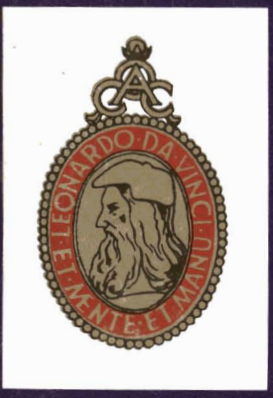
Vol. 63 No. 4 JOCCAB 63(4) 137–182(1980) April 1980



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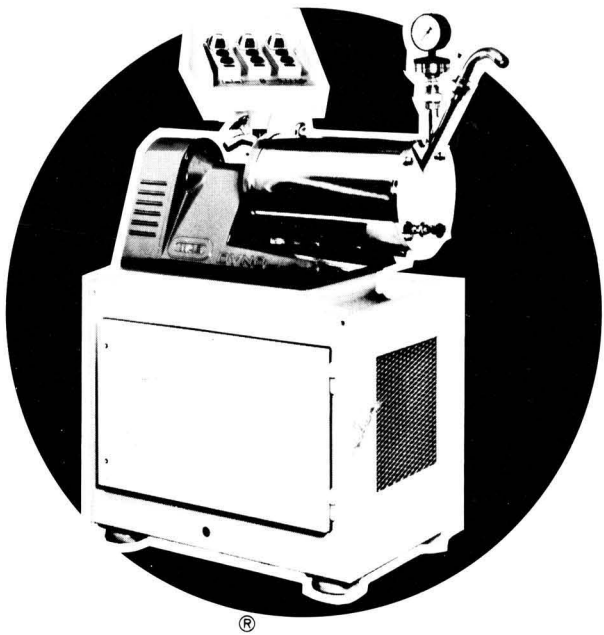
The loneliness of the long distance runner



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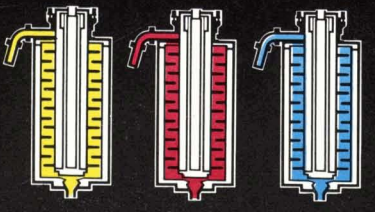

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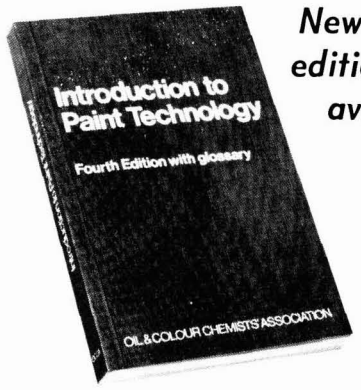

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Transactions and Communications

A study of the natural weathering of sealants*

By M. J. Welch, P. J. C. Counsell and C. V. Lawton

Evode Limited, Common Road, Stafford

Summary

Natural weathering of sealants has been compared in a temperate climate and three different tropical situations. Temperate natural exposure has also been compared to artificial environments. Penetration experiments and visual observations were used to compare the performance of the sealants.

Keywords

Types and classes of coatings and allied products
sealant

Types and classes of structures or surfaces to be coated
aluminium
concrete
wood

Processes and methods primarily associated with analysis, measurement or testing
accelerated weathering

Raw materials for coatings binders (resins, etc.)
vegetable oil
bitumen
silicone resin
polysulphide

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

Une étude sur la résistance aux intempéries des mastics pour assurer l'étanchéité

Résumé

On a comparé la résistance aux intempéries des mastics pour assurer l'étanchéité dans un climat tempéré avec celle à trois différents emplacements des tropiques. La résistance aux intempéries dans un climat tempéré a été comparée également avec celles dans des environnements artificiels. On utilisait des expériences de pénétration et des observations visuelles pour comparer le rendement des mastics.

Eine Studie der natürlichen Bewitterung von Dichtungsmitteln

Zusammenfassung

Die natürliche Bewitterung von Dichtungsmitteln in einem gemässigten Klima und in drei verschiedenen tropischen Lagen wurde untersucht und verglichen. Die Bewitterung im gemässigten Klima wurde auch mit künstlicher Bewitterung verglichen. Die Leistung der Dichtungsmittel wurde durch visuelle Beobachtung und mit Hilfe von Nadeleindringungsexperimenten beurteilt.

Sealants

Refs. 1-3

A sealant is a material which creates a barrier between two environments. The sealants described in this paper were prepared from synthetic polymers (polysulphides, silicones) and oils derived from natural sources (glycerides from oil seeds and bitumen) and are used in the building industry and civil engineering to seal gaps and joints. There are several reasons for requiring sealants, all due to articulation in construction, for example the use of adjacent dissimilar materials, to absorb movement in an expansion joint, to reduce air borne sound or to weatherproof external walls. The sealants examined in this report are used mainly in the latter situation. Those based on glyceride oils and bitumen are used in joints which have to absorb low to moderate movement (strain up to ±7.5 per cent of the mean joint width) the polysulphides and silicones are used in joints which impose frequent regular high movement (strains up to ±17.5 per cent). Sealants used on the external face of a building must be able to resist degradation under weathering influences.

Weathering resistance is not an easy material characteristic to measure, nor is it easy to compare the performance of different materials. An effective study is improved if a quantitative measurement of a property is possible during the usually lengthy time scale of experiments. Some of the articles that have been previously published on the subject are listed[1-3]. N. G. Reynolds[1] used standard analytical techniques to compare aged and unaged polysulphide sealant, but it is not clear how the ageing was achieved. B. J. Gunderson[2] records in detail the performance of polyurethane, asphalt and PVCl seals in horizontal joints exposed to traffic movement and weather. Because of the significant influence of traffic and movement the report recommendations are not relevant to the use of the seals in buildings, but other comments about mixing two component sealants correctly, using appropriate primers and attention to joint design will all help to encourage the sensible use of sealants. R. G.

*Paper presented at a symposium on "The weathering of plastics and rubbers" held by the Plastics and Rubber Institute and published by permission of the Institute.

Groeger and S. Barrett[3] reported on a technique that combined movement and weathering. The performance was assessed visually and led to a comparison of sealants based on different polymers, by exaggerated movement in wooden assemblies that expanded and contracted a joint by variation in moisture content.

An attempt has been made to measure a physical property and also to compare the performance of materials which have been artificially and naturally weathered, to see if predictions of performance are possible.

Choice of a property for measurement

Because of the large number of formulations that need to be weathered during a development programme, and for many people the simple constraint of space available in a secure area for the exposure farm, a method was required that could make as much re-use as possible of an original specimen. The technique should not replace the well established screening tests, but should complement those used in the long term (up to fifteen years) weathering evaluation of the chosen formulations which had passed through the screening stage and were on sale or undergoing sales development. The method adopted was originally developed by Mack, at the Building Research Station at Garston, Watford, who described it as "Constant rate penetration" and the apparatus as a "Constant rate penetrometer". Mack used the apparatus to investigate glyceride oil and butyl based sealants. This method was adapted for use with a Hounsfield Type E tensometer (Figure 1) to investigate the four types of sealant mentioned earlier. The method was used in preference to surface indentation or hardness measurements because the probes penetrate the sealant and record physical changes both at and beneath the surface.

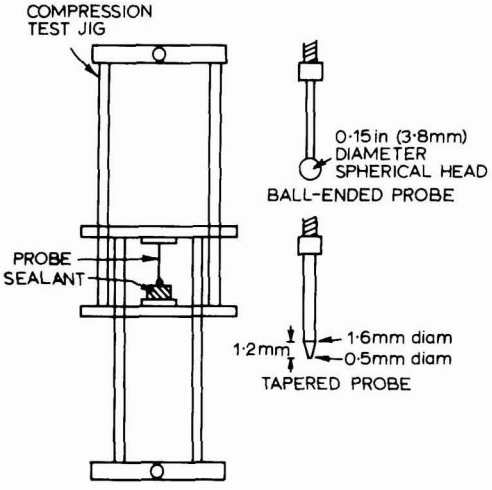

Figure 1. Penetration assembly for Hounsfield

For this work all the sealants were aged in channels and successive readings were taken on the same sample during the ageing programme. The channels were made of aluminium, cement mortar or soft wood. The internal dimensions of the channels were; depth 19 mm, width 25 mm, length 175 mm.

The probe (round ended for the glyceride oil based sealant and tapered for the other sealants) was pushed into the sealant at a constant rate. Typical plots of penetration depth versus force are given in Figure 2. The curve for the glyceride oil based sealant shows the following features:

(a) The presence of a tough flexible skin and the soft plastic fluid mass beneath the skin.
(b) The increase in viscosity, which can occur on ageing.
(c) The influence of the substrate; hardening at the interface of a porous or alkaline surface will produce an upward swing in the penetration force.

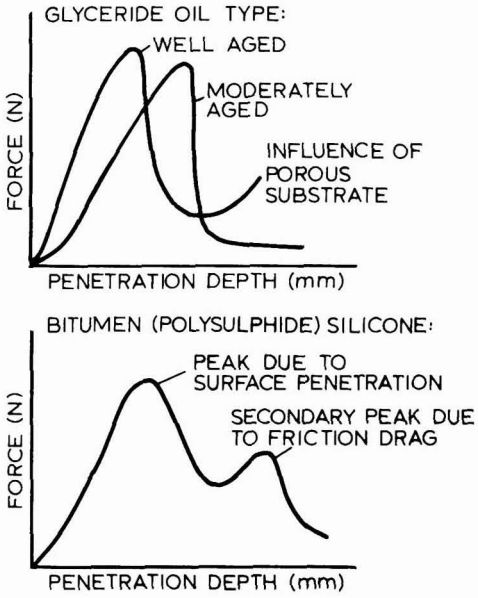

Figure 2. Typical constant rate penetration curves

The plot for the other sealants obtained with the tapered probe shows the characteristic shape consisting of two peaks. The first peak is the one used in the assessment of sealant behaviour, the second is caused by frictional drag between the sealant and the probe.

The results have been recorded for comparison of the sealant's behaviour by plotting the maximum force from the stress strain curve against the period of exposure.

In addition, visual changes have been recorded and summarised.

Natural weathering procedures

The sealants were exposed at a site in Staffordshire on racks at 45° facing South and at sites run by the Ministry of Defence and Australian Government in N. Queensland. Two areas of jungle are used at Innisfail, one of which is cleared to provide maximum sunshine; the second is an uncleared jungle site. A few hundred miles inland the station operates an exposed desert site. At the three sites the racks face North at an angle of 45°.

The sealants were exposed at each of the sites in channels made from cement mortar and aluminium. Inspec-

tions were made after three, six and twelve months and specimens were sent back to Stafford for the physical measurements. Corresponding control sets of sealant were exposed at Stafford for inspection and testing. This set of specimens also formed the control for the artificial ageing described later. Primers were only used as follows. All the channels were primed before filling them with silicone sealant. The cement mortar channels were primed before they were filled with the bitumen and polysulphide sealants.

Artificial environmental ageing

The reproduction of natural weathering in artificial weathering devices (weatherometers) has been used in the paint and textile industries with an acceptable level of correlation and acceleration of performance.

The first experiments were made with a "Marr" weatherometer. No quantitative assessments were made when it became apparent that the apparatus gave no correlation with natural weathering. In the "Marr" weatherometer the sealants were exposed intermittently to shade and a carbon arc source and distilled water spray. The surface changes on a variety of sealants caused toughening which protected the product beneath the skin to a greater degree than was observed when the sealants were given an equivalent period of natural weathering. In these experiments the sealants were allowed to mature for several days in an indoor laboratory atmosphere for the glyceride oil types to form a skin, polysulphides to cure and "solvent release" types to form a dry surface before artificial ageing.

Following this two other artificial ageing programmes were examined. In one experiment a cycle of the separate agressive elements of natural weather was used; ultraviolet radiation, water, infrared radiation and temperature extremes. In the second experiment a different type of weatherometer was used.

Artificial ageing in laboratory apparatus

The conditions used are recorded in Table 1. It was noted that the Marr weatherometer caused a surface toughening which protected the mass beneath from radiation and water penetration. In these experiments the effects of the first conditioning period on the subsequent performance was tested by starting the cycle at each of the conditions 1-6 in Table 1 and then continuing in the order given in the Table. Sufficient samples using aluminium, soft wood and cement mortar channels were prepared for this. At the end of each six day cycle the samples were allowed to cool or warm or dry at room temperature before measurement with the constant rate penetrometer and proceeding with the next cycle.

Artificial weatherometer ageing

A Xenotest 150 was used for this piece of work. The specimen holders for the apparatus were not designed to support sealant samples. However, it was possible to make up a selection of pieces that were used for visual observation and "Constant rate penetration". The climatic programme selected for the work is given in Table 2. The Xenotest 150 is designed to have a spectral energy distribution closely resembling the radiation of the sun and sky on the horizontal plane in European latitudes. Filters are used to cut out long infrared (approximately 800 nm) and short wavelength UV (below 290 nm). The specimen holders rotate around the Xenon lamp at 5 rpm and on an axis about 180° during each revolution around the lamp. Artificial rain is sprayed for periods which can be selected in combination with dry periods from a programme. Air circulation within the chamber can be humidified.

Table 1
Conditions used in a six part cycle of environmental ageing

Reference Number	Condition	Duration
1	Water immersion at room temperature	6 days
2	Low temperature storage (−16°C)	6 days
3	Low intensity UV 250 watt mercury vapour lamp, wavelength 250-400 nm. Samples were placed 300 mm from the source, the average cabinet temperature was 45°C	6 days
4	IR exposure, average surface temperature 55°C	4 h on 20 h off for 6 days
5	Oven, temperature 70°C	6 days
6	High intensity UV 1200 watt mercury vapour lamp. Samples placed 250 mm from the source. Average temperature 82°C	1 h on 23 h off daily for 6 days.

Table 2
Xenotest 150 climatic programme and points of observation

Observation point	Exposure time total (hours)	Exposure condition	Time at each condition (hours)
1	nil	–	–
2	21.2	Waterspray on 0.25 h per 0.5 h; UV lamp on; temp. 25-30°C; RH 50-97%	21.2
3	39.2	. . . .ditto. . . .	18
4	60.6	No waterspray; UV lamp on; temp. 40-45°C; RH 26%	21.4
5	125	Waterspray on 0.166 h per 0.5 h; UV lamp on; temp. approximately 30°C; RH 50-97%	64.4

Two sets of specimens were prepared, the first was tested and immediately put into the Xenotest. The second set was matured for seven days, tested and put into the Xenotest.

Survey and discussion of results

Weathering in a temperate and tropical climate

The functional properties examined visually were:

(1) Changes in surface appearance – chalking, cracking, crazing, wrinkling, blistering, colour change, dirt and dust retention and tendency to support micro-biological growth.

(2) Changes in the body of the sealant – shrinkage, swelling, slumping.

(3) Changes in adhesion to the channel.

(4) Miscellaneous changes – bleeding of sealant into substrate and consequent staining, attack by vermin, insect or bird life.

At the end of the twelve month comparative period all sealant samples were in a functional state, and there were few significant differences between behaviour in aluminium and concrete channels. Comments about the performance after seven years weathering show that widening differences in performance can be expected. The individual sealants behaved as follows:

Polysulphide. This sealant showed only slight chalking and surface colour change.

During the four years at the Stafford site, loss of gloss and some dirt retention occurred followed during the next three years by fine surface microcrazing. There was no volume change or loss of adhesion.

Bitumen. Quite severe wrinkling was observed where this sealant was exposed to strong sunlight. Dirt retention and colour change to dark brown was observed to some degree at all sites. No microbiological growth took place. Shrinkage causing dishing in the channel occurred.

Longer exposure after three years saw the onset of surface crazing and cracks close to the channel walls, and these effects progressed to more noticeable features during the next four years.

Glyceride oil based. Chalking, surface cracking and crazing, colour change and dirt retention were noticed quite extensively. Microbiological attack occurred at the jungle sites but tended to diminish with extended exposure time. The sealant had been formulated with a biocide.

Adhesion loss was also present being worse in concrete than aluminium channels.

The early changes recorded during the one year comparative study did not progress at a rapid rate signifying the protective influence of the layer of oxidised surface formed on this type of sealant. After seven years exposure the most noticeable change was a bleaching of the colour to a lighter tan shade.

Silicone. Dirt retention, colour change and a tendency to support microbiological growth were a feature of the behaviour of this sealant, although with the latter the incidence decreased with exposure time. Adhesion loss and some shrinkage was also observed.

Prolonged exposure during the seven years increased the dirt retention to the extent that surface colour definition was masked.

There were some general observations worth noting about the overall performance at the three tropical sites.

Cleared jungle site. The sealants were in a satisfactory condition, though there was a considerable degree of dirt retention and microbiological growth on the glyceride oil and silicone sealants.

Uncleared jungle site. Surface changes were more pronounced, the dirt retention and microbiological growth more severe, and the polysulphide and glyceride oil sealants had been mildly damaged by some form of wildlife. Chalking was not as noticeable at this site.

Desert site. Specimens generally resembled those at the cleared jungle site. Small differences were an absence of microbiological growth, and the surface dirt consisting of fine brown dust and the residue from chalking.

Stafford site. The specimens exposed for one year at Stafford had all retained some wind blown dirt but there had been much less chalking and no microbiological growth.

Constant rate penetration. The changes recorded in the peak penetration values are plotted in Figures (3 – 10).

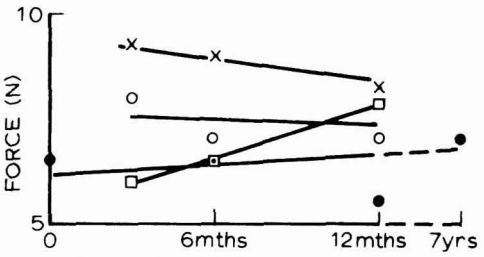

Figure 3. Polysulphide – Aluminium channel

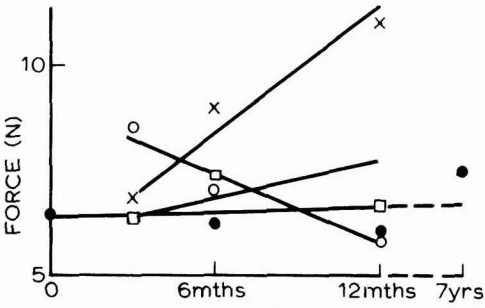

Figure 4. Polysulphide – Cement mortar channel

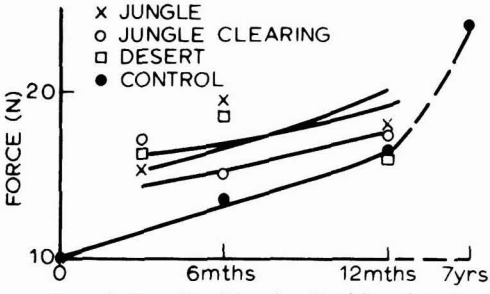

Figure 5. Glyceride oil based – Aluminium channel

The penetration force for the polysulphide sealant was fairly constant except for the samples in concrete in the jungle sites. The samples exposed at Stafford were not as tough. If the force for the tropically exposed specimens are extrapolated at constant value to the line of gradually increasing force for the specimens which continued to be exposed at Stafford (Figure 14) it suggests that ageing was

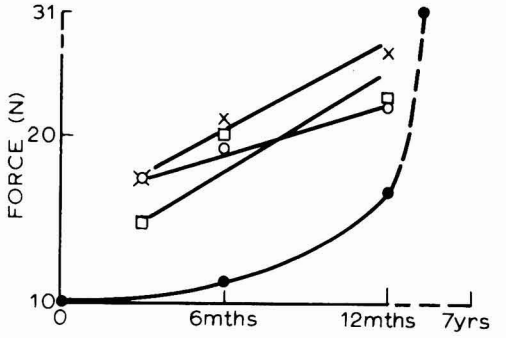

Figure 6. Glyceride oil based – Cement mortar channel

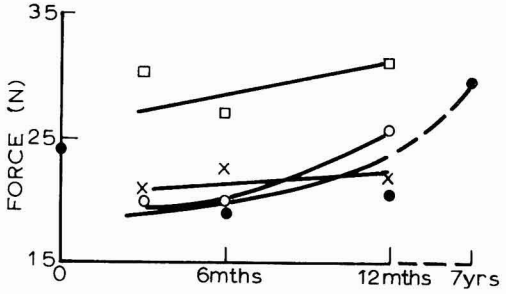

Figure 7. Silicone – Aluminium channel

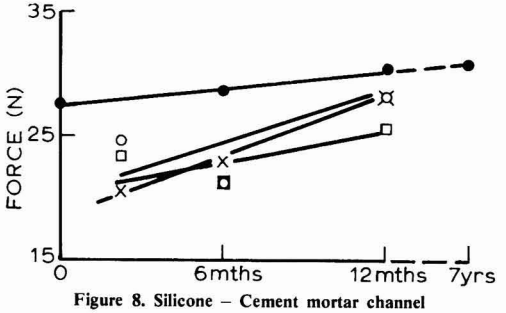

Figure 8. Silicone – Cement mortar channel

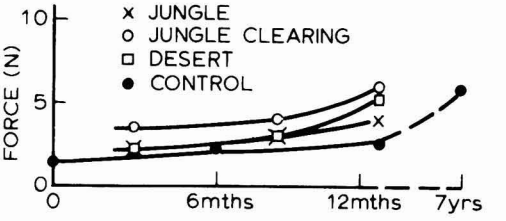

Figure 9. Bitumen – Aluminium channel

occurring at a faster rate of some nine to ten times in the tropics.

The penetration results for the glyceride oil sealants in aluminium were fairly constant and increased graduàlly in the cement mortar channel for the twelve month

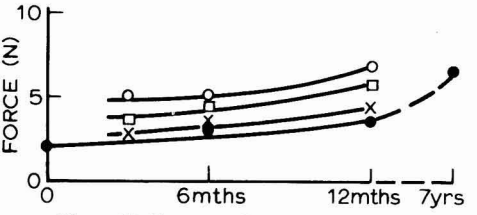

Figure 10. Bitumen – Cement mortar channel

programme. Extrapolation of the results (Figure 15) show that this type of sealant aged more rapidly in cement mortar and that the acceleration in the tropics is approximately one to two fold. In aluminium channels the proportion was between two and three fold.

The results for the silicone sealant indicate a slow toughening of the material. A pattern of environmental influence on performance was difficult to establish and it is possible that the method is not suitable for sealants with a high modulus and a relatively low tear strength.

The thermoplastic bituminous sealant responded well to the method. In each environment the product gradually toughened; the change being more noticeable in the warm, wet climate of the cleared jungle site. Extrapolation of the results indicates an acceleration of four to six times.

From the curves for the four types of sealant it is possible to estimate the relative rates of ageing. After six months the silicone sealant generally began to increase in hardness at a rate which is not any slower than that of the polysulphide. The polysulphide sealant aged much more slowly than the bitumen which in turn was ageing less rapidly than the glyceride oil based sealant.

Artificial laboratory ageing

Constant rate penetration. Penetration measurements were recorded at the end of each cycle in the procedure; the results, for two of the complete cycles and one of the channels, which illustrate the performance and the outdoor controls, are given in Figures 11 and 12. Glyceride oil sealants gave a very different pattern from the other sealants, characterised by high penetrations after oven ageing at 70°C and irradiation with UV and IR.

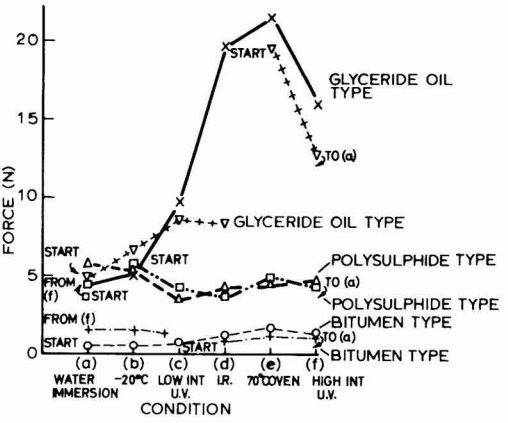

Figure 11. Penetration results of sealants aged in artificial laboratory environments in wooden channels

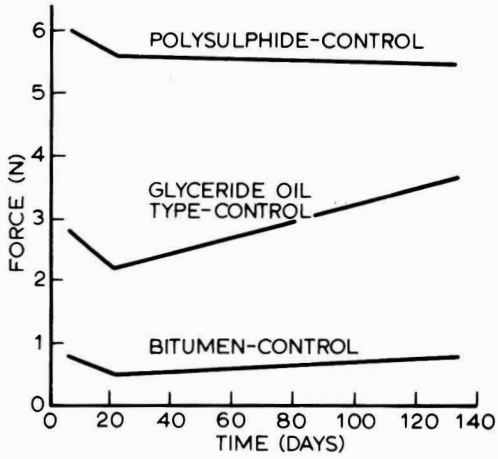

Figure 12. Outdoor exposure – Effect on penetration values

Simulation or acceleration of natural weathering was not achieved by this combination of laboratory environments and no difference in performance was observed at whatever point the cycle commenced.

Glyceride oil based. The artificial conditions produced a noticeable toughening of the surface, slight shrinkage of the mass and some splitting of the surface skin. By comparison, natural weather did not toughen the skin to the same extent and caused some minor surface crazing and discolouration due to air borne dust which was loosely adherent to the surface.

Polysulphide based sealants. The artificial high temperature conditions caused some bubbling of the same type of sealant in the concrete specimens. Very little change was seen after natural weathering; minute crazing developed on the surface of some specimens and air borne dust caused some discolouration.

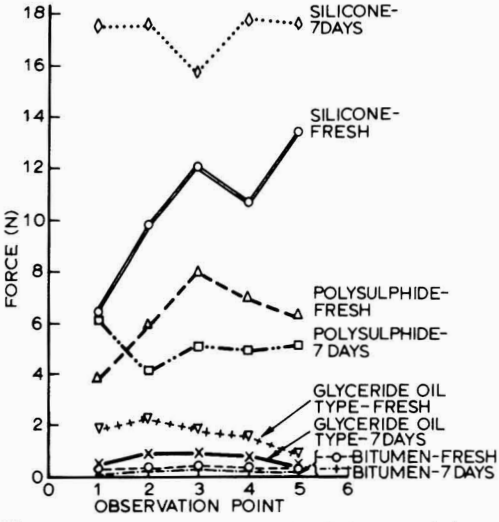

Figure 13. Penetration results of sealants exposed in a Xenotest 150

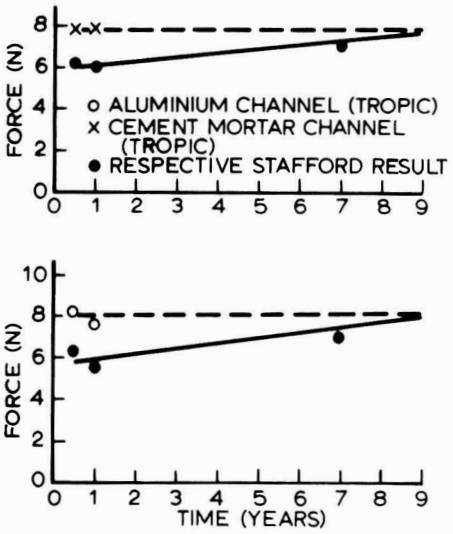

Figure 14. Extrapolation – Polysulphide

Bitumen based sealant. The material dulled at the surface and became tougher due to more rapid solvent loss.

