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**REVIEW ISSUE**

# JOURNAL OF THE IL & COLOUR CHEMISTS' ASSOCIATION

The use of arsenates as reinforcing toxicants in soluble antifouling paints based on cuprous oxide

*V. Rascio, J. J. Caprari, M. J. Chiesa, R. D. Ingheniero*

Developments in electropaint coatings

*R. L. Nicolay*

Liquid polybutadiene resins for surface coatings

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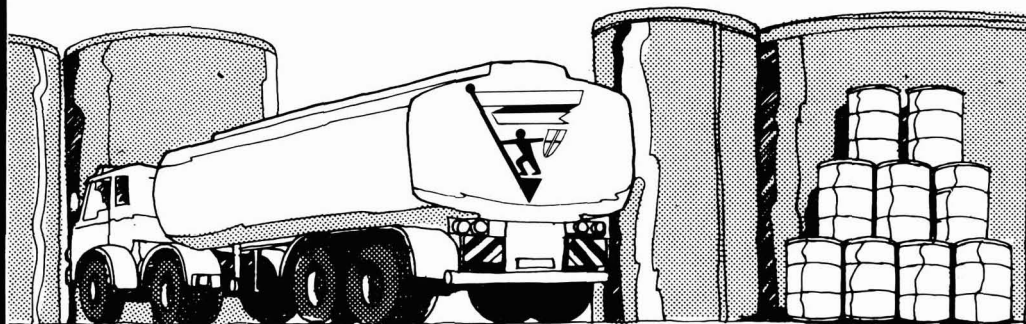
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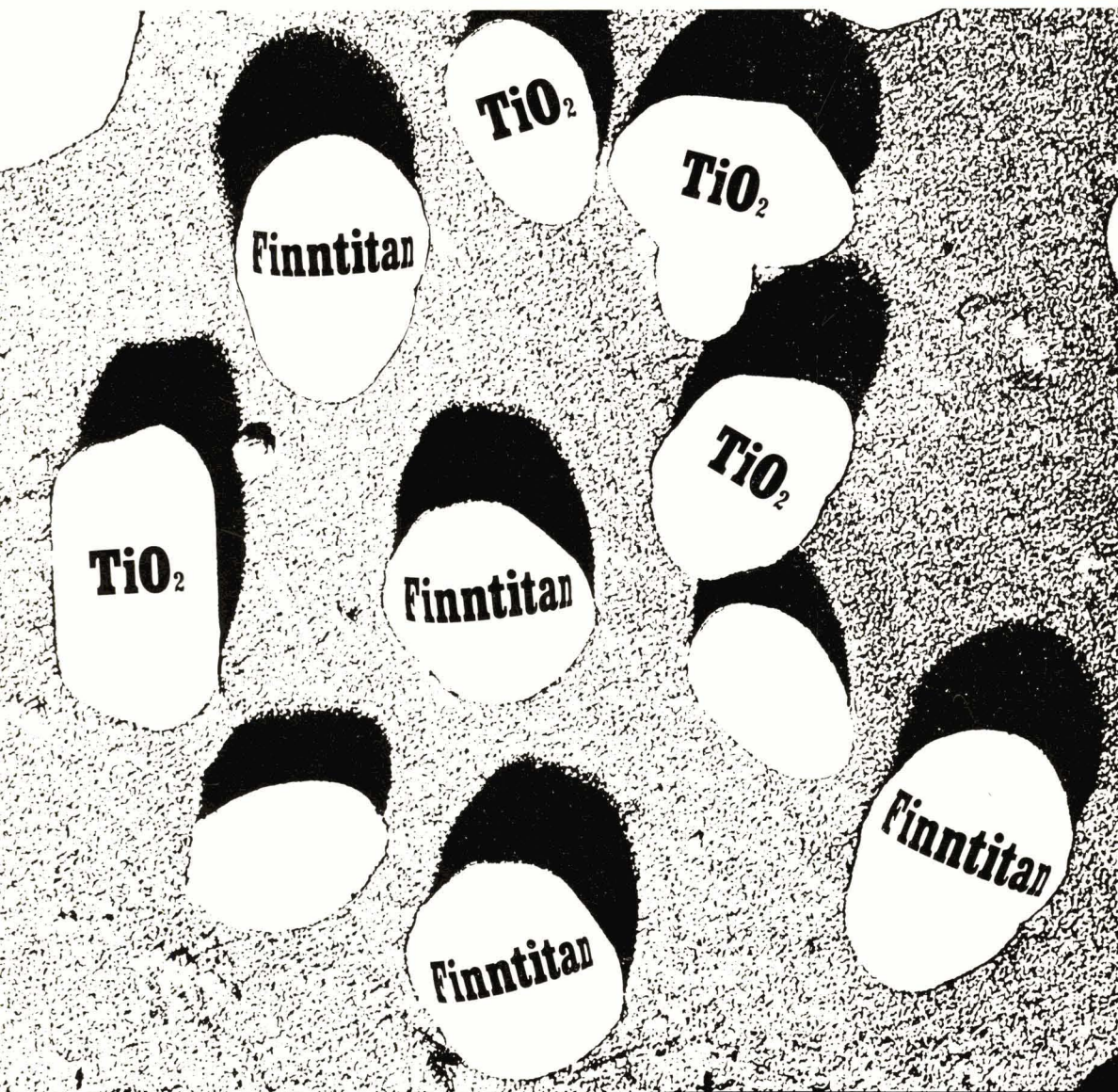
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Hon. Editor: S. R. Finn, B.Sc, FRIC, FTSC

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Vol. 60 No. 5

May 1977

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Annual subscription to non-members:  
 £25.00 (\$50), post free by surface mail,  
 payable in advance.

Single copies £2.50 (\$5), post free by  
 surface mail, payable in advance.

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Published by

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

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# The use of arsenates as reinforcing toxicants in soluble antifouling paints based on cuprous oxide

By V. Rascio, J. J. Caprari, M. J. Chiesa and R. D. Ingeniero

CIDEPINT, Research & Development Centre for Paint Technology, Le Plata, Argentina.

## Summary

This work was designed to formulate long life antifouling paints based on cuprous oxide and with cuprous oxide supplemented by other toxicants such as mercurous orthoarsenate, calcium arsenate, zinc arsenate and lead arsenate. The arsenates were prepared in the laboratory and the solubility of these toxic compounds in water and in a sodium chloride solution 3.4 per cent (artificial sea water) was determined by chemical methods and by atomic absorption.

Sixteen samples of antifouling paints with different pigment combinations in the same soluble binder (resin WW plasticized with a phenolic varnish) were tested in an experimental raft. The effectiveness of the paints with mercurous orthoarsenate and lead arsenate was demonstrated. Some of these formulations gave good protection during 12, 15 and 20 months.

## Keywords

### *Types and classes of coatings and allied products*

antifouling coating  
ship bottom paint

### *Raw materials:*

#### *prime pigments and dyes*

copper oxide  
zinc oxide

#### *binders (resins, etc)*

resin  
phenolic resin

### *biologically active ingredients*

copper salt  
zinc oxide  
mercurous arsenate  
zinc arsenate  
calcium arsenate  
lead arsenate

## L'emploi d'arsénates en tant qu'agents toxiques supplémentaires en peintures "anti-fouling" solubilisables à base de l'oxyde cuivreux

### Résumé

Cette étude a été conçue en vue de mettre au point les formules de peintures "anti-fouling" de longue vie, à base soit de l'oxyde cuivreux soit de l'oxyde cuivreux supplémenté par d'autres agents toxiques tels que l'orthoarséniate mercurieux, l'arséniate de chaux, l'arséniate de zinc, et l'arséniate de plomb. Ces arsénates ont été préparés dans le laboratoire, et leur solubilité à l'eau et à une solution aqueuse de 3,4% de chlorure de sodium (eau de mer artificielle) a été dosée par des méthodes chimiques et par l'absorption de spectre atomique.

Sur un radeau expérimental on a essayé seize échantillons de peintures "anti-fouling" contenant de diverses combinaisons pigmentaires et basées sur le même liant solubilisable (colophane WW plastifiée par un vernis formo-phenolique).

L'efficacité des peintures basées sur l'orthoarséniate mercurieux et l'arséniate de plomb a été démontrée. Certaines peintures donnaient de bonne protection pendant 12, 15, et 20 mois.

## Der Einsatz von Arsenaten als verstärkende Giftstoffe in löslichen, auf Kupferoxydul basierenden Antifoulingfarben

### Zusammenfassung:

Ziel dieser Arbeit war Antifoulingfarben von langer Lebensdauer zu entwickeln und zwar solche, die auf Kupferoxydul basieren und durch Kupferoxydul zuzüglich anderer Giftstoffe wie Merkuro-ortho-Arsenat, arseniksaures Kalzium, arseniksaures Zink und arsenikgaures Blei ergänzt wurden. Die Arsenalsalze wurden im Laboratorium hergestellt, und die Löslichkeit dieser Giftstoffe in Wasser, sowie einer 3,4% Kochsalzlösung (künstliches Seewasser) durch chemische Methoden und atomare Absorption bestimmt.

Sechzehn Muster von verschiedene Pigmentkombinationen und das gleiche lösliche Bindemittel (Kolophonium WW weichgemacht mit Phenolharz) enthaltenden Antifoulingfarben wurden auf einem Prüfraft getestet.

Die Wirksamkeit der Merkuro-ortho-Arsenat und Bleiarsenat enthaltenden Farben wurde aufgezeigt. Einige dieser Rezepturen gewährten guten Schutz für 12, 15 und 20 Monate.

## Introduction

### *Refs. 1-7*

The investigations which have been carried out up to the present have allowed the authors to make an exhaustive study of some variables of composition affecting the durability and performance of antifouling paints in raft trials. It has been necessary to determine the hydrological and biological conditions in the experimental area<sup>1,2</sup> and the variables which affect the fouling settlement on panels immersed in sea water.

The colonisation of inert plates by the fouling is favoured by the slime film formed by diatoms, protozoa and bacteria, which form an adequate substrate and provide a nutrient for the larvae<sup>3</sup>. Other important factors affecting this settlement are the roughness of the surface, the water movement over the plates, the pH, temperature and salinity of the sea water, and the quantity of light, which depends on the depth of immersion.

The use of antifouling paints in ships' bottoms tends to

control the attachment of organisms. The prevention of fouling is not a simple problem, it depends on the solubility of the toxic substances present, which is related in turn to the characteristics of the binder. These coatings form dynamic systems with a gradual film degradation. In paints with an insoluble matrix and formulated with a high concentration of toxicant, the latter is the only substance dissolved. In soluble matrix paints prepared with toxicant and extenders (ferric oxide, calcium carbonate, etc) the binder is formed by a resin soluble in sea water, and this resin is dissolved together with the toxicant. The solubility of the toxic substances must be reduced to the minimum quantity necessary to exert its action in long periods of time.

The velocity of dissolution is different for each toxicant, and it is a characteristic of the chemical composition and related to the temperature of the medium. This is the reason why long life antifouling paints can be obtained by adjusting the solubility of the matrix and making a selection of complementary toxic substances (called reinforcing toxicants) with highly specific actions and less solubility than cuprous oxide.

The idea is to improve the resistance to fouling settlement and to obtain high performance antifouling paints, but considering such other factors as the cost, availability of the raw materials, storage properties of the product, etc. An important condition is that toxicants must not react with the components of the matrix during the milling process and must not produce insoluble compounds with the sea water salts since this might reduce their toxic action.

Some arsenates are considered in this research to be possible reinforcing toxicants: namely mercurous orthoarsenate which has already been used in previous tests with good results<sup>4,5</sup>, in this case the anion and the metal can both be considered as toxic substances; the calcium arsenate, whose cation has no toxic action; the zinc arsenate (the zinc oxide is used in some formulations to improve the cuprous oxide action); and finally, the lead arsenate (it is known that there are organolead compounds with good antifouling action<sup>6,7</sup>).

The object of this paper is to establish the properties of the different antifouling mixtures and the relative merits of the arsenates used.

## Experimental

*Refs. 8-11, 14, 15*

All the arsenates mentioned above were prepared in the laboratory. A careful study of the literature was made to find the characteristics of these substances. The reactions, conditions of precipitation and pH of the media were established in every case.

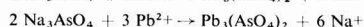
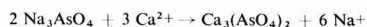
Sodium arsenite was obtained by combination of the arsenic trioxide with sodium carbonate, at pH 8.5-9.0:



and with the subsequent oxidation to arsenate by treatment with hydrogen peroxide in an alkaline medium:



Calcium arsenate<sup>8,9</sup>, lead arsenate<sup>10</sup>, zinc arsenate<sup>11</sup> and mercurous orthoarsenate were prepared from the sodium arsenate:



In every case, the precipitation conditions and the sequence of additives of each reaction are different. Calcium arsenate precipitates at pH 8.5 and lead and zinc arsenates at pH 5.5, and under these conditions the formation of basic salts is avoided. A highly acid pH (4.0) is necessary to precipitate the mercurous orthoarsenate. In all cases a careful treatment was made to eliminate impurities in the reaction.

The solubility of the different arsenates thus obtained in water and in sodium chloride solution 3.4 per cent (artificial sea water) was determined.

The following method was used in all cases: an excess of the toxicant was placed with 950 ml of twice distilled water in a litre container ( $25 \pm 3^\circ\text{C}$ ). It was stirred for 24 hours at 48 rpm. After sedimentation, the solution was decanted and rejected since it might contain soluble impurities. The operation was repeated twice with the precipitate, stirring for 72 hours in each case. The same technique was repeated using the sodium chloride solution to obtain the values of solubility of mercuric oxide and arsenic trioxide.

With the last of the solutions thus obtained, the content of arsenite, arsenate and calcium was determined by chemical methods. The determination of mercury, lead and zinc was carried out by atomic absorption taking into account the low content of metal in the solutions.

The values obtained and the final pH of the solutions are shown in Tables 1 and 2. The values for mercuric oxide and arsenic trioxide in water and in sodium chloride solution are given in Table 3.

Sixteen samples of antifouling paints with different pigment combinations in the same medium (rosin WW plasticised with a phenolic varnish, 5:1 ratio by weight) were prepared in a laboratory porcelain ball mill. In all cases cuprous oxide was the main toxicant and the arsenates were added in

Table 1 Solubility of the toxicants in water (g/litre)

Toxicant	Final pH of the solution	Arsenite ( $\text{AsO}_3^{3-}$ )	Arsenate ( $\text{AsO}_4^{3-}$ )	Metal
Mercurous orthoarsenate	3.6	0.06	0.81	0.001
Calcium arsenate	6.8	0.34	0.62	0.29
Zinc arsenate	4.5	0.18	0.19	0.07
Lead arsenate	6.1	0.0045	0.0689	0.0034

Table 2 Solubility of the toxicants in sodium chloride solution 34 g/litre

Toxicant	Final pH of the solution	Arsenite (AsO <sub>3</sub> <sup>3-</sup> )	Arsenate (AsO <sub>4</sub> <sup>3-</sup> )	Metal
Mercurous orthoarsenate	9.4	0.057	7.53	0.043
Calcium arsenate	7.5	0.057	3.13	0.37
Zinc arsenate	5.8	0.060	1.76	0.055
Lead arsenate	7.6	0.011	1.27	0.005

Table 3 Solubility of arsenic trioxides and mercuric oxide in water and in sodium chloride solution (g/litre)

Toxicant	Final pH		Solubility		Metal	
	Water	ClNa	Water	ClNa	Water	ClNa
Arsenic trioxide (As <sub>2</sub> O <sub>3</sub> )	5.3	6.4	2.54	2.59	—	—
Mercuric oxide (HgO)	6.3	7.0	0.0034	0.02	0.0031	18.4

Table 4 Composition of the paints with different quantities of reinforcing toxicants (g/100 g)

	W-1	W-2	W-3	W-4
Cuprous oxide	31.4	31.4	31.4	31.4
Zinc oxide	3.1	3.1	3.1	3.1
Mercurous orthoarsenate	13.0	—	—	—
Calcium arsenate	—	13.0	—	—
Zinc arsenate	—	—	13.0	—
Lead arsenate	—	—	—	13.0
Aluminium stearate	2.5	2.5	2.5	2.5
Binder and solvents	50.0	50.0	50.0	50.0
	X-1	X-2	X-3	X-4
Cuprous oxide	34.1	34.1	34.1	34.1
Zinc oxide	3.4	3.4	3.4	3.4
Mercurous orthoarsenate	10.0	—	—	—
Calcium arsenate	—	10.0	—	—
Zinc arsenate	—	—	10.0	—
Lead arsenate	—	—	—	10.0
Aluminium stearate	2.5	2.5	2.5	2.5
Binder and solvents	50.0	50.0	50.0	50.0
	Y-1	Y-2	Y-3	Y-4
Cuprous oxide	36.8	36.8	36.8	36.8
Zinc oxide	3.7	3.7	3.7	3.7
Mercurous orthoarsenate	7.0	—	—	—
Calcium arsenate	—	7.0	—	—
Zinc arsenate	—	—	7.0	—
Lead arsenate	—	—	—	7.0
Aluminium stearate	2.5	2.5	2.5	2.5
Binder and solvents	50.0	50.0	50.0	50.0
	Z-1	Z-2	Z-3	Z-4
Cuprous oxide	39.6	39.6	39.6	39.6
Zinc oxide	3.9	3.9	3.9	3.9
Mercurous orthoarsenate	4.0	—	—	—
Calcium arsenate	—	4.0	—	—
Zinc arsenate	—	—	4.0	—
Lead arsenate	—	—	—	4.0
Aluminium stearate	2.5	2.5	2.5	2.5
Binder and solvents	50.0	50.0	50.0	50.0

decreasing quantities (13, 10, 7 and 4 per cent) replacing equal weights of cuprous oxide.

Zinc oxide and aluminium stearate were used in all the formulations. The composition of the paints is shown in Table 4.

The milling process was carried out for 24 hours, and the cuprous oxide was incorporated during the last three hours.

Two coats of antifouling paint (average thickness between 150 and 200 microns) were applied to sandblasted plates previously protected with a vinyl wash-primer, and three coats of a good performance anticorrosion paint, with 24 hours between coat. The plates were placed on the experimental raft for the seawater exposure tests in Mar del Plata's harbour, 48 hours after the application of the last coat of antifouling. Raft trials started in December 1973 (summer) and concluded in August 1975.

The plates were observed at three monthly intervals. The merit rating of the paints during the test and the deterioration after a period of 20 months' exposure was evaluated, in accordance to the scale 0-5 shown in Table 5, and considered in previous papers<sup>14,15</sup>.

## Discussion

*Refs. 12, 13, 16-19*

The values of fouling settlement registered after 3, 6, 9, 12, 15 and 20 months are shown in Table 5 and they are represented in Fig. 1.

A clear difference is observed between the results obtained during the first year of immersion and those obtained during the period between 12 and 20 months.

In the first case, 14 paints (87 per cent of the samples) showed a good performance with fouling rates below 1 (rare), which is the maximum fouling fixation admissible in our scale of evaluation (paints with 80 per cent effectiveness). Only the samples X-2 and Z-2 with calcium arsenate (10 and 4 per cent respectively) had a settlement between common and abundant.

After one year's exposure a great difference can be observed in the bioactivity of the arsenate studied. At the end of the experiment (20 months) only the samples Y-1 (mercurous orthoarsenate 7 per cent), X-4 (lead arsenate 10 per cent) and Y-4 (lead arsenate 7 per cent) fulfilled the requirements of the specification.

*Table 5 Fouling settlement during the experimental period (Mar del Plata's harbour, 15-XII-73/15-VIII-75)*

Paints	Reinforcing toxicant (%)	Degree of settlement after (+)					
		3 months	6 months	9 months	12 months	15 months	20 months
<i>Mercurous orthoarsenate:</i>							
W-1	13.0	0-1	1	1	1	2-3	3
X-1	10.0	0	0-1	0-1	0-1	2	2
Y-1	7.0	0	0	0	0-1	1	1-2
Z-1	4.0	0	0-1	0-1	0-1	2-3	3
<i>Calcium arsenate:</i>							
W-2	13.0	0-1	1	1	1	3-4	3-4
X-2	10.0	0	0-1	1	3-4	3-4	3-4
Y-2	7.0	0-1	0-1	0-1	0-1	2-3	2-3
Z-2	4.0	0	0-1	0-1	1-2	2-3	3
<i>Zinc arsenate:</i>							
W-3	13.0	0-1	1	1	1	3-4	3-4
X-3	10.0	0	1	1	1	2-3	3
Y-3	7.0	0	0-1	0-1	0-1	1-2	1-2
Z-3	4.0	0-1	0-1	0-1	1	2	2-3
<i>Lead arsenate:</i>							
W-4	13.0	0-1	1	1	1	2	2
X-4	10.0	0	0-1	0-1	0-1	1	1
Y-4	7.0	0-1	0-1	0-1	0-1	1	1
Z-4	4.0	0-1	0-1	0-1	6	2	2

(+) Degree of settlement: 0 Without fouling  
 1 Rare  
 2 Common  
 3 Very common  
 4 Abundant  
 5 Completely fouled  
 The other are intermediate values.

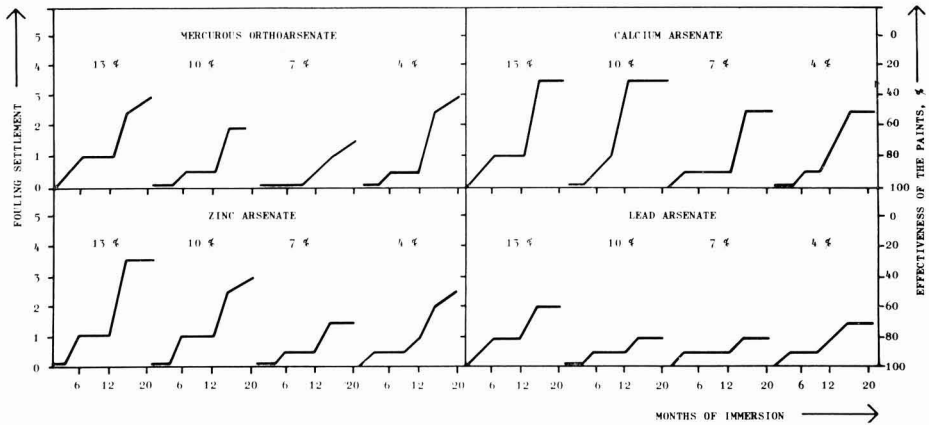


Fig. 1. Settlement of fouling after 3, 6, 9, 12, 15 and 20 months, for different arsenates and concentrations (experimental raft, Mar del Plata's harbour)



Fig. 2. Samples with calcium arsenate (8), zinc arsenate (9) and lead arsenate (16) after 12 months immersion (concentration 13 per cent, settlement 1 in all cases)

In the paints with calcium arsenate, the loss of efficiency is very important and the values of settlement increased very rapidly from 0.1 to 3.4 within a few months. This arsenate has a high solubility for the calcium ( $\text{Ca}^{2+}$ ) as well as for the anion under the experimental conditions used in the laboratory: a closed system with equilibrium between the solid and the solution<sup>16</sup> (Table 1). In artificial seawater, calcium chloride is produced (it has great affinity with water and forms several kinds of hydrates<sup>12</sup> or autocomplexes). This fact was demonstrated by Noyes<sup>13</sup> in his studies on the variation of the transport number with concentration. Although the binder limits the solubility of the pigments, calcium arsenate dissolves very quickly and the antifouling action is reduced to the main toxicant ( $\text{Cu}_2\text{O}$ ) action alone. It has already been proved in previous raft trials that the action of the antifouling paints containing only cuprous oxide rarely last more than one year's immersion without deterioration and fouling settlement in Mar del Plata's harbour, due to the harshness of the environment, unless binders of lesser solubility have been used.

Zinc arsenate shows a fair performance (settlement 0.1) after 12 months' immersion, and the sample having the best results is that with 7 per cent of reinforcing toxicant (Y-3).

The settlement on this plate reaches to 1-2 after 20 months. Zinc solubility in water and in sodium chloride solution is low (0.07 and 0.055 g/litre). In sodium chloride (pH 8.0 to 8.2 is the normal value for uncontaminated sea water) it may form partially soluble complex halides with basic characteristics, whose general formulation is  $\text{Zn}(\text{Hal})_2 \cdot 4 \text{Zn}(\text{OH})_2$  and  $\text{Zn}(\text{Hal})_2 \cdot 3 \text{Zn}(\text{OH})_2$ <sup>12</sup>. The insoluble portion of these complexes is formed by concentric layers where the normal salt and the hydroxide are superimposed. For this reason there is a diminution in the quantity of liberated zinc to act as the toxic substance.

Mercurous orthoarsenate has shown a poorer performance in this series of experiments than those observed in previous raft trials. The exceptionally aggressive conditions of the harbour during the exposure must be mentioned<sup>19</sup>. The best performance for the paints including this compound correspond to the sample Y-1, which had settlement 1 (rare) after 15 months and settlement 1-2 (between rare and common) at the end of the trial.

The solubility differences given in Tables 2 and 3 make it possible to explain the greater toxicity shown by the mercurous arsenate compared to arsenic trioxide and mercuric

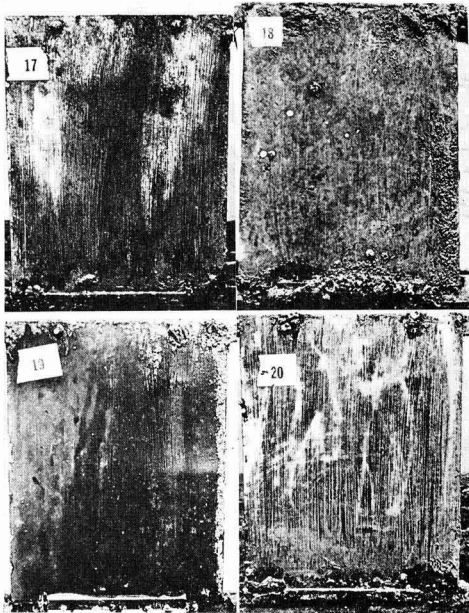


Fig. 3. Samples with mercurous arsenate (17), calcium arsenate (18), zinc arsenate (19) and lead arsenate (20) after 20 months immersion (concentration 10 per cent, settlement 0-1, 1, and 0-1)

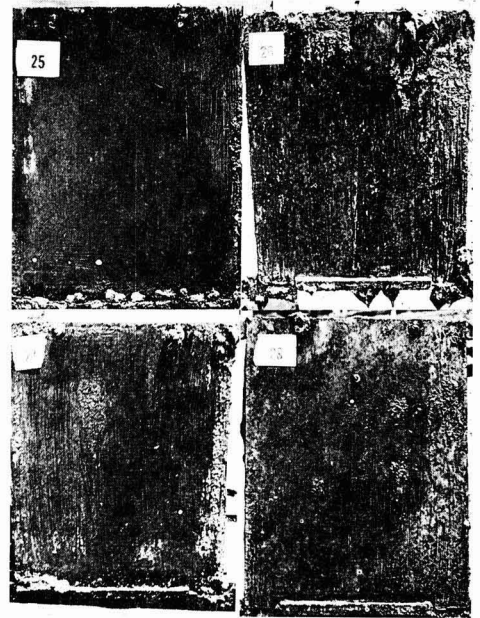


Fig. 5. Samples with mercurous arsenate (25), calcium arsenate (26), zinc arsenate (27) and lead arsenate (28) after 12 months immersion (concentration 4 per cent, settlement 0-1, 1-2, 1 and 1)

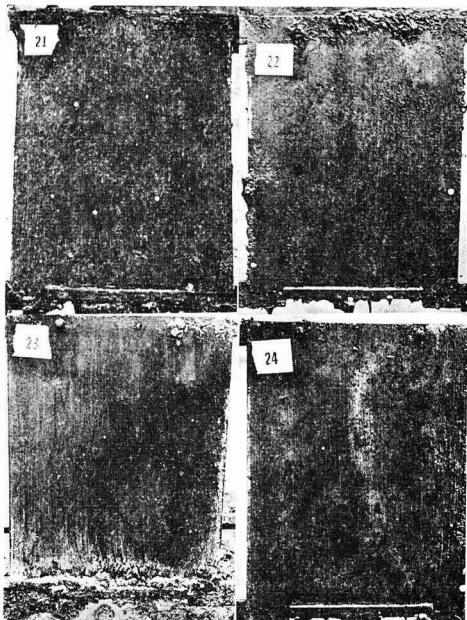
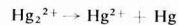
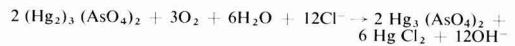


Fig. 4. Samples with mercurous arsenate (21), calcium arsenate (22), zinc arsenate (23) and lead arsenate (24) after 12 months immersion (concentration 7 per cent, settlement 0-1, 0-1, 1, and 0-1)

oxide. Arsenic trioxide forms the chloride and it is dissolved very quickly; the arsenic as  $As^{3+}$  has toxic action only on certain species. The mercuric oxide produces a high concentration of  $Hg^{2+}$  ions and the mercurous orthoarsenate is hydrolysed forming mercurous chloride and metallic mercury (both of them insoluble), because of its tendency to produce an oxidation-reduction action. These reactions may be expressed:



The mercurous chloride and the metallic mercury remain insoluble, and in this condition they do not act as toxic substances. It is possible that the toxic action is due to the arsenate anion.

Lead arsenate is the toxicant having the best bioactivity of all the arsenates tested. The four samples prepared had a settlement between 0-1 and 1, after an immersion period of 15 months. Paints X-4 (10 per cent lead arsenate) and Y-4 (7 per cent lead arsenate) had a settlement 1 (rare) after 20 months, and for the other two samples (W-4 and Z-4) the settlement recorded was very slight (2, common). The differences in the merit ratings for these samples are not significant.

The small settlement observed in these paints between 12 and 20 months shows that the dissolution of the toxicant is very slow and it is perfectly controlled by the matrix (soluble binder). There is a high probability that the main toxicant action was due to the arsenate and arsenite anions, considering that lead as  $Pb^{2+}$  is not very soluble.

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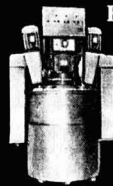
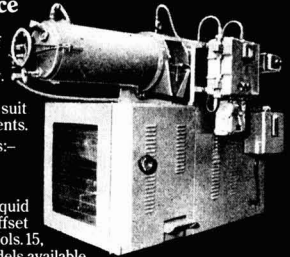
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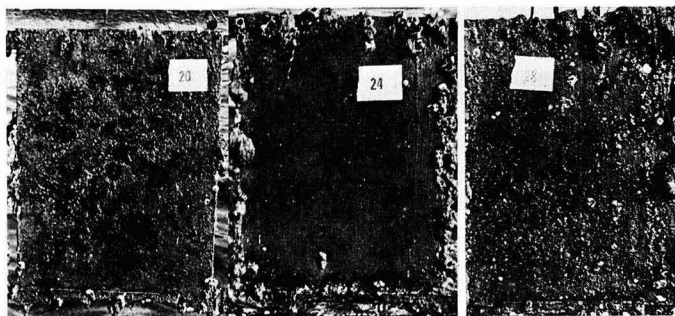


Fig. 6. Samples with lead arsenate 10 per cent (20), lead arsenate 7 per cent (24) and lead arsenate 4 per cent (28) after 20 months immersion in Mar del Plata's harbour (Argentina) (settlement 1, 1 and 2 respectively)

The curves shown in Fig. 1 suggest that the most adequate concentration of reinforcing toxicant is 7 per cent in all cases. In Table 6 the ratio of dissolved arsenite/dissolved metal and dissolved arsenate/dissolved metal has been calculated, and it was established that the minimum values correspond to the calcium arsenate and the maximum ones to lead arsenate. The degree of settlement after 20 months in the raft trials is in inverse ratio of these quantities.

action is associated with the cation present and the metal regulates the velocity of dissolution.

2. The most effective concentration is 7 per cent. This amount gives paints of good performance in raft trials during 12 months in Mardel Plata's harbour, with all the arsenates used.

Table 6 Ratio of arsenate and arsenite to metal

	Settlement after 20 months' immersion	AsO <sub>3</sub> <sup>3-</sup> /metal ratio	AsO <sub>4</sub> <sup>3-</sup> /metal ratio
Lead arsenate	1	2.20	254.0
Mercurous orthoarsenate	1-2	1.33	175.1
Zinc arsenate	1-2	1.09	32.0
Calcium arsenate	2-3	0.15	8.5

The toxic action of the arsenate anion (AsO<sub>4</sub><sup>3-</sup>) is also corroborated by its affinity to the chemical groups of the proteins. The arsenate anion acts on the metabolic processes; it tends to combine with SH<sup>-</sup> groups, immobilising them<sup>17,18</sup>. A similar mechanism can be proposed to interpret the toxic activity of mercury and lead.

Finally, it will be necessary to repeat some experiments with arsenates with the purpose of establishing the exact concentrations necessary to obtain the maximum reinforcing toxicant action, and to determine the most suitable characteristics of composition for the binder.

It is also necessary to state that the presence of cuprous oxide in the formulations assures a general toxic action and permits the formulation of economical and effective antifouling compositions. The partial replacement of this substance by more specific toxicants tends to provide long life antifouling compositions.

## Conclusions

1. The antifouling action of the arsenates used is due mainly to the presence of soluble arsenate and arsenite ions; their

3. The lead arsenate dispersed in a soluble binder (rosin WW/phenolic varnish) is the reinforcing toxicant which gives the best results. Paints with 10 per cent of this substance have only settlement 1 (rare) after 20 months' exposure.

4. Mercurous orthoarsenate is the next best in efficiency. The sample with 7 per cent showed settlement 1 after 15 months and settlement 1-2 after 20 months.

5. Zinc arsenate paints gave only 12 months' protection. During that period they did not show any appreciable settlement.

6. Calcium arsenate is highly soluble and it is rapidly leached from the paint film. All the samples fouled very quickly after the first year.

[Received 4 October, 1976]

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# Developments in electroplate coatings\*

By R. L. Nicolay

Plascon-Evans Paints (Natal) Ltd., PO Box 1386, Durban 4000, South Africa

## Summary

The process of electropainting is outlined with special reference to the situation within the Republic of South Africa. The advantages and disadvantages of the process are discussed, as are the problems which can and do arise, with special reference to bacteriology, inaccessibility and "Faraday cages". Remedial methods such as

the use of auxiliary cathodes, ultra-filtration and biocidal action are discussed.

Some thoughts on the future of the process and variations thereof are noted.

## Keywords

*Types and classes of coatings and allied products*  
electrocoating

*Types and classes of structures or surfaces to be coated*  
steel

*Raw materials—paint additives:*  
biologically active agents  
bactericide

*Equipment primarily associated with applications of coatings and allied products*

electrocoating equipment

*Processes and methods primarily associated with application of coatings and allied products*

electrodeposition

*Miscellaneous terms*

biodegradation

## Développements dans le domaine des peintures électrodéposables

### Résumé

On trace les grandes lignes du procédé de peinture par électro-déposition, à l'égard particulier de la situation dans la République de l'Afrique du Sud. On discute les avantages et les inconvénients du procédé et également, les problèmes éventuels et réels, en particulier ceux qui sont entraînés par les bactéries, la forme de l'article à être peint, et les cages de Faraday. On discute les

méthodes curatives, telles que l'emploi des cathodes auxiliaires, de l'ultrafiltration et des agents biocides.

On mentionne quelques observations sur l'avenir du procédé et ses variations.

## Entwicklungen auf dem Gebiet der Elektrottauchlackierung

### Zusammenfassung:

Elektrottauchlackieren wird mit besonderem Bezug auf die Situation innerhalb der Republik Südafrika beschrieben. Vorteile und Nachteile des Prozesses werden abgewogen, ebenso wie Probleme, welche auftreten könnten oder tatsächlich auftreten, wobei spezieller Bezug auf Bakteriologie, Unzugänglichkeit und "Faraday Käfige" genommen wird. Methoden zur Abhilfe, wie z.B. die Verwendung

von Hilfskathoden, Ultrafiltration und biozide Massnahmen, werden besprochen.

Bemerkungen werden auch über Gedanken hinsichtlich der Zukunft des Verfahrens und Variationen desselben gemacht.

## Introduction

Electropainting is, in fact, just what the word suggests—the application of a film of paint to a conductive substrate by means of a direct electric current. This current may be in the continuous form as supplied by a full-wave rectifier or may be "chopped" by means of a rectifier and electronic switchgear into a pulsating so-called "square wave" current. The latter method has been the subject of much discussion and controversy over the years and further reference will be made to it later in this paper.

In addition to electropainting, the process is commonly called by several other names such as electrophoresis, E-coat, electrocoat *etc.* The term "electrophoresis" is popularly used in Europe, but is somewhat of a misnomer as the process also involves electrolysis, electro-coagulation and electro-osmosis. Hence the wider term, electropainting, is preferred.

The article or work-piece to be coated can be made the anode or the cathode in the system depending on the medium employed. These processes are often termed "anaphoresis" and "cataphoresis" respectively, but in the author's opinion the same logic applies to the nomenclature as in the case with "electrophoresis". Up to the present the vast majority of industrial application has been confined to anodic deposition for reasons which will be discussed later. In this paper the term "electropainting", except where otherwise specified, refers to anodic deposition.

The components which comprise the electropaint concentrate *viz.* resin(s), pigments, extenders, coupling solvents and so-called solubilising agents *etc.* are in all cases dispersed in water to a non-volatile content of usually between 10 and 20 per cent to provide the ready for use electropaint.

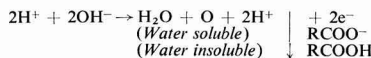
## The mechanism and process of electropainting

Electropainting constitutes a self-limiting system. If a tank containing electropaint with a submerged cathode and anode

\*Presented at the Sixth National Symposium held jointly by the South African Division of OCCA and CSIR on 8 and 9 October 1976.

is considered, at the instant of switch-on, the only resistance between the electrodes is that of the electropaint itself resulting in a large current flow. However, as deposition occurs, an insulating film builds up on the anode causing a rapid drop in the current within the first 10 to 15 seconds as the resistance of this semi-porous coating increases. This slow film build-up continues for 60 to 90 seconds with a further gradual drop in current, and eventually only a small residual current flows. In other words, the system has now limited itself. This usually and desirably occurs when the film build has reached a thickness of some 25 microns, and it is due to this self-limitation that the process has the ability to coat hidden areas, in other words, exhibits the phenomenon of "throwing-power". Of course, the extent of this ability to coat hidden areas is also governed by other paint parameters especially that of conductivity.

The reaction mechanism leading to the deposition of the relatively non-conductive coating on the anode may be demonstrated as follows:—



While this may indeed be an over simplification of the actual reactions involved, it does show what is probably the main sequence of events resulting in the coagulation on the substrate of a dense adherent acid resinous film, containing the entrained pigments *etc.*, from the alkaline bath. This acid coating is no longer water soluble, which explains how it is possible in industry to wash the adhering "cream-coat", electropaint and pigments from the coated object by means of demineralised water and ultrafiltrate sprays without causing damage to the electro-deposited film. Subsequent curing of the film is effected by stoving at a temperature in the order of 180°C for a period of usually 10 to 20 minutes. During the deposition process metal ions are released from the substrate and these catalyse the curing process. However, this is a mixed blessing as the release of these metallic ions also result in a disruption of the phosphate layer which, in practice, is almost universally deposited on the steel surface prior to electropainting. Such disruption lessens adhesion at the steel phosphate interface and also that most important property—corrosion resistance. An in-depth study of the depth of penetration, concentration and effects of this substrate ion release has been carried out, but it is felt that such detailed consideration is beyond the scope and purpose of this paper.

It will be remembered that the discharge of hydroxyl ions at the anode resulted in the formation of water, oxygen and electrons with the consequential formation of excess protons. This release of gaseous oxygen affects the physical nature of the deposited film profoundly. The film is not a homogeneous mass but is a matrix occluding numerous oxygen bubbles, rather resembling an emulsion of oil in water or a sponge. Obviously, no bubble should be large enough to breach the film or a loss of protection and wet-film resistance must of necessity occur. When encountered in practice, such a large bubble formation is referred to as "gassing" and results in a poor rough coating. One cause of such excessive and large bubble formation is the use of too high an application voltage, that is, exceeding the rupture voltage of the system. It is here that the previously mentioned pulsating square-wave current plays a useful part. The author has deposited films from a single bath using firstly straight D.C. and then pulsating D.C. The voltages used were approaching rupture voltage of the system. Photomicrographs of sections cut from these films (when cured) clearly showed a much finer dis-

persion of oxygen bubbles in the case of the film deposited using the pulsating current. A detailed and involved consideration of the factors involved in this observation gives a theoretical basis for the possible advantages which could be discussed, but let it suffice to say that of the three major tanks in the Republic of South Africa, two have the facility for using pulsating current and one of these two, situated outside Durban, has used this facility continuously for approximately five years. It is also, perhaps, of significance that this plant does not use secondary cathodes but relies on the throwing-power of the system to achieve the excellent penetration which is achieved. This method has also found some staunch support in Europe.

In addition to the three large electropaint installations in the Republic of South Africa (automobile assembly industry) which range in capacity from approximately 150 to 200 metric tons, there are perhaps a dozen small plants, mostly associated with the manufacture of parts for the automotive industry. All of these plants operate the anodic deposition process.

In concluding this section it is perhaps necessary to examine, very briefly, the process of cathodic deposition. Here the bath is acid, usually at a pH of five or less from which a basic coating is deposited. No dissolution of the substrates occurs, but double the volume of hydrogen is evolved as in the corresponding anodic deposition. This inevitably means more porosity with consequential drop in insulation and reduced throwing-power. Baths are also of low conductivity. Without special catalysts, curing problems are inherent in the system.

## Advantages

When it is considered that there are between 180 and 200 major tanks in the world today engaged in the coating of motor-car bodies only, it becomes abundantly clear that electropainting must have something very definite to offer. An American manufacturer of, inter alia, grills and diffusers (intricately shaped work) says:

"Electrocoating gives us a uniform film thickness with no sags or runs. Edges and hidden areas all receive an even coating. In addition, electrocoating the completely assembled product cuts down on handling, giving us a superior finish with increased production per man-hour".

Generally this statement applies equally to the automotive industry. Further, paint-shops are certainly high fire-risk areas. Electropainting is a water-borne system and hence eliminates any fire hazard in this area of a paint-shop. Indeed, if needs be, the ready for use *E*-paint could be used to extinguish a fire.

Uniformity of film-build over the entire unit and coverage of inaccessible areas assures a corrosion resistance superior to that obtainable from other processes *for the unit considered as a whole*. Results from panels coated by other processes give good salt-spray test figures as good as, or indeed sometimes better than, those obtained from electropainted panels. This, however, cannot be translated into complete unit performance because of the non-uniformity of build (compared with electrocoat) of such processes. After all, the film build at its thinnest point must be sufficient to pass the paint specification. A salt-spray cabinet to take complete units has been constructed by the assembly plant outside Durban and tests are carried out regularly. The cabinet is to A.S.T.M. Specification and the results obtained after 240 hours of salt-spray are certainly impressive.

The interiors of the box-sections in motor vehicles have always been difficult items to paint. This problem is effectively dealt with by electropainting providing:

- (a) that the design is such that the box-section can fill rapidly with electropaint on submersion in the tank. Of course, if the box-section is completely closed no electropaint can enter and there is no deposition. When the initial design of an article is made up with electropainting in view, this type of problem is largely obviated. Units designed with the requirements of electropainting fully considered are the norm in the motor vehicle industry today. Nevertheless, the occasional problem area does certainly arise;
- (b) that such areas are not over-screened from the cathodes forming the so-called "Faraday Cages".

When filling problems occur they are usually easily overcome by enlargement of existing holes or cutting one or two additional suitably placed holes. In the event of electrical screening (Faraday cages) being inherent in the design of the unit, secondary or auxiliary cathodes may become necessary to ensure an adequate coating within the box-section. Such devices are in continuous use in the plant in Uitenhage with resulting excellent overall coverage. The auxiliary electrodes are simply extensions of the existing cathodes which can be suitably positioned. Quite simply, a busbar, running the length of the tank, is connected to the negative leg of the rectifier set-up. The busbar is fitted with a sliding "pick-up" to which are attached suitable insulated rods or frames which in turn are positioned where required. The auxiliary cathodes are placed in position immediately before entry into the electropaint tank and removed on exit from the tank prior to curing. Obviously additional labour costs are involved.

The technique of electropainting lends itself admirably to automation. In these days of rising labour costs this is an advantage which cannot be taken lightly.

Finally, it must be realised that the electrocoat follows the profile of the substrate exactly. A well finished metal surface properly phosphatised to meet all requirements provides the base for an electrocoat which is beautiful to behold, but any defect in the pretreatment shows up clearly, particularly such things as file and grinding marks—electropaint hides none of this. Hence it is difficult to enter this property on the credit or debit side—it depends on the metal finish and pretreatment.

### Disadvantages

No process or technique is perfect and electropainting is no exception to this rule. One definite disadvantage is the high capital cost of installation. High ampere output transformers and rectifiers are expensive items, and since flow through resistances generate heat, heat exchangers and chilling units are required. An ultrafiltration plant is today regarded as an essential component to overcome carry-over wastage of electropaint and to control contamination of the tank itself, all this equipment is costly.

Effluent disposal can present a problem and tanks for coagulation of non-volatiles in the waste wash-off liquids are used. This has been largely reduced, indeed almost obviated, by the advent of efficient ultrafiltration installations. It has always been difficult to dispose of chromates.

Also on the debit side is the fact that electropainting is a sophisticated electro-chemical process and as such, the bath requires more servicing, control and adjustment than does a dipping tank.

Last, but assuredly not least in the relatively short list of disadvantages, are the ravages which result from uncontrolled bacterial infection. However, this problem is considered sufficiently important to warrant a heading of its own.

### Bacteriology

Being a water-borne system, electropaint is patently prone to bacterial infection. Some fifteen varieties of gram-negative organisms have been identified at various times in the tank near Durban and occasionally gram-positive organisms of which the yeast, *Candida Albicans*, seems to be the most common. This could be the result of air-borne contamination from a large brewery in the vicinity but the same organism has also been found in the Uitenhage tank. Of the gram-negative organisms *Proteus Vulgaris* has been the one most commonly encountered in both of the above tanks. Its appearance does seem, from experience, to be associated with digging operations—soil moving—in proximity to the tank. But when what finds its way into an electropaint tank is considered, despite rigorous rules and inspection, *via* the units themselves, it is difficult to be dogmatic about other origins of infection. In this list are such things as Bantu beer containers, milk cartons, sandwiches, lunch-boxes, meat, bones, clothing as well as all the biologically harmless bric-a-brac associated with the assembly process. Since most tanks only have a thorough clean-out once a year, a very considerable amount of foreign material accumulates. This situation obviously necessitates careful and effective monitoring of the biological activity in the tank with additions of a suitable biocide when necessary. A suitable biocide may be described as one which is effective for protracted periods at a low concentration over a broad spectrum of bacteria and which has minimal effect on the process of electro-deposition in both the short and long term. For instance, biocides which release formaldehyde are effective and fine in the short term. However, in time, the aldehyde oxidises to formic acid with resultant severe interference with electro-deposition, of a similar nature to that caused by the bacteria.

Since bacteria have the peculiar property of becoming resistant to a particular type of biocide by the evolution of mutants, it is necessary to use at least two or three biocides of known effectiveness, in sequence. Whilst this all seems very formidable, with experience, and given a close degree of co-operation between user and supplier, it becomes relatively simple to maintain proper biological control at sterile or near sterile conditions. In the author's experience, bacterial infection has presented by far the worst problem encountered in electropainting in the Republic of South Africa. This is probably true of other countries as well. It is also likely that on occasions tanks have been ruined by bacterial action without the cause being diagnosed. This can easily happen as a result of improper sampling techniques.

A further form of infection stems from the process of demineralising water. It is well known that the ion-exchange resin beds provide fertile breeding grounds for bacteria. This is easily overcome by irradiating all D.M. water with ultra-violet light which is both cheap and virtually 100 per cent effective. Alternatively, but less wisely, biocidal action in the tank can be relied upon to destroy bacterial from this source.

A further potent weapon against the effects of bacterial infection has become available with the advent of improved ultrafiltration. To appreciate this, it is necessary to consider, very briefly, how the bacteria affect electropaint. In themselves they have no effect—but their metabolic products most decidedly do, in particular, the lower carboxylic acids such as formic, acetic, propionic, butyric *etc.* Of course, if bacterial proliferation is allowed to continue too far, resin degradation and subsequent coagulation occurs.

Ultrafiltration is a process whereby molecules of relatively low molecular weight, as compared with the macro-molecular resins, are "squeezed" out of the system *via* a membrane. Hence, *inter alia*, the anions resulting from bacterial action are removable from the tank. All three major tanks in the Republic of South Africa now have this facility, albeit probably more because of economic than technical considerations. The ultra-filtrate is used to rinse adhering electropaint from the units in stages and most of these washings are recycled into the tank, resulting in very considerable savings. These advances, technical and economic, have no doubt helped to consolidate the technique in industry.

#### Future developments and variations

The last six years have seen the establishment of three major and quite a number of smaller tanks in the Republic of South Africa, all based on anodic deposition. For reasons discussed, mainly as advantages, it does seem probable at least that this trend will continue. As yet but little penetration has been achieved outside of the automotive industry. There

is undoubted scope for further ingress into other fields, especially that of domestic appliances. Hence, the advantages of the cathodic deposition process may out-weigh its inherent difficulties and find industrial application, as has happened to a limited extent in the U.S.A. Far reaching improvements can be anticipated in the chemistry of both systems. Indeed, only a brave man or a fool would be really dogmatic about which direction major industrial advance will take.

Plant-wise it is difficult to envisage much major improvement. Innovations such as the "*Vertak process*" in which the work-piece is jugged vertically on a continuous conveyor, thus reducing the necessary tank volume, may well be exploited. No doubt research will be directed at lessening energy requirements and/or the more efficient use of energy.

Given normal economic conditions, coupled with normal progress and development, the process as a whole seems assured of a bright future in the coating of mass volume metallic articles. Furthermore, "one-coat finish coats" are being developed and used. Even metallics of this sort are applied industrially in the USA.

#### Acknowledgments

The author wishes to express thanks to the Directors of Plascon-Evans Paints (Natal) Limited for permission to prepare and publish this paper and to Volkswagen of South Africa Ltd. for their permission to take photographs.

[Received 18 October, 1976]

# Liquid polybutadiene resins for surface coatings\*

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## Summary

Following a brief review of the various types of polymerisation initiators which can be used for the production of liquid polybutadienes, one particular system based on the anionic initiator n-butyl lithium is studied in more depth. Emphasis is placed on the parameters controlling such important physical properties as viscosity, microstructure, molecular weight, and molecular weight distribution.

## Keywords

### Raw materials for coatings:

binders (resins, etc)

polybutadiene

### Paint additives:

catalysts, accelerators, inhibitors

catalyst

initiation

Some of the features which make liquid polybutadienes of particular interest to the surface coatings chemist are discussed in the context of the wide range of physical properties available from this initiator system, and their influence on the applications technology.

### Processes and methods primarily associated with manufacturing or synthesis

polymerisation

### Properties, characteristics and conditions primarily associated with materials in general

viscosity

## Les résines polybutadiènes liquides destinées aux revêtements de surface

### Résumé

Après un bref aperçu des divers types d'initiateur de polymérisation qui peuvent être utilisés au cours de la fabrication des polybutadiènes liquides, on considère plus profondément un système en particulier, basé sur l'initiateur anionique, le lithium tétra n-butyle. On vise sur les paramètres qui exercent une influence dominante sur les caractéristiques importantes telles que la viscosité, la microstructure, le poids moléculaire, la répartition de poids moléculaire.

Certains aspects des polybutadiènes liquides d'un intérêt aux chimistes de l'industrie de revêtements de surface sont discutés au point de vue de la gamme étendue de caractéristiques physiques de ces résines rendues par ce système d'initiation, et également de leur influence sur la technologie de leur utilisation.

## Flüssige Polybutadienharze für Lacke

### Zusammenfassung:

Nach einer kurzen Übersicht über die verschiedenen Typen von Polymerisationsinitiatoren, welche zur Erzeugung von flüssigen Polybutadienen eingesetzt werden können, wird ein System auf Basis eines anionischen Initiators n-Butyllithium gründlicher untersucht. Die Parameter, welche wichtige physikalische Eigenschaften, wie Viskosität, Mikrostruktur, Molekulargewicht und Molekulargewichtsverteilung kontrollieren, werden besonders betont.

Einige der Merkmale, welche flüssige Polybutadiene besonders interessant für den Lackchemiker machen, werden im Zusammenhang mit den zahlreichen, aus diesem Initiatorsystem resultierenden physikalischen Eigenschaften, und ihr Einfluss auf die Applikationstechnologie besprochen.

## Introduction

Refs. 1-11

A wide selection of liquid, low molecular weight polybutadienes both functional and non-functional are commercially available<sup>1</sup>. They can be prepared using free radical<sup>2</sup>, cationic,<sup>3</sup> Ziegler-Natta<sup>4,5</sup> or anionic<sup>6-11</sup> polymerisation initiator systems and also by depolymerisation of high molecular weight polybutadiene. The molecular architecture of the products is largely controlled by the method of preparation. Free radical and cationic initiator systems yield branched polymers, the latter system having a tendency to yield very broad molecular weight distributions, whereas anionic systems yield predominantly linear polymers. Microstructure

can vary from greater than 95 per cent total 1,4 (mainly cis-1,4) for Ziegler-Natta, up to 80 per cent trans-1,4 for cationic, to the familiar 60 per cent trans-1,4, 20 per cent cis-1,4, 20 per cent vinyl 1,2 for the free radical systems. Dependant upon the initiator, solvent etc., the anionic systems can yield microstructures varying between 90 per cent total 1,4 to 90 per cent vinyl 1,2 content.

The following sections describe two methods of preparing liquid polybutadienes using organo-lithium based anionic initiator systems and the resultant properties of the polybutadienes. The wide choice of physical properties, coupled with a high level of unsaturation leads to a wide range of applications, particularly in the field of surface coatings. The materials are marketed under the trademark 'Lithene'.

\*Presented at the Sixth National Symposium held jointly by the South African Division of JOCCA and CSIR in Port Elizabeth on 8 and 9 October, 1976.

## Mechanism of polymerisation

Lithene polybutadienes are prepared by two different mechanisms.

- (a) a 'telomerisation' system, originally developed by Lithium Corporation of America,<sup>6-8</sup> which provides a very economic route to low molecular weight products and
- (b) the classical anionic "living polymer" technique.

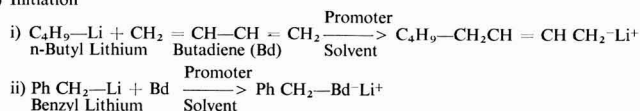
In both cases an organo-lithium initiator is used in conjunction with a promoter, since this class of initiator is soluble in hydrocarbon solvents and permits considerable variation of the polybutadiene microstructure. The necessity for two types of reaction mechanism is related to the cost of organo-lithium initiators, a factor which should become evident from the description of the mechanisms below.

### (A) Telomerisation Process. (Lithenes P, P-4 and A Series)

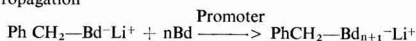
*Ref. 12*

The reaction scheme is outlined in Fig. 1. Butadiene is polymerised in toluene solvent using an initiator system comprising *n*-butyl lithium and a promoter. The toluene not only acts as solvent, but also as the "telogen" in step (c) whereby growing polymer chains are terminated by "transmetallation" to toluene with the formation of benzyl lithium. The benzyl lithium can initiate new chains (step (a) ii) and thus during polymerisation "dead" polymer is continuously being formed and new chains initiated at the same rate. A small amount of initiator can, therefore, be used to produce a large quantity of polymer provided impurities such as water, air, *etc.*, are excluded from the reaction.

#### a) Initiation



#### b) Propagation



#### c) Transmetallation

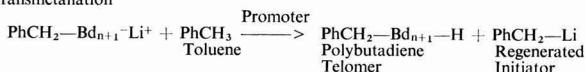


Fig. 1. Reaction mechanism for the preparation of polybutadienes using organo-lithium catalyst

There are many possible "telogens" for the transmetallation. However, toluene, in the presence of a suitable promoter possesses a hydrogen atom of sufficient reactivity for adequate transmetallation rates at convenient polymerisation temperatures, coupled with the activity of benzyl lithium towards re-initiation of chains. Since the transmetallation reaction occurs several times during polymerisation, the vast majority of the polybutadiene chains possess a benzyl end group, hence the term "telomers".

The presence of a promoter is necessary for two reasons:

- (i) to increase the activity of the initiator system to both polymerisation and transmetallation and

- (ii) to modify the physical properties of the Lithene polymer.

Favoured promoters for the telomerisation process are *N,N,N',N'*-tetramethylethylenediamine (TMEDA) and the alkali metal alkoxides<sup>12</sup> *e.g.*, sodium or potassium tertiary-butoxide.

### (B) "Living Polymer" Process (Lithene N and N4 Series)

For the living polymer process, the mechanism of polymerisation is similar to that shown in Fig. 1 with the omission of steps (c) and (a)(ii). That is, there is no transmetallation reaction between growing chains and toluene, and all initiation is from the *n*-butyl lithium. The chains all possess a butyl end group and the same growing chain is active throughout polymerisation.

Dependent upon the physical properties required, the living polymer polymerisation can be carried out either in the presence or absence of a promoter. If toluene is used as solvent, the promoter has to be relatively weak (such as tetrahydrofuran, diethyl ether) and used at a level which minimises the possibility of transmetallation. Alternatively, a strong promoter can be used in conjunction with an inert solvent (such as benzene, cyclohexane).

### Polymerisation technique

Polymerisation is carried out at atmospheric pressure under nitrogen, in a reactor equipped with a stirrer, temperature probe, butadiene inlet tube, and a chilled condenser. Butadiene is added continuously at a controlled rate to the vigorously stirred contents of the reactor. the polymerisation

rates being sufficiently high to minimise reflux on the condenser. The polybutadiene concentration in the reaction mixture varies from zero initially to a final value of 50-65 per cent by weight, accurate temperature control being maintained throughout polymerisation by external jacket cooling. All reagents are dried by treatment with Type 3A molecular sieve before polymerisation.

Typical reaction conditions, dependent upon the grade being produced are:

- (a) initial *n*-butyl lithium concentrations, 0.04-0.2 moles/l
- (b) polymerisation temperatures, 50-105°C.
- (c) butadiene addition rates, 3-12 g/kg solvent/minute.



Following polymerisation, the initiator is deactivated, removed by precipitation and filtration, and the solvent removed by vacuum distillation to yield the colourless/pale yellow liquid polybutadiene.

## Molecular weight of Lithenes

### (A) Molecular Weight Distribution (MWD)

The two polymerisation mechanisms described above result in liquid polybutadienes which differ in one major property, the MWD of the product. In the telomerisation process the transmetallation reaction can occur at any stage of chain growth, leading to a product with a statistical distribution of chain molecular weights. In the living polymer mechanism, the same chains are active throughout polymerisation and hence they all propagate to the same length, provided, the rate of initiation is not too slow relative to propagation, there is a uniform distribution of monomer through the reaction mixture and termination reactions are absent.

The MWD of the two different types of Lithene products is illustrated by the two typical gel permeation chromatograms shown in Fig. 2. For the telomer products, the MWD is usually in the range 1.5-2.2 dependent upon the telomer grade, and for a living polymer product 1.0-1.2.

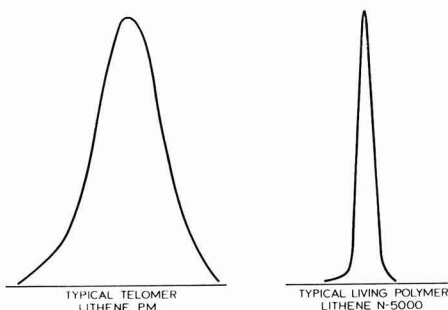


Fig. 2. Gel permeation chromatograms of two different MWD Lithenes

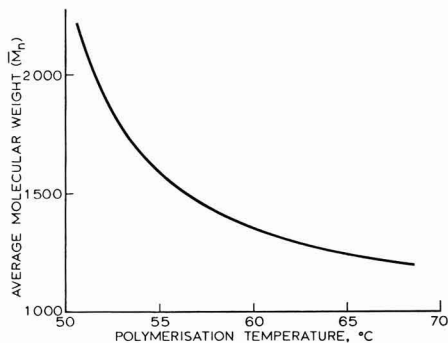
All references to product molecular weight in this paper are number average values i.e.  $\bar{M}_n$ .

### (B) Variation of Molecular Weight

In the telomerisation process, molecular weights can be varied within wide limits, independent of initiator concentration. The average molecular weight of the product is primarily controlled by the competition between propagation and termination by transmetallation to toluene. The major factors which control these competitive reactions are as follows:

(i) *Polymerisation Temperature.* As the polymerisation temperature is increased, the transmetallation reaction is increasingly favoured over propagation, and the average molecular weight of the product is decreased. Almost certainly, this is due to the activation energy for transmetallation being higher than that for propagation. The relationship between molecular weight and polymerisation temperature for the Lithene 'P' telomer system is shown in Fig. 3.

(ii) *Butadiene Addition Rate.* A high butadiene addition rate will result in a high "stationary state" concentration of



#### Polymerisation Conditions:

Initial n-Butyl Lithium	0.04 moles/l
Solvent	Toluene
Molar ratio n-Butyl Lithium: potassium	1-Butoxide
	1:0.5
Butadiene addition rate	13g/k solvent/minute
Final polymer concentration	60-65%

Fig. 3. Variation of molecular weight with polymerisation temperature for Lithene P series

butadiene in the reaction mixture. The probability that a growing chain end will propagate with butadiene rather than transmetallate to toluene is increased, and therefore the average molecular weight is also increased.

(iii) *Ratio of n-Butyl Lithium: Promoter.* The competition between propagation and transmetallation is dependent upon the choice of promoter. For a given promoter, an increase in the ratio of n-butyl lithium: promoter reduces the rate of transmetallation relative to propagation and yields an increase in molecular weight.

(iv) *Addition of Inert Solvent.* An inert solvent is classed as one which will not undergo the transmetallation reaction. Dilution of toluene with inert solvent results in an increase of molecular weight by an analogous argument to (ii) above.

For the living polymer process, it is evident from the reaction mechanism that the molecular weight of a polybutadiene prepared in this manner is independent of the factors (i)-(iv) above. In this case, the molecular weight is a direct function of the ratio of the weight of butadiene polymerised to the number of moles of n-butyl lithium initiator.

## Microstructure of Lithene polybutadienes

Refs. 13-15

For a polybutadiene, the microstructure is defined by the relative proportions of cis-1,4, trans-1,4, vinyl-1,2, and cyclic saturated structures (Fig. 4), linked together in a random manner<sup>13</sup> to form the polymer chain. In organo-lithium initiated polymerisations the microstructure can be varied between wide limits by a suitable choice of polymerisation solvent, temperature, and the initiator-promoter combination.<sup>14</sup>

The latter possibility is the one most relevant to the mechanisms under discussion. By a suitable choice of promoter and by variation of the ratio n-butyl lithium: promoter, the telomeric products can be prepared with an overall 1,4

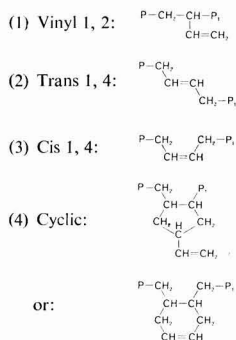


Fig. 4. The microstructure of polybutadienes

content in the range 30–75 per cent and the living polymer products between 10–85 per cent. For both product types, the ratio of cis-1,4: trans-1,4 remains virtually constant at approximately 40:60, irrespective of vinyl-1,2 or cyclic structure content.<sup>13</sup>

Cyclic saturated structures are formed when strong chelating promoters (such as TMEDA) are employed, and probably arise by metallation of a vinyl or 1,4 double bond by an active chain end via a “back-biting” reaction. It may be coincidental that the strong promoters yield a high vinyl-1,2 content and therefore likelihood of blocking of 1,2 units, but the structure shown in Fig. 4 could arise from a laddering reaction of adjacent vinyl-1,2 units. However, other structures are possible.<sup>15</sup>

As will be shown, the microstructure of a polybutadiene can have a profound influence on the physical and hence application properties. Typical microstructures are given in Table 1.

### Viscosity of Lithene polybutadienes

The bulk viscosity of a liquid polybutadiene is controlled by three main parameters, the average molecular weight, MWD, and microstructure.

#### (A) Molecular Weight and MWD

For a given microstructure the bulk viscosity of a liquid polybutadiene is very dependent upon molecular weight. Furthermore, for the same average molecular weight and microstructure, the bulk viscosity of a narrow MWD living polymer type product is considerably lower than the telomeric products which possess a broad MWD.

These effects are illustrated in Figs. 5 and 6 for the telomer and living polymer products respectively.

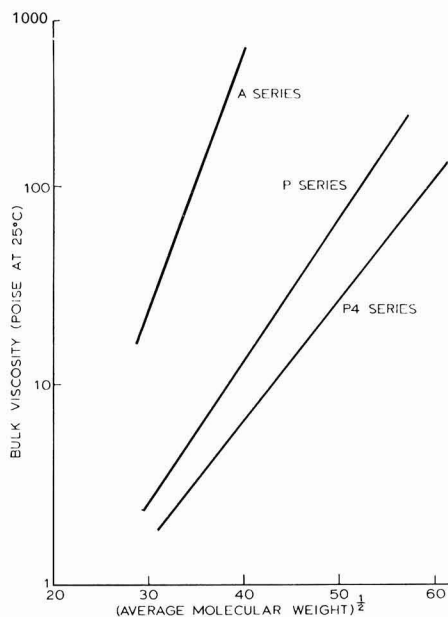


Fig. 5. Viscosity vs molecular weight for Lithene telomers

Table 1  
Typical properties of Lithene liquid polymers of butadiene

Lithene Grade	Approx. Molecular Weight ( $M_n$ )	Bulk Viscosity in Poise		Microstructure Polybutadiene (%)				Flash Point C.O.C. (°C)	Density (g/ml)	Solvent Content (wt. %)
		25°C	50°C	Vinyl 1,2	Trans 1,4	Cis 1,4	Cyclic			
<b>A) Telomer Grades</b>										
PL	900	3	1	40–50	30–40	15–25	—	150	0.89	≳1
PM	1,300	7	2	40–50	30–40	15–25	—	170	0.89	≳1
PH	2,600	85	20	40–50	30–40	15–25	—	NONE	0.89	≳0.5
PM-4	1,500	7	2	20–30	40–50	20–30	—	NONE	0.89	≳1
PH-4	3,400	85	20	20–30	40–50	20–30	—	NONE	0.89	≳0.5
AL	1,000	40	8	40–50	15–25	10–20	15–20	186	0.93	≳1
AM	1,300	150	18	40–50	15–25	10–20	15–20	NONE	0.93	≳1
AH	1,800	450 (35°C)	100	40–50	15–25	10–20	15–20	NONE	0.93	≳1
<b>B) Living Polymer Grades</b>										
N5,000	4,500	80	25	40–50	30–40	15–25	—	NONE	0.89	≳1
N4-5,000	5,000	40	—	15–25	45–55	25–35	—	NONE	0.89	≳1
N4-10,000	10,000	400	120	15–25	45–55	25–35	—	NONE	0.89	≳2

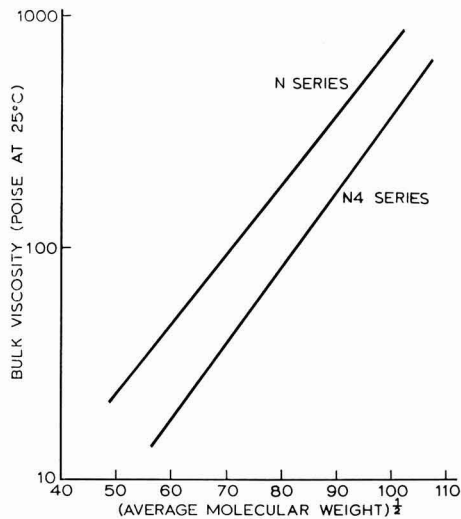


Fig. 6. Viscosity vs molecular weight for Lithene living polymer grades

#### (B) Microstructure

For a given average molecular weight and MWD, the bulk viscosity of a liquid polybutadiene decreases as the total 1,4 content increases at the expense of either vinyl-1,2 or cyclic microstructure (Figs. 5 and 6). It should be noted that the reverse situation can apply when solution viscosities are being considered.

The bulk viscosity of a liquid polybutadiene decreases rapidly with an increase in temperature as illustrated in Table 1. The higher vinyl-1,2 microstructures show a more rapid change in viscosity with temperature than the higher 1,4 products.

A list of typical properties for some Lithene polybutadienes is given in Table 1. However, it should be emphasised that the versatility of these polymerisation processes makes "tailor-making" of polybutadienes for specific applications a viable proposition. Although only homopolybutadienes have been considered here, it is also possible to produce copolymers with monomers such as styrene or alpha-methylstyrene.

## The properties and applications of liquid polybutadiene resins

### Introduction

All liquid polybutadienes are characterised by two outstanding features:

- (1) they are highly unsaturated and therefore reactive to oxygen. They will cure in thin films by autoxidation during baking or, when metallic driers are added, at room temperature. The iodine number of the polymer is approximately 450—considerably greater than that of common natural drying oils (linseed and soya bean oils have iodine numbers of about 175 and 133 respectively). Hence, depending on their molecular weight and microstructure, they generally cure much more rapidly than the natural oils.

- (2) they possess a hydrocarbon backbone which renders them highly resistant to hydrolysis and other chemical attack. This is to be contrasted with the sensitive nature of ester and amide linkages found in polymers prepared by condensation reactions. Indeed, the outstanding water resistance of the polymers provides excellent corrosion resistance when they are employed as metal primers. Maleinised polybutadienes in electro-deposited paints in the automobile industry have set a new standard of excellence and are rapidly gaining in their already widespread acceptance.

These two features make them worthy of more detailed investigation by the surface coating chemist for use in a wide range of applications.

### The range of polybutadiene polymers

As mentioned earlier, a wide variety of liquid polybutadiene resins is available from the different polymerisation methods. They vary with regard to:

- (a) Molecular weight—the polymers span the range 750–10,000 and for a fixed microstructure and molecular weight distribution an increase in molecular weight gives a corresponding increase in both the rate of autoxidation and the flexibility of the cured film.
- (b) Microstructure—the polymers span the range 90 per cent 1,4 content to 90 per cent 1,2 content, with an increase in 1,4 content giving a corresponding increase in both rate of autoxidation and flexibility of the cured film.
- (c) Viscosity—depending on molecular weight and microstructure, the viscosities vary from 1 to 30,000 poise. The viscosity obviously limits the choice of polymer consistent with the required application viscosity of a coating material.

The Lithene range of products prepared with organolithium catalysts are perhaps of greatest interest to the surface coating chemist, since they cover a wider range of the properties than products from any other catalyst system.

Lithenes are available

- across the full range of molecular weights 750–10,000
- with microstructures from 10 to 85 per cent 1,4 content
- with viscosities from 1 to 400 poise.

Thus, they provide a product range on which coatings can be designed having the:

- optimum rate of cure
- required film flexibility
- correct applicational viscosity

by the correct choice of polymer with regard to molecular weight and microstructure.

### Air drying properties of Lithenes

The air drying performance of the more reactive polymers is compared with simple natural drying oils in Table 2.

Table 2  
Air-drying properties of Lithene polymers compared to natural drying oils

Sample	Approx. Molecular Weight	Vinyl 1,2 Content (%)	Viscosity* (Poise)	Colour (Gardner Scale)	Drying Time at 20°C***		Hardness*** (B.S. Scratch Resistance)
					BK Recorder (hours)		
					Set	Hard	
Refined Linseed Oil	—	—	0.75	5—	5	17	100—
Refined Soya Oil	—	—	0.75	5	8-9	—	100—
Tung Oil	—	—	1.0 (50 <sup>o</sup> )	8	3	7	300—
Linseed Stand Oil	—	—	100	6	4-5	9	200+
Lithene N-5,000	4,600	44	72	1—	4	8	900+
Lithene N4-5,000	5,500	25	67	1—	2.5	7	700+
Lithene N4-10,000	10,000	20	336	1—	1.5	2.5	900+
Lithene PH-4	3,500	28	128	1—	2.5	5	800+

\*Determined at 25°C, unless otherwise stated.

\*\*Samples contained 0.06 wt. % Cobalt drier.

\*\*\*Determined after ageing for 72 hours at 20°C.

Film Thickness  $1.5 \times 10^{-3}$  inches.

Table 3  
Air drying properties of Lithene/natural drying oil blends

Lithene/Natural Drying Oil Blend	Blend Ratio	Viscosity at 50°C (Poise)	Colour (Gardner Scale)	Drying Time at 20°C*		Hardness† (B.S. Scratch Resistance)
				BK Recorder (hours)		
				Set	Hard	
PH-4/Varnish Linseed Oil	40/60	3.0	2+	2.5	10	600
PH-4/Tung Oil	40/60	6.5	5+	2	5	500+
N-5,000/Tung Oil	40/60	4.5	5+	2	7	500+
PH-4/Soya Oil	60/40	10.0	2+	6	10	700—
N-5,000/Soya Oil	60/40	4.5	2+	7	13	600—
N4-5,000/Soya Oil	60/40	5.0	2—	6	8	600—
N4-10,000/Soya Oil	60/40	18	2—	5	6	700+

\*Samples contained 0.06 wt. % Cobalt drier.

†Determined after ageing for 72 hours at 20°C.

Film Thickness  $1.5 \times 10^{-3}$  inches.

The results are in accordance with the observations made earlier regarding the influence of molecular weight and microstructure on rate of autoxidation. Furthermore, they show the Lithenes to give harder films and improved colour.

Lithenes are generally compatible with natural drying oils (except blown oils) and optimum performance and applicational viscosity may be achieved by a blend. The air drying performance of several of such blends is shown in Table 3. The performance of the natural oil is improved by the addition of Lithene and the following extra features are observed:

- film hardness and final colour are improved
- a range of film flexibilities can be obtained by blending
- a range of applicational viscosities is obtained.

#### Flexibility of stoved films of Lithene resins

The flexibilities of stoved films of some Lithene polymers have been tested and the results shown in Table 4. The results confirm the earlier statement that flexibility increases both

with molecular weight and 1,4 microstructure. The effect is combined with a decrease in film hardness.

#### Cooking of Lithenes and Lithene/natural drying oil blends to produce stand oils

Lithene polymers can readily be polymerised thermally by cooking at temperatures up to 200°C without gelation to produce high viscosity stand oils.

Similarly, stand oils can be prepared from blends of Lithene with natural drying oils. Details of the preparation and properties of stand oils made from natural drying oils and blends with Lithene N-5000 are shown in Table 5. The results again confirm the advantages derived from Lithene with regard to colour and rate of air drying; furthermore, the following advantages are obtained:

- the rate of bodying is increased, thus permitting lower process temperatures and/or shorter process times.
- the acid value of the stand oil is very much lower than with the natural drying oil alone. This is an advantage where the application involves reactive pigments.

Table 4  
Film flexibilities of stoved Lithene polymers

Sample	Approx. Molecular Weight	Vinyl 1,2 Content (%)	Impact Test (Force in inch pounds required to crack film to allow copper to deposit)		Mandrel Test (Distance from narrow end to first deposit of copper—max. 5cm)		Scratch Hardness (grams)	
			30'/180°C	45'/180°C	30'/180°C	45'/180°C	30'/180°C	45'/180°C
Lithene PM	1,300	45	20	10	3	5	2,600	2,300
Lithene PM-4	1,300	25	40	20	2.5	4	2,400	2,300
Lithene N-5,000	5,000	45	60	20	2.5	3	2,200	2,000
Lithene N4-5,000	5,000	20	80 slight deposit	20 slight deposit	Trace	1	1,700	1,600

Films were laid and cured on standard mild steel plates.

Film Thickness  $0.7 \times 10^{-3}$  inches.

Cracking of the film was detected by painting with acidified copper sulphate solution.

Table 5  
Preparation and properties of stand oils prepared from natural drying oils with Lithene N-5000

Sample	Blend Ratio	Initial Viscosity (Poise at 25°C)	Process Time* (hours)	Final Viscosity (Poise at 25°C)	Acid Value (mg KOH/g)	Colour (Gardner Scale)	Drying Time at 20°C† BK Recorder (hours)	
							Set	Hard
Refined Linseed Stand Oil	—	0.75	≤ 24	ca30	6-7	6	5	6.5
Refined Soya Stand Oil	—	0.75	≤ 24	ca30	6-7	6	8	18
N-5,000/Refined Soya Stand Oil	30/70	3.5	19	30.5	0.6	3+	4.5	6
N-5,000/2 poise Soya Stand Oil	30/70	7.5	21	30.0	5.3	4	3.5	6.5
N-5,000/Varnish Linseed Oil	30/70	3.0	12	30.0	0.9	3+	3.0	5.0
N-5,000/Raw Wood Oil/Varnish Linseed Oil	30/30/70	8.5	4	150	2.0	5+	5.0	7.5

\*Process conditions: Heated to 250°C with stirring, under nitrogen for time stated.

Film Thickness  $1.5 \times 10^{-3}$  inches.

†Samples contained 0.06 wt. % Cobalt drier.

The results shown refer only to blends with Lithene N-5000, but similar results would be anticipated for the other Lithenes described earlier.

As has been shown, many Lithene grades (either alone, in combination with natural drying oils, or combined with natural drying oils in a stand oil) give air drying rates comparable with, or considerably better than, most alkyd resins. Thus, they could serve as binders for fast drying interior and exterior paints. However, as the polybutadiene content in the resin system increases, so too does the tendency to chalking and yellowing in comparison to the basic natural drying oil. As a consequence, the advantages of the polybutadiene combinations are best realised in highly pigmented systems or in undercoats. Thus, they are ideal for fast-drying primers and undercoats, especially in the rust protection of metal.

### High solids and water-borne coatings

Pressure to reduce the use of organic solvents continues to be exerted on the surface coating industry by pollution control agencies and by the continually rising price of such solvents. Accordingly, in recent years, interest has increased tremendously in both high solids and water-borne coatings. Liquid polybutadienes lend themselves admirably to these systems.

As has been seen earlier, some of the more reactive Lithenes have drying rates comparable with alkyds. *E.g.* Lithene N4-5000 surface dries in 2.5 hours and becomes hard in about 7 hours. This resin has a bulk viscosity of about 40 poise at 25°C and a 2 poise viscosity in white spirit at 66 per cent solids. In this respect, it is superior to most oil modified drying alkyds; a glance in a resin manual will show most alkyds give the same viscosity at only 40-50 per cent. Thus, in a given PVC paint recipe, the Lithene as binder would give a higher solids product than most alkyds of comparable performance.

Lithenes may also be used in water borne-systems by way of the maleinisation of the polymers. Polymers up to a molecular weight of 5000 can be maleinised without fear of gelation to a low free acid value. At a ratio of Lithene: maleic anhydride 80:20, the polymers after half esterification and neutralisation become completely water soluble. However, in the absence of a co-solvent, the viscosity/solids relationship of such systems is very unfavourable and in practice, a small quantity of a suitable polar solvent such as isobutanol is added to achieve workable viscosities. This also improves the wetting out of surfaces, especially when coating metal.

A recipe is shown in Table 6 for the preparation of a 90:10 Lithene: maleic anhydride adduct which is soluble in an isobutanol/water vehicle.

Such a product is suitable for:

- (a) a can coating lacquer,
- (b) a dip or spray metal primer,
- (c) a paint for electro-deposition,
- (d) a one-coat metal coating when in combination with another water-soluble resin such as a melamine.

Table 6

Preparation of an isobutanol/water-soluble Lithene resin

	Parts by weight
Lithene N4-5000	240
Anti-gelation additive	1.2
Reflux aid (Xylene)	7.2
Maleic anhydride	26.6
Heat for 4½ hours at 190°C under nitrogen, then cool to 80°C, then add	
Methanol	13.1
Gently reflux at 80°C for 1 hour, cool, then let down with	
Isobutanol	108

Product:	TSC	70%
	Lithene: MAH	90:10
	Viscosity (poise at 25°C)	42

After the addition of an appropriate base, e.g. ammonia or triethylamine, the product is infinitely reducible with water.

### Alkyd resins based on polybutadiene resins

Possibly the most exciting potential for polybutadiene resins in surface coatings has yet to be fully explored. This is their combination into alkyd resins, where the maleinised polymer may be used as a partial replacement for the fatty acid component. The work so far has shown that products with substantially quicker drying and better water and chemical resistance can be produced. Because the Lithene range provides a wide choice of molecular weights and microstructure, Lithene modified alkyds can be prepared to give a similarly wide choice of film flexibility. A typical formulation for the inclusion of Lithene in an alkyd is shown in Table 7. Long term tests so far indicate that 20–30 per cent of the natural fatty acid may be replaced by polybutadiene without any significant change in the weathering resistance, when the alkyd is used for exterior paints.

Table 7

Preparation of an alkyd resin from a Lithene/natural drying oil blend

Recipe:		
Refined soya bean oil	702g	} A
Pentaerythritol	30g	
4% Cobalt Naphthenate	2g	
Lithene PM:MAH adduct (100:7)	596g	} B
Xylene	80g	

Mixture A was heated to 245°C for 1 hour under reflux in an inert atmosphere. Mixture B was then added and the whole heated, with agitation, for 6 hours at 230–250°C; water was removed by azeotropic distillation. After removal of solvent the product had the following properties:

Viscosity at 25°C	28 poise
Colour (Gardner scale)	5–
Acid Value	2.0 mg KOH/g
Drying time—B.K. Recorder SET	2.5 hours
	HARD 5.0 hours

The resin dried to give a very hard flexible film with high colour and high gloss; chemical resistance was excellent.

In undercoats and primers, the use of higher levels appears to be possible. As metal primers, such alkyds have been shown to offer considerable improvements in corrosion resistance.

### Conclusion

As a conclusion, it can be said that the physical and chemical properties of liquid polybutadienes make them suitable for a wide range of surface coating applications. Of the polymerisation techniques available, that using organo-lithium catalyst offers the greatest range of molecular weights and microstructures which are the major influences in determining:

- (1) coating viscosities; (2) drying characteristics; (3) final film properties.

[Received 24 September, 1976]

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## Next month's issue

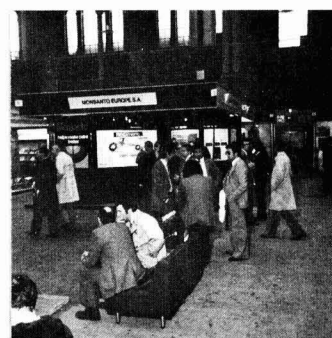
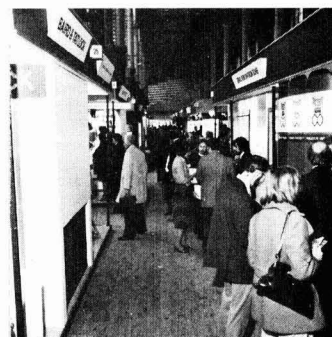
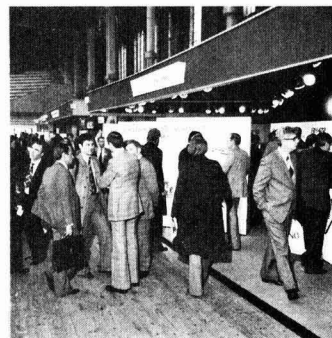
The Honorary Editor has accepted the following papers for publication, and they are expected to appear in the June issue of the *Journal*:

Test methods used for the evaluation of powder coatings based on epoxy resins by C. H. J. Klaren

The effect of oxidative coordination drier systems on film properties by D. J. Love

Steel cleaning standards—a case for their reappraisal by A. N. McKelvie

The integration of the protection function when building a ship by J. O. Jemitus and A. N. McKelvie





**Exhibitors from 16 countries  
Visitors from 50 countries**

The Twenty-Ninth Annual Technical Exhibition (OCCA-29) of the Oil and Colour Chemists' Association was held at Alexandra Palace, London N22, from 22-25 March, 1977, and was one of the most successful in attracting overseas exhibitors and visitors.

Represented as direct Exhibitors were companies from 16 countries:

Austria, Belgium, Denmark, East Germany, Holland, Hungary, Italy, Norway, Poland, Romania, Spain, Sweden, Switzerland, United Kingdom, USA, West Germany. Many other overseas organisations showing in conjunction with other companies were included among more than 100 names mentioned in the Official Guide to the Exhibition.

Once more, this year, interpreters were available at the Information Centre to help both Exhibitors and visitors, and their services were in constant demand.

**The international forum for display and discussion in the surface coatings industries**

The motif for the Exhibition, designed by Robert Hamblin, drew attention to the many parts of the world from which Exhibitors and visitors came to the Exhibition by using inward pointing arrows, which in turn form outward pointing arrows between them to symbolise the subsequent spreading of knowledge of technical development in the industries.

**The crowd puller!**

Admissions of 10 000 were recorded and visitors were known to have come to OCCA-29 from 50 countries.

Many Exhibitors expressed their appreciation of the advantages of holding the exhibition at Alexandra Palace: unlimited free parking for cars, restaurant facilities, a cafeteria and two licensed bars, all entirely at the disposal of the Exhibition. In addition, for visitors travelling on the London Underground the Association ran a free bus shuttle service to and from Turnpike Lane station on the Piccadilly Line, which, it is hoped, will extend all the way to Heathrow Airport in time for next year's Exhibition. As the weather was fine for most of the days, many visitors were able to enjoy a walk along the South Terrace and were able to view the Palace grounds where spring flowers were beginning to come into evidence on the slopes.

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# EXHIBITION REVIEW

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## OCCA-29 AN OUTSTANDING SUCCESS!

An innovation, welcomed by Exhibitors at OCCA-29, was the opportunity for Exhibitors to serve alcoholic refreshments on their Stands if they desired; many smaller Exhibitors in particular appreciated this as it allowed their personnel to remain on their Stands throughout the Exhibition.

On the opening day of the Exhibition a buffet luncheon was held for principal officers of other societies and special guests, including a party from the House of Commons, and in the afternoon the Exhibition Committee gave them a conducted tour of the Stands.

**"I am pleased to report that from our point of view the Exhibition was an unqualified success."**

Reports coming in from Exhibitors indicate that from their point of view the Exhibition was an outstanding success. For example, one Exhibitor has reported that by the end of the third day he had conducted 300 in-depth interviews on his Stand; another reported that he had taken as many enquiries on the first day as he had anticipated for the whole Exhibition; and yet another mentioned 200 useful contacts on one day alone! Many

Exhibitors had to call back to their offices to get reinforcements to cope with the rush on their Stands.

A new exhibitor writes "I think you would like to know that this was, without doubt, the most successful exhibition in which we have ever participated; the interest was absolutely enormous.... We have simply never known anything like it."

As a result of participation in this years Exhibition, many Companies have asked if larger sites can be allocated to them, and a number of requests have already been received from companies who were not able to exhibit at OCCA-29.

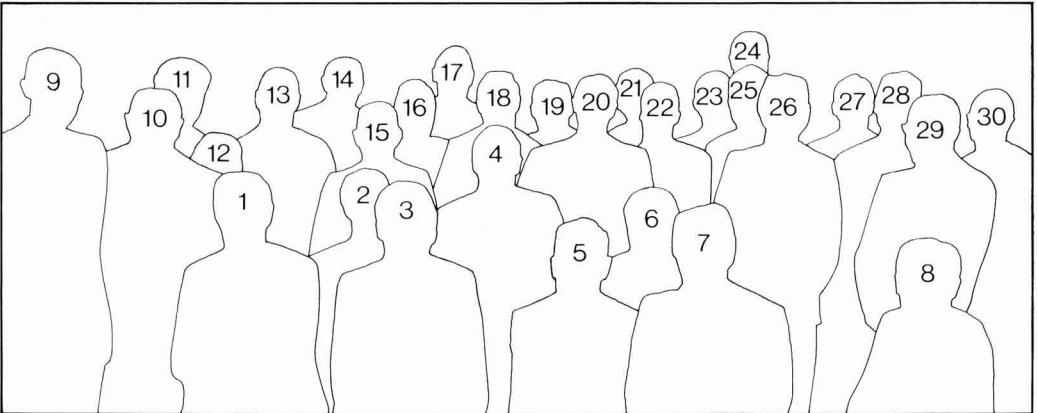
**The cost effective Exhibition**

Arrangements have now been made for OCCA-30, which will be held at Alexandra Palace from 18-21 April 1978. Invitations to Exhibit will be despatched in May 1977 and the allocation of stand space will take place in October 1977. Any company wishing to have details of OCCA-30 should write to the Director & Secretary of the Association, Mr R.H.Hamblin, at the address on the Contents page.



A view of the Information Centre at the Exhibition with one of the two seating areas in front of it





The Exhibition Committee and their guests before the tour of the Exhibition:

1. Ted Garrett, MP; 2. Dr J Edwards, Pres., Institute of Metal Finishing; 3. Dr H R Hamburg, Hon. Treasurer, OCCA; 4. H Rose, Pres., Paintmakers Assoc.; 5. A T S Rudram, President, OCCA; 6. Dr S Wernick, OBE, Hon. Sec. Genl., Institute of Metal Finishing; 7. A McLean, President-Designate, OCCA; 8. S R Finn, Hon. Editor, OCCA; 9. G Burrell, Chairman, British Colour Makers' Assoc.; 10. F Sowerbutts, Exh. Commee, OCCA; 11. C G Salt, National Westminster Bank; 12. Ray Mawby, MP; 13. Lt Cdr C Powell RN, Sec., Parliamentary & Scientific Commee.; 14. J Atkinson, President-Elect, Society of Dyers & Colourists; 15. C N Finlay, Hon. Res. & Dev., Off., OCCA; 16. Sir Ralph Perring, Bt, JP, Worshipful Company of Painter Stainers; 17. David Crouch, MP; 18. V Vohralik, Chairman, British Adhesives Manufacturers' Assoc.; 19. H C Worsdall, Exh. Commee., OCCA; 20. Dr P Bosworth, Sec., British Adhesive Manufacturers' Assoc.; 21. B Boocock, Pres. British Resin Manufacturers' Assoc.; 22. L Bilefield, Sec., Paintmakers Assoc.; 23. J N Ratcliffe, Sec. Genl., Plastics & Rubber Institute; 24. Dr M Tordoff, Gen. Sec., Society of Dyers & Colourists; 25. J T Tooke-Kirby, Exh. Commee., OCCA; 26. J Arendt, Res. Director, Paint Research Assoc.; 27. R H W Roff; 28. R T Bowes, Pres., Society of British Printing Ink Manufacturers; 29. R H Hamblin, Director & Sec., OCCA; 30. C Sweett, Worshipful Company of Painter Stainers.



All photographs with the exception of some on page 193, were taken by the Exhibition Official Photographer, RON LUCAS PHOTOGRAPHY.

## Exhibition Report 1977

Additives, driers, surfactants and hardening agents ★ Chemical intermediates ★ Extenders, fillers and matting agents ★ Laboratory apparatus and testing equipment ★ Manufacturing equipment, drums etc. ★ Oils and fatty acids ★ Pigments ★ Resins—acrylic, alkyd, amino, emulsion and water-based, epoxy, polyester, polyurethane ★ Solvents and plasticisers ★ Technical journals and services.

### Additives, driers, surfactants and hardening agents

A.B.M. CHEMICALS LTD. exhibited its range of photosensitisers and photoinitiators which include the *Glocure* series of benzoin ethers available in powder or liquid form. Pigmented systems sensitised to UV light by benzil or benzoin were displayed. The *Solumins* and *Petrones* are emulsifying agents for use in emulsion polymerisation. Also shown was *Glokill*, a biocide for polymer based coatings, *Catafor CA*, an additive for electrostatic spray coatings, *Catafor POW* to improve the spraying properties of electrostatic powder coatings and a range of *Glokernel* waxes to improve the hardness and scuff resistance and to improve the salt spray resistance of paint systems.

ALBRIGHT AND WILSON LTD showed the new aqueous pigment dispersant *Empircyl APD* and a range of pigment dispersants based on the sodium salts of a polymer of maleic anhydride and di-isobutylene. Also available is a series of anionic, cationic and nonionic surfactants for use in latices, emulsion polymers, paints and inks. Tributyl tin oxide and other organotin compounds are available for use as fungicides.

ANCHOR CHEMICAL CO. LTD showed the latest additions to the *Ancamide 500* range of amido-amines for epoxy curing agents suitable for solvent-free coatings, flooring, concrete repairs and crack injection compounds. The latest developments in the field of water-dispersible and under water curing epoxy systems were also shown, which include three modified cyclo aliphatic epoxy curing agents. *Development Curing Agent 1693* has excellent colour stability, low viscosity and good chemical resistance. It is recommended for high-build systems. *1680* and *1704* offer low viscosity, excellent chemical resistance and cure under adverse conditions. They are recommended for floorings and high-build coatings. *1680* systems have greater flexibility than *1704* systems. *Development Curing Agent 1532* is a  $BF_3$  complex for rapid cure and flexibility. It cures standard resins in 2.5 mins at ambient temperature and is recommended for rapid set adhesives.

CHEMOLIMPEX exhibited its ranges of versatate driers, organic peroxides and *Xanthan* resin emulsifier.

DEGUSSA showed *Aerosil R 927*, an aid to flow in powder coatings and zinc-rich paints. Also introduced was a new bodying agent *Transparfill Printex 2/0* for black U/V curing inks.

HERCULES POWDER COMPANY LTD displayed new grades of *Natrosol* having greatly improved resistance to microbiological attack to simplify the formulation of emulsion paints and to widen the scope of use of cellulose ethers.

IMPERIAL CHEMICAL INDUSTRIES LTD showed a new organic based thixotrope, *Thixomen*, especially suitable for chlorinated rubber and also for vinyl, epoxy, acrylic and other systems.

K & K GREEF INDUSTRIAL CHEMICALS LTD exhibited the *Dow* range of *Methocel* cellulose thickeners, and *Dowicide* bactericides. The *Sherwin Williams Chemical Division* showed the *Colratric Benzotriazole* and *Tolytriazoles* for the inhibition of corrosion of copper based metals.

LAPORTE INDUSTRIES LTD had information available on the *Laponite* range of inorganic thickeners for numerous purposes.

MONSANTO EUROPE SA displayed the *Modaflow* and *Multiflow* ranges of flow modifying agents, these are efficient for non-aqueous coatings. *Modaflow Powder II* is designed to reduce surface imperfections in industrial powder coatings.

NL INDUSTRIES INC. showed its rheological control additives for solvent- and water-based systems, including *Bentones*, *Thixins*, *Thixatrol ST*, *MPA 60*, *MPA 1078*, *Thixseal 1084* and *Post 4* as well as a new product for printing inks, designated as *EA 1128*.

CHEMISCHE INDUSTRIE SYNRES BV exhibited the *Troy* ranges of mercurial and non-mercurial preservatives and fungicides and a series of paint additives for various purposes.

TENNECO CHEMICALS EUROPE, LTD showed a wide range of anti-foaming and defoaming additives and its resin sizes for the paint, paper, adhesive and the rubber industry.

TITANIUM INTERMEDIATES LTD have available a wide range of organic titanate additives. The *Tilcom AT* range of thixotropes includes *AT 23* and *AT 33* which have high flash points and are resistant to yellowing. Titanates for use as non-reversible cross-linking agents are available to provide faster curing rates, reduced water sensitivity, to increase salt spray resistance, improve flexibility and give lower curing temperatures.

UCB sa CHEMICAL SECTOR are able to offer copolymerisable photoinitiators, *Uvecryl P 36* and *P 37* and synergists *Uvecryl P102* and *P 104*.

WARD BLENKINSOP & CO. LTD exhibited the *Quantacure* UV curing agents specially designed for printing inks and surface coatings. Blending, printing and curing operations were demonstrated on the stand together with examples of UV cured thick wood finishes and chip board fillers. Methyl ethyl ketoxime and *n*-butylaloxime anti-skinning agents, the *Adurex* range of substituted benzo phenones and the *Coremalux* range of optical brightening agents were also demonstrated.

### Chemical intermediates

ALBRIGHT AND WILSON LTD are able to supply a series of alkyl methacrylate monomers in the alkyl radical range of  $C_8$  to  $C_{20}$  including lauryl/myristyl and cetyl/stearyl methacrylates.

They have a wide range of chemicals based upon toluene, such as benzoic acid, benzaldehyde, benzophenone, diphenyl methane etc and a series of phosphorus compounds and inorganic phosphates.

ARCODE LIMITED are able to supply maleic and phthalic anhydrides, crude tall oil, adipic acid and intermediates for pigment manufacture.

ANCHOR CHEMICAL CO. LTD. *Anconer Ltd*, an associated company, showed its range of *Sartomer* acrylic monomers, polyfunctional methacrylates suitable for infrared and ultraviolet curing systems, which include ethylene glycol dimethacrylate, 1 - 3 butane diol dimethacrylate and trimethylolpropane trimethacrylate. Polyfunctional acrylates for electron beam and UV curing systems include lower viscosity diacrylates and higher viscosity tri- and tetra- acrylates, such as hexane diol and neopentyl diacrylates, trimethylolpropane triacrylate and pentaerythritol tri- and tetra-acrylates.

K & K GREEF INDUSTRIAL CHEMICALS LTD provided information on the use of *Amoco* isophthalic acid and trimellitic anhydride in resin manufacture.

MONTEDISON GROUP offered information on trimethylolpropane, pentaerythritol, formurea 80 and maleic anhydride.

SYNTHESE BV introduced a range of high quality multifunctional acrylic monomers and prepolymers for the coatings and printing ink industries and illustrated their application in radiation curing. Monomer types include *TMPA*, *PETA*, *PEGDA*, *HDDA* and *NPDA*.

UCB sa CHEMICAL SECTOR have available a number of polyfunctional acrylates, acrylated oligomers, polyurethane-acrylates, polyester-acrylates, epoxy-acrylates and polyacrylic-acrylates. Starting formulations based upon these prepolymers, oligomers and acrylates were suggested for a wide range of applications in UV and EBC curing.

### Extenders, fillers and matting agents

JOSEPH CROSFIELD & SONS LTD showed a new range of high performance matting agents, which include *Crosfield's HP 34* and *HP 94* silicas combining high matting efficiency with good dispersibility, excellent smoothness, clarity and mar resistance in the finished product. Another new product is *Gasil 23F* for vinyl cloth and wall coverings. The results of recent work on the matting of powder coatings with *GM2* silica and the use of *Gasil WP* in water based coatings was demonstrated.

DEGUSSA. The use of the matting agent *TS100* (formerly *TK 100*) introduced in 1975 has been extended to wider areas of application and panels illustrating these were displayed. The exhibits of *Aerosil*, *Aluminium oxide* and *Transparfill* are described under 'Additives'.

K & K GREEF INDUSTRIAL CHEMICALS LTD showed the *Cabot Carbon Cab-o-sil* fumed silicas which find wide applications in the surface coating industries.

LAPORTE INDUSTRIES LTD showed the *Laponite* range of inorganic thickeners for producing thixotropy in aqueous based applications.

SACHTLEBEN CHEMIE GmbH exhibited its range of blanc fixe and white barytes.

### Laboratory apparatus and testing equipment

ACS (APPLIED COLOUR SYSTEMS INC.) showed the new *ACS-500* colour control system which employs the new *spectra sensor* a high speed, high resolution scanning spectrophotometer feeding improved accuracy, repeatability and ease of operation. It was shown in conjunction with *BOC Automation*.

BAIRD & TATLOCK LTD displayed a wide range of laboratory equipment, which included the *Neotec "Du Colour"* which allows the rapid determination by unskilled operators of colour difference, opacity and brightness, CIE X, Y & Z values and absolute reflectance/transmittance. Also shown were photochemical reactors, a quantitative yield photoreactor for accurate investigation of photochemical reactions and a range of viscometers. Samples of a range of laboratory reagents were displayed.

BOC AUTOMATION showed for the first time the new *Hunterlab D54 P-5* spectrophotometer, which combines the latest micro computer processors with the *Hunterlab* optical system; it allows the use of A, C, D 65 and F illuminants and conversion to a wide range of colour spaces, colour differences, specific indices of colour, such as yellowness, whiteness and metamerism. The *ACS-500* control system was also shown in conjunction with the latest *D.54* and *DEC* computer equipment. A *Hunterlab* colourmeter interfaced to a microprocessor for colour measurement of a wide range of objects and for a number of industries was also displayed: the combination is known as the *Incomat system*.

CONTRAVES INDUSTRIAL PRODUCTS LTD exhibited a wide range of rotational viscometers and rheometers, including the multi-speed laboratory instruments for research purposes and single speed instruments for quality control. The 30 speed *Rheomat 30* covers a wide range of shear rates and shear stresses, it may be used in conjunction with a programmer and X-Y recorder for automatic plotting of rheograms and can be adapted to include a number of measuring systems. A high pressure *HV 6* capillary viscometer was shown which may be used with non-Newtonian substances at very high shear rates.

DH INDUSTRIES LTD showed the *Vollrath* single speed, two speed and variable speed mixers available from 0.3 to 200 HP. The laboratory *Sussmeyer Sand Mills* of both open and sealed types and the laboratory model of the horizontal *Supermill* were also displayed.



DIFFUSION SYSTEMS LTD displayed their optical test equipment for the paint, ink and plastics industries. The *TRU Colour* colorimeter was demonstrated with applications to colour difference measurements, and the *Spherical Hazemeter*, the *Varispec Glosshead* and the *Corning-Eel Nephelometer* head were also shown.

GLEN CRESTON LTD exhibited the *Bachofen KDL pilot Dyno Mill* for laboratory formulation and rapid small scale production.

JOHN GODRICH demonstrated the *Rotostat 05* laboratory model mixing machine and showed the *Sintest* and *Xenotest* light and weatherfastness testers and also salt spray,  $SO_2$  test and other laboratory equipment.

HUNTERLAB showed the new *D54 P-5* spectrophotometer which was displayed in conjunction with *BOC Automation* and is described under this company's stand.

MACBETH COLOR & PHOTOMETRY DIVISION OF KOLLMORGEN (UK) LTD demonstrated the use of colour as a fingerprint; the development of colour-sensors has allowed their use for on-line measurement during manufacture, assembly, printing and other operations. The *Munsell Colour Order System* standards were shown, as well as the *Macbeth Daylight Cabinets*. The *Macbeth MS 2000* spectrophotometer uses a pulsed xenon light source, laser tuned selector and micro-processor giving a choice of illuminants, three colour difference programmes and is able to detect metamerism and fluorescence. The *Macbeth 1010 Colorimeter* is based upon a similar technology for the spectrophotometer and offers high speed from the microprocessor.

MSE SCIENTIFIC INSTRUMENTS LTD showed the extensive range of *Haake* rotational viscometers for routine measurements and the study of flow behaviour, which may be used for a variety of purposes. Also shown were the *Orion* specific ion electrodes and meters and the *Vitatron 2001 Flat Bed* potentiometric single/dual channel recorder.

PILAMEC LTD exhibited laboratory and pilot scale high energy vibratory mills (see under Manufacturing equipment). The application of vibrational energy to the dry grinding, dispersing and blending of pigments was featured on the laboratory and pilot scale.

RK PRINT-COAT INSTRUMENTS LTD demonstrated the use of the *K Control Coater* for the application of a wide range of materials, such as UV polymer resins, inks of all kinds, paints and adhesives on to almost any substrate, including draw-down charts, films papers, foils, glass, metal plates, textiles and on the samples provided by visitors.

RESEARCH EQUIPMENT (LONDON) LTD exhibited the latest models of a series of instruments for various purposes. Instruments originally developed by *ICI Ltd* included Cone and Plate Viscometers, Drying Time Apparatus, and the Pressure Weight per Gallon Cup. *REL* equipment included Instruments for Scratch Test, Salt spray cabinets, Flow cups, Impact test, Abrasion test, Single and double head metering pumps and Fineness of grind gauges. Also shown

was the new *Gamma-Kugel* for the determination of specific gravity which combines accuracy with speed of operation, and information was available on the Pneumatic Micro-indentation apparatus.

SCIENTIFIC & EDUCATIONAL AIDS (ABR) LTD showed its range of laboratory equipment, which included laboratory weighing machines, together with a selection of magnetic stirrers and hot plates. Information was provided on the *SEA* laboratory furnaces and dissolved oxygen meters.

WENTWORTH INSTRUMENTS LTD exhibited the new *Atlas UVCON* apparatus for exposing materials to alternate cycles of fluorescent UV light and condensation. It enables screening tests to be made which give early indications of breakdown and supplements more complete accelerated weathering systems. The *Kesternich (SO<sub>2</sub>)* corrosion test apparatus was also displayed which can now be adapted for salt fog tests. Information was available on the *High Intensity Infra-red Conveyorised system* manufactured by *Research Inc. of Minneapolis* for drying/curing, the *Gardiner XL 20 Tristimulus Colorimeter*, which can be interfaced with a mini-computer to form the *XL 30 Colorimeter/Computer System*, and the new *Gardener Multiangle Portable Glossmeter* which enables measurements to be made at 20°, 60° and 85° angles by means of a changeover switch.

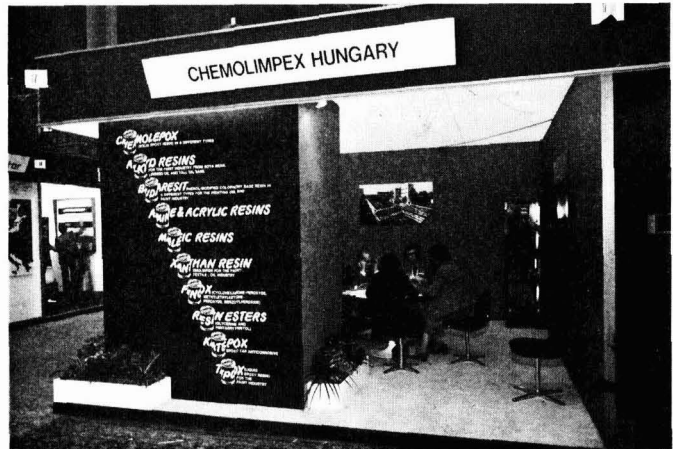
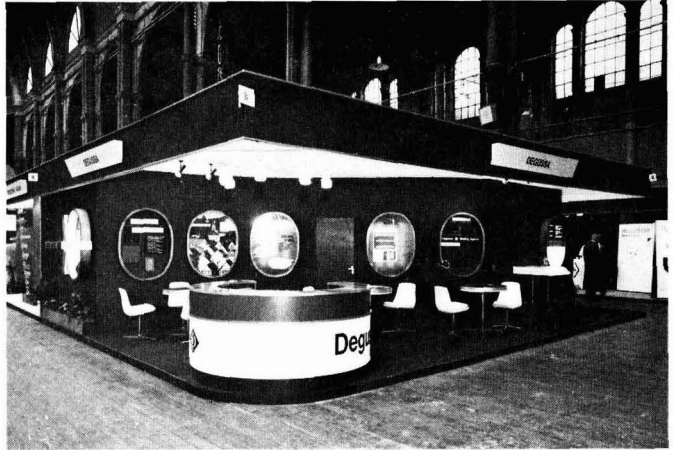
**Manufacturing equipment, drums, etc.**

CONTRAVES INDUSTRIAL PRODUCTS LTD. In addition to the viscometers mentioned under 'Laboratory apparatus', the *DC series* of single or multi-speed viscometers are available for *in-line* viscosity measurement, which are fitted with stainless steel measuring chambers and can be used at high temperatures and pressures. Also shown was the *Covistat F* for open tank applications.

DH INDUSTRIES LTD showed details of a wide range of equipment which included: *Sussmeyer* and *Oliver & Batlle* sand and micro-element mills of both open and sealed types; Plant for resin manufacture and solvent recovery; The *Centrimill* batch bead mills and a new *Supermill* horizontal bead mill; The *DeVree* semi-automatic filling machine with facilities for automatic tin feeding, lid dispensing and batching into cartons; The *Vollrath* single-, two- and multi-speed mixers from 0.3 to 200HP in electric and hydraulic drive; The *Exentrik* and dual shaft dissolvers; The range of *Cuno* filters from *AMF International Ltd.* Also shown were the *AB Metall* range of *Preba* filters, the *Peter Kupper* heavy z-blade kneader, the *Pamasol Willi Mader* complete range of aerosol filling plant from laboratory to full scale plant, and the *Graco* fluid transfer pumps from *Berk Ltd.*

DIAF A/S exhibited dissolvers and mixers for stationary or portable containers from 1 to 275 HP, filling and lidding machines and vibratory sieves. This exhibit was in conjunction with *Herbert Smith and Co. Ltd.*

DRAISWERKE GmbH showed the *Perl Mill STS* fitted with special cooling and designed for highly viscous and heat-sensitive materials and incorporating many



new features. The 'swimming slot' is a new method of discharge suitable for use with fluids of any viscosity. The *Drais TEX Mill RS* is designed for the production of high quality inks and incorporates the new 'swimming slot' and eliminates problems which may arise when using 0.5mm and smaller diameter beads. A new disperser with a stator and rotor reversed in principle from any other system available has a production rate four or five times that of a conventional machine and consumes 20 per cent less power. The *Drais Direct Perl Mill* enables continuous production without the use of a premixer, and the *Drais Pinned Disc Mill* is intended for use when a high degree of pre-dispersion is required.

G. J. ERLICH LTD displayed a full range of *Molteni* plant for the paint and allied industries, including a new planetary mixer of larger capacity with fully closed hydraulic drive which supercedes the mechanical variable speed drive, three new types of triple roll mills (*S80H*, *AN.S 100* and *Z.3A*) having a completely new hydraulic operating system which ensures that the initial settings are maintained during operation and a new grinding mill, *Microsfera*, for high viscosity pastes. Other machines available included filter plant and vessel cleaning apparatus. *Dutch finger* tools for steam working plant were also shown.

GLEN CRESTON LTD exhibited the *Bachofen Dyno mills*, with special attention drawn to the 15 litre model which is capable of producing many hundreds of litres per hour and needs as little as 10 mins to clean between batches even when a colour change is involved. The need for screens has been eliminated by the use of a tungsten carbide dynamic separator.

JOHN GODRICH showed the range of *Chemcol* mixers which have no bearings in the immersed part, alternative rotors and stators which enable the flow pattern during mixing to be varied according to the material being processed.

MARCHANT BROTHERS LTD displayed the latest model *TRA4* of the 3in x 6in triple roll mill which incorporates the best features of its predecessors and provides economy in operation. The *Marchant Service & Spares Division* offers machinery maintenance and overhaul facilities for roll mills, camber roll mills, mixers and general equipment, together with factory plant installation and removal.

MASTERMIX ENGINEERING CO. LTD has extended the range of *HVS High Speed and High Torque* dispersers to cover from 5 to 100 HP and a new range of *Fixed High Speed, Fixed Low and Variable Speed* models from 1 to 10 HP has been introduced. Safety features of the *Mastermix Dispersers* include an adjustable clamping device, a limit switch to stop the shaft immediately when it is raised above a predetermined level, shaft protection and an optional interlocked container cover to control dust and prevent the operator making contact with any moving part.

The improved *PMD* for products covering a wide range of viscosities is now available in from 1350 to 9000 litre capacities and offers optimum dispersion for less power consumption, by linking slow speed mixing with high speed dispersion. The *Horizontal Mastermill* for dispersion and particle size reduction can cope with

continuous or automated production. Super dispersions of up to 'chip' quality can be obtained, and it is anticipated that it should replace ball mill and vertical mill systems. It is available in 1, 15, 30, 60 and 150 litre sizes.

VEB KOMBINAT NAGEMA are able to supply *Heidenau* triple roll mills in the sizes: *Horizontal type 3KF1/600* (280 x 540 mm), *Inclined type NVH813/1* (322 x 800 mm) and *NVH913/1* (400 x 1000 mm). The *NVH913/1* model now has the four point roll pressure control already supplied to the *NVH813/1* machine.

NETZSCH FEINMAHLTECHNIK GmbH have available a large range of grinding, homogenising, dispersing, emulsifying, dissolving and agitating milling equipment, which includes the *576 Agitator Mill* (John System) designed for superfine grinding and the dispersion of micronised solids in liquids. The working volume is compressed into a zone of high activity which ensures relatively uniform grinding; it is manufactured in five sizes with outputs from 5.5 to 1300 litres/hour. The *KE Molinex Mill* is available in eight sizes covering 20/1500 to 4000 litres/hour outputs for the processing of pastes. The recently introduced *LM 506 Agitator Mill* is a horizontal mill which can be fitted with the John system or the *Molinex* system. It is designed for use with 0.25mm diameter micro beads with a high charge level of 90 per cent or greater.

NORATOM-NORCONTROL A/S This company in conjunction with the paint manufacturers *Jonut A/S* has developed the *Data Paint* concept, which is based on (1) Paint formulation with a reduced number of raw materials, on-line dispersion and batch production from a minimum number of bases and (2) Highly automated handling of powders and fluids, with complete monitoring from raw materials to finished bases and paints. The two firms offer services comprising of a preliminary study, process technology, knowledge of automatic production and equipment to modernise existing plant or the provision of complete production lines.

PILAMEC LTD exhibited equipment illustrating the application of vibratory energy to a series of processes. Laboratory, pilot scale and production equipment was shown which included high energy vibration mills operating on a batch or continuous flow basis which apply 10 to 20 times the energy of conventional milling equipment and give proportionately higher through-puts often providing a quality of grind equal to that of a jet mill. *Pilamec* continuous flow mills can be adapted to continuous blending in cases where particle size reduction is not required by modification of the grinding chamber. The *Pilamec MEGA-BLEND A* equipment covers a range of fluidised bed blenders employing vibrational energy for wet or dry products.

PORTER LANCASTRIAN LTD exhibited the *Portatank* for both storage and transport of liquids under air-free conditions. The static *Portatank* can be used for in-plant storage of liquids, such as tinters and the demountable tank for transport between manufacturer and user. Cleaning is made unnecessary by the use of a sterile, disposable polythene liner and avoids oxidation or skinning during storage and the contents may be discharged by the application of air pressure between

the tank and its liner. The *Plastics Division* showed plastic liners, for the low cost lining of mixing pans etc.

RIO BEER MASCHINENFABRIK in conjunction with *Herbert Smith & Co. Ltd* exhibited industrial washing equipment for cleaning top entry 'bung hole' drums, which is also suitable for open drums, and a new version of the *F-ex* for cleaning small but heavy charge cans. Also shown was the *C-ex* for cleaning open top buckets, pails etc. up to 900mm in height and diameters from 320 to 650 mm at a rate of 35-60 containers per hour. All the machines can be used with solvents, caustic soda and hot or cold water.

ROBAN ENGINEERING LTD offer the *Turnkey* project service to design and construct bulk solvent storage schemes, including approvals, building, electrical and mechanical work and utilising pumps and flow meters of *Roban* design. Examples of the latter were exhibited together with a new high capacity solvent pump for discharging tankers. Services covering small building alterations and flameproof lighting are also available.

LUDWIG SCHWERDTTEL GmbH showed the *S2 Press* automatic and semi-automatic for filling cans and pots of ink, which make it possible to change colour in 10 mins. The *S3E* pump has an electro-pneumatic drive system which provides a low cost alternative to the hydraulically operated machine in the normal *Schwerdttel* range. An automatic electrical device allows quantities from 50ml to 100 litres to be continuously and accurately dispensed.

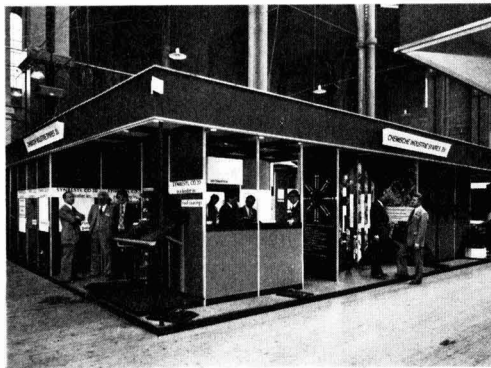
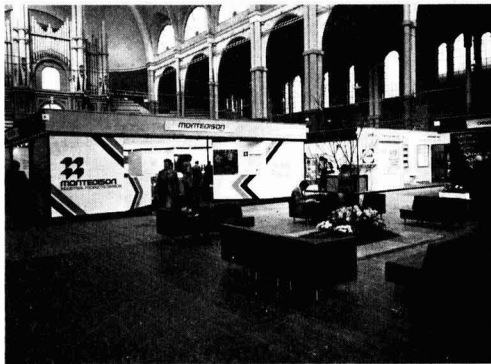
HERBERT SMITH & CO. (GRINDING) LTD exhibited equipment manufactured by *Diaf*, *Rio Beer* and *Sweco*. The plant shown by the first two named companies has been described under these names. The *Werner Pfeifederer* range of twin screw compounding machines were exhibited. Type *ZDS-K* for the production of powder coatings is available in three sizes giving 20, 240 and 750 kg/hour outputs respectively. These machines continuously melt and mix a preblend of all ingredients and discharge the product as a viscous liquid on to a cooling band for subsequent crushing and grinding. A *Sweco Separator* was shown which in addition to sieving dry powder coatings, can be used to separate liquids and solids and is extremely effective for specific de-watering purposes.

STRAZDINS PTY LTD demonstrated the improved designs of the *Blendorama Colourant* Dispensers, including the small 50ml capacity machine and the double pump 150 and 600ml machines for bulk blending. All machines are fitted with stainless steel cylinders and teflon slip rings. Measuring pumps for epoxies and other products which have to be accurately proportioned were also shown, as well as the *Spinmix* manufactured by *Merris Ltd* which mixes paint in pint tins.

TENNECO CHEMICALS EUROPE LTD exhibited the *Graco* colour of dispensing machines for colour dispersions in conjunction with the *Tenneco Colortrend* system (see Technical services).

## Oils and fatty acids

ARCODE LTD are able to supply crude tall oil.





## Pigments

ARCODE LTD exhibited a complete range of inorganic and organic pigments, which included dyestuffs for the textile and leather industries and synthetic iron oxides.

CIECH have available raw materials and intermediates for paint and leather manufacture. The pigments include zinc chromate, zinc tetroxychromate, chrome yellow, basic lead sulphate and ultramarine.

DEGUSSA introduced *Special Black 10* having excellent flocculation and flocculation resistance and superior ease of dispersion.

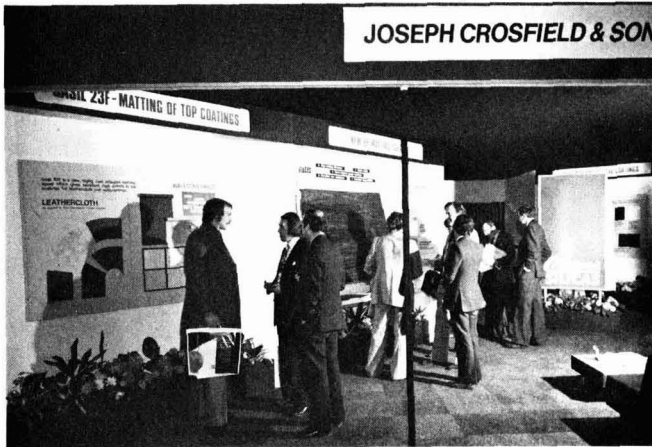
ECKART WERKE showed for the first time their range of special *Aluminium pastes* produced by a special manufacturing process to give a brilliance and sparkle which has not previously been obtainable. Also shown were newly developed *Aluminium powders* having properties required for use in powder coatings. The products are distributed in the UK by *Johnson and Bloy Ltd.*

HERCULES POWDER COMPANY LTD showed the latest improvements in the *Radglo* fluorescent pigments, the *R-104-G* range includes orange, yellow chartreuse and green. These pigments, as well as the *P-1800* range have been improved to give greater colour strength and brilliance. The *R-303-G* range has been extended to include chartreuse. *Ten Horn* demonstrated the lead chromate pigments which meet the requirements of both UK and continental markets, a new *Horna Diarylide yellow* which is easily dispersible, and for water based systems a new, high concentration, low viscosity *LVP* range of paste colours.

HILTON-DAVIS CHEMICAL CO. exhibited the range of pigments available to give a number of economic advantages, together with improved performance in many respects, including greater strength, improved gloss, cleaner colours and easier handling. Included in the exhibition were *Transparent iron oxide*, *Sup-R-Conc* non-dusting pigment concentrates, *Microspin* resin encased pigments, lead-free pigments, dry pigments and various flushed pigments for ink and coatings purposes. Also shown were the *Safer Seatone* dispersions for architectural latex paints and the *Eco-Set* flushed colours for low emission heat set ink applications.

INDUSTRIAL COLOURS LTD have extended the range of *Flare* aqueous pigment pastes and fluorescent pigments. The *Flare 600* series are utility thermoplastic grades for screen printing inks and low temperature-worked plastics. The *610* series are fine particle sized pigments for inks, paints, and paper coatings. The *U 610* series is similar but with improved light stability; the *630* series are ultra-fine particle size pigments of very high tinctorial strength for letterpress, offset, gravure and flexographic inks. The *710* series have identical chemical properties to the *610* series but are brighter and stronger, giving either economy in formulation or brighter and stronger colours. The *810* series are heat and solvent resistant pigments for paints, lacquers, inks, plastics and rubber.

K & K GREEF INDUSTRIAL CHEMICALS LTD featured the new *Powdura Blue* range of dry pigments for printing inks and carbon papers. The *Sherwin-Williams Alkali Blue* pigments and





the *Moly-White* range of pigments for corrosion resistance were also shown.

LAPORTE INDUSTRIES LTD based its exhibition on the application of titanium dioxide in paint, powder coatings and printing inks. A feature was the latest work on the newer industrial resin systems using the chloride process *Runa RH 472* and also *Runa RH 52* which is intended for high quality decorative paints and combines troublefree use with specialist high gloss potential and ease of dispersion. A bulletin was available on the high durability grade *Runa RO 676*.

MONTEDISON GROUP showed their very wide range of *rutile* and *anatase* titanium dioxides for plastics, rubber, paper, paints, water-based paints, flooring, traffic paints and general purposes. The *ACNA* range of organic pigments, including monoazo and bisazo derivatives, aniline condensates, phthalocyanines and dioxazines for a wide range of products and dyestuffs for natural and synthetic fibres were shown.

NL INDUSTRIES INC. INDUSTRIAL CHEMICALS DIVISION exhibited the range of *Oncor* lead silicochromate based anticorrosive pigments and the non-toxic *Nalzin SC 1* pigment. Information was available on two new antimony based flame retardants, the economic and highly efficient *Oncor 75 RA* and the high performance *Oncor 55*, as well as the smoke retardant *Ongard II*.

SACHTLEBEN CHEMIE GmbH introduced a new grade *Hombitan 511*, a general purpose rutile grade made by the sulfate process. It is easily dispersed in enamels, emulsion paints and inks, and has a high tinting strength, haze-free gloss and good resistance to chalking. It is very suitable for air drying and stoving enamels and in emulsion paints giving high brightness, purity of tone and good optical efficiency. The use of titanium dioxide of various types in environmentally acceptable coatings, such as high solids, water based, powder coatings and for coil coatings was described.

SILBERLINE LTD showed the *Sparkle Silver* range of products, including high quality non-leafing pastes. The *Sparkle Silver* grades 3500, 5500 and 7500 were exhibited, the two last named are for non-leafing silver or gold inks, giving brilliance and good rub resistance. A series of automotive acid resisting pigments, including the new *Sparkle Silver 3122-AR* and its regular purity equivalency *Sparkle Silver 3622* were also shown.

SUN CHEMICAL CO. placed emphasis on a number of products. For printing inks a new range of *Quantum Set* flushed colours for use in the formulation of infrared curing inks and a new range of *Inter-set* low energy heat flushings including *Sun pure 47*, *Fossil-set* and *Sun-set* flushed colours was shown, as well as easily dispersed diarylide yellow, lithol rubine and phthalocyanine pigments for liquid and oil inks and also high solids press cakes. For paints, a full range of lightfast organic pigments and also a high solids press cake for convenience in tinting emulsion paints with a minimum of dispersion, and high performance quinacridone and carbazole pigments for automotive paints were shown. For plastics, high performance pigments for use in vinyl materials and a range of colourants for polyethylene were demonstrated.



**TENNECO CHEMICALS EUROPE LTD** showed the *Tenneco Colortrend BV* comprising four separate colour systems based on the glycol based universal colourant technology, which enables paint manufacturers to be supplied with a standard or special range of tinters to produce any number of colours from the palest to the deepest full shade. The combination of the *Tenneco* colourants with the *Graco* dispensing machines and the *Colwell* colour displays gives complete flexibility in colour formulation from one source. The new Colortrend 877 line of aqueous pigment dispersions and the *Col-Tint* line of universal tinting colours were also shown.

**TIOXIDE INTERNATIONAL LTD.** Since its introduction in 1973, the multi-purpose, chloride process titanium dioxide *R-TC 4* has demonstrated its versatility and outstanding qualities. Up to date information was provided on its use with all types of media. Five grades of sulfate process pigment *R-HD2*, *R-HD 6*, *RXL*, *R-CR 2* and *R-XG* are available and each has certain specific qualities when used in paints. Further research on *Spindrift* has been carried out during 1976 and the latest developments were described, showing the cost benefits and convenience in manufacture obtained by its use, particularly in high quality matt vinyl latex paints, samples of which were available on the stand for evaluation by users.

## Resins

**CHEMOLIMPEX** are able to supply rosin esters, colophony-based and maleic resins, and colophony modified phenolics, including special grades for printing inks.

**HERCULES POWDER COMPANY LTD** exhibited the range of *Dresinol* solvent-free aqueous dispersions of rosin derived and hydrocarbon resins intended for incorporation into emulsion paints and solvent-free adhesive systems. The *Hercules* range of phenolic modified resins has been expanded to include improved and new versions. The *Natrosol* cellulose ethers are mentioned under 'additives'.

**IMPERIAL CHEMICAL INDUSTRIES LTD** showed the latest developments in *Alloprene* chlorinated rubber for use in a variety of environments, for marine, land based steel structure and traffic marking paints, and for printing ink media and adhesives.

**K & K GREEF INDUSTRIAL CHEMICALS LTD** exhibited the *Amoco Indopol* polybutenes which may be used as permanent plasticisers in coatings, sealants and adhesives.

**MONTEDISON GROUP** have available a number of phenolic resins in the *Resiaten* and *Resurfene* series.

**CHEMISCHE INDUSTRIE SYNRES BV** placed emphasis on the low pollution aspects of the printing industry and introduced a new grade of rosin modified phenolic resin, *Alsynol RL 43* which has excellent compatibility with low odour petroleum used in heat-set printing. It has fast setting, good gloss and low tack and may be used in conjunction with the higher viscosity resins *Alsynol RL 41* and *RL 42*.

**WARWICK CHEMICAL LTD** exhibited the range of phenolic modified resins, which includes the new *Mitchenol 42* to meet the latest requirements of the heat offset printing process and *Mitchenol 38* for use in both gravure and offset processes. Information was given on the new *Band Flaker* installation introduced for the manufacture of hard resins.

**WORDSALL CHEMICAL CO. LTD** showed *Estogel 102*, a new structuring material for modifying the rheological properties of printing inks. A number of charts were shown which illustrated the effect on the tact of varying the percentage of *Estogel 102* on *Estoset* and *Estovar* ink vehicles and on *Estokyd* alkyds. These charts were produced on a *Rudolph Meyer "Tackscope"* and were untouched laboratory originals.

Also shown were offset litho prints from inks based on urethane modified vehicles, *Estosets 600* and *610* which are products developed in the last year.

## Acrylic resins

**DYNO INDUSTRIER AS** has developed an aqueous dispersion of a hydroxylated acrylic resin, *H-265W* which can be cross-linked with melamine resins to overcome the odour of monomers and solvents when thermosetting acrylics are used in industrial coatings, such as wood finishes, coil coating and flexible packages.

**MONTEDISON GROUP** have available a number of acrylic and styrene-acrylic resin dispersions and a series of acrylic resin solution (*Resiacrils*).

**ROHM & HAAS (UK) LTD** exhibited acrylic resins in solution or emulsion form for a very wide range of purposes (see under 'Emulsions and water soluble resins').

**CHEMISCHE INDUSTRIE SYNRES BV** showed aqueous acrylic dispersions *CO25* and *CO26* for finishing wood, fibre and plaster boards, and a hydroxy acrylate copolymer dispersion *TP363DF* for water based coil coatings and *TP367DF* for acid curing wood lacquers.

**SYNTHESE** bv offer a range of high quality monomers and polymers for the coating and printing ink industries with special reference to UV curing. (See also under 'polyesters'). *Setalux UV 2276* and *2241* to *2245* are prepolymers of phenolic epoxy acrylates. *Setalux EPV 76-77* is intended for one component high solids systems in conjunction with *MF* resins as well as for two component high solids isocyanate systems.

**UCB sa CHEMICAL SECTOR** this year stressed non-polluting systems and have developed resins for various forms of radiation curing system. *Ebecryl* resins are for use in ultraviolet/electron beam curing and *Uvecryl* resins are specifically for UV curing. Other acrylic resins are the polyurethane-acrylics and a series of epoxy-acrylates, polyacrylic-acrylates. Acrylated oligomers, polyfunctional acrylates and copolymerisable photoinitiators are also available.

## Alkyd resins

**ARCODE LTD** showed its range of alkyd resins for a wide number of purposes.

**BEROL KEMI AB** exhibited new developments in the field of alkyd emulsions for air drying gloss finishes and water-reducible alkyd systems for industrial purposes. New developments in solvent based alkyds were also illustrated.

**CIECH** are able to supply a number of phthalate resins.

**CHEMOLIMPEX** have available more than 30 types of alkyd resins for a wide range of applications.

**K & K GREEF INDUSTRIAL CHEMICALS LTD** featured the series of alkyd resins made by the *Barford Chemical Company* which were formerly manufactured by *Soab Ltd*.

**MONTEDISON GROUP** gave information on the latest *Resial* and *Restrol* alkyd resins.

**WARWICK CHEMICAL LTD** showed the latest additions to its *Surkyd* and *Mitchelac* series of alkyd resins for industrial paints and specialised coatings.

**WORDSALL CHEMICAL COMPANY LTD** exhibited the newer *Estokyd*s for paints and other purposes.

## Amino resins

**CHEMOLIMPEX** is able to supply a series of amino resins.

**DYNO INDUSTRIER AS** have developed a versatile new melamine resin, *Dynamin MM 75* which is compatible with both water and solvent dilutable resins and can be cured at room or elevated temperatures, its high solids content allows the formulation of paints with a wide range of solid contents at application viscosities and is capable of cross-linking with alkyds, polyesters, epoxies, acrylics and many types of hydroxyl containing products, such as cellulose and vinyl derivatives. *Dynamin MM 100* is recommended in conjunction with the low viscosity polyester, *Dynotal 05*, for high solids stoving finishes with excellent flexibility.

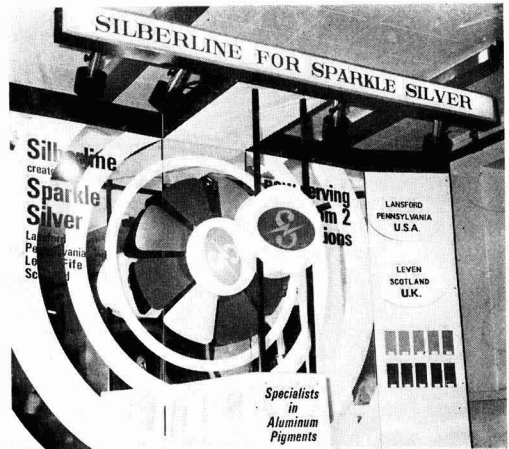
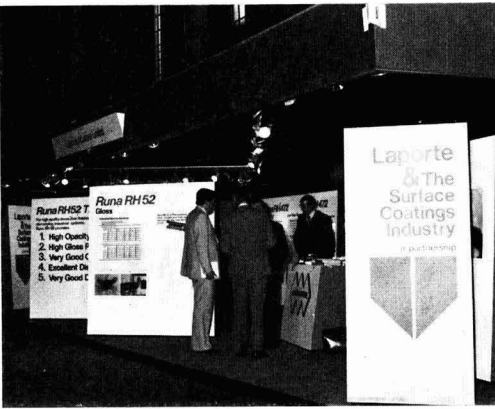
**MONSANTO EUROPE SA** displayed the high solid *Resimene* range of melamine - and urea-formaldehyde resins to provide essentially any required film performance. These *Resimenes* are designed for use in aqueous and high solid coatings, but can readily be used in solvent based coatings and are capable of cross-linking with a wide range of media to give enamels which provide excellent cost/performance ratios.

**MONTEDISON GROUP** showed the range of *Resiplast*, *Resfurin* and *Resmelin* amino resins.

## Emulsion and water-based resins

**BEROL KEMI AB** can supply alkyd resin emulsions for air drying gloss systems and water-thinnable alkyd and polyester resins for industrial purposes.

**DYNO INDUSTRIER AB** showed methylolated melamine resins suitable for use in water-thinnable and high solids coatings (see 'Amino resins'). *Dynocryl H-265W* is a water dispersion of a hydroxy acrylic resin for cross linking with melamine resins.





K & K GREEF INDUSTRIAL CHEMICALS LTD provided information regarding the new *Vinaking 7030/55 PVAc* recently developed by the *Kirklees Chemical Company*. The new 30 per cent *Veova* emulsion is designed for medium build texture coatings and high quality interior/exterior paints to supplement the already popular *8020* general purpose emulsion.

MONTEDISON GROUP showed its homopolymer and copolymer vinyl acetate dispersions, acrylic and styrene-acrylic dispersions (*Crelat*)

ROHM & HAAS (UK) LTD displayed the range of acrylic emulsions for a wide range of purposes, including water-based flat, silk and glossy decorative paints, as well as for primers, undercoats, maintenance paints and factory finishes for boards and coil coating, printing inks and can coatings. *Primal AC-64* was featured for use in primers, flat paints and wood stains and *Primal AC-67* as a binder for aqueous caulks and glazing compounds.

CHEMISCHE INDUSTRIE SYNRES BV demonstrated the latest developments which have been made in resins for water-dilutable wood, decorative coatings and coil coatings. (See also under 'acrylic resins').

SYNTHÈSE bv supply dispersions for *NAD* paint systems for which solid colour in high gloss and high build systems is required.

#### Epoxy resins

ARCODE LIMITED have available a number of epoxy resins.

CHEMOLIMPEX exhibited a number of epoxy resins.

SYNTHÈSE bv have available pre-polymers based upon epoxy/acrylate systems.

#### Polyester resins

ARCODE LTD exhibited polyester resins for various purposes.

BEROL KEMI AB showed polyester resins for industrial applications.

CHEMOLIMPEX offer hydroxy functional resins for use in polyurethane coatings.

DYNO INDUSTRIER AS exhibited a low viscosity polyester, *Dynotal 05*, for high solids stoving finishes giving excellent flexibility when cross-linked with methylated melanine resins.

SYNTHÈSE bv showed a saturated carboxylic polyester resin, *Setapoll 1001* for powder coatings which can be combined with epoxy resins. It offers maximum flow and minimum yellowing. New paint systems stoving enamel based upon polyester and acrylic resins and two component isocyanate systems based on a polyester/acrylic polyol. Saturated polyester resins for high solids, one component systems in conjunction with MF or HMMM resins, and unsaturated polyester resin for pre-catalysed putties and surfaces are also available.



## Solvents and plasticisers

ALBRIGHT AND WILSON LTD have available diethyl oxalate and aryl phosphates and dialkyl ester plasticisers.

ARCODE LTD have available toluene, xylene and petroleum derivatives.

BEROL KEMI AB can supply a range of plasticisers and solvents.

IMPERIAL CHEMICAL INDUSTRIES LTD exhibited a range of *Cereclor* chlorinated paraffins and gave information on their use as plasticisers or resin extenders in conjunction with *Alloprene* and vinyl copolymer resins.

K & K GREEF INDUSTRIAL CHEMICALS LTD exhibited the *Amoco Indopol* polybutenes and gave information on their use as plasticisers for coatings sealants and adhesives.

MONSANTO EUROPE SA showed the range of *Santizer* plasticisers for lacquer and coating applications.

TENNECO CHEMICALS EUROPE LTD. The *Solvents Division* exhibited a range of plasticisers, such as trioxetyl phosphates, for use with nitrocellulose and have available narrow and broad cut aliphatic hydrocarbons, low and high boiling aromatics, oxygenated and speciality solvents. Information was available on the *Keroset* range of distillates for use in printing inks etc.

## Report of Council Meeting

A Meeting of Council took place at the Great Northern Hotel, London N1 on 6 April 1977 with the President, Mr A. T. S. Rudram, in the Chair. There were twenty-three members of Council present.

Council learned with regret of the death of Mr T. Drummond Kerr, who had rendered distinguished service to the Association in earlier days and had been a Vice-President. It was hoped to publish an obituary notice in the May issue of the *Journal*.

It was reported that Mr R. G. J. Toms had agreed to represent the Association on BSI Committee PVC - Pigments, Paints and Varnishes Industries Committee.

Reports were received on the Eastbourne Conference and the 1977 Exhibition.

The Annual Accounts of the Association were adopted for inclusion in the Annual Report of the Council to be circulated in May.

It was recorded that the number of members whose subscriptions had not been received was lower than at the comparable time in 1976 and it was resolved that the names of any members still in arrears with 1977 subscriptions at the end of June should be removed from the Register. In accordance with Article 11, a resolution was passed for the second successive Council Meeting concerning 1978 subscriptions and this resolution would now be incorporated in the Agenda for the Annual General Meeting.

The Honorary Editor reported that all the Conference papers were now being

## Technical journals, services and miscellaneous

BOC AUTOMATION. The apparatus displayed at their stand has been described under 'Laboratory apparatus'. The *Incomat System* can provide colour data processing in conjunction with a *Hunterlab* colourimeter, paint plastics, paper, textile, pigment, food and cosmetic industries.

MARCHANT BROTHERS LTD offer a service of machinery maintenance, overhaul of roll mills, mixers and general equipment, together with factory plant installation and removal.

MASTERMIX ENGINEERING LTD are able to design, manufacture and install complete manufacturing plants.

NORATOM-NORCONTROL A/S. The *Data Paint System* of automated factory production was described. It is more fully reported under 'Manufacturing equipment'.

POLYMERS PAINT AND COLOUR JOURNAL showed the current number of the *Journal* which provides a service of commercial and technical news and comment relating to the industries within its scope. Copies of the *Year Book* were also available containing a new section which additionally lists polymer suppliers and processors, as well as die and pattern makers. Copies of 'The Technology of Powder Coating' by S. T. Harris and the new BRMA Surface Coating Resin Index for 1977 were also shown.

proved and that the Review of OCCA-29 would appear in the May issue of the *Journal*.

Council were extremely pleased to learn that negotiations for the purchase of Priory House, arising from the rent review, had reached a satisfactory stage and a note to this effect was added to the Annual Report for the information of Members.

The venue for the 1977 Annual General Meeting was discussed and it was agreed that it should be held at a Central London venue following a technical meeting, probably consisting of a lecture from an overseas source and a luncheon, both organised by the London Section.

Council were informed that since its last meeting one Fellow and five Associates had been admitted to the Professional Grade and that recruitment advertisements mentioning the professional grade had now appeared. A number of enquiries and application for admission to the Professional Grade had been received at the Information Centre at OCCA-29.

As a result of a recommendation by both the Scottish Section Committee and the President's Advisory Committee, it was agreed to confer a Commendation Award on Mr G. H. Hutchinson for his outstanding services to the Association at Section and Branch level and as a lecturer (including ten consecutive years at the exhibition to the school parties).

Section Chairmen and Representatives reported on the activities on their Sections at home and overseas.

ROBAN ENGINEERING LTD gave information on the "Turnkey" project service to design and construct solvent bulk storage schemes. See also under "Manufacturing equipment".

A STRAZDINS PTY LTD demonstrated its system for the production of tinted paints, which includes tinpiercing, addition of the required tinters, hole plugging and mixing. See "Manufacturing equipment".

TENNECO CHEMICALS EUROPE LTD illustrated the *Colortrend System* for producing colours from the palest pastel to the deepest full shade. It can be used in conjunction with the *Graco* dispensing machines and the *Colwell* colour displays to give great flexibility of approach to retail and professional colour systems (see under 'Manufacturing equipment').

WHEATLAND JOURNALS LTD showed the latest edition of 'Paint Manufacture' which is published ten times per year. It publishes information on all aspects of paint production from the raw materials to the despatch of the filled containers and covers all types of paint. A number of associated Journals, including 'Finishing Industries', which covers the field previously covered by *Industrial Finishing and Surface Coating and Electroplating and Metal Finishing*, were shown. Copies of the 1977 'Industrial Finishing Industries Manual' were available, whose purchase price includes a year's subscription to 'Finishing Industries'.



The motif, designed by Robert Hamblin, uses the symbol of a moving indicator on a calendar to emphasise the importance of the continuous dialogue year by year between suppliers and manufacturers. The inward-pointing letters recall the international aspect of this unique annual focal point for the surface coatings industries, which in 1977 attracted visitors from 50 countries.

The Loyal Address to Her Majesty the Queen on her Silver Jubilee was shown to the Council.

This being the last Council Meeting before the Annual General Meeting, a vote of thanks to Mr Rudram for his chairmanship of the meeting was recorded with acclamation.

The President thanked members of Council for their support throughout his period of office and for their attendance at the meeting; he then declared the Meeting closed at 4 pm.

## Hull Section

### Antiques

The seventh meeting of the 1976/77 session was held at the 'George Hotel', Land of Green Ginger, Hull on Monday 7 March 1977. This was a meeting especially arranged for the ladies, and 36 members and guests attended. Mr T. W. Wilkinson, the Section Chairman, introduced Mr G. Baitson of the Edwardian Auction Galleries, Antlaby Road, Hull who gave a talk entitled "Antiques".

The speaker, a well-known Auctioneer and Valuer, discussed the origin and use of antiques, exhibiting many items of a varied nature in the world of glass, metal, ivory, porcelain and wood. Mr Baitson's talk was very light-hearted as well as informative and instructive. A buffet was arranged after the meeting which was closed with a vote of thanks from Mr E. Armstrong.

D.M.W.

## Scottish Section

### Ladies night

The Annual Ladies Night of the Scottish Section was held in the Albany Hotel on Friday 14 January 1977. During an extremely interesting meal not only the traditional haggis but also the sweet was piped in. The occasion was used to



The addition to the Presidential Insignia which has been presented in memory of Mr J. Miller.

perform the official presentation of the addition to the Presidential Insignia in memory of Mr J. Miller. The presentation was made, in the presence of Mrs J. Miller and family, by Mr Hirsch, Marketing Director of Vinyl Products Ltd, to Mr A. Rudram the Association President. Mr Hirsch outlined the considerable contribution by the late Mr J. Miller to the Association and especially his interest in the Student Group Activities.

The dance following the meal was both energetic and enjoyable: old friendships

were reactivated and new friendships formed. The majority decision was to accord Mr McCallum and his aides a hearty vote of thanks and to book early for next year.

### News of Members

Mr J. A. Burns, the immediate past Chairman of the Trent Valley Branch, has been appointed Chairman Designate of the Midland Section. Mr Burns is a director of E. Earnshaws (1965) Ltd of Nottingham.

Mr J. Davidson, the Chairman of the Scottish Section, has retired as Deputy Chairman of Federated Paints Ltd after 45 years' service, but will continue to be available in a consultative capacity.

Mr M. H. Birrell, an Associate Member of the Hull Section, has retired after twenty-four years with Reckitt's (Colours) Ltd. Mr Birrell was the Sales Director of Reckitt's, and has been a member of the Association since 1937.

The death of Mr T. Drummond Kerr, an Ordinary Member of the London Section and a past Vice-President of the Association, is recorded with regret. It is hoped that a full obituary will be included in the June issue of the *Journal*.

## 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

ARENDR, JOHN HARRY, BSc, Paint Research Association, Waldegrave Road, Teddington, Middlesex TW11 8LD. (*London*)  
 BAKER, BRIAN DEXTER, 12 Borrowdale Drive, Bury, Lancs BL9 8HT. (*Manchester*)  
 BARKER, MICHAEL JOHN, 26 Ivedon Road, Welling, Kent DA16 1NW. (*London*)  
 CAMPBELL, COLIN DENNIS, PhD, BSc, Ciba-Geigy (UK) Ltd, Hawkhead Road, Paisley, Renfrewshire. (*Scottish*)  
 CHANDRA, MAHESH, BSc, PhD, MSc, 1 Este Road, London, SW11 2TL. (*London*)  
 COY, JOHN HUGH, PhD, 29 Merrygreen Place, Stewarton, Ayrshire. (*Scottish*)  
 GRAY, ALAN, BSc, Reed Pigments Ltd., 199 New Toronto Street, New Toronto, Toronto M8V 2E9, Canada. (*Ontario*)  
 HIGNETT, LESLIE DONALD, 37 Wheatcroft Road, Allerton, Liverpool, Merseyside L18 9UF. (*Manchester*)  
 IYENGAR, DORESWAMY, BSc, MSc, PhD, FRIC, Chemetron Corporation, Pigments Division, 491 Columbia Avenue, Holland, Michigan 49423, U.S.A. (*General Overseas*)  
 KEAN, NORMAN BUCHANAN, PhD, BSc, Ciba-Geigy Plastics & Additives Co., Hawkhead Road, Paisley, Renfrewshire. (*Scottish*)  
 KONCZ, ATTILA PAUL, MSc, 2300 Confederation Parkway No. 1608, Mississauga, Ontario L5B 1R5, Canada. (*Ontario*)  
 KUHN, JOHANNES ANDRIES, BSc, PO Box 77, Winklespruit 4145, South Africa. (*Natal*)  
 LAWRENCE, SIMON GAYNER, PhD, BSc, 28 Corsebar Drive, Paisley, Renfrewshire. (*Scottish*)  
 MARTIN, FELIPE, BSc, 273 Pharmacy Avenue, Apt. 1112, Scarborough, Ontario M1L 3E9, Canada. (*Ontario*)  
 MCCRAE, JAMES MCGEACHIE, PhD, BSc, ARIC, 9 Merrick Avenue, Stewarton, Ayrshire. (*Scottish*)  
 MORRIS, COLIN HENRY, 51 Mill Street South, Brampton, Ontario, Canada. (*Ontario*)  
 PETERSON, WILLIAM, 114 Morse Street, Toronto M4M 2P8, Ontario, Canada. (*Ontario*)

PRIESTMAN, KENNETH MARTIN, BSc, Bevaloid SA (Pty) Ltd, PO Box 65, New Germany, Natal, South Africa. (*Natal*)  
 RANDS, DAVID BARRETT, BSc, PhD, MSc, 37 Mulberry Street, Maungaraki, Lower Hutt, New Zealand. (*Wellington*)  
 ROONEY, ROBERT LAMBE, GRIC, Ciba-Geigy Plastics & Additives Co., Hawkhead Road, Paisley, Renfrewshire. (*Scottish*)  
 SKELTON, PETER, 81 Grandview Avenue, Thornhill, Ontario L3T 1H3, Canada. (*Ontario*)  
 WAITE, PHILIP STEVEN, Hoechst UK Ltd, Pegasus House, Burley's Way, Leicester. (*Midlands*)  
 WELLBELOVE, BARRY FREDERICK, Giant Paints Ltd, Ngauranga Gorge, Wellington, New Zealand. (*Wellington*)  
 WHALEY, ALAN RAY, BSc, Macpherson Coatings, Radcliffe Road, Bury, Lancs. (*Manchester*)  
 WHEELER, IAN ROBERT, BSc, Ciba-Geigy Plastics & Additives Co., Pigments Division, Hawkhead Road, Paisley, Renfrewshire. (*Scottish*)  
 WILMOT, BRIAN, 17 Willowbank Avenue, Lake Wilcox, Ontario, Canada. (*Ontario*)

### Associate Members

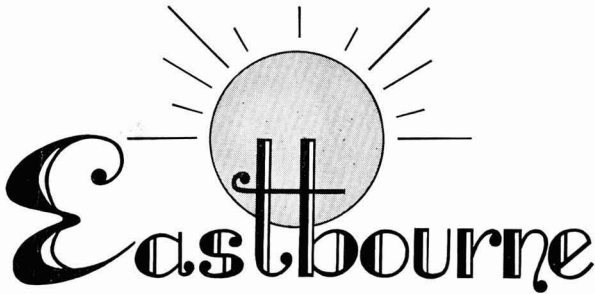
HOFMEYER, JOHN MURRAY, Union Carbide (SA) (Pty) Ltd, PO Box 8194, Johannesburg 2000, South Africa. (*Transvaal*)  
 PATON, DUNCAN JOHN EDWARD, 44 Allen Terrace, Linden, Wellington, New Zealand. (*Wellington*)  
 PROOME, RODERICK MATTHEW, Union Carbide (SA) (Pty) Ltd, PO Box 8194, Johannesburg 2000, South Africa. (*Transvaal*)  
 RICARD, WARREN, RR No. 1, Lefray, Ontario, Canada. (*Ontario*)  
 SIDA, PETR, 354A Broadview Avenue, Toronto M4M 2G9, Canada. (*Ontario*)  
 STURINO, MICHAEL, 49 Clair Road, Downsview, Ontario M3N 1A7, Canada. (*Ontario*)

### Registered Students

BENT, LINCOLN EARL, Romford YMCA, Rushgreen Road, Romford, Essex. (*London*)  
 LINFORD, COLIN EDWARD, 208 Biggin Avenue, Bransholme, Hull, Yorkshire. (*Hull*)  
 SMITH, ANNE PATRICIA, Harrison Mayer Ltd, Uttoxeter Road, Meir. (*Midland*)

# Eastbourne Conference

## 16-19 June 1977



The conservation of energy, materials and other resources in the surface coatings industry

### Registrations

The closing date for registration for the Conference was given as 1 April 1977 primarily for the benefit of the Hotel managements who would be in a position to let any accommodation not taken by that date. Registrations have been received from delegates in the United Kingdom and several overseas countries.

Applications can still be accepted, and delegates are reminded that VAT (8 per cent at the time of going to press) applies to all registrations.

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.

### Preprints

Preprints of the papers are now being prepared and it is expected that these, together with details of accommodation, badges, programmes etc., will be sent to those who have registered at the beginning of June. It is a feature of the Association's Conference that preprints are sent out well in advance of the function, in order that

delegates can read them before the Conference, at which lecturers illustrate their topics, but do not read their papers in their entirety. This allows for a much longer discussion period than at any other conferences and has proved of immense value to those attending previous Association Conferences.

### Dates and times of sessions

As a result of several requests after the last Association Conference, this year the Conference dates include a weekend to make it easier for delegates to arrange to attend. The Conference assembles on the evening of Thursday 16 June when, in accordance with its usual tradition of hospitality, the Association will hold a reception for all those attending from overseas, which will be followed by a meeting of the lecturers and chairmen of the sessions. The conference sessions (which this year comprise 14 papers) will be held as follows:

#### Friday 17 June (9.30 am–12.30 pm)

Chairman: C. N. Finlay, ATSC (Hon. Research and Development Officer, OCCA).

Mr M. A. Parrish (Ward Blenkinsop) "Ultra Violet polymerisation".

Mr J. A. Seiner (P.P.G. Industries, USA) "Microvoid coatings—material and energy savers".

Dr S. Haagenrud (SLF) "Atmospheric corrosion testing of metallised, metallised and painted, and painted steel".

Dr A. O. Christie (International Paint Co.) "Recent developments in anti-fouling".

#### Friday 17 June (2.30 pm–4.30 pm)

Chairman: Dr L. Valentine, FTSC (Director of Research and Development, Berger Jenson & Nicholson Ltd and a former member of Council).

Mr M. A. Glaser (Dexter Corporation, USA) "Conserving human resources through innovation".

Mr J. G. Balfour (BTP Tioxide Ltd) "The cost of flocculation".

Professor K. Hamann and Dr G. Joppin (Research Institute for Pigments and Paints, Stuttgart). "Layer structures of absorbed polymers at pigment/solution interfaces and their influence on the dispersion stability of pigments in paints".

#### Saturday 18 June (9.30 am–12.30 pm)

Chairman: Dr F. M. Smith, FTSC (President, Paint Research Association and a Vice-President of OCCA).

Mr D. J. T. Howe (Consultant to the Paintmakers Association). "The paint industry in a situation of diminishing availability of raw materials".

Dr J. L. Mondt (Hoechst AG, Germany). "Binders without environmental pollution and with good penetration properties on the basis of acrylic emulsions with very fine particle sizes".

Mr A. F. Sherwood and Mr T. R. Bullett (Paint Research Association). "Save your paint, your money and your substrate."

Professor W. Funke (University of Stuttgart). "Possible uses of reactive microgels in paint formulation".

#### Saturday 18 June (2.00 pm–4.00 pm)

Chairman: Mr A. G. Holt, FTSC (ICI Ltd, Paints Division and a former Chairman of the Thames Valley Section and former Vice-President of OCCA).

Mr K. Winterbottom, Mr N. S. Moss and Mr D. J. R. Massy (Ciba-Geigy Plastics & Additives Co) "A study of the effects of thiol modification of alkyd resins on their ease of cure with amino-plasts".

Mr R. W. Kay (HM Factory Inspectorate). "Labelling of dangerous substances and preparations in the EEC".

Mr H. Hardisty (Bath University) "Analysis of the constant-rate period of ink drying".



A view of the promenade at Eastbourne

### Social events

A full range of social events has been organised for the delegates and their families at the Conference, including a golf tournament, table tennis, coach tours, Ladies' talks, and a theatre party.

There will be an informal reception for all delegates at lunchtime on Friday and a Civic Reception will be held, at which the Mayor and Mayoress of Eastbourne will welcome the delegates, on the evening of the same day. The Association's Dinner and Dance will be the closing function of the Conference on the Saturday night, at which Mr N. Estrada, President of the Federation of Societies for Coatings Technology, will be proposing the Toast to the Associa-



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# UV polymerisation

The twelve papers in this volume were originally published in the *Journal* earlier in 1976. They are based on lectures given at a Symposium of the Newcastle Section of the Association, held at Durham University on 10 and 11 April 1975. Titles and authors are listed below:

**Photochemical excitation and its consequences—a review** by *R. B. Cundall*

**The application of UV-curing materials and technology to packaging** by *A. D. Lott*.

**Photoinitiation by aromatic carbonyl compounds** by *A. Ledwith*.

**The technological literature relating to polymerisation photoinitiators** by *A. Pryce*.

**Photopolymerisation: the kinetics of a-type photopolymerisation** by *F. C. de Schryver and N. Boens*.

**The use of polyfunctional monomers in UV curing** by *J. R. Younger*.

**Sensitisation and stabilisation in monomer/polymer systems** by *D. Phillips*.

**Photodegradation of polymers** by *I. C. McNeill*.

**UV-drying equipment, design and installation** by *R. E. Knight*.

**Ultraviolet curing inks** by *A. A. Gamble*.

**Some aspects of the pigmentation of UV-curable systems** by *B. E. Hulme*.

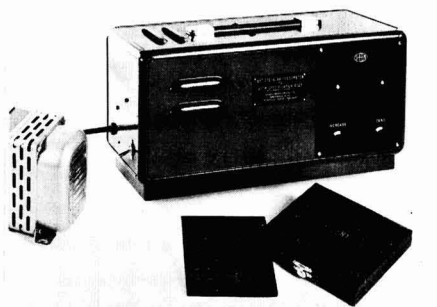
**Some aspects of the formulation of UV-curable polyester based systems** by *A. Laws, S. Lynn and R. Hall*.

Copies of this book are available at £5.00 or US \$10.00 each (prepayment only) from the Association's offices at the address on the Contents page of this issue.



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tion at the Dinner, to which the President will reply and will welcome the guests; The Mayor of Eastbourne will reply on behalf of the guests. Further details of the social programme are given in the Conference programme leaflet, available from the Association's offices.

### Ultraviolet light curing: some benefits and recent advances

by M. A. Parrish (*Ward Blenkinsop*)

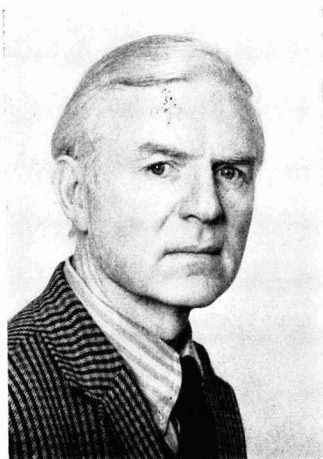
*Summary:* A rapid appreciation of the advantages of UV-curing has taken place within the last few years, so that the technique is virtually established within the surface coatings, printing and plastics fields. These advantages are briefly outlined and quantitative data are presented in order to highlight energy conservation.

As with any new technique, technical problems arise, for example, the curing of pigmented formulations by UV light. An outline of some new photoinitiators which help overcome this problem is presented.

### Analysis of the constant-rate period of ink drying

by Mr H. Hardisty (*University of Bath*)

*Summary:* High velocity impinging air jets are commonly used to accelerate evaporative ink drying on rotary presses for the



Mr H. Hardisty

packaging and converting industry. To provide data for dryer designers a programme of research has been implemented to study the heat and mass transfer processes which underlie the drying of thin ink films. In the paper, the heat transfer situation under impinging jets is outlined and some

experimental results are presented. A non-contact, infra-red technique for continuously monitoring the ink drying process is described and drying curves for an ink based on a single solvent (4-Methyl-2-Pentanol, MIBC) are presented. The constant rate sections of the IR curves are analysed and experimentally determined drying times are compared with those calculated using established heat and mass transfer theory.

## 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.

## Section Proceedings

### London

#### Printing on textiles

A one-day symposium was held jointly by London Section OCCA and London Region SDC on Wednesday 9 February 1977 at Thames Polytechnic, Woolwich.

Following an introduction by Mr J. Tooke-Kirby, Chairman of London Section OCCA, and a welcome to the Polytechnic by Dr Currell, Head of Chemistry, Mr G. M. Roberts, Chairman of London Region SDC took the chair for the morning session.

#### 1. Pigments for textile printing

The first paper was presented by Mr J. Ferguson, Hoechst UK Ltd, and began with an outline of the reasons for the rapid growth in pigment printing during the past few years. These were; the simplicity and therefore economy of the process; technical advances resulting in improved quality and fastness of prints; versatility, enabling a variety of natural and synthetic fibres, and mixtures of these, to be printed; the special effects which can be achieved using pigments, such as resist prints.

The fact that all processes have some disadvantages cannot be overlooked however, and Mr Ferguson then described in detail the correlation between adverse effects on handle and pigment/binder ratio, and the glass transition temperatures of various possible binders. The properties required of the binder are good adhesion to the substrate, a soft colourless film, and fastness to light and dry cleaning solvents. Monopolymers at the two extremes of a list of possibles are butadienes and acrylics. Butadienes glass transition temperature - 87°C give a very soft film, but rubbing fastness is poor, and the binder is susceptible to light ageing; Acrylics, glass transition temperature 100-106°C give a very hard film, good rub-resistance, but a harsh handle. For these reasons, copolymers generally provide the basis for present day binder systems.

New synthetic thickeners have been developed, based on high molecular weight acrylates, which not only increase the viscosity of the print paste but also act as acid donors at the curing temperatures to which pigment prints are subjected. This is particularly useful when cross-linking agents are added to improve fastness properties, as these cross-linkers are generally acid catalysed melamine formaldehyde precondensates. Cross-linking should only occur at the curing temperature, otherwise, troubles develop during printing, such as screen blocking and soiling of blankets or back-greys.

A wide range of pigments is available for textile printing, and selection is governed by those fastness properties required of the finished print which depend on the pigment, such as fastness to heat, light and solvents. Some fastness properties are dependent only on the binder, some on both binder and pigment.

The three main types of pigment printing systems in bulk use now are emulsions, solely aqueous, or low-white spirit emulsions, the price and ecological undesirability of white spirit being increasingly considered. It is common practice now to print designs, which a few years ago would never have been considered practicable for pigment printing, and examples of work being done were available for inspection.

#### 2. Screen printing techniques

Mr H. H. Lavell of Sericol first gave some general information about flat-bed screen printing, and mentioned that the thickness of the ink film applied was between 10 and 30 microns (dry). This enables prints of high opacity and colour intensity to be applied to almost any substrate.

The methods of producing photo stencils were explained, with particular reference to replacement of bichromates by diazo sensitizers.

After referring to the now widely used vapour-phase heat transfer process, Mr Lavell gave details of a transfer system

where the vehicle is also transferred. Screen printing is particularly suitable for laying down thick films of PVC plastisol *i.e.* polyvinyl acetate/chloride copolymer particles dispersed in plasticiser. Conversion to a continuous film is brought about by heating to about 110°C, and the image can be subsequently transferred and fused at 170°C. The same medium can be used for direct printing and fusion, and is particularly useful as a flock adhesive.

### Questions

Replying to a question on how the adhesive characteristics of binders were measured, Mr Ferguson said that this was generally judged by the rubbing-fastness achieved; on cellulosic fibres adhesion was very good, whilst polyamide was more difficult, and extra binder or cross-linker were needed. The question of formation of a continuous film, with bridging across the fibres was not one generally met, the coating preferably being only on each fibre surface; bridging is undesirable. The types of pigments used were the same as for paints and printing inks.

The fact that a matt effect was normally obtained with the print pastes described was agreed, but Mr Lavell pointed out that glossy prints were possible with the plastisol based inks.

Asked whether other methods than screen printing were used on textiles, Mr Ferguson said the historical development had been from hand block printing to copper rollers, then separate hand screens, automatic flat-bed screen printing machines, and then rotary screens. All types are still currently used.

The very interesting ICI film on 'Colour' was shown before lunch, during which Mr I. Gailey, President of the SDC expressed his approval of this joint symposium.

### 3. Dyeing and printing methods for the colouration of carpets by jet impregnation

The first afternoon paper was given by Dr J. L. Dawson of ICI, and dealt with the very latest techniques of applying patterns to carpets. Space dyeing was one method of obtaining a random pattern, and the *OPI* and *TAK* processes were alternative methods. The *Millitron* machine involves pumping dye liquor, viscosity 200–300 centipoises through 75–95 micron jets on to a continuously moving web of carpet. The *Chromotronic* employs different needle valves, and there are different types of equipment also from Mathias Mills, the *Multichromat*, and *Tibar Engineering*.

Drop printing methods involve breaking the dye-liquor stream into charged droplets and then passing them between deflector plates. It is possible to print 15 colours at 60 metres per minute. There is a low liquor pick-up, and this is controlled by adjusting the pressure, particularly to obtain an even pick-up. The viscosity of the liquor must not be too high, otherwise there is no penetration into the fibres. Wetting agents do not improve this; Butyl Cellosolve is used as a viscosity control additive.

### 4. New transfer printing techniques

Dr Jones from Leeds University first explained the principles of the sublimation process, and mentioned recently attempted improvements using vacuum and differential air-flow techniques. The main limitation is that no vapour-phase method is available for natural fibres, so the following are being considered:

- (1) *Dry transfer methods*: (a) Melt transfer; *Star Stampa Milan*; 20–80 tons pressure/sq. cm.  
 (b) Film release; *Fabprint*.  
 (c) Resin treatment.



A group photograph of some of the lecturers at the one-day Symposium held jointly by the London Section of OCCA and the London Region of SDC at the Thames Polytechnic, Woolwich, on Wednesday, 9 February. (From left to right) Dr R. C. Denney (Thames Polytechnic), Dr F. Jones (University of Leeds), Mr J. Tooke-Kirby (Chairman, London Section OCCA), Mr H. Lavell (Sericol Group Ltd), Mr J. C. Ferguson (Hoechst (UK) Ltd), Mr I. Gailey (President, Society of Dyers and Colourists), Mr M. Tordoff (Director and Secretary, General SDC), Dr T. L. Dawson (ICI Ltd), Mr M. Roberts (Chairman, London Region SDC).

The very high pressures required for (a) are obvious disadvantages and incomplete transfer is another.

System (b) relies on there being a higher adhesion between the heated ink layer and the fabric than between the ink and the release film. This is not always achieved when transferring to polypropylene or polyester. The medium used is based on clay/latex and is difficult to print except by the screen process.

In the case of (c), the fabric is first treated with a crease-resist resin with an affinity for disperse dyes. The resin is a melamine formaldehyde pre-condensate, and good results have been obtained on 50/50 polyester/cotton.

- (II) *Wet transfer methods*: (a) *Fastran*  
 (b) *Aquatran*

(a) was developed initially for applying acid dyes to wool and leather which are pre-padded with stabilised thickeners, and washing off after printing is necessary.

The *Aquatran* method (b), employs the *Dewprint* calender, a joint Tootals/Transprint UK development. There are two types of transfer paper, *Aquatran AC* for acrylics and *Aquatran C* for cellulotics.

### Questions

In reply to a question concerning the type of paper used for vapour-phase transfers, Dr Jones said that there were really no special properties required of it. On the question of re-use of paper for the film-release method he said this was unusual, as although all the colour may be transferred the release film may be damaged.

A question was asked regarding the clogging of nozzles in the jet dyeing and printing process. Dr Dawson replied that the inks were passed through a 5 micron filter, and there are in-line filters on the *Millitron* machine. This has 4,000 jets across its 2 metre width. Experiments with disperse dyes and pigments showed no problems of flocculation on standing which could lead to clogging of nozzles.

The final item was a film on Rotary Screen Printing made by Storck Brabant.

Summing up the days events, Mr S. Schofield gave some facts and figures about the textile printing industry. Over 12 000 million metres of fabric are printed world-wide, about 250 million metres of this in the UK, only about one tenth of the share of printing enjoyed in the peak year, 1913. Introduction recently of printed bed-linen has increased the meterage. Copper roller printing still accounts for 50-60 per cent, flat screens, 15 per cent and rotary screens, developed during the past 12 years, 25-35 per cent.

About 100 million metres of transfer paper was printed in the UK last year, 70 per cent was exported, leaving 30 million metres used in the UK. This proportion of world production is 20-30 per cent, *Sublistatique* having about 40 per cent of this. Film release transfer papers are screen printed, vapour-phase mainly gravure, some flexo, and a few screen printed.

Future trends are likely to be for pigments to take an increasing share of the market, but use will still be made of some of the advantages of soluble dyes. Rotary screens are still on the increase, and transfer printing is likely to grow further, so the interest from the ink and paper side of industry is certainly appropriate.

K.L.B.

#### Flammability testing

An evening meeting of the Section was held on Thursday 3 March, 1977 at Manson House, W1 when Mr A. G. Walker of Anzon Ltd presented a paper entitled 'Flammability testing and its relevance to flame retardant paints'.

In opening his lecture Mr Walker first discussed how all fires exhibited a pattern of initiation, growth, steady state and extinction, but that each part of the fire was very variable and this made it difficult to develop one test that could accurately predict the effects of every real fire situation.

Flammability tests fell into two groups. Fire predictive tests were used to test the fire resistance of raw materials and those which tested structures were the only ones of any validity. Combustion characteristic tests were the most important group of tests and examined the combustion of products under specified conditions.

Tests which were used to determine the ease of ignition and rate of spread of flame were then discussed. Of the former type there were many standard tests, using either bars of material under test (*eg.* BS. 2782 method 508A) or panels mounted at various angles (*eg.* BS. 476 part V). In each case the material was subjected to a flame for a specified period and the ease and spread of flaming noted. Since these tests were carried out at ambient temperatures they could be considered only as go/no go tests for a particular material. The Limiting Oxygen Test, which determines the amount of oxygen required just to prevent burning, could be used to rank different materials. By preheating the input gases the effects of temperature on burning rates could also be evaluated. This method is being circulated as a British Standard.

Another series of tests were available which measured the ease of ignition from electrical heat inputs, such as BS. 2782 method 508E.

In the second category, spread of flame tests measured both the rate of spread of flame and the heat released by burning material. The latter aspect was important as the heat generated more gaseous fuel which promoted further burning. BS. 476 part VII was a typical test for measuring rate of spread of flame and BS. 476 part VI for heat release. In this test, a fire propagation box was used and the temperature pattern during burning was measured.

It was important to realise that ease of ignition and rate of spread of flame were not related and that both were specified in Building regulations.

Smoke emission from materials is another important area in burning as suffocation and loss of visibility causes the greatest number of deaths in fires. The most universally used test was the American National Bureau of Standards method.

Mr Walker then discussed how intumescent and fire retardant paints could be used to reduce the combustibility and flame spread characteristics of building materials. Intumescent coatings reduced flammability by modifying the surface on exposure to heat. Phosphorus compounds, for instance, were used extensively in combination with blowing agents to remove the source of heat from the flammable substrate. Fire retardant paints contained materials that prevented burning of the gas phase. These types were used more extensively than intumescent ones as they can be formulated more easily to give typical paint application and film properties. Halogenated compounds and antimony oxide are incorporated into the paint. On exposure to heat, halogen radicals were produced and these reacted with the gaseous phase to prevent further burning. Chlorinated compounds are most suitable, being both solid at room temperature and decomposing to radicals at typical fire temperatures.

In conclusion Mr Walker discussed briefly the application of the building regulations to painted products. Paint was not considered a construction material, unless preprepared panels were used on site. Only new buildings or major redevelopments are covered by the regulations but insurance agents, fire prevention officers and building planning officers can all specify the use of particular fire resistant materials as demanded by local conditions.

Mr D. Bayliss, Vice-Chairman, London Section OCCA, concluded the meeting with a vote of thanks to the lecturer for his most interesting paper and for giving an enlightening insight into the subject.

A.J.N.



The Top Table at the Scottish Section Dinner and Dance (see page 197). Front row: Mrs Hirsch, Mrs Davidson, Mrs McKendrick, Mrs Rudram, Mrs Hodgson. Second row: Mrs McCallum, Mrs Brooke, Third row: Mr L. J. Brooke, Mr J. D. W. Davidson, Mr A. T. S. Rudram, Mr K. V. Hodgson. Back row: Mr I. R. McCallum, Mr A. McKendrick, Mr S. H. A. Hirsch.

## Midlands

### Trent Valley Branch

#### Exporting

Mr C. Butterworth, in his capacity as Export Manager of the Silver Paint & Lacquer Co. Ltd, delivered an informative paper on "exporting" to an audience of members and guests on 10 March at the Crest Motel, Derby.

The lecturer briefly outlined his firm's development in paint exports leading to the considerable volume of paint which is exported to date. During the period of 1973/75 it was reported that the total paint exports from the UK increased from 43 million to 60 million litres per annum.

Mr Butterworth then went on to outline the principal areas of vital importance to the would-be paint exporter, who must first overcome the very natural reluctance to spend money in preparing trade links, satisfying customer requirements, overcoming competitor penetration and so on. The intrepid aspirant must not be put off by the cost of good packaging, essential to the safe arrival of goods in transit and recognised by low insurance rates.

Documentation, shipping regulations, dock and town dues congestion tariffs, forwarding, C.I.F., F.O.B., bills of exchange, letters of credit were covered and the audience were left in no doubt that competent administration is essential for the satisfactory conclusion of export deals.

The smaller company is not excluded from exporting because it can turn to the many Export agents, who operate from the UK and provide excellent product intelligence throughout the globe, and are qualified to service the complete operation of an export deal.

In spite of the handicap induced by the discomfiture of a sore throat, Mr Butterworth was able to conclude his talk and stimulate a lively question period. Topics such as colour cards, can and carton sizes, climatic differences affecting paint properties, flash point regulations, cargo dead lines, insurance in transit, credit worthiness of "emerging" countries were discussed.

A vote of thanks was proposed by Mr S. Watson and approved warmly by the entire company.

J.R.K.

## Scottish

### Pigment dispersions

A talk on a "Pigment Dispersion" was given by Mr R. Monk in the Beacon Hotel Glasgow on 20 January 1977. Mr Monk concentrated his talk on aspects of aqueous pigment dispersions, primarily designed for colouration of emulsion paints. The various types of equipment available were described: Mr Monk indicated that the optimum equipment could vary with formulation. The major formulation controls were the surfactant balance and settling aids. The large audience participated in a full discussion on the topics of costs, product optimisation and quality control. A vote of thanks was proposed by Mr I. McCallum and the audience showed its appreciation in the normal manner.

G.H.R.

## 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.

### Monday 2 May

*Hull Section:* Ladies' Evening "Pottery, colour and decoration" by Mr A. Simkin-Blythe Colours Ltd, to be held at the "Haven Inn", Barrow Haven, Lincs.

*Irish Section:* Golf outing—details to be announced.

### 16-19 June

*Association Biennial Conference and AGM at Eastbourne.* Details on page 198

## West Riding

### A review of silicone protective coatings

A Meeting of the Section was held on Tuesday, 8 February 1977 at the Griffin Hotel, Leeds. Mr J. G. Price of Dow Corning Ltd, presented a lecture dealing with silicone based coatings.

Silicones are based on both silicon and carbon compounds. The inorganic silicon-oxygen back-bone contributes the thermal, oxidative and chemical stability typical of silica and silicates, whilst the organic substituents effect re-activity, solubility and plasticity. Typical unmodified silicones show resistance to heat, cold, chemical and ultra-violet attack, high surface activity, incompatibility with organic materials, water repellency, inertness, non-toxicity and non-biodegradability, and electrical resistance. Mr Price then briefly outlined the processes for manufacturing silicones.

Early silicone-organic coatings were nearly all based on simple cold blends of silicone resins with organic resins. Significant improvements were achieved in colour and gloss retention. Further work on increased substitution by organic radicals led to improved compatibility and other properties.

High performance maintenance paints can utilise silicone based systems and Mr Price discussed their use in high temperature coatings and air drying paints. He also discussed the various systems which have been developed and indicated their merits or disadvantages. The use of silicone modified polyesters is widely adopted in the USA for coil coating applications and the lecturer considered the various combinations being used and discussed the merits of various polyols being used at present as well as possible future developments.

Other applications for silicone based products include appliance finishes, release coatings and masonry water repellents and Mr Price dealt with each aspect in some depth before briefly mentioning the various uses of silicones as paint additives.

A lively discussion ensued and the proceedings were brought to a close by a vote of thanks from Mr M. J. Cochrane.

R.A.C.C.

## Newcastle

### Mechanical Testing

The sixth meeting of the 1976/77 session was held at the Royal Turks Head Hotel, Newcastle on March 3 when 34 members and visitors attended to receive a paper entitled "The value of mechanical tests in assessing paint performance and their relevance to specifications" by Mr C. E. Hoey of the Ministry of Defence. The speaker dealt with bend, scratch and impact tests indicating the difficulties encountered in interpreting results and stressed the need for more meaningful definitions. It was concluded that more thoughtful study of such tests was required to understand their nature and limitations. A useful discussion period followed the presentation of the paper before the Chairman brought the meeting to a close.

T.H.

# Information Received

## ICI expansion

ICI have announced that they are to spend £15m on a major expansion of manufacturing capacity for Procion fibre-reactive dyestuffs at the Grangemouth Works of ICI Organics Division in Stirlingshire. The expansion will more than double the capacity of the present plant at Grangemouth and will enable ICI to meet forecast world demand for Procion dyestuffs.

## SPL acquire Leeds Paint Manufacturing Co. Ltd

The Silver Paint and Lacquer Company Ltd announce that they have acquired the Leeds Paint Manufacturing Co. Ltd of Morley near Leeds which will continue to operate as an independent company within the SPL Group and plans are being made to further develop fully the six and a half acre site in the future.

## Doverstrand acquire BWC's latex business

Doverstrand Ltd, a subsidiary of Revertex Chemicals Ltd, has acquired from 1 May the latex business in the UK and Europe of Borg-Warner Chemicals.

## Marine exposure testing

The Ministry of Defence Procurement Executive, Central Dockyard Laboratory, have announced that Marine Exposure Trials (ETS) are under consideration at their Eastney Section and may be made available to industry on a commercial basis. ETS has hitherto been reserved solely for Ministry sponsored evaluation programmes, which although still in existence, do not use all the facilities all the time.

## Pressure leaf filters

Amalfilter (UK) Limited, a subsidiary of the Dutch Company Amalfilter B.V., has been formed to market the Ama-Niagara pressure leaf pressure filters in the United Kingdom. The vertical leaf pressure filters are designed to deal with all aspects of solid/liquid separation in the chemical, petrochemical and pharmaceutical industries.

## Degussa change names

Degussa have announced that they are to change gradually the names of their silica type products from the present system to a new rationalised naming system. Degussa will in future use the abbreviation 'FK' for all standard precipitated silica products and they intend to use a trade name 'Sipernat' for the spray-dried silicas (K.322, K.322S) and for the hydrophobic silica types D 17. The change-over will take place gradually as Degussa obviously have to use up existing stocks of packaging material, but one product which has already changed is Silica K.320DS which will now be known as FK.320DS.

## Control production starts

Bayer have announced that first trial production runs have started at their new 935 acre industrial site at Brunsbüttel, Northern Germany. Technical testing and trial production of Bayers Desmodur T 80, an intermediate for polyurethanes, has now commenced following near-completion of the first construction stage of the Brunsbüttel development, the fifth Bayer AG production site in Germany. The testing phase will last several months and full scale production is scheduled to start in October 1977. The second stage of the



View of the new Degussa Alabama Inc. plant

development is intended to be a new dyestuffs plant.

## New plant opens

Degussa, the West German chemical and precious metal enterprise headquartered in Frankfurt am Main, have opened their new chemical plant in Alabama USA. The plant, which occupies a 430 acre site in the Theodore Industrial Park southwest of Mobile, was opened on 7 March. Governor George Wallace and numerous other guests of honour were present. Degussa returns to the USA as a manufacturer after an absence of almost 60 years. The plant will specialise in production of the filler Aerosil, the amino acid methionine and the intermediate cyanuric chloride.

## Ciba-Geigy double capacity

Ciba-Geigy have announced that they expect double by the end of 1977 their output of triglycidyl isocyanurate, a polyepoxide compound with high epoxy content, which is used as a starting material presently available for the formulation of weather-resistant powder coatings. TGIC (commonly known as Araldite) is produced in Ciba-Geigy plants in Switzerland, West Germany and the USA.

## Pressure containers

The British Standards Institution has revised BS 1101 pressure containers for paint and other substances. This standard applies to cylindrical pressure containers not exceeding 850 mm in internal diameter and having design pressures not exceeding 1 N/mm<sup>2</sup>. BS 1101 specifies materials, construction and welding requirements, determination of the dimensions of scantlings, inspection, testing etc.

## New factory opens

Barking MP, Jo Richardson, opened Macpherson Powder Limited's new factory in Barking on 3 March. The factory covering almost 14,000 sq. ft, is purpose built and houses some of the latest powder coatings application equipment. Powder coatings are extensively used in the automotive, household appliance, electrical and commercial freezer industries.

## Change of address

Manchem Limited, part of the RTW Chemicals Group, have changed their address from 18 April to Ashton New Road, Manchester M11 4AT.

## New products

### New solvent soluble dye

The Pigments Division of Ciba-Geigy has introduced a new addition to its range of solvent soluble dyes, Orasol Yellow 2GLN which lies between Orasol Yellow 2GL and Orasol Yellow GRLN in colour strength. Orasol Yellow has good general properties including lightfastness and compares favourably in this respect with other solvent soluble dyes of a similar type and has excellent solubility in a wide variety of solvents, together with good stability in solution. The recommended fields of application include flexographic and gravure printing inks, surface coating lacquers and wood stains.

### Chemical dosing pumps

Advanced Pumping Systems Ltd have been appointed stockists and distributors in the UK for the range of chemical dosing pumps for flow metering of colourants and treatments throughout the paint manufacturing industry by Chem-Tech International of America. APS are to carry stocks of pump models together with a range of spare parts and accessory components.

### New fluorescence detector

Perkin-Elmer Ltd have announced a new fluorescence [detector for liquid chromatography, model LC-1000, designed with emphasis on high sensitivity, selectivity and ease of operation. A major feature of the model LC-1000 is the use of xenon source providing a continuum over the UV/Visible region.

### New paint spray mask

Hodge Clemco Ltd have produced a revolutionary type of face mask for paint spray operators which offers greater safety and ease of working and completely cuts off the operator from dangerous or offensive

fumes by projecting air in a conical curtain in front of the facial area. Made of aluminium, the mask is light and is fed by a quarter inch air line. Air is piped to the back of the mask and dispersed round the frame through small vents to provide an effective air barrier.

#### New additives from Italy

The Italian Company, Supercolori, who have for some time been producing anti-setting agents for manufacturers of paints, have now introduced a further range of products, defoaming, dispersing and wetting agents, for the surface coating industry. Neodef 2000, a non-silicone base for water paints or plastic wall coatings, is the new type of defoaming agent designed specifically to tackle foam problems that do not respond well to conventional defoamers. For defoam problems of a less severe nature the company markets three grades of its Superad defoamers, which are also a non-silicone base. The new wetting agent is Bamax A2 which is suitable for use in vinyl and acrylic based water paints and is also a good wetting agent for water soluble synthetic systems, primers and enamels.

#### Temperature indicating strips

Synthetic and Industrial Finishes Ltd have announced considerable savings in the amount of time and money spent on planned maintenance by using Thremindex Temperature Indicators in paints and self-adhesive strips to monitor temperature rises on machinery, such as electric motors, giving a visual indication that a service is needed. The strips are available in various temperature ranges and offer a simple and accurate method of checking the temperature of almost any surface. The strips change colour to black when a designated temperature has been reached.



Electric motor with Thremindex Indicators fixed to the casing to give an early warning of impending troubles

#### Lurafix dyes

BASF has supplemented its range of Lurafix dyes for the production of transfer printing inks (gravure, flexographic, letterpress, offset) with a new Lurafix Yellow 7GFL, a brilliant greenish yellow with a clear shade and very good fastness properties, and Lurafix Blue B, a blue dye with brilliant fastness properties.

#### Block bottom liners

Porter Lancasterian Ltd have announced a system for mixing paint, chemicals and other liquids. The basis of the new system

is a disposable block bottom polythene liner for use in mixing pans and drums. Use of the liner results in considerable savings in time and labour, eliminating the need for costly cleaning materials when cleaning between batches.

#### Spray tip guard

Prodef Engineers Ltd have announced the new protective Red-Guard which is designed to protect the expensive spray tips used on airless spray guns.

#### Pure water

Elga Products Ltd have launched a new system of laboratory orientated equipment for producing "nuclear grade" resins for the production of ultra-pure water. The resins will be available as part of a totally flexible modular range of water purification equipment named Elgastat Spectrum.

#### New hose

The chemical plant division of BTR Silvertown has added Europe's first PFA (perfluoroalkoxy) hose to their Fluoroline range. BTR have developed this hose as a successor to the PTFE hose which it is expected to replace within two or three years. The new hose has an increased temperature range of  $-75^{\circ}\text{C}$  to  $+232^{\circ}\text{C}$ .

#### Electrostatic paint spraying

Prodef Engineers Ltd are marketing the precision Swiss Everspray Electrostatic Electronic, an add-on unit for converting any airless spray equipment to electrostatic spray at low cost. Using the principle of transverse field electrodes in the gun, the paint particles receive a double charge of high intensity causing the paint to "wrap" itself round the most intricately shaped objects.

#### New mass spectrometer

AEI Scientific Apparatus introduce the MS45 a new high-resolution, high-sensitivity mass spectrometer which has a resolution of 80 000 and a sensitivity of  $3 \times 10^{-9}$  coulombs per microgram at 2000 resolution.

#### Powder sieving unit

Russell Finex Ltd have announced the introduction of their new vacuum assisted powder sieving unit, the Vacu-Sonic Finex, which combines a low frequency vibration, a high frequency vibration and vacuum assisted sieving to handle the so called "difficult" powders at realistic throughput rates. To meet health and safety hazards the powder is collected in dust-tight cabinets alongside the sieve.

#### Literature

##### Coil coating review

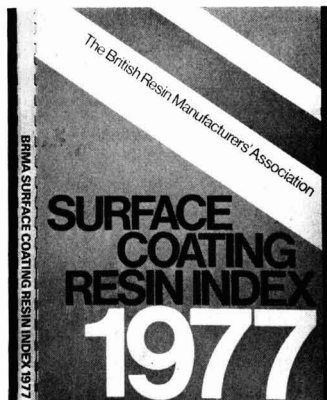
R.H.Chandler have published a new book "Coil coating review 1970-76" which deals with the coil coating industry, a major user of paints.

##### Business ratio report

ICC Business Ratios have published the 1977 edition of the Business Ratio Report on paint and printing ink manufacturers which is a guide to the fortunes of the industry in the last year.

##### Chemfacts

IPC Business Press Limited have announced the publication of their review of the British Chemical Industry "Chemfacts: United Kingdom" and "Chemical Company profiles Western Europe".



The new Surface Coating Resin Index

#### Resin Index

The British Resin Manufacturers' Association has announced the publication of the new edition of its Surface Coating Resin Index 1977 which is published every three years. It forms a comprehensive guide to manufacturers of surface coating resins in the United Kingdom and lists the names and addresses of thirty-six manufacturers and over 1300 products together with details and specifications.

#### Film catalogue

BASF have issued a new book listing twenty-one award winning films available in the UK covering BASF products and international activities.

#### Technical services report

Berger Chemicals have published their latest technical services report entitled "Solutions No. 3" which deals with the formulation and properties of a range of gloss enamels.

#### Conferences, courses etc.

##### Lead Conference

An International Conference will be held at the Hilton Hotel, London, on 14-16 June 1977 with the theme "Lead and zinc into the 80s" incorporating the Sixth International Lead Conference.

##### Eurochem

Eurochem 1977, 20-24 June 1977, the International Exhibition of chemical and process engineering will be opened at the National Exhibition Centre, Birmingham, by Mr A. Williams, MP, Minister of State at the Department of Industry.

##### Chemical Literature Seminar

The Science Reference Library is to hold a Seminar on Using Chemical Literature in the British Library on 3-4 May 1977.


##### Gordon Research Conferences

The Gordon Research Conferences will be held from 13 June to 26 August, 1977 in various locations in New Hampshire and California, USA.

##### Paint courses

The University of Missouri-Rolla is repeating the five short paint courses, which were held in January and February, in September and October 1977.





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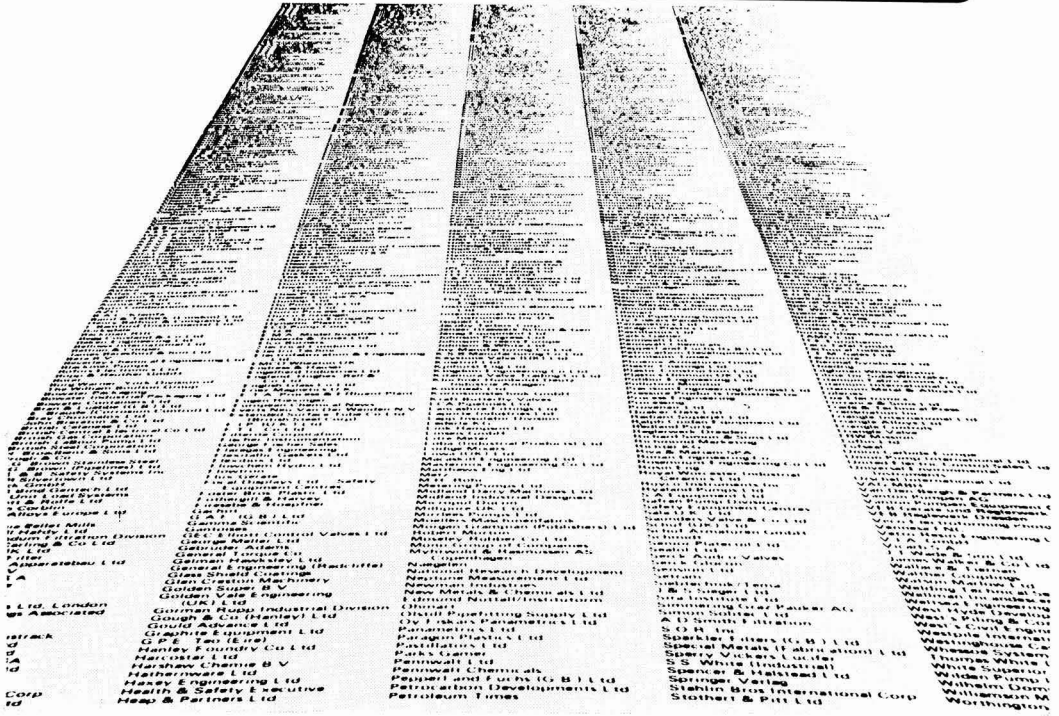
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