.492	8.888	8.055
84. Ethyl chloroformate	9.720	8.619	8.509	10.003	8.619
85. γ-Methyl butyl chloroformate	9.016	8.383	8.199	9.256	8.383
86. β-Methyl propyl chloroformate	8.876	8.325	7.940	9.545	8.325
87. n-Propyl chloroformate	9.428	8.000	8.382	9.709	8.000
88. Ethyl fumarate	9.403	8.521	8.912	9.582	8.521

Table 2

Solubility parameter of ethers (cal/cc)$^{0.5}$

Compound	δ (S)	δ (H, K)	δ (H)	δ (Coh)	δ (K)
	1	2	3	4	5
1. Allyl ethyl ether	7.559	7.905	6.878	—	7.905
2. Allyl methyl ether	7.668	8.042	6.866	—	8.042
3. Allyl phenyl ether	9.102	9.469	8.654	—	9.469
4. Allyl o-tolyl ether	8.997	9.324	8.553	—	9.324
5. Allyl m-tolyl ether	8.959	9.129	8.517	—	9.129
6. Allyl p-tolyl ether	9.032	9.557	8.586	—	9.557
7. Amyl ethyl ether	7.596	7.975	6.983	8.515	7.975
8. Amyl phenyl ether	9.589	10.016	9.105	9.501	10.016
9. Benzyl butyl ether	8.792	9.183	8.349	9.097	9.183
10. Benzyl methyl ether	9.308	9.768	8.712	9.681	9.768
11. Butyl ethyl ether	7.581	7.979	6.901	8.220	7.979
12. ter-Butyl ethyl ether	7.580	7.978	6.415	8.621	7.978
13. Butyl methyl ether	7.571	7.993	6.804	8.764	7.993
14. Butyl phenyl ether	8.995	9.407	8.508	9.288	9.407
15. Butyl m-tolyl ether	8.906	9.279	8.427	9.291	9.279
16. Butyl p-tolyl ether	8.918	9.291	8.439	9.306	9.291
17. α-Chloroethy ethyl ether	9.403	9.833	8.533	10.210	9.833
18. β-Chloroethyl ethyl ether	9.279	9.460	8.402	10.014	9.460
19. Chloromethyl methyl ether	11.923	12.105	10.409	11.709	12.105
20. α, β, Dichloroethyl ether	9.177	9.300	8.392	9.966	9.300
21. Ethyl heptyl ether	7.826	8.188	7.295	8.407	8.188
22. Ethyl iso-amyl ether	7.489	8.028	6.841	8.027	8.028
23. Ethyl iso-butyl ether	7.395	8.030	6.681	8.385	8.030
24. Ethyl iso-propyl ether	7.378	8.004	6.570	8.960	8.004
25. Ethyl methyl ether	7.624	8.131	6.562	9.262	8.131
26. Ethyl octyl ether	7.836	8.187	7.342	8.410	8.187
27. Ethyl propyl ether	7.601	8.025	6.831	8.782	8.025
28. Heptyl methyl ether	7.912	8.290	7.329	8.595	8.290
29. Hexyl phenyl ether	8.904	9.291	8.483	9.082	9.291
30. Heptyl phenyl ether	8.806	9.179	8.412	8.969	9.179
31. iso-Amyl phenyl ether	8.552	9.073	8.088	9.165	9.073
32. iso-Butyl methyl ether	7.434	8.064	6.619	8.994	8.064
33. iso-Propyl methyl ether	7.335	8.029	6.403	8.622	8.029
34. iso-Propyl phenyl ether	8.763	9.354	8.208	9.505	9.354
35. Methyl propyl ether	7.607	8.065	6.717	8.981	8.065
36. Methyl o-tolyl ether	9.322	9.749	8.683	9.878	9.749
37. Phenyl ethyl ether	9.115	9.566	8.532	9.581	9.566
38. o-chlorophenyl ethyl ether	10.545	10.741	9.918	10.439	10.741
39. Diallyl ether	7.895	8.164	7.358	—	8.164

Table 3

Solubility parameter of general compounds (cal/cc)$^{0.5}$

Compound	δ (S)	δ (H, K)	δ (H)	δ (Coh)	δ (K)
	1	2	3	4	5
1. Acetone	9.574	10.159	7.621	9.692	10.159
2. Acetonyl acetone	10.616	11.563	9.264	10.640	11.563
3. Acetyl methyl acetate	10.610	10.489	9.422	10.600	10.489
4. Diacetyl methane	10.831	11.875	9.302	10.920	11.875
5. Acetyl bromide	12.207	11.356	9.047	11.230	11.356
6. Acetyl chloride	10.684	10.839	8.677	11.090	10.839
7. Acetyl fluoride	9.779	9.924	7.244	10.450	9.924
8. 1-2, Dibromoethane (cis)	11.089	10.044	9.329	10.750	10.044
9. 1-2, Dichloroethane (cis)	10.073	8.973	8.629	10.420	8.973
10. Amyl benzene (n)	8.572	8.652	7.859	8.708	8.652
11. Amyl benzene (tert)	8.562	8.745	7.941	8.752	8.745
12. Amyl benzene ether	9.450	9.860	9.003	9.356	9.860
13. Amyl bromide (n)	8.757	8.491	7.517	8.950	8.491
14. Amyl bromide (iso)	8.458	8.386	7.196	9.099	8.386
15. Amyl chloride (n)	8.368	8.101	7.243	8.798	8.101
16. Amyl chloride (sec)	8.171	8.101	7.007	8.007	8.101
17. Amyl chloride (tert)	7.779	8.032	6.647	8.762	8.032

Table 4

Solubility parameters of compounds and comparison with values reported in the literature (cal/cc)$^{0.5}$

Compound	δ (S)	δ (H, K)	δ (H)	δ (Coh)	δ (K)	δ (Literature)
	1	2	3	4	5	6
1. Ethyl acetate	8.90	8.16	7.71	9.48	8.16	8.91
2. n-Hexyl acetate	8.65	8.30	7.90	8.88	8.30	8.64
3. n-Heptyl acetate	8.48	8.19	7.79	8.73	8.19	8.19
4. iso-Amyl acetate	8.31	8.07	7.44	9.02	8.07	8.45
5. iso-Butyl acetate	8.34	8.03	7.41	9.16	8.03	8.43
6. iso-Propyl acetate	8.41	8.02	7.35	9.35	8.02	8.58
7. Methyl acetate	9.23	8.27	7.79	9.87	8.27	9.46
8. n-Propyl acetate	8.71	8.12	7.69	9.22	8.12	8.80
9. n-Butyl acrylate	8.66	8.07	7.82	—	8.07	8.90
10. Ethyl acrylate	8.87	8.10	7.88	—	8.10	8.40
11. Methyl acrylate	9.13	8.20	8.00	—	8.20	8.90
12. Ethyl benzoate	9.73	9.32	9.01	9.27	9.32	9.75
13. Ethyl iso-valerate	8.28	8.04	7.45	9.10	8.04	8.65
14. Acetone	9.57	10.15	7.62	9.69	10.15	9.62

In the case of a compound where F_i or E_i values of any one of the groups present in it was not available in the literature, the constant F or cohesive energy E was calculated from the reported value of δ for a number of compounds belonging to the same series and containing that particular group, and then the value of F_i or E_i was back-calculated. For example, the contributions due to a group for which F_i or E_i values have not been reported in the literature, are calculated using the relationships between F, E, δ and V by the following simple equations:

$$F_i = \delta V - \sum_{n-1} F_i \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

$$E_i = \delta^2 V - \sum_{n-1} E_i \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Whilst making use of the above equations (rearranged) for the estimation of the contribution of a particular group the values of F_i and E_i of the other groups reported by the same author were used.

Discussion

Refs. 26, 15

Looking at the calculated values of δ for ester series, it can be pointed out that the solubility parameters calculated by adding up the contributions of individual groups to the cohesive energy are found to be generally of a higher magnitude than those obtained by other methods. However, they are comparable with those calculated using the contributions proposed by Small (Table 1) and the values reported in the literature (Table 4, column 6, obtained from equations based on the heat of vaporisation of a compound). Basically there is no difference between the δ values of a compound calculated by Hoftyzer and Krevelen constants and atomic and bond constants (Tables 1–4, columns 2 and 5). The values obtained using group contributions suggested by Hoy are relatively low (Table 1, column 3).

Solubility parameters of ethers determined using the contributions suggested by Hoftyzer and Krevelen, unlike in the case of esters, are found to be generally higher than those calculated using Small's method (Table 2, columns 2 and 1). However, these values are comparable with those based on cohesive energy (Table 2, columns 2 and 4).

No distinct demarcation is observed amongst δ values for the other compounds and they are comparable with each other, except that those obtained from the contributions suggested by Hoy are relatively low.

The δ values calculated by the contributions suggested by Hoy are found to be low in all cases. The reason for the low values could be due to Hoy's use of Haggenmacher's equation[26] for the calculation of ΔH_V (heat of vaporisation) and δ, whereas others have used different equations. In his calculations, Hoy obtained δ-values slightly lower than found by others. Consequently the values calculated by him for individual groups and the total of the contributions are comparatively lower.

A scrutiny of the values of the contribution of a particular group reported by different authors indicates that they vary considerably from each other. However, the overall total of contributions by the groups present in a molecule does not differ so much, when it is obtained by adding up the contributions suggested by individual workers. Hence the outcome (that is, the δ value) is always found to be comparable with the value calculated by using the contributions suggested by one of the workers. The slight differences noticed in the δ values of a compound calculated by using the contributions suggested by various workers can be attributed to the methods by which the contributions of individual groups are obtained.

It has also been observed that the values of the solubility parameters for the different isomers are in the order of δ (normal) $>$ δ (iso) $>$ δ (tertiary). The decrease is due to the packing of groups around the central atom, proceeding from normal to tertiary compounds which in turn lowers the value of total contribution[15].

An increase in the value of δ is observed proceeding from ethyl acetate to ethyl dichloroacetate, ethyl dibromoacetate and ethyl cyanoacetate. Likewise, an increase in δ values is noticed amongst ethers: amyl ethyl ether, amyl phenyl ether; heptyl ethyl ether, heptyl phenyl ether, etc. The δ value increases with the substitution of bulky groups of electrophiles and nucleophiles in the normal chain of the compound. As the contribution to the total contribution F due to bulky groups is more than that due to the simpler groups, the resultant δ is found to be greater in such cases. In the case of aromatic ethers, the δ values are in the order meta- $<$ ortho- $<$ para- and this is due to an increase in the density of the compound with respect to the meta-, ortho- and para- positions of substitution.

In the case of ethanoyl halides, the values of δ are in the order bromo- $>$ chloro- $>$ fluoro-. This may be due to the fact that the electronegativity of the halides is in the order F $>$ Cl $>$ Br. The more electronegative the substituent halide group, the less is the value of δ.

It is difficult to suggest which of the values of group contribution suggested by different workers should be used for the theoretical calculation of δ, unless the theoretically calculated δ values are compared with the practically determined ones. Nevertheless, the pioneering work of Small has made it possible to determine the solubility parameter values which cannot be calculated theoretically, especially in the case of compounds whose heats of vaporisation cannot be calculated theoretically. The δ values of such compounds can be determined by group contribution data.

Acknowledgments

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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 April 1977 issue of the *Journal*:

Techniques for the investigation of the biodeterioration of paints developed at CSIRO Australia *by E. Hoffmann*

Adhesion and failure of organic coatings *by W. J. McGill*

Synthesis of some water-soluble etherfield methyloated melamine resins and their use as hardeners for water soluble alkyd resins *by N. A. Rizk, F. F. Abd El-Mohsen and N. A. Ghanem*

Porosity of building materials—a collection of published results *by P. Whiteley, H. D. Russman and J. D. Bishop*

Information Received

New company formed—Anzon Ltd

On 1st January the antimony and zircon business of Associated Lead Manufacturers Ltd was concentrated on a new company—ANZON Ltd.

The formation of Anzon has brought together the whole operation of research, purchasing, manufacture, marketing, distribution and accounting, on one site at Willington Quay, Wallsend, England.

Anzon's original company was the first part of a family of businesses eventually to become Lead Industries Group. It was established in the Newcastle upon Tyne area in 1704. The site at Willington Quay was originally the location of one of the earliest Cookson factories, probably built during the early years of the XVIII century.

"Timonox" brand antimony trioxide was first produced in 1919, since when it has been steadily developed as a paint pigment and now is accepted as probably the most effective flame retardant used in the plastics industry. It is particularly in the plastics field that Anzon will continue to advance as the world's largest producer of Antimony Trioxide.

The zircon side is very much younger. After discussions between Mr R. Cookson (now a non executive director of Lead Industries Group) and the National Lead Company of America, a start was made in 1947 to take in USA materials for resale, and Associated Lead rapidly assumed European Agent status.

At the beginning of the 1950's the UK production of zirconium silicates and zirconium oxides was started, and a new factory was built on a site adjacent to the old Cookson Antimony Works at Willington Quay. This factory has been regularly expanded since that time. In 1958 production of dielectric raw materials commenced, again with considerable help from associates in the United States.

Towards the end of the 1960's it was decided that the antimony business could only expand to meet current and future demands if the old factory was demolished and rebuilt. There then followed one of the most extensive modernisations of an old works so far undertaken by L.I.G., and today there is now a highly efficient plant with excellent back-up service to allow Anzon to be a front runner in Lead Industries Group in the 1980's.

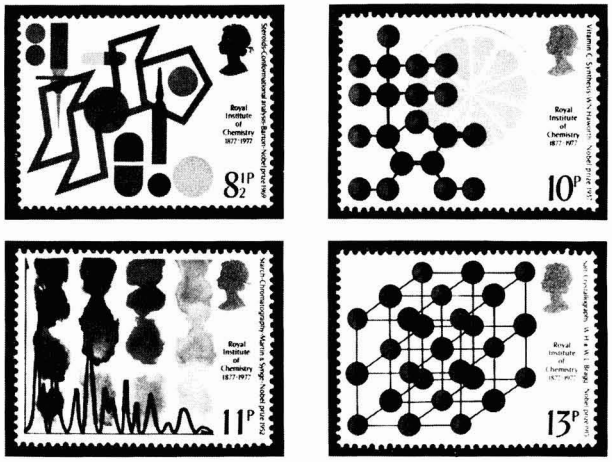
EIB lends US$51 million for British Petroleum projects

Two loans, totalling US$51 million (45.9 million units of account) have been made by the European Investment Bank, the EEC's long-term finance institution, to the British Petroleum group (BP), for eight years at an interest rate of 8.5 per cent.

The first loan, US$33 million, will help to finance the construction of an acetic acid plant at Hull, North-East England. The main uses of acetic acid are in the manufacture of synthetic fibres and vinyl acetate (a constituent of emulsion paints and adhesives). The group is spending about £55 million on setting up this new plant.

The second loan, US$18 million (16.2 million u.a.), also for eight years at 8.5%, will go towards BP's share of the cost of a pipeline system about 180km long from the Ninian oil field in the British sector of the North Sea to crude oil processing, storage and loading facilities at Sullom Voe in the Shetland Islands. The estimated total cost of the system is around £200 million.

Oil is expected to flow through the system from the spring of 1978 onwards, and throughput, including production from the nearby Heather field, should reach about 18 million tons per year by 1980.



The new issue of stamps, available from March, commemorating the centenary of the Royal Institute of Chemistry

Marine paint merger

International Paint, a member of the Courtaulds Group and the world's largest marine paint-maker, has announced the conclusion of a major technical and commercial agreement for marine paint with Nippon Paint Company of Osaka, Japan's biggest paint manufacturer, itself a leader in marine coatings.

The association is the result of three years of negotiations. It involves a complete "marriage" between Nippon's marine operations in Japan and International's extensive marine operations in other parts of the world, as well as the integration of both company's marine technology. It will formally come into operation on May 1 this year.

A major objective of the association is to develop a fully-integrated range of products through International's world-wide network of installations, mostly subsidiaries, in 32 countries and through Nippon's service network in Japan. This integration of the technologies of the two companies will mean that shipowners can expect uniform product quality and technical service all over the world. Japanese shipowners can anticipate particular benefits as their vessels increasingly trade and dry-dock outside Japan.

Luwa to market Japanese blower/sifter

The Process Division of Luwa (UK) Ltd has recently acquired the UK agency for the Taikohsha Blower/Sifter. This new design of sifter will sift almost any kind of powder through a 10-2,000 mesh screen.

The sifter is compactly designed, fully automatic and totally enclosed, giving vibration-free, dustless operation in the minimum space.

Eriks-Allied Polymer to sell du Pont "Kalrez"

E.I. du Pont de Nemours & Co. of Wilmington, Delaware, USA, has announced that Eriks-Allied Polymer Ltd (EAP) of Altrincham will handle sales of "Kalrez" perfluorelastomer parts in the United Kingdom.

With their existing nationwide coverage and comprehensive service to the engineer in most forms of industrial rubber, packings, seals and engineering products, EAP will be offering a first-class service in "Kalrez" parts, such as O-rings, seals, tubing, rod and sheet.

Swale products to be manufactured in France and Spain

Negotiations have been completed for the manufacture of Swale Chemicals' lacquers for packaging materials by Polychimie, France, with the marketing to be undertaken by Polychimie's holding company, Safic-Alcan et Cie, 3 Rue Bellini, 92806 Puteaux, Paris.

In the early part of 1977, Safic-Alcan will also promote Swale Chemicals' products in Spain where they will commence manufacture. Arrangements have been concluded for supplies to Holland and Belgium to be maintained from the French production unit in order to give more rapid delivery overland.

New products

Infrared multisampler from Perkin-Elmer

A fully automatic multisampler for use with any of their current range of infrared spectrophotometers has been announced by Perkin-Elmer Limited.

The multisampler is fully integrated electronically with the scan controls of the

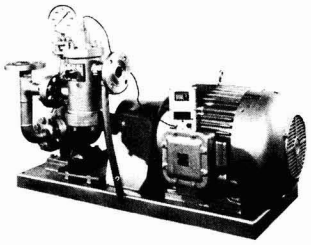
instrument and accommodates thirty potassium bromide discs or thirty films. The disc and film holders have been specially designed for easy loading, and protection of the sample itself. The standard disc holder accommodates normal 1mm discs, but a special version is available for discs up to 1.5mm in thickness. The unit is compact enough to allow the sample compartment lid to be closed during operation so that the spectrophotometer may be purged with dry air or nitrogen. This is particularly useful for accurate work in regions of atmospheric absorption or if the samples themselves are water sensitive.

Ultrasonic homogenisers for polyester resin

Ultrasonic homogenisers, designed and constructed by Ultrasonics Ltd for use with polyester resins, will normally carry out dispersion tasks faster, to a higher standard and at a lower cost than competitive machines. Dispersions are produced at high speed, without air entrainment or heat build-up. Four models are available with throughputs ranging from 750 l/hr to 12 000 l/hr.

The equipment consists of an Ultrason homogenising head complete with pump, motor, pressure gauge and pressure relief valve. Powders are added to the resin and a rough premix is formed by stirring. This premix is then passed once through the homogenising head to storage or packing.

When using the ultrasonic homogeniser to disperse thickening agents it is often possible to use less than would be considered necessary when using conventional equipment.



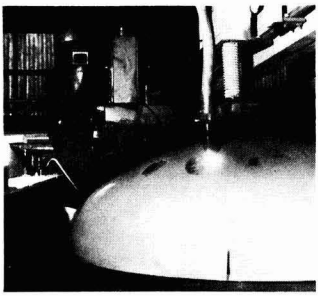
The new ultrasonic homogeniser from Ultrasonics Ltd

Another application with polyester resins is in dispersing tinting pigments and fillers. It is essential in all these applications that the powders are finely dispersed and an ultrasonic homogeniser can normally be relied on to carry out these tasks satisfactorily.

Safety mittens

Safety mittens capable of providing operator protection up to temperatures of 350° have been developed by Safety Equipment Centres. Manufactured in Du Pont non-flammable Nomex fibre, the mittens weigh less than half as much as equivalent asbestos products, and are claimed to be far more comfortable in use.

Intended for use in bakeries, foundries, moulding shops, printers' platemaking, and for most applications calling for handling hot materials, the mittens are available in two sizes: small and large for female and male operators.



A steel dished-end having branch holes cut by plasma arc (see below)

Dished-end service for the petrochemical industry

Plascut Limited, the metal service centre, are offering a custom-made dished-end service for the petrochemical and associated processing industries. Fabricated in stainless steel, either from Plascut's own stock or from customers' materials, the dished-ends are widely used on new mixing and process vessels and for the repair of corroded plant.

Circular blanks are produced in-house at Plascut's Rotherham factory on their modern plasma arc profiling equipment and then dished by a local subcontractor. Subsequent operations are carried out within Plascut's own MOD approved fabrication shop and include hand plasma-arc trimming, cutting of branch holes, welding of flanges and 100% x-ray inspection, if required.

New mass spectrometer data aquisition system

Known as the Datashrinker, the new DS50S, from AEI Scientific Apparatus Ltd, based on the Nova 3/12 computer with a 32K MOS store and a 10 Megabyte dual-disc drive, is capable of the acquisition and processing of data simultaneously, thus considerably increasing the throughput of samples. Command entry is simple and output of results is via a fast alpha-graphics terminal or a teletype.

In addition to the real time conversion of raw data from low or high resolution or double beam spectra, the DS 50S has the invaluable facility of providing interscan reports. These reports give the user condensed facts on the nature of the sample under analysis while the scans are being carried out.

New Gelman modular clean benches

A new range of Laminar Air Flow work benches from Gelman Hawksley provides economical complete clean work stations. They are widely used in critical applications, such as the treatment of thin films, assembly of optical components and in electronic production and particle analysis laboratories. They are also used extensively in pharmaceutical applications, sterility testing, tissue culture preparation and drug formulation.

Vacuum impregnation plant

Cole Electronics Ltd have recently added to the wide range of Encapsulation and Impregnation Plants marketed in the UK a range of Vacuum Impregnation Units manufactured by the West German firm of Huebers KG and these are known as the Traenkfix III "Piccolo" and "Mini".

The equipment comprises a storage tank for the impregnant, 20 litres and 33 litres respectively; an impregnation chamber incorporating a swivel lid with clamping device for loading and unloading a vacuum pump and the necessary control valves and gauges, all mounted on a base plate. As optional extras, a double walled storage container suitable for cooling and a motor driven stirrer to prevent sedimentation, are available.

New range of toxic gas analysers

Detection Instruments Limited have announced a new range of toxic gas analysers, including portable monitors and units for fixed installation. Thew analysers utilise an electrochemical transducer which can be made specific for carbon monoxide, sulphur dioxide, hydrogen sulphide, nitrogen dioxide and chlorine, and provides an accuracy of ± 2 per cent FSD.

The portable toxic monitors are powered by internal rechargeable batteries, but can also be operated on mains AC. They are offered with a wide range of linear scales and fully adjustable audible and visual alarms. The instruments are ruggedly constructed and weigh only 8lbs.

The new COtector Model 1140 from Detection Instruments

For permanent installation, Detection Instruments have introduced the LD Series Monitors to provide safety against the build-up of toxic gas in potentially hazardous areas. Five basic versions are available for continuously measuring carbon monoxide, sulphur dioxide, hydrogen sulphide, nitrogen dioxide and chlorine. The units are packaged in thermostatically controlled, dust-proof and water-proof enclosures and are normally provided with audible and visual outputs for remote alarm signalling. The alarm set point is continuously adjustable throughout the full scale range of the analyser. The volume of the alarm itself is adjustable. A multi-point sequential sampling unit can be provided with any LD Series model when it is required to monitor a large area.

Because of their high sensitivity and specificity, these new analysers represent a major advance in toxic gas monitoring.

Hull

High solid coating systems

The third ordinary meeting of the 1976/77 session was held at the George Hotel, Land of Green Ginger, Hull on Monday 6 December 1976. Mr T. W. Wilkinson, the section chairman, introduced Dr D. Faulkner of Rohm and Haas (UK) Ltd, who gave a lecture entitled "High solid coating systems".

Dr Faulkner began by saying that within the last few years, it has become necessary to cope with the scarcity of solvents and energy whilst simultaneously alleviating air pollution and toxicity hazards of industrial finishing. Means had to be found to reduce considerably, if not fully resolve, the problems cited. Coatings in water/co-solvent blends were one route to this end, but solvent-based coatings with high solid contents gave another means to reduce solvent content.

The basic characteristics of solvents and water highlighted several of the benefits and deficiencies to be expected from solvent-based high solids coatings. Whereas a wide range of solvents with the desired thermodynamic properties could be selected in solution coatings, the aqueous systems must utilise water having a high heat of vaporisation and inconvenient boiling and freezing points. These parameters were directly related to problems of slow drying, popping in ovens and freezing of the aqueous paint. Bacterial growth, high surface tension and the high conductivity were properties of water which could also lead to difficulties in putrefaction during storage, substrate wetting and electrostatic spraying respectively. Although progress continued to be made in the development of aqueous coatings, despite their inherent drawbacks, the necessity for the development of high solids solvent-based systems to supplement water based systems has been deemed essential.

The relative amounts of solvent contained in, and emitted from, various types of coatings of differing solvent content could be gauged from calculation of the amount of solvent per unit of dry non-volatile applied. Expressed as such, the solvent content rose exponentially as the solids content of the applied paint was lowered. The economic incentive for moving away from lacquers towards enamels of very high solids was therefore apparent.

Dr Faulkner intimated that his company had developed a proprietary process for the synthesis of various acrylic oligomers in the molecular weight range 1000 to 1500 and with very narrow molecular weight distributions. The comparative properties of titanium dioxide pigmented white enamels based on a carboxyl oligomer/epoxy (40/60) system and a conventional acrylic/epoxy (80/20) system were cited. The oligomer system gave 25 per cent higher application solids and an unusual combination of high hardness, solvent and detergent resistance with excellent flexibility and impact resistance.

Two different functional oligomers were suitable for formulating urethane enamels. The first was the hydroxyl type which reacted with isocyanates to yield urethanes. The second kind of functional oligomer was the oxazolidine type. The oxazolidine ring could be considered as ethanol-amine functionality which was blocked by aldehyde. No reaction with isocyanate took place so long as moisture was excluded from the system. However, when the oxazolidine was exposed to atmospheric moisture as in a thin coating, ring opening proceeded at a rapid rate, much faster than the undesired competitive reaction of water with isocyanate. The room temperature cured oxazolidine oligomers had an excellent combination of hardness and flexibility, which surpassed those of many industrial finishes. The oxazolidine oligomers had special ability to disperse difficult organic pigments to give coatings with very high gloss. Oxazolidine based films also gave good exterior durability.

The hydroxyl-melamine finishes were the most general in their use. Hard and soft hydroxyl functional oligomers had been developed analogous to hydroxy acrylic polymers. The oligomers are supplied as 80 per cent solids vehicles whereas the polymers were provided as 50 per cent solids vehicles at about the same viscosity. The hard oligomeric titanium dioxide pigmented systems gave excellent hardness and solvent resistance which was much better than that of the polymeric systems at some 30 per cent higher application solids. The hard oligomer was compatible with a variety of oil-free polyesters and alkyds which could serve as plasticisers. Hence, finishes could be manufactured with solids contents intermediate between those of an oligomeric and a polymeric system.

This informative lecture generated considerable interest and provoked a very large number of questions. The evening was closed with a vote of thanks from Mr F. D. Robinson, who humorously praised the lecturer for his first class presentation. The meeting was attended by 18 member and visitors.

D. M. W.

Manchester

Micro-emulsions

The Section held a meeting at the Manchester Literary & Philosophical Society, George Street, Manchester, on Wednesday 12 January. Some 70 members and guests assembled to hear a lecture on "Micro-emulsions" by Mr K. H. Falkin of Perstrop AB. This paper has also been presented to the London Section, who will be reporting the main content. (*It is expected in the April issue—Ed.*)

A. McW.

West Riding

Extender in emulsion paint

A meeting of the Section was held on Tuesday 11 January 1977 at the Griffin Hotel, Leeds. Mr D. J. Huxtable of English China Clays Lovering Pochin and Co. Ltd, gave a lecture dealing with china clay and its possibilities as a pigment extender.

The first part of the programme comprised a film which described the mining, purification and grading of the clay as well as the laboratory facilities available.

Mr Huxtable then briefly discussed the physical structure of the untreated clay, which of itself has practical applications. Calcined clays had been developed which were dehydroxylated in the process and the particles sintered together. Another grade also had some calcining but of short duration so that only the surface of the particle underwent calcining. The different treatments had particular effects on end use properties, but both gave better light scattering and hence, improved opacity in a paint than the untreated feed clay. These effects were illustrated by reference to a comparison of contrast ratios at different pigment volume concentrations in an emulsion binder. This was followed by some results comparing the dispersion characteristics of different types of clay in alkyd resins.

Looking ahead, some success was being achieved in further improving brightness and opacity. Finally, some discussion took place on the possible alternative methods of handling china clays, particularly bulk transportation in slurry form.

A number of questioners raised the subject of slurry deliveries (which were, generally, not commercially available for paint grades) and some of the obvious problems were discussed. Questions were also asked about the use of china clays in alkyd based paints and Mr Huxtable said that there were sound technical as well as economic reasons for recommending their use in semi-gloss paints, but not in full gloss paints. Finally, Mr K. Smith proposed the vote of thanks.

R.A.C.C.

CHEMICALS FOR RADIATION CURING

ucb

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CHEMIST'S GUIDE TO I

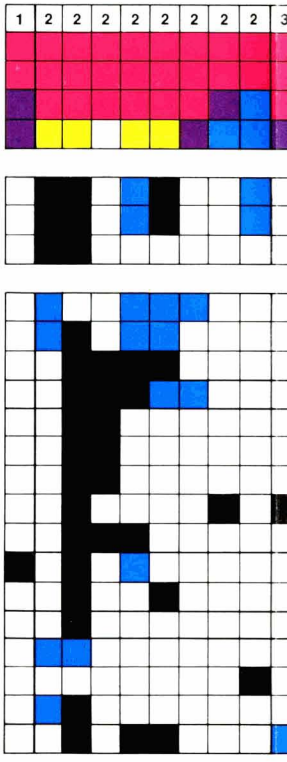
uv-ebc

TYPES OF PRODUCTS			
TRADE NAMES			
		FUNCTIONALITY	
		MOLECULAR WEIGHT	(1)
		VISCOSITY	(2)
		COLOUR	(3)
		PRIMARY IRRITATION INDEX	(4)

EBC	COATINGS	WOOD, HARDBOARD AND CHIPBOARD	GROUND COATING	
			TOP LACQUER	
		MISCELLANEOUS MATERIALS	OUTDOOR APPLICATIONS	◆
ULTRA-VIOLET CURING	COATINGS	WOOD HARDBOARD CHIPBOARD. ETC...	FILLERS	
			PAINTS	
			OPEN PORE VARNISHES	◆
		PAPER AND CARDBOARD	OVERPRINTING VARNISHES AND OTHERS	◆
		PLASTIC AND SYNTHETIC SUBSTRATES	PLASTICISED PVC	◆
			RIGID AND SEMI-RIGID PVC	
			POLYURETHANE (AND LEATHER)	◆
			POLYSTYRENE	◆
			TREATED POLYESTER FOIL	
		METAL	WHITE BASE COAT	◆
			VARNISHES	◆
	LAMINATING ADHESIVES			◆
	SILK SCREEN PRINTING	PRINTED CIRCUIT BOARDS	ETCH-RESIST	
			SOLDER-RESIST	◆
			INKS	
		SYNTHETIC MATERIALS	INKS AND VARNISHES	◆

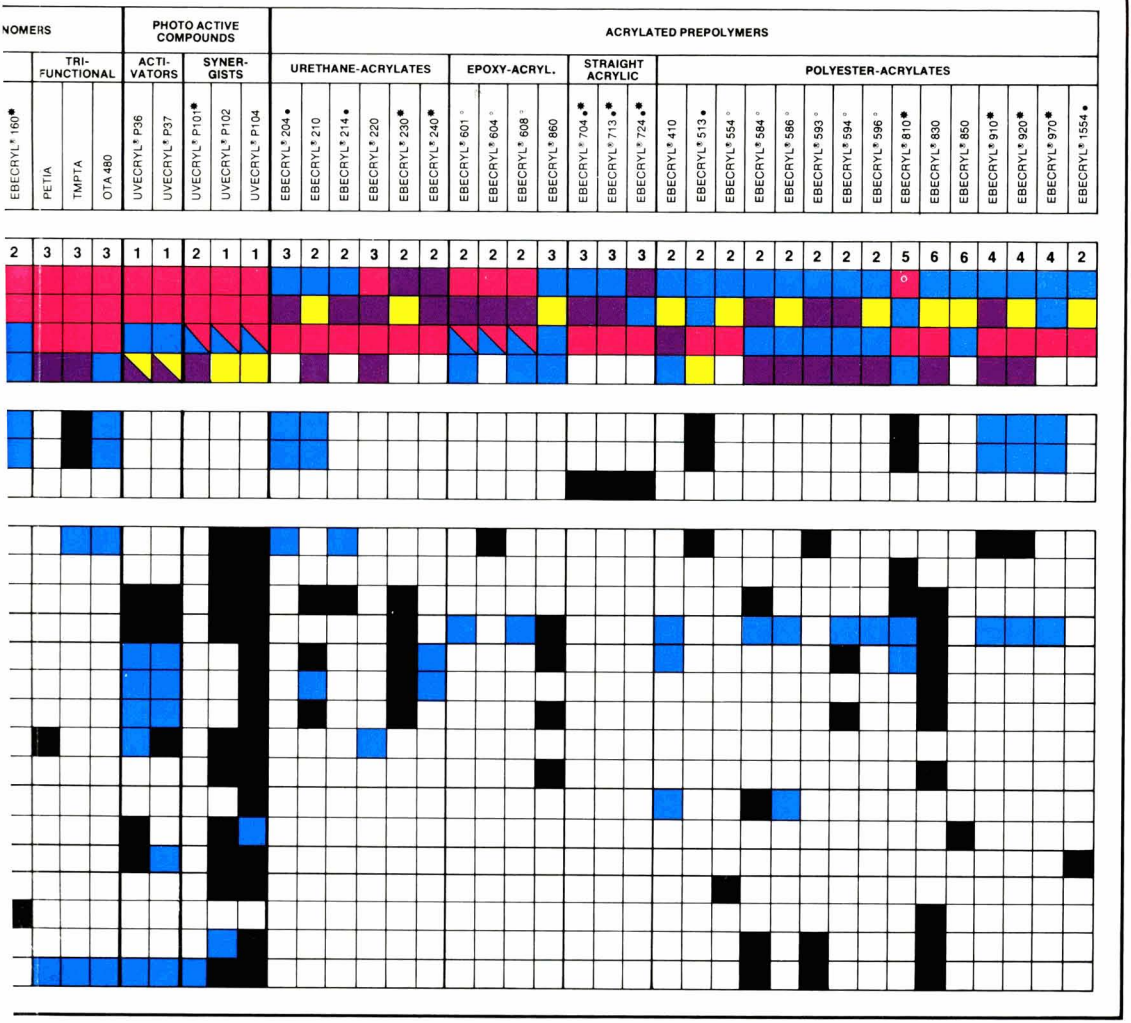
POLYOL POLYACRYLATE MONOMERS

Mono	DIFUNCTIONAL								FU
EBECRYL® 110	BUDA	HDDA	NPGDA	DEGDA	TEGDA	PEG 400 DA	EBECRYL® 150	EBECRYL® 160	PLTIA
1	2	2	2	2	2	2	2	2	3



(1) MOLECULAR WEIGHT	(2) VISCOSITY	(3) COLOUR (GARDNER)	(4) PRIMARY IRRITATION INDEX	◆ NEW DEVELOPMENTS
100 TO 1000	LESS THAN 2 P	1 - 2 G	UNDER INVESTIGATION	ALTHOUGH ALL THE APPLICATIONS QUOTED ABOVE HAVE BEEN SURVEYED BY OUR R & D LABORATORIES, WE ARE AT PRESENT ESPECIALLY FOCUSING ON THOSE MARKED ◆
1000 TO 2500	2 P TO 20 P	3 - 4 G	SLIGHTLY IRRITANT	
OVER 2500	20 P TO 200 P	MORE THAN 5 G	MODERATELY IRRITANT	
	ABOVE 200 P		SEVERELY IRRITANT	

) IRRADIATION CURING



SUGGESTED USES

RECOMMENDED USES

○ PREPOLYMER ONLY SUPPLIED IN THE REFERRED MONOMER

● PREPOLYMER ALSO SUPPLIED IN OTHER MONOMER THAN REFERRED

✳ NEWLY DEVELOPED PRODUCTS WHOSE APPLICATION POSSIBILITIES HAVE STILL TO BE FULLY EXPLORED.

FOR EBECRYL® PREPOLYMERS SUPPLIED IN MONOMER THE LAST DIGIT REFERS TO MONOMER AS FOLLOW:

0 : NO MONOMERS
1 : EBECRYL 150
2 : DEGDA
3 : BUDA
4 : HDDA
5 : TEGDA
6 : TMPTA
7 : NPGDA
8 : OTA 480
9 : 2-HYDROXYETHYL-ACRYLATE

ucb

A comprehensive range of radiation curing materials:

UCB develop and market:
- polyfunctional acrylic monomers
- acrylated photoactive compounds (UVECRYL®)
- prepolymers for UV and EBC (EBECRYL®)
  - polyester-acrylates
  - urethane-acrylates
  - polyether-acrylates
  - polyacrylic-copolymer acrylates
  - epoxy-acrylates.

The research laboratories of UCB's Chemical Sector have developed high performance products covering many fields of application as illustrated in the "CHEMIST'S GUIDE TO IRRADIATION CURING".

UCB have applied for and have been granted an important number of patents relating to the synthesis and application of their resins.

Working in close co-operation with UV lamp and EB accelerator manufacturers, the commercial and research departments of UCB can assist in obtaining products to suit specific requirements.

Should you seek more information about ultra-violet and electron beam polymerisation, request UCB's irradiation brochure from one of the following addresses:

UCB s.a. Chemical Sector
Direction Spécialités - Irradiation
Anderlechtstraat 33
B-1620 DROGENBOS - BRUSSELS
Phone: (02) 377 11 70
Telex: 22342 UCBOS B

FOR DENMARK AND SOUTHERN SWEDEN (SCANIA) :
SKANDINAVISK BELGISK KEMI A/S
Århusgade 88
DK-2100 COPENHAGEN Ø
Phone: (01) 26 14 66/26 16 79
Telex: 16851 SCNBEL DK

FOR FRANCE :
Société Commerciale UCB
Rue La Boétie 55
F-75008 PARIS
Phone: 359 75 36
Telex: 280142 FRACOREP Paris

FOR THE FEDERAL REPUBLIC OF GERMANY, AUSTRIA AND SWITZERLAND (German speaking area) **:**
UCB Chemie GmbH
Hüttenstrasse
Postfach 80
D-5159 SINDORF BEI KÖLN
Phone: Horrem (2273) 5092
Telex: 888043 UCB D

FOR GREAT BRITAIN :
HONEYWILL & STEIN Ltd
Greenfield House
69/73 Manor Road
GB-WALLINGTON, Surrey, SM6 OBP
Phone: (01) 669 44 33
Telex: 946560 BPCLGH G

FOR NORWAY :
PAUS & PAUS A/S
Box 281, Sentrum
Kongens Gt. 14
N-OSLO 1
Phone: (02) 41 50 60
Telex: 11207 OPAUS N

FOR SPAIN :
QUIMICA IBERICA
a) Plaza Marqués de Salamanca 11
E-MADRID 6
Phone: (01) 2257400/09
Telex: 43597 QISA E

b) Poligono Industrial Santiga
Talleres 2 - Nave n.8
E-SANTA PERPETUA DE MOGUDA (Barcelona)
Phone: (03) 288 16 52

FOR SWEDEN (except Scania) :
DETLOW B. von BRAUN
Skeppsbron 4
S-41121 GÖTEBORG
Phone: (031) 11 19 59/13 79 24
Telex: 21766 Detlow S

ucb

uv-ebc

Printed in Belgium

OCCA-29 EXHIBITION PREVIEW

100 organisations from 16 countries

★ Australia ★ Belgium ★ Denmark ★ East Germany ★ Holland ★ ★ Hungary ★ Italy ★ Norway ★ Poland ★ Romania ★ Spain ★ ★ Sweden ★ Switzerland ★ UK ★ USA ★ West Germany ★

The annual focal point *for the surface coatings industries*

The Exhibition Committee is pleased to welcome to the OCCA-29 Exhibition 100 organisations, representing the UK and fifteen overseas countries: Australia, Belium, Denmark, East Germany, Holland, Hungary, Italy, Norway, Poland, Romania, Spain, Sweden, Switzerland, USA and West Germany. A full list of Exhibitors is given on pages 108 and 109. **Stand space has been allocated to several new Exhibitors since the printing of the Official Guide : see page 110 for further details.**

Venue

The twenty-ninth annual Exhibition of raw materials, plant and equipment for the paint, printing ink, colour and allied industries organised by the Association will be held at Alexandra Palace, London N22. Alexandra Palace was the venue for the exhibition held in March 1976 and for the series of exhibitions from 1965 to 1969.

Dates and times

The 1977 Exhibition will take place on the following dates and times:

Tuesday	22 March ..	09.30 – 17.30 hrs.
Wednesday	23 March ..	09.30 – 17.30 hrs.
Thursday	24 March ..	09.30 – 17.30 hrs.
Friday	25 March ..	09.30 – 16.00 hrs.

Theme of the Exhibition

The Committee emphasises that whilst it naturally encourages the showing of new products it **does not stipulate that new products have to be shown by exhibitors each year and it attaches equal importance to the advantage to personnel at all levels of meeting and discussing their common technical problems in an informal atmosphere.**

Refreshments on stands

This year in pursuance of this theme the Committee has amended the rule which had previously prohibited the serving of alcoholic refreshments on the stand. Exhibitors at previous Association Exhibitions at Alexandra Palace have commented that the visitors tend to spend longer time at the Exhibition.

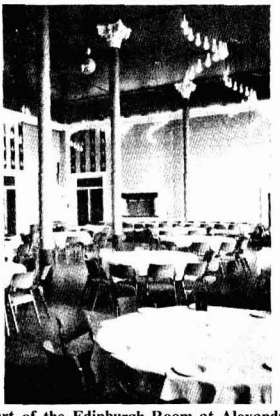
Visits by principal officers of other societies

The Exhibition Committee has extended an invitation to the principal officers of many technical societies, research associations and government departments, to a private luncheon at Alexandra Palace on the opening day (Tuesday 22 March). The Committee will be conducting the party around the Exhibition and visiting the stands during the afternoon.

Facilities at Alexandra Palace and travel arrangements

Visitors to OCCA-28 last year were impressed by the facilities available, which included two restaurants, two bars, a cafeteria and an exhibitors' bar. Other facilities include this year ample free car parking space, which is of considerable benefit especially to those using the M1 motorway, which links with the North Circular Road.

The Association will once again organise a free bus shuttle service to and from Turnpike Lane Station on the London Underground (Piccadilly Line). The journey from central London on the Piccadilly Line takes approximately 18 minutes and connections to the Piccadilly Line can be made easily from all mainline stations.



Part of the Edinburgh Room at Alexandra Palace, which will be open between 11.30 and 14.30 hrs on the four days of the Exhibition and where tables may be reserved

It is hoped that the new electrification of British Rail services will be completed by March 1977 so that some visitors may find it easier to travel by train from King's Cross to Wood Green Station, from which station the London Transport W3 bus travels to Alexandra Palace. A further link which will be of benefit for those travelling by air will be the extension of the Piccadilly Line to Heathrow Airport, which is scheduled for completion in 1977. This will give a direct link with Turnpike Lane Station and in the meantime a bus service operates from Heathrow Airport to Hounslow West Station. Visitors who prefer to travel from Heathrow Airport to the West London Air Terminal in order to leave their luggage at hotels, can board the Piccadilly Line trains at Gloucester Road Station.

The Association has arranged for the exhibition to be held on its own at Alexandra Palace, which means that the facilities are exclusively available for exhibitors and visitors to this important international meeting place. The Exhibition Committee, therefore, draws particular attention to this aspect of this annual exhibition in providing an annual international focal point for the surface coatings industries, where the display and discussion of technical developments and knowledge can take place in an informal atmosphere.

"Official Guide"

The "Official Guide" to the Exhibition has now been published and despatched to all members of the Association and those requesting copies as a result of the Association's widespread publicity.

Members are asked to ensure that they bring their tickets to the Exhibition **since otherwise the charge for admission will be made and no refund will be applicable in these cases.**

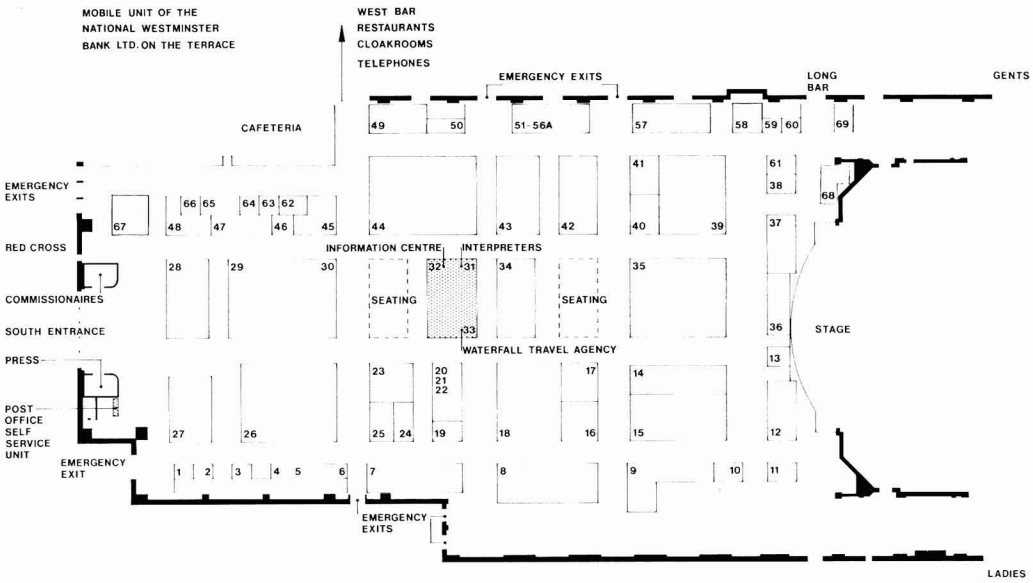
Copies of the "Official Guide" (including season admission ticket) are available at £2·00 each (prepayment only) from the Association's offices **and they will also be available for purchase at the entrance to the Exhibition Hall.**

For the last two exhibitions, it was decided that a small charge of £2.00 (US $5.00) should be made both for the "Official Guide" and for season admission tickets to the exhibition. This policy undoubtedly deterred 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. The innovation was welcomed by many exhibitors and in no way acted as a deterrent to visitors to this exhibition. A similar charge will be made for the "Official Guide" to OCCA-29.

Information in foreign languages

As in previous years, the Association has been circulating information leaflets in six languages, which will contain application forms for those wishing to purchase copies of the "Official Guide" and season admission tickets before the exhibition.

Plan of the Exhibition Hall at Alexandra Palace



Exhibitors at OCCA-29

For position of Stand, see plan of Exhibition Hall above

For alphabetical list of Exhibitors, see Analysis of Exhibits table on pages 113, 115 and 116

Stand	
1	Polymers Paint & Colour Journal
2	RK Chemical Co. Ltd
3	Research Equipment (London) Ltd
4	Herbert Smith & Co.
4	Werner & Pfleiderer UK
5	Diaf A/S
6	Rio Beer
7	Berol Kemi AB
8	Laporte Industries Ltd
9	Hercules Powder Co. Ltd
10	Sheen Instruments (Sales) Ltd
11	BOC Automation
11	Hunterlab
11	Applied Color System
12	Arcode Ltd
13	John Godrich
14	Wallace Knight
14	Brandhurst Co. Ltd
14	Honeywill & Stein Ltd
14	UCB S.A.
15	Rohm & Haas (UK) Ltd
16	Worsdall Chemical Co. Ltd
17	Chemolimpex
18	Degussa
18	Bush Beach & Segner Bayley Ltd
19	Silberline Ltd
20	Veb Kombinat Nagema
21	Netzch
22	Marchant Bros Ltd

Stand	
23	Monsanto Europe SA
24	Porter Lancastrian Ltd
25	Hopkin & Williams
25	Baird & Tatlock
26	Synres International BV
26	Troy Chemical Co. Ltd
27	Dyno Industrier AS
27	Charles Tennant & Co. Ltd
28	Synthese BV, Division of Akzo Chemie
29	Tioxide International Ltd
30	Titanium Intermediates Ltd
34	ICI Ltd, Mond Division
35	Montedison
36	KWR Chemicals Ltd
36	Schwerdtel GmbH
36	Draiswerke GmbH
37	Ancomer Ltd
37	Anchor Chemical Co. Ltd
38	ABM Chemicals Ltd
39	Joseph Crosfield & Sons Ltd
40	Mastermix Engineering Co. Ltd
41	Noratom-Norcontrol A/S
41	Jotun A/S
42	Sachtleben Chemie GmbH
43	Colwell
43, 48	Graco
43	Tenneco Colortrend BV
43	Tenneco Malros Ltd
43	Tenneco Organics Ltd

Stand	
44	Shear Colour
44	Sweco (Europe) SA
44	Sun Chemical Corporation
44	Warwick Chemical Ltd
45	Ciech Import & Export
46	Wheatland Journals Ltd
47	Contraves Industrial Products
48	AB Metall
48	AMF International Ltd
48	AMK Peter Kupper
48	Ateliers Sussmeyer
48	Berk Ltd
48	Degussa
48	J. de Vree
48	Oliver & Battle
48	Pamasol Willi Madder
48	Paul Vollrath
49	Willy A. Bachofen
49	Glen Creston Ltd
50	Pilamec Ltd
51	Barford Chemical Co

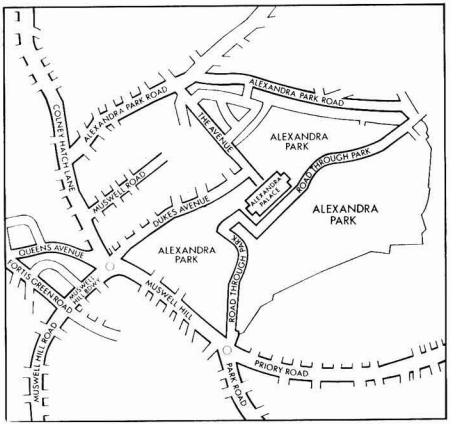
Stand	
52	Amoco Chemicals (UK) Ltd
53	Kirklees Chemical Co.
54	Sherwin-Williams
55	Dow Chemical Co.
56	K & K Greeff Industrial Chemical Ltd
56a	Cabot Carbon
57	NL Industries Inc.
58	Macbeth Colour & Photometry Division, Kollmorgan (UK) Ltd
59	Scientific & Education Aids (ABR) Ltd
60	Cornelius Chemicals
60	Hilton Davis Chemical Co.
61	G. J. Erlich Ltd
62	Diffusion Systems
63	Roban Engineering Ltd
64	Industrial Colours Ltd
65	Eckart-Werke
65	Johnson & Bloy
66	A. Strazdins (Pty) Ltd
67	Ward Blenkinsop
68	Cavadell
69	Albright & Wilson Ltd

Stand telephone numbers

Many Exhibitors have applied to the Post Office for telephones to be connected to their Stand for use during the period of the Exhibition. A complete list (including late allocations made after the "Official Guide" went to press) is given below, but it is emphasised that these numbers are for use *during the opening hours of the Exhibition only*.

Stand	*Exhibitor*	*Stand telephone number*
38	ABM Chemicals Ltd	01–883 1363
37	Anchor Chemical Co. Ltd	01–883 1059
12	Arcode Ltd	01–883 0680
7	Berol Kemi AB	01–883 2545
17	Chemolimpex	01–883 4199
45	Ciech Import & Export	01–883 2548
47	Contraves Industrial Products	01–883 2788
39	Crosfield, Joseph & Sons Ltd	01–883 1729
18	Degussa	01–883 4099
48	DH Industries Ltd	01–883 0745
62	Diffusion Systems	01–883 0087
27	Dyno Industrier	01–883 3335
61	Erlich, G. J., Ltd	01–883 0120
49	Glen Creston Ltd	01–883 0932
9	Hercules Powder Co. Ltd	01–883 0815
34	ICI Ltd	01–883 3148
64	Industrial Colours Ltd	01–883 3999
1	Industrial Newspapers	01–883 4125
53	K & K Greeff Industrial Chemicals	01–883 3536
36	KWR Chemicals Ltd	01–883 2005
28	Kunstharsfabriek Synthese N.V.	01–883 3167
8	Laporte Industries Ltd	01–883 8318 (3 lines)
58	Macbeth Color & Photometry Division, Kollmorgen (UK) Ltd	01–883 0240
22	Marchant Bros. Ltd	01–883 1161
23	Monsanto Europe	01–883 3775
57	NL Industries Inc.	01–883 2899
(*Mobile unit*)	National Westminster Bank Ltd	01–883 0458
32	OCCA Information Centre	01–883 2110
63	Roban Engineering Ltd	01–883 3928
42	Sachtleben Chemie GmbH	01–883 1730
10	Sheen Instruments (Sales) Ltd	01–883 1531
19	Silberline Ltd	01–883 1470
66	Strazdins (Pty) Ltd	01–883 4062
26	Synres International N.V.	01–883 3585
43	Tenneco Chemicals Europe Ltd	01–883 4062
29	Tioxide International Ltd	01–883 9706 (2 lines)
67	Ward Blenkinsop & Co. Ltd	01–883 4134
33	Waterfall Travel Agency	01–883 2399
46	Wheatland Journals Ltd	01–883 1999
16	Worsdall Chemical Co. Ltd	01–883 2699

Alexandra Park and locality



There are adequate car parking facilities available at Alexandra Palace. Visitors travelling by road may consult the simplified diagram on page 114 showing the approach roads from central London and the Motorways, and the enlargement above, of the area around Alexandra Park. The entrance through Dukes Avenue is for *pedestrians only*.

Membership of the Association

Members are requested to bring to the attention of their non-member colleagues the many advantages of membership. In addition to receiving a **free copy** of the **"Official Guide"** and **season admission ticket** to the Association's annual Exhibition, Members also benefit in the following ways:

1. Personal copy of the monthly *Journal* and other publications sent to Members.
2. Personal copy of Joint Programme of Section meetings and notice of monthly meetings.
3. Special reduced fees for Conferences and Symposia.
4. Opportunity for Ordinary Members to enter the Optional Professional Grade, and to use the designatory letters so conferred.
5. Reduced Membership subscription rate for Registered Students up to 25 years of age and specially arranged student activities in certain Sections.
6. Group membership of the British United Provident Association.
7. Opportunities to participate in co-operative research.
8. Specially designed items incorporating the Association's insignia, available to Members only, are Ties, Blazer Badges, Car Badges, and Wall Plaques.

Further details of membership of the Association and application forms will be made available at the Information Centre, Stand 32, at the forthcoming OCCA–29 Exhibition at Alexandra Palace. They can also be obtained by writing to the Association's headquarters, at the address on the Contents page of the *Journal*.

News of Exhibitors at OCCA-29

The OCCA Exhibition "Official Guide" is published many weeks before the dates of the Exhibition, so that visitors can obtain copies in advance and plan their itineraries. The "Official Guide" contains full descriptions of Exhibitors' Stands and much other useful information; copies of the "Official Guide" and season admission tickets may be purchased (at £2.00 *each)* either *in advance from the Association's offices* or *at the entrance to the Exhibition, and additional copies of the "Official Guide" will be on sale at the Information Centre (Stand* 32*). Details of additional applicants for Stand space and news of Exhibitors issued since the publishing of the "Official Guide" are given below.*

★ ★ ★ ★ ★ ★ ★ Additional Exhibitors at OCCA-29 ★ ★ ★ ★ ★ ★ ★

In addition to those organisations mentioned in the "Official Guide", stand space has now been allocated to the following companies (for position of stand, refer to plan on page 108).

Stand 69

Albright and Wilson Ltd

The Detergents Sector of the *Albright and Wilson Ltd*, Detergents and Chemicals Group, will be demonstrating its wide range of surfactant materials. The company offers a comprehensive series of anionic, cationic, non-ionic and speciality surfactants which are used in the production of latex emulsion, polymers, paints, inks and surface coatings.

A number of new surfactants will be introduced, including the aqueous pigment dispersant *Empicryl APD*; additionally, ranges of phosphate esters, sulfosuccinates, fatty nitrogen compounds and alkyl methacrylate monomers will be featured.

The Detergents Sector of *Albright and Wilson Ltd* specializes in the manufacture of high quality surfactants tailored to industry's needs. The company manufactures its wide range of surfactants in Whitehaven, Cumbria, with similar manufacturing facilities in Australia, France, Italy, Spain and South Africa, and has sales offices and agents with their own storage and distribution networks in most countries of the world.

Stand 67

Ward Blenkinsop & Co. Ltd

Ward Blenkinsop & Co. Ltd, Wembley, Middlesex, is exhibiting at OCCA -29 this year primarily to launch its new range of "*Quantacure*" UV-curing agents, designed specifically for use in printing inks and surface coatings. Their introduction follows two years of intensive research and development, and complements the company's already well-established range of industrial additives. Blending, printing and curing operations will be demonstrated on the stand, and commercial and technical staff will be available to answer queries and to deal with any specific problems which visitors may have.

Other products already established in the surface coatings industries will also be exhibited, and these include: anti-skinning agents (methyl ethyl ketoxime, n-butyraldoxime; ultra-violet light absorbers the *Aduvex* range of substituted benzophenones); and *Coumalux* optical brightening agents.

Ward Blenkinsop & Co. Ltd is an independent British chemical company, its manufacturing plant being located at Halebank near Widnes, Merseyside. In addition to an extensive range of pharmaceutical and industrial chemicals, confidential custom synthesis facilities are offered. Sales enquiries to head office: Fulton House, Empire Way, Wembley, Middlesex HA9 OLX England.

Stand 68

Cavadell Ltd

The company will show a range of equipment for the surface coatings industries, including micronisers, fluid energy mills, colloid mills, homogenisers and filters. *Cavadell* also has available a range of gellants for both water- and solvent-based paints.

★ ★

Stand 38

A.B.M. Chemicals Ltd

The use of ultraviolet radiation in curing surface coatings has gained widespread acceptance in the USA and continental Europe. *A.B.M. Chemicals Ltd* is exhibiting its range of photosensitisers including the *Glocure* benzoin ethers. These highly cost effective materials ensure maximum utilization of UV energy for the polymerisation process. This results in energy-economy, low pollution and faster line speeds.

Pigmented resin systems may be sensitised to UV light by benzil or benzoin, and these will also be on display.

A range of surface active agents are to be presented. The *Solumins* and *Pentrones* are emulsifying agents for use in emulsion polymerisation and can improve the dispersion of films and modify the wetting characteristics of polymer systems. For preservation of polymer based coatings *Glokill 77* is an effective biocide.

Products for application in non-aqueous coatings, and particularly paints, include *Catafor CA* used as an additive for electrostatic spray paints. More recently, *Catafor POW* has been added to the range and is designed to improve the spraying characteristics in electrostatic powder coating.

The *Glokem Wax* range of products are effective additives for paint systems, improving the hardness and scuff resistance of paints in addition to increasing the moisture-proof qualities and salt spray resistance.

Stand 37

Anchor Chemical Co. Ltd

A comprehensive range of curing agents for epoxide resins will be featured on the *Anchor* Stand.

The latest additions to this range include the *Ancamide 500* series, which are amidoamines. These are low viscosity materials suitable for use in solvent-free coatings, flooring, concrete repair and crack injection compounds.

Ancomer, an associated company, is commissioning a new ester manufacturing plant during 1977 and will be pleased to discuss manufacture of any speciality ester.

Stand 25

Baird & Tatlock (London) Ltd

Baird & Tatlock will be exhibiting a number of instruments including:

Neotec "Du colour" which with one flick of a switch permits an unskilled operator to measure precisely:

(a) colour difference
(b) opacity and brightness
(c) shade differences
(d) CIE X, Y, Z
(f) absolute reflectance/transmittance

Photochemical Reactors. A variety of photochemical reactors is now available for the synthetic photochemist engaged in synthesis employing halogenation, oxidation, polymerisation or degradation methods.

Other items on display will be a *quantum yield photoreactor*, a range of *Brookfield viscometers*, a *micro-viscometer* and other equipment.

Also exhibiting will be *Hopkin & Williams*, suppliers and manufacturers of laboratory chemicals, including their *AnalaR*, *UltraR* and *G.P.R.* ranges of chemicals.

Detailed literature will be available dealing with the *Hopkin & Williams* ranges of chemicals for science and industry.

Stand 11

BOC Automation

BOC Automation, manufacturers of microprocessor and mini-computer control systems, will be showing for the first time in Europe, the new *Hunterlab D54P-5* spectrophotometer, which represents a major breakthrough in spectrophotometer design. It combines the latest micro-computer

From the World of Surface Coatings - Paint Additives from Henkel

HENKEL MAKES GOOD PRODUCTS EVEN BETTER

Make no compromises when quality and profitability are at stake - Henkel products guarantee your sales success.

How much profit you make on your paint sales depends on a great many factors: effective market analysis, keeping ahead with new trends, optimum formulae, economical but effective components, energy conservation, reduced polution, trouble-free processing – the list goes on and on.
Well, we are not going to offer to do any market research for you but we are offering a large selection of surface coating additives, not only designed to improve the quality of your paint but also the profitability.

Henkel

Paint additives for solvent-containing surface coatings

Appearance
Highly suitable
Limited use

Name	Use	Liquid	Paste	Powd.	Additional Comments	Amount to be used	Calculated on
Texaphor	Anti-settling and wetting agent				Incorporation before or after grinding	0.1 – 1.0 %	finished product
Texaphor Special	Anti-settling and wetting agent				Incorporation before or after grinding	0.2 – 0.6 %	finished product
Texaphor 963	Anti-settling, dispersing, anti-flooding and anti-floating agent				Incorporation before or after grinding	0.2 – 2.0 %	pigments and fillers
Texaphor 963 S	Anti-flooding and floating, dispersing, anti-settling agent and grinding aid				Incorporation during grinding	0.5 – 2.0 %	pigments and fillers
Texaphor 277	Anti-settling and wetting agent, pre-dispersing agent for Bentone*) gellants (see data sheet)				Incorporation before or after grinding	0.1 – 0.5 %	finished paint
Product 100	Wetting agent and dispersing agent				Incorporation before grinding	0.2 – 0.5 %	finished paint
Rilanit Special	Thickening and thixotropic agent; Anti-settling and anti-sagging agent				Grinding Temp 35 – 55 °C	0.2 – 2.0 %	finished paint
Rilanit HT	Heat-resistant thickening and thixotropic agent; Anti-settling and anti-sagging agent				Grinding Temp. 40 – 75 °C	0.2 – 2.0 %	finishing paint
Dehysol	Thickening and anti-sagging agent				Allows grinding temps. over 60 °C	0.5 – 2.0 %	finished paint
Dehysol R	Thickening, thixotropic, wetting and dispersing agent				Incorporation before or after grinding	0.2 – 1.0 %	finished paint
Perenol E 1	Air release agent					0.05 – 1.0 %	finished paint
Texaquart 253	Conductivity improver				For electrostatic spray paints	0.2 – 2.0 %	finished paint
Edenol BS 20 N, MS 20 N, IBS	Improve sandability, stackability, scratch resistance and "touch"				Non-gelatinizing plasticizers	see data sheet	
Edenol LFW 101	Improves sandability, stackability of fast sanding primers				Non-gelatinizing plasticizer	see data sheet	
Edenol LFW 100, LFW 104	Improve sandability, stackability of fast sanding primers				Bi-functional special phthalic acid esters	see data sheet	
Edenol 344	Plasticizer with migration resistance, low volatility				For foil coatings	see data sheet	
Edenol D 81, B 316, B 35	Stabilizers, plasticizers and dispersing agents				Epoxidized oils	see data sheet	
Tetrahydronaphthalene	Solvent, flow promotion agent, suspending agent for alu-bronze powder				Avoids cratering	5.0 – 10.0 %	solvents
Decahydronaphthalene	Solvent, flow promotion agent				Avoids cratering	5.0 – 10.0 %	solvents
Dehydril NRC, NRL, N Special	Anti-skinning agents				Methylethylketoxime	0.2 – 3.0 %	drying binder
Alcophor AC	Corrosion inhibiting agent				Inactivates rust residues	2.0 – 3.0 %	finished paint
Perenol F 3	Flow promoter, especially for epoxy, acrylic and polyester powder finishes and coil coatings				Incorporation before grinding	0.5 – 1.0 %	binder

*) Bentone = Registered trademark of NL Industries Inc., USA

We have taken your problems to heart and developed additives which have become recognized "trouble-shooters" in the paint world, i.e.:

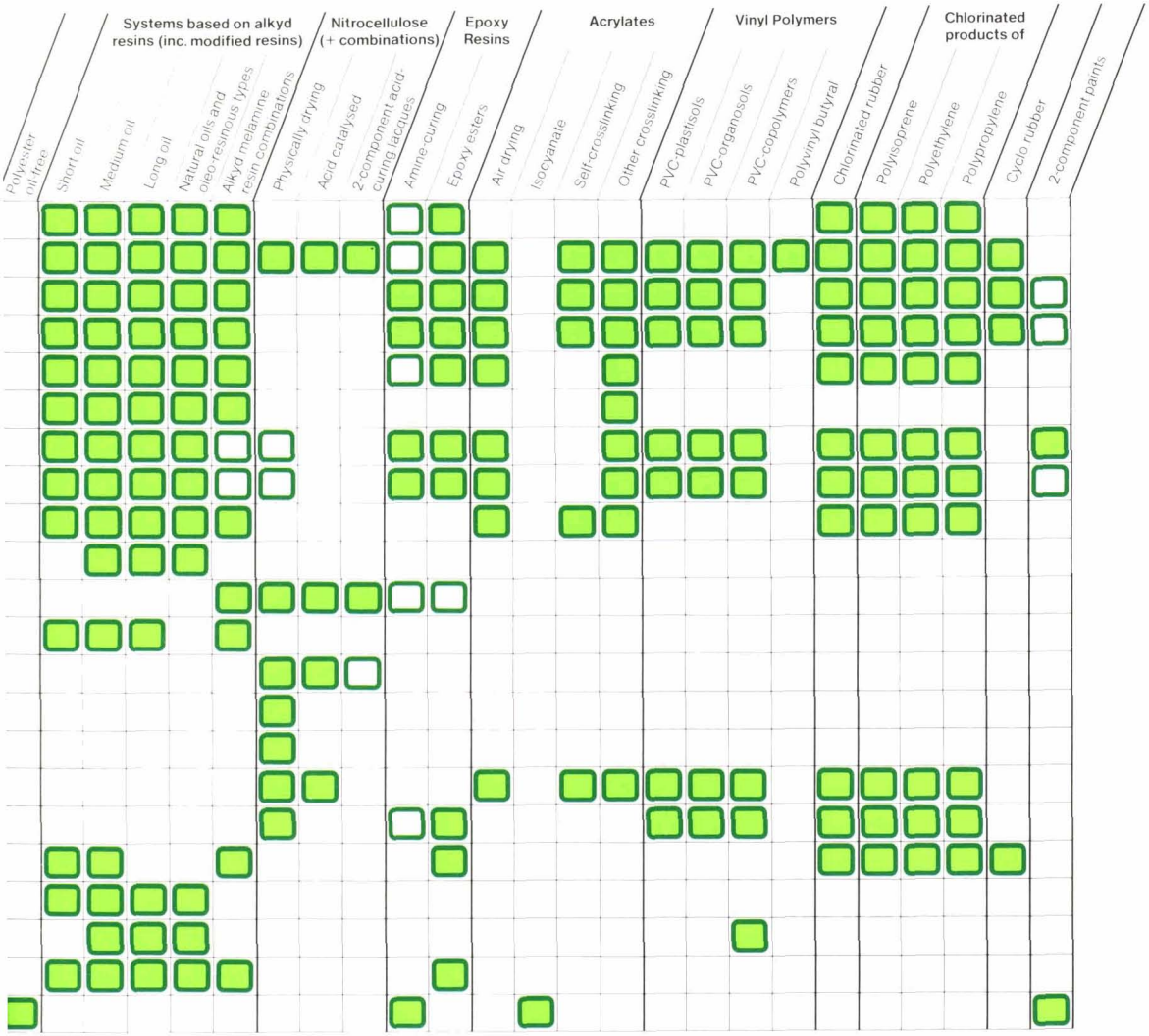
- anti-settling agents and grinding aids
- anti-flooding/floating agents
- wetting and dispersing agents
- thickening and thixotropic agents
- special plasticizers
- solvents
- rust passivators
- anti-skinning agents
- conductivity improvers
- specialty products for water-borne systems, electro-static spraying, powder and coil-coatings.

The following table has been prepared to facilitate your choice of the most suitable additive for your needs and which gives, at a glance, information on:

- the systems in which the additive can be used
- the main properties of the additive
- the average or starting dosage.

We would, of course, be more than pleased to send you technical leaflets and samples or to help you solve any particularly "sticky" technical problems.

Take advantage of our offer and send off the enclosed reply card, today!



New Developments - Specialties

TEXAPHOR® 963 S

Highly effective electroneutral **anti-floating/flooding, anti-settling** and **dispersing agent.**
TEXAPHOR® 963 S is highly suitable for use with the "difficult" pigments: phthalocyanine blue, iron oxide yellow, carbon black and chromoxide green.

PERENOL S 4

Slip-agent for solvent-containing and solvent-free finishes. Improves the scratch and soiling resistance and flow properties. Suitable for paints based on air-drying alkyd resins, alkyd/melamine resin combinations, air-drying, self and other cross-linking polyacryl resins, polyurethanes, nitrocellulose, oil-free polyesters. Dosage 0.1–0.5%, calculated on the finished paint.

RILANIT® HT

Heat resistant thixotropic bodying, anti-sagging and settling agent in powder form for traffic and marine paints.

PERENOL E 1

Silicone-free **air release agent** for nitrocellulose lacquers. Particularly suitable for curtain coating.
Transporting speed of the chip-boards from 20–150 m/min. possible. Also prevents cratering in alkyd melamine stoving enamels.

ALCOPHOR® AC

Corrosion passivator for use in primers and one-coat finishes intended for direct application to metal substrates.
a) inactivates rust deposits still remaining after wire-brushing and hinders new rust formation.
b) absorbs remaining moisture, so that it can have no negative affect on the paint adhesion.
c) absorbs the minute fat and grease residues on the film, also preventing adhesion problems.

PERENOL F 3

Liquid silicone-free **flow agent** for powder and coil-coatings. Cratering, fish-eyes and orange-peel effects, etc. will be prevented. It ensures a smooth surface finish resulting in increased gloss. No reduction in film hardness, delay in drying time or deterioration in adhesion.

Henkel

HENKEL INTERNATIONAL GMBH · DEHYDAG-PRODUKTE
POSTFACH 4320 · D-4000 DÜSSELDORF 1 · GERMANY

processors with *Hunterlab's* renowned optical design expertise, resulting in a system which produces colour measurements with accuracy, speed and flexibility never before achieved by a spectrometer.

In addition, and again for the first time in the UK, *BOC Automation* will be showing an *ACS (Applied Color Systems)* 500 colour control system featuring the latest *DEC* computer equipment interfaced with automatic spectrophotometers such as the new *ACS Spectra-sensor*, and includes a package of computer processor, floppy disk, console terminal, spectrophotometer and interface, computer software including the *ACS Chroma-Pac* library of programmes for colour laboratory and production applications.

Also exhibited will be a *Hunterlab* colorimeter interfaced to a microprocessor for colour measuring and shade sorting of a wide variety of objects and materials. Known as the *Incomat* system, it can provide colour data processing in industries such as ceramics, paints, plastics, papers, textiles, powders and pigments, foods and cosmetics.

BOC Automation—part of *BOC Ltd*—is sole UK sales and service agent for both the *Hunterlab* and the *ACS (Applied Color Systems)* ranges of colour measuring equipment.

Stand 39

Joseph Crosfield & Sons Ltd

A new range of high performance matting agents will make their debut on the *Crosfield* Stand.

From the experience gained in two decades of close contact and collaboration with the surface coating industry, new silicas have been developed for use over a wide range of matting applications. *Crosfield HP43* and *HP94* silicas combine high matting efficiency and good dispersibility with excellent smoothness, clarity and mar resistance in the final film coating.

Stand 49

Glen Creston Ltd

Glen Creston will exhibit manufacturing equipment from *Willy A. Bachofen*, who make *Dyno Mills* for industry and the laboratory.

Glen Creston also supply the *Spex Fluorolog* spectrofluorometer, a digital research grade instrument incorporating double monochromators for excitation and emission. Scattered light is so low that fluorescence is measurable for such intransigents as turbid liquids and rough solids. Its modular construction and very large sampling area makes it suitable for all types of unusual applications. A photon counting detection system is available, which significantly improves signal-to-noise ratio.

In addition to the standard emission and ratio emission measurements, it is possible to measure transmittance, absorption and partial fluorescence efficiency without changing the configuration of the *Fluorolog*. In the ratio emission (or emittance) mode, excitation spectra are corrected automatically by the reference detector. Emission and higher order corrections are possible with the computerised counterpart of the instrument which is known as the *Fluorocomp:* this incorporates the necessary computer and software.

A phosphorimetry attachment is available as well as many other accessories, such as sample heater/cooler, variable temperature accessory and polarization kit.

Stand 65

Eckart-Werke

Stapa is a product of *Eckart-Werke* known throughout the world. For one-hundred years, the name *Eckart* has been closely related with the production of metal powders. Nowadays, *Eckart-Werke* is Europe's largest manufacturer of aluminium and bronze powders, aluminium and bronze pastes, and other non-ferrous metal powders. This leading position is the result of the excellent constant quality of these products, which are produced in modern plants specially designed for the process.

For many years the aluminium pastes, *Stapa Metallic*, have been of great importance. They correspond in a high degree to the demands of the industry for differentiated effects. The corrosion resistance is a special characteristic of the *Stapa Metallic* pastes. This characteristic is strongly marked with the R-types of this paste range. These advantages have also opened the metallic range for other fields of application in the coating industry. The *Stapa Metallic* pastes, newly developed in recent years, meet in all respects the demands of the automotive industry for even brighter and high reflecting metal effect lacquers.

With the new development of the products "*Standart-Spezial-Aluminium Powder PC* 20" and "*Standart-Spezial-Aluminium Powder PC* 100" in different finenesses, *Eckart-Werke* has succeeded in making a decisive opening in the field of powder coating. These powders are suitable for all powder coating systems, especially for epoxy resins, acrylic, polyamide, polyurethane, polyester, polystyrene, and also PVCl formulations.

Stand 60

Hilton-Davis Chemical Co.

Hilton-Davis is a basic manufacturer of pigments, flushed and dispersed colours utilised in the surface coatings industries, printing ink industries and plastic industries. Not only is *Hilton-Davis* a basic manufacturer, but expert *Hilton-Davis* technology, based on 54 years' experience, is built into every product made.

Highlights of *Hilton-Davis* product areas include the following:

Transparent iron oxides: flushed, dispersed, dry pigments.

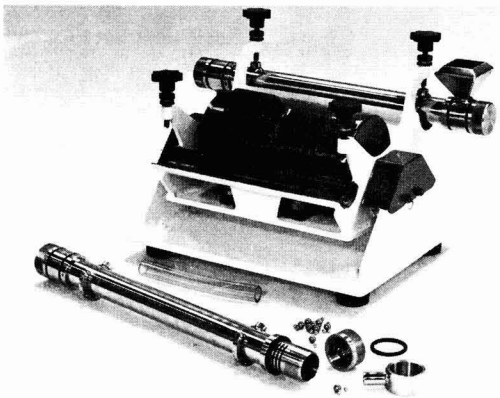
Sup-R-Con non-dusting pigment concentrates.

Microspin resin-encased pigments.

Lead-free pigments.

Dry pigment.

Various *pigment flushings* to meet printing ink and coating requirements.



The Pilamec Ltd "Megapact" vibratory ball mill, which will be displayed at an OCCA Exhibition for the first time this year. The equipment is shown here partially disassembled to illustrate construction of the chambers and ports. (See also page 112.)

Stand 34

ICI Ltd, Mond Division

To show how paints based on chlorinated rubber (CR) satisfy the economic and physical requirements of modern painting practice, *ICI Mond Division*, manufacturers of "Alloprene" chlorinated rubber, have produced an informative leaflet, "9 basic factors in the choice of a paint system". The leaflet considers CR in relation to nine basic factors normally taken into account when deciding upon a paint system. These factors are: surface preparation; method of application; painting off or on site; film thickness; temperature; intercoat adhesion; permeability; ease of use; and resistance to environment.

Copies of the leaflet will be available on ICI's Stand at the Exhibition.

A neutron activation analysis service—likely to be of interest to many industries—is now available from *ICI Petrochemicals Division* on a commercial basis.

The fully confidential service is a non-destructive, instrumental analysis, the results of which will normally be available within 24/48 hours. A priority service can also be provided.

The technique used is to irradiate the sample in a nuclear reactor when some of the atoms of the material will react with neutrons to give new nuclei. Most of these will be radioactive.

A measure of the quantity of each element present in the irradiated materail can be gauged by the intensity of the characteristic radiation which is subsequently emitted by the radioactive nuclei.

In most cases the analysis is non-destructive. The sample is unaffected either chemically or physically by the activation process and the induced radioactivity decays completely within a very short time. Problems of contamination frequently encountered in conventional analytical techniques are thus avoided.

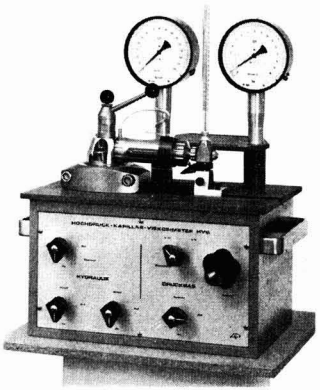
Stand 63

Roban Engineering Ltd

Engineers will be available on *Roban's* stand to discuss the particular problems of storage, pumping and metering of low flash-point solvents.

A "*Turnkey*" project service is available to design and construct solvent bulk storage schemes inclusive of approvals, building, electrical and mechanical work and utilizing pumps and flowmeters of *Roban* manufacture. This range of positive displacement pumps and flowmeters will be exhibited, together with a new high capacity solvent pump for road tanker off loading.

Roban also offer their services in part, such as small building alterations and flameproof lighting, necessitated by the handling of low flash-point liquids in the production process.



Contraves Industrial Products Ltd will be demonstrating its full range of laboratory and industrial instruments for viscosity measurement on Stand 47, including this most recent addition, the HV6 high shear rate capillary viscometer.

Stand 23

Monsanto

Following the successful representation at the 1976 Exhibition, *Monsanto* is exhibiting for the second consecutive year at OCCA-29 and on Stand 23, covering some 25 square metres, will be showing five major speciality lines:

Resimene resins; *RJ*100/101 styrene allyl alcohol copolymers; *Butvar* polyvinyl butyral resins; *Modaflow*, *Multiflow* and *Modaflow Powder II* flow modifiers; and *Silesters* and *Syton* silica binders.

Stand 50

Pilamec Ltd

Pilamec Ltd will exhibit a range of equipment demonstrating the company's expertise in the application of vibrational energy to a range of processes which are important in the manufacture of wet and dry surface coatings. Laboratory, pilot-plant and production equipment will be shown, including high-energy vibration ball mills capable of processing down to sub-micron sizes, and wet and dry blending and dispersing equipment, also based on vibrational technology.

Stand 2

RK Print-Coat Instruments Ltd

RK Print-Coat Instruments Ltd is now handling all sales of *RK Chemical Company Ltd.*

At the 1975 Exhibition, *RK Chemical Company Ltd* introduced a prototype of the *K Control Coater*. This year the production model of *K Control Coater*, as well as an enlarged version to coat 30 × 30cm (12" × 12") panels, will be demonstrated. Larger models are also marketed.

Stand 42

Sachtleben Chemie GmbH

Following the successful introduction of two new chloride grades of *Hombitan* titanium dioxide in 1975, *Sachtleben* will be introducing a new titanium pigment.

Hombitan R 511 is a general purpose rutile grade made by the sulfate process. The excellent dispersibility in enamels, emulsion paints and inks, combined with high tinting strength, haze-free gloss and good resistance to chalking, make *Hombitan R 511* an outstanding pigment for all-round performance.

Stand 66

A. Strazdins Pty.

At the 1977 OCCA Technical Exhibition in London, *A. Strazdins Pty. Ltd* will demonstrate a full range of their improved designs for the *Blendorama colourant dispensers.*

They will demonstrate their single pump 50ml capacity dispensing machines for small and medium stores, together with the double pump 150ml capacity for larger stores and their large 600ml capacity double pumps for bulk blending in factories or depots.

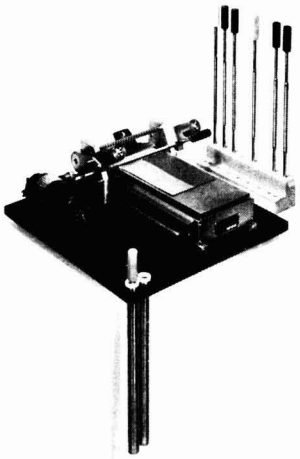
Apart from this, they will display *measuring pumps* for epoxies or any other product which has to be accurately proportioned prior to use.

They cater only for a quality market using stainless steel cylinders and "teflon" slip-rings for all vital parts. In this way, they offer trouble-free, versatile machines with the durability to be expected from high quality precision equipment.

Stand 10

Sheen Instruments

Sheen Instruments (Sales) Ltd will be displaying their updated range of *specular glossmeters* to ASTM, BS and ISO specifications, which provide digital read-out with improved reproducibility of performance.



The K Control Coater film applicator, which will be exhibited by RK Print-Coat Instruments Ltd on Stand 2 (See centre column on this page).

In their appearance and competitiveness these new models maintain much of the character of the well known "*Sheen*" *glossmeters*, but performance has been significantly improved by the development of new integrated circuits to incorporate a digital meter with its attendant advantages.

Similar modifications have been applied to the meter used with their *miniature 45 glossmeter*, *opacity reflectometers and miniature colourmeter*. This meter will be available as an alternative to the conventional galvanometer previously employed with these instruments, thereby increasing their accuracy.

These new meters, together with other instruments, will be available for the measurement of any appropriate test panel which visitors may care to provide.

Stand 29

Tioxide International Ltd

Since its introduction in 1973, the multi-purpose pigment *R-TC4* has become the most important *Tioxide* chloride pigment. The versatile and outstanding qualities responsible for its growing popularity are demonstrated, and up-dated information on its value in all types of media is available.

The comprehensive range of *Tioxide* pigments produced by the sulfate method is illustrated by the five grades *R-HD2*, *R-HD6*, *RXL*, *R-CR2* and *R-XG*. Each of these grades possesses certain qualities valuable in paints, for example, *R-HD6* is best for whiteness, brightness and opacity, while *R-HD2* has excellent wetting and dispersion properties. The distribution of *Tioxide* factories around the globe will be shown, including the most recent of them, in Spain, that came on stream in 1976.

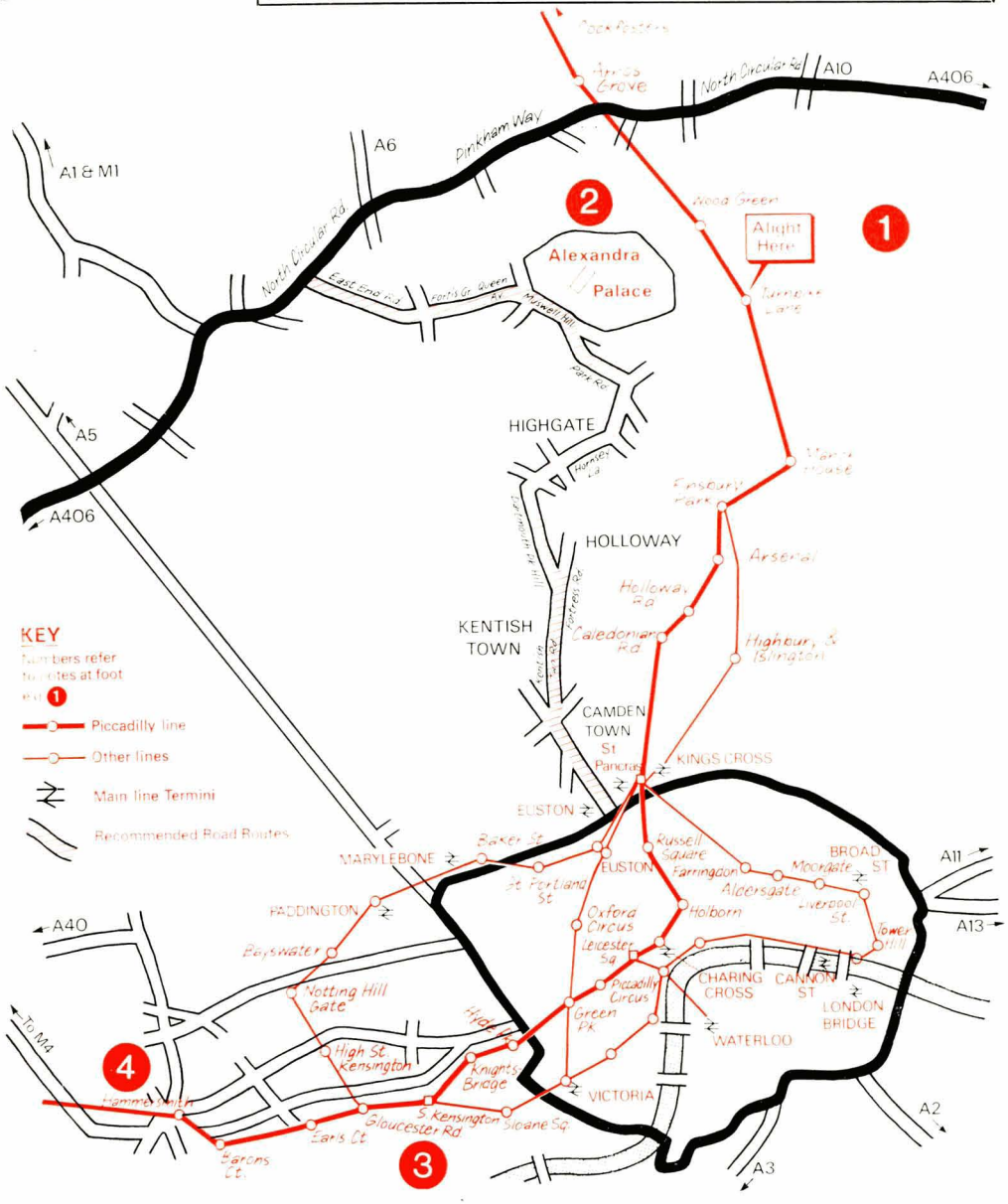
Spindrift is a revolutionary product introduced in 1975 and further researched, in 1976. The *Spindrift* story, in some detail, will demonstrate the cost benefits, the convenience of paint manufacture with *Spindrift*, and *Spindrift's* special value in high-quality vinyl matt latex paints.

Analysis of Exhibits

Stand	Exhibitor	Resins	Extenders, fillers, matting agents	Pigments	Additives, driers, surfactants etc.	Chemical intermediates	Manufacturing equipment, drums etc.	Laboratory apparatus and testing equipment	Miscellaneous
48	AB Metall						•		
38	ABM Chemicals Ltd				•				
48	AMF International Ltd						•		
48	AMK Peter Kupper						•		
52	Amoco Chemicals (UK) Ltd	•				•			
37	Anchor Chemical Co. Ltd	•							Buying agents for epoxide resins
37	Ancomer Ltd	•							Acrylic monomers
11	Applied Color Systems							•	
12	Arcode Ltd	•		•	•				
48	Ateliers Sussmeyer						•		
11	BOC Automation							•	Instrumentation and quality control equipment
49	Bachofen, Willy A						•		
25	Baird & Tatlock Ltd							•	
51	Barford Chemical Co.	•							
48	Berk Ltd						•		
7	Berol Kemi AB	•			•				
14	Brandhurst Co. Ltd	•							
18	Bush Beach & Segner Bayley Ltd		•	•					
56a	Cabot Carbon		•						
27	Charles Tennant & Co. Ltd	•							
17	Chemolimpex	•			•				
45	Ciech Import & Export			•		•			Technical literature and colour cards
43	Colwell			•					
47	Contraves Industrial Products							•	
60	Cornelius Chemical Co. Ltd			•					
18	Degussa		•	•					
48	DH Industries Ltd						•		
5	Diaf A/S						•		
62	Diffusion Systems							•	
55	Dow Chemical Co.	•			•				
36	Draiswerke GmbH						•		
27	Dyno Industrier AS	•							
61	G. J. Erlich Ltd						•		
49	Glen Creston						•		
43, 48	Graco			•					

OCCA-29

For the benefit of intending visitors to the Exhibition, a map is reproduced below of the area around Alexandra Palace showing the mainline stations in central London, the Piccadilly, Circle and Victoria Lines of the underground system and also the road links with the North Circular Road and motorways. See also the enlarged map of Alexandra Palace, reproduced on page 109.



1. A free bus shuttle service will operate between Alexandra Palace and Turnpike Lane station on the Piccadilly Line (Underground), which is denoted by the thick coloured line. Destinations of trains may be marked as "Cockfosters" or "Arnos Grove" or "Wood Green",

2. Those travelling by road will find free car parking facilities at Alexandra Palace. See map on page 109.

3. Visitors arriving at West London Air Terminal may board the Piccadilly Line trains at Gloucester Road station.

4. At present the Piccadilly Line reaches westward as far as Hatton Cross Station and in 1977 will be extended by the addition of a further station in Heathrow Airport Terminal, so that visitors will then be able to travel direct from the airport terminal to Turnpike Lane station. In the meantime, a bus service operates between the air terminal and Hounslow West station on the Piccadilly Line.

5. The map also shows the position of the mainline stations in relation to the Piccadilly Line.

Tioxide®

on stands 29 and 30 at OCCA 1977

U.K. SALES: **BTP TIOXIDE LIMITED** · BILLINGHAM · CLEVELAND TS23 1PS
INTERNATIONAL SALES: **TIOXIDE INTERNATIONAL LIMITED** · LONDON · ENGLAND

OCCA EXHIBITION 1977

March 22-25 1977
Alexandra Palace
London N22

Tuesday/Wednesday/Thursday 09.30-17.30 hours

Friday 09.30-16.00 hours

The Tioxide Stands 29 and 30

OCCA EXHIBITION 22-25 MARCH 1977

Tioxide International Limited: Since its introduction in 1973, the multi-purpose pigment R-TC4 has become the most important Tioxide chloride pigment. The versatile and outstanding qualities responsible for its growing popularity are demonstrated, and up-dated information on its value in all types of media is available.

The comprehensive range of Tioxide pigments produced by the sulphate method is illustrated by the five grades R-HD2, R-HD6, R-XL, R-CR2 and R-XG. Each of these grades possesses certain qualities valuable in paints, e.g. R-HD6 is best for whiteness, brightness and opacity, while R-HD2 has excellent wetting and dispersion properties. The distribution of Tioxide factories around the globe will be shown including the most recent of them, in Spain, that came on stream in 1976.

Spindrift is a revolutionary product introduced in 1975 and further researched in 1976. The Spindrift story, in some detail, will demonstrate the cost benefits, the convenience of paint manufacture with Spindrift, and Spindrift's especial value in high-quality vinyl matt latex paints.

Titanium Intermediates Limited: TIL is the world's largest producer of organic titanates for non-captive use. A comprehensive range of products are manufactured which are used mainly as catalysts and cross-linking agents.

The Tilcom AT range of thixotropes is well known, particularly Tilcoms AT23 and AT33 which have high flash points and are resistant to yellowing. These products, which are simple to use, produce a reversible structure in latex paints.

In other systems titanates are used as non-reversible cross-linking agents. Depending on the system, they can confer a number of desirable properties which include:–

Faster Curing Rates	Increased Adhesion
Reduced Water Sensitivity	Increased Salt Spray Resistance
Improved Impact Resistance	Lower Curing Temperatures
Increased Heat Stability	Modified Rheology

To help you in your search for product improvement, TIL staff are always available and you can meet them on the Stand to discuss new ideas and problems.

Name_____

Company_____

Address_____

_____

_____

Every visitor who brings this form, completed, to the information bureau on the Tioxide Stand No. 29 will be presented with a sample tin of latex paint pigmented with Spindrift.

Analysis of Exhibits—*continued*

Stand	Exhibitor	Resins	Extenders, fillers, matting agents	Pigments	Additives, driers, surfactants etc.	Chemical intermediates	Manufacturing equipment, drums etc.	Laboratory apparatus and testing equipment	Miscellaneous
4	Herbert Smith & Co...						•		
9	Hercules Powder Co. Ltd	•		•	•				
60	Hilton Davis Chemical Co.			•					
14	Honeywill & Stein Ltd	•							
25	Hopkin & Williams					•			Fine chemicals
11	Hunterlab							•	
34	ICI Ltd Mond Division	•			•				
64	Industrial Colours Ltd			•					
48	J. de Vree						•		
13	John Godrich						•	•	
39	Joseph Crosfield & Sons Ltd		•						
41	Jotun A/S						•		
56	K & K Greeff Industrial Chemicals Ltd ..	•		•	•				
36	KWR Chemicals Ltd						•		
53	Kirklees Chemical Co.	•							
8	Laporte Industries Ltd			•		•			
58	Macbeth Colour & Photometry Division, Kollmorgen (UK) Ltd							•	
22	Marchant Bros. Ltd						•		
40	Mastermix Engineering Co. Ltd						•		
23	Monsanto Europe SA	•			•				
35	Montedison	•		•		•			
57	NL Industries Inc.			•	•	•			
21	Netzch						•		
41	Noratom-Norcontrol A/S						•		
48	Oliver & Battle						•		
48	Pamasol Willi Madder						•		
48	Paul Vollrath						•		
50	Pilamec Ltd						•	•	
1	Polymers Paint & Colour Journal								Technical journal and services
24	Porter Lancastrian Ltd								Storage and transport of liquids
2	RK Chemical Co. Ltd							•	
3	Research Equipment (London) Ltd ..							•	
6	Rio Beer						•		
63	Roban Engineering Ltd						•		Process plant installation
15	Rohm & Haas (UK) Ltd	•							

Analysis of Exhibits—*continued*

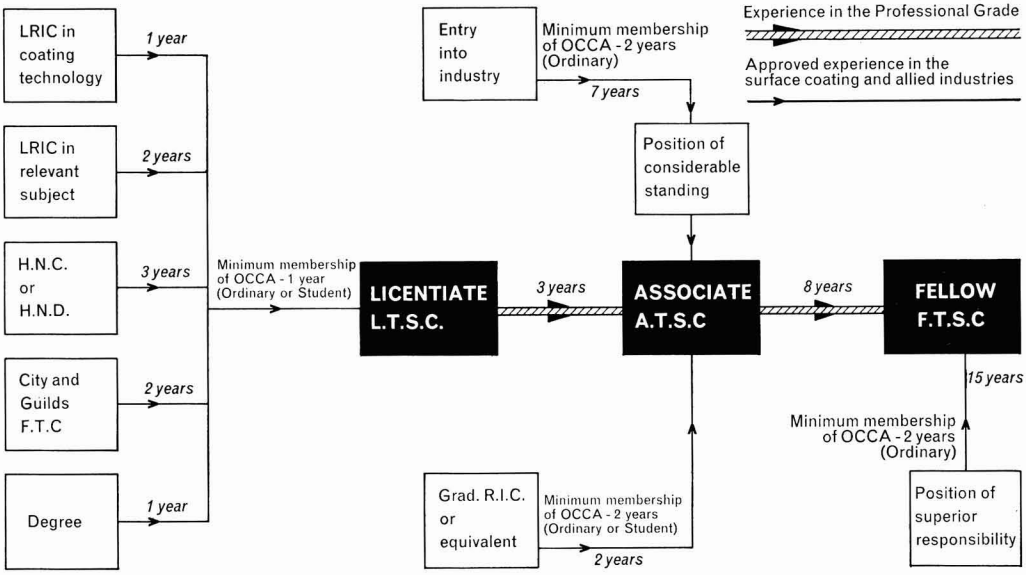
Stand	Exhibitor	Resins	Extenders, fillers, matting agents	Pigments	Additives, driers, surfactants etc.	Chemical intermediates	Manufacturing eqnipmedt, drums etc.	Laboratory apparatus and testing equipment	Miscellaneous
42	Sachtleben Chemie GmbH			•					
36	Schwerdtel GmbH						•		
59	Scientific & Education Aids (ABR) Ltd							•	
44	Shear Colour Ltd			•					
10	Sheen Instruments (Sales) Ltd							•	
54	Sherwin-Williams			•					
19	Silberline Ltd			•					
44	Sweco (Europe) SA						•		
26	Synres International BV	•			•				
28	Synthese BV Division of Akzo Chemie	•							
44	Sun Chemicals Corporation			•					
9	Ten Horn Pigments BV			•					
43	Tenneco Colortrend BV			•					
43	Tenneco Malros Ltd				•				
43	Tenneco Organics Ltd				•				
29	Tioxide International Ltd			•					
30	Titanium Intermediates Ltd					•			
26	Troy Chemical Co. Ltd				•				
14	UCB sa	•							
20	Veb Kombinat Nagema						•		
14	Wallace Knight	•							
44	Warwick Chemical Ltd	•							
4	Werner & Pfleiderer UK						•		
46	Wheatland Journals Ltd								Technical journals and services
16	Wordsall Chemical Co. Ltd	•							
69	Albright & Wilson Ltd (Late applicant)				•				
68	Cavadell (Late applicant)							•	
65	Eckart Werke (Late applicant)			•					
66	A. Strazdins (Pty) Ltd (Late applicant)								Colorant dispensers
67	Ward Blenkinsop & Co. Ltd (Late applicant)				•				UV curing agents

The 1978 Exhibition (OCCA-30) will be held from Tuesday 18 to Friday 21 April 1978 at Alexandra Palace, London N.22

Optional Professional Grade for Ordinary Members

The innovation of the Professional Grade has proved to be most successful, as evidenced by the impressive list of names in the December 1975 issue of the *Journal*. For the convenience of potential applicants, a chart indicating different routes to the various grades is shown below.

Routes to the Professional Grades



Note: At present there is no restriction on Students up to 21; between 21 and 25 a certificate from the employer or college confirming the course being taken is required.

Regulations for admission to the Professional Grade

Note: For the sake of simplicity, reference is made only to UK examinations etc., but equivalent qualifications overseas will naturally be accepted.

A. Licentiate

1. Shall be an Ordinary Member of the Association and have been an Ordinary Member or Student of the Association for not less than one year.

2. Shall have attained the age of 22.

3. (a) Shall be a Licentiate of the Royal Institute of Chemistry in Coatings Technology (*viz.* Higher National Certificate + Endorsement in coatings technology + 1 year approved experience in the science or technology of coatings after passing the endorsement examination).

OR (b) Shall be a Licentiate of the Royal Institute of Chemistry in another relevant subject such as advanced analytical chemistry, colour chemistry or polymer science, and shall have two years' approved experience of coatings since so qualifying.

OR (c) Shall hold the Full Technological Certificate of the City and Guilds of London Institute in a relevant subject as approved by the Professional Grade Committee and shall have two years' approved experience in the science or technology of coatings since gaining the FTC.

OR (d) Shall have passed Higher National Certificate or Higher National Diploma with three years' approved experience in the science or technology of coatings since qualifying, but two years' approved pre-qualification experience shall be deemed equivalent to the third post-qualification year.

OR (e) Shall be graduate in relevant subject with not less than 1 year's approved experience.

OR (f) Shall have passed such other qualifications as approved by the Professional Grade Committee from time to time.

4. Shall be required to satisfy the Professional Grade Committee, or some other body approved by the Professional Grade Committee in a *viva voce* examination and submit a dissertation on a topic previously approved by the Professional Grade Committee.

5. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.

6. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

B. Associate, being already a Licentiate

1. Shall, since his election to the Licentiateship, have practised the science or technology of coatings for not less than three years.

2. Shall provide evidence acceptable to the Professional Grade Committee of his superior professional skill and maturity.

3. Shall hold the City & Guilds of London Institute Insignia Award OR shall submit a thesis or dissertation of comparable level on a topic previously approved by the Professional Grade Committee OR shall have published work which, in the opinion of the Professional Grade Committee, is of comparable merit.

4. MAY be required to satisfy the Professional Grade Committee or some other body as approved by the Professional Grade Committee in a *viva voce* examination.

5. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.

6. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

C. Associate, not already a Licentiate

EITHER

1. Shall be not less than 24 years of age.

2. Shall be an Ordinary Member of the Association and have been an Ordinary Member or Student of the Association for not less than two years.

3. Shall hold the Graduateship of the Royal Institute of Chemistry or Council of Physics or a University or Council of National Academic Awards degree recognised by the Royal Institute of Chemistry or Institute of Physics as giving full exemption from the Graduateship examination.

4. Shall have not less than two years' approved post-graduate experience in the science or technology of coatings.

5. Shall normally be required to satisfy the Professional Grade Committee or some other body approved by the Professional Grade Committee, at a *viva voce* examination.

6. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.

7. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

OR

8. Shall be not less than 30 years of age.

9. Shall be an Ordinary Member of the Association and have been an Ordinary Member of the Association for not less than two years.

10 Shall have been engaged in practising the science or technology of coatings for not less than seven years and shall have attained a position of considerable standing in the industry.

11 Shall normally be required to satisfy the Professional Grade Committee in *viva voce* examination of his professional competence.

12 Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either Associate or Fellow) at least one of whom must be a Fellow.

13 Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

D. Fellow

Note: This is the senior award of the professional grade and signifies that the holder has made outstanding contributions to the science or technology of coatings or has reached a position of eminence in the industry through the practice thereof. The Professional Grade Committee will require substantial evidence of professional maturity in the science or technology of coatings although commercial experience will be taken into account in assessing the merits of candidates.

1. Shall be not less than 33 years of age.

2. Shall have been an Ordinary Member of the Association for not less than two years.

3. Shall be engaged in a position of superior responsibility in the coatings industry.

4. EITHER (a) shall have been an Associate of the professional grade for at least eight years;

   OR (b) shall have not less than fifteen years' experience of the science or technology of coatings in a position of superior reponsibility.

5. Shall submit, with his application, an account of his experience, with due reference to scientific and technological interests, achievements and publications.

6. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade, all of whom must be Fellows.

7. Shall have paid the fee stipulated by the Council and have paid the current subscription payable by an Ordinary Member.

The fees payable with applications are as fellows:

Fellow—£10.00 Associate—£6.00
Licentiate—£3.00
(Plus VAT at standard rate)

Application

Completed application forms should be returned, together with the appropriate remittance, to the Director & Secretary at the Association's offices (except in the case of those Members attached to the Auckland, South African and Wellington Sections who should address their forms to their Section Hon. Secretaries).

The Committee wishes it to be known that Members rejoining the Association after a period in other industries may include length of service as an Ordinary Member before their resignation as part of the qualifying periods for entry into the Grade.

Students wishing to apply for entry into the Professional Grade must first make application in writing for upgrading to Ordinary Membership, giving the reasons for their eligibility for such regrading. Applications, together with the appropriate remittance, should be addressed as for application for admission to the Professional Grade.

Potential applicants are recommended to give the fullest possible details of their appointments, including the number and type of staff under their control, and indicating to whom the applicant is responsible, as this aids the committee considerably in its deliberations.

It is felt that applicants for admission to the Licentiate grade might wish to have further information on the pattern which it is suggested should be followed for dissertations, the subjects of which have first to be approved by the Professional Grade Committee.

The dissertation should be preceded by a short summary and commence with a brief introduction and some account of the current state of knowledge. Where practicable it should follow the general format of a paper in *JOCCA*.

The dissertation may be a review of a subject, a theoretical treatment, descriptive of practical work or a combination of these. It must indicate that the candidate has a reasonably wide and up-to-date knowledge of his chosen subject and understands the basic scientific principles underlying it, and that he is able to think critically and constructively.

Where practical work is described, some attempts should be made to draw theoretical conclusions or to form some provisional hypothesis, together with an outline of what further work would be required to confirm the views put forward or further to advance the knowledge of the subject.

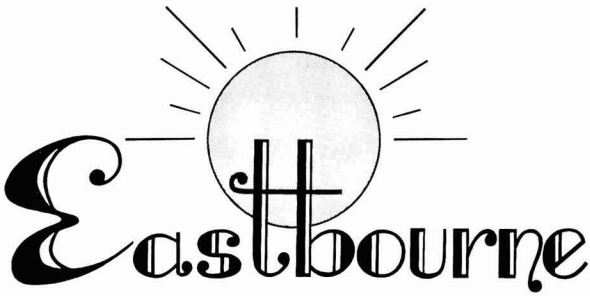
Where the dissertation is a review or a theoretical treatment, there should be an attempt to contrast and compare any opposing views expressed in earlier works, to examine the views critically, to suggest any compromise interpretation, to account for all the known facts and to outline any further work by which the opposing views could be tested.

Where applicable, references should be given to published work, graphs, diagrams etc. to be appended.

Length: Text should be approximately 5 000 words.

Applicants should refer to the paper by Moss which appeared in the January 1973 issue; the Professional Grade Committee feels that candidates for the Licentiate grade could with advantage use this paper as a model for their dissertations.

ASSOCIATION CONFERENCE 1977



Conservation of energy, materials and other resources in the surface coating industry

In the November 1976 issue of the *Journal* (pp 420–425) full details were given of the lectures which are to be presented at the Association's Conference together with biographies of the lecturers.

Copies of the Conference brochure and registration form were enclosed in all copies of the December 1976 issue of the *Journal* sent to Members attached to the General Overseas Section and non-member subscribers to the *Journal*. The brochures have been sent to all Members attached to the UK and Irish Sections with Section circulars. Any non-member who has not yet received a copy of the brochure and wishes to register for this important Conference should apply for the necessary form to the Association's offices. Non-members wishing to avail themselves of the preferential Conference fee for Members may do so, by sending in **a membership application form at the same time as they submit their Conference registration form** and the fee enclosed should cover both the Membership entrance fee, 1977 subscription and the Conference registration fee. Membership application forms can be obtained from the Association's offices.

The registration fees for the Eastbourne Conference will be £40.00 (plus Value Added Tax at the standard rate) for Members, £60.00 (plus VAT) for non-members and £15.00 (plus VAT) for wives.

The Association Conference has been organised on this occasion to include a weekend and it will assemble on the evening of Thursday 16 June 1977 and disperse on the morning of Sunday 19 June. The headquarters of the Conference will be the Grand Hotel, Eastbourne, Sussex, England, where the lecture sessions will be held on Friday 17 and Saturday 18 June. The Association's AGM will take place on 18 June at the Grand Hotel.

Preprints of the papers will be prepared in the coming months and will be circulated to those who have registered for the Conference several weeks before the event, so that lecturers will be able to give a brief introduction to the topic and a longer period will then be available for discussion purposes. This has been the practice at previous Association Conferences and has proved of immense value to those attending.

Of the thirteen papers being presented to the Conference, two from the United States are designated as being presented on behalf of the FSCT, one from Germany is being presented on behalf of FATIPEC, and a paper from Holland is being presented on behalf of the SLF (see page 84 of the February issue of the *Journal*). Further details will be available on the Information Centre (Stand 32) at the forthcoming OCCA–29 Exhibition being held from 22 to 25 March at Alexandra Palace.

A full social programme has been arranged for the benefit of those attending the Conference, including delegates' wives, and this includes golf and table tennis tournaments, and coach parties to places of interest and beauty spots in the locality.

A theatre party and a Reception for Overseas Visitors will be arranged for the evening of 16 June, a Civic Reception for the evening of 17 June, and the Association's Dinner Dance for the evening of 18 June.

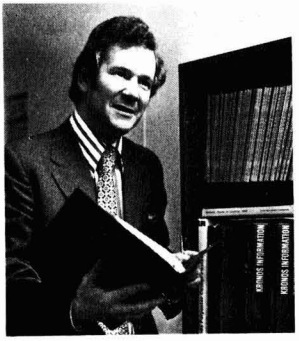
News of Members

Mr W. R. Lunt, an Ordinary Member attached to the West Riding Section and a Fellow of the Professional Grade, has recently joined Whitford International Ltd—Consulting Engineers of Leeds as a coatings and corrosion consultant.

Mr C. A. Soman, an Ordinary Member attached to the General Overseas Section, has been appointed Technical General Manager for Tespenos Espanoles S.A., Barcelona, Spain.

Before joining Terpenos Espanoles, Mr Soman was associated with Emery Industries, Crosby Chemicals, Newport Division of Reichhold Chemicals, and recently as development supervisor for Union Camp Corporation, all of USA. In his present position, he will be responsible for the R & D process, production and international development activities of Terpenos Espanoles S.A.

Mr C. N. Finlay, attached to the Newcastle Section, currently the Association's Hon. Research and Development Officer, and an Associate in the Professional Grade, has recently been appointed Technical Manager Market Development with Durham Chemicals Ltd. The appointment and others at the Birtley works have been made as part of a programme of increased support for the current and future product ranges of Durham Chemicals and Durham Raw Materials.



Mr R. Barrett, an Ordinary Member attached to the Midlands Section, who has recently returned from a lecture tour of South Africa, where he presented papers to the Transvaal Section and at the Division's 6th National Symposium in Port Elizabeth.

Mr M. Cowley, an Ordinary Member attached to the Midlands Section, has been appointed Technical Services Manager of Binks Bullows Ltd, Brownhills, Staffs. He will be responsible for the company's demonstration facilities, equipment evaluation, materials assessment and liaison with paint suppliers.

OCCA Anniversary

Diamond Jubilee

In May 1978 the Association will celebrate the sixtieth anniversary of its foundation and it is felt that Members (and others who wish to take part in the celebrations) would like to have as much notice as possible of the dates. Following the pattern successfully used at the Association's Fiftieth Anniversary in 1968, the main events will be on two consecutive days. On the evening of Thursday 11 May it is planned to hold at a City Livery Hall a Commemorative Lecture, followed by a Dinner to which Past Presidents, Past Honorary Officers of the Association, Honorary Members and the surviving Founder Member will be invited as guests. On Friday 12 May the Association's Dinner and Dance will be held at the Savoy Hotel, London WC2 and Presidents of other societies, together with their ladies, will be invited to attend.

West Riding Section

Golf Tournament

In October 1976, the Section held its annual Gold Tournament on the Knaresborough course; the weather was kind and there was a good turn out, fifteen players competing for an impressive array of prizes. The eventual winner of the main competition for the Chairmans' Cup was Mr A. Wood, with Mr T. Wright a close runner-up.

The best Stableford score of the day was recorded by Mr P. Kerr of the Newcastle Section, who won the visitors' prize, and scooped the sweep, which found its way to the bar, to complete a very pleasant day.

The Section records its appreciation for the prizes, donated by the following companies: BTP Tioxide, Synres Ltd, BASF, Silver Paint & Lacquer, and K. & K. Greeff Industrial Chemicals.

Register of Members

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

Ordinary Members

BORRELL, WILLIAM, LRIC, 100 Westminster Road, Failsworth, Manchester M35 9HW *(Manchester)*

CHANG, MIKE, PhD, Pitney Bowes, Corporate R & D, Walnut & Pacific Street, Stamford, Ct. USA 06904 *(General Overseas)*

MARR, PETER, BSc, PhD, Reed Pigment Division, 199 New Toronto Street, Toronto, Ontario M8V 2E9, Canada *(Ontario)*

PETERS, EDWARD ALAN, BSc, 15 Woodland Way, Alkrington, Middleton, Manchester *(Manchester)*

RAJU, KONDA AHOBALA, MSc, 15/1 Hindusthan Park, Calcutta 29, India *(General Overseas)*

ROWLEY, GRAHAM NIGEL, MSc, BSc, 16 Park Avenue, St. Albans, Herts *(London)*

YUEN, SHU WAH, 606 Po Hing Building, San Po Kong, Kowloon, Hong Kong *(General Overseas)*

Associate Member

GROOTVELD, FRANS, 858 York Mills Road, Don Mills, Ontario M3B 3A8, Canada *(Ontario)*

Registered Students

JONES, RICHARD DAVID, 271 Lichfield Road, Shelfield, Nr. Walsall, West Midlands *(Midlands)*

PIEARCE, COLIN GEOFFREY, Batchelor Robinson Coatings Ltd, Middlemore Lane West, Aldridge, Walsall, West Midlands *(Midlands)*

Forthcoming Events

Details are given of Association meetings in the United Kingdom and Ireland up to the end of the month following publication and in other parts of the world up to the end of the second month following publication.

March

Thursday 3 March

London Section: "Flammability testing and its relevance to flame retardant paints" by Mr A. G. Walker, Associated Lead Manufacturers Ltd. Evening meeting at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London W.1, commencing at 7.00 p.m.

Newcastle Section: "The value of mechanical tests in assessing paint performance and their relevance to specifications" by Mr C. E. Hoey, Ministry of Defence.

Monday 7 March

Hull Section: Ladies' Evening: "Antiques" by Mr G. Baitson of the Edwardian Auction Galleries, to be held at the "George Hotel", Land of Green Ginger, Hull, commencing at 6.30 p.m.

Manchester Section: "High solids water reducible animoplast crosslinkers for modern coatings" by Dr M. Donnez, Monsanto Europe SA, to be held at The Woodcourt Hotel, Sale, Cheshire, commencing at 6.30 p.m.

Tuesday 8 March

West Riding Section: "Titanium dioxide pigment selection for water based glosses" by Mr J. Clark, of BTP Tioxide Ltd, to be held at the Griffin Hotel, Boar Lane, Leeds, commencing at 7.30 p.m.

Thursday 10 March

Midlands Section—Trent Valley Branch: An informal discussion on paint exporting, with Mr L. Silver, Silver Paint and Varnish Co., to be held at the Crest Hotel, Pastures Hill, Littleover, Derby, commencing at 7.00 p.m.

Scottish Section: "Primers for wood finishes". Progress report on Scottish Section research project to be held at the Beacon's Hotel, 7 Park Terrace, Glasgow, G3 at 6.00 p.m.

Wednesay 16 March

Manchester Section: Student works visit in the afternoon to ICI Ltd, Organics Division, ARTS Block.

Scottish Section—Eastern Branch: Annual General Meeting followed by a film show to be held in the Carlton Hotel, North Bridge, Edinburgh at 7.30 p.m.

Friday 18 March

Midland Section: "Newton Friend" Lecture—Ladies Invitation, to be held at Birmingham Chamber of Commerce and Industry at 7.30 p.m. "A Victorian magic lantern entertainment" by Mr M. J. Simpkins.

Tuesday 22–Friday 25 March

OCCA-29 Technical Exhibition, Alexandra Palace, London—see pages 107 to 116 for further details.

Wednesday 23 March

Ontario Section: "Organic pigments for trade sales paints" by Mr R. E. Edelman, Du Pont USA. To be held in the Starlight Room, Skyline Hotel, Toronto.

Thursday 24 March

Thames Valley Section: "Return of the vulture" by Dr M. Clarke of the City of London Polytechnic. A talk on corrosion, to be held at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks at 6.30 for 7.00 p.m.

Friday 25 March

Bristol Section: "Lead chromes, their present uses and future trends, with particular emphasis on recent regulations" by Mr R. M. W. Wilson of SCC Colours Ltd, to be held at the Royal Hotel, Bristol at 7.15 p.m.

Irish Section: "Solvents and safety" by Mr C. W. Andrews, BP Chemicals Ltd, to be held at the Clarence Hotel, Dublin at 8.00 p.m.

April

Friday 1 April

Midlands Section—Trent Valley Branch: Annual General Meeting, followed by Buffet Dance at Cross Keys Inn, Turnditch, at 7.30 pm.

Tuesday 12 April

West Riding Section: Annual General Meeting to be held at the Griffin Hotel, Bear Lane, Leeds commencing at 7.30 pm.

Thursday 14 April

Newcastle Section: Annual General Meeting at Belle Vue Hotel, Low Fell, Gateshead.

Scottish Section: AGM followed by a Ladies Evening to be held at the Beacon's Hotel, 7 Park Terrace, Glasgow G3 at 6.00 pm.

Thursday 21 April

Thames Valley: Annual General Meeting and talk on "Furniture" by Mr L. E. D. Baskerville of Parker Knoll Ltd (Ladies invited) to be held at the Beaconsfield Crest Motel (White Hart), AylesburyEnd, Beaconsfield, Bucks at 6.30 for 7.00 pm.

Midland Section: Annual General Meeting to be held at Birmingham Chamber of Commerce and Industry, Harbourne Road, Edgbaston B.16 at 6.30 for 7.00 pm.

London Section: Annual General Meeting.

Friday 29 April

Bristol Section: Annual General Meeting to be held at the Royal Hotel, Bristol at 7.15 pm.

Irish Section: Annual General Meeting to be held at the Clarence Hotel, Dublin at 8.00 pm.

CLASSIFIED ADVERTISEMENTS

Classified Advertisements are charged at the rate of £3.00 per cm. Advertisements for Situations Wanted are charged at 80p per line. A box number is charged at 50p. They should be sent to C. A. Tayler, BSc, Assistant Editor, Oil & Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF. JOCCA is published EVERY month and Classified Advertisements can be accepted up to at least the 12th, and in exceptional circumstances the 20th of the month preceding publication. Advertisers who wish to arrange for an extension of the copy deadline should contact the Assistant Editor, Mr C. A. Tayler, at the address given above (telephone 01-908 1086, telex 922670 OCCA Wembley).

SITUATIONS VACANT

Chemist/Paint Technologist South Herts

Our Client, a member of a large group and operating on a world-wide basis, have been manufacturing paints for nearly 100 years. Their growth, characterised by a policy of specialisation, has led to an involvement in product finishes, protective coatings and paints for the marine industry.

They now require a Chemist/Paint Technologist, with experience in the paint and allied industry, for development of the company's products and with some involvement in customer liaison.

The company offer an excellent salary for the right candidate with usual company benefits and assistance with relocation if required.

Telephone Elizabeth Allen, Luton (0582) 417562, PER, 56 Park Street, Luton, Beds.

PER PROFESSIONAL and EXECUTIVE RECRUITMENT

This vacancy is open to male or female candidates.

SITUATIONS WANTED

Paint Technologist, 32, with wide experience in formulation, testing and manufacture of modern industrial paints, seeks opportunity in overseas. Languages: fluent German, English and some Spanish. Box No. 439.

AT ANY TIME
DAY OR NIGHT

TELEX YOUR CLASSIFIED

FOR

JOCCA

Telex 922670 (OCCA Wembley)

See above for details of rates for Classified Advertisements.

BOOKS WANTED

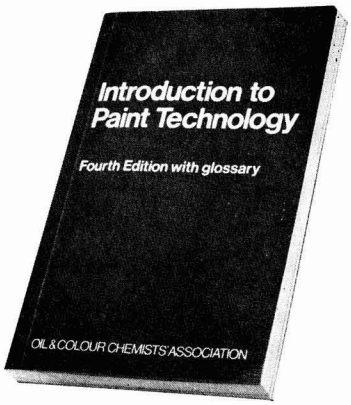
Books Wanted: Overseas student particularly wishes to obtain complete set of the Paint Technology Manuals Parts I-VII. Please state in reply whether the copies of Parts I-III are the first or second edition and the price required. Box No. 435.

BOOKS FOR SALE

Retired member of the Association wishes to dispose of copies of JOCCA 1948–76 (less one copy March 1956) unbound. £10.00 o.n.o. Box No. 437.

INTRODUCTION TO PAINT TECHNOLOGY

New fourth edition now available



The Association's extremely popular book "Introduction to Paint Technology", which forms an excellent introduction to the whole field of surface coatings and related technologies and which has already sold over 16 000 copies, has now been completely revised and updated in a new fourth edition. An important addition in this latest printing is a glossary of most of the chemical and technical terms used in the text: this has been included for the benefit of those readers who require a less superficial knowledge of paint formulation. A brief account of the history and development of chemistry and chemical symbols, formulae and equations is included as an introduction to the glossary itself.

Copies of the book are available at £5.00 each (prepayment only), post free by surface mail, from:

OIL AND COLOUR CHEMISTS' ASSOCIATION
Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF

and from the Association's stand at the Exhibition,
Stand 32, the Information Centre.

INDEX TO ADVERTISERS

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OIL & COLOUR CHEMISTS' ASSOCIATION

TECHNICAL EXHIBITION

22-25 MARCH 1977

The motif, designed by Robert Hamblin, uses red arrows to symbolise how exhibitors and visitors are drawn from all points of the compass to the Exhibition. The heads of the red arrows form white arrows in the opposite direction showing the subsequent spreading of knowledge of technical advancements from this unique annual focal point for the surface coatings industries.

TRAVEL ARRANGEMENTS FOR VISITORS TO OCCA-29

In recent years, travel arrangements have been improved by the addition of the Victoria Line to the Underground system, which now links Victoria Station to the Piccadilly Line at Finsbury Park. The building of the extension of the Piccadilly Line from Hounslow to the Airport terminal at Heathrow is now well advanced and when this is completed it will give a direct link with Turnpike Lane Station on the Piccadilly Line. In the meantime, a bus service operates from Heathrow Airport to Hounslow West Station. Those travelling by the Piccadilly Line should alight at Turnpike Lane Station and the Association will be running a bus shuttle service from this station to and from Alexandra Palace. The journey from central London to Turnpike Lane takes approximately 18 minutes.