Artificial weatherometer ageing (Xenotest 150)

Constant rate penetration. The results for the two sets of samples are given in Figure 13. Some differences in sealant behaviour were noticed, dependent on whether they were aged before placing in the apparatus. The cure of the silicone exposed immediately was retarded, due it is believed to an evaporation of curing agent. The skin for-

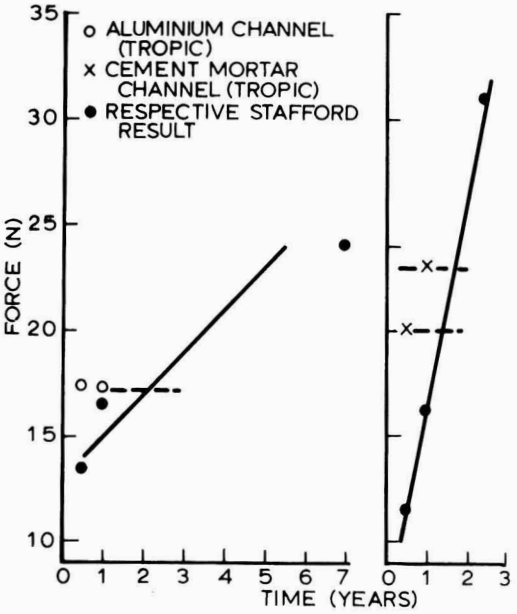

Figure 15. Extrapolation – Glyceride oil

FORMULA 80 THE MULTI-COLOURED TRADE FAIR

Formula 80 will be the first international trade fair on the European continent for the paint, paint products and printing-ink industries. The trade fair will give an overall view of the latest technological developments in these fields. At the exhibition visitors will find raw materials, measuring and control equipment, computer systems, equipment and mechanical aids for these industries. The exhibition programme will also include patent products and processes for the treatment and regeneration of water, air and waste matter. Legislation in respect of environmental hygiene have given rise to rapid technological developments in this branch of science.

Exhibitors
It is likely that this trade fair will attract many visitors. Not only from Europe, but also from other continents. There will be nearly 100 exhibitors from 11 countries at Formula 80.

Fatipec congress
Simultaneously with Formula 80, the bi-annual European Congress of Paint Technicians is to take place at the RAI Congress Centre. This well-known Fatipec congress will now be held for the fifteenth time. Its theme will be: "Activities of the coatings industry within the framework of Ecology, Energy and Economy problems". The Fatipec congresses attract an average of 1000 technicians from all over the world.

FORMULA 80 **International trade fair for the paint, paint products and printing-ink industries**

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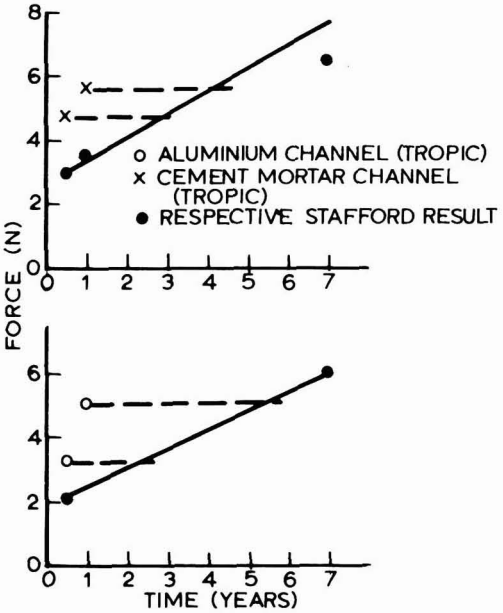

Figure 16. Extrapolation – Bitumen

mation of the glyceride oil based sealant and the cure of the polysulphide, both oxidation mechanisms, were accelerated. The general inertness of bitumen was demonstrated. A good degree of correlation with the penetration of the samples exposed to natural weather (see Figure 12) is shown for the polysulphide, glyceride oil and bitumen sealants, although the period of exposure in the Xenotest 150 was not long enough for any acceleration of ageing to become apparent.

The visible surface changes were the least noticeable after Xenotest 150 exposure. Silicone sealants became slightly dirty, polysulphide and bitumen based sealants lost their surface gloss and oil based sealants wrinkled to some extent.

Conclusions

The constant rate penetration method was suitable for the purpose of repeating measurements several times on a single channel specimen. Reproducibility with the probes used, was good with glyceride oil and bitumen based sealants, satisfactory with polysulphide sealants but poor with silicone sealants.

The artificial ageing programme in the unsophisticated equipment did not simulate natural changes. Further work to adjust the lengths and sequence of the cycles does not appear to be worthwhile. The simultaneous combination of environments in the Xenotest 150 gave, on balance, a reasonable correlation with natural weathering and it would have been interesting to have continued this experiment for a longer period.

Pollution was one effect that artificial ageing could not reproduce and the differences between the sealant types and formulations examined were accelerated by the tropical conditions. Changes in modulus and surface toughness were also accelerated and it has been proposed that accelerating factors are: between one and two for glyceride oil based sealants, nine to ten for polysulphide and four to six for bitumen.

Acknowledgement

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References

1. Reynolds, N. G., *Chem. Ind.*, 1969, 1247.
2. Gunderson, B. J., *California Div. of Highways Research Report.*
3. Groeger, R. G. and Barratt, S., *Industrialised Building* Vol 3(1), 6–11.

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Evaluation of varnishes by capacitance and resistance measurements

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Summary

Four varnishes, a modified phenolic linseed stand oil, a chlorinated rubber, an epoxy linseed ester and an epoxy/polyamide were prepared and coated onto mild steel panels at various thicknesses. Resistance and capacitance measurements in 5 per cent sodium chloride solution were made at different frequencies, using a Weyne Kerr Universal Bridge B 224. Data on the changes of capacitance and resistance with frequency and time give a consistent indication of the superior performance of the epoxy ester resin. The results also indicate that chlorinated rubber may be blended so as to give a performance equal to that of the epoxy ester. The data has enabled the presentation of diagrammatical models of the coatings before and after immersion in sodium chloride solution. Epoxy ester gives results which correspond to a model showing gradual absorption of electrolyte and chlorinated rubber to a model showing a filling up of the pores to the metal substrate.

Keywords

Types and classes of coatings and allied products
clear coating
varnish

Properties, characteristics and conditions primarily associated with materials in general
electrical resistivity
capacitance
immersion resistance

Raw materials for coatings binders (resins, etc.)
chlorinated rubber
epoxy resin
polyamide resin
phenolic varnish

Types and classes of structures of surfaces to be coated
steel

L'évaluation des vernis au moyens des mesures de capacitance et de résistance

Résume

Quatre vernis, à base respectivement; de standolie de lin et une résine phénolique modifiée; de caoutchouc chloré; d'un ester époxydique d'huile de lin: une résine époxyde/polyamide, ont été préparés et appliqués à diverses épaisseurs aux éprouvettes en acier doux. Au moyens d'un pont universel de Weyne Kerr, type B 224, on a effectué des mesures de résistance et de capacitance à de différentes fréquences sur des solutions de 5% en chlorure de sodium. Les données sur les changements de capacitance et de résistance en fonction de la fréquence et du temps indiquent constamment la supériorité de l'ester époxydique. Les résultats indiquent d'ailleurs que le caoutchouc chloré peut être élaboré de façon qu'il donne un rendement qui est égal à celui de l'ester époxydique. Les données ont assuré la présentation des modèles diagrammatiques des revêtements avant et après leur immersion dans la solution de chlorure de sodium. L'ester époxydique donne des résultats qui sont en accord avec un modèle envisageant l'absorption progressive d'électrolyte, et dans le cas du caoutchouc chloré avec un modèle qui envisage le remplissage des pores qui vont jusqu'à la surface du support métallique.

Auswertung von Klarlacken durch Kapazitäts-und Widerstandsmessungen

Zusammenfassung

Stahlblechplatten wurden mit verschiedenen Schichtdicken von vier Klarlacken überzogen. Die Lacke waren auf (1) Leinöl/Standöl, (2) Chlorkautschuk, (3) Epoxid/Leinölester und (4) Epoxid/Polyamid basiert. Widerstands-und Kapazitätsmessungen in 5% iger Natriumchloridlösung wurden mit Hilfe einer Weyne-Kerr Universalbrücke ausgeführt. Die erhaltenen Daten zeigen eine klare Überlegenheit des Epoxidesterharzes. Die Resultate ergaben auch, dass Chlorkautschuk so verschnitten werden kann dass die Leistung der des Epoxidharzes gleichgestellt werden kann. Die Daten gestatteten die Darstellung von diagrammatischen Modellen der Lacke vor und nach der Immersion in der Natriumchloridlösung. Der Epoxidester ergibt ein Modell das der allmählichen Absorption des Elektrolyten entspricht und Chlorkautschuk zeigt dass die Poren der metallischen Untergrundes gesättigt werden.

Introduction

Refs. 1-11

In an earlier paper[1] the physico chemical and mechanical properties of several varnishes were discussed in relation to their structural characteristics. It was concluded that from the point of view of good resistance to oxidation and hydrolytic breakdown, good adhesion, toughness, tensile strength and low permeability to water vapour and oxygen, systems intended for protection of outdoor steel structures which should be further developed include: epoxy resins modified with crosslinking agents such as amines and oils; phenolic resins modified with amines and oils; chlorinated rubber with crosslinking agents and polyvinyl resins with crosslinking agents. This paper deals with the capacitance and resistance characteristics of epoxy resins modified with linseed fatty acid, epoxy resin/polyamide combination, modified phenolic linseed stand oil and chlorinated rubber plasticised with dibutyl phthalate.

Measurement of electrical resistances of paints and varnishes (both applied on metal surfaces and as detached films) have been made by several workers by DC and AC methods[2-5]. It has been concluded from these studies that there is a good correlation between electrical resistances of paints and varnishes and the degree of corrosion protection afforded by them. By means of such measurements, "D" (direct) and "I" (inverse) portions have been identified in the same film[5b], the former having pores and showing an inverse proportionality with resistance of the electrolyte. Most studies relate to the measurement of electrical resistance as a function of the time of immersion in the surrounding corrosive medium at a fixed frequency. More recently, it has been proposed that more information on the dielectric behaviour of varnishes could be obtained if the resistance is recorded as a function of frequency, both initially and after various periods of immersion[6,7].

Capacitance measurements as a function of time can give specific information on the uptake of water by paint films[3,8]. More recently, however, it has been shown that information on the dielectric behaviour of a paint or varnish before and after immersion in a corrosive medium can be obtained by the measurement of capacitance as a function of frequency[6,9-11].

Experimental

Materials

Varnishes:
(1) Modified phenolic linseed stand oil.
(2) Chlorinated rubber.
(3) Epoxy ester.
(4) Epoxy polyamide.

Corrosive medium:
5 per cent solution of A. R. sodium chloride

Metal panels:
15 cms x 10 cms x 0.15 cm thick mild steel panels were used as the metal substrate for the varnish.

Experimental procedure

Modified phenolic medium:
One part by weight of rosin modified phenolic resin and two parts by weight of linseed stand oil were heated together at 270°C for an hour, cooled, and thinned with white spirit to give 70 per cent solids. 0.05 per cent cobalt and 0.5 per cent lead as naphthenate, as a percentage of binder, were added and mixed together by stirring.

Chlorinated rubber:
Sixty parts by weight of Chlorub 20 (Rishiroop Polymers Pvt. Ltd, Bombay–1) and 30 parts by weight of dibutyl phthalate were dissolved in 30 parts by weight of xylene/ethyl cellosolve (1:1) solvent and mixed thoroughly by mechanical stirrer.

Epoxy ester:
Forty parts by weight of epoxy resin (CIBA Araldite 6071 of molecular weight 1001) and 60 parts by weight of linseed fatty acid were charged together in a stainless steel reactor and heated for three hours with stirring at 250 ±10°C. When the acid number had fallen to a value of 8 the product was cooled and thinned to 50 per cent solids with a 1:1 mixture of xylene and white spirit. 0.05 per cent cobalt as naphthenate was added and thoroughly mixed.

Epoxy/polyamide:
Seventy parts of epoxy resin (CIBA Araldite 6071) were dissolved in 50 parts of a 1:1 mixture of xylene and methyl isobutyl ketone and 150 parts of polyamide (Sympol 123, Ahmedabad), and dissolved in 50 parts of a 1:1 mixture of xylene and butanol. These two solutions were mixed in the ratio of 2:1.

Preparation of varnish coated panel

15 cm x 10 cm x 0.15 cm thick mild steel panels were pickled in inhibited hydrochloric acid, washed, dried and coated by brushing. The varnishes were applied to different panels at various thicknesses and dried for a week. The coating thickness was measured using an Elcometer.

Capacitance and the resistance measurements

The Universal Bridge B 224 (Wayne Kerr Company Limited, England) is able to measure resistance in the range of 10 ohms to 1000 mega ohms and capacitance in the range of 0.1 picofarad to 10 microfarads with 0.1 per cent accuracy. In order to carry out the measurements at different frequencies, an RC oscillator (Toshniwal Brothers Bombay) was used as an external source. The cell arrangement used was as follows:

Three cylindrical glass tubes 2.5 cm diameter x 5 cm height were placed over different portions of the coated steel plates, the edges sealed with araldite and the tubes filled with solution to a height of 3 cm. A 1.5 cm^2 platinum foil with a stem was placed in the solution and used as the electrical lead for the measurements. The capacitance and the resistance were measured by using the section between the steel plate and the platinum foil as one arm of the bridge. Measurements were made daily for 20 days at three frequencies; 1 kHz, 5 kHz and 10 kHz. Measurements were made at three positions on the steel plate and values obtained at the portions giving the most consistent values were plotted.

Results

Table 1 gives the resistances and the capacitances measured initially and at the end of 20 days in contact with 5 per cent NaCl solution for the four varnishes used to coat the panels. The initial resistance is in the following decreasing order: Epoxy ester, epoxy/polyamide, modified

Table 1
Change of capacitance and resistance of coated mild steel panels in 5 per cent NaCl at frequency 5 kHz

Varnish	Thickness (mil)	Resistance (Ohm)		Capacitance (pF)	
		Initial	After 20 days	Initial	After 20 days
Chlorinated rubber	1.5	108 k	37 k	173	430
	3.0	2.04 M	769 k	121	190
	4.0	3.22 M	341 k	94	120
Epoxy/ Polyamide	1.25	5 M	303 k	200	550
	2.5	6.6 M	2 M	120	165
MPSO	2.0	2.22 M	3.84 k	250	2100
Epoxy Ester	3	6.06 M	1.4 M	132	200
	4	10 M	1.96 M	96	140
	5	12.5 M	3.30 M	66	93

phenolic stand oil (MPSO), chlorinated rubber. The initial resistances of the various coatings are not proportional to their thicknesses. The increase in resistance with thicknesses is one order of magnitude higher in the case of chlorinated rubber, whilst the epoxy/polyamide shows a marginal increase and epoxy ester shows an increase which is roughly proportional to the increase in the thickness. Contact with NaCl solution for 20 days causes a sharp decrease in resistance in the case of MPSO and epoxy/polyamide. The resistance decreases to one-third or to one-fifth for thicknesses of 3 and 4 mils with the epoxy ester and 1.5 and 3 mils with the chlorinated rubber film.

The initial capacitance decreases with increasing thickness, but it is not proportional. The smallest increase in capacitance measured after 20 days of immersion was with the epoxy ester, and the largest increase observed was with the MPSO. Chlorinated rubber and epoxy/polyamide behave similarly.

Figures 1 to 8 show the change of capacitance and resistance with time and frequency for various thicknesses of the four varnishes. There is a small, but gradual, increase in capacitance and decrease in resistance with time in the case of the epoxy ester. The capacitance is

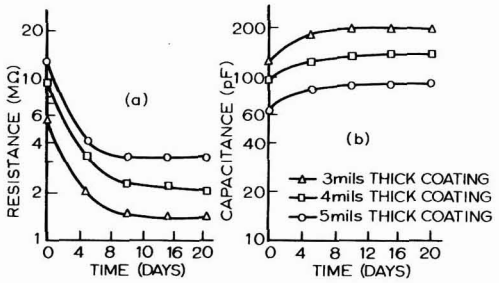

Figure 1. Epoxy ester, frequency 5 kHz. (a) Resistance vs time; (b) Capacitance vs time

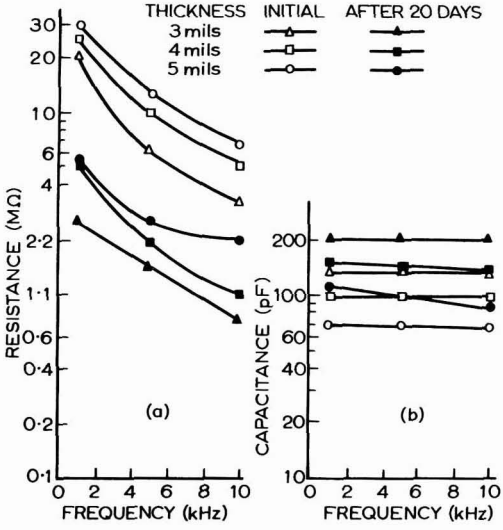

Figure 2. Epoxy ester. (a) Resistance vs frequency; (b) Capacitance vs frequency

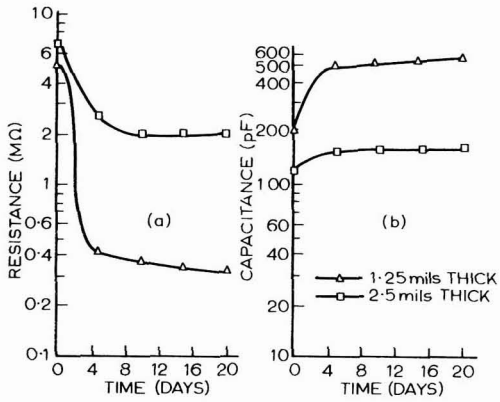

Figure 3. Epoxy/polyamide, frequency 5 kHz. (a) Resistance vs time; (b) Capacitance vs time

independent of frequency both initially and after immersion. Resistance decreases with frequency and the slope is quite steep. Unlike epoxy ester, the MPSO shows a steep decrease in resistance and a large increase in capacitance with time. Although capacitance is initially independent of frequency, after some time it becomes depedent. The slope of the resistance with frequency curve is as large as that of epoxy ester initially, but becomes independent after immersion. With chlorinated rubber, the observations are somewhat similar to those of the epoxy ester, but the changes are much greater. With 1.5 mil thickness, the independence of capacitance with frequency ceases after immersion and a definite slope develops. The slope of resistance with frequency diminishes after immersion. With epoxy/polyamide the initial changes with time are quite large. The capacitance vs frequency curve develops a slight slope after immersion and the slope of the resistance vs frequency curve is not eliminated by immersion.

Discussion

Refs. 12, 13

Electrical capacitance is given by the equation $C = KA/4\pi D$ where K is the permitivity, A is the area of the capacitor plate and D is the thickness of the dielectric. The capacitance can be expected to increase if D diminishes or K increases for a given area of the capacitance plate. In the case of a pure dielectric the permitivity is not affected by frequency[12,13]. If a polar substance is absorbed by the dielectric, the capacitance will increase and the increased capacitance will decrease with frequency, because polar materials tend to become dielectric at higher frequencies. If pores are formed in the dielectric and the pores become filled with electrolyte, then the capacitance should also increase depending upon the depth of pore. Until it penetrates to the metal, the unaffected portion may show the same behaviour as that of a pure dielectric having a diminished thickness, but once the metal surface is reached the behaviour becomes that of the electrolyte. The resistance of a pure dielectric decreases with frequency due to dielectric loss, but that of an electrolyte is independent of frequency. Thus, resistance will decrease with absorption of electrolyte and become independent of frequency. If pores are formed and are filled with electrolyte, the decrease of resistance will be very sharp. If the pore reaches the metal surface, only the resistance of the electrolyte in the pore is measured.

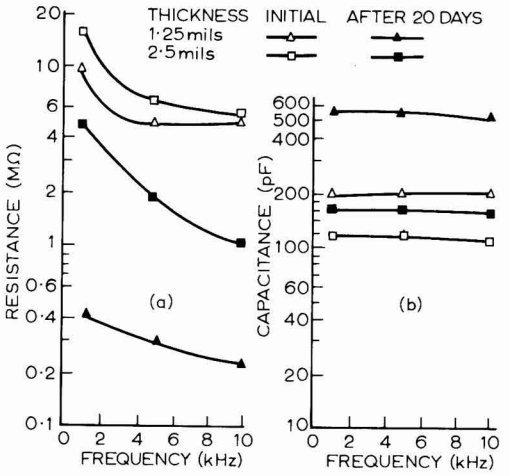

Figure 4. Epoxy/polyamide, frequency 5 kHz. (a) Resistance vs frequency; (b) Capacitance vs frequency

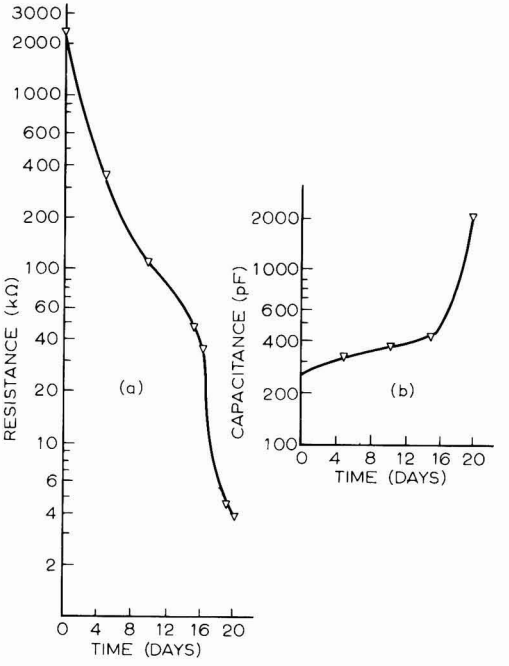

Figure 5. Modified phenolic stand oil, thickness 2 mils., frequency 5 kHz. (a) Resistance vs time; (b) Capacitance vs time

Based on these consideration, a diagrammatic model of the varnish coatings before and after immersion in NaCl solution is given in Figure 9 for the three situations:

(a) Gradual absorption of electrolyte

(b) Filling up of pores up to metal.

(c) Filling up of pores up to certain depth.

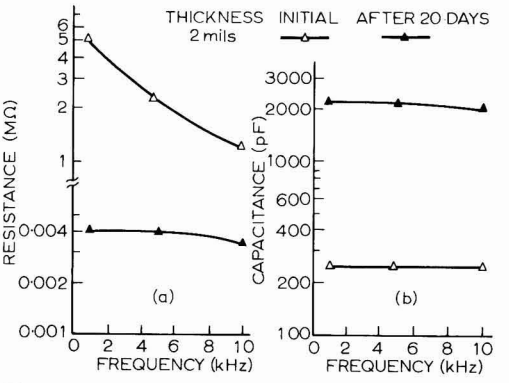

Figure 6. Modified phenolic stand oil, thickness 2 mils. (a) Resistance vs frequency; (b) Capacitance vs frequency

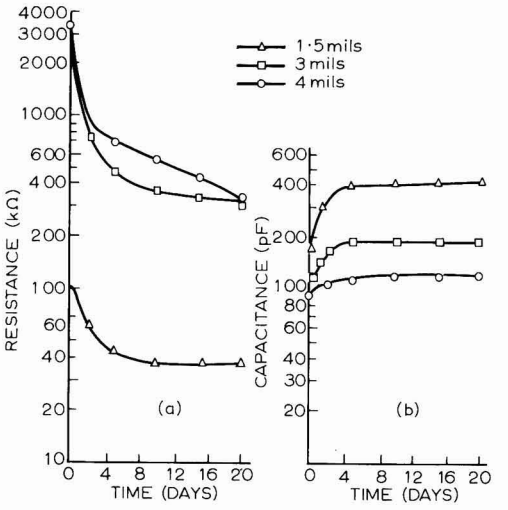

Figure 7. Chlorinated rubber, frequency 5 kHz. (a) Resistance vs time; (b) Capacitance vs time

The expected capacitance vs time, resistance vs time, capacitance vs frequency and resistance vs frequency curves are also illustrated in this figure for the three situations.

From the initial and final resistance values epoxy ester is seen to be the system with highest resistance and least deterioration in contact with a corrosive solution. MPSO shows the maximum deterioration in contact with the solution, although its initial resistance is quite high. Both chlorinated rubber and epoxy/polyamide are intermediate. Epoxy/polyamide shows higher resistance than chlorinated rubber. The lack of proportionality between electrical resistance and the thickness of film may be attributed to the fact that these varnishes cannot be considered as pure dielectrics. Considering the capacitance values, the lowest capacitance is again observed with the epoxy ester and the changes with time of immersion are also the least. MPSO again shows the maximum deterioration as shown by its steep increase with time of immersion. As observed earlier, epoxy/polyamide and chlorinated

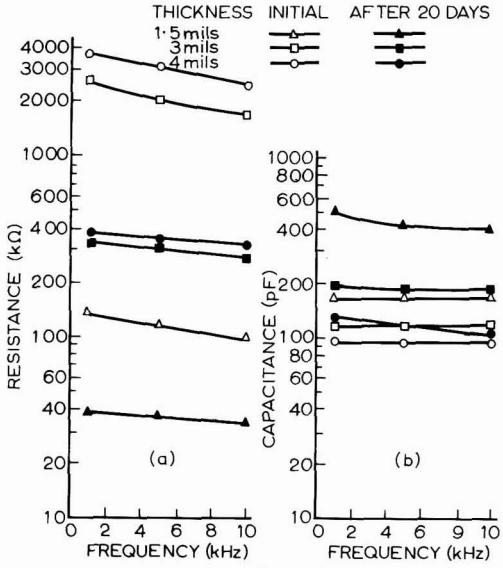

Figure 8. Chlorinated rubber. (a) Resistance vs frequency; (b) Capacitance vs frequency

rubber are also intermediate in the capacitance measurements. The measurement with time and frequency show that epoxy ester clearly belongs to model (*A*). Chlorinated rubber seems to belong to the model (*B*). Epoxy/polyamide also belongs to model (*B*), but the changes are greater with this system than with chlorinated rubber. MPSO belongs to model (*A*), but the absorption of electrolyte is so large that changes take place in orders of magnitude greater in comparison with the small changes with epoxy ester.

Conclusion

It is concluded that the best performance is given by epoxy ester resin. It might be possible to blend a chlorinated rubber coating in such a manner that the creation of pores, however small and few, is avoided and performances equal to epoxy ester obtained.

Acknowledgement

The authors thank Dr H. V. K. Udupa, Director, Central Electrochemical Research Institute, Karaikudi-623006 for permission to publish this article. Thanks are also due to Shri V. Chandrasekaran and Shri V. Ganesa Sarma for their help in preparing the varnishes.

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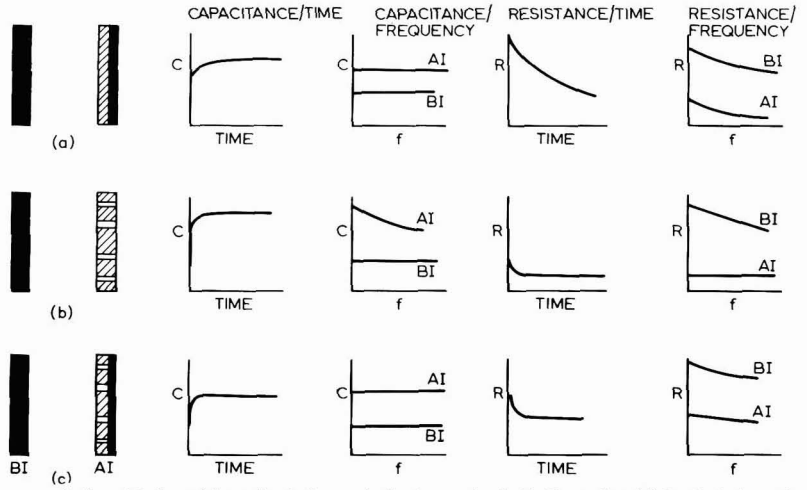

Figure 9. Diagrammatical model of varnish coating before and after immersion in NaCl solution. (a) Gradual absorption of electrolyte; (b) Filling of pores to metal; (c) Filling of pores to certain depth. BI – Before immersion, AI – After immersion, f – frequency in hertz

References

1. Guruviah, S. and Rajagopalan, K. S., "Correlation of physio chemical properties and structural characteristics with paint performance", January 1977, *National Test House*, Calcutta.
2. Bacon, C. R., Smith, T. J. and Rugg, F. M., *Ind. Eng. Chem.*, 1948, **40**, 161.
3. Wormwell, F. and Brasher, D. M., *J. Iron & Steel Inst.*, 1949, **162**, 129 and 1950, **164**, 141.
4. Kittleberger, W. W. and Elm, A. C., *Ind. Eng. Chem.*, 1952, **44**, 326.
5. Mayne, J. E. O., *JOCCA*, 1957, **40**, 183.

5b. Buller, M., Mayne, J. E. O. and Mills, D. T., *JOCCA*, 1976, **59**, 351.

6. Rosenfeld, I. C., Bryan, V. N. and Zhigalove, K. A., "Paint and varnish materials and their uses", *Met. Kont. Anali, Isp (USSR)*, 1966, **5**, 52.

7a. Touhsaent, R. E. and Leidheiser, H., *Corrosion (NACE)*, 1972, **28**, 435.

b. Kendig, M. W., Leidheiser, H., *J. Electrochem. Soc.*, 1976, **123**, 98.

8. Gentle, J. K., *JOCCA*, 1963, **46**, 850.
9. Tomashow, N. D. *et al., Corrosion* 20, 1964, 125t and 218t.
10. Miller, R. N., *Mat. Protn.*, 1968, **7 (11)**, 35.
11. Rajagopalan, K. S., Guruviah, S., Sundaram, M. and Chandrasekaran, V., *JSIR*, 1975, **34**, 482.
12. "Dielectric material and application", R. Von Appel (Ed), *John Wiley & Sons*, 1954, New York.
13. "Physics of dielectric materials", B. Tareev, *Mir Publishers*, 1975, Moscow.

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Modification of hydrolysed lac with epichlorohydrin and epoxy resin

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Summary

Hydrolysed lac on modification with epichlorohydrin or epoxy resin and curing with toluene diisocyanate yields products which give very hard, glossy and flexible films even after air drying. The films have good resistance to water, solvents and chemicals.

Keywords

Raw materials for coatings
binders (resins, etc.)
lac resin
shellac
epoxy resin

Processes and methods primarily associated with
manufacturing or synthesis
hydrolysis
catalysed conversion

La modification de gomme-laque hydrolysée avec l'épichlorhydrin ou les résines époxydes

Résumé

La gomme-laque hydrolysée rend, après modification avec l'épichlorhydrin ou une résine époxyde et durcissement par le diisocyanate de toluène, des produits dont leurs films sont très durs, brillants et souples même après séchage à l'air. Les films ont une bonne résistance à l'eau, aux solvants et aux agents chimiques.

Modifikation von hyrolysiertem Lackharz mit Epichlorhydrin und Epoxidharzen

Zusammenfassung

Hydrolysiertes Lackharz das mit Epichlorhydrin oder mit Epoxidharzen modifiziert und mit Toluol-diisocyanat gehärtet wurde, ergibt sehr harte, glänzende und biegsame Filme sogar wenn diese nur der Lufttrocknung unterworfen werden. Die Filme besitzen guten Widerstand gegen Wasser, Lösungsmittel und Chemikalien.

Introduction

Refs. 1-7

Shellac, on saponification with alkali and treatment of the resulting solution with a mineral acid, gives a water-insoluble, soft, sticky mass to the extent of 70-75 per cent of the weight of the parent shellac, which is called "hydrolysed lac"[1]. If, on the other hand, lac is hydrolysed in an alcoholic medium and the hydrolysed lac is regenerated from the alcoholic hydrolysate either by neutralising with a slight excess of alcoholic sulphuric acid followed by treatment with calcium carbonate, or by passing through a strong cation exchange resin, the yield is almost quantitative[2]. Hydrolysed lac is a versatile material of considerable promise for diverse uses, mostly in the fields of adhesives, cements and glues. As such or in conjunction with shellac, it is used for lamination of paper and fibre boards, cementing electrical instruments, production of flexible micanite[3,4], gasket shellac compound, black insulating tape, etch primer for aluminium surfaces[5] and varnishes for natural and synthetic rubbers.

Several attempts have been made to modify hydrolysed lac. It has been esterified with ethylene glycol to give a product which is resistant to hydrocarbon solvents and is remarkable for its low-temperature flexibility at as low as −25 °C. Hydrolysed lac has also been reacted with maleic and phthalic anhydrides to give balsam-like products[6] which dry to hard, water-resistant coatings after baking. Its butyl ester[7] has been recommended as a plasticiser, because it is compatible with nitrocellulose and polyvinyl chloride. The present paper describes work relating to the modification of hydrolysed lac with epichlorohydrin and epoxy resins of different molecular weights.

Materials and methods

Refs. 1, 8, 9

Hydrolysed lac was prepared from seedlac in an aqueous medium by the usual process[1]. The sodium salt of hydrolysed lac was prepared by dissolving seedlac in distilled denatured spirit and allowing it to stand at room temperature overnight. After 24 hours, the solution was filtered to remove impurities and wax. Sodium hydroxide (20 per cent on the weight of lac) was added and refluxed for 4-5 hours. Most of the spirit was removed by distillation and the final traces of solvent were removed in a vacuum oven. Hydrolysed lac was thus obtained in the form of its sodium salt.

Analysis

The epoxide content was estimated by a hydrochloric acid

– dioxane reagent method[8] and acid and hydroxyl values as described in the *Handbook of Shellac Analysis*[9].

Modification with epichlorohydrin

The reaction between hydrolysed lac and epichlorohydrin was brought about using various catalysts as follows:

(1) Sodium salt of hydrolysed lac (25 g) and epichlorohydrin (75 g) were placed in a three necked flask and benzyl trimethyl ammonium chloride (0.25 g) added. The flask was fitted with a reflux condenser, stirrer and thermometer and placed in a heating mantle. It was refluxed for 3 hours, after which the hydrolysed lac became completely soluble in epichlorohydrin. The product was washed three times at 50°C with water. Unreacted epichlorohydrin was removed by distillation under reduced pressure and finally by evaporation at 50°C under vacuum. A sticky, viscous mass was obtained having a nil acid value and an epoxide value 0.182 equiv/100 g. The product did not harden at room temperature in the presence of amines.

(2) The product (10 g) obtained as above by reacting the sodium salt of hydrolysed lac with epichlorohydrin in the presence of benzyl trimethyl ammonium chloride, was reacted with a further quantity of epichlorohydrin (10 g) in the presence of boron trifluoride etherate (0.2 g) at 70-80°C for three hours. The resulting product was dissolved in dioxane and refluxed in the presence of sodium aluminate for eight hours. After filtration, the solvent was removed by distillation under reduced pressure. A viscous sticky product was obtained. The acid value of the product was nil and epoxide value was 0.198 equiv/100 g.

(3) Hydrolysed lac (25 g) was reacted with epichlorohydrin (75 g), first in the presence of benzyl trimethyl ammonium chloride, and subsequently in the presence of boron trifluoride. The reaction mass was then brought to a pH of 10.0 by the addition of aqueous sodium hydroxide. It was allowed to stand for 30 minutes and then the pH was reduced to 6.5 by the addition of dilute hydrochloric acid. The product thus obtained was washed and dried. It was found to be neutral with an epoxide value 0.154 equiv/100 g.

(4) When carbon dioxide was used to decrease the pH instead of hydrochloric acid, a slightly higher epoxide value (0.176 equiv/100 g) was obtained.

(5) In another set of experiments, hydrolysed lac (20 g) was reacted with epichlorohydrin (60 g) in the presence of boron trifluoride in an atmosphere of nitrogen. The resulting product was dissolved in dioxane (300 ml) and refluxed in the presence of sodium aluminate (15 g). The solution was filtered and excess solvent distilled under reduced pressure. The product thus obtained was neutral with an epoxide value 0.1923 equiv/100 g. It cured with amines when stoved and with diisocyanate at room temperature.

The products obtained by reacting hydrolysed lac with epichlorohydrin were tested as cold-curing adhesives using amines as curing agents. Adhesion on glass to glass, metal to metal and metal to glass was tested, but the bond obtained was not very strong. The surface coating properties of these products were also studied using amines and diisocyanates as curing agents. With amines alone, the films obtained were not hard even after stoving. However, with isocyanates, very hard films were obtained after 24 hours, even at room temperature. Films were very glossy and resistant to water, dilute acids and alkalies. However, flexibility was somewhat poor.

The products obtained by the methods mentioned in (2) and (5) were found to give better results, obviously due to their higher epoxide contents.

Modification with a low molecular weight epoxy resin

Hydrolysed lac was reacted with epoxy resin of molecular weight about 400 in different proportions by heating them together at 150°C for up to four hours and acid and hydroxyl values of the resulting products were determined

Table 1
Reduction in acid and hydroxyl values on heating hydrolysed lac and epoxy resin

Parts of epoxy resin/100 parts of hydrolysed lac	Reaction time (hr)	Heated at 150°C		Refluxed in butanol/xylene mixture (1:1)	
		Acid value	Hydroxyl value	Acid value	Hydroxyl value
Nil (control)	Nil	200.2	356.2	–	–
Nil (control)	0.5	194.8	343.5	–	–
Nil (control)	1	179.0	331.7	–	–
Nil (control)	2	156.4	269.0	–	–
25	Nil	162.5	286.5	162.5	286.5
25	0.5	98.6	271.0	–	–
25	1	78.2	260.6	102.4	280.8
25	2	58.5	222.4	86.5	268.0
25	4	–	–	62.8	242.8
50	Nil	135.3	238.7	135.3	238.7
50	0.5	59.4	230.6	–	–
50	1	45.6	220.5	67.2	230.5
50	2	32.4	186.0	44.0	223.0
50	4	–	–	36.5	208.4
100	Nil	101.3	182.1	101.3	182.1
100	1	2.5	149.6	48.8	162.2
100	2	Nil	136.0	29.2	150.6
100	4	–	–	2.6	148.0

(Table 1). Products so obtained were partly soluble in methanol and ethanol but completely soluble in acetone, methyl isobutyl ketone, methanol/acetone (1:2), ethanol/acetone (1:2), ethanol/benzene (1:2) and butanol/xylene (1:1).

As difficulty is likely to be encountered on dry heating if the reaction is carried out on a large scale, the reaction between hydrolysed lac and epoxy resin was carried out in a solvent medium (butanol/xylene mixture (1:1)) by refluxing and acid and hydroxyl values of the resulting products determined (Table 1).

It can be seen from the results that during the course of the reaction, there is reduction in both acid and hydroxyl values, signifying that both these groups take part in the reaction. The reaction rate is somewhat slow in the solvent medium.

The surface coating properties of the resulting products were studied by preparing films on glass and tin panels. It was found that the film remained tacky after seven days' air drying, and even on baking at 150°C for 30-60 minutes, a hard finish could not be obtained. Curing agents were, therefore, tried. When triethylene tetramine (2.5 to 5 per cent on the weight of solids) was used, the films remained soft on air drying but on stoving at 150°C for 30 minutes, hard, glossy, and highly flexible films were obtained. Resistance to water, solvents and chemicals of these films was, however, not good.

With toluene diisocyanate (10-15 per cent on the weight of solids), very hard, glossy and flexible films were obtained, even on air drying and resistance to water, solvents and chemicals of the films was also much improved. The product with 50 parts of epoxy resin and 100 parts of hydrolysed lac was found to give the best performance.

Modification with epoxy resin of high molecular weight

Hydrolysed lac was heated with varying proportions of epoxy resin (Dob-Eckot 500) of molecular weight about 1000 at 150°C and the gelation time was noted. It was observed that, at first, the gelation time decreases with the increasing proportions of the epoxy resin, but subsequently increases. The minimum (62 minutes) was found with 6 parts of hydrolysed lac and 4 parts of the epoxy resin. For further studies, hydrolysed lac and epoxy resin were heated together for 50 minutes in three different ratios – 60:40, 50:50 and 40:60. Their solubility behaviour, acid values and film properties were studied.

These products were found completely soluble in acetone, dioxane, alcohol with benzene/toluene, butanol with xylene, but only partially soluble in denatured spirit, methanol, butanol, esters and hydrocarbons.

Acid values of these products are shown in Table 2.

In a further set of experiments, the reaction between hydrolysed lac and epoxy resin was carried out in a solvent medium using 50 parts each of hydrolysed lac and epoxy resin and dissolving in butanol and xylene (1:1). To this solution, 1 g of dicyandiamide was added and the mixture was refluxed for 8 hours. The acid value of the product was found to be 74.6 before and 22.8 after the reaction.

The products with 60:40 and 50:50 ratio were dissolved in butanol and xylene (1:1) so as to make 25 per cent solutions and films were prepared on glass slides and tin plates. Properties of the stoved (at 150°C for 30 minutes) and air dried films were studied. Baked films were quite hard, glossy and very flexible. They were also found to be unaffected after 20 days' immersion in water and sulphuric acid (10 per cent). Resistance to the action of sodium hydroxide (2 per cent aqueous) was also good and lifting of films occurred only after 36 hours.

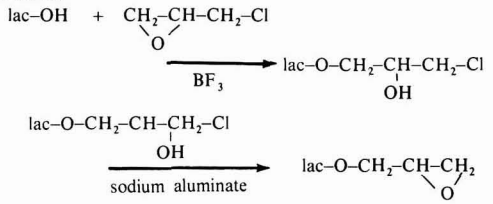
Table 2
Reduction in acid value on heating hydrolysed lac and epoxy resin. Temperature 150°C; Duration 50 minutes

Hydrolysed lac/epoxy resin ratio	Acid value no reaction	Acid value obtained	Decrease in acid value
100:00	146.10	114.30	31.80
60:40	87.62	53.62	33.98
50:50	73.50	43.70	29.80
40:60	58.40	35.50	22.90

Discussion

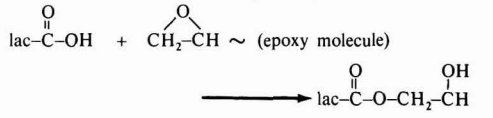
Refs. 10-12

Srinivasan and Kapur[10] studied the reaction between epichlorohydrin and lac in the presence of boron trifluoride and sodium aluminate and considered it to be as follows:

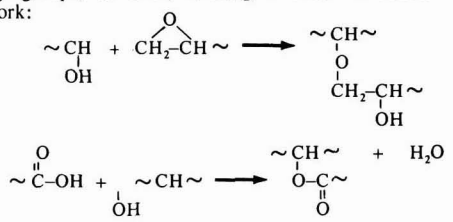


They obtained an epoxide content of 0.054 equiv/100 g using lac in contrast to 0.1923 equiv/100 g obtained with hydrolysed lac by the authors.

Tripathi[11] *et al*, on the other hand by fusing lac epoxy resins came to the conclusion that the principal reaction is between the epoxide group of the epoxy resin and the carboxyl group of lac which may be represented as:



On further fusion or stoving, crosslinking takes place, presumably due to the reaction between the hydroxyl (of shellac or nascent hydroxyls produced by the above reaction) and carboxyl groups or between the hydroxyl and epoxy groups, or both, forming a three dimensional network:



Hydrolysed lac has a higher acid value (nearly 200 against 70) and hydroxyl value (350 against 250) compared to shellac, but it is expected to behave in a similar way to shellac on reacting with epichlorohydrin or epoxy resin. The fact that the reduction in acid value is greater than in hydroxyl value indicates that carboxyl groups are involved to a greater extent in the reaction.

Isocyanates have the extremely reactive group, $-N=C=O$, which reacts with hydroxyl groups[12] present in the epoxy resin chains or with shellac to provide crosslinking.

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References

1. Bose, P.K., Sankaranarayanan, Y. and Sengupta, S. C., *Chemistry of Lac* (Indian Lac Research Institute, Ranchi, India), 1963, 186.
2. Banerjee, R. K. and Sengupta, S. C., *Paintindia*, 1971, **XXI** (10), 26.
3. Ghosh, P. K. and Venugopalan, M., *Res. & Ind.*, 1958,**3**, 141.
4. Kamath, N. R., *Ethylene glycol ester of hydrolysed lac, its preparation and properties*, London Shellac Research Bureau, Bull. No. 6, 1944, 10.
5. Shellac Export Promotion Council, Calcutta, India – Information Literature, *Modified shellac for priming and finishing of metals*, 1960, 7.
6. Venugopalan, M., *Current Sci.*, 1939, **8**, 14.
7. Kamath, N. R., Potnis, S. P. and Rao, M. G. K., *Paintindia*, Shellac Supplement, 1962,**XII** (1), 31.
8. Burge (Jr.), R. E. and Geyer, B. P., *Analytical Chemistry of Polymers: High Polymer Series*, Vol. XII, Part I, edited by G. M. Cline (Interscience Publishers Inc., New York), 1959, 123.
9. Rangaswami, M. and Sen, H. K., *A Hand Book of Shellac Analysis* (Indian Lac Research Institute, Ranchi, India), 1952, 66 and 112.
10. Srinivasan, S. R. and Kapur, S. L., *Indian J. Technol.*, 1964, **2**, 72.
11. Tripathi, S. K. M., Kumar, S. and Misra, G. S., *Indian J. Technol.*, 1966, **4**, 15.
12. Lee, H. and Neville, K., *Epoxy Resins – Their Applications and Technology* (McGraw Hill Book Co. Inc., New York), 1957, 160.

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Study of variables which affect dispersion of antifouling paints in ball mills

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Summary

Manufacturing processes require a detailed knowledge of the operational characteristics of the equipment and prototypes in order to produce in pilot plant scale antifouling paints that behave successfully as shown in previous raft and ship trials.

The variables discussed in this paper have a marked influence on the behaviour of the toxic formulations, as they are frequently responsible for the failure to obtain similar results with laboratory and industrially prepared products.

Variables which affect dispersion and milling in a ball mill are assessed. As regards porcelain balls, their optimum load and interstitial spaces generated were determined both for uniform size balls or mixtures (1/1 w/w) of two different diameters.

The results were obtained independently of the ball mill sizes in order that the conclusions could be applied to ball mills of various capacities.

Also mentioned are load, density, size and shape of the balls.

The optimum paint load of the mill for efficient dispersion is also considered, as is the influence exerted by the density, viscosity and pigment/binder ratio.

The paper also discusses the more satisfactory relationship between the rotation speed and diameter of the jar. Also discussed is the technique for the assessment of the different milling rates, consisting of a sedimentation analysis of the size of the pigment selected from a paint sample in order to determine the settlement speed of the particles on the basis of Stokes' law.

Keywords

Types and classes of coatings and allied products
antifouling coating

Processes and methods primarily associated with manufacturing or synthesis
dispersion
milling

Properties, characteristics and conditions primarily associated with materials in general
particle size

Equipment primarily associated with manufacturing or synthesis
ball mill

Une étude des variables qui exercent une influence sur la dispersion, en broyeurs à billes, des peintures "anti fouling"

Résumé

Les procédés de fabrication exigent une connaissance détaillée des caractéristiques opératoires du matériel et des prototypes, afin de produire, à l'échelle pilote, les peintures "anti fouling" qui comportent avec le même succès qu'ils ont montré lors des essais au radeau et sur navires.

Les variables que l'on discute dans cet exposé exercent une influence bien marquée sur le comportement des compositions toxiques, puisqu'elles sont souvent responsables pour les différences qui se présentent entre le même produit préparé au laboratoire et à l'échelle industrielle.

On apprécie les variables qui exercent une influence sur les procédés de dispersion et de broyage dans un broyeur à billes. A l'égard des billes en porcelaine, on a déterminé la volume de leur charge optimale et des interstices associées, dans le cas à la fois des billes de la même grandeur et des mélanges (1:1 par poids) de billes de deux diamètres différents.

De sorte que les conclusions pouvaient être appliquées aux broyeurs à billes de diverses capacités, les résultats ont été obtenus indépendamment de la grandeur du broyeur à billes.

On mentionne d'ailleurs la charge, la densité, et la grandeur des billes.

On considère, également, la charge optimale de peinture pour assurer un procédé de dispersion efficace, ainsi que l'influence qu'exercent, la densité, la viscosité et le rapport pigment/liant.

On discute aussi un rapport plus satisfaisant entre la vitesse de rotaion et le diamètre du broyeur. De plus on discute la technique d'appréciation de l'effet de différentes cadences de broyage qui comprend l'analyse sédimentomètrique de la grandeur d'un pigment extrait d'un échantillon de peinture, afin de déterminer la vitesse de sédimentation des particules en raison de la loi de Stokes.

Untersuchung der Faktoren welche die Dispersion von Antifoulingfarben in Kugelmühlen beeinflussen

Zusammenfassung

Produktionsmethoden benötigen eine genaue Kenntnis der betrieblichen Eigenheiten der Maschinen und Ausgangsbautypen um im Versuchsverfahren Antifoulingfarben herzustellen die sich in früheren Schiffs-und Flossauswertungen erfolgreich erwiesen haben.

Die vorliegende Arbeit diskutiert die veränderlichen Faktoren die einen starken Einfluss auf das Verhalten der giftigen Formulierungen haben, da diese Faktoren oft für das unterschiedliche Verhalten von Laboratoriums-und Fabriksprodukten verantwortlich sind.

Die Variablen die Einfluss auf die Dispersion und das Mahlen in Kugelmühlen haben, werden eingeschätzt. Die optimale Beschickung mit Porzellankugeln wurde für Kugeln einheitlicher Grösse und für gemischte Grössen mit zwei verschiedenen Durchmessern bestimmt. Die Ergebnisse wurden unabhängig von der Grösse der Kugelmühle erzielt damit die Schlussfolgerungen auf Kugelmühlen von verschiedenem Volumen angewendet werden können.

Dichte, Grösse und Gestalt der Kugeln werden auch erwähnt.

Die optimalen Lackquantitäten zu Erzielung der besten Dispersion und der Einfluss der Dichte, Viskosität und Pigment/Bindemittel Beziehungen wurden auch in Betracht gezogen.

Die Arbeit behandelt auch zufriedenstellende Beziehungen zwischen Umdrehungsgeschwindigkeit und Durchmesser der Kugelmühle. Methoden für die Beurteilung verschiedener Mahlgeschwindigkeiten mit Hilfe von Sedimentationsanalysen der Korngrösse der Pigmente werden auch beschrieben.

Introduction

Refs. 1-4

The preparation of the binders and of the experimental paints has been carried out for operative and fundamentally economic reasons, as part of the research projects under development, using high speed dispersers, ball mills, sand mills and agitating tank type reactors on a laboratory scale.

At the same time, the assessment of the properties of the products so prepared has been established by physico-chemical and electrochemical tests, accelerated weathering and exposure on experimental rafts. Subsequently, by statistical treatment of the results, the necessary basic information has been obtained to achieve, in a second stage, optimisation of the formulations that have been studied.

Subsequently, and as a result of the above-mentioned programme, intensive studies were started on a pilot plant scale on anticorrosive and antifouling paints which had previously been found to behave satisfactorily[1-3]. On finalising the equipment required for full scale manufacture, which included the design and calculation of a reactor for the polymerisation of oils and preparation of varnishes[4], research was started on those marine paints which were tested on ship hulls. The experiments were carried out on panels of an area of approximately 12 square metres and in some cases over the whole of the hull.

Bearing in mind that ball mills have been the most widely used equipment for the manufacture of paints, it was decided to begin these studies by establishing the different variables involved in the change of scale of manufacture. For this purpose, mills of different volumes (3, 10, 28, 141 and 400 litres) have been used.

The variables to be assessed may well influence the properties of both the anticorrosive and the antifouling paints. In the latter case, it is particularly important to establish the optimum dispersion time of the cuprous oxide so as to achieve an adequate distribution of particle size, a minimum reaction between pigments and other components of the composition and the maximum bioactivity and performance in service.

Methods of assessing the degree of dispersion

Refs. 5-8

The dispersion process involves the wettability of the pigment particle, its mechanical fracture and finally the stabilisation of the dispersion against flocculation[5]. During the first part of the process the wet air/pigment interface is replaced by a binder/pigment one; in the second stage, the particles of the pigment are fragmented into smaller ones; during the stabilisation a product is obtained that can be maintained for long periods without any important changes. Various authors have made exhaustive studies of these processes[6,7].

The quantitative assessment of the degree of pigment dispersion in paints presents many problems. Normally a grind gauge and a scraper are used, but this method only serves to establish the presence of improperly dispersed particles and it does not give information on the smaller particles. In this case, the method used to determine the distribution of the pigment particle sizes was a microscopic study, followed by a sedimentation analysis in conjunction with a grind gauge.

To establish the distribution of the pigment particle sizes in the paint by a sedimentation analysis, their settlement speeds are determined by means of the Stokes' law[8]. The final falling speed is established when the viscous resistance to the dropping of a sphere in a fluid is equal to the force of gravity of the sphere minus the floating force of the fluid:

$$6\,\pi\,r\,\nu V = \frac{4}{3}\,(\pi r^3 d_e g) - \frac{4}{3}(\pi r^3 d_f g)$$

$$V = \frac{2\,(d_e - d_f)\,g\,r^2}{9\,\nu} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

in which:

- r is the radius of the sphere (cm)
- ν the dynamic viscosity of the fluid (poise)
- V the falling speed (cm/s)
- d_e the density of the sphere (g/cm^3)
- d_f the density of the fluid (g/cm^3)
- g the acceleration of gravity (cm/s^2)

For a given temperature equation (1) can be simplified to:

$$V = c\,D^2$$

where: $c = \dfrac{(d_e - d_f)\,g}{18\,\nu}$ and D = radius of the particle.

Thus, by knowing the settlement speed for a specified temperature, the diameter, D, of the particle can be calculated.

In a strictly theoretical sense, the Stokes' law is valid only if the following conditions are met:

(a) The particles must have reached their critical falling velocity, which according to Weyssenhoff [8], is reached almost instantly (0.003 s) by particles whose diameter D is 50 μm or less.

(b) The particles must be spherical, rigid and smooth.

(c) There must be no slip between the particles and the fluid, the latter having infinitely greater dimensions in relation to the particles.

(d) The applicability range varies between 0.5 and 50 μm; particles of less than 0.5 μm are affected by a Brownian motion which prevents them from falling in a straight line; particles of more than 50 μm generate turbulence, although in the range 50-62 μm the error is small.

Prior to the sedimentation analysis, it is necessary to extract the pigment by means of a liquid shown to be suitable in a previous test. In the IRAM Specification 1109, Method A-VI, different solvents and mixtures of solvents are mentioned.

The technique used consisted of weighing approximately 25 g of paint, with a precision of 10^{-4} g. The composition of the sample is shown in Table. 1

Table 1
Composition of the anticorrosive paint studied, per cent (w/w)

Pigment:	Red iron oxide	34.9
	Aluminium stearate	2.1
Binder:	Phenolic resin (Beckacite 5209)	7.4
	Tung oil	14.8
Solvents;	Toluene/Xylene (1/1)	40.8

PVC = 29.4%
Solids in volume = 40.0%
Specific gravity = 1.27 g/cm^3
Viscosity ($180s^{-1}$) = 3 poise

In order to eliminate the particles of a size larger than 50 μm, the red iron oxide used was first sieved using an IRAM 62 μm (No. 230) mesh. Thus the formation of turbulence was avoided, as well as the introduction of experimental errors during the test. The quantity retained was three per cent of the total material screened.

The sample was placed in a centrifuge tube with a torispherical* bottom, in order to facilitate the separation of the solids. The extraction liquid (mixture of toluene and xylene for the first extractions and petroleum ether at the end) was added and mixed carefully with a glass rod; the latter was washed and the tube was filled to its level, which was of approximately 60 ml. After centrifuging, the supernatent portion was removed and the extraction was repeated until the liquid used remained clean.

The pigment was dried in an oven and weighed on an analytical balance (approximately 10 g). A small quantity of distilled water was then added and it was then redispersed in a high speed equipment. In order to facilitate the deflocculation it is advisable to heat it and after that add hydrogen peroxide, for the total elimination of the organic matter.

An ammoniacal surface active agent was then incorporated to allow an adequate dispersion. The product was subsequently poured into a test tube of 1000 ml capacity and was filled to capacity with distilled water. It was shaken to achieve a uniform distribution of the material and a microscopic examination was made to check that deflocculation was complete.

Aliquots of the suspension were removed using a graduated pipette at times and at depths calculated on the basis of Stokes' law. To determine the variable diameter of the particle (D) it is necessary to know the temperature of the suspension, in order to be able to introduce the corresponding density values, $V = c.D^2$, into the formula.

The extracted fractions were poured into a crucible and dried in an oven at a temperature below the boiling point, and were then weighed on an analytical balance. The operation was continued until constant weight was reached.

The aliquot extracted in zero time, i.e. when the suspension is completely homogeneous, corresponds to a representative sample of all the material. On multiplying by the factor, total volume/aliquot volume, the weight so obtained must be equal to the weight of the pigment originally introduced.

In subsequent extractions, the reduction in weight between two consecutive samples indicates the fraction deposited corresponding to those diameters.

When this series of operations is completed, the percentages of each of the fractions deposited are calculated. The percentages were shown in graphs in the form of histograms where the ordinates represent the percentage of the particles (P) and the abscissas the diameter D.

The efficiency of the milling process is established by means of coefficient moments which are calculated in the following manner:

$$\textit{Coefficient moment} = \Sigma P D_m$$

in which D_m is the average diameter at the intervals taken into account. From this it may be deduced that high coefficient moments imply less efficient dispersive actions than those cases where the coefficient moments are smaller.

Variables studied and results obtained

Ref. 9

The manufacture of paints either for anticorrosive or antifouling purposes requires, on account of the foregoing reasons, a knowledge of the variables of the process that might influence their behaviour.

For example, in order to reproduce the excellent bioactivity characteristics of some of the antifouling paints prepared in laboratory ball mills and tested on experimental rafts, it is necessary to define the operational characteristics of the equipment to be used at pilot scale level.

For the design starting from small models ("scaling up"), two different alternatives can be used: "similarity" and "experimental".

For the design by similarity, different criteria can be used: geometric similarity, mechanical similarity (static, kinematic and dynamic), thermal similarity and chemical similarity.

Geometric similarity implies that all the equivalent

*See Perry, J. H., Chemical Engineers Handbook, 4th Ed., p24, *McGraw Hill*, Tokyo.

lengths have a constant relationship, i.e. that they are geometrically similar; when the similarity is distorted there may be different scale factors for each direction.

In the mechanical similarities (static, kinematic and dynamic) the applied forces, speed outlines and forces of the same type (viscous, inertia, gravity, pressure, etc) cause distortions which are related to corresponding points of the system.

There is thermal similarity if the difference in temperature between corresponding points maintains a constant relationship; heat energy is directly proportional to such increases.

There is chemical similarity when the concentration differences of each of the components maintain a definitive relationship throughout the process.

It is important to point out that each of the similarities mentioned implicity includes the previous ones. It is a case, consequently, of decreasing implications.

In some similarity designs, it is possible to find a solution that requires, for example, a change of fluid. If *Re* and *Fr* are, respectively, the non-dimensional numbers of Reynolds and Froude, for the small model:

$$Re_1 = \frac{\rho_1 D_1^2 N_1}{\nu_1}$$

$$Fr_1 = \frac{D_1 N_1^2}{g}$$

and for the prototype:

$$Re_2 = \frac{\rho_2 D_2^2 N_2}{\nu_2}$$

$$Fr_2 = \frac{D_2 N_2^2}{g}$$

where:

ρ = density of the fluid (g/cm³)
D = characteristic length (diameter of the jar) (cm)
N = number of revolutions per time unit (rps)
ν = absolute viscosity of the fluid (g/cms)

Equating the Reynolds and simplifying gives:

$$\frac{N_1}{N_2} = \frac{\rho_2}{\rho_1} \frac{\nu_1}{\nu_2} \left(\frac{D_2}{D_1}\right)^2$$

and equating the Froudes and simplifying gives:

$$\frac{N_1}{N_2} = \left(\frac{D_2}{D_1}\right)^{1/2}$$

The simultaneous solution of both equations is possible only if:

$$\frac{\rho_2}{\rho_1} \quad \frac{\nu_1}{\nu_2} \neq 1$$

i.e., different fluids are necessary.

It was because of this incompatibility of scale that the similar design was not adopted in this case and the experimental design was chosen, which is based on defining the variables that influence the process and determining the relationship between them by means of experiments, assigning constant values to those not subject of the study.

The variables to be studied, in the cases of dispersion and milling processes[9], are those relating to the balls (load volume, density, size, shape, interstitial spaces generated), the variables relating to load (volume and composition, including density, viscosity, pigment/binder relationship, etc.) and the variables relating to the mill (diameter and rotation speed).

Variables relating to the balls and the load

(a) Ball volume and paint load

In order to carry out an effective dispersion it is important to arrange the load and the characteristics of the balls so as to lead to a high number of impacts; this is achieved with a large load and a minimum diameter. Furthermore, the density of the balls must be high in relation to that of the load, to increase the force acting on the balls when they cascade.

However, an excessive ball load will result in a high consumption of energy, whilst an insufficient ball load will cause a delay in the dispersive action. Between these two extreme situations, there is a load which will produce an optimum operational process. This is the aspect which it is intended to determine in this part of the work. Furthermore, the balls of a minimum diameter produce a maximum number of impacts and a maximum dispersion area, but at the same time the smaller interstitial space between the balls limits the load of the mill, thus diminishing the yield of the process.

It is important to bear in mind that the selection of the density and of the diameter of the balls for efficient milling is closely connected with the properties of the paints and, fundamentally, with their density and viscosity. The force acting on each ball has the same direction and sense as the force of gravity and is the result of the difference between the weight of the ball and the buoyancy effect exerted by the mill load. The force acting on each ball is represented by the equation:

$$F = (\rho_b - \rho_c)\, g\, B_v$$

where:

ρ_c = density of the load (g/cm³)
ρ_b = density of the balls (g/cm³)
g = gravity acceleration (cm/s²)
B_v = ball volume (cm³)

The component of this force, parallel to the free surface of the moving load, is responsible for the sliding and the dispersive action. It can be deduced from this equation that balls of greater density tend to produce a higher dispersive action.

To determine the optimum volume of the balls, experiments were carried out with different load percentages (between 20 and 80 per cent of the total of the mill). For this purpose mills of 3.3 litres total capacity were used.

The composition of the paint used in the experiment is given in Table 1. Its volume is considered a variable because it is directly linked to the ball load. The time and rotation speed of the mill (24 hours and 70 rpm, respectively) were maintained constant throughout the

experiment. Sampling was effected every 6 hours over a total of two days of milling.

It is important to bear in mind that a smaller quantity of paint than that required to fill the void spaces results in the collision of the balls against each other. This causes an unnecessary wear of the balls and a reduction of the dispersive action. At the other extreme, a very large load causes the excess not to be dispersed until it is eventually incorporated into the active portion. The processing time is thus delayed.

For this reason the experiments were carried out with different paint loads between the necessary amount to cover the balls up to a maximum volume equivalent to 30 per cent of the total volume of the mill, increasing the load by five per cent in each successive experiment.

Bearing in mind that the temperature is a variable of fundamental importance, the experiments were carried out at 18-20°C.

It can be seen from the graphical representation of the coefficient moments in relation to the different dispersion time (Figure 1) that the optimum base load for each of the different ball loads is that which fills the interstitial spaces. Thus, for example, for an apparent ball load of 50 per cent of the total capacity of the container (which generates a 42 per cent of interstitial space) and for a milling time of up to 48 hours and paint loads of 34.6, 30.0, 25.5 and 21.0 per cent, it can be deduced that if a basic load volume is specified at 21.0 per cent (which corresponds to the level at which the balls are entirely covered) a more efficient milling degree would be obtained.

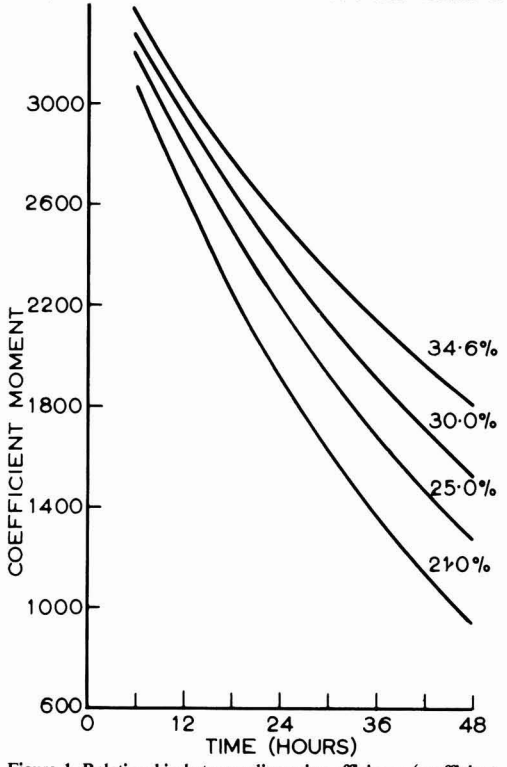


Figure 1. Relationship between dispersion efficiency (coefficient moments) and the different rotation rates of the mill for several paint volumes

Similarly, from the graph of the coefficient moments for different ball loads at constant dispersion times, it can be seen that the most satisfactory apparent ball load, in all cases, is that of 50 per cent of the volume of the mill (Figure 2).

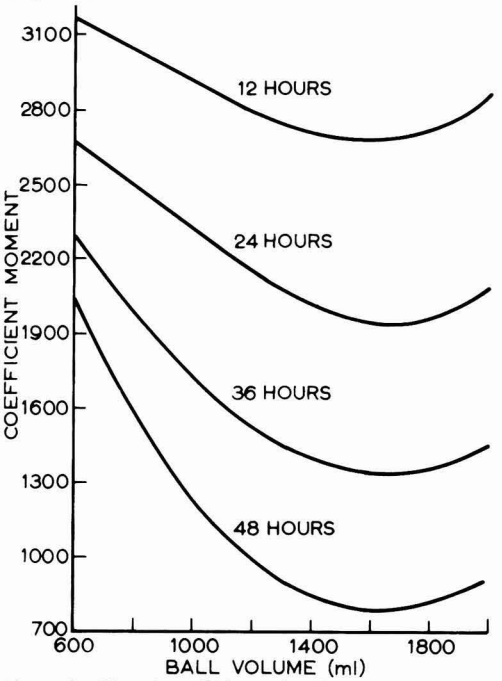


Figure 2. Dispersion efficiency (coefficient moments) for different ball charges with constant milling time

An analysis of the results shows that this optimum load meets some theoretical considerations: the greatest distance covered by the balls in the dispersive action is that in which the mill has a load equal to half its capacity.

It is important to remark that, in practice, it is advisable to load the mill with an excess of the product so that a layer remains at the bottom of the fall to avoid direct impact between the balls.

Finally, a relationship can be seen between the excess of paint added to a process considered to be efficient and the increase in milling time needed to achieve the same dispersive action. For example, if a coefficient moment of 1920 is chosen, it can be seen that for a paint load of 21.0 per cent of the total capacity of the mill, 24 hours of milling time is required, whereas for 34.6 per cent approximately 44 hours are necessary. In this case an increase of 13.6 per cent in the load requires approximately a doubling of the milling time.

In order to establish the influence of the variables that affect the dispersion and milling processes, as well as to give the most efficient working conditions, the experimental correlations from which it is possible to predict the interstitial spaces, expressed in percentages of the

apparent load volume, were obtained using uniform diameter balls or of two different sizes (weight ratio 1/1) in mills which can be classified as laboratory and industrial mills according to their production capacity.

(b) *Interstital spaces*

The different stages in the determination of the interstitial volumes were developed in a similar manner in each of the experiments, both for the various paints tested and the different ball loads. The diametrical height of each of the mills was divided into five equal parts, the first four levels and that at 50 per cent of the diameter were studied to determine the influence of this variable. The assessment was not made for the container when completely filled because this was of no practical value.

With regard to the ball load, balls of uniform size and mixtures of equal weight, corresponding to two different diameters, were chosen. Porcelain balls of six different diameters (14.0, 19.5, 22.5, 25.0, 38.0 and 50.0 mm) were used, the average density being of 2.38 g/cm^3. The mills were of different total volumes (3.3, 10.9, 28.5 and 141.5 litres). Their general features are shown in Table 2.

In each case, a corresponding ball load was placed in the mill. Each of the mills used was rotated for a number of revolutions to obtain a fully uniform distribution.

The number of balls used was that necessary to obtain each of the re-established levels and thus avoid the wetting of the excess of balls which would give rise to an error in the readings.

After weighing the container and balls, distilled water was added to reach the various heights of the internal diameter of the mill: 1/5, 2/5, 1/2, 3/5 and 4/5. This was achieved through holes in the covers which were expressly prepared for this purpose (Figure 3). It should be pointed out that the mills, placed in a horizontal position, were previously levelled for their proper assessment.

The interstitial mass of water was determined in each case by difference of weight between the last determination and the previous one. The weights of the partial volumes corresponding to each level, without the ball load, were determined in the same manner. In all cases, the final value obtained was the average of three determinations.

Finally, and considering the density of the water at the temperature of the experiment, each of these results was expressed by volume and finally as a percentage of the apparent ball volume.

In the case of spherical balls of uniform size the relationship between the interstitial space (I) expressed in percentage, and the diameter (D) of the balls, has been shown graphically for each of the mills used and for each level tested (Figure 4).

It can be seen that there is a direct proportionality between the parameters I and D as regards the different heights tested.

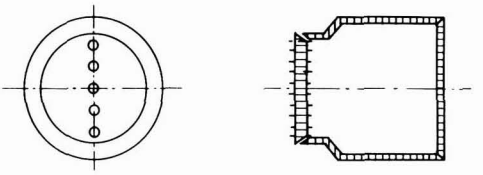


Figure 3. Transverse and longitudinal sections of the mill used in the experiments

Figure 5 shows the relationship between the interstitial space (I) and the real volume of the balls (B_r), only for apparent volumes corresponding to 50 per cent of the whole capacity of the container. Also in this case the direct proportionability between I and D can be seen.

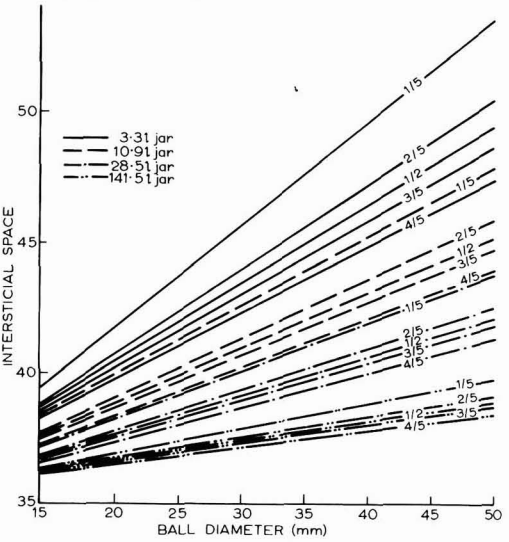


Figure 4. Interstitial spaces generated by uniform size spherical balls vs various diametrical charge levels

Analysing the results so obtained, it can be deduced that to achieve equal interstitial spaces in mills of different capacities, it is necessary to use balls of very varied sizes. Therefore, the edge effect is an important factor and has marked influence on the results. For example, by using balls of 38 mm in mills of 170 and 570 mm diameters, with an apparent volume of balls equivalent to 50 per cent of the capacity of the container. interstitial spaces will be generated of 45.9 and 38.0 per cent, respectively, thus affecting the dispersion efficiency.

Table 2
Characteristics of the mills employed in the experiments

Capacity of the mill (litres)	Height (mm)	Diameter (mm)	Relation D/h
3.3	165	170	1.03
10.9	230	235	1.02
28.5	330	330	1.00
141.5	555	570	1.03

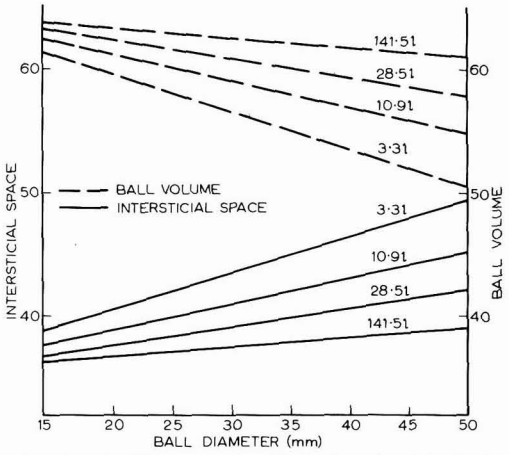


Figure 5. Interstitial space and real ball volume in relation to the diameter of the ball

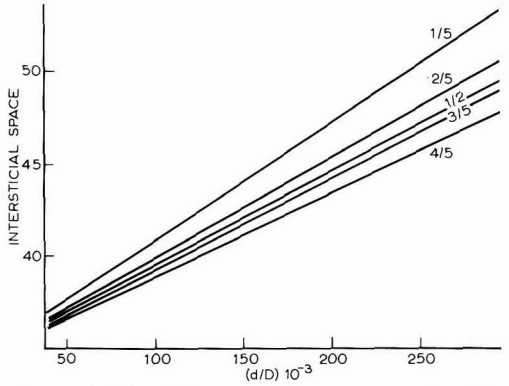


Figure 6. Relationship between the interstitial space (I) and the non-dimensional parameter (d/D) for different ball charge levels

Considering the diameter of the mill (D) as a characteristic of the system, it is possible to establish a relation between the diameter of the balls (d) and D, to obtain the non-dimensional parameter d/D. A linear relationship can also be observed between I and d/D (Figure 6), but the fact that the experimental results are now independent of the size of the mill is of fundamental importance, being applicable to mills of different sizes.

The same technique was used with mixtures of spherical balls of two different sizes (Table 3) in a 1/1 weight ratio, to determine the interstitial spaces in each of the above mentioned mills.

The experimental results obtained for I in each of the five levels into which the diameter of the container was divided, were represented with regard to the different sizes of the balls. Thus, selecting a ball to identify the curve, the corresponding I with regard to the diameters of the remaining balls that conform the mixtures of Table 3 are shown graphically for the different levels selected. Figures 7 and 8 show the results pertaining to the mills of 3.3 and 10.9 litres, respectively. Figure 9 shows the same

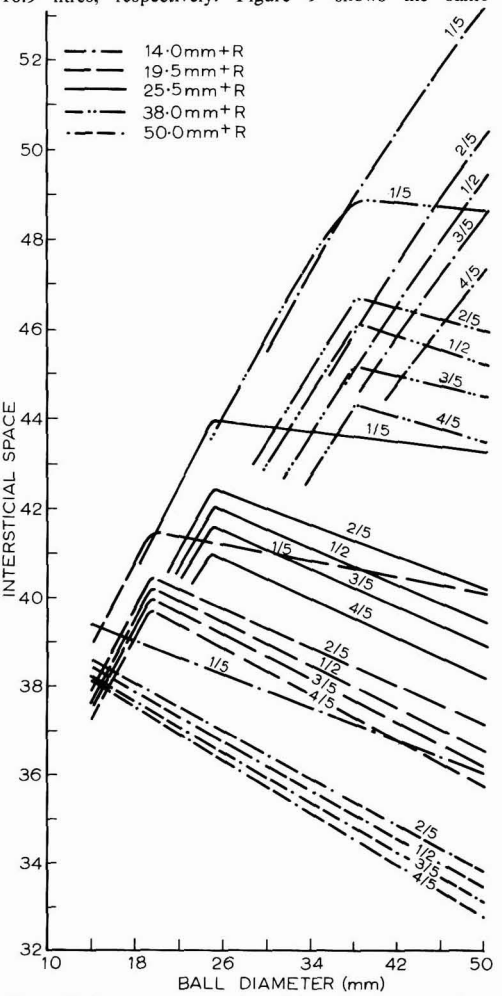


Figure 7. Determination of interstitial spaces generated by mixing spherical balls of two different diameters (1/1 weight ratio) for different charge levels (ball mills of 3.3 litre capacity)

Table 3
Mixtures of balls (Ratio 1/1 in weight)
of two different diameters (mm)
employed in the determination of the interstitial spaces

14.0 + 19.5	14.0 + 22.5	14.0 + 25.0	14.0 + 38.0	14.0 + 50.0
19.5 + 22.5	19.5 + 25.0	19.5 + 38.0	19.5 + 50.0	
22.5 + 25.0	22.5 + 38.0	22.5 + 50.0		
25.0 + 38.0	25.0 + 50.0			
38.0 + 50.0				

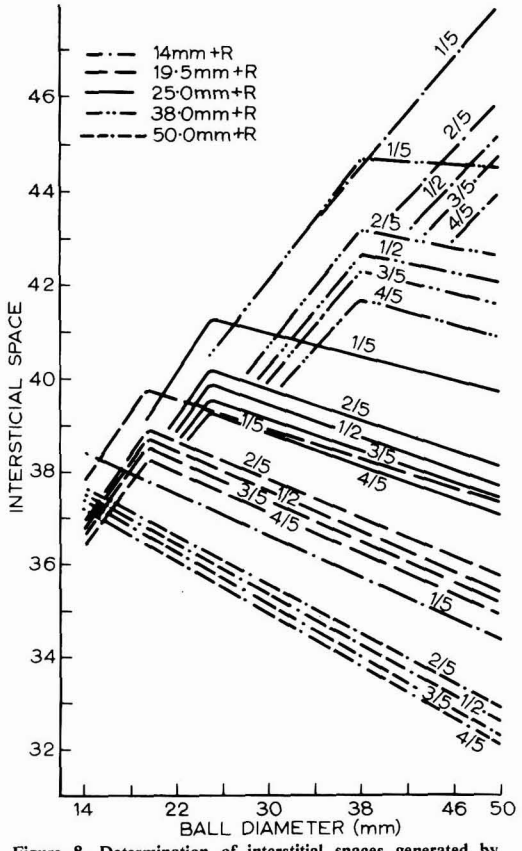


Figure 8. Determination of interstitial spaces generated by mixing spherical balls of two different diameters (1/1 weight ratio) for different charge levels (ball mills of 10.9 litre capacity)

parameters for the mills of 3.3, 10.9 and 28.5 litres, but only for the level $D/2$, that is an apparent volume of 50 per cent of the capacity of the mill.

It can be seen that the maximum of each curve corresponds to the single size ball, that is the mixture of the ball with itself, and that the curves for each mill have an appreciable similarity, although the increase in the diameter of the mill implies a reduction in the ordinates of the group of curves.

In order that the size of the mill be independent of the experimental results of I, the values d_1/D and d_2/D were calculated, in which d_1 is the diameter of the biggest ball and d_2 that of the smallest one. Subsequently, d_1/D and d_2/D were shown graphically in ordinates and abcissas for each of the different load levels used. Figure 10 corresponds to 20, 40 and 50 per cent of ball loads and Figure 11 to 60 and 80 per cent.

These diagrams make it feasible to predict the size of the balls with which the mill must work in order to obtain the desired interstitial space. For example, for a porcelain mill of 20 litre capacity, in which the diameter is approximately the same as the height (295 mm) and working with balls of 45 mm diameter, the curves of Figure 10 show that for the particular case in which it is

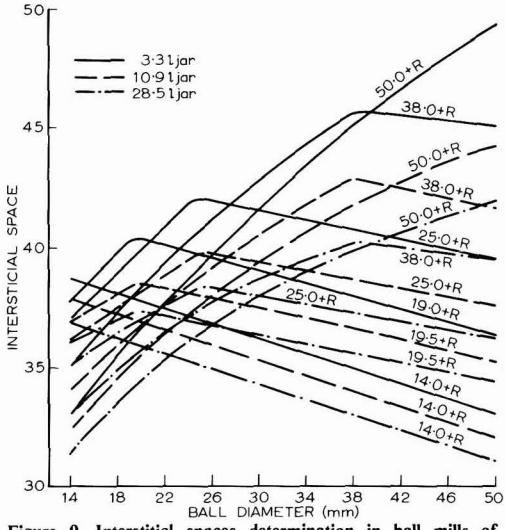


Figure 9. Interstitial spaces determination in ball mills of different capacity, using spherical ball mixtures of two different diameters (1/1 weight ratio)

desired to work with an apparent ball volume of 50 per cent of the total capacity of the mill and an interstitial space of 41 per cent, the above balls should be accompanied by balls of 39 mm or 69 mm. This alternative arises from the possibility of considering the 45 mm ball as either the bigger or smaller size, respectively.

On the other hand, it is also possible to determine any of the variables that are concerned from a knowledge of, or by defining the remainder. Thus, by establishing the diameter of the container ($D = 500$ mm) and the sizes of the balls to be used ($d_1 = 100$ mm; $d_2 = 60$ mm), the interstitial space generated can be established ($I = 39$ per cent) for a determined ball load (50 per cent).

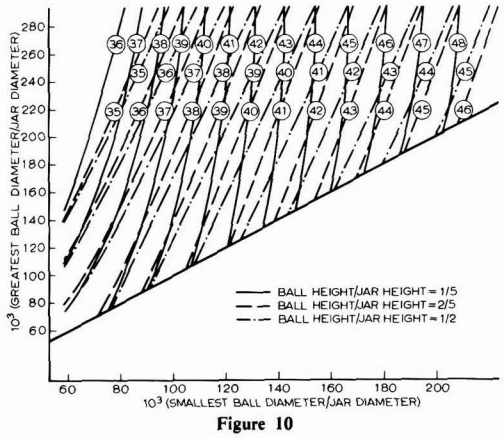


Figure 10

Variables relating to the mill

As mentioned previously, the diameter of the mill and its speed of rotation are of fundamental importance. Both aspects are closely linked and, therefore, determining their influence should be performed simultaneously.

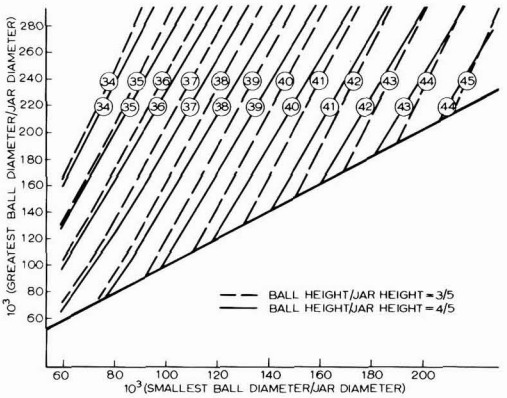


Figure 11

The course followed by the balls inside the mill depends on its rotational speed. A high rate of revolutions would retain the balls firmly against the inside wall of the mill, rotating jointly with it but without moving. In this case dispersion would not be very effective.

On the other hand, with reduced angular speeds, the balls would move on the inside wall of the mill and reach a certain height above the horizontal diametrical axis. They would then fall and move on the surface free of balls, that is contained approximately on an inclined plane.

A rate of revolution that generates this type of movement, because of the greater angle formed between the horizontal plane and the above mentioned inclined plane, is the optimum for an efficient process. Higher speeds would mean the balls being hurled inside the mill after reaching a maximum height and, therefore, they would not have the high number of impacts that is achieved with a surface movement.

The study of these variables was carried out using porcelain mills of 3.3, 10.9 and 28.5 litres. To be able to rotate the mills at different speeds, an electronic speed regulator (generating speeds ranging from 10 to 90 rpm) was adapted to the mill.

After selecting the optimum ball load (50 per cent of the apparent capacity of the mill) and spherical balls of uniform size (25 mm diameter) which generates similar interstitial spaces (42, 40 and 38 per cent of the apparent balls volume for mills of 3.3, 10.9 and 28.5 litres, respectively), different rotation speeds were applied. The final fineness of grinding was measured with the grind gauge and the corresponding sedimentation analyses were made after microscopic observation. The results are shown in Figures 12 and 13.

The paint load of the mill was the same in all the cases and its composition was that already mentioned in Table 1. The chosen volume was sufficient to cover the balls. Considering for all the mills an average interstitial space of 40 per cent in relation to the balls volume; each mill had, of its total capacity, 50 per of free space, 30 per cent of balls and 20 per cent of load (paint).

By graphically representing the coefficient moments with regard to the rotational speed of the container for the various milling times (Figure 14), the optimum rotational

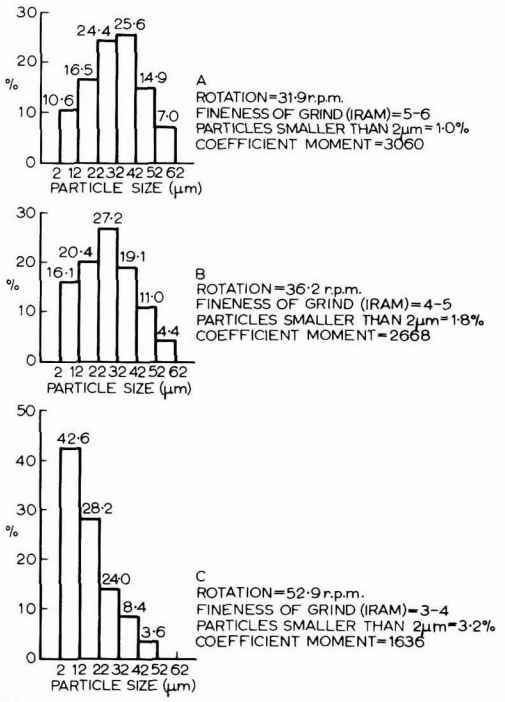


Figure 12. Paint pigment particle size distribution for different rotational speeds (31.9, 36.2 and 52.9 rpm)

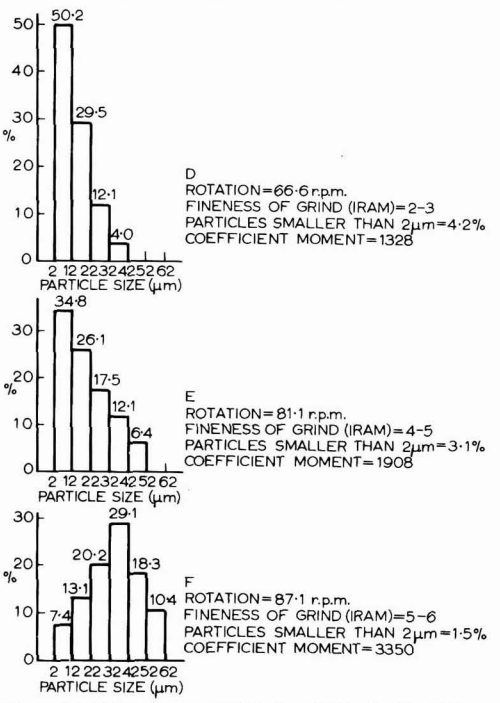


Figure 13. Paint pigment particle size distribution for different rotational speeds (66.6, 81.1 and 87.1 rpm)

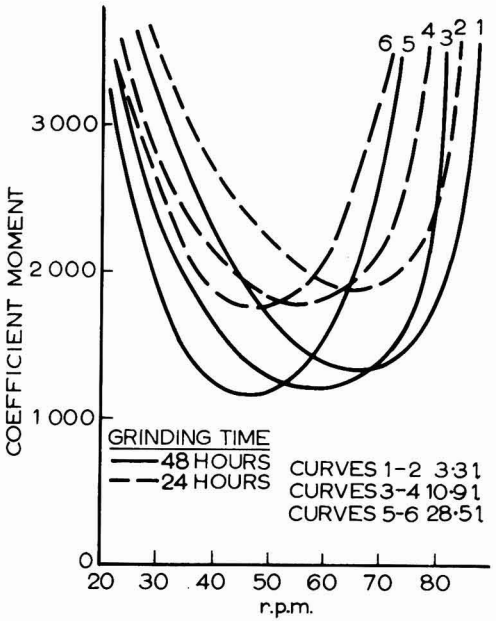


Figure 14. Dispersion efficiency (coefficient moments) for different rotational speeds and mill capacities

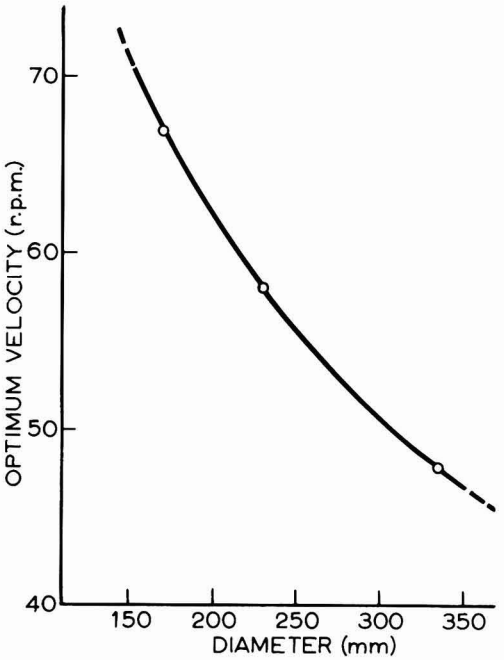


Figure 15. Relationship between ball mill diameter and optimum rotational speed for an efficient dispersion process

speed (minimum coefficient moment) can be determined for each of the mills studied.

Finally, these points, represented with regard to the diameters of the mills, allow the curve of Figure 15 to be obtained, where it is possible to establish the optimum rotational speeds for mills of different diameter at laboratory levels.

[*Received 30 October 1979*

References

1. Rascio, V., Giúdice, C. A., Benítez, J. C. and Presta, M., *JOCCA*, 1978, **61**, 383.
2. Rascio, V. Giúdice, C. A., Benítez, J. C. and Presta, M., *JOCCA*, 1979, **62**, 282.
3. Rascio, V. and Caprari, J. J., *J. Coat. Technol.*, 1978, **50** (637), 65.
4. Benítez, J. C. and Giúdice, C. A., *CIDEPINT-Anales*, 1978, 157.
5. Crowl, V. T., *JOCCA*, 1972, **55**, 388.
6. Crowl, V. T., *JOCCA*, 1963, **46**, 169.
7. Patterson, D. (Editor), "Pigments, an introduction to their physical chemistry", *Elsevier*, 1967, London.
8. Carver, R., "Procedures in sedimentary petrology", *Wiley & Sons*, 1971, New York.
9. Patton, T. C., "Paint and flow pigment dispersion", *Interscience*, 1968, New York.

Next month's issue

The Honorary Editor has accepted the following papers for publication. They are expected to appear in the May issue of the *Journal*:

Correlation of the adhesion of a polystyrene lacquer to inorganic substrates and their wetting characteristics *by S. G. Croll*

The chromatographic analysis of fatty polyamide resins after alkali fusion *by J. K. Haken and J. A. Obita*

A radio tracer study of the competitive adsorption on titanium dioxide of stearic acid paired with linoleic acid and with palmitic acid *by C. I. Smits, P. M. Heertjes and Z. Kolar*

A low shear viscometer: An instrument for measuring flow and sag resistance in coatings *by M. L. Colclough, N. D. P. Smith and T. A. Wright*

Further information on any items mentioned below may be obtained by circling the appropriate *Reader Enquiry Service* number on the form at the back of the *Journal*. Enquiries will be forwarded to the Section concerned or may be forwarded to the lecturer.

occa meetings

Auckland

Aqueous pigment dispersions

Mr T. Sewell of British Paints New Zealand Limited gave a lecture to 47 members of the Auckland Section at a meeting held on 7 February 1980 at the Auckland Leagues Club on the subject of aqueous pigment dispersions.

Mr Sewell first described the traditional way of manufacturing paint using dry pigments and commented on the cost in energy and time. After defining the various terms he proposed to use he described the basic formula of an aqueous dispersion.

The pigments are hydrophilic and have a natural tendency to flocculate and form aggregates due to inter-particle attractive forces. Dispersion reduces the aggregates and expels air from the particles, replacing it with the medium which includes surfactants. There are four types of surfactant, anionic, cationic, non-ionic and amphoteric, with the non-ionic being the most important in lowering the coefficient of friction and in producing antifoam, antigell and antisettling properties. The lowest effective concentration is used, so as not to affect film durability, hardness etc. For each dispersant there is an optimum concentration for a particular pigment system, which produces the maximum deflocculation. Optimum viscosity is achieved when the pigment surface is saturated with the dispersing agent. Auxiliaries such as glycols and preservatives are used.

The pH of the pigment slurry in water and surfactant is adjusted and the slurry is then dispersed at high speed with the maximum of shear. Glycols, etc. are added and final dispersion is carried out by triple roll mill or attritor, before checking for tinctorial strength, viscosity and dispersion.

Cost comparisons were made for printing ink and paint, showing that the use of pigment dispersions can be cheaper than dry pigments.

The lecturer closed by recommending a close look at manufacturing costs and the possible advantages of new methods and systems.

Reader Enquiry Service No. 21 A.M.

Hull

Adhesion – Facts and fiction

The third ordinary meeting of the Hull Section was held on 3 December, when Dr M. Wilkinson of Blundell-Permoglaze Ltd, gave a lecture entitled "Adhesion – Facts and fiction".

Dr Wilkinson introduced his talk with a series of slides which illustrated the adhesion requirements of a range of coatings on different substrates. He then outlined the forces that can be acting at the interface, when referring to adhesion on a molecular scale. These forces can vary from relatively strong covalent electronic interactions of some 100 Kcal/mole and can range over a distance of r^{-1} where r is the distance between molecules, as compared to much weaker dipole-induced dipole attractive forces which are found to be approximately 1 Kcal/mole and operate over a range of r^{-6}. These attractive forces were defined as adhesive forces.

Of the proposed theories of adhesion, he instanced the four principle ones. These were: Mechanical theory, Adsorption theory, Diffusion theory, and Electrical theory.

The Mechanical theory was illustrated as the theory where prominence was given to the surface roughness of the adhered, where the coating penetrated the capillaries or the valleys of the substrate, and thereby formed mechanical interlocked links when the coating hardened.

In the Adsorption theory two distinct types of adsorption were visualised, a physical type which involved electronic interactions between molecules which included forces between permanent dipoles (Keesom forces) and between dipoles and induced dipoles (Debye forces). The other type of adsorption process was considered to be a chemical one (chemisorption) involving surface chemical compound formation, where the material had groups which reacted with the substrate.

Diffusion adhesion was best illustrated by the example of thermoplastic welding, when inter-diffusion takes place during heating and sealing; it is also known as self-adhesion or auto-adhesion.

In the Electrical theory the formation of an electrical double layer at the coating/substrate interface is proposed to explain certain adhesion phenomena. Dr Wilkinson stated that combinations of the above theories may be required to explain particular facts, and many adhesion problems still remain as "grey areas".

The lecture was concluded with a comprehensive list of the methods used to measure adhesion with a comment on each one concerning its value as a reliable test method.

After a lively discussion period the vote of thanks was proposed by the Hull Section Vice-Chairman, Mr P. Munn, who congratulated the lecturer on his excellent presentation.

Reader Enquiry Service No. 22 F.D.R.

Midlands

The Paint Research Association and the surface coating industry

A technical meeting of the Midland Section was held on Thursday, 21 February 1980 at the County Cricket Ground, Edgbaston, Birmingham.

occa meetings

Mr D. Dasgupta of the Paint Research Association gave a talk entitled "The Paint Research Association and the surface coating industry". The speaker opened by stating that his talk would be divided into two parts, the research and the information activities. Regarding the research activities the speaker said that he had spent the past 15 years working on corrosion studies. The chemistry of steel corrosion was now fully understood but more work was still needed to find the ideal pretreatment and painting system. Grit blasting was the preferred way of removing rust and mill scale on steel, but this gave rise to problems on painting especially if a coarse grit was used. Aqueous primers can be applied directly onto wet grit blasted steel providing the ambient temperature is above 5°C and the humidity low. At present the cost of steel protection was equal to the cost of the steel and this was unacceptable.

Mr Dasgupta concluded his talk by outlining the information activities of the Paint Research Association. He said that it was not the function of the Association to create information but to collect it. The information is created by paint manufacturers and raw material suppliers. The Association collects this information, abstracts it, then distributes it to its members.

A lively discussion time followed and the meeting was brought to a close with a vote of thanks proposed by Mr H. J. Clarke.

Reader Enquiry Service No. 23 B.E.M.

West Riding

An integrated approach to dispersion applications

A meeting of the West Riding Section was held at the Mansion Hotel, Leeds, on 5 February. Some thirty-six members and guests enjoyed a talk on the above topic, given by Messrs R. W. English and J. Perkins of Mastermix Engineering Co. Ltd.

Mr Perkins opened the discussion by introducing ideas on future developments in dispersing machines. The following parameters were thought to be essential, for any new machine: enclosed construction, self-cleaning, it should not be labour intensive, low energy input with good dispersion and simple machine layout.

Mr Perkins went on to discuss high speed mixers. Their major features and their chief problems were highlighted and it was suggested that greater problems existed with larger batches of paint. The speaker then described experiments that have been carried out to optimise the efficiency of high speed mixers. Several new techniques were introduced for controlling the position of the disperser discs and blade height. These were based on sonar and sound systems.

Mr Perkins showed various colour slides illustrating a new machine for large scale emulsion paint production, consisting of an enclosed vessel with a side-angled modified high speed mixer.

The second speaker, Mr English, introduced the use of electronics, particularly computers and microprocessors, in production and process control for a completely automatic paint manufacturing unit. Mr English mentioned that microprocessors are used in weighing, measuring, monitoring and controlling processes and endeavoured to use a small computer to illustrate the use of such a machine in production control. Due to an electronic failure, however, the computer failed to function.

After a very enthusiastic question period, a vote of thanks was given by Mr Hugh Young.

Reader Enquiry Service No. 24 D.V.M.

London

Pigments Symposium

A one-day symposium was held in conjunction with the Thames Polytechnic at Woolwich on 28 November 1979. Seventy-five members and guests heard five papers on the subject of "Pigments". The first paper entitled "Health and safety aspects of pigments" was presented by Mr B. F. Gilliam of Cowan Colours. Mr Gilliam reviewed the health and safety aspects from three viewpoints, that of the pigment manufacturer, the pigment user (i.e. paint or ink manufacturer) and the user of the pigmented product. Generally, the extent of the hazard decreased along the user chain. One consequence of the introduction of the Health and Safety at Work, etc. Act (HSWA), was the preparation of health and safety data sheets indicating the risks involved in the use of various pigments. The British Colour Makers' Association codings were used to indicate the degree of hazard. The storage, fire, dust and health hazards of each pigment were assigned to a particular class (A to D, with A being the least and D the most hazardous). In addition hazard labels were prepared for each container stating basic precautionary hygiene warnings.

The greatest hazard generally from pigments is from their dust and good working practices and industrial hygiene are essential where pigments are being handled. The necessary personal protective equipment was discussed in detail as were ventilation requirements.

Mr Gilliam went on to discuss Threshold Limit Values (TLVs) and the recommendation made by the Health and Safety Executive (HSE) that a value of three times the time weighted average should not be exceeded, except for short periods. To determine airborne pigment dust concentrations, samples need to be taken as close to the breathing zone of the operators as possible and then analysed quantitatively. Both dry and wet working areas may show high dust concentrations, the latter due to build up of pigments on overalls and protective clothing. Regular checks on the efficiency of the extraction system and medical checks on operators are also necessary procedures. In the absence of specific TLVs it is generally considered good practice to aim for dust concentrations below 10 mg/cm^3. This figure is the TLV set in the UK for non-siliceous mineral dusts.

Mr Gilliam then went on to describe in detail the health hazards associated with a range of pigments generally

considered to be hazardous. The pigments considered were barium, benzidine, cadmium, carbon black, chromate, ferrocyanide, lead, manganese, molybdenum, tungsten and titanium dioxide containing products.

The second paper was presented by Mr G. A. Dunn of Courtaulds Ltd, Synthetic Fibres Laboratory, who discussed the theoretical aspects of pigment dispersion. The ability efficiently to disperse pigment particles and then to obtain a stable non-flocculated product is dependent on the repulsive forces due to solvation, adsorbed layers and possibly coulombic forces exceeding the attractive, Van der Waals forces by a factor several orders of magnitude higher than the thermal energy of the particles. Mr Dunn went on to describe how the net potential energy of a dispersion could be plotted and the stability of the system shown to be a factor of particle separation distance.

Either ionic or non-ionic species can be adsorbed on to a pigment particle. In the former case, as charged particles, they would repel each other, and this occurs in polar (water borne) systems. In the latter instance, a protective layer is formed which leads to repulsion between particles. A number of factors influence the stability of such systems, including the affinity of the anchoring group of the adsorbed molecule for the particle and their frequency on the adsorbed material.

In considering dispersion of pigments in media it is essential that a medium which is adsorbed by the pigment surface is used. Failure to do so results in an equilibrium between flocculated and stabilised particles. The rate of adsorption is a function of molecular size, smaller particles being adsorbed first. In addition, the optimum molecular size of the medium varies with particle size and as there is a spread of particle sizes, a medium with a corresponding spread of molecular weights needs to be used. Suitable resins can be tailor made for a particular application or it is possible to develop surfactants which can be film formers in their own right.

The trend in pigments is in the production of grades with surface treatments to aid dispersion and stability. Pigment slurries, vesiculated beads and encapsulated pigments are available, but at the present time all have deficiencies which make them unattractive for surface coatings applications.

In the third lecture, on "Pigmentation of printing inks", Mr R. Hagger of Usher-Walker firstly described the various printing processes and then went on to list the general requirements of a pigment to make it suitable for use in a printing ink. In more detail the specific properties for letterpress, lithographic, gravure and flexographic printing processes were considered, and manufacturing techniques, grind charge size, pigment choice and performance properties were also discussed. The need for high tinctorial strength at low film thicknesses requires high pigment loadings; triple roll or bead mills are used to disperse pigments.

The elimination of chrome pigments from printing inks leads to problems as the alternatives are often more expensive and exhibit poorer opacity at low viscosities. There is a trend towards the use of aqueous borne inks because of the lower fire risk and cleaner working environments.

Mr F. J. Morpeth of Foscolor Ltd presented the fourth paper entitled "The incorporation of colourants into thermoplastics". He first reviewed the various techniques available for the colouration of plastics – precompouding, dry colouring, liquid colouring and masterbatching. Compounding is well established, whilst dry colouring is a dusty operation and thus is not favoured. Liquid colouring has been only slowly adopted in the UK and has had most impact in the small injection moulding markets. Masterbatching, either dilute or concentrated, of pigments in the same polymer as that to be processed is the most attractive system and is increasingly being used.

occa meetings

The choice of colourant for a particular system depends very much on the technical specification for the product, the polymer system, the compounding machine type and even whether additives are to be used or not.

Mr Morpeth then went on to discuss the effects of recent legislation on the plastics industry and, in particular, the Swedish Government's ban on cadmium pigments (effective July 1980) and the Materials and Articles in Contact with Food Regulations (1978). The former legislation is designed solely to prevent any increase in the total amount of cadmium in the environment when the product is disposed by burning or burial in the soil. The result is that plastics manufacturers have had to develop a special non-cadmium range if they wish to do business in Sweden. The other regulations are an enabling act, applying to the final form of the food package. However, no test methods or toxicity limits have been established and there is no guidance on safe components or compositions. A positive response from pigments suppliers has been recommended to give guidance on the acceptability of the pigment to existing legislations e.g. Toys Regulations.

As far as replacement of cadmium pigments is concerned, whilst a number of organic pigments have been developed as alternatives they have only achieved partial success, being suitable for specific applications only. Mr Morpeth stressed the need for continued use of cadmium pigments in food contact applications if cost effective performance was to be maintained.

The final lecture was presented by Mr B. Witham of Ciba-Geigy on behalf of the British Colour Makers' Association and was entitled the "Colourmaker's view". In reviewing the problems besetting the pigment industry, Mr Witham discussed the expense involved in meeting Health and Safety Regulations, the cost of plant and its maintenance, the rapid increases in raw material costs and the cost of carrying out research and development. It was not possible to recoup all of these additional costs, and margins inevitably were being squeezed.

In the future fewer new types of material would be available and development efforts would be concentrated on improving dispersion, strength and handling of existing pigments. *Reader Enquiry Service No. 25*

International standard methods of test for paints

The third evening technical meeting of the 1979/80 session was held on Thursday 17 January 1980 at the "Princess

occa meetings

Alice", Forest Gate. Mr A. Hipwood, Materials Quality Assurance Directorate, MOD, Woolwich presented a lecture entitled "International standard methods of test for paints" to an audience of over forty members and guests, including a party of Higher Certificate TEC students from the Polytechnic of the South Bank.

Mr Hipwood divided his presentation into three parts: the aims and workings of the International Standards Organisation (ISO); its achievements, specifically related to paint testing; finally some views on the impact of ISO standards on consumers and paint suppliers.

Formed in 1947, ISO covers all aspects of technology with the exception of electrotechnology which is served by an equivalent International Standards Organisation. It is financed by voluntary contributions from member countries of which there are currently 65. In addition, 17 correspondent members currently support the activities and these will progress to full membership status after a fixed time. The workings of ISO are organised through committees. There are presently 150 technical committees (TCs) who are supported by 493 sub-committees (SCs). These in turn are advised by 852 working groups (WGs) comprised of technical experts. The relevant TC for the paint industry is TC/35 and sub-committee TC/35/SC9 deals with test methods for paint. This SC is served by 19 WGs. In line with ISO policy, the chairman and secretary of each TC and SC are appointed from the same country, TC/35 from the Netherlands and TC/35/SC9 from the UK. ISO standards are not binding on any country although in the UK the BSI works to harmonise British Standard Specifications with the appropriate ISO standard.

Mr Hipwood then described the way in which an ISO standard is developed. A working group is given the task of submitting a draft proposal to the technical committee based on collaborative investigation by the WG technical experts. Following acceptance by the technical committee the proposal becomes a draft ISO Standard and only becomes a full ISO Standard when voted upon and approved by the ISO Council. There is a requirement that every ISO Standard is reviewed every five years.

In the UK the BSI committee PVC/10 supports the workings of ISO sub-committee TC/35/SC9 and the former initiates technical work through the appropriate BSI sub-committees, e.g. PVC/10/6 – environmental testing. Within the paint and coating fields ISO Standards are based strongly on the BS 3900 series standards.

Mr Hipwood went on to discuss the present position of ISO Standards, describing the status of the Standard and its relevance to existing BS 3900 series standards. An ISO Standard can exist as a full standard (ISO), a draft international standard (DIS), a draft proposal (DP) or a technical report (TR) – the last classification indicates that fewer than 75 per cent of the member countries have accepted the ISO. Mr Hipwood predicted that the section of ISO Standards relating to optical tests on paint films, where there are currently few BS Standards, will have the greatest impact on the paint industry.

In the final section of his lecture Mr Hipwood discussed the implications of International Standards and their value. The existence of international standards make it easier for coatings companies to supply paint multinationally and for products to be used internationally; the requirements currently made by certain Government departments on paint supplies to quote the performance parameter of their products will increase in the future and performance meeting ISO Standards will be sought.

Following an interesting and stimulating question time a vote of thanks to the lecturer was proposed by Mr B. Gilliam and warmly echoed by the audience. Following a recent custom at the Princess Alice, the lecture was followed by a free buffet supper which the majority of the audience attended.

Reader Enquiry Service No. 26

A.J.N.

news

Further information on any items mentioned below may be obtained by circling the appropriate *Reader Enquiry Service* number on the form at the back of the *Journal*. Enquiries will be forwarded to the organisation concerned.

Powder coatings growth

A new study just completed by Frost & Sullivan Inc., New York, has forecast an average annual growth rate for the powder coating industry in excess of nine per cent during the period 1980-85. This compares with an anticipated rate of 1.8 per cent for all industrial finishes over the same period. It is also forecast that powder coatings will steadily increase their share of the industrial finishes market from 4.5 per cent in 1979 to 8.3 per cent by 1984/85.

Reader Enquiry Service No. 31

Main dealer

Boro Labs have announced their appointment as main dealer/stockist for Grant Instruments' well-known range of products.

Boro Labs and Grants have been associated for many years on an agency basis and this appointment reflects the past success of the relationship.

Reader Enquiry Service No. 32

Emulsion business take-over

With effect from mid-February, the Harlow Chemical Company Limited, Essex, have taken over the emulsion business belonging the Perstop Ferguson Limited. This includes all emulsion products manufactured under the Nestor trade mark.

Reader Enquiry Service No. 33

Powder coating for chipboard

Verycote Limited of Harpenden has announced the successful conclusion of two years development of a new process for powder coating chipboard.

Previous attempts have been made to apply powder coating systems to wood-based materials, but the high curing temperatures required have resulted in damage both to the surface of the substrate and to the bonding resins used in them. There have also been problems in applying the powder coatings by the normal electrostatic method.

The new process involves the pre-coating of the chipboard with a base coat which protects the substrate from heat required for curing and provides a surface which makes efficient electrostatic spraying possible. The finished coating

possesses flexibility and has excellent adhesion. It is durable, waterproof and relatively heat resistant.
Reader Enquiry Service No. 34

AMK choose OBS

AMK International manufacturers of mixing, extrusion/kneading and compounding machinery, have appointed OBS Machines Limited as sole agents for their product range in the UK.

The range of machinery available includes the VIS range of slanting mixer/kneaders, the AMK extrusion/kneader VIU and a range of tilt kneaders. There is also a full range of mixing machines with working capacities from 20 to 4000 litres and AMK also build machines to particular specifications.
Reader Enquiry Service No. 35

Outdoor weathering services

South Florida Test Service Inc., of Miami, a subsidiary of Atlas Electric Devices Company, Chicago, has announced the opening of a third test site at Phoenix, Arizona. The additional site will permit natural test exposures under sub-tropical conditions in Miami, light industrial conditions in Chicago and desert exposures in Phoenix. Accelerated weathering, fading and fluorescent sun lamp tests using Atlas Weather-Ometers, Fade-Ometers and UVCON continue to be available through expanded laboratory facilities at the Miami site.
Reader Enquiry Service No. 36

Plant modernisation

Petrocarbon Developments Limited has been appointed main contractor for a major modernisation project at the Speke factory of Goodlass Wall & Company Limited, the manufacturers of Valspar Paints.

The project, valued at £7.5 million, is to improve production facilities for resins, oil and emulsion paints, warehousing for raw materials and finished products.
Reader Enquiry Service No. 37

new products

New pigment

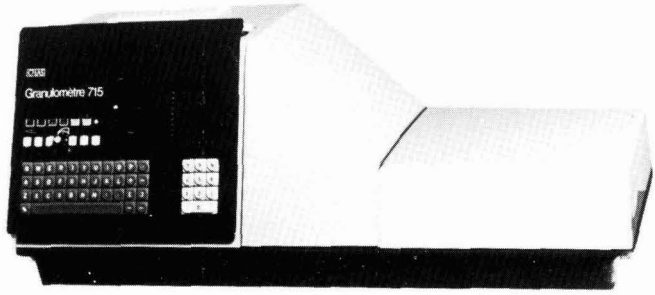
CIL-Gould of Manchester has added a mid-shade of phthalocyanine green pigment to its range. Marketed as Cilcalite Phthalocyanine Green 95, this pigment possesses all the good resistance properties normally associated with phthalocyanine pigments, together with excellent heat fastness and light fastness characteristics.
Reader Enquiry Service No. 38

Temperature chart recorder

Channel Electronics Limited has introduced model M2115 temperature chart recorder which uses a high input impedance amplifier and is designed for use in a wide selection of plug-in range cards to provide strip chart recordings over an extensive range of temperatures.

A development of the basic M288 chopper bar recorder, the instrument offers such features as robust and reliable construction, a wide variety of chart speeds, two point time sharing, etc.
Reader Enquiry Service No. 39

news



The new Cilas 715 laser based analyser

Laser-based particle size analyser

The new Cilas type 715 Granulometer, available from Specfield Limited, provides a 16-point 1-192 micron printout of the particle size distribution of a powder within ten seconds of its dispersion in the sample holder of the instrument and displays a continuously updated curve of the distribution on an LED matrix display.

Approximately 1 gram of the powder examined is dispersed in 500 ml of liquid which is continuously circulated through a glass cell transilluminated by a laser beam. Each particle entering the beam creates a diffraction ring, the size of which is proportional to its mean diameter.

The measurement process consists of measuring the relative intensity of the rings of diffraction created by each particle in suspension and comparing the values obtained via an Intel 8080A microprocessor.

A built-in ultrasonic generator coupled with continuous agitation of the dispersed sample ensure its homogeneity and allows a typical repeatability of ± 1 per cent. The printed analysis is the mean result of 16 consecutive measurements and is presented as a cumulative weight percentage undersize in microns.
Reader Enquiry Service No. 40

Electrostatic hand guns

A new range of five electrostatic hand guns for the application of traditional and water soluble materials to wood and metal with minimal overspray waste has been launched by Binks Bullows Limited. Four of the new guns are air assisted, the fifth is an air assisted airless gun.

They will apply materials from a very wide resistivity range and with viscosities ranging from 25 to 80 seconds, and can be fitted with round or fan spray nozzles to suit the nature of the workpiece. The size of the pattern can be varied very easily by a control on the gun. The spray nozzles are interchangeable between guns.
Reader Enquiry Service No. 41

An electrostatic hand gun from Binks-Bullows Ltd

Enceprint colours

BASF has introduced a new range of highly concentrated pigment preparations based on alcohol-soluble nitrocellulose with a phthalate ester plasticiser. The new range has been developed for the printing ink sector and similar fields of application.

The difference between Enceprint colours and the well-known Ence Print types is not merely the higher pigment concentration, but also the type and con-

news

centration of plasticiser. Instead of dibutyl phthalate the less volatile dioctyl phthalate has been used in reduced concentration which gives the advantage of a wider field of application.
Reader Enquiry Service No. 42

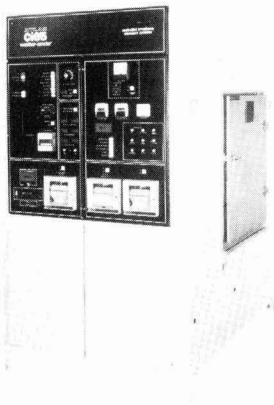
Organic pigment granules

BASF has introduced Lithol Rubine D 4565 Granules, suitable for the production of offset, flexographic and gravure inks. Its advantages over the corresponding powder grades are that it eliminates dust during processing, is readily dispersible and yields prints with a high gloss.
Reader Enquiry Service No. 43

New Weather-Ometer

The Atlas Series C Weather-Ometer represents the latest development in accelerated weathering and lightfastness equipment. The Series C consists of three basic and two combination models all employing solid state digital controls and features not available in other similar instruments. A choice of three light sources is available, 6500 watt xenon arc lamp, sunshine carbon arc lamp, and twin enclosed carbon arc lamp.

Extensive options are available for all models such as up to three two function strip chart recorders, introduction of atmospheric contaminants, refrigeration coils and controls and extra air and water heaters. Complete details are available from the sole UK representatives, Westlairds Limited.
Reader Enquiry Service No. 44



The Atlas Series C Weather-Ometer

Powder spray gun

Mindon Engineering (Nottingham) Limited, has introduced the Mindon tribo-charged airstatic powder spray gun which incorporates three new features to ensure high-quality spraying, faster paint colour change and the virtual elimination of maintenance costs.

The Mindon tribo-charged airstatic powder spray gun

The Mindon gun now incorporates a 6-stage powder paint pump which gives smooth and consistent delivery of powder at the precise rate over the complete range of requirements.

Faster paint colour change is made possible by a new quick-release fluidised bed holding the powder paint. The fluidised bed may be detached, cleaned, purged and re-assembled for the next colour in a few minutes.
Reader Enquiry Service No. 45

HP21 silica

The Applied Silicas Division of Joseph Crosfield and Sons Limited has available Crosfield HP21 Silica which is the smallest particle sized product available from their range of silicas.

Its average particle size, of approximately 1 micron, makes it useful as an anti-blocking agent for thin plastic film, for the matting of solution vinyl and thermosetting acrylic coil coatings, to prevent the hard settlement of heavy pigments in primers and paints. It is also useful to eliminate residual tack in polymer and resin coatings and as a viscosity control additive to increase the structure of liquid systems.
Reader Enquiry Service No. 46

888E polyester resin

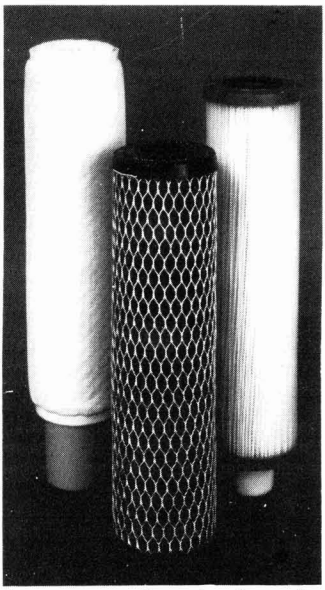
British Industrial Plastics Limited has introduced polyester resin 888E as the latest addition to its range of general purpose polyester resins, offering a new combination of benefits in a pre-accelerated, thixotropic, low viscosity "Beetle" resin.
Reader Enquiry Service No. 47

Hot melt adhesive

Baxenden Chemicals are marketing a unique non-blocking hot melt adhesive specially developed as a laminating medium. The product called Bibbicote can be used to bond or laminate most materials, including natural and synthetic fibres, paper and aluminium foil. It has FDA approval and may be used for food and drink packaging. Bibicote is non-toxic, clean and non-messy to apply.
Reader Enquiry Service No. 48

HPLC guard columns

Bioscan, the UK distributors of Supelco Chromatography products, has introduced a new range of guard columns for HPLC columns. The highest HPLC column efficiency available (60,000 to 80,000 plates per metre) is provided by columns packed with particles 5 microns in diameter, but these columns are susceptible to several types of damage through routine use. Guard columns (or pre-columns) may be used for protection by trapping fine particles and absorbing the destructive, non-eluting components present in many samples.
Reader Enquiry Service No. 49



A new range of guard columns for HPLC columns

In-line filter housing

A new longer body housing for Stockdale Engineering's well established in-line 150 STC Cartridge Filter has been introduced, together with a new range of specialised cartridges. Moulded from corrosion resistant polypropylene with glass fibre, the new body is designed to accommodate either a Carbon Filled or Micro Porous Cartridge, as an alternative to the standard element cartridge.
Reader Enquiry Service No. 50

literature

Infrared Data Station brochure

Perkin-Elmer's Data Station is presented in a new twelve page brochure containing many illustrative applications. The brochure provides a concise introduction to the most modern techniques of computerised dispersive infrared spectroscopy. Instrument software and hardware capabilities are discussed and one entire section is devoted to the Perkin-Elmer Infrared Search Applications Programme, designed to assist the spectroscopist in the actual interpretation of an infrared spectrum.
Reader Enquiry Service No. 51

British standards

The British Standards Institution has available the following publications:

BS 5598: Part 8: 1980 Methods of sampling and test for halogenated hydrocarbons. Part 8. Determination of non-volatile residue in fluorinated hydrocarbons.

BS 4325: Part 6: 1980 (ISO 5506-1978) Methods for the analysis of oilseed residues – Part 6 Determination of urease activity in soya bean products.
Reader Enquiry Service No. 52

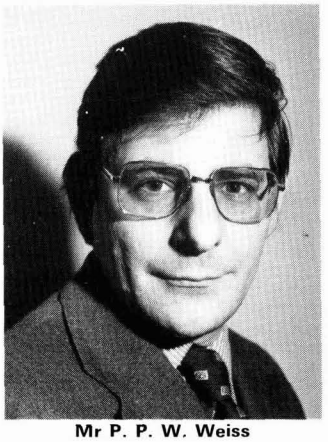
Separation procedures

Charles Griffin and Company Limited has recently published a book by R. S. Young entitled "Separation Procedures in Inorganic Analysis. A practical handbook". The book is designed as a practical reference on separations for the analyst or student. It should also be useful to many in the inorganic chemical industries, in hydrometallurgy, and in pollution control, where separations are common operations.
Reader Enquiry Service No. 53

Sticky problems

Baird & Tatlock (London) Limited has available a publication entitled "Solutions to Sticky Problems" which discusses the Brookfield Viscometer with regard to obtaining the best results and maximum use from it.
Reader Enquiry Service No. 54

appointments



Mr P. P. W. Weiss

Mr P. P. W. Weiss has been appointed director-in-charge of Croda Paints, Birmingham (previously Thornley and Knight) and operations director of Croda's Paints Division.

Peter Weiss joined Croda in 1974 and was appointed executive-in-charge of Croda Paints, Birmingham in 1977 and operations manager in 1979.

Dr Brian Pagdin

Dr Pagdin was previously Manager of the Dispersions & Pigments Division and will be succeeded in that position by **Friedrich-Karl von Lyncker** on secondment from BASF AG.

Following the retirement of E. J. Hill after almost fourteen years with the company, **Dr Brian Pagdin** has been appointed Director, Business Area Colours, Auxiliaries & Dispersions covering the Dispersions & Pigments and Textile Divisions of BASF UK Limited.

news

Further information on any items below may be obtained by circling the appropriate *Reader Enquiry Service* number on the form at the back of the *Journal*.

Obituary

George Wiseman

Mr George (Nick) Wiseman who died suddenly on 29 September 1979, came to the PRA in 1933, aged 18, as laboratory assistant to the newly arrived Dr S. H. Bell and Dr C. W. Price, and was soon to meet his wife-to-be, Miss Dora Cole, who with her sister Joan also served at the PRA.

In 1935 he joined the laboratory staff of Walter Carson and Sons. After successive promotions during Company changes and developments, he became technical director of Bestobell Paints and Chemicals.

His wealth of technical knowledge and experience, and his pleasant friendly manner, earned great respect from his colleagues. Nick maintained contact with friends old and new throughout the industry and for more than thirty years was a member of OCCA. His hobbies included gardening, wood-turning and carving, and, in recent years, painting in oils, and he assisted friends in various charitable activities. He will be affectionately remembered.

S.H.B.

Northern Section Golf Tournament

Tony McWilliam Memorial Trophy

The Tony McWilliam Memorial Trophy will be the main prize in a golf tournament organised for the Manchester, West Riding, Hull and Newcastle Sections, to be held at the Pannal Golf Club, Harrogate on 27 June 1980.

Tony McWilliam was the Chairman of the Manchester Section at the time of his sudden death on 13 November 1978. Prior to that, he had been Honorary Publications Officer and Honorary Secretary of the West Riding Section.

It is proposed that the Trophy will be in the form of an inscribed shield with six plaques to be awarded to the best six scores. The venue for the competition will alternate annually between courses in the West Riding area.

Full details of the competition will be sent to the members of the relevant Sections during April.

occa news

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OCCA-32 Exhibition

13-15 May 1980

Cunard International Hotel
Hammersmith, London W6

EXHIBITION PREVIEW

The Exhibition Committee is pleased to welcome to the OCCA 32 Exhibition 124 organisations representing the UK and 13 overseas countries:

Austria, Belgium, Denmark, East Germany, Holland, Hungary, Italy, Japan, Poland, Sweden, Switzerland, USA and West Germany.

It is particularly pleasing to note the return of many regular exhibitors from previous years as well as several new multi-national organisations exhibiting for the first time or returning to the Exhibition after an absence of several years.

The OCCA Exhibition, which is known as an international focal point for the surface coatings industries, is the most important annual event of its kind and offers an unparalleled opportunity for personnel in the manufacturing industries to meet and discuss their requirements with their counterparts in the supplying industries.

Many young technologists and scientists who visited earlier Exhibitions have now risen to high positions within their organisations, and the advantage to exhibitors of keeping in constant contact with them need hardly be stressed.

Theme for the Exhibition

Motif: The motif, designed by Robert Hamblin, uses the compass to symbolize the unique attraction of the OCCA exhibitions which annually draw exhibitors and visitors from numerous countries.

The aim of the Exhibition is the presentation of technical and commercial information relating to raw materials, plant and equipment used in the paint, polymer, printing ink, colour, adhesive and allied industries, both in manufacture, processing and application.

Dates and times

The thirty-second annual OCCA Exhibition, a three day event, will be open as follows:

Tuesday 13 May 1980 . . . 09.30 to 17.30
Wednesday 14 May 1980 09.30 to 17.30
Thursday 15 May 1980 . . 09.30 to 17.30

The Cunard International Hotel

The new venue for the 1980 Exhibition will be the Cunard International Hotel, Hammersmith, London W6, and the main part of the Exhibition will be in two sections: on the ground floor, forming the entrance to the Exhibition, traditional style stands will be accommodated in the New Exhibition Hall where exhibitors of heavy machinery will be located; on the first floor of the hotel, in the Queen Mary Suite, the stands will be of a simplified nature with the objective of allowing exhibitors to use modular display systems. These stands will have no platform, being erected directly on to the carpeted Suite floor, and so it will not be possible for heavy equipment to be displayed in this section.

Access between these two areas will be through the intermediate Mezzanine floor, where there are a number of rooms in the Armada Suite for companies to display free standing exhibits, together with an Exhibitors' lounge.

In addition there will be several suites and syndicate rooms on the third floor of the hotel, either for companies who wish to use this type of facility to exhibit, or for those who wish to have somewhere convenient to entertain their visitors in addition to their main stands elsewhere in the Exhibition. Already, several organisations have taken advantage of this opportunity to have a main stand for general enquiries, and the more private room for detailed discussions.

The hotel has a selection of restaurants, shopping facilities and bars. There is a coffee shop close to the Queen Mary Suite (which itself contains a bar), an Exhibitors' Lounge on the Mezzanine floor, and there are plans for a coffee bar to be erected in the New Exhibition Hall for the Exhibition.

Official Guide

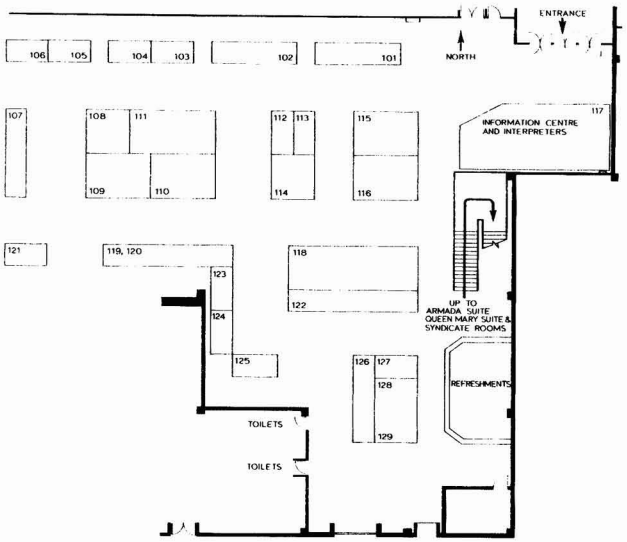
The *Official Guide* to the Exhibition has now been published and despatched to all members of the Association and those requesting copies as a direct result of the Association's widespread publicity.

Additional copies of the Official Guide are available at £1.50 (pre-payment only) from the Association's offices and **they will also be available for purchase at the entrance to the Exhibition.**

The Cunard International Hotel

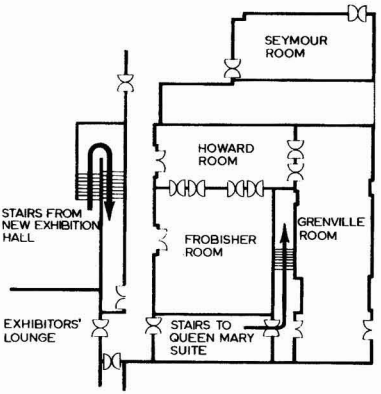
OCCA-32 Exhibition – Layout of Stands and Rooms

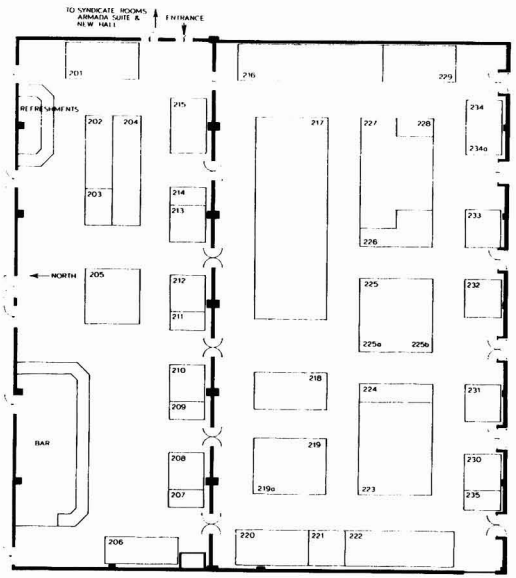
(NEW EXHIBITION HALL – *Ground Floor*)



ARMADA SUITE

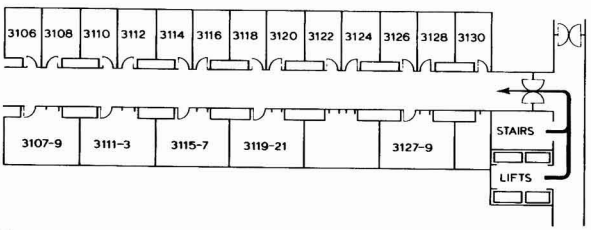
Mezzanine Floor





QUEEN MARY SUITE

First Floor



SYNDICATE ROOMS – *Third Floor*

occa news

Exhibitors at OCCA-32

For position of Stand, see plans of Exhibition above

For numerical list of Exhibitors, see Analysis of Exhibits table on page 174, 175 and 176

In the list below (*N*) indicates the New Exhibition Hall (Ground Floor), (*M*) indicates the Armada Suite (Mezzanine Floor), (*Q*) indicates the Queen Mary Suite (First Floor), and (*S*) indicates the Syndicate Rooms (Third Floor).

Stand/Room		
214	(*Q*)	Baird & Tatlock (London) Ltd
202	(*Q*)	Blagden Campbell Chemicals Ltd
3130	(*S*)	British Industrial Plastics Ltd
209	(*Q*)	C & W Specialist Equipment
204	(*Q*)	Chemolimpex
220	(*Q*)	Ciba-Geigy Plastics & Additives
215	(*Q*)	Ciech – Import & Export of Chemicals Ltd
111	(*N*)	Contraves Industrial Products Ltd
229	(*Q*)	Coulter Electronics Ltd
Grenville	(*M*)	Cray Valley Products Ltd
222	(*Q*)	Croda
225a	(*Q*)	Dow Chemical Co.
218	(*Q*)	Durham Chemicals Ltd
116	(*N*)	Eiger Engineering Ltd
233	(*Q*)	Elcometer Instrument Ltd
234a	(*Q*)	Emser Werke AG
231	(*Q*)	Engelmann & Buckham Ancillaries Ltd
106	(*N*)	Fillworth Ltd
221	(*Q*)	SA Floridienne NV
235	(*Q*)	FMK International Ltd
212	(*Q*)	Foscolor Ltd
101	(*N*)	Frames Tours Ltd
118	(*N*)	Glen Creston Machinery
234	(*Q*)	Grilon (UK) Ltd
219	(*Q*)	H. Haeffner & Co. Ltd
Frobisher	(*M*)	Harlow Chemical Co. Ltd/RCL
115	(*N*)	Hercules Powder Co. Ltd
207	(*Q*)	Industrial Dispersions Ltd
107	(*N*)	International Tin Research Institute
126	(*N*)	Italtinto Industria Vernici s.r.l.
122	(*N*)	Jenag Equipment Ltd
114	(*N*)	John Godrich
225	(*Q*)	K & K-Greeff Chemicals Ltd
225b	(*Q*)	Kirklees Chemicals Ltd
223	(*Q*)	Laporte Industries Ltd
208	(*Q*)	Lawrence Industries
206	(*Q*)	MSE Scientific Instruments Ltd

Stand/Room		
210	(*Q*)	Macbeth Division of Kollmorgen
119	(*N*)	Marchant Brothers Ltd
108	(*N*)	Mason & Morton (Engineering) Ltd
105	(*N*)	Mastermix Engineering Co. Ltd
232	(*Q*)	Microfine Minerals & Chemicals Ltd
112	(*N*)	Microscal Ltd
205	(*Q*)	Morris Ashby Ltd
216	(*Q*)	NL Chemicals
102	(*N*)	Netzch (UK) Ltd
117	(*N*)	OCCA Information Centre
125	(*N*)	Paint Manufacture & Resin News
109	(*N*)	Paint Research Association
103	(*N*)	Paintmakers Association of Great Britain Ltd
230	(*Q*)	Paragon Chemicals Ltd
211	(*Q*)	Polymers Paint Colour Journal
113	(*N*)	Q-Panel Co.
128	(*N*)	Roban Engineering Ltd
110	(*N*)	Sanyo-Kokusaku Pulp Co. Ltd
129	(*N*)	Sartorius Instruments Ltd
127	(*N*)	Scale Services
3111-13	(*S*)	Schering Chemicals Ltd
201	(*Q*)	Scott Bader Co. Ltd
224	(*Q*)	Sheen Instruments Ltd
Howard	(*M*)	Shell Chemical Co.
203	(*Q*)	Silberline Ltd
227	(*Q*)	Soab AB
104	(*N*)	Society of Dyers & Colourists
219a	(*Q*)	Swada (London) Ltd
3127-29	(*S*)	Synthetic Resins Ltd
217	(*Q*)	Tioxide International Ltd
226	(*Q*)	UCB SA
120	(*N*)	Veb Kombinat Nagema
124	(*N*)	Vickers Instruments
228	(*Q*)	Victor Wolf Ltd
Seymour	(*M*)	Vinyl Products Ltd
121	(*N*)	Werner & Pfleiderer (UK) Ltd

In addition to the Exhibitors listed above, reference is also made in the *Official Guide* to the following companies whose products are also on show:

Stand/Room		
205	(*Q*)	Amalgamated Oxides (1939) Ltd
205	(*Q*)	American Gilsonite Company
118	(*N*)	Willy A. Bachofen AG
122	(*N*)	BTR Ltd
205	(*Q*)	Billiton/Shell Group of Companies
226	(*Q*)	Brandhurst Ltd
207	(*Q*)	Cornelius Chemicals
215	(*Q*)	Daltrade Ltd
205	(*Q*)	Deanshanger Oxide Works Ltd
118	(*N*)	Diaf AS
219	(*Q*)	Ecomax
208	(*Q*)	Engelhard Minerals & Chemicals Inc.
233	(*Q*)	Erichsen
219	(*Q*)	Ernstrom International
214	(*Q*)	Karl Fischer
233	(*Q*)	Gardner Laboratory
106	(*N*)	Gleefield Ltd
206	(*Q*)	Haake

Stand/Room		
207	(*Q*)	Hilton-Davis
226	(*Q*)	Honeywill & Stein Ltd
211	(*Q*)	Industrial Newspapers Ltd
223	(*Q*)	Interox Chemicals Ltd
221	(*Q*)	S.C. Johnson & Son Inc.
216	(*Q*)	Steetley Minerals
124	(*N*)	Joyce-Loebl Ltd
114	(*N*)	Kesternich
216	(*Q*)	Kronos Titanium Pigments Ltd
233	(*Q*)	Leneta
230	(*Q*)	M.L. Chemicals Ltd
120	(*N*)	Maschinenfabrik Heidenau
209	(*Q*)	Mebon Ltd
206	(*Q*)	Mettler Instruments
229	(*Q*)	Micromeritics Corp.
221	(*Q*)	Micro Powders Inc.
221	(*Q*)	Micro Products Company
202	(*Q*)	Neville-Cindu Chemie

128	(N) Peerless Pump Ltd	204	(O) Tiszamenti Vegyimüvek
Frobisher	(M) Resinous Chemicals Ltd	128	(N) Tokheim
Howard	(M) Royal Dutch/Shell Group of Companies	Seymour	(M) Urachem International
218	(Q) S.A. Des Talc de Luzenac	3127-29	(S) Unilever Group
223	(Q) Solvay & Cie	215	(Q) Union Of Plastics & Paint Industry
233	(Q) Taber	219	(Q) Westerlins
205	(Q) Talkumwerke Naintsch	103	(N) Wheatland Journals Ltd

Stand telephone numbers

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

Stand	*Exhibitor*	*Stand telephone number*
202	Blagden Campbell Chemicals Ltd	01-741 3883
220	Ciba-Giegy Plastics & Additives	01-741 3913
215	Ciech – Import & Export of Chemicals Ltd	01-741 3955
Grenville	Cray Valley Products Ltd	01-741 3975/83
225a	Dow Chemical Company	01-741 3873
218	Durham Chemicals Ltd	01-741 3885
234a	Emser Werke AG	01-741 3973
231	Engelmann & Buckham Ancillaries Ltd	01-741 3925
106	Fillworth Ltd	01-741 3843
101	Frames Tours Ltd	01-741 3863
118	Glen Creston Machinery	01-741 3835
234	Grilon (UK) Ltd	01-741 3973
219	H. Haeffner & Co. Ltd	01-741 3845
115	Hercules Powder Co. Ltd	01-741 3893
122	Jenag Equipment Ltd	01-741 3915
225	K&K-Greef Chemicals Ltd	01-741 3873
225b	Kirklees Chemicals Ltd	01-741 3873
223	Laporte Industries Ltd	01-741 4030/8/9
119	Marchant Brothers Ltd	01-741 3833
108	Mason & Morton (Engineering) Ltd	01-741 3943
205	Morris Ashby Ltd	01-741 3895
216	NL Chemicals	01-741 3933
117	OCCA Information Centre	01-741 3855
109	Paint Research Association	01-741 3923
211	Polymers Paint Colour Journal	01-741 3945
128	Roban Engineering Ltd	01-741 3935
201	Scott Bader Co. Ltd	01-741 3965
224	Sheen Instruments Ltd	01-741 3875
227	Soab AB	01-741 3963
219a	Swada (London) Ltd	01-741 3845
217	Tioxide International Ltd	01-741 7101/2
226	UCB SA	01-741 3953
120	Veb Kombinat Nagema	01-741 3833

Visits by principal officers of other societies

The Exhibition Committee has extended an invitation to the principal officers of many technical societies, research associations and Government departments to visit the Exhibition on Wednesday 14 May. The Committee will be conducting the party around the Exhibition to visit the stands.

Information in foreign languages

As in previous years, interpreters will be in attendance on the Association's Information Centre at the Exhibition to assist overseas exhibitors and visitors with their queries.

Travel arrangements

The Exhibition Committee has decided to move the venue of the 1980 Exhibition to the Cunard International Hotel, as it is felt that the more central site and greater range of types of exhibiting facilities it offers will be welcomed both by exhibitors and visitors to the Exhibition.

The Hotel is situated near Hammersmith Station on the Piccadilly Underground Line between Heathrow Airport and the centre of London. Visitors from overseas may board the Piccadilly Line in the Airport complex, which will take them direct to Hammersmith Station or to central London where they may be staying. Hammersmith Station is also served by the Metropolitan and District Underground Lines (the latter of which connects to Victoria Station for those arriving at Gatwick Airport). The Hotel is adjacent to the Hammersmith flyover on the M4 Motorway which links Heathrow Airport by road. Car parking at the Hotel is limited, but there is a large NCP car park close by in King's Mall off King Street.

Admission

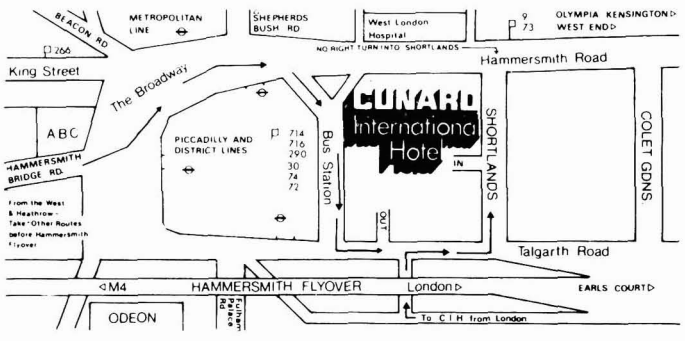
Admission to the Exhibition will be free, and visitors will be asked to complete registration cards which will be available from the Association with copies of the *Official Guide* in advance. Copies of the *Official Guide* will be charged at £1.50 each, and both registration cards and copies of the *Official Guide* will also be available at the entrance to the Exhibition.

Notes on map below

Visitors arriving at Heathrow Airport can board a train within the Airport complex which will take them direct to Hammersmith Station on the Piccadilly Underground Line. Trains will be running from the airport at four minute intervals during peak hours.

There is a frequent British Rail connection direct from Gatwick Airport to Victoria Station, London S.W.1. From Victoria Station, visitors can board the District Underground Line which will take them to Hammersmith Underground Station.

Reference to the map below will show that the Cunard International Hotel is within easy walking distance of Hammersmith Station. The entrance to the Exhibition will be via the New Exhibition Hall on the ground floor.



Analysis of Exhibits

Stand	Exhibitor	Resins	Extenders, fillers, matting agents	Pigments	Additives, driers, surfactants etc.	Chemical intermediates	Manufacturing equipment, drums etc.	Laboratory apparatus and testing equipment	Miscellaneous
	NEW EXHIBITION HALL								
101	Frames Tours Ltd								Services
102	Netzsch (UK) Ltd						•		
103	Paintmakers Association of Great Britain Ltd								Technical education
104	Society of Dyers & Colourists								Information
105	Mastermix Engineering Co. Ltd						•		
106	Fillworth Ltd						•		
107	International Tin Research Institute								Information
108	Mason & Morton (Engineering) Ltd						•		
109	Paint Research Association								Information
110	Sanyo-Kokusaku Pulp Co. Ltd	•							
111	Contraves Industrial Products Ltd							•	
112	Microscal Ltd							•	
113	Q-Panel Co.							•	
114	John Godrich						•	•	
115	Hercules Powder Co. Ltd.	•							Water-soluble polymers
116	Eiger Engineering Ltd						•	•	
117	**OCCA Information Centre**								Services
118	Glen Creston Machinery Ltd						•	•	
119	Marchant Brothers Ltd						•		
120	Veb Kombinat Nagema						•		
121	Werner & Pfleiderer (UK) Ltd						•		
122	Jenag Equipment Ltd						•		
124	Vickers Instruments							•	
125	Paint Manufacture & Resin News								Journal
126	Italtinto Industria Vernici s.r.l.								Colour dispensers
127	Scale Services							•	
128	Roban Engineering Ltd						•		Bulk storage installations
129	Sartorius Instruments Ltd							•	
	QUEEN MARY SUITE								
201	Scott Bader Co. Ltd			•		•			
202	Blagden Campbell Chemicals Ltd	•		•	•	•			
203	Silberline Ltd			•					

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OCCA CONFERENCE 1981

Alternative technologies in coatings

CALL FOR PAPERS

The next OCCA Biennial Conference will be held at the Beaufort Hotel, Bath from 17 – 20 June 1981 with the theme "Alternative technologies in coatings".

The future holds both opportunity and challenge for alternative technologies and topics covered by the Conference should include, EEC regulations covering the introduction of new chemicals, alternative means of obtaining opacity, the impact of microprocessors and computers on processing and application methods, high solids coatings, aqueous systems, radiation curing and powder coatings.

A departure from the usual conference format will be the inclusion of a "Discourse" session with the sub-title "Alternatives to coatings", where the use of techniques such as cathodic protection and substitution of coated items by plastics could be discussed.

The Hon. Research & Development Officer now invites offers of papers for presentation at this Conference. Anyone wishing to submit a paper for consideration should notify his intention as soon as possible to: **The Director & Secretary, Oil & Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF, England (Tel: 01-908 1086; Telex: 922670 OCCA G).**

Stand	Exhibitor	Resins	Extenders, fillers, matting agents	Pigments	Additives, driers, surfactants etc.	Chemical intermediates	Manufacturing equipment, drums etc.	Laboratory apparatus and testing equipment	Miscellaneous
204	Chemolimpex	•		•					
205	Morris Ashby Ltd		•	•					
206	MSE Scientific Instruments Ltd							•	
207	Industrial Dispersions Ltd			•					
208	Lawrence Industries		•						
209	C & W Specialist Equipment							•	
210	Macbeth Division of Kollmorgen							•	Production control colour monitors
211	Polymers Paint Colour Journal								Journal
212	Foscolor Ltd			•					Pigment chips, dispersions
214	Baird & Tatlock (London) Ltd							•	
215	Ciech – Import & Export of Chemicals			•		•			
216	NL Chemicals			•	•				
217	Tioxide International Ltd			•					
218	Durham Chemicals Ltd		•	•	•	•			
219	H. Haeffner & Co. Ltd		•	•			•		
219a	Swada (London) Ltd			•					
220	Ciba-Geigy Plastics & Additives Co.	•			•				
221	SA Floridienne NV	•			•				
222	Croda	•				•			
223	Laporte Industries Ltd			•					
224	Sheen Instruments Ltd							•	
225	K & K Greeff Chemicals Ltd	•			•	•			
225a	Dow Chemical Co.				•	•			
225b	Kirklees Chemicals Ltd	•							
226	UCB S.A.	•							
227	Soab AB	•							
228	Victor Wolf Ltd	•			•	•			
229	Coulter Electronics Ltd							•	
230	Paragon Chemicals Ltd	•							
231	Engelmann & Buckham Ancillaries Ltd							•	
232	Microfine Minerals & Chemicals Ltd		•						
233	Elcometer Instruments Ltd							•	
234	Grilon (UK) Ltd	•			•				
234a	Emser Werke AG	•			•				
235	FMK International Ltd							•	

Room	Exhibitor	Resins	Extenders, fillers, matting agents	Pigments	Additives, driers, surfactants etc.	Chemical intermediates	Manufacturing equipment, drums etc.	Laboratory apparatus and testing equipment	Miscellaneous
	ARMADA SUITE – MEZZANINE FLOOR								
Seymour	Vinyl Products Ltd	•							
Frobisher	Harlow Chemical Co. Ltd/RCL	•							
Howard	Shell Chemical Co.	•				•			Solvents
Grenville	Cray Valley Products Ltd	•			•				
	THIRD FLOOR – SYNDICATE ROOMS								
3127-29	Synthetic Resins Ltd	•			•				
3119-21	NL Chemicals			•	•				
3115-17	Ciba-Geigy Plastics & Additives Co.	•			•				
3111-13	Schering Chemicals Ltd	•							Organotin intermediates
3130	British Industrial Plastics Ltd	•							
3128	Victor Wolf Ltd	•			•	•			
3126	Morris Ashby Ltd		•	•					
3124	Croda	•				•			
3122	UCB SA	•							

News of Exhibitors at OCCA-32

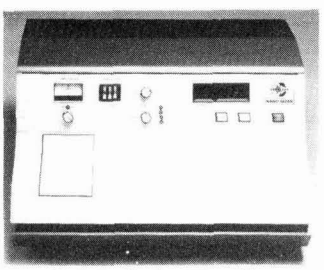
The OCCA Exhibition "Official Guide" is published many weeks before the dates of the Exhibition, so that visitors can obtain copies in advance and plan their itineraries. The "Official Guide" contains full descriptions of Exhibitors' Stands and much other useful information; copies of the "Official Guide" may be purchased (at £1.50 each) either *in advance from the Association's offices* or *at the entrance to the Exhibition, and additional copies of the "Official Guide" will be on sale at the Information Centre (Stand 117).*

Stand 229

Coulter Electronics Ltd

Coulter Electronics Limited will be displaying the new Coulter Nano-Sizer for the measurement of very small particles in industrial laboratories.

The Nano-Sizer determines the average particle size in suspensions and emulsions in the overall range of 0.04 – 3.0 micrometres. This, together with an index of the width of the size distribution, is presented typically within 2–4 minutes, with no operator attention, calculation or calibration.



The new Coulter Nano-Sizer

The instrument combines the natural phenomenon of Brownian Motion with auto correlation spectroscopy of scattered laser light.

Seymour Room

Vinyl Products Ltd

Vinyl Products Ltd is a major, independent manufacturer of polymer emulsions. Its display at the Exhibition includes emulsion based surface coating systems for air drying and forced drying wood finishes with excellent resistance to solvents: for forced drying finishes on fibre and particle board; for mineral fibreboard finishes with established long-term durability; for metal finishes; for durable high-build exterior coatings for use on walls and roofs; and for conventional decorative finishes ranging from gloss/silk finishes and specialised exterior paints to economical, cost-effective interior paints.

Also featured will be vinyl acetate-ethylene copolymer emulsions and PVA and acrylic binders for a range of adhesive applications.

Stand 206

MSE Scientific Instruments

Amongst the products being displayed by MSE Scientific Instruments will be the Haake Rotovisco range of viscometers and, for the first time at the *OCCA* Exhibition, they will be showing the Mettler Automatic DL40 Memotitrator.

The DL40 is microprocessor controlled. Titrations are often complete in less than one minute and results are displayed in a digital print out.

Of particular relevance to paint and ink rheologists is the new Haake PK100 cone and plate instrument which offers a wide range of cone sizes up to the plate

diameter of 10 cm. The standard temperature range is up to 200°C with built-in digital temperature read-out to 0.1°C.

Also on show will be several other versatile viscometers including the Haake model RV12, the model RV2 and the Haake Viscotester VT181/24, a reliable hand-held viscometer.

Stand 226

UCB SA

The specialities division of UCB SA will be presenting two lines of non-polluting, 100 per cent systems developed during recent years.

The range of UCB's radiation curing materials is distributed in the UK by Honeywill & Stein Ltd and includes oligomers, photo-active compounds and polyfunctional momomers. Many applications have already been developed to the commercial stage, including paper and cardboard varnishes, wood open-grain finishes, PVCl and plastics finishes, laminating adhesives etc.

Also on display will be Crylcoat reactive polyester resins for thermosetting electrostatic powder coatings which are distributed in the UK by Brandhurst Ltd. The range of Crylcoat resins comprises hydroxylated and carboxylated polyesters designed for crosslinking by block-isocyanates, TGIC and aromatic-type expoxy resins.

Stand 121

Werner & Pfleiderer (UK) Ltd

Werner & Pfleiderer will be exhibiting their twin-screw compounding extruders type ZSK. These machines convert a dry pre-mix of polyester, epoxy, acrylic etc., resins, fillers and additives into a well-dispersed hot viscous strip for subsequent cooling, crushing and grinding into fine powder.

The W&P technology is based on the use of two closely intermeshing co-rotating screws which wipe each other along their entire length and therefore ensure that no product can build up on them.

When colour or formulation changes need to be made, all that is normally required is for the machine to be run empty and a small quantity of purging material passed through it.

Stand 232

Microfine Minerals and Chemicals Ltd

Microfine is already the largest processor of ground mica and its range of products is unrivalled. New mica products being introduced at the Exhibition based on UK origin raw materials are extremely price competitive and will, for the first time, include black mica for special decorative effects.

Also on show will be the range of Microcarb chalk whitings, a full range of white talcs, barytes and marble carbonates.

Stand 110

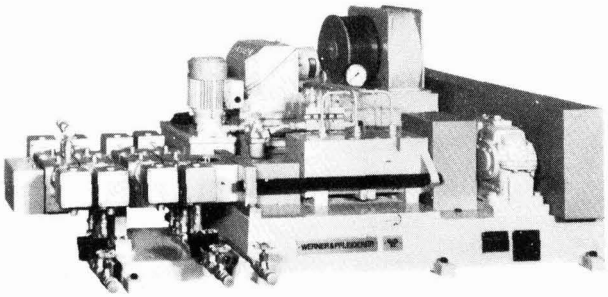
Sanyo-Kokusaku Pulp Co. Ltd

The Chemicals Division of Sanyo-Kokusaku will be showing their range of Superchlon chlorinated polyolefines including chlorinated polypropylene and chlorinated polyethlene. Brochures will be available describing the use of Superchlon chlorinated polyolefines in heavy duty anticorrosive coatings suitable for application on zinc pre-treated steel surfaces.

Stand 201

Scott Bader

Amongst the products to be shown on the Scott Bader stand will be new base materials for ready-to-use ceramic tile adhesives which pass the 7-day air dry, 7-day total water immersion requirement of BS 5383: Part 1: 1976: Test A 4 8 i b. These materials are styrene/acrylate copolymers in aqueous emulsion-Texicryl 17-0125 and Texicryl 13-036. The new Scott Bader polymer emulsions overcome the difficulties of poor water resistance in normal gypsum-filled PVA emulsions and the limited pot life encountered with 100 per cent reactive systems.



The ZSK 30 for the manufacture of powder coatings

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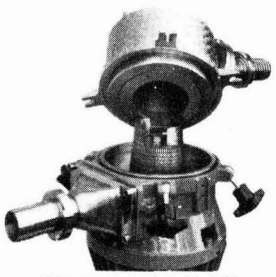
Stand 108

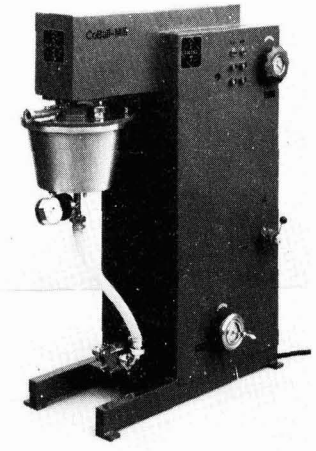
Mason & Morton (Engineering) Limited

The process equipment division of Mason & Morton Limited will be displaying the following items:



The toothed Colloid Mill

The Toothed Colloid Mill
This is designed for the dispersion of pigments or other solids in a liquid medium; for the coarse grinding of particles in a range down to approximately 0.1 mm and for the emulsification and homogenising of liquid and pasty products.



The CoBall-Mill

occa diary

CoBall-Mill
The grinding chamber of the CoBall-Mill is not a cylindrical vessel, but a narrow gap through which the suspension is forced to flow. Therefore, a high fineness with a regular narrow particle size distribution is achieved, as well as a good throughput.

Stand 129

Sartorius Instruments Ltd

Satorius Instruments will be displaying a selection of electronic analytical and top-pan balances linked to various types of data-processing equipment. Examples from the range of mechanical balances available will also be shown, together with a representative selection from the Janke & Kunkel range of mixers and stirrers.

Stand 106

Fillworth Ltd/Gleefield Ltd

On show for the first time are the Fillworth and Gleefield ranges of mixing machines which range from simple stirrers to the unique Fillworth patented Batchmaster.

The Batchmaster VGM series of machines are extremely flexible and suitable for handling products with a very high solids content which would not normally be processed in a vertical rotary mixer. The high shear produced by the Batchmaster also makes it eminently suitable for the dispersion of low viscosity products.

Stand 205

Morris Ashby Limited

Morris Ashby Limited, a member of the Billiton/Shell group of companies, will be displaying Zincoli zinc dusts from Amalgamated Oxides (1939) Ltd. These are for use in zinc-rich and other anti-corrosive formulations. Zincoli zinc oxides may be used as pigments and fungistatic additives and Zincoid collodial zinc oxide is currently of special interest in powder coatings.

On display from the Deanshanger Oxide Works Ltd will be Deanox synthetic iron oxide. A range of red and yellow shades are available, thus providing the formulator with opportunities for their cost effective use in many products.

From the American Gilsonite Company several grades of Gilsonite, a high quality natural asphaltum, will be displayed.

Stand 230

Paragon Chemical Company

The Paragon Chemical Company will be exhibiting a comprehensive range of resins of particular interest to both decorative and industrial paint manufacturers.

Stand 116

Eiger Engineering Ltd

Eiger Engineering Ltd have now been successfully producing their direct drive bead mills for approximately 3 years and throughout that period the range of mills has been steadily widened to cover demand. This range now consists of 0.1, 1, 10, 20, 40, and 75 litre sizes. The mills are performing in a wide range of processing plants and laboratories where the finest wet grinding and dispersing is absolutely necessary.

Frobisher Room

Harlow Chemical Company/RLC

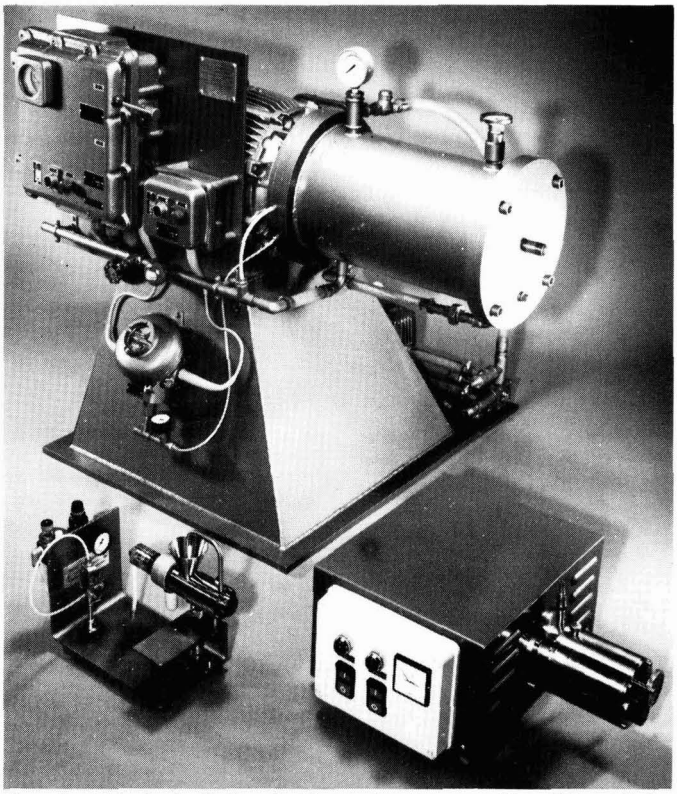
Harco, the leading UK manufacturer of water based synthetic resin emulsions for the paint, adhesive and allied industries, are displaying a new range of products in the Frobisher Room. Highlights of the display will be high opacity emulsions, roofing compounds, VA/E emulsions and water resistant wood adhesives.

Room 3130

British Industrial Plastics Ltd

BIP Chemicals Division will have displays illustrating the characteristics of the following "Beetle" resins: BA549 – a versatile semi-drying, short oil alkyd; BA503 – an oil-free alkyd of high acid value which is compatible with "Beetle" and melamine resins; BA531 – a carboxyl terminated saturated polyester primarily for use in epoxy resins in powder coatings.

Other items exhibited will be a low odour isobutylated urea resin BA691 and melamine resin BE692, both having good reactivity. Melamine resin BE692 is particularly suitable for low bake finishes.

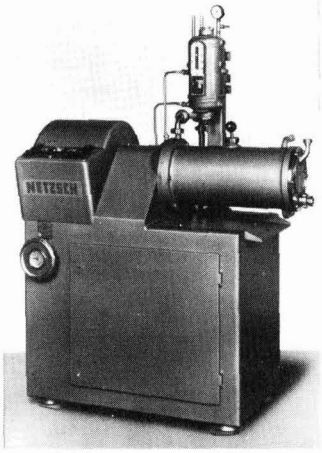


Three direct drive bead mills from the Eiger Engineering range which will be on display

Stand 102

Netzsch (UK) Ltd

Netzsch will be exhibiting models from their range of Horizontal Bead Agitator Mills.



The Netzsch LME 20

Stand 227

Soab AB

Soab AB will introduce the new company tripod philosophy for the industry and will highlight new developments in the following fields:

- Water dilutable and solvent based polyester resin systems
- Air drying alkyds for industrial applications
- Polyurethane alkyds.

Stand 231

Engelmann & Buckham Ancillaries Ltd

Engelmann & Buckham Ancillaries Ltd are exhibiting the Photomaker Colour Analysis Systems, a low cost microprocessor based, portable instrument which may be used in any working environment with the same accuracy as laboratory based equipment.

Attagel 50, a highly micronised grade Attapulgite, has unique thickening and suspending properties and is suitable for both water based and solvent based systems.

Stand 235

FMK International Ltd

On display will be the CheckScan unit, a self-contained microprocessor based device designed to control up to three electronic balances. The unit offers the end user a sophisticated and durable check weighing unit which can be easily operated by non-technical personnel who require minimal training.

The unit incorporates a memory bank having a capacity to hold up to 200 batches and reference codes and their associated culminated weights. This memory can be extended to suit users' particular applications.

Stand 208

Lawrence Industries

The process minerals division of Lawrence Industries concerns itself with the supply of specialist clays from the deposits of Engelhard Minerals & Chemicals Inc., USA.

Amongst the range available from stock in the UK are Engelhard's aluminium silicate pigments and calcined kaolin extenders, Satintones. These products have a wide variety of extender applications from electro-deposition coatings to household emulsions.

The calcined Satintones have been developed with high brightness and superior opacity properties and low abrasion characteristics.

Stand 127

Scale Services

Scale Services will be exhibiting a wide range of Sauter electronic balances. On show for the first time in the UK will be the new RL4 automatic dual range electronic balance which has the unique ability to change from one weight range to another according to the load applied.

Also on display will be the RA 25 kg x 1 g mixture balance which is designed for weighing a series of ingredients into a common container. During the weighing operation three separate displays indicate the individual weight of the last ingredient, the total nett weight of combined ingredients and the total gross weight (container and ingredients).

occa news

Room 3111-13

Schering Chemicals Ltd

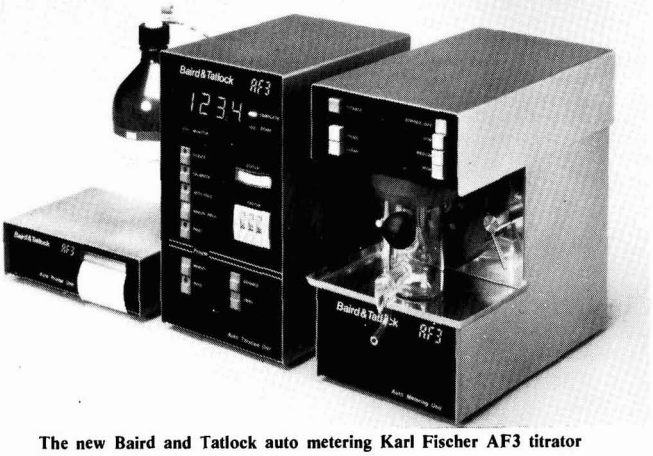
The range of Schering products on display for the paint, building protection, adhesive and printing ink industries will include:

Europox – Epoxy resins
Euredur – Hardeners for epoxy resins
Euresyst – Epoxy resin systems
Eurelon – Thermoplastic polyamide resins
Euretek – Adhesion promoters for PVC1 plastisols
Polyurethane resins for sealing compounds
Organo-tins as biocides.

Stand 214

Baird & Tatlock (London) Ltd

Baird & Tatlock will be exhibiting a range of instruments including the new Baird & Tatlock AF3 direct reading Karl Fischer titrator. Designated the AF3, it employs modern computer technology and a controlled impulse metering pump (instead of the usual burettes) as the two principal elements of a fully-automated, push-button system.



The new Baird and Tatlock auto metering Karl Fischer AF3 titrator

occa news

Stand 228

Victor Wolf Ltd

For over forty years Victor Wolf Ltd has been specialising in the production of unsaturated fatty acids for the surface coating industry. Details of their full range will be available including the latest information on the 'Dedico' group of dehydrated castor oil fatty acids.

Victor Wolf will also be showing their established range of polymers for the curing of epoxy resins, and non-reactive polyamide resins for the formulation of flexographic and gravure printing inks.

Grenville Room

Cray Valley Products Ltd

The following products from the company's internationally known range or resins will be displayed:

A view of part of the Queen Mary Suite at the Cunard International Hotel

Synolack – alkyds
Gelkyd – thixotropic binders
Synocryl – thermosetting acrylics
Synocure – cold-curing acrylics
Unithane – urethane polymers
Versamid – polyamides.

Also on display will be the new Super Gelkyds which are thixotropic binders of improved performance and an extended range of Crayvallac structuring additives.

Stand 232

Microfine

Ferrophos, an iron phosphate extender/enhancer specifically developed by Hooker Chemicals and Plastics Corporation for use as a partial substitute for zinc dust in zinc-rich primers, will be displayed on the Microfine stand.

Manchester Section

Annual Dinner Dance 1979

The above event, which is the highlight of the Section's social calendar, was held as in previous years at the Hotel Piccadilly in the heart of Manchester. Four hundred and ten OCCA members and their guests were entertained in the hotel's Peacock Suite and were present to hear the toast to the Manchester Section proposed by the Chairman of Synthetic Resins Ltd, Mr Brian Boocock. The Manchester Section Chairman, Mr A. C. Jolly responded and also proposed a toast to the guests. Dr F. M. Smith, the President of the Association, and himself an ex-Chairman of the Manchester Section, responded on behalf of the guests present.

The festivities continued until 1.00 am and the general concensus of opinion was that yet again the Dinner Dance had achieved the usual high standard of previous years.

F. B. W.

Scottish Section

Forensic science

A most entertaining and revealing insight into the work of the Strathclyde Police Forensic Science Department was given at the February meeting of the Section.

The talk given by Dr W. J. Rodgers of this Department proved to be most enlightening and the message came over loud and clearly even to Oil and Colour Chemists that Crime does not pay.

The evening was rounded off by a vote of thanks given by Mr Hugh Munro, who said that the success of the talk was quite clearly illustrated by the very wide variety of questions from the floor.

Shown at the annual Dinner Dance of the Scottish Section held on 11 January are: Dr F. M. Smith (President) and Mrs Smith, Mr R. Brooks (Chairman, Hull Section), Mr J. A. Burns (Chairman, Midlands Section) and Mrs Burns, Mr K. Callaghan (Chairman, Irish Section) and Mrs Callaghan, Mr R. H. Hamblin (Director and Secretary), Mr G. V. G. Hill (Chairman, Thames Section) and Mrs Hill, Mr T. L. M. Humphrey (Vice-Chairman, Scottish Section) and Mrs Humphrey, Mr A. C. Jolly (Chairman, Manchester Section) and Mrs Jolly, Mr A. McKendrick (Chairman, Eastern Branch) and Mrs McKendrick, Mr I. R. McCallum (Chairman, Scottish Section) and Mrs McCallum.

Report of Council Meeting

A Meeting of the Council took place at 2.00 p.m. on 20 February at the Great Northern Hotel, Kings Cross, London N1, with the President (Dr F. M. Smith) in the Chair. In addition to the 24 members present, Mr D. S. Newton (a former Hon. Editor) was present by invitation and the President opened the Meeting by extending a welcome to Mr Newton.

It was reported that Mr D. N. Fidler had had to resign as Chairman of the Bristol Section through ill health and that Mrs E. N. Harper, in her capacity as Immediate Past Chairman, would carry out the duties of Chairman until the next Section Annual General Meeting. The Council recorded their thanks to Mr Fidler for his many years of service to the Association and extended their best wishes to him.

It was reported that Dr Parfitt and Mr Tabbernor had accepted nominations to serve as Association Representatives on the British National Committee for Chemistry and the Technical Training Board for the Printing Ink Industry respectively.

Mr K. Lord had accepted nomination to serve as the Association's Representative on the British Standard Institution Committee LGL/9 Artificial Daylight for Colour Matching and The Colour Group.

It was noted that the BSI had requested the Association to nominate a Representative on a Committee which would deal with the Revision of BS 4610 – Colours for High Visibility Clothing and BS 5064 – Optical Performance on Reflective Agents for use in High Visibility Garments and Accessories.

The West Riding Section Committee was asked if they could nominate a Member for this Committee.

The Annual Report of the Council for 1979 was adopted.

The Agenda for the Annual General Meeting, to be held on 26 June, was discussed and adopted.

Reports were received on the arrangements for the Annual General Meeting which will be preceded by a meeting of the Past Presidents of the Association. Following the Luncheon, a lecture will be given by Professor, Sir Hermann Bondi, KCB, FRS, Chief Scientist at the Department of Energy and Chairman of the Advisory Council on Energy Conservation. The Annual General Meeting would follow the lecture.

It was reported that a considerable number of tickets had been sold for the Association's Dinner & Dance to be held at the Savoy Hotel, on 11 April 1980. Prof. R. O. C. Norman, FRS, President of The Royal Institute of Chemistry, had consented to reply on behalf of the guests to the President's Address of Welcome.

In accordance with Article 14, it was resolved that any members whose current subscription was 3 months in arrears should not receive any issues of the *Journal* after the March issue, until payment of subscription and they should not be entitled to receive any issues published during the period of arrears.

A report was received on the 1980 Exhibition, which had been extremely well supported, and full details are being published elsewhere in this issue. A general discussion also took place on the 1981 Exhibition.

The Council learnt with interest that the replies received from the Readership Survey form which had been enclosed with the November issue of the *Journal* indicated that the Association's *Journal* appeared to have a readership in excess of 20,000. A further innovation had been the institution of a Reader Enquiry Service and, from the number of enquiries already received, this was proving to be of value to readers and reinforced the extent to which the *Journal* was widely read.

Details were given of the subject and timing of the sessions for the 1981 Conference, which would include one session in the form of a Discourse when several subjects would be introduced by different speakers for discussion. The general heading of the Conference would be "Alternative technologies in coatings".

Council received a report on the venue for the 1981 Conference and decided that it would be held on 17 – 20 June 1981 with headquarters at the Beaufort Hotel, Bath; further details will be appearing in the *Journal*.

occa news

It was reported that the professional Grade Committee had admitted two Fellows, had transferred three Associates to Fellowship, had admitted four Associates and had referred two applicants for vivas.

It was unanimously agreed to confer a Commendation Award on Mr N. H. Seymour for his services to both the Manchester and Midlands Sections.

Council accepted the Petition for the formation of a Nigerian Branch of the General Overseas Section and was pleased to have a first-hand report from Mr J. Clark (Chairman, Newcastle Section) who had recently given a lecture in Nigeria.

It was decided to reintroduce the Association Ties with single motif but with a choice of Blue or Maroon background.

It was reported that arrangements had been made to publicise the forthcoming Symposium, organised by the Birmingham Paint Varnish & Lacquer Club. At the forthcoming FATIPEC Congress three papers would be given in one session by members of the Association and Mr T. W. Wilkinson (a Vice President) would be presenting a paper at the forthcoming FSCT Convention.

Other matters discussed at the Meeting concerned Technical Education, the new layout of the *Journal* and reports of section activities.

There being no other business, the President thanked members for their attendance and declared the Meeting closed at 4.14 p.m.

Professional Grade

At a meeting of the Professional Grade Committee held on 20 February 1980, the following Ordinary Members of the Association were admitted to the categories shown. The Section to which each member is attached is shown in brackets.

Fellows

Johnson, Roland Emanuel George (*Gen. Overseas – Zimbabwe Rhodesia*)
Thukral, Prem Sagar (*London*)

Transfers from Associate to Fellow

Aitken-Smith, Frank Joseph (*Auckland*)
Dowsing, George Frederick (*London*)
Silsby, Denys John (*Midlands*)

Associates

Lau, Ang Kong (*Gen. Overseas – Singapore*)
Lever, Colin (*Manchester*)
Payne, Edward James (*Manchester*)
Payne, Kenneth (*Bristol*)

new 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

ACETO, ELISED, PO Box 32065, Mobeni 4060, Republic of South Africa *(Natal)*

BRIDGFORD, GLENN ROY, BSc, Matua Road, RDI, Kumeu, New Zealand *(Auckland)*

DEARLING, TERENCE BERTRAM, BSc, Building Research Establishment, Princes Risborough, Aylesbury, Bucks. *(Thames Valley)*

HEYES, STUART GRAHAM, BSc, 34 Somerset Road, Rishtun, Nr. Blackburn, Lancs. *(Hull)*

LUTHARDT, HANS JUERGEN, PhD, Deutsche Akzo Coatings GmbH, Postfach 300709, 7000 Stuttgart 30, W. Germany *(General Overseas)*

MEHTA, NAVINCHANDRA O., BSc, Rustins Ltd, Waterloo Road, London NW2 *(London)*

PARRISH, MICHAEL ANTHONY, BSc, MTech, PhD, Lambson Limited, Aire & Calder Works, Cinder Lane, Castleford, Yorks. *(West Riding)*

SALIM, MOHAMMED SHARIF, PhD, BSc, 10 Whelan Avenue, Bury, Lancs. BL9 9QD *(Manchester)*

TEARNE, LEONARD JAMES, 166 Mississaga Street, Oakville, Ontario L6L 3A8, Canada *(Ontario)*

VAN ZUILEKOM, KASPER DIRK, PO Box 32065, Mobeni 4060, Republic of South Africa *(Natal)*

Associate Members

EXETER, BARRY RAYMOND, PO Box 11–123, Ellerslie, Auckland, New Zealand *(Auckland*

HAICK, BRIAN R., 445 Finnelly Avenue, Ajax, Ontario, Canada *(Ontario)*

KNIGHTLEY, JACK ALBURY, 39 Fulwell Road, Bozeat, Wellingborough, Northants. *(Midlands)*

MACFARLANE, S. P., 17 Durham Street, Ajax, Ontario, L1S 1W7, Canada *(Ontario)*

WHITTAKER, JOHN, Durham Raw Materials Ltd, Lynnfield House, Church Street, Altrincham, Cheshire *(Manchester)*

occa diary

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

April

Midlands Section – Trent Valley Branch: Annual General Meeting, to be followed by a Buffet Dance at the Cross Keys Inn, Turnditch. *Details to be announced.*

Tuesday 1 April

West Riding Section: Annual General Meeting, at the Mansion Hotel, Roundhay Park, Leeds 8, commencing at 7.30 p.m. *Details to be announced.*

Thursday 10 April

Newcastle Section: Annual General Meeting, at the Students Common Room, St. Mary's College, Elvet Hill Road, Durham, commencing at 6.30 p.m. *Details to be announced.*

Friday 11 April

Association Dinner Dance, at the Savoy Hotel, London WC2.

Thursday 17 April

Thames Valley Section: Annual General Meeting. "Unusual experiences of a paint supplier" by R. Peacop of Technical Paint Services, at the Beaconsfield Crest Motel (White Hart), Aylesbury End, Beaconsfield, Bucks commencing at 6.30 p.m. for 7.00 p.m.

Friday 18 April

Irish Section: Annual General Meeting, at the Clarence Hotel, Dublin, commencing at 8.00 p.m. *Details to be announced.*

Manchester Section: Annual General Meeting, at the Lancashire Cricket Club, Old Trafford, Manchester. *Details to be announced.*

Wednesday 23 April

Scottish Section – Eastern Branch: Annual General Meeting, followed by "Pencil manufacture" by D. W. Tee of the Cumberland Pencil Co., at the Murrayfield Hotel, 18 Corstorphine Road, Edinburgh commencing at 7.30 p.m.

Thursday 24 April

London Section: Annual General Meeting, at the Rubens Hotel, Buckingham Palace Road, SW1 commencing at 6.30 p.m., followed by a lecture of general interest *(speaker and subject to be announced). Ladies' Evening.*

Friday 25 April

Midlands Section: Annual General Meeting, at the Belfry Hotel, Lichfield Road, Wishaw, commencing at 7.30 p.m. There will be a golf tournament in the afternoon at the adjoining golf course.

Bristol Section: Annual General Meeting at the Royal Hotel, College Green, Bristol, commencing at 7.15 p.m. A film will be shown at the end of the proceedings.

May

Friday 9 May

Bristol Section: Skittles Match, at BP Chemicals, Stroud. *Details to be announced.*

13 – 15 May

OCCA-32 Exhibition, at the Cunard International Hotel, Hammersmith, London W6. 09.30 to 17.30 hrs.

June

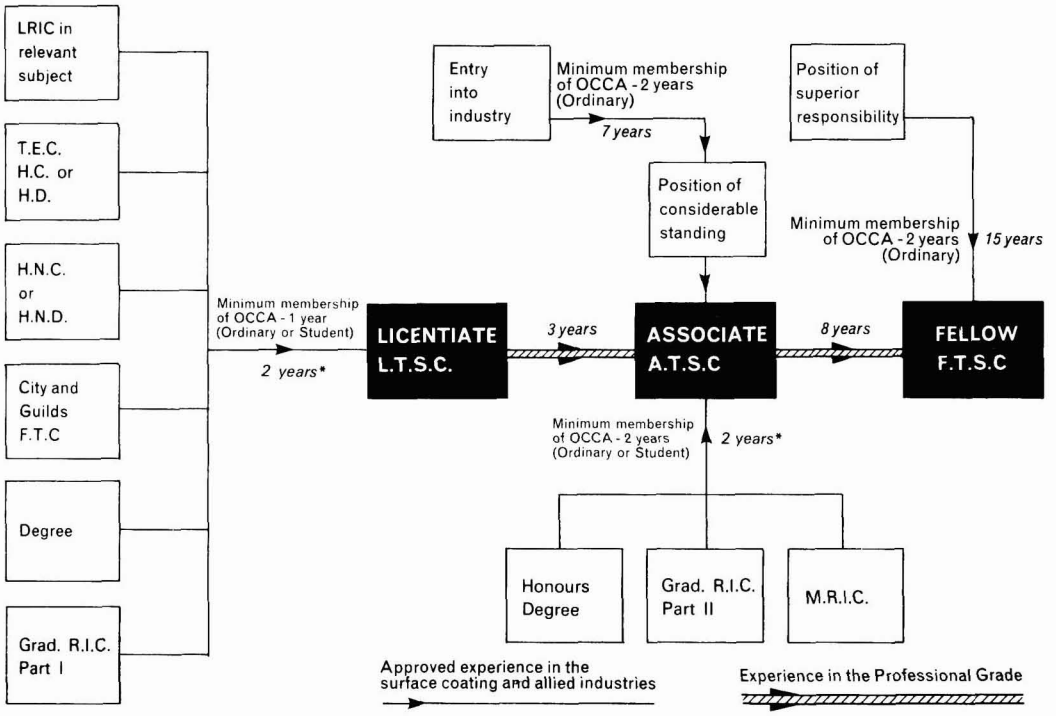
Thursday 26 June

Association Annual General Meeting, at the Piccadilly Hotel, London N1, commencing at 3.00 p.m.

Optional Professional Grade for Ordinary Members

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

Routes to the Professional Grades



*Not necessarily after qualification – see regulations.
Note: At present there is no restriction on Students up to 21; between 21 and 25 a certificate from the employer or college confirming the course being taken is required.

Regulations for admission to the Professional Grade – Amended December 1979

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

A. Licentiate

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

2. Shall have attained the age of 22.

3. (a) Shall be a Licentiate of the Royal Institute of Chemistry in Coatings Technology or another relevant subject, such as advanced analytical chemistry, colour chemistry or polymer science.

OR (b) Shall have passed the Higher Certificate or Higher Diploma of the Technician Education Council in coatings technology or other relevant subjects.

OR (c) Shall have passed Higher National Certificate or Higher National Diploma in a relevant subject.

OR (d) Shall hold the Full Technological Certificate of the City and Guilds of London Institute in a relevant subject.

OR (e) Shall be a graduate in a relevant subject.

OR (f) Shall have passed Part I of the examination for the Graduateship of the Royal Institute of Chemistry or Council of Physics.

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

4. Shall have attained approved experience in the science or technology of coatings. It is not expected that sufficient experience would be gained in a period of less than two years in the industry. Approved experience may be gained before, during or after the qualifications in paragraph (3) above have been attained.

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

6. Shall normally be sponsored by three Ordinary Members of the Association in the professional grade (either

Associate or Fellow) at least one of whom must be a Fellow.

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

B. Associate, being already a Licentiate

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

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

3. Shall have published work which, in the opinion of the professional Grade Committee, is of a sufficiently high standard OR may be required to submit a thesis or dissertation on a topic previously approved by the professional Grade Committee OR shall hold the City & Guilds of London Institute Insignia Award.

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

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

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

C. Associate, not already a Licentiate

EITHER

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

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

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

4. Shall have attained approved experience in the science or technology of coatings. It is not expected that sufficient experience would be gained in a period of less than two years in the industry. Approved experience may be gained before, during or after the qualifications in paragraph (3) above have been attained.

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

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

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

OR

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

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

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

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

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

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

D. Fellow

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

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

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

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

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

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

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

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

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

The fees payable with applications are as follows:

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

Application

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

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

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

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

CLASSIFIED ADVERTISEMENTS

Classified Advertisements are charged at the rate of £4.00 per cm. Advertisements for Situations Wanted are charged at £1.00 per line. A box number is charged at 50p. They should be sent to D. M. Sanders, Assistant Editor, Oil & Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HA0 2SF. JOCCA is published EVERY month and Classified Advertisements can be accepted up to at least the 12th, and in exceptional circumstances the 20th of the month preceding publication. Advertisers who wish to arrange for an extension of the copy deadline should contact the Assistant Editor, D. M. Sanders, at the address given above (telephone 01-908 1086, telex 922670 OCCA G).

SITUATIONS VACANT

MISCELLANEOUS

CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

UNION CARBIDE

CHEMIST

We are looking for a young chemist for our COATINGS LABORATORY located in Versoix (Geneva), Switzerland.

Candidates should have the following qualifications:

- a University degree in Organic Chemistry,
- a few years' technical experience in industrial coatings,
- a good knowledge of polymer chemistry,
- ability to work in English and a working knowledge of French and German.

The Chemist's main responsibilities are:

- the development and evaluation of industrial coatings based on Union Carbide's raw materials and
- customer technical service which will require frequent travel throughout Europe.

Detailed applications should be addressed to:

UNION CARBIDE EUROPE SA
I. K. Ferguson – Personnel Manager
5, rue Pedro-Meylan
1211 – GENEVE 17
SWITZERLAND

RECONDITIONED EQUIPMENT FOR SALE

Flame-Protected Battery Electric Forklift Trucks!!!

Flame-protected to Groups 2 & 3 (gases and vapours). Suitable for paint and allied industries. Re-conditioned to an exceptionally high standard with new electronic systems fitted. Issued with load test certificates and guaranteed.

Double fixed drum clamps and rotating clamps can also be supplied.

We also purchase or part exchange your surplus flame-protected Forklift Trucks.

Full details and photographs available from:

Speed Electrics, The Wells Road, Mapperley, Nottingham
Tel: 0602-609782

Please retain our name and number. You may need our services in the future

Sales opportunity

A major international supplier of chemical process plant (including mixers, dispersers and filling machines) for the paint, ink and allied chemical industry, offers a unique sales career opportunity. Ideally, applicants should possess previous sales experience and be familiar with the technical application of plant and equipment used within these industries. Salary is negotiable and a generous bonus scheme is in operation. A company car is provided together with expenses. The company also operates a free private medical plan and pension scheme.

Applications in strict confidence to:

Box No 484

MISCELLANEOUS

Scottish Section

Printing Ink Symposium Reprints

Enquiries for reprints of the lectures given at the Scottish Section, Eastern Branch, Printing Ink Symposium at Stirling University in January 1979 are still coming in. Both the response and interest shown since this Symposium has been most encouraging and so far orders for reprints have been received from places as far afield as Quebec, Canada, San Jose, Costa Rica, Holland and New Zealand as well as from many places south of the border.

Further reprints are still available at a cost of £3.00 each plus postage and these can be obtained from: **A. McKendrick Esq., c/o Craig & Rose Limited, 172 Leith Walk, Edinburgh.**

SMALL FACTORY TO LET

7,000 sq ft on one level, 2,100 sq ft flame-proofed for lacquer manufacture and storage. Compact office and laboratory suite, adequate outside storage and car parking area. Adjacent to Bishop's Stortford entrance to M.11.

Box No. 485

CLASSIFIED ADVERTISEMENTS

CROXTON+GARRY

TECHNICAL SALES REPRESENTATIVE

We are one of UKs leading suppliers of mineral fillers/extenders and speciality raw materials to the Plastics, Rubber, Paint and Chemical Industries.

A vacancy now exists for an experienced Technical Sales Representative to cover the Surface Coating and Printing Ink Industries. This appointment will be based at Dorking but will cover these industries on a nationwide basis.

The ideal applicant will be in his late twenties, intelligent, well educated and personable. Sales and/or laboratory experience in the surface coating industry with relevant qualifications are also desirable. Opportunity exists for promotion to Sales Manager of Surface Coatings Division.

Commencing remuneration of c. £6,000 per annum is envisaged, plus profit sharing, BUPA benefits, together with a company car, expenses and non-contributory life assurance and pension scheme. Reasonable re-location expenses will be met.

Please submit handwritten applications (which will be treated with the strictest confidence) to:

Group Sales Director
CROXTON + GARRY LIMITED
Curtis Road, Dorking, Surrey RH4 1XA

South Africa/Johannesburg
Top Position

PAINT AND POLYMER CHEMIST

REQUIRED: Resin Plant experience in production and formulation of UPE/PE resins. Ability to formulate Epoxy/PU resins would be a strong recommendation.

OFFERED:
*Top salary
*Very attractive position with excellent scope for advancement
*Fringe benefits
*Assistance in transport costs from UK to South Africa
*Assistance in finding accommodation

Please reply, with full curriculum vitae to:

Elite Chemical Industries (Pty) Ltd
PO Box 27216
BENROSE 2011
South Africa

SITUATIONS VACANT

Ripolin

Ripolin Limited are one of the most rapidly expanding paint manufacturers in the country and require a:

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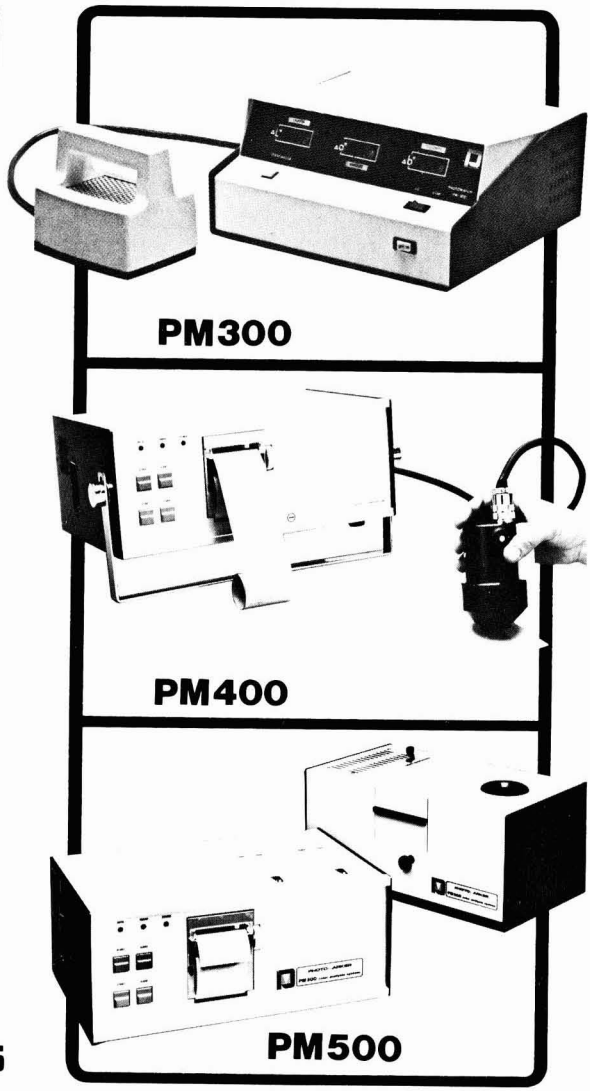

